Environmental
Geotechnical
Specialists

RGS

PHASE 2 & 3

ENVIRONMENTAL & REMEDIATION REPORT

job number	C3732/23/E/5713
date	11.10.23
site address	Land off Scott Lane Cleckheaton BD19 3LX
written by	R.A. Palmer
checked by	I. Sakoor
issued by	R.A. Palmer

Please consider the environment before printing this report.

Constructionline
A UK GOVERNMENT CERTIFICATION SERVICE

QMS ISO 9001 : 2015 REGISTERED Cert No. 14123657

QMS ISO 14001 : 2015 REGISTERED Cert No. 14127804

QMS ISO 45001 : 2018 REGISTERED Cert No. 14130281

CITATION APPROVED HEALTH & SAFETY SYSTEMS Registered Member

UKAS United Kingdom Accreditation Service

<ENVIRONMENTAL><GEOTECHNICAL>

Rogers Geotechnical Services Ltd
Offices 1 & 2 Barncliffe Business Park, Near Bank, Shelley, Huddersfield, HD8 8LU
01484 604354 Company No. 5130864

Contents

Appendices

Report on a Phase 2 Environmental Investigation & Phase 3 Remediation Statement

Location:	Land off Scott Lane Cleckheaton, West Yorkshire, BD19 3LX		
For:	John Brooke Builders Ltd		
Consultants:	Fox Architecture and Design		
Report No.	C3732/23/E/5713	Report date:	October 2023

For and on behalf of **Rogers Geotechnical Services Ltd**

Rob Palmer MSc FGS ACIEH
Senior Geo-environmental Engineer

Imran Sakoor BEng FGS
Geo-environmental Engineer

1. Introduction

It is understood that the site is to be developed by the construction of nine industrial units. Consequently, a site investigation has been undertaken in accordance with the instruction from the client. This work was required in order to determine the nature of the underlying soils and to assess the risk of any contamination present. This report describes the work undertaken, presents the data obtained and discusses the ground conditions in relation to the proposed works.

2. Limitations

The recommendations made and opinions expressed in this report are based on the ground conditions revealed by the site works, together with an assessment of the site and of the laboratory test results. Whilst opinions may be expressed relating to sub-soil conditions in parts of the site not investigated, for example between borehole positions, these are for guidance only and no liability can be accepted for their accuracy.

This report has been prepared in accordance with our understanding of current best practice. However, new information or legislation, or changes to best practice may necessitate revision of the report after the date of issue.

3. Previous Site Work & Local Authority Correspondence

A Phase 1 Desk Study was undertaken by JNP Group Consulting Engineers and the results were presented as report number B22866 in November 2018. In addition, it should be appreciated that a geo-environmental site investigation (report number G19086, dated April 2019) and subsequent gas monitoring letter (report number G19086, dated July 2019) was completed by GeoInvestigate.

Despite the proposed commercial end use, the site investigation report utilised screening values for a residential end use. This choice of screening values suggested that the site is contaminated, although limited remedial measures were proposed. This is something that has been queried in Consultation Responses by Kirklees Council Environmental Health, most recently in October 2022 (responding reference WK/202225000). With reference to this consultation response and a previous response by Kirklees, it would appear that GeoInvestigate has provided further information by email. The response from GeoInvestigate states that "*a commercial development would significantly raise the GAC* (Screening) *levels for contaminants and that the site is almost exclusively hardstanding or building, breaking the pollutant pathways*". However, Kirklees requested that further information be submitted, most notably including an up to date conceptual site model. RGS has subsequently has become involved with the project.

It is understood that the existing phase one desk study shall be submitted as part of the application. As the desk study was completed in 2019, to account for any potential subsequent contamination to the site from off-site sources, additional gas monitoring and contamination testing has been completed to further supplement the original site investigation report and create an updated conceptual site model. Notwithstanding this, it should be noted that a recent site walkover and a review of publically available information of data available since 2019 have not revealed any recent contamination sources that are of concern.

4. Fieldworks

The fieldworks were undertaken on the 1st September 2023 and included the following:

- Three windowless sample boreholes.
- Installation of three gas monitoring standpipes.

The investigatory locations are shown on the site plan which is presented in Appendix 1 to this report. These locations should be cross-referenced with the site plan with the GeoInvestigate report.

4.1 Windowless Sample Boreholes

These boreholes were sunk using a drive-in windowless sampler. The cores were undertaken in 1m lengths and reduced in diameter from 87mm for the first 1m through 77mm for subsequent 1m increments. The recovered cores were sealed and returned to the laboratory for logging and subsequent testing. The soils were described in general accordance with BS5930: 2015 +A1: 2020 and full descriptions are given on the windowless sample records which are presented in Appendix 2. Also included on these records are the core diameters and percentages of core recovered.

4.2 Gas Monitoring Standpipes

Gas monitoring standpipes were installed in all of the boreholes and the installation details are shown on the appropriate borehole records. In all cases, the monitoring standpipe consisted of a perforated pipe from the base of the borehole to 1.0m below surface, with a non-perforated pipe to ground level. The response zone was filled with pea gravel, with a bentonite seal at the base and above, and the installation was capped with a stop box cover in a concrete surround.

5. Geology

The available published geological data for the site has been examined and the following table presents the anticipated geology:

Table 1: Geological Data for the Site

Strata Type	Strata Name[1]	Previous Name[2]	Description[3]
Superficial Geology	-	-	None indicated.
Solid Geology	Pennine Lower Coal Measures Formation	Lower Coal Measures	Interbedded grey mudstone, siltstone and pale grey sandstone, commonly with mudstones containing marine fossils in the lower part, and more numerous and thicker coal seams in the upper part.

6. Strata Conditions

The borehole records have revealed a capping of topsoil beneath which made ground was present to depths of between 0.68m and 0.9m. Variably graded sandy silty clay with occasional gravel was then revealed beneath the fill. Such soils are considered to represent the weathered fraction of the underlying Pennine Lower Coal Measures Formation. It should be appreciated that these ground conditions correlate well with the findings of the GeoInvestigate site investigation report.

No groundwater strikes were observed during the site investigation. However, it should be appreciated that the normal rate of boring does not permit the recording of an equilibrium water level for any one strike, moreover, groundwater levels are subject to seasonal variation or changes on local drainage conditions.

[1] Sources: British Geological Survey (NERC) Map Sheet 77; Huddersfield; Solid and Drift Edition, and Geology of Britain Viewer [*online resource from www.bgs.ac.uk*]
[2] Sources: British Geological Survey (NERC) Lexicon of Named Rock Units [*online resource from www.bgs.ac.uk*]

7. Insitu Testing

7.1 Gas and Water Level Monitoring

The standpipes were recently monitored on the 20th and 27th of September 2023. The results of the gas monitoring undertaken to date, including previous gas monitoring at the site, are tabulated below and full results are presented in Appendix 3:

Table 2: Gas Monitoring

Location	Date	CH_4 (%)	CO_2 (%)	O_2 (%)	Flow (l/h)	Barometric Pressure (mb)	Water Level (m)	Standpipe Depth (m)
GeoInvestigate 2019								
BH03	18.04.19	0.2	1.7	19.0	<0.1	981		-
	26.04.19	0.1	1.5	19.9	<0.1	1000		
	02.05.19	0.5	2.0	19.4	<0.1	1007		
	10.05.19	0.2	1.7	19.4	<0.1	992		
	17.05.19	0.2	2.0	19.8	<0.1	1002		
	19.06.19	0.2	1.7	19.4	<0.1	996		
BH04	18.04.19	0.0	0.6	20.6	<0.1	981		-
	26.04.19	0.0	0.8	20.1	<0.1	1000		
	02.05.19	0.5	2.5	16.1	<0.1	1007		
	10.05.19	0.2	3.6	16.4	<0.1	992		
	17.05.19	0.2	3.8	16.9	<0.1	1002		
	19.06.19	*	*	*	*	*		
BH05	18.04.19	0.1	2.4	16.8	<0.1	981		-
	26.04.19	0.0	2.3	16.4	<0.1	1000		
	02.05.19	0.0	0.2	20.8	<0.1	1007		
	10.05.19	*	*	*	*	*		
	17.05.19	0.2	1.4	20.3	<0.1	1002		
	19.06.19	0.1	1.5	20.1	<0.1	996		
RGS 2023								
WS01	20.09.2023	0.0	6.5	15.9	0.0	980↑	-	2.0
	27.09.2023	0.0	4.8	16.4	0.0	1004↔	-	
WS02	20.09.2023	0.0	2.6	14.7	0.0	981↑	-	1.8
	27.09.2023	0.0	2.0	13.6	0.0	1004↔	-	
WS03	20.09.2023	0.0	3.8	18.3	0.0	981↑	-	2.0
	27.09.2023	0.0	3.7	17.9	0.0	1005↔	-	

↑ - rising pressure ↓ - falling pressure ↔ -steady pressure *waterlogged

The monitoring completed by RGS was undertaken using a Geotechnical Instruments (UK) Ltd. GA5000 (serial No G503524) which was last calibrated on the 12th September 2023.

8. Laboratory Testing - Environmental

A suite of testing was conducted on samples from across the site and the following regime was undertaken.

- Metals – Cd, Cr^{VI}, Cu, Hg, Ni, Pb, V and Zn.
- Semi and Non-Metals - As, Se, Free CN^{-}.
- Polycyclic aromatic hydrocarbons (PAHs).
- Others – pH, organic content and total/soluble SO_4^{2-}.
- Asbestos screen.

This testing was undertaken by i2 Analytical Ltd and the results of all of the chemical testing are presented in Appendix 4 of this report.

9. Discussion of Ground Conditions - Environmental

9.1 Discussion of Test Results

It is understood that the site is to be developed by the construction of nine industrial units. Provisional plans indicated that some soft landscaping areas were going to be present, however it is understood that these plans have now been revised and the entirety of the site shall be capped by buildings and hard-standing. Consequently, the site may be classified as commercial.

9.1.1 Soil Samples

The results of the chemical testing undertaken on soil samples obtained during this investigation have been compared to the ATRISK soil screening values (SSVs) as compiled by WS Atkins plc. With respect to the results it should be appreciated that the soil organic matter (SOM) content for the samples tested was found to range between 2.0% and 2.8%. On this basis, it is considered that the screening values associated with 1% SOM should be adopted. These values have been derived in such a way as to adhere to the principles within the revised CLEA model and include the most current release of the SGVs. A list of subscribers is provided within the website[3] and these include many local authorities.

A comparison of the results of the testing, together with the data given above, can be found within Appendix 4. These results indicate the following:

Table 3: Summary of Contaminated Areas

Location	Depth (m)	Contaminants found to be exceeding SSVs (Commercial)
WS1	0.4	PAHs (chrysene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene).
WS2	0.1	PAHs (indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene)
WS3	0.5	
GeoInvetigate Max Concentrations	Variable	PAHs (benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene).

[3] http://www.atrisksoil.co.uk/pages/general/subscribers.asp

Concentrations of cadmium, chromium^{VI}, mercury, selenium and free cyanide were below the detection limits for the tests. Detectable levels of all other contaminants were recorded, but these fell below the associated Atrisk Soil Screening Values. In addition, no asbestos was detected within the soils samples tested.

It should be appreciated that the soil screening values for PAHs and TPHs (where appropriate) represents vapour saturation limits. The inhalation of vapour pathway contributes less than 10% of total exposure, which is unlikely to significantly affect the combined assessment criterion[4]. In view of this, the ATRISK soil SSVs notes that the users may wish to consider using a combined assessment criterion if free product is not observed, the values for which are also provided on the summary of contamination analysis. It is therefore considered that the criteria for no free product should be adopted for the PAHs and TPHs at this site. The results of the contaminants found to exceed these screening values are tabulated below:

Table 4: Summary of Areas Contaminated by PAHs & TPHs

Location	Depth (m)	Contaminants found to be exceeding SSVs (Commercial)
WS1	0.4	None
WS2	0.1	None
WS3	0.5	None
GeoInvetigate Max Concentrations	Variable	None

On the basis of the above information, the results of the investigation have concluded that the site is not contaminated for the intended end use.

9.1.2 Gas Concentrations

With respect to ground gas, the results of the monitoring visits (across both investigations) indicated a maximum concentration of 0.2% methane, with concentrations of carbon dioxide ranging between 0.2% and 6.5%, in association with oxygen levels of between 13.6% and 20.8%. It should be appreciated that on non-contaminated sites there is generally about 20% by volume of oxygen, associated with low levels of carbon dioxide. Negligible flow was recorded, therefore a flow rate of 0.1 litres per hour will be employed in the following calculations.

The principal driving force for initiating the movement of gas in the ground is a change in barometric pressure. The most onerous gas condition on a site is usually observed on days of low or falling barometric pressure, preferably below 1000mb. It has been noted that measurements undertaken solely during high pressure conditions may be of lesser value. At this site the readings undertaken to date were at atmospheric pressures of between 981mb and 1007mb.

In order to establish the gas screening value (GSV) for carbon dioxide or methane, the maximum gas concentration (expressed as a decimal) is multiplied by the borehole flow rate (l/hr). In this case 0.2% (0.001) methane was recorded along with 6.5% (0.065) carbon dioxide, in association with a maximum flow rate of 0.1 l/hr. This results in a GSV of 0.0001 l/hr for methane and a GSV of 0.0065 l/hr for carbon dioxide. In accordance with Table 2 of BS8485: 2015*, Code of practice for the design of protective*

[4] Ref: ATRISK soil, SSVs derived using CLEA v1.071 for 1% SOM, Commercial land use, 23.06.17.

measures for methane and carbon dioxide ground gases for new buildings, this meets the criteria for *Characteristic Situation Level 1*. However, as levels of carbon dioxide exceeded 5%, the site should be upgraded to Characteristic Situation Level 2. Therefore, it is considered that there is some risk of harm to end users and some protection measures are required.

With regard to the number of monitoring visits required reference is made to Tables 5.5a and 5.5b of CIRIA report C665 (2007)[5]. Accepting that the proposed development is of low sensitivity and that the generation potential is very low, these tables suggest that 4 readings could be undertaken over a period of 1 month. This has been achieved at this site.

Following the additional monitoring visits, it should be appreciated that there has been a change in ground gas conditions. Indeed, levels of carbon dioxide have increased slightly, therefore suggesting that gas protection measures should be considered as Characteristic Situation Level 2 is now considered to be more appropriate for the site.

9.2 Site Specific Risk Assessment

9.2.1 Approach

The presence of contamination hazards and the risks associated with them should be assessed in accordance with industry practice and the 'suitable for use' approach. This has been conducted with reference to The Department for Environment, Food and Rural Affairs (DEFRA) and The Environment Agency[6] advice on the assessment of risks arising from the presence of contamination in soils and using the source-pathway-receptor approach.[7] This method dictates that there must be a risk of contaminant produced at a 'source' in sufficient concentration to cause harm and there must be a 'pathway' for the contaminant to reach an identifiable 'receptor' for the linkage to be proved and a contamination hazard to be considered present. Not all substances are contaminants and not all contaminants are considered to be a risk. Indeed DEFRA and The Environment Agency state that 'a contaminant is a substance which has the potential to cause harm, while a risk itself is considered to exist if such a substance is present in sufficient concentration to cause harm and a pathway exists for a receptor to be exposed to the substance.'[8]

9.2.2 Conceptual Ground Model and Risk Assessment

In view of the results of the chemical testing undertaken the conceptual site model is presented accordingly as Table 5.

The preliminary risk assessment has been evaluated with reference to the following ratings and definitions:

N/A - A source-pathway-receptor linkage is not considered to exist and therefore a risk assessment is not required.

Low - A pollution linkage is unlikely and/or the likelihood of harm occurring is low and of minor consequence.

[5] Adapted from tables 5.5a and 5.5b of CIRIA C665, 2007, *Assessing risks posed by hazardous ground gas to buildings, p60.*
[6] R&D Publication CLR 8, 'Assessment of Risks to Human Health from Land Contamination: An overview of the Development of Soil Guideline Values and Related Research'.
[7] The pollution linkage approach was developed by 'Circular 2/2000 Contaminated Land: Implementation of Part II of The Environmental Protection Act 1990' which provides meanings for the terms contained in The Environmental Protection Act 1990 Part IIA, the primary legislation for addressing the issues of contaminated land.
[8] See 'Circular 2/2000 Contaminated Land: Implementation of Part II of The Environmental Protection Act 1990', appendix A.

Moderate - The linkage exists but the likelihood of harm occurring is not considered to be significant although remedial action may be necessary

High - The linkage exists and the available data indicates that significant harm may be caused and remedial action could be necessary.

The results of the risk assessment are presented in Table 5.

Table 5: Conceptual Site Model and Site-Specific Risk Assessment				
Conceptual Site Model			**Site Specific Risk Assessment**	
Pathways	**Receptor**	**Linkage Present?**	**Risk Rating**	**Notes**
Direct contact/dermal absorption/soil ingestion	Operative	Yes – made ground present at the site which contains elevated levels of contamination.	Moderate	Precautionary measures will be required during the construction phase.
	End User	No – site to be capped by hard-standing.	Low	
	Neighbours	Yes – soil contamination falls below screening levels for the proposed end use. Site anticipated to be secure during the construction phase.	Low	
Inhalation of Dust/Vapours	Operative	Yes – dust may be derived from contaminated soils.	Moderate	Precautionary measures will be required during the construction phase.
	End User	Yes – contamination falls below screening values.	Low	
	Neighbours	Yes – contamination found to be present at the site and residential and commercial properties located within 250m radius of the site and possible inhalation of dust during the works.	Low to Moderate	
Ingestion of fruit/vegetables and/or waters	Operative	No – no edible plants or contained water sources in the area of the proposed new works.	N/A	No further action required.
	End User	No – commercial development with no soft landscaping.	N/A	
	Neighbours	Yes – contamination falls below screening values and is not anticipated to be significantly mobile.	Low	
Migration of hazardous gases via permeable strata or shallow mining activity	Operative	Yes – elevated carbon dioxide has been found to be present at the site (assuming *Characteristic Situation Level 2*).	Low	Action required.
	End User		Moderate	

	Neighbours	No – site not considered to represent a generative source.	N/A	
Spillage/loss/run off direct to receiving water	Controlled Waters	No – no known controlled waters within 250m.	N/A	Old services to be inspected for serviceability.
Migration via permeable unsaturated strata	Controlled Waters	Yes – a Secondary A aquifer is present beneath the site. However, the site is underlain by cohesive soils of low permeability. Contamination is not anticipated to be significantly mobile.	Low	
Run off via drainage/sewers etc	Controlled Waters	Yes – old services may be present on site. However, the site is underlain by cohesive soils of low permeability. Contamination by is not anticipated to be significantly mobile.	Low	
Direct contact with contaminated soils	Plants	No – no planting areas proposed.	N/A	
Uptake via root system			N/A	
Direct contact with contaminated soils	Building Materials	Yes – minor PAH contamination revealed at the site may represent a risk to building materials or plastic water pipes. Moreover, testing indicates that the aggressive chemical environment for concrete classification needs to be carefully considered.	Moderate (plastic services)	
Direct contact with contaminated groundwater			Moderate (buried concrete)	
Exposure to Radon	Operative	Yes – in a radon affected area.	High	Between 3% and 5% of properties are above the action level. Basic radon protection measures required.
	End User			

10. Remediation Statement

10.1 Remediation Objectives

Based on the site-specific risk assessment the object of the remediation is as follows.

- To protect the site operatives during the construction process from the ingestion of soil or dust, dermal contact with the soil and inhalation of dust and vapours.
- To protect the end user from the elevated levels of carbon dioxide and radon gas.
- To protect neighbours from the inhalation and ingestion of dust during the construction process.
- To protect plastic services from being penetrated by, or degrading due to the presence of, contamination in the soil or groundwaters.

10.2 Development Requirements

Whilst the precise nature of this development has not been finalised it is understood that it is to be developed by the construction of commercial units with hard-standing areas.

10.3 Outline Strategy

In order to fulfil the objectives defined above it is considered that the following remedial strategy shall be utilised. It is recommended that a pragmatic approach be undertaken, with observational techniques being employed at each stage of the work.

Ground-works

During the ground-works phase of the development, protection to the site operatives is required. The risk to site operatives is considered under the Health and Safety at Work Act 1974, together with regulations made under the act, which includes the Control of Substances Hazardous to Health (COSHH) regulations. Therefore, the risks to site personnel must be considered under the Construction Design and Management (CDM) regulations at the planning stage and be included in the contractor's Health and Safety Plan and site specific Method Statements. These documents should include the following main elements.

- Site operatives at all levels shal be made aware of the fundamental principles of identifying potentially contaminated soils and the hazards of working with such soils not identified by the ground investigation.
- Personal hygiene facilities, including washing and messing, must be provided and site operatives be encouraged to use them.
- Where work is undertaken in dry weather the site shall be dampened down to avoid dust. In addition, dust masks must be provided to all site operatives for use in dry weather.
- In order for contaminated soils to be disposed of to an appropriate landfill, it may be necessary to carry out Waste Acceptance Criteria (WAC) testing in accordance with BS EN 12457.
- Any stockpiles of contaminated soil on site shall be sheeted over to prevent excessive amounts of airborne dust and cross contamination of imported fill.
- Where vehicles are transferring soil to the landfill site they shall be covered to prevent contamination of the surrounding area by dust.

- Where work is undertaken in wet weather, vehicle and wheel washing facilities are required to ensure that the vehicles leaving the site do not transfer contamination to surrounding areas.

On completion of the ground-works a careful site inspection of the sub-grade will be required. Should visual or olfactory evidence of contamination be revealed then further testing may become necessary.

Construction

During the construction phase of the contract the following items are required to protect the end user from the potential contaminants revealed at this site.

- Beneath buildings, pavements and hard-standings clean inert granular sub-base will be employed.
- Any redundant services revealed at this site shall be de-commissioned and piped services sealed. Any existing services that are to be employed in the new development will be carefully inspected to ensure that they are serviceable.
- New plastic services shall be constructed in a surround of clean inert material and selected in accordance with the recommendation given in the United Kingdom Water Industry Research (UKWIR) website under Report Ref. No. 10/WM/03/21 - 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites'. The statutory water authority for the area in which site is located may have a risk assessment form to complete which allows these recommendations to be met. However, further determinand specification contamination testing may be necessary.
- For buried concrete the results of the sulphate and pH testing indicate that the design sulphate class for the site shall be DS-3.
- Due to the site being located within a radon affected area, basic radon protection will be required. This will comprise a radon-proof membrane which will cover the whole building and be fully sealed around service penetrations. The radon-proof membrane will also be capable of acting as a DPM.

Gas Protection Measures

In order to assess the protection measures required BS8485: 2015+A1:2019: *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings* has been employed. In accordance with Table 3, *Building types,* of the code, the development may be considered to conform to Type D. Therefore, on the basis of Table 4 *Gas protection score by CS and type of building,* the minimum gas protection score (points) is 1.5. The gas protection system shall consist of at least two different elements. The elements work independently and collaboratively, and a single element shall not be used because there would be no redundancy to allow for defects in the component.

In order to achieve this score the following shall be undertaken:

Table 6: Combination of Protection Elements (BS8485: 2015) for CS2

Reference	Protection Element	Score
Table 5	Reinforced cast in situ suspended floor slab.	1.0
Table 6	Pressure relief pathway (no fines hardcore beneath slab)	0.5
	Total Score	**1.5**

10.4 Fill Materials

Any fill material, either site-won or imported, to be employed at the site shall be subjected to the following assessment to determine its suitability.

Fill materials shall be initially screened, by a suitably qualified engineer to establish that:

- It is a suitable growing media if it is to be employed as such, including compliance with BS3882 (2015)
- It is free from obvious contamination i.e. visual or olfactory evidence
- It has not come from areas where Japanese Knotweed or other invasive or injurious plants are suspected to be growing
- It is not a statutory nuisance, such as being odorous
- It is free from unsuitable material i.e. whole bricks, brick ties, timber or glass.

It shall also be appreciated that any fill will need to be subjected to validation testing to assess its suitability. The following table has been taken from YALPAG[9] documentation and may be used as a guide. Depending on the origin and nature of the material, not all fill will require the sampling frequency and testing indicated, although this should be in agreement with any regulatory bodies (such as the Local Authority).

Table 7: Validation Sampling and Testing

Fill Type	Frequency	Minimum Determinands
Virgin Quarried Material	1 or 2 depending on the type of stone utilised, to confirm the inert nature of the material.	Standard metals/metalloids (should include as a minimum As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn)
Crushed Hardcore, Stone, Brick	Minimum 1 per 500m³	Standard metals/metalloids (as above), PAH (16 USEPA speciation), asbestos, total TPH. Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).
Greenfield/ Manufactured Soils	Minimum 3 Dependent on source and receptor, between 1 per 50m^3 and 1 per 250m^3	Standard metals/metalloids (as above), PAH (16 USEPA speciation), asbestos, pH and soil organic matter (SOM) (or calculated from total organic carbon (TOC)).
Brownfield/ Screened Soils	Minimum 6 Dependent on source and receptor, between 1 per 50m^3 and 1 per 100m^3	Standard metals/ metalloids (as above), PAH (16 USEPA speciation), TPH (CWG banded), asbestos, pH and SOM (or calculated from TOC). Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).

[9] *YALPAG Technical Guidance for Developers, Landowners and Consultants – Verification Requirements for Cover Systems V4 .1* Appendix 1a, June 2021

10.5 Verification Report

In order to demonstrate that the remedial works has been sufficiently carried out where applicable, it will be necessary to produce a verification report for submission to any statutory authorities.

It will be necessary for this report to include the following:

- Evidence that suitable gas protection measures have been implemented and installed.

The report detailed above should be produced by a suitably qualified engineer. The number of verification areas for the development should be confirmed with any statutory authorities for the site.

11. Recommendations for Further Work

- This report should be forwarded to the relevant authorities as soon as practicable to ensure they have sufficient time to review and discuss any issues.
- Discussions with ground work contractors in relation to the requirement for testing of materials to be disposed off-site (Waste Acceptance Criteria) and the suitability of imported materials.
- Discussions with service providers regarding suitable materials for pipe work given the nature of chemical determinands found within the soils on site.
- Produce a validation report to demonstrate that the ground gas risks discussed in this report have been mitigated.
- Detailed design of the sub-structure.

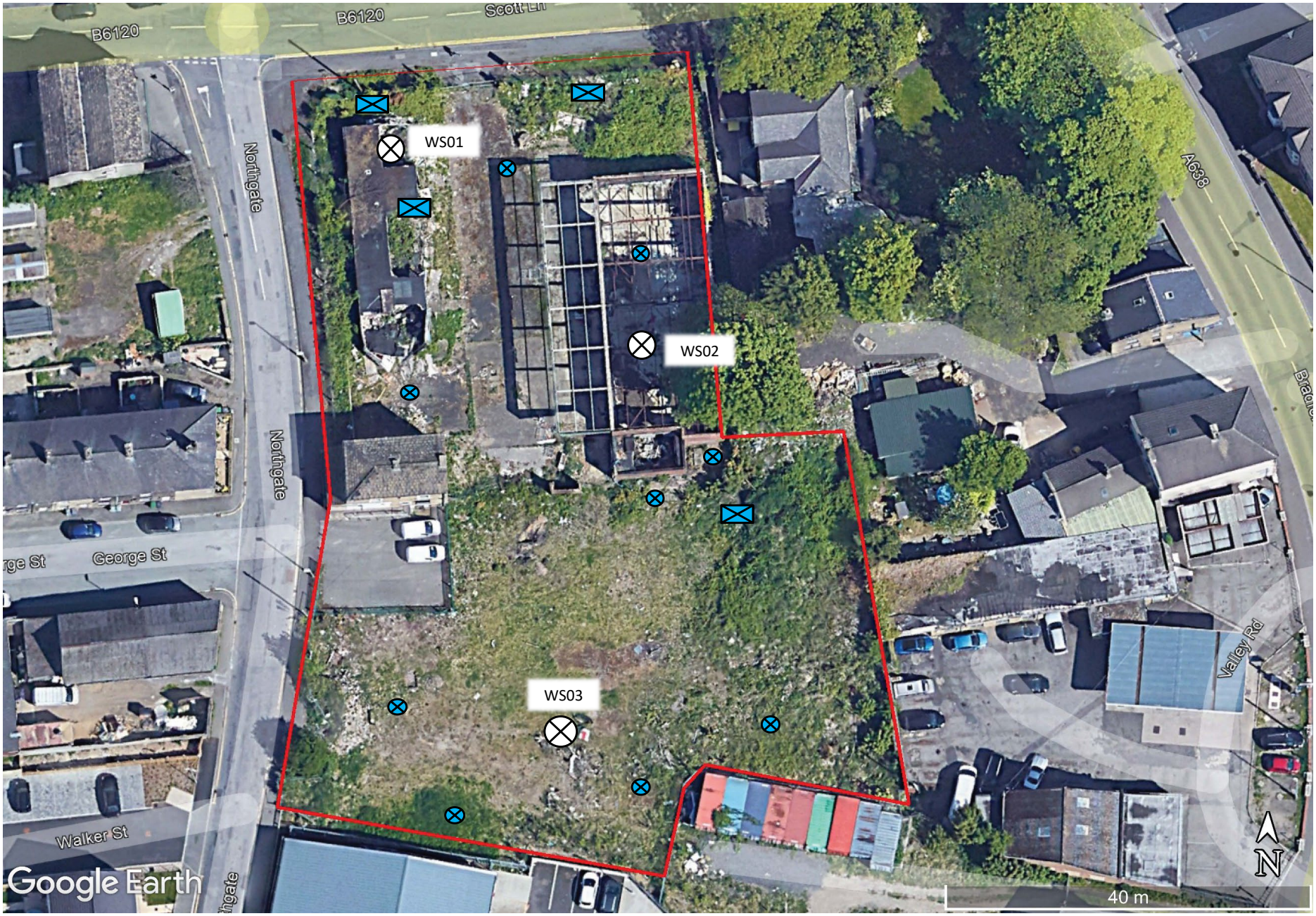
Clearly Rogers Geotechnical Services Ltd would be happy to offer advice with respect to the above and assist where necessary.

12. References

- British Geological Survey (NERC) (2023), BGS, Keyworth.
  - Geology of Britain Viewer: (*http://maps.bgs.ac.uk/geologyviewer_google/googleviewer.html)*
  - Lexicon of Named Rock Units:
  - (*http://www.bgs.ac.uk/lexicon/)*
- British Standards Institution (1990) BS1377: *British standard methods of test for soils for civil engineering purposes,* B.S.I., London.
- British Standards Institution (2015 +A1: 2020) BS 5930: *Code of practice for ground investigations,* B.S.I., London.
- British Standards Institution (2011), BS 10175: *Investigation of potentially contaminated sites – Code of Practice,* British Standards Institute.
- British Standards Institution (2015 +A1:2019) BS8485: *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings,* B.S.I., London.
- British Standards Institution (2013), BS 8576 Guidance on Investigations for Ground Gas – Permanent Gases and Volatile Organic Compounds.
- British Standards Institution (2017) BS EN ISO 14688: *Geotechnical investigation and testing – Identification and classification of soil*, B.S.I., London.
- Building Research Establishment (BRE) Special Digest 1 (2005), Third Edition: Concrete in aggressive ground, BRE Press, Garston.
  - Part C: *Assessing the aggressive chemical environment.*
  - Part D: *Specifying concrete for general cast-in-situ use.*
- Department for Environment, Food and Rural Affairs and the Environment Agency (2009) DEFRA Science Report – Final SC050021/SR2, *Human Health toxicological assessment of contaminants in soil*. Environment Agency, Bristol.
- Department for Environment, Food and Rural Affairs and the Environment Agency (2009) DEFRA Science Report – SC050021/SR3, *Updated technical background to the CLEA model*. Environment Agency, Bristol.
- Department for Environment, Food and Rural Affairs (2014) SP1010: *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document*.
- Wilson S, Oliver S, Mallet H, Hutchings H, Card G, *Assessing risks posed by ground gasses to buildings,* CIRIA Report C665.

Appendix 1

Site Plan



Notes:

Investigation positions approximated from site operative's notes.

RGS Environmental Geotechnical Specialists

Rogers Geotechnical Services Ltd

Offices 1 & 2, Barncliffe Business Park,
Near Bank,
Shelley,
Huddersfield,
HD8 8LU

Telephone: 0843 50 66 87
www.rogersgeotech.co.uk

Client:

D&M Middleton

Job Number:

C3732/23/E

Project Details:

Land off Scott Lane, Cleckheaton

Scale: Not to scale - reference only

Appendix 2

Borehole Records

Borehole Log

Environmental Geotechnical Specialists

Borehole No. **WS01**

Sheet 1 of 1

Project Name:	Land off Scott Lane	Project No. C3732/23/E/5713	Co-ords:	Hole Type WLS
Location:	Cleckheaton, BD19 3LX		Level:	Scale 1:50
Client:	John Brooke Builders		Dates: 01/09/2023	Logged By SH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.40	C	87	100		0.54			TOPSOIL (Dark brown, organic, sandy gravelly SILT. Sand is fine to coarse. Gravel is fine to coarse and angular to sub-angular of sandstone, brick, glass and various other lithologies).
				77	100		0.90			MADE GROUND (Firm, light brown mottled grey, slightly sandy, gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse and angular to sub-angular of brick and sandstone).
							2.00			Stiff, light brown mottled grey, slightly sandy gravelly silty CLAY. Sand is fine to coarse. Gravel is fine to coarse and angular to sub-angular of sandstone. PENNINE LOWER COAL MEASURES FORMATION - SANDSTONE
										End of Borehole at 2.00m

Remarks

AGS

Borehole Log

Borehole No. **WS02**

Sheet 1 of 1

Project Name:	Land off Scott Lane	Project No. C3732/23/E/5713	Co-ords:
Location:	Cleckheaton, BD19 3LX		Level:
Client:	John Brooke Builders		Dates: 01/09/2023

Hole Type: WLS

Scale: 1:50

Logged By: SH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.10	C	87	100		0.15			TOPSOIL (Dark brown, slightly sandy, gravelly SILT. Sand is fine to coarse. Gravel is fine to coarse and angular to sub-angular of brick, sandstone and concrete).
							0.68			MADE GROUND (Firm to stiff, light brown slightly sandy, slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is fine to coarse and angular to sub-angular of sandstone and occasional brick). REWORKED NATURAL
				77	100		1.30			Firm to stiff, light brown, slightly sandy, gravelly, silty CLAY. Sand is fine to coarse. Gravel is fine to coarse and angular to sub-angular of sandstone. PENNINE LOWER COAL MEASURES FORMATION - SANDSTONE
							1.80			Light brown, slightly clayey, silty, sandy fine to coarse and sub-angular GRAVEL of sandstone. Sand is fine to coarse. PENNINE LOWER COAL MEASURES FORMATION - SANDSTONE
										End of Borehole at 1.80m

Remarks

Borehole Log

Borehole No. **WS03**

Sheet 1 of 1

Project Name:	Land off Scott Lane	Project No. C3732/23/E/5713	Co-ords:
Location:	Cleckheaton, BD19 3LX		Level:
Client:	John Brooke Builders		Dates: 01/09/2023

Hole Type: WLS

Scale: 1:50

Logged By: SH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.50	C	87	100		0.15			TOPSOIL (Dark brown, organic, slightly sandy, gravelly SILT. Sand is fine to coarse. Gravel is fine to coarse and angular to sub-angular of various lithologies).
							0.90			MADE GROUND (Light brown, slightly clayey, sandy fine to coarse and angular to sub-angular GRAVEL of sandstone and occasionally various other lithologies).
				77	100		1.52			Firm to stiff, light brown, sightly sandy, slightly gravelly, silty CLAY. Sand is fine to coarse. Gravel is fine to coarse and angular to sub-angular of sandstone. PENNINE LOWER COAL MEASURES FORMATION - SANDSTONE
							2.00			Light brown, slightly clayey, silty, sandy fine to coarse and angular to sub-angular GRAVEL of sandstone. Sand is fine to coarse. PENNINE LOWER COAL MEASURES FORMATION - SANDSTONE
										End of Borehole at 2.00m

Remarks

Appendix 3

Gas Monitoring Sheets

Rogers Geotechnical Services Ltd

GAS/WATER MONITORING - SITE RECORD

Client:

Site:

Input by : M. Tuck Checked by : R. Palmer

Date : 27.09.2023 Date : 03.10.2023

Gas Monitor: Geotech GA5000
Serial No. G503524
Calibration Date: 12.09.2023
Dip Meter: 003

(If second monitor is used)
Gas Monitor:
Serial No.
Calibration Date:
Dip Meter

Borehole No	Date	CH_4 (%)	CO_2 (%)	O_2 (%)	Flow (l/hr)	Barometric Pressure (mb)	Water Level (m)	Standpipe Depth (m)	Depth During Visit	Atmospheric Conditions	COMMENTS
1	20.09.2023	**0.0**	**6.5**	15.9	**0.0**	**980**	_		1.96	Rain	Rising pressure CO 0
	27.09.2023	**0.0**	4.8	16.4	**0.0**	1004	_		1.96	Cloudy	Steady pressure CO 0
2	20.09.2023	**0.0**	2.6	14.7	**0.0**	981	_		1.80	Rain	Rising pressure CO 0
	27.09.2023	**0.0**	**2.0**	**13.6**	**0.0**	1004	_		1.80	Cloudy	Steady pressure CO 0
3	20.09.2023	**0.0**	3.8	**18.3**	**0.0**	981	_		2.08	Rain	Rising pressure CO 0
	27.09.2023	**0.0**	3.7	17.9	**0.0**	**1005**	_		2.08	Cloudy	Steady pressure CO 0

CERTIFICATION OF CALIBRATION

4533

Date Of Calibration: 12-Sep-2023

Certificate Number: G503524_2/33564

Issued by: QED Environmental Systems Ltd.

Customer: **QED Environmental Systems Ltd (Lease)**
Barncliffe Mills Near Bank Shelley
HUDDERSFIELD HD8 8LU UNITED KINGDOM

Description: Gas Analyser

Model: GA5000

Serial Number: G503524

UKAS Accredited results:

Results after adjustment :

Methane (CH_4)		
Certified Gas (%)	**Instrument Reading (%)**	**Uncertainty (%)**
5.0	5.0	0.072
15.0	15.0	0.13
60.0	59.7	0.42

Carbon Dioxide (CO_2)		
Certified Gas (%)	**Instrument Reading (%)**	**Uncertainty (%)**
5.0	5.0	0.074
15.0	15.0	0.13
40.0	40.0	0.29

Oxygen (O_2)		
Certified Gas (%)	**Instrument Reading (%)**	**Uncertainty (%)**
20.2	20.3	0.25

The inwards assessment was carried out 01-Aug-2023.
The maximum adjustment is larger than the specification limit.
Inwards assessment data is available if requested.

All concentrations are molar.

CH_4, CO_2 readings recorded at : 33.5 °C ± 2.5 °C

O2 readings recorded at : 23.9 °C ± 2.5 °C

Barometric Pressure : 1003 mbar ± 4 mbar

Method of Test : The analyser is calibrated in a temperature controlled chamber using a series of reference gases, in compliance with procedure LP004.

Instrument has passed calibration as the measurement result is within the specification limit. The specification limit takes into account the measurement uncertainty.
The results relate only to the item calibrated

Calibration Instance:118 IGC Instance:117

www.qedenv.com +44 (0) 333 800 0088 sales@qedenv.co.uk

QED Environmental Systems Ltd. Cyan Park - Unit 3, Jimmy Hill Way, Coventry, CV2 4QP, UNITED KINGDOM

Registered in England and Wales 1898734

CERTIFICATION OF CALIBRATION

4533

Date Of Calibration: 12-Sep-2023

Certificate Number: G503524_2/33564

Issued by: QED Environmental Systems Ltd.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Calibrations marked 'Non-UKAS Accredited results' on this certificate have been included for completeness.

Non-UKAS accredited results after adjustment:

Barometer (mbar)	
Reference	**Instrument Reading**
1003	1003

Additional Gas Cells		
Gas	**Certified Gas (ppm)**	**Instrument Reading (ppm)**
CO	500	500
H_2S	273.5	274

Internal Flow	
Applied (l/hr)	**Instrument Reading (l/hr)**
5.0	4.9
10.0	9.9

Date of Issue : 15-Sep-2023 **Approved by Signatory**

Keeley Knight

Laboratory Inspection

End of Certificate

Calibration Instance:118 IGC Instance:117

www.qedenv.com +44 (0) 333 800 0088 sales@qedenv.co.uk

QED Environmental Systems Ltd. Cyan Park - Unit 3, Jimmy Hill Way, Coventry, CV2 4QP, UNITED KINGDOM

Registered in England and Wales 1898734

Appendix 4

Laboratory Testing

Rogers Geotechnical Services: Soil Screening Values Comparison Sheet

Rogers Geotechnical Services Ltd: Soil Screening Value (SSV) Comparison Sheet

Job Number	C3732/23/E
Job Name	Land off Scott Lane Cleckheaton
Date	03.10.23
Client	D&M Middleton

A = WS Atkins PLC, Atrisk Soil Screening Values.
A+ = Values updated June 2017.
A* = Atrisk's SSV is lower than Chemtest's detectable limit for this compound.
B = health criterion values, which are available from toxicological reviews published in the C4SL project methodology report.
C = Category 4 Screening Levels (C4SLs) based on 6% soil organic matter.
D = Value provided is based on Methyl Mercury. Should elemental mercury be observed or a source be known then a limit of 102 should be used.

KEY
- Exceeds SSV
- Exceeds 2017, Below 2015
- Below limit of detection (LOD)

Determinand	Units	Ref	LOD	Commercial 1%		Sample Location	WS01	WS02	WS03		Geoinv Min	Geoinv Max				
				Atrisk 2015 (No Free Product	Atrisk 2017	Depth Top	0.4	0.1	0.5							
						Depth Base										
Cadmium	mg/kg	C	0.2		410		< 0.2	< 0.2	< 0.2		< 0.2	4.50				
Chromium (Hexavalent)	mg/kg	B/C	1.8	49.1	19.7		< 1.8	< 1.8	< 1.8		< 1.0	< 1.0				
Copper	mg/kg	A+	1.0		106000		42	31	26		31.00	342.00				
Mercury	mg/kg	A/D	0.3		350		< 0.3	< 0.3	< 0.3		< 0.3	< 0.3				
Nickel	mg/kg	A+	1.0		1770		17	24	16		13.00	56.00				
Lead	mg/kg	C	1.0		2310		190	65	39		43.00	1084.00				
Zinc	mg/kg	A+	1.0		1100000		130	130	57		63.00	536.00				
Vanadium	mg/kg	A+	1.0		7490		25	24	20							
Arsenic	mg/kg	C	1.0		635		12	10	12		12.00	55.00				
Selenium	mg/kg	A	1.0		13000		< 1.0	< 1.0	< 1.0		0.60	1.80				
Cyanide (Free)	mg/kg	A	1.0		373		< 1.0	< 1.0	< 1.0		< 1.0	< 1.0				
Total Phenols	mg/kg	A	1.0		685											
Naphthalene	mg/kg	A+	0.05	90.1	75		0.29	0.05	< 0.05		0.08	12.43				
Acenaphthylene	mg/kg		0.05				0.1	< 0.05	< 0.05			0.26				
Acenaphthene	mg/kg	A+	0.05	83600	156.8		0.15	< 0.05	< 0.05			24.23				
Fluorene	mg/kg	A+	0.05		66500		0.17	< 0.05	< 0.05			22.04				
Phenanthrene	mg/kg		0.05				1.2	0.27	< 0.05			207.63				
Anthracene	mg/kg	A+	0.05		535000		0.22	0.07	< 0.05			55.69				
Fluoranthene	mg/kg	A+	0.05		72200		1.4	0.6	< 0.05			184.71				
Pyrene	mg/kg	A+	0.05		54100		1.3	0.63	< 0.05			161.68				
Benzo[a]anthracene	mg/kg	A	0.05	131	1.71		0.83	0.46	< 0.05			66.59				
Chrysene	mg/kg	A	0.05	14000	0.44		0.75	0.42	< 0.05			60.56				
Benzo[b]fluoranthene	mg/kg	A	0.05	142	1.22		1	0.7	< 0.05			77.75				
Benzo[k]fluoranthene	mg/kg	A	0.05	1430	0.686		0.36	0.38	< 0.05			25.28				
Benzo[a]pyrene	mg/kg	B/C	0.05	76.3	26.1		0.77	0.61	< 0.05			66.59				
Indeno(1,2,3-c,d)Pyrene	mg/kg	A*	0.05	142	0.0614		0.38	0.34	< 0.05			47.50				
Dibenz(a,h)Anthracene	mg/kg	A	0.05	14.3	0.00393		0.11	< 0.05	< 0.05			7.32				
Benzo[g,h,i]perylene	mg/kg	A	0.05	1440	0.0187		0.52	0.4	< 0.05			47.34				
Total Of 16 PAH's	mg/kg		0.8													
Aliphatic TPH >C5-C6	mg/kg	A+	0.001	4490	327											
Aliphatic TPH >C6-C8	mg/kg	A+	0.001	10400	157											
Aliphatic TPH >C8-C10	mg/kg	A+	0.001	1370	82.4											
Aliphatic TPH >C10-C12	mg/kg	A+	1.0	7900	49.9											
Aliphatic TPH >C12-C16	mg/kg	A+	2.0	34000	20.9											
Aliphatic TPH >C16-C21	mg/kg	A+	8.0		3620000							75.00				
Aliphatic TPH >C21-C35	mg/kg	A+	8.0		3620000							71.00				
Aliphatic TPH >C35-C44	mg/kg		10.0									15.00				
Total Aliphatic Hydrocarbons	mg/kg		10.0													

Rogers Geotechnical Services: Soil Screening Values Comparison Sheet

Rogers Geotechnical Services Ltd: Soil Screening Value (SSV) Comparison Sheet

Job Number	C3732/23/E
Job Name	Land off Scott Lane Cleckheaton
Date	03.10.23
Client	D&M Middleton

A = WS Atkins PLC, Atrisk Soil Screening Values.
A+ = Values updated June 2017.
A* = Atrisk's SSV is lower than Chemtest's detectable limit for this compound.
B = health criterion values, which are available from toxicological reviews published in the C4SL project methodology report.
C = Category 4 Screening Levels (C4SLs) based on 6% soil organic matter.
D = Value provided is based on Methyl Mercury. Should elemental mercury be observed or a source be known then a limit of 102 should be used.

KEY

- Exceeds SSV
- Exceeds 2017, Below 2015
- Below limit of detection (LOD)

Determinand	Units	Ref	LOD	Commercial 1%		Sample Location	WS01	WS02	WS03		Geoinv Min	Geoinv Max				
						Depth Top	0.4	0.1	0.5							
						Depth Base										
Aromatic TPH >C5-C7	mg/kg	A+	0.001		12.5											
Aromatic TPH >C7-C8	mg/kg	A+	0.001	27900	834											
Aromatic TPH >C8-C10	mg/kg	A+	0.001	2210	613											
Aromatic TPH >C10-C12	mg/kg	A+	1.0	12300	369							6.00				
Aromatic TPH >C12-C16	mg/kg	A+	2.0	41300	155							56.00				
Aromatic TPH >C16-C21	mg/kg	A+	10.0		28400							1033.00				
Aromatic TPH >C21-C35	mg/kg	A+	10.0		28400							265.00				
Aromatic TPH >C35-C44	mg/kg		10.0													
Total Aromatic Hydrocarbons	mg/kg		10.0													
Total Petroleum Hydrocarbons	mg/kg		10.0													
pH			N/A				**10.50**	8.50	**7.40**							
Sulphate (2:1 Water Soluble) as SO4	g/l		0.0013				0.914	**0.201**	**1.74**							
ACM Type			N/A													
Asbestos Identification	%						Not detected	Not detected	Not detected							
ACM Detection Stage			N/A													
Moisture	%		0.01				13.00	11.00	13.00							
Soil Colour			N/A													
Other Material			N/A													
Soil Texture			N/A													
Sulphate (Total)	%		0.005													
Organic Matter	%		0.1				**2.80**	**2.00**	**2.00**							

Harry Letch
Rogers Geotechnical Services Ltd
Offices 1&2 Barncliffe Business Pk
Near Bank, Shelley
Huddersfield
West Yorkshire
HD8 8LU

t: 01484 604354

e: harry.letch@rogersgeotech.co.uk

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

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 23-54528

Project / Site name:	Cleckheaton	**Samples received on:**	04/09/2023
Your job number:	C3732	**Samples instructed on/ Analysis started on:**	04/09/2023
Your order number:	RGS3732	**Analysis completed by:**	11/09/2023
Report Issue Number:	1	**Report issued on:**	11/09/2023
Samples Analysed:	3 soil samples		

Signed:

Anna Goc
PL Head of Reporting Team
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

Excel copies of reports are only valid when accompanied by this PDF certificate.

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.

Analytical Report Number: 23-54528
Project / Site name: Cleckheaton
Your Order No: RGS3732

Lab Sample Number				2800246	2800247	2800248
Sample Reference				WS01	WS02	WS03
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.40	0.10	0.50
Date Sampled				01/08/2023	01/08/2023	01/08/2023
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	13	11	13
Total mass of sample received	kg	0.001	NONE	0.8	0.8	0.7
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	PDO	PDO	PDO

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	10.5	8.5	7.4
Free Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Water Soluble Sulphate as SO4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	1800	400	3500
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.914	0.201	1.74
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	914	201	1740
Organic Matter (automated)	%	0.1	MCERTS	2.8	2	2

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	0.29	0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	0.1	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	0.15	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	0.17	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	1.2	0.27	< 0.05
Anthracene	mg/kg	0.05	MCERTS	0.22	0.07	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	1.4	0.6	< 0.05
Pyrene	mg/kg	0.05	MCERTS	1.3	0.63	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.83	0.46	< 0.05
Chrysene	mg/kg	0.05	MCERTS	0.75	0.42	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	1	0.7	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	0.36	0.38	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.77	0.61	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.38	0.34	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.11	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.52	0.4	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	9.46	4.93	< 0.80

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	12	10	12
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	20	20	12
Copper (aqua regia extractable)	mg/kg	1	MCERTS	42	31	26
Lead (aqua regia extractable)	mg/kg	1	MCERTS	190	65	39
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	17	24	16
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	25	24	20
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	130	130	57

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

Analytical Report Number : 23-54528
Project / Site name: Cleckheaton

* 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 *
2800246	WS01	None Supplied	0.4	Brown clay and sand with gravel and vegetation.
2800247	WS02	None Supplied	0.1	Brown clay and sand with gravel and vegetation.
2800248	WS03	None Supplied	0.5	Brown clay and sand with gravel and vegetation.

Analytical Report Number : 23-54528
Project / Site name: Cleckheaton

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
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.	L038-PL	D	MCERTS
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	A001-PL	D	ISO 17025
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 (Skalar)	L080-PL	W	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
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
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.	L019-UK/PL	D	NONE
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Sulphate, water soluble, in soil	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS

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 30oC.
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.

Sample Deviation Report

Analytical Report Number : 23-54528
Project / Site name: Cleckheaton

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
WS01	None Supplied	S	2800246	c	Free cyanide in soil	L080-PL	c
WS01	None Supplied	S	2800246	c	Hexavalent chromium in soil	L080-PL	c
WS01	None Supplied	S	2800246	c	Organic matter (Automated) in soil	L009-PL	c
WS01	None Supplied	S	2800246	c	Speciated EPA-16 PAHs in soil	L064-PL	c
WS01	None Supplied	S	2800246	c	pH in soil (automated)	L099-PL	c
WS02	None Supplied	S	2800247	c	Free cyanide in soil	L080-PL	c
WS02	None Supplied	S	2800247	c	Hexavalent chromium in soil	L080-PL	c
WS02	None Supplied	S	2800247	c	Organic matter (Automated) in soil	L009-PL	c
WS02	None Supplied	S	2800247	c	Speciated EPA-16 PAHs in soil	L064-PL	c
WS02	None Supplied	S	2800247	c	pH in soil (automated)	L099-PL	c
WS03	None Supplied	S	2800248	c	Free cyanide in soil	L080-PL	c
WS03	None Supplied	S	2800248	c	Hexavalent chromium in soil	L080-PL	c
WS03	None Supplied	S	2800248	c	Organic matter (Automated) in soil	L009-PL	c
WS03	None Supplied	S	2800248	c	Speciated EPA-16 PAHs in soil	L064-PL	c
WS03	None Supplied	S	2800248	c	pH in soil (automated)	L099-PL	c