

**Environmental
Geotechnical
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PHASE 2 ENVIRONMENTAL REPORT

job number C482/20/E/1669	date 15/12/2020
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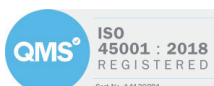
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Report on a Phase 2 Environmental Investigation

Location: 29 Berry Brow (Land to Rear of)
Clayton Bridge, Manchester, M40 1GR

For: GS Construction (NW) Ltd

Report No. C482/20/E/1669

Report date: December 2020

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

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Environmental Engineer

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Geo-environmental Engineer

Report Summary¹

Item	Comments	Section
Development	Construction of a new residential dwelling.	1.
Geology	Superficial geology – Devensian Till. Solid geology – Collyhurst Sandstone Formation.	5.
Strata Conditions	Variable thickness of made ground overlying till.	6.1
Groundwater	None encountered during investigation.	6.2
Contamination	A hotspot of Lead and PAH contamination revealed at WS4.	9.1.1
Effect of Sulphates	DC-1 concrete.	9.1.2
Ground Gasses	Characteristic Situation Level 2 should be adopted for the site.	9.1.3

¹ This summary should not be relied upon to provide a comprehensive review. All of the information contained in this document should be considered.



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1. Introduction

It is understood that the land to the rear of No 29 Berry Brow, Clayton Bridge, Manchester, M40 1GR is to be developed by the construction of a new residential dwelling which will be located towards the southern end of the site area, as per plans within Appendix 1. 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 establish the risk from any contamination which may be 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. Moreover, this report only considers the environmental issues related to the development. Geotechnical issues (e.g. foundation design, concrete design sulphate class etc.) are not covered within this document.

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. Desk Study

A Phase 1 Desk Study has been undertaken by Rogers Geotechnical Services (RGS) and the results were presented as report number C482/20/E/29 in January 2020. This report has been used extensively during the current intrusive investigation.

4. Fieldworks

After an initial failed mobilisation to the site on the 5th October 2020, the fieldworks were subsequently undertaken on the 3rd November 2020 following clearance of the site and included:

- Four windowless sample boreholes.
- Standard penetration tests within all boreholes.
- Three gas monitoring standpipes.

The investigatory locations are shown on the site plan which is presented in Appendix 1 to this report.



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4.1 Windowless Sample Boreholes

These boreholes were sunk using a drive-in windowless sampler. The cores were undertaken in 1m lengths and generally reduced in diameter from approximately 90mm for the first 1m through 80mm, 70mm and 60mm 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 Standard Penetration Tests

Standard penetration tests (SPT) were undertaken at regular depth increments within all the windowless sample boreholes. The SPTs were conducted in accordance with the procedures given in BS EN ISO 22476: Part 3: 2005 +A1: 2011, and the results are summarised on the borehole record. During this work an automatic trip hammer of 63.5kg falling through 750mm was employed to drive either a cone or split barrel sampler assembly into the ground and the recovered barrel samples were retained in air tight plastic containers. It may be appreciated that the approximate cohesion of clay soils may be obtained by multiplying the equivalent SPT value by approximately 4.5 (after Stroud, 1975).

4.3 Gas Monitoring Standpipes

Gas monitoring standpipes were installed between 3m and 4.45m depth in boreholes WS1, WS2 and WS3 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 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 ²	Previous Name ³	Description ³
Superficial Geology	Devensian Till	-	Variable lithology, usually sandy, silty clay with pebbles, but can contain gravel-rich or laminated sand layers. Varied colour and consistency. [Generic description].
Solid Geology	Collyhurst Sandstone Formation	Permian Sandstone Lower Permian Sandstone	A soft red sandstone with abundant beds of 'millet seed' sand grains alternating with beds of fine-grained sharp sand. Some Interbedded grey sandstone locally present.

² Sources: British Geological Survey (NERC) Map Sheet 85; Manchester; Solid and Drift Edition, and Geology of Britain Viewer [online resource from www.bgs.ac.uk]

³ Sources: British Geological Survey (NERC) Lexicon of Named Rock Units [online resource from www.bgs.ac.uk]



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6. Strata Conditions

In accordance with the geology of the area, the succession has been shown to include the following:

Table 2: Generalised Strata Profile

Depth m below ground level to underside of layer	Strata Type	Positions Encountered	Groundwater Strikes m below ground level
0.05	TOPSOIL	All	None
0.25 – 2.1	MADE GROUND	All	None
0.9m	Orangish brown mottled gray CLAY [Reworked Till].	WS4	None/
0.9 – 1.3	Firm, locally soft orangish brown, sandy CLAY. [Till]	WS1, WS2, WS4	None
2.5	Very loose orangish brown clayey SANDs and GRAVELs. [Till]	WS4	None
2.0	Loose light grey silty gravelly SAND. [Till]	WS1	None
2.75	Medium dense dark brown very silty SAND. [Till]	WS1	None
+3.0 – 4.45+	Firm dark brown sandy slight gravelly CLAY. Gravel is subrounded fine to medium of mixed lithologies.[Till].	WS1, WS2, WS3	None

'+' denotes that the strata extended below the termination depth of the investigated positions, thus the extent of the deposit is only proven to the depths indicated

6.1 General Strata

In general, the borehole records indicate that beneath a 0.05m capping of topsoil, cohesive made ground comprising reworked clays was present to depths of between 0.25m and 0.5m at positions WS1, WS2 and WS4, whilst deeper made ground was present to 2.1m below ground level (bgl) at WS3. The gravel within the made ground generally included brick, although some clinker was noted at WS4.

Below the made ground, at positions WS1, WS3 and WS4, soft to firm locally gravelly clays were observed to depths of between 0.9m and 1.3m bgl, these were noted to be reworked to a depth of 0.9m bgl at the position of WS4. Beneath the locally gravelly clays, very loose to medium dense sands and gravels were then observed to depths of between 2.5m and 2.7m bgl at positions WS1 and WS4.

Beneath the made ground at WS2 and the sands and gravels at other positions, generally firm becoming stiff slightly gravelly clays were then revealed to the termination depth of all positions. With respect to the published geological data for the site, it is considered that these soils represent till deposits, which are anticipated to be present below the site.

6.2 Groundwater

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.



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7. Insitu Testing

7.1 Standard Penetration Tests

Standard penetration tests carried out in all boreholes and are summarised in the following table:

Table 3: Summary of Standard Penetration Tests

Strata	Depth Range (m)	SPT 'N' (Blows/300mm)		Comments
		Granular soils	Cohesive soils	
SAND/GRAVEL within WS4 [Till].	1.0m to 2.45m	3 & 4	–	SPT's indicate granular material is in a very loose in-situ condition.
Slightly gravelly SAND [Till].	1.0m to 1.45m	10	–	SPT's indicate granular material is in a loose in-situ condition.
Very silty SAND [Till].	2.0m to 2.45m	22	–	SPT's indicate granular material is in a medium dense in-situ condition.
Slightly gravelly CLAY [Till].	2.0m to 2.45m	13 – 14	–	SPT's a firm becoming very stiff in-situ condition.
	3.0m to 3.45m	21 – 24	–	
	4.0m to 4.45m	32 – 33	–	

7.2 Gas and Water Level Monitoring

The standpipes were monitored between the 18th November 2020 and the 7th December 2020. The results of the gas monitoring undertaken to date are tabulated below.

Table 4: Gas Monitoring

Location	Date	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	Flow (l/h)	Barometric Pressure (mb)	Water Level (m)	Standpipe Depth (m)
WS01	18.11.20	0.1	1.7	21.1	0.1	1000↔	0.9	3.00
	30.11.20	0.1	4.9	20.0	0.1	1011↔	0.1	
	07.12.20	0.1	5.9	20.2	0.1	988↑	0.25	
	15.12.20	0.1	6.2	19.2	0.1	996↓	0.85	
WS02	18.11.20	0.0	2.3	20.1	0.1	1000↔	0.7	4.45
	30.11.20	0.1	3.9	18.2	0.1	1011↔	0.85	
	07.12.20	0.1	4.1	18.8	0.1	991↑	0.1	
	15.12.20	0.1	4.8	19.3	0.1	996↓	0.3	
WS03	18.11.20	0.1	2.8	19.9	0.1	1000↔	0.9	4.45
	30.11.20	0.1	4.7	19.5	0.1	1011↔	0.1	
	07.12.20	0.1	5.0	17.0	0.1	991↑	0.3	
	15.12.20	0.1	4.8	18.4	0.1	996↓	0.85	

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

This work was undertaken using a Geotechnical Instruments (UK) Ltd. GA5000 (serial No G503524) which was last calibrated on the 12th November 2020.



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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⁻ and Phenols.
- Polycyclic aromatic hydrocarbons (PAHs).
- Petroleum hydrocarbons (TPHs).
- Others – pH, organic content and total/soluble SO₄²⁻.
- Asbestos.

This testing was undertaken by Chemtest Ltd and the results of all of the chemical testing are presented in Appendix 3 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 a new residential dwelling with associated areas of hardstanding and garden areas. Consequently, the site may be classified as residential with plant uptake.

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 3.8% and 7.2%. 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 website⁴ and these include many local authorities.

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 criterion⁵. 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.

⁴ <http://www.atrisksoil.co.uk/pages/general/subscribers.asp>

⁵ Ref: ATRISK soil, SSVs derived using CLEA v1.071 for 6% SOM, Residential without home grown produce land use, 23.06.17.

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A comparison of the results of the testing, together with the data given above, can be found within Appendix 3. These results indicate the following:

Table 5: Summary of Contaminated Areas

Location	Depth (m)	Contaminants found to be exceeding SSVs (Residential with plant uptake)
WS1	0.05 – 0.35	None.
WS2	0.3 – 0.5	None.
WS4	0 – 0.15	Lead, PAHs (benzo(a)anthracene, benzo(a)pyrene, dibenzo(a,h)anthracene).

Concentrations of chromium(VI), free cyanide, phenols (total) and total petroleum hydrocarbons (aliphatic C5 to C21; aromatic C5 to C12) were below the detection limits for the tests. Detectable levels of all other contaminants were recorded, but these fell below the associated At Risk Soil Screening Values. In addition, no asbestos was detected within the soils samples tested.

On the basis of the above information, a 'hotspot' of lead and PAH contamination has been observed to exceed the appropriate screening values at the position of HDTP4. It should be appreciated that this contamination coincides with the observation of coal ash fragments (clinker) within this borehole, which was not observed within the other boreholes and as such, it is reasoned that this contamination could be associated with localised coal ash fragments within the near surface soils in this area.

However, the other areas of the site appear to be the results of the site appear to be generally uncontaminated.

9.1.2 Gas Concentrations

With respect to ground gas, the results of the monitoring visits indicated a maximum concentration of 0.1% methane, with concentrations of carbon dioxide ranging between 1.7% and 6.2%, in association with oxygen levels of between 17.0% and 21.1%. 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. In addition, a maximum flow rate of 0.1 litres per hour was recorded and 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 988mb and 1011mb.

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 0.1% (0.001) methane was recorded along with 6.2% (0.062) 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 0.0062 l/hr for carbon dioxide. However, as levels of carbon dioxide exceeded 5%, the site should be

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upgraded to Characteristic Situation Level 2. Therefore, it is considered that there is a low risk of harm to end users and some protection measures are required.

The sufficiency of gas monitoring data is considered in BS 8576: 2013: *Guidance on investigations for ground gas – Permanent gasses and Volatile Organic Compounds (VOC's)*. In this standard Table F3, *Assessing sufficiency of data* has been employed to justify the curtailment of monitoring. In this context it should be noted that the gas screening value threshold for Characteristic Situation level 2 is <0.7 l/hr. Assuming the flow rate remains constant at 0.1l/hr the gas concentration of carbon dioxide would need to exceed 700% to move into the next risk band, which is not reasonable. Moreover, by keeping the concentration constant, the flow rate would need to increase to 11.9l/hr to move into the next band, which is in excess of a 100 fold increase. We consider that these increases are not feasible given the flow rates encountered. In view of the above it is considered that the site is fully characterised.

In light of the above, it is considered that the site can be fully classified as Characteristic Situation Level 2.

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 Agency⁶ 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 6. Sources of contamination include the following:

On-site – Made Ground (Lead and PAHs, Carbon Dioxide).

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.



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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. |
| 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 6.

**Table 6: Conceptual Site Model and Site Specific Risk Assessment [Contamination: Lead and TPHs]**

Conceptual Site Model			Site Specific Risk Assessment	
Pathways	Receptor	Linkage Present?	Risk Rating	Notes
Direct contact/dermal absorption/soil ingestion	Operative	Yes – a hotspot of lead and PAH contamination found to be present at the site and contact with soil likely during works.		A hotspot of lead and PAH contamination is present at WS4. Precautionary measures will be required during the construction phase.
	End User	Yes – a hotspot of lead and PAH contamination found to be present at the site and site to be developed into an apartment block with landscaped areas.	High (WS4 Hotspot) Low (Other Areas)	Remediation will be required to either remove the contamination or break pathways.
	Neighbours	Yes – however, the site is underlain by cohesive soils of low permeability through which contamination by lead and PAHs is not anticipated to be significantly mobile. Furthermore, the site is anticipated to be secured during the development phase.	Low	
Inhalation of Dust/Vapours	Operative	Yes – dust may be derived from contaminated soils. However, lead and PAH contamination is not considered to represent a significant vapour risk.	High (WS4 Hotspot) Low (Other Areas)	A hotspot of lead and PAH contamination is present at WS4. Precautionary measures will be required during the construction phase. Remediation will be required to either remove the contamination or break pathways.
	End User	Yes – dust may be derived from contaminated soils. However, lead and PAH contamination is not considered to represent a significant vapour risk.	High (WS4 Hotspot) Low (Other Areas)	
	Neighbours	Yes – a hotspot of lead and PAH 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.	High (WS4 Hotspot) Low (Other Areas)	
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	A hotspot of lead and PAH contamination is present at WS4. Precautionary measures will be required during the construction phase.
	End User	Yes – a hotspot of lead and PAH contamination found to be present at the site and site to be developed by the construction of a new low rise residential dwelling.	High (WS4 Hotspot) Low (Other Areas)	Remediation will be required to either remove the contamination or break pathways.
	Neighbours	Yes – however, the site is underlain by cohesive soils of low permeability through which contamination by lead and PAHs is not anticipated to be significantly mobile.	Low	
Migration of hazardous gases via permeable strata or shallow mining activity	Operative	Yes – elevated levels of carbon dioxide have been found to be present at the site (<i>Characteristic Situation Level 2</i>).	High	Gas protection measures are required.
	End User		High	
	Neighbours	No – whilst some concentrations of ground gas have been found to be present at the site (assuming <i>Characteristic Situation Level 2</i>), no structures directly adjoin the site, therefore any gases migrating from the site would vent to atmosphere before reaching neighbouring structures.	N/A	



Spillage/loss/run off direct to receiving water	Controlled Waters	Yes – a hotspot of lead and PAH contamination found to be present at the site however, the site is underlain by cohesive soils of low permeability through which contamination by lead and PAHs is not anticipated to be significantly mobile.	Low	
Migration via permeable unsaturated strata	Controlled Waters	Yes – a hotspot of lead and PAH contamination found to be present at the site however, the site is underlain by cohesive soils of low permeability through which contamination by lead and PAHs is not anticipated to be significantly mobile.	Low	
Run off via drainage/sewers etc	Controlled Waters	Yes – old services may be present on site.	High (WS4 Hotspot) Low (Other Areas)	Old services to be removed or capped.
Direct contact with contaminated soils	Plants	Yes – a hotspot of lead and PAH contamination found to be present at the site which may affect plants.	High (WS4 Hotspot) Low (Other Areas)	A hotspot of lead and PAH contamination is present at WS4. Precautionary measures will be required during the construction phase.
Uptake via root system			High (WS4 Hotspot) Low (Other Areas)	Remediation will be required to either remove the contamination or break pathways.
Direct contact with contaminated soils	Building Materials	Yes – PAH contamination revealed at the site may represent a risk to building materials or plastic water pipes.	Moderate (plastic services)	Please see section 11.3.3 for information on good building practice.
Direct contact with contaminated groundwater				
Exposure to Radon	Operative End User	Yes – in a lower risk radon affected area, as between 1% and 3% of properties are above the action level.	Low	The publication BR211 states that no protection measures are necessary.



9.3 Indicative Remediation Strategy

In view of the site specific risk assessment it is considered that remediation will be required at this site. Such a strategy should include the following main elements.

9.3.1 Remediation Objectives

Based on the site specific risk assessment the object of the remediation is likely to be 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.
- To protect the end user from the ingestion of soil or dust, dermal contact with the soil and inhalation of dust.
- To protect neighbours from the inhalation and ingestion dust during the construction process.
- To protect plants from direct contact with contamination and prevent uptake via root system.
- To protect operatives, end users and neighbours from the ingestion of contaminated fruit and vegetables.
- To protect plastic services from being penetrated by, or degrading due to the presence of, contamination in the soil or groundwater.
- To protect the end user from the elevated levels of carbon dioxide.

9.3.2 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 a new residential dwelling. In view of the above a site specific remediation strategy should be undertaken after the proposed development has been finalised. However, for preliminary design and costing the following remediation proposals are offered.

9.3.3 Outline Strategy

In order to fulfil the objectives defined above it is likely that the following remedial strategy could 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 should be made aware of the hazards of working with contaminated soils.
- Site operatives at all levels should be made aware of the hazards of working with contaminated soils and the hazards of working in an area where accumulations of bulk ground gasses (carbon dioxide) could occur, particularly in confined spaces.
- 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 should 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 should 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 should 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 would 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 should be employed.
- Any redundant services revealed at this site should be de-commissioned and piped services sealed. Any existing services that are to be employed in the new development should be carefully inspected to ensure that they are serviceable.
- New plastic services should 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.

WS4 Hotspot Area

It is understood that there is proposed to include soft landscaped areas with grass and shrubs on the northern area of the development, as per Appendix 1. In view of this and the hotspot of contamination observed at WS4, it is considered that some remediation will be required.

Given that WS4 is located towards the northern boundary of the site, and the other positions did not indicate any contamination (or include any clinker), it is considered that only the landscaped areas north of WS3 will require remediation. For this area, the remediation could include the provision of a clean cover system including a capping layer of say 500mm of inert material, which will put the contaminated ground out of the end users' dig range. At the base of this layer, a granular capillary break of say 100mm of free draining granular soil should be placed in order to prevent mobile contamination rising upward. This expedient should also provide a suitable root barrier to isolate the plants from the underlying contaminated ground.

Permanent Hard-standing

Notwithstanding the above, areas of permanent hard-standing would break the pathway between the end user and the source. Therefore, no remediation is considered to be necessary beneath any permanent hard-standing, which includes building footprints.

9.4 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 A. Therefore, on the basis of Table 4 Gas protection score by CS and type of building, the minimum gas protection score (points) is 3.5. The gas protection system should consist of at least two different elements. The elements work independently and collaboratively, and a single element should not be used because there would be no redundancy to allow for defects in the component.

In order to achieve this score the following should be undertaken.

Table 7: Combination of protection elements (BS8485: 2015) for CS2

Reference	Protection Element	Score
Table 5	Precast suspended segmental sub-floor (i.e. beam and block).	0



	Cast insitu ground-bearing floor slab (with only nominal mesh reinforcement).	0.5
	Cast insitu monolithic reinforced ground bearing raft or reinforced cast insitu suspended floor slab with minimal penetrations.	1.0 or 1.5 ⁹
Table 6 ¹⁰	Pressure relief pathway ¹¹ (usually formed of low fines gravel with a thin geocomposite blanket or strips terminating in a gravel trench external to the building)	0.5
	Passive sub-floor dispersal layer (Note 1):	
	Good Performance Very good performance	1.5 2.5
Table 7	Gas resistant membrane complying with the requirements given in Table 7 (Note 2)	2
Total Score		Min: 3.5 Max: 4.5

Note 1:

Dispersal layers could include:

- Clear void.
- Polystyrene void former blanket.
- Geocomposite void former blanket.
- No-fines gravel layer with gas drains.
- No-fines gravel layer.

Note 2:

The gas resistant membrane shall meet the following criteria:

- Sufficiently impervious (methane gas transmission rate <40.0ml/day/m²/atm (average) BS ISO 15105-1 manometric method).
- Sufficiently durable and strong to remain serviceable for the anticipated life of the building, to withstand in-service stresses and installation process.
- Capable, after installation, of providing a complete barrier to the entry of the relevant gas.
- Verified in accordance with CIRIA C735: 2014: *Good practice on the testing and verification of protection systems of buildings against hazardous ground gasses.*

It should be appreciated that if the membrane installed does not meet all the criteria above, then the score for the membrane is considered to be zero.

In addition to the above, the following points shall be considered.

⁹ To achieve a score of 1.5, the raft or suspended slab should be well reinforced to control cracking and have minimal penetrations cast in.

¹⁰ For details on the criteria for good and very good performance see Annex B of BS84845: 2015.

¹¹ If the layer has a low permeability and/or is not terminated in a venting trench (or similar), then the score is zero.



- Technical drawings of the incorporation of the gas protection measures into the sub-structure will be provided by a suitably qualified engineer/architect and produced in accordance with the guidance given in BRE 414.
- The sequence of construction indicating when the gas protection system will be installed will be included with the remediation statement. Where possible the installation of membranes will take place as a unique activity on site and shall not take place until sub-structure construction is complete.
- During and following the installation of the membrane, all parties in attendance at the site shall be made aware that a gas protection system is to be employed within the construction. Such communications should include, but not be limited to, the CDM documentation for the site and site inductions.
- The installation of the membrane shall be carried out only by suitable personnel and the qualifications or experience/training will be included as part of the remediation statement. The suitability of personnel will be assessed in accordance with Annex 1 of CIRIA C735.
- The installation shall be in strict accordance with manufacturer specifications and recommendations, which shall also be included as part of the remediation statement.
- The membrane system employed will not be an ensemble (i.e. a system comprising a mixture of products from different manufacturers will not be employed).
- Membranes shall be supplied to site on a single wound roll, creased product will not be accepted or employed.
- Whilst membranes are exposed, signage will be provided to indicate the access to the installation area is prohibited unless authorised. Footwear will be checked prior to accessing the membrane surface to ensure no sharp objects are apparent, such as stones caught in treads. The use of sharp objects or hot-works around the exposed membrane will be strictly prohibited unless the risk of damaging the membrane has been fully assessed and mitigated.
- Non-conformance of manufacturer recommendations shall be discussed and agreed as acceptable, in writing, with a suitably qualified person from the manufacturer.

9.5 Fill Materials

It should also be appreciated that any fill material, either site-won or imported, to be employed at the site should be subjected to the following assessment to determine its suitability.

Fill materials should 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 BS3883 (2007)
- 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 should also be appreciated that any fill should be subjected to validation testing to assess its suitability. The following table has been taken from YALPAG¹² 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 8: Validation Sampling and Testing

Fill Type	Frequency	Minimum Determinands
Virgin Quarried Material	1 or 2 depending on the type of stone (to confirm the inert nature of the material)	Standard metals/metalloids (As, Cd, Cr, Cr(VI), Cu, Hg, Ni, Pb, Se, Zn)
Crushed Hardcore, Stone, Brick	Minimum 1 per 1000m ³	Standard metals/metalloids as above plus PAH (16 USEPA) and Asbestos
Greenfield/ Manufactured Soils	The greater of a minimum of 3 or 1 per 250m ³	Standard metals/metalloids as above plus PAH (16 USEPA) and Asbestos
Brownfield/ Screened Soils	The greater of a minimum of 6 or 1 per 100m ³	Standard metals/metalloids as above plus PAH (16 USEPA), TPH (CWG banded) and Asbestos Any additional analysis dependant on the history of the donor site.

The screening values for the above regime should also be agreed with any regulatory bodies; however, the following is recommended in the first instance.

Table 9: Fill Screening Values

Contaminant	Screening Value (Residential with Plant Uptake) (mg/kg)		Reference
	1% SOM	6% SOM	
As	37	37	Atrisk ^{SOIL} SSVs
Cd	22.1	22.1	Atrisk ^{SOIL} SSVs
Cr(VI)	3.62	3.63	Atrisk ^{SOIL} SSVs
Cu	4730	4790	Atrisk ^{SOIL} SSVs
Hg	8.81	15.8	Atrisk ^{SOIL} SSVs
Ni	136	136	Atrisk ^{SOIL} SSVs
Pb	200	200	Atrisk ^{SOIL} SSVs
V	136	138	Atrisk ^{SOIL} SSVs
Zn	20000	20300	Atrisk ^{SOIL} SSVs

Please see summary sheet within Appendix 4 for full screening values including PAHs & TPHs.

The above screening values should be considered with respect to the Soil Organic Matter (SOM) of the subject material i.e. 1% SOM would be typical for granular fill and 6% SOM for topsoil. Testing should comply with UKAS and MCERTS, where applicable, and undertaken by an accredited laboratory. Where the material has been derived from a commercial company, certificates or other industry quality protocol compliance i.e. WRAP should be obtained. However, it will be necessary to ensure that this

¹² YALPAG Technical Guidance for Developers, Landowners and Consultants – Verification Requirements for Cover Systems V3.3 Appendix 1a, October 2016.



documentation specifically related to the material being imported, it is no more than two months old and complies with the screening and frequency requirements given above.

Suitable fill materials should be either placed immediately or sufficiently quarantined to prevent cross-contamination. If it is necessary, the quarantined material should be placed on appropriate sheeting and covered to prevent it becoming mixed with contaminated soils or dust, or penetrated by mobile contaminants.

9.6 Verification Report

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

WS4 Hotspot Area

- The extents of any areas where made ground has been wholly removed.
- Characterisation of the suitability of the clean material including the derivation of the material, comments from a visual screen, the tests results of chemical screening, delivery tickets where appropriate and the conditions by which the clean material has been stored and handled on site.
- Photographic and logged evidence the clean material has been handled on site and placed in a sufficient thickness over areas where made ground remains. This may be either at the time of placement or after placement by means of hand excavated trialpits. Photographs should include visual site references or reference boards to prove the location and date taken. A measurement reference should be visible in the photographs to substantiate the thickness of material placed. Please note that it may also be necessary to undertake a topographical survey and the requirement for which should be checked with any statutory authorities.

Ground Gas Protection System

- The qualifications or relevant experience/training of the persons carrying out the installation.
- The independence of the person carrying out the verification, along with evidence of their qualifications or relevant experience/training.
- Details of the verification process including the dates of inspections and findings.
- Signed statements to confirm that protection measures were constructed as agreed. These statements shall also include confirmation that:
 - Membranes were free from tears and punctures, and installed in accordance with manufacturer guidelines.
 - Underfloor voids were clear and free from debris.
- Clear photographic evidence of the construction of membranes and/or underfloor voids, which should include key details such as air vents, membrane penetrations etc.
- Details of non-conformances and how they were rectified.
- A declaration that remedial objectives set out in the conceptual site model have been achieved.

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.



10. 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.
- Discussions with contractors in relation to the suitability of materials and installation methods for gas protection measures.
- Produce a validation report to demonstrate that the environmental 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.

11. References

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 - Geology of Britain Viewer:
(http://maps.bgs.ac.uk/geologyviewer_google/googleviewer.html)
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(<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.
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- 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



Title: **Investigation Location Plan**

 Rogers Geotechnical Services Ltd	Site Name: 29 Berry Brow (Land to Rear of)	Job No: C482/20/E
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Appendix 2

Borehole Records



Borehole Log

Borehole No.

WS1

Sheet 1 of 1

Project Name: Site Adjacent to 29 Berry Brow

Project No.
C482/20/E/1669

Co-ords:

Hole Type
WLS

Location: Clayton Bridge, Manchester M40 1GR

Level:

Scale
1:50

Client: GS Construction (NW) Ltd

Dates: 03/11/2020

Logged By
MC

Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Dia. (mm)	TCR (%)	Results					
		1.00	SPT	90	95	N=10 (2,1/2,4,2,2)	0.05		TOPSOIL (Dark brown organic sandy CLAY)		
				80	70		0.50		MADE GROUND (Dark brown mottled red sandy slightly gravelly CLAY. Gravel is subangular fine to medium of brick).		
							0.90		Firm orangish brown mottled grey CLAY.		
		2.00	SPT	70	85	N=22 (6,2/3,6,6,7)	2.00		Medium dense dark brown very silty SAND.		
							2.75		Firm dark brown sandy slightly gravelly CLAY. Gravel is subrounded fine to medium of mixed lithologies.		
		3.00	SPT			N=24 (2,3/4,5,7,8)	3.45		End of Borehole at 3.45m		

Remarks





Borehole Log

Borehole No.

WS2

Sheet 1 of 1

Project Name: Site Adjacent to 29 Berry Brow

Project No.
C482/20/E/1669

Co-ords:

Hole Type
WLS

Location: Clayton Bridge, Manchester M40 1GR

Level:

Scale
1:50

Client: GS Construction (NW) Ltd

Dates: 03/11/2020

Logged By
MC

Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Dia. (mm)	TCR (%)	Results					
							0.05			TOPSOIL (Dark brown organic sandy CLAY).	
				90	75		0.45			MADE GROUND (Dark brown mottled red sandy slightly gravelly CLAY. Gravel is subangular fine medium of brick). Soft orangish brown very sandy CLAY.	1
		1.00	SPT			N=9 (1,1/1,2,3,3)					
				80	95		1.30			Dark brown mottled grey sandy slightly gravelly CLAY. Gravel is subrounded fine to medium of mixed lithologies.	
		2.00	SPT			N=13 (2,2/2,3,4,4)					2
										2.0-3.0m: Wet, poor recover	
		3.00	SPT			N=21 (3,3/4,5,6,6)					3
				70	85						
		4.00	SPT			N=32 (5,5/8,8,8,8)					4
							4.45			End of Borehole at 4.45m	5
											6
											7
											8
											9
											10

Remarks





Borehole Log

Borehole No.

WS3

Sheet 1 of 1

Project Name: Site Adjacent to 29 Berry Brow

Project No.
C482/20/E/1669

Co-ords:

Hole Type
WLS

Location: Clayton Bridge, Manchester M40 1GR

Level:

Scale
1:50

Client: GS Construction (NW) Ltd

Dates: 03/11/2020

Logged By
MC

Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Dia. (mm)	TCR (%)	Results					
		0.05					0.05			TOPSOIL (Dark brown organic sandy CLAY).	1
		0.90					0.90			MADE GROUND (Dark brown mottled red sandy slightly gravelly CLAY. Gravel is subangular fine medium of brick).	
		1.00	SPT			N=4 (1,0/1,1,1,1)	1.00			MADE GROUND (Orangish red sandy subangular fine to coarse GRAVEL of brick).	2
		2.00	SPT			N=14 (2,2/3,3,4,4)	2.10			MADE GROUND (Dark brown mottled red sandy slightly gravelly CLAY. Gravel is subangular fine medium of brick).	
		3.00	SPT			N=23 (3,2/5,5,6,7)				Firm dark brown mottled grey sandy slightly gravelly CLAY. Gravel is subrounded fine to medium of mixed lithologies.	3
		4.00	SPT			N=33 (5,5/7,7,9,10)	4.45				
										End of Borehole at 4.45m	4
											5
											6
											7
											8
											9
											10

Remarks





Borehole Log

Borehole No.

WS4

Sheet 1 of 1

Project Name: Site Adjacent to 29 Berry Brow

Project No.
C482/20/E/1669

Co-ords:

Hole Type
WLS

Location: Clayton Bridge, Manchester M40 1GR

Level:

Scale
1:50

Client: GS Construction (NW) Ltd

Dates: 03/11/2020

Logged By
MC

Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Dia. (mm)	TCR (%)	Results					
		1.00	SPT	90	95	N=3 (2,2/1,1,1,0)	0.05 0.25 0.70 0.90			TOPSOIL (Dark brown organic sandy CLAY). MADE GROUND (Dark brown mottled red sandy slightly gravelly CLAY. Gravel is subangular fine medium of brick, concrete and rare clinker). Soft orangish brown mottled gray sandy CLAY (Reworked). <i>0.6m: Becomes grey</i> Very loose brown clayey SAND (Possibly Reworked). <i>0.7m: Potential band of clinker</i> Very loose orangish brown clayey SAND/ GRAVEL. Gravel is subrounded fine to coarse of mixed lithologies.	1
		2.00	SPT	80	25	N=4 (1,1/1,1,1,1)					2
				70	85		2.50 3.00			Firm dark brown mottled grey sandy slightly gravelly CLAY. Gravel is subrounded fine to medium of mixed lithologies.	3
										End of Borehole at 3.00m	4
											5
											6
											7
											8
											9
											10

Remarks





Appendix 3

Chemical Laboratory Testing

Rogers Geotechnical Services: Soil Screening Values Comparison Sheet

Rogers Geotechnical Services Ltd					Soil Screening Value (SSV) Comparison Sheet										KEY			
Job Number	C482/20/E/1669				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.										Exceeds SSV Exceeds 2017, Below 2015 Below limit of detection (LOD)			
Job Name	Land to the rear of 29 Berry Brow, Clayton Bridge, Manchester, M40 1GR																	
Date	10/12/2020		Sample Location		WS1	WS2	WS4											
Client	GS Construction (NW) Ltd		Depth Top		0.05	0.30	0.00											
			Depth Base		0.30	0.50	0.15											
Determinand	Units	Ref	LOD	Residential With Plant Uptake 1%														
				Atrisk 2015 (No Free Product)	Atrisk 2017													
ACM Type			N/A			-	-	-										
Asbestos Identification	%		0.001			No Asbestos Detected	No Asbestos Detected	No Asbestos Detected										
ACM Detection Stage			N/A			-	-	-										
Moisture	%		0.020			17	19	18										
Soil Colour			N/A			Brown	Brown	Brown										
Other Material			N/A			Roots and	Stones	Stones										
Soil Texture			N/A			Clay	Clay	Clay										
pH			N/A			8.5	6.8	7.9										
Sulphate (2:1 Water Soluble) as SO4	g/l		0.010			< 0.010	< 0.010	< 0.010										
Cyanide (Free)	mg/kg	A	0.50		34	< 0.50	< 0.50	< 0.50										
Sulphate (Total)	%		0.010															
Arsenic	mg/kg	C	1.0		37	28	21	29										
Cadmium	mg/kg	C	0.10		22.1	0.16	0.69	0.67										
Copper	mg/kg	A+	0.50		4730	59	53	73										
Mercury	mg/kg	A/D	0.10		8.81	0.26	0.32	0.76										
Nickel	mg/kg	A+	0.50		136	25	30	27										
Lead	mg/kg	C	0.50		200	140	97	240										
Selenium	mg/kg	A	0.20		375	0.53	0.46	0.75										
Vanadium	mg/kg	A+	5.0		136	30	25	30										
Zinc	mg/kg	A+	0.50		20000	75	190	180										
Chromium (Hexavalent)	mg/kg	B/C	0.5	20.5	3.62	< 0.50	< 0.50	< 0.50										
Organic Matter	%		0.40			7.2	3.8	6.9										
Aliphatic TPH >C5-C6	mg/kg	A+	1.0	0	42.7	< 1.0	< 1.0	< 1.0										
Aliphatic TPH >C6-C8	mg/kg	A+	1.0	0	99.3	< 1.0	< 1.0	< 1.0										
Aliphatic TPH >C8-C10	mg/kg	A+	1.0	0	13.9	< 1.0	< 1.0	< 1.0										
Aliphatic TPH >C10-C12	mg/kg	A+	1.0	81.7	49.9	< 1.0	< 1.0	< 1.0										
Aliphatic TPH >C12-C16	mg/kg	A+	1.0	385	20.9	< 1.0	< 1.0	< 1.0										
Aliphatic TPH >C16-C21	mg/kg	A+	1.0		210000	< 1.0	< 1.0	< 1.0										
Aliphatic TPH >C21-C35	mg/kg	A+	1.0		210000	< 1.0	< 1.0	17										
Aliphatic TPH >C35-C44	mg/kg		1.0			< 1.0	< 1.0	< 1.0										
Total Aliphatic Hydrocarbons	mg/kg		5.0			< 5.0	< 5.0	17										
Aromatic TPH >C5-C7	mg/kg	A+	1.0		0.137	< 1.0	< 1.0	< 1.0										
Aromatic TPH >C7-C8	mg/kg	A+	1.0	0	113	< 1.0	< 1.0	< 1.0										
Aromatic TPH >C8-C10	mg/kg	A+	1.0	0	20.5	< 1.0	< 1.0	< 1.0										
Aromatic TPH >C10-C12	mg/kg	A+	1.0	0	70	< 1.0	< 1.0	< 1.0										
Aromatic TPH >C12-C16	mg/kg	A+	1.0	165	155	< 1.0	< 1.0	6.9										
Aromatic TPH >C16-C21	mg/kg	A+	1.0		319	< 1.0	< 1.0	6.9										
Aromatic TPH >C21-C35	mg/kg	A+	1.0		1120	< 1.0	20	340										
Aromatic TPH >C35-C44	mg/kg		1.0			< 1.0	< 1.0	< 1.0										
Total Aromatic Hydrocarbons	mg/kg		5.0			< 5.0	20	350										
Total Petroleum	mg/kg		10.0			< 10	20	370										
Naphthalene	mg/kg	A+	0.10	0	0.829	< 0.10	< 0.10	0.54										
Acenaphthylene	mg/kg		0.10			< 0.10	< 0.10	0.38										
Acenaphthene	mg/kg	A+	0.10	608	157	< 0.10	< 0.10	1.1										
Fluorene	mg/kg	A+	0.10	0	735	< 0.10	< 0.10	1.0										
Phenanthrene	mg/kg		0.10			4.2	0.98	12										
Anthracene	mg/kg	A+	0.10	0	10200	0.57	0.17	2.1										
Fluoranthene	mg/kg	A+	0.10		983	5.8	2.2	16										
Pyrene	mg/kg	A+	0.10		668	6.7	2.3	17										
Benzo[a]anthracene	mg/kg	A	0.10	4.52	1.71	2.3	1.2	6.9										
Chrysene	mg/kg	A	0.10	585	0.44	2.9	1.3	7.7										
Benzo[b]fluoranthene	mg/kg	A	0.10	7.72	1.22	2.6	1.3	7.6										
Benzo[k]fluoranthene	mg/kg	A	0.10	84.4	0.686	1.3	0.80	3.4										

Rogers Geotechnical Services: Soil Screening Values Comparison Sheet

Benzo[a]pyrene	mg/kg	B/C	0.10	4.95	1.51	2.0	1.1	6.2							
Indeno(1,2,3-c,d)Pyrene	mg/kg	A*	0.10	7.31	0.0614	1.2	0.74	3.7							
Dibenz(a,h)Anthracene	mg/kg	A	0.10	0.838	0.00393	0.53	0.32	1.4							
Benzo[g,h,i]perylene	mg/kg	A	0.10	96.2	0.0187	1.5	0.80	4.5							
Total Of 16 PAH's	mg/kg		2.0			32	13	92							
Total Phenols	mg/kg	A	0.30		267	< 0.30	< 0.30	< 0.30							



Final Report

Report No.: 20-31234-1
Initial Date of Issue: 20-Nov-2020
Client Rogers Geotechnical Services Ltd
Client Address: Unit 4, Barncliffe Business Park
Near Bank
Shelley
Huddersfield
West Yorkshire
HD8 8LU
Contact(s): Harry Letch
Project C482/20/E/1669 Berry Brow Clayton

Quotation No.:		Date Received:	17-Nov-2020
Order No.:	PO-1050	Date Instructed:	17-Nov-2020
No. of Samples:	3		
Turnaround (Wkdays):	7	Results Due:	25-Nov-2020
Date Approved:	20-Nov-2020		

Approved By:

Details: Glynn Harvey, Technical Manager

Results - Soil

Project: C482/20/E/1669 Berry Brow Clayton

Client: Rogers Geotechnical Services Ltd	Chemtest Job No.:				20-31234	20-31234	20-31234
Quotation No.:	Chemtest Sample ID.:				1097658	1097659	1097660
	Client Sample ID.:				D1	D1	D1
	Sample Location:				WS1	WS2	WS4
	Sample Type:				SOIL	SOIL	SOIL
	Top Depth (m):				0.05	0.30	0.00
	Bottom Depth (m):				0.30	0.50	0.15
	Date Sampled:				09-Nov-2020	09-Nov-2020	09-Nov-2020
	Asbestos Lab:				COVENTRY	COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD			
Cadmium	M	2450	mg/kg	0.10	0.16	0.69	0.67
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50
Copper	M	2450	mg/kg	0.50	59	53	73
Mercury	M	2450	mg/kg	0.10	0.26	0.32	0.76
Nickel	M	2450	mg/kg	0.50	25	30	27
Lead	M	2450	mg/kg	0.50	140	97	240
Zinc	M	2450	mg/kg	0.50	75	190	180
Vanadium	U	2450	mg/kg	5.0	30	25	30
Arsenic	M	2450	mg/kg	1.0	28	21	29
Selenium	M	2450	mg/kg	0.20	0.53	0.46	0.75
Cyanide (Free)	M	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50
Total Phenols	M	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30
Naphthalene	M	2700	mg/kg	0.10	< 0.10	< 0.10	0.54
Acenaphthylene	M	2700	mg/kg	0.10	< 0.10	< 0.10	0.38
Acenaphthene	M	2700	mg/kg	0.10	< 0.10	< 0.10	1.1
Fluorene	M	2700	mg/kg	0.10	< 0.10	< 0.10	1.0
Phenanthrene	M	2700	mg/kg	0.10	4.2	0.98	12
Anthracene	M	2700	mg/kg	0.10	0.57	0.17	2.1
Fluoranthene	M	2700	mg/kg	0.10	5.8	2.2	16
Pyrene	M	2700	mg/kg	0.10	6.7	2.3	17
Benzo[a]anthracene	M	2700	mg/kg	0.10	2.3	1.2	6.9
Chrysene	M	2700	mg/kg	0.10	2.9	1.3	7.7
Benzo[b]fluoranthene	M	2700	mg/kg	0.10	2.6	1.3	7.6
Benzo[k]fluoranthene	M	2700	mg/kg	0.10	1.3	0.80	3.4
Benzo[a]pyrene	M	2700	mg/kg	0.10	2.0	1.1	6.2
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.10	1.2	0.74	3.7
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.10	0.53	0.32	1.4
Benzo[g,h,i]perylene	M	2700	mg/kg	0.10	1.5	0.80	4.5
Total Of 16 PAH's	M	2700	mg/kg	2.0	32	13	92
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0	17

Results - Soil

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	Date Sampled:				09-Nov-2020	09-Nov-2020	09-Nov-2020
	Asbestos Lab:				COVENTRY	COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD			
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	17
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	6.9
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	6.9
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	20	340
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	20	350
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	20	370
pH	M	2010		4.0	8.5	6.8	7.9
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	< 0.010	< 0.010	< 0.010
ACM Type	U	2192		N/A	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-	-	-
Moisture	N	2030	%	0.020	17	19	18
Soil Colour	N	2040		N/A	Brown	Brown	Brown
Other Material	N	2040		N/A	Roots and Stones	Stones	Stones
Soil Texture	N	2040		N/A	Clay	Clay	Clay
Sulphate (Total)	M	2430	%	0.010	0.096	0.062	0.093
Organic Matter	M	2625	%	0.40	7.2	3.8	6.9

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Alkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.

Report Information

Key

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

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

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

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

All Asbestos testing is performed at the indicated laboratory

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

Sample Deviation Codes

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

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt

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

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com



Appendix 4

Fill Screening Values

Rogers Geotechnical Services Ltd.

Atkins ATRISK Soil Screening Values (SSVs) - Residential With Plant Uptake Landuse

Tox Data Report No.	Compound	Residential with Homegrown Produce Landuse (mg/kg)				Reference
	<i>Metals</i>	SOM: 1%		SOM: 6%		
3	Cadmium	22.1		22.1		C
4	Chromium VI	3.62	20.5	3.62	20.5	B/C
	Copper	4730		4790		A+
7	Mercury	8.81		15.80		A/D
8	Nickel	136		136		A+
	Lead	200		200		C
	Zinc	20000		20300		A+
	Vanadium	136		138		A+
	<i>Semi and Non Metals</i>					
1	Arsenic	37		37		C
10	Selenium	375		375		A
	Free Cyanide	34		34		A
9	Phenols (total)	267		1200		A
	<i>Poly Aromatic Hydrocarbons</i>	Free product	No free product	Free product	No free product	
20	Napthalene	0.829		12.2		A+
	Acenaphthene	157	608	2760		A+
	Fluorene	735		2610		A+
	Anthracene	10200		26200		A+
	Fluoranthene	983		2980		A+
	Pyrene	668		2120		A+
	Benzo(a)anthracene	1.71	4.52	8.54		A
2	Chrysene	0.44	585	2.64	927	A
2	Benzo(b)fluoranthene	1.22	7.72	7.29	9.86	A
2	Benzo(k)fluoranthene	0.686	84.4	4.12	100	A
2	Benzo(a)pyrene	1.51	4.95	0.998	5	B/C
2	Dibenzo(a,h)anthracene	0.00393	0.838	2.05	4.95	A*
2	Indeno(1,2,3-cd)pyrene	0.0614	7.31	0.368	9.75	A
2	Benzo(g,h,i)perylene	0.0187	96.2	0.112	103	A
	<i>Petroleum Hydrocarbons</i>					
	Aliphatic C5-C6	42.7		369		A+
	Aliphatic C6-C8	99.3		768	1240	A+
	Aliphatic C8-C10	13.9		204		A+
	Aliphatic C10-C12	49.9	81.7	297	1180	A+
	Aliphatic C12-C16	20.9	385	125	4130	A+
	Aliphatic C16-C21	210000		210100		A+
	Aliphatic C21-C35	210000		210100		A+
	Aromatic C5-C7 (Benzene)	0.137		0.871		A+
	Aromatic C7-C8 (Toluene)	113		780		A+
	Aromatic C8-C10	20.5		232		A+
	Aromatic C10-C12	70		468		A+
	Aromatic C12-C16	155	165	830		A+
	Aromatic C16-C21	319		1040		A+
	Aromatic C21-C35	1120		1710		A+
A+ = Values update June 2017.						
A* Atrisk's SSV is lower than Chemtest's detectable limit for this compound.						
B = Health Criterion Values (available from toxicological reviews published in the C4SL project methodology report).						
C = Category 4 Screening Levels (C4SLs).						
D = SSV provided is for Methyl Mercury.						