

Kincardine Court, Manchester

Ground Investigation

Curtins Ref: 072071-CUR-00-XX-RP-GE-001

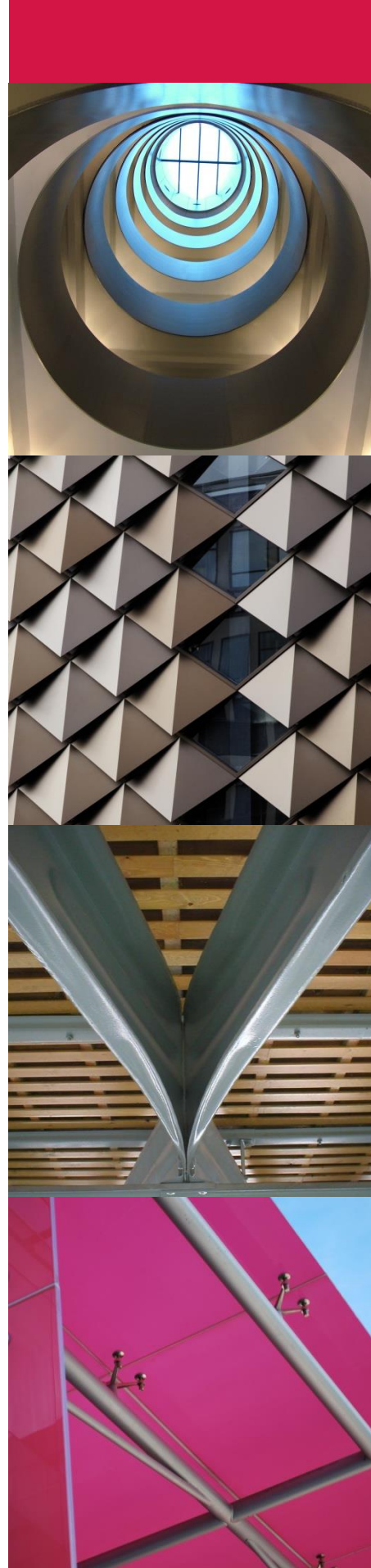
Revision: P02

Issue Date: 19 August 2020

Client Name: The Unite Group Plc

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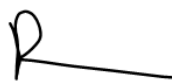
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Rev	Description	Issued by	Checked	Date
P02	Updated following completion of ground gas monitoring	PN	RA	19/08/2020

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Executive Summary

Appointment	In January 2020 Curtins were instructed by Unite Group Plc to undertake a Ground Investigation at Kincardine Court located on Kincardine Road, Manchester, M13 9JA. The site is centred on NGR SJ 84882 96973 and covers an area of 0.46Ha, the proposed development comprises 0.19Ha of the total site. The proposed redevelopment proposals include the erection of a part 4, part 5 and part 6 storey extension comprising 100 student apartments with associated communal space, cycle parking, recycling and refuse bin storage.
Site Summary	The site is located off Kincardine Road, Manchester, M13 9JA. The site is currently occupied by a six storey student residential building. The external landscaping is a mix of hardstanding and soft landscaping. An electrical substation is present on the eastern boundary on the site. The site levels are generally flat. The area of the proposed redevelopment is occupied by car parking and soft landscaping. Historic mapping from 1848 indicates the site was occupied by terraced residential housing with a road traversing through the centre of the site orientated northeast to southwest. From 1960, the terraced buildings on site were demolished and the Frank Taylor Centre (Home for the Aged) was developed covering the majority of the site with a number of additional buildings in the western corner. By 2006, the Frank Taylor Centre was no longer recorded and the site has been redeveloped to Kincardine Court. Made Ground deposits are not indicated to be present onsite according to BGS, however given the site's history and visual evidence at the surface they are likely to be present. Superficial soils are recorded as Glacial Till. Bedrock, recorded as the Chester Formation, comprising reddish brown pebbly sandstone with sub-ordinate beds of red-brown mudstone. The Glacial Till is recorded as a Secondary Undifferentiated Aquifer and the Chester Formation is recorded as a Principal Aquifer. The site is not located in a Source Protection Zone (SPZ). There are no surface water features recorded within 1km of the site.
Unexploded Ordnance	Risk mapping for UXOs has placed the site in a moderate-risk area. Moderate risk areas are those that show a moderate density of bombing hits (11 bombs per 1000 acres) and may contain potential WWII targets. Explosives were dropped 40m to the west and a bomb was dropped 100m north west of the site. Given the site has been redeveloped on two occasions, the UXO risk is determined to be Low. Specialist UXO support undertook a specific tool box talk prior to the commencement of intrusive works. Further assessment should be undertaken by relevant contractors prior to the construction phase. The relevant contractor should satisfy themselves regarding mitigation measures implemented during post-investigation intrusive works including excavations and during the potential installation of piles.
Fieldworks Undertaken	Fieldworks were carried out between 17th and 18th February 2020, comprising two dynamic sampling boreholes to bedrock, one dynamic sampling to bedrock with rotary cored follow on and eight hand dug foundation pits. Ground gas and groundwater monitoring standpipes were installed within the three dynamic sampling boreholes (BH101-BH103). Selected soil samples were subjected to laboratory analysis. Six ground gas monitoring visits have been undertaken between 27th February and 24th June 2020.
Encountered Ground Conditions	Topsoil was encountered in two locations to depths of 0.10m and 0.25m bgl comprising slightly sandy clay with rare brick gravel. Asphalt was encountered in five locations to a depth of 0.10m bgl. Made ground was encountered in all exploratory holes from ground level to a maximum recorded depth of 1.90m bgl. Granular made ground was encountered in all exploratory holes except FP01 and FP07, typically comprising light grey slightly sandy gravel underlain by grey/black slightly sandy gravel. Gravel is angular to subangular of limestone, brick, sandstone, concrete and terracotta. IN FP02, FP04 and FP08 light brown fine to medium sand was recorded. Cohesive material was recorded in six locations recorded as brown slightly gravelly slightly sandy clay. Superficial soils were encountered beneath the made ground to depths of 3.30m to 3.58m bgl. The deposits were predominantly granular comprising loose to dense brown slightly gravelly fine to coarse sand and dense reddish brown fine to coarse gravel. Cohesive superficial deposits were encountered in BH101 between 1.20m – 1.70m bgl and 3.30 – 3.40m bgl comprising soft to stiff brown slightly sandy slightly gravelly clay. Residual soils (bedrock), encountered from 3.30m to 3.58m bgl comprising a layer of weathered soils recorded as very dense reddish brown slightly gravelly fine sand. The Chester Formation was encountered in BH102 at 4.00m bgl. It was recorded as very weak to weak brownish red medium to coarse grained sandstone. No groundwater strikes were recorded in the exploratory hole locations. It was not possible to determine water strikes within the bedrock due to the use of water flush during rotary borehole progression. Return groundwater level monitoring recorded the boreholes are dry.
Environmental Laboratory Testing	With respect to the proposed end-use of the site, no exceedances were noted in selected soil samples when compared against Residential without Home Grown Produce GAC thresholds. Soil samples were also screened for asbestos. No asbestos was positively identified in any of the soil samples analysed and no suspected asbestos containing materials were observed during the investigation.

Ground Investigation

and Ground Gas Monitoring Results	During ground gas monitoring a maximum carbon dioxide concentration of 3.4% v/v was recorded. Hydrogen sulphide (H₂S) was recorded as 2ppm and carbon monoxide was recorded as 5ppm. Methane (CH₄) were recorded below the limit of detection of the monitoring equipment. Adopting a 'representative' scenario, results for the calculated gas screening values (GSV) to date was calculated as 0.0442 l/hr for carbon dioxide. The site is designated as CS-1 requiring no gas protection measures.
Ground Contamination and Ground Gas Risk Assessment	A Low risk rating is identified to end-users from direct contact, inhalation and ingestion of contaminants within Made Ground soils. No exceedances were recorded within analysed soil samples with respect to the nominated 'Residential without Plant Uptake' screening criteria. The risk to maintenance and construction workers from direct contact and dermal uptake, soil and dust ingestion, dust and migration inhalation is considered Low, accounting for appropriate PPE and environmental management controls. The risk presented to controlled waters (groundwater and surface water) was identified as Moderate and Low within the Phase 1 Preliminary Site Assessment. The site conditions identified ground conditions consistent with those identified in the Phase 1 Preliminary Risk Assessment, no exceedances were recorded in soil samples and no groundwater was encountered. As such the risk is Low and Very Low. A Low risk rating is identified to site end-users from ground gas arising from made ground and natural soils migrating into buildings and subsequent inhalation by on-site employees. This corresponds with a Characteristic Situation 1 classification which requires no gas protection measures.
Geotechnical Assessment	It is understood the proposed development comprises a part 4 storey, part 5 storey and part 6 storey extension to the existing development. The shallow ground conditions on site comprise made ground overlying predominantly granular glacial till underlain by the Chester Formation. Due to the likely loads of the proposed development, it is considered that shallow spread foundations in the superficial deposits are unlikely to be suitable at the site. It is therefore considered that a piled foundation solution be adopted transferring loads to the underlying Chester Formation. The load capacity of piles depends not only on their size and the identified ground conditions, but also the method of their installation. It is recommended that specialist piling contractors are contacted as to the suitability and carrying capacity of their piles, in the ground conditions pertaining to the site. Based on observations onsite together with the results of laboratory tests, it is recommended that consideration is given to a suspended ground floor slab. As piled foundations are anticipated, a suspended slab is recommended to bear on the pile caps by a network of beams which will minimise any differential settlement between the floor and the piled structure. Based on the laboratory test results it is considered that Design Sulphate Class of DS-1 with an ACEC class of AC-1 within the made ground, superficial deposits, residual soils and the bedrock formation may be taken.
Recommendations	Based on the findings of the ground investigation, the following recommendations are made: 1) Construction and maintenance workers should be provided with appropriate PPE for all groundworks with respect to the soil environmental chemistry results. 2) It is recommended that specialist piling contractors are to be consulted to establish suitable pile design.

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- Appendix B Exploratory Hole Logs**
- Appendix C Chemical Laboratory Testing Results**
- Appendix D Geotechnical Laboratory Testing Results**
- Appendix E Ground Gas and Groundwater Monitoring Results**
- Appendix F GAC Screening Thresholds**
- Appendix G Risk Assessment Methodology**

1.0 Introduction

1.1 Project Background

In January 2020 Curtins were instructed by Unite Group Plc to undertake a Ground Investigation at Kincardine Court on Kincardine Road, Manchester, M13 9JA. The site is centred on NGR SJ 84882 96973 and covers an area of 0.46Ha, the proposed development area comprised 0.19Ha of the total site.

The proposed work on site comprises redevelopment proposals to include the erection of part 4, part 5 and part 6 storey extension. The extension will consist of 100 student apartments with associated communal space, cycle parking, recycling and refuse bin storage.

1.2 Scope of Services

This investigation addresses recommendations as presented in the Kincardine Court Phase 1 report (Ref.1), with the aim of this Ground Investigation Report to characterise geo-environmental and geotechnical conditions prior to development of the site. This report is also produced in support of an associated planning application. The current development plans can be referred to within *Appendix A* of this report.

This report is intended to determine:

- a) Likely risk of the proposed end-user being adversely impacted by potential contamination in shallow site soils that may be present on the site due to its known current, recent and historical use;
- b) Likely risk of groundwater and/or surface water being adversely impacted by potential contamination that may be present on the site due to its known current, recent and historical use;
- c) If there is a risk to the end-user from soil gases including methane, carbon dioxide, carbon monoxide and hydrogen sulphide;
- d) Recommendations for the design of foundations and building ground floor slabs; and
- e) Recommendations for the specification of sub-structure concrete and water supply pipes.

Consideration of detailed flood risk, ecology and archaeological issues are outside of the scope of this report.

1.3 Geotechnical Category

BS EN 1997-1:2004 describes Geotechnical Categories that can be introduced to establish geotechnical design requirements. The Geotechnical Category is an assessment of the ground conditions and nature of the proposed construction.

This project comprises conventional types of structures, earthworks and foundations with no exceptional geotechnical risk or difficult ground or loading conditions and is therefore classed as **Geotechnical Category 2**.

2.0 Site Summary

This section presents a summary of the current site setting, history, geology and hydrogeology/hydrology, previously detailed in the Curtins Phase 1 Report (Ref.1). As such it is advised that this report is read in conjunction with the Phase 1 Report (Ref.1). A summary of the pertinent Phase 1 Preliminary Risk Assessment Report information is presented in the following sub-sections.

This information will feed into the geotechnical assessment (refer to Section 10.0) and geo-environmental risk assessment (refer to Section 7.0).

2.1 Current Setting

The site is located off Kincardine Road, M13 9JA, as shown on *Figure 2.1*.

The site is currently occupied by a single six storey student residential building. The external landscaping is a mix of hardstanding and soft landscaping. An electrical substation is present on the eastern boundary of the site. Site levels are generally flat.

The area of proposed redevelopment is occupied by car parking and soft landscaping.

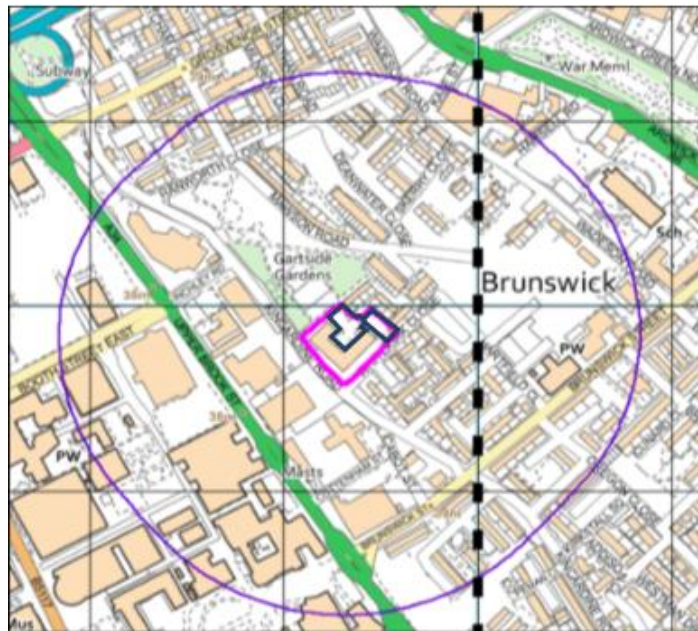


Figure 2.1 – Site Location Plan, site boundary shown in pink and the proposed development in blue.

2.2 Site History

A review of the Kincardine Court Phase 1 Report (Ref. 1) and the available historical map for the site has been undertaken with specific reference to potential sources of contamination and geo-hazards.

Earliest historical map (1848) indicates that the site was occupied by terraced residential houses with a road traversing through the centre of the site orientated northeast to southwest.

From 1960, the terraced buildings on site were demolished and the Frank Taylor Centre (Home for the Aged) was developed covering the majority of the site with a number of additional buildings in the western corner.

By 2006, Frank Taylor Centre is no longer recorded and the site has been redeveloped to Kincardine Court.

2.3 Published Geology

A review of the Curtins Phase 1 (Ref. 1), BGS borehole records and British Geological Survey (BGS) 1:50,000 mapping records (Solid and Drift Editions) for Manchester (Sheet 85) indicates the following succession underlying the site:

- Glacial Till, Devensian; overlying,
- Chester Formation

2.3.1 Made Ground Deposits

Made Ground deposits are not indicated in the Curtins Phase 1 (Ref. 1) however, based on the site's history and review of the historic exploratory hole logs there is potential for unrecorded Made Ground deposits.

2.3.2 Superficial Deposits

Superficial geological deposits are recorded as Devensian Glacial Till consisting of sandy silty clay with pebbles.

2.3.3 Bedrock Deposits

Bedrock deposits are indicated to comprise the Chester Formation. The Chester Formation is reddish brown pebbly sandstones with subordinate beds of red-brown mudstone.

2.3.4 Mining and Quarrying

The site is in a Coal Mine Reporting Area however, it does not lie within a development high risk area and is not within 1km of a coal outcrop. The risk to the development from coal mine workings is **Low** and has not been considered further.

There are no record mineral sites within 1km of the site.

2.3.5 Other Pertinent Ground Stability Issues

The Curtins Phase 1 Report (Ref. 1) confirms there is no hazard to very low risk from the following ground stability hazards on and around the site; collapsible ground, compressible ground, ground dissolution, landslide ground, running sands and shrinking or swelling clay.

2.3.6 Ground Gas

UK Radon Mapping confirms the site is situated in an areas where <1% of homes are above the radon action level. Where the new development incorporates a basement, the advice of a specialist Radon assessor must be obtained.

2.4 Hydrogeology and Hydrology

The Chester Formation is classified as a Principal Aquifer, defined as:

“Layers of rock or drift deposits that have high intergranular and/or fracture permeability – meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.”

The Glacial Till superficial deposit is classed as a Secondary Undifferentiated Aquifer. Defined and assigned in cases where:

“Has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.”

The nearest surface water feature is the River Medlock located 517m north of the site.

The site is not situated in a Source Protection Zone (SPZ). There are no potable groundwater abstractions within 1km of the site. There are no surface water abstractions recorded within 1km of the site.

There is one discharge consent located 480m north operated by United Utilities for storm sewage overflow discharged into a freshwater stream/river.

2.5 Unexploded Ordnance (UXO) Preliminary Risk Assessment

Risk mapping for UXOs has placed the site in a Moderate risk area. Moderate risk areas are those that show a density of bombing hits of 11-50 bombs per 1000 acres and may contain potential WWII targets.

A review of historical maps from the Curtins Phase 1 report (Ref. 1) indicates that residential properties on site did not disappear during WWII. However, it indicates residential and commercial properties in the surrounding area did including a ruin 300m south west (1948).

Analysis of historical bomb mapping from the University of Manchester (*Figure 2.6*) indicates the following:

- Explosives were dropped 40m to the west of the site on 04/12/1940
- A bomb was dropped 100m north west of the site on 11/10/1940
- Significant disappearance of terraced residential housing on and off site from 1960 possibly due to bomb damage



Figure 2.6 – WWII Bomb Damage Mapping (site boundary shown in pink). Red circles for fire bombs; blue circles for high explosives; pink shading for damaged buildings; red shading for demolished buildings; green marks: line mines, indicating bomb damage by the Luftwaffe during the Blitz

Based on the foregoing commentary, the likelihood of encountering UXO on site as part of the ground investigation or development works in Moderate, and on this basis, it is recommended that a Detailed UXO Assessment is procure prior to any intrusive works commencing at the site.

2.6 Preliminary Conceptual Site Model

A summary of potential pollutant linkages at the development site identified in the Curtins Phase 1 report (Ref.1) presented in *Table 2.6*, were identified as requiring further investigation to enable the safe redevelopment of the site.

Table 2.6 – Preliminary Conceptual Site Model (Ref.1)

Conceptual Site Model			Qualitative Risk Assessment
Source	Pathway(s)	Receptor(s)	Risk
Made Ground of unknown composition from uncontrolled deposition of construction and demolition	Direct contact, ingestion, inhalation.	Construction and Maintenance Workers	Moderate
		End-user of site Commercial end user	
Potential contamination associated with industrial use surrounding site, including garage, warehouse, tramway and works.	Vertical migration through the superficial deposits (soils)	Water Environment (groundwater)	Moderate
On and off-site soils with the potential to generate ground gases	Vertical and horizontal migration through the superficial and bedrock deposits.	End user of site	Moderate/Low

Potential contaminants of concern associated with the sources identified within the Conceptual Site Model include but are not limited to: broad range aliphatic and aromatic hydrocarbons present within any fuel oils; polycyclic aromatic hydrocarbons (PAHs); phenols; inorganic compounds including heavy metals; sulphate; and asbestos present in discarded building materials.

Potential contaminants associated with the airborne dust/particulates include but are not limited to: polycyclic aromatic hydrocarbons and inorganic compounds including toxic metals that are also accounted for by potential onsite contaminants of concern.

The qualitative risk assessment determined the above risks associated with the proposed development of the site warrant further investigation.

The scope of the investigation undertaken in detailed in *Section 3.0*.

3.0 Ground Investigation Scope of Works

Site investigation works were undertaken between the 17th and 18th February 2020.

The scope of the ground investigation was designed in general accordance with current UK guidance including:

- CLR11 (Ref.2);
- British Standard (BS) 10175:2011+A2:2017 (Ref.3);
- BS5930:2015 (Ref.4); and,
- BSEN1997: Part 2:2007 Eurocode 7 (Ref.5).

A summary of the scope and rationale are summarised in *Table 3.0*.

Table 3.0 – Scope and Rationale of Fieldwork Undertaken

Exploratory Hole Type	Exploratory Hole Ref.	Exploratory Hole Depth (m bgl)	Rationale
Dynamic Sample with Rotary Cored Follow on	BH102	10.00	Confirm the ground and groundwater conditions; Collect soil & water samples for chemical & geotechnical testing; Collect rock core samples for geotechnical testing; Undertake in-situ testing; and Groundwater level monitoring.
Dynamic Sample Boreholes	BH101 BH103	4.62 4.09	Confirm the shallow ground and groundwater conditions; Collect soil samples for chemical & geotechnical testing; and Ground gas and groundwater monitoring.
Hand Dug Foundation Pits	FP01 FP02 FP03 FP04 FP05 FP06 FP07 FP08	0.90 1.20 0.92 0.90 0.90 0.87 0.90 0.40	Confirm shallow ground conditions Expose and confirm existing foundations/services.

The exploratory hole location plan is included in *Appendix A*, Curtins drawing refs. 072071-CUR-00-XX-DR-GE-002-P01.

3.1 Soil Logging and Sampling

Exploratory hole arisings were logged onsite by a qualified Engineer from Curtins and in accordance with the requirements of BS5930 (Ref.4), including recording of any observed visual contamination. Exploratory hole logs are provided in *Appendix B*.

Representative soil samples were selected based on field observations, for geotechnical and geo-environmental testing, to ascertain information about the ground conditions.

3.2 Rock Logging and Sampling

Collected rock cores were logged by Curtins, in accordance with BS5930 (Ref. 4), including recording the rock quality parameters, fracture indices and other detailed descriptions. Selected rock samples were scheduled for geotechnical testing, undertaken by Structural Soils Ltd, a UKAS accredited laboratory.

3.3 Monitoring Well Installations

Ground gas and groundwater monitoring (50mm diameter slotted) pipes were installed within BH101, BH102 and BH103.

A bentonite seal was placed above and below the screened section of the borehole to minimise potential for downward migration of contaminants and the creation of a preferential migratory pathway. A gravel surround was installed in the annulus between the sides of the borehole and the slotted sections of pipe.

A summary of the response zone is presented in *Table 3.3*.

Table 3.3 – Monitoring Well Response Zones

Borehole Ref.	Response Zone(s) (m bgl)	Strata Description(s)
BH101	1.00 – 4.00	Made ground and glacial till
BH102	0.50 – 2.00	Made ground
BH103	1.00 – 3.00	Glacial till

The shallow monitoring wells were primarily installed for ground gas and groundwater level monitoring purposes, within strata likely to have the highest permeability. In absence of sufficient thicknesses of made ground, screened sections of pipe were installed within granular superficial soils.

A copy of the borehole logs can be referred to in *Appendix B* of this report.

3.4 Post-Investigation Monitoring

3.4.1 Ground Gas and Groundwater Monitoring

Six rounds of ground gas and ground water monitoring were completed between 27/02/2020 and 24/06/2020 to assess ground gas conditions as identified in the Preliminary Conceptual Site Model in the Phase 1 Preliminary Site Assessment (Ref. 1).

The results of the groundwater level monitoring are detailed in *Section 5.6*.

4.0 Laboratory Testing

Selected soil samples for the purposes of geotechnical and geo-environmental testing were obtained. The Geo-environmental and geotechnical samples were placed in laboratory provided containers and stored in cool boxes prior to being transported to the nominated laboratory, under the laboratory's chain of custody documentation.

The laboratory selected by Curtins for chemical analysis was Envirolab (UKAS and MCERTS accredited) and for geotechnical analysis was Structural Soils (UKAS accredited).

Given the potential site wide source of contamination (made ground), the sampling positions (boreholes) were generally located in a non-targeted, systematic array to give adequate and representative coverage of the site accounting for the historical site use, proposed end-use and the immediate environmental setting.

4.1 Geo-environmental Analysis

Representative soil samples were selected for laboratory chemical analysis, based on field observations and to provide a characterisation of the made ground and natural strata encountered.

4.1.1 Soil Analysis

The source material of contaminants of concern potentially present on the site was considered to include, amongst others; organic matter, ash and fill, hydrocarbons (e.g. fuel/oils), heavy metals and asbestos the extent of which is captured by the broad environmental testing suite listed in *Table 4.1.1*.

Table 4.1.1 – Environmental Chemistry Analysis Suite: Soils

Suite Ref.	Analyte	LOD
Soils Suite A	Asbestos Screen, pH and Soil Organic Matter (SOM)	-
	Arsenic, Chromium, Chromium VI, Copper, Lead, Selenium, Zinc, Nickel	1 to 5 mg/kg
	Boron (water soluble)	1 mg/kg
	Cadmium	0.5 mg/kg
	Mercury	0.17 mg/kg
	Cyanide (total)	1 mg/kg
	Phenols (screen)	0.2 mg/kg
	PAHs (USEPA 16)	0.1 to 0.8 mg/kg
	TPH (Aro/Ali Split)	0.01 to 0.1 mg/kg

	2:1 Water Soluble Sulphate	0.01 g/l
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Six soil samples were taken from within Made Ground. Each of the samples was tested for Suite A.

Copies of the environmental chemistry testing certificates are presented in *Appendix C*.

4.1.2 Quality Assurance and Quality Control

Soil and groundwater chemical analysis was conducted by Envirolab Laboratories, a UKAS and MCERTS accredited laboratory. All samples were delivered in appropriate containers for the suites tested and analysed within designated holding times.

4.2 Geotechnical Testing

Soil samples for testing were prepared in accordance with BS1377: Part 1:2016 (Ref. 6). Rock samples were prepared and tested in accordance with ISRM Suggested Methods (Ref. 7). Copies of the geotechnical testing certificates are presented in *Appendix D*. The geotechnical testing undertaken are summarised in *Table 4.2a*.

Table 4.2a – Geotechnical Testing, Shallow Site Soils

In Situ Testing		
Test Type	Quantity	Standard
Standard Penetration Testing	15	BS 5930: 2015, Clause 41
Laboratory Testing		
Test Type	Quantity	Standard
Atterberg Limit	1	BS1377 1990, Part 2 (clause 4.5, 5.3 & 5.4)
Moisture Content	1	BS1377 1990, Part 2
Particle Size Distribution Testing	5	BS1377 1990, Part 2 (clause 9.2)
Water Soluble Sulphate	6	BS1377 1990, Part 3 (clause 9.4 & 9.5)
pH Value	6	BS1377 1990, Part 3 (clause 5.3 & 5.5)
Point Load Index Test (PLT)	Axial Plane: 7	ISRM Suggested Methods: 2007
	Diametral Plane: 5	
2:1 Water Soluble Sulphate	4	ISO 17025 MCERTS



In Situ Testing		
Test Type	Quantity	Standard
pH Value	4	ISO 17025 MCERTS

Copies of the geotechnical testing certificates are presented in *Appendix D*.

5.0 Encountered Ground Conditions

The ground conditions across the site, determined during the Curtins 2020 ground investigation works, generally comprises cohesive/granular made ground overlaying cohesive/granular Glacial Till underlain by the Chester Formation

5.1 General

A summary of the ground conditions encountered during the site investigation works is presented in Table 5.1, with detailed information presented in the exploratory hole logs included in *Appendix B*.

Table 5.1 – Summary of Ground Conditions Encountered

Strata	Depth to Top of Strata		Depth to Bottom of Strata		Thickness	
	Min (m bgl)	Max (m bgl)	Min (m bgl)	Max (m bgl)	Min (m bgl)	Max (m bgl)
Topsoil/Asphalt/Made Ground	0.00	0.00	0.60	1.90	0.60	1.90
Glacial Till	0.60	1.90	3.30	3.58	1.68	2.71
Residual soils	3.30	3.58	4.00	4.62	0.42	1.32
Chester Formation*	4.00	4.62	10.00	-	6.00	-

¹ - Thickness not proved

5.2 Made Ground/Topsoil

Topsoil was encountered in FP01 and FP02 from ground level to depths of 0.10m and 0.25m bgl. Topsoil generally comprised brown slightly sandy clay with frequent rootlets and rare brick gravel.

Asphalt was encountered from ground level to depths of 0.10m bgl in five locations (BH101, BH102, BH103, FP01 and FP02) overlying Made Ground.

Made ground was encountered in all exploratory holes from ground level ranging between 0.60 to 1.90m bgl. FP01 to FP08 terminated in the made ground therefore the base was not encountered.

Granular made ground was encountered in all exploratory holes, apart from FP01 and FP07. In BH101, BH102 and BH103, it typically comprised light grey slightly sandy fine to coarse gravel underlain by grey/black slightly sandy fine to coarse gravel with high ash content. In BH102, an additional granular layer was recorded comprising brown slightly sandy medium to coarse gravel. Gravel is angular to subangular of limestone, brick, sandstone, concrete and terracotta.

In FP03, FP05, FP06 and FP08 it typically comprised light grey medium to coarse gravel overlying brown slightly clayey fine to coarse gravel.

FP02, FP04 and FP08 recorded light brown fine to medium sand.

Cohesive made ground was recorded underlying the granular in BH101, BH102, FP02, FP06 and FP07. In FP01, only cohesive was encountered.

In BH101 and BH102, the granular strata was underlain by brown/black mottled grey slightly gravelly slightly sandy clay. Gravel is typically fine to coarse angular to subangular including brick, concrete and coal.

In FP01, FP02, FP06 and FP07, the cohesive deposits comprised brown slightly sandy slightly gravelly clay.

5.3 Glacial Till

Superficial deposits underlying the made ground were recorded in BH101, BH102 and BH103. FP01 to FP08 were terminated in the made ground.

Superficial soils were predominantly granular comprising loose to dense light brown slightly gravelly fine to coarse sand and dense reddish brown/brown sandy fine to coarse gravel. Gravel is typically fine to coarse, rounded to subrounded of sandstone and mudstone.

Cohesive glacial Till was encountered in BH101 at 1.20m to 1.70m bgl described as soft slightly sandy clay.

5.4 Residual Soils (Weathered Bedrock)

Deposits indicative of heavily weathered bedrock were encountered in BH101, BH102 and BH103 from a minimum depth of 3.30m to 3.58m bgl with a thickness of between 0.42m and 1.32m.

Weathered bedrock was typically recorded as very dense red brown slightly gravelly fine sand. Gravel is fine to medium rounded of sandstone.

In BH101, cohesive soils were recorded as stiff red brown slightly gravelly clay between 3.30m and 3.40m bgl.

5.5 Chester Formation

Solid geology of the Chester Formation was encountered in BH102 at 4.00m bgl.

The sandstone was recorded as very weak brownish red medium to coarse grained sandstone and weak brownish red medium to coarse grained sandstone.

Fractures are 0 to 10°, extremely closely to close space, planar and rough.

5.6 Groundwater

No groundwater strikes were recorded during the site works.

Due to the use of water flush and air mist for the progression of the rotary borehole (BH102), it was not possible to determine the water table within the bedrock.

Six rounds of groundwater monitoring have been undertaken between 27th February 2020 and 24th June 2020, the results of which are presented in *Table 5.6*. Details of the monitoring response zones for each installation are presented in *Table 3.3*.

Table 5.6 – Groundwater Monitoring Results, Visits 1 - 6

Monitored Water Levels				
Borehole Ref.	Installation Strata	Elevation (m AOD)		
		27/02/20	13/03/2020	27/03/2020
BH101	Clay and Sand	_(1)	_(1)	_(1)
BH102	Made Ground	DRY	DRY	DRY
BH103	Sand	DRY	DRY	DRY

(1) Borehole not accessed as screw unable to be removed.

During the monitoring visits all the boreholes monitored were recorded as dry.

5.7 Observed Potential Contamination

No potential visual or olfactory contamination was observed during the intrusive investigation works.

6.0 Ground Model

6.1 Made Ground

Tarmac was encountered in BH101, BH102, BH103 and FP07 from ground level to depths of 0.03m to 0.10m bgl. Topsoil was encountered in FP01 and FP02 to depths of 0.10m and 0.25m bgl. In FP03, FP04, FP05, FP06 and FP08 light grey gravel to depths of 0.03m to 0.05m bgl.

Made ground was encountered underlying the topsoil/tarmac/gravel to a maximum depth of 1.90m bgl, but generally recorded between 0.60m and 1.20m bgl.

Due to the variable nature of made ground, no geotechnical testing was undertaken on this stratum.

An SPT was undertaken in BH102 at 1.20m bgl in the made ground, recording a SPT 'N' value of 6.

6.2 Glacial Till

Natural glacial till deposits were recorded underlying the made ground in BH101, BH102 and BH103. Superficial deposits were predominantly recorded as granular material. Cohesive material was recorded in BH101.

The geotechnical results recorded within the granular and cohesive glacial till are summarised in *Section 6.2.1* and *Section 6.2.2* respectively.

6.2.1 Granular

A summary of the geotechnical tests undertaken within the granular superficial deposits is presented in *Table 6.2a*. Full details of the geotechnical results can be found in *Appendix D*.

Table 6.2.1 – Summary of geotechnical test results – superficial deposits

Parameter	No. of tests	Minimum	Maximum
pH	2	7.72	8.98
Water Soluble Sulphate (mg/l)	2	10	-
PSD (%)	3	0	0
Cobbles		11	75
Gravel		20	73
Sand		4	16
Silt/Clay			
SPT 'N' Value Granular ⁽¹⁾	6	2	35

(1) Only includes SPTs tests in which full penetration was achieved.

6 SPT 'N' values were recorded within the granular strata, ranging from 2 to 35. The SPT 'N' results increase with depth. The results are presented on *Figure 6.2.1a*.

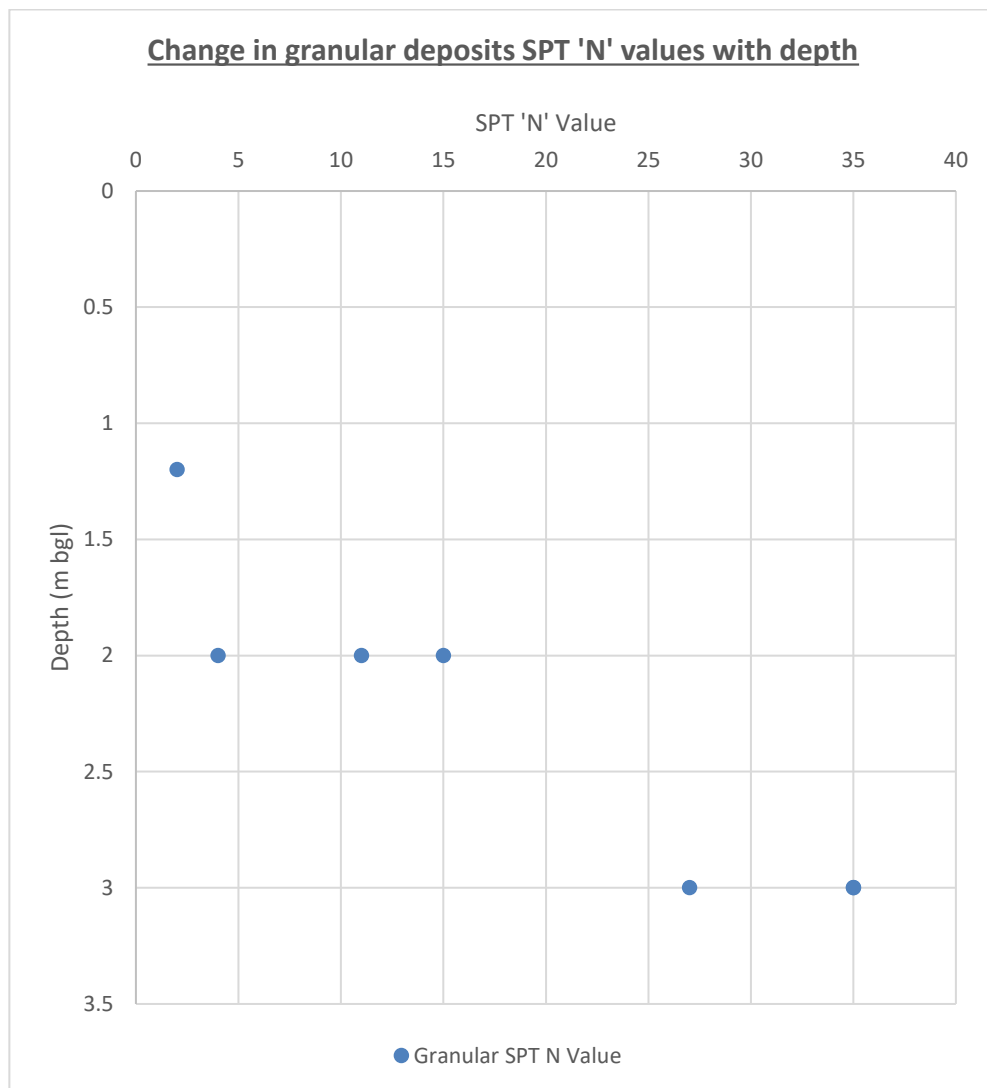


Figure 6.2.1a – SPT 'N' Values vs. Depth

A moderately conservative characteristic unit weight of 19kN/m³ is deemed suitable for loose to dense granular glacial till deposits (Ref. 10)

A moderately conservative characteristic Angle of Shearing Resistance (ϕ') has been derived from correlation with SPT 'N' values (Peck et al, 1967, Ref 8) and a review of published values. The results are shown in *Figure 6.2.1.b*.

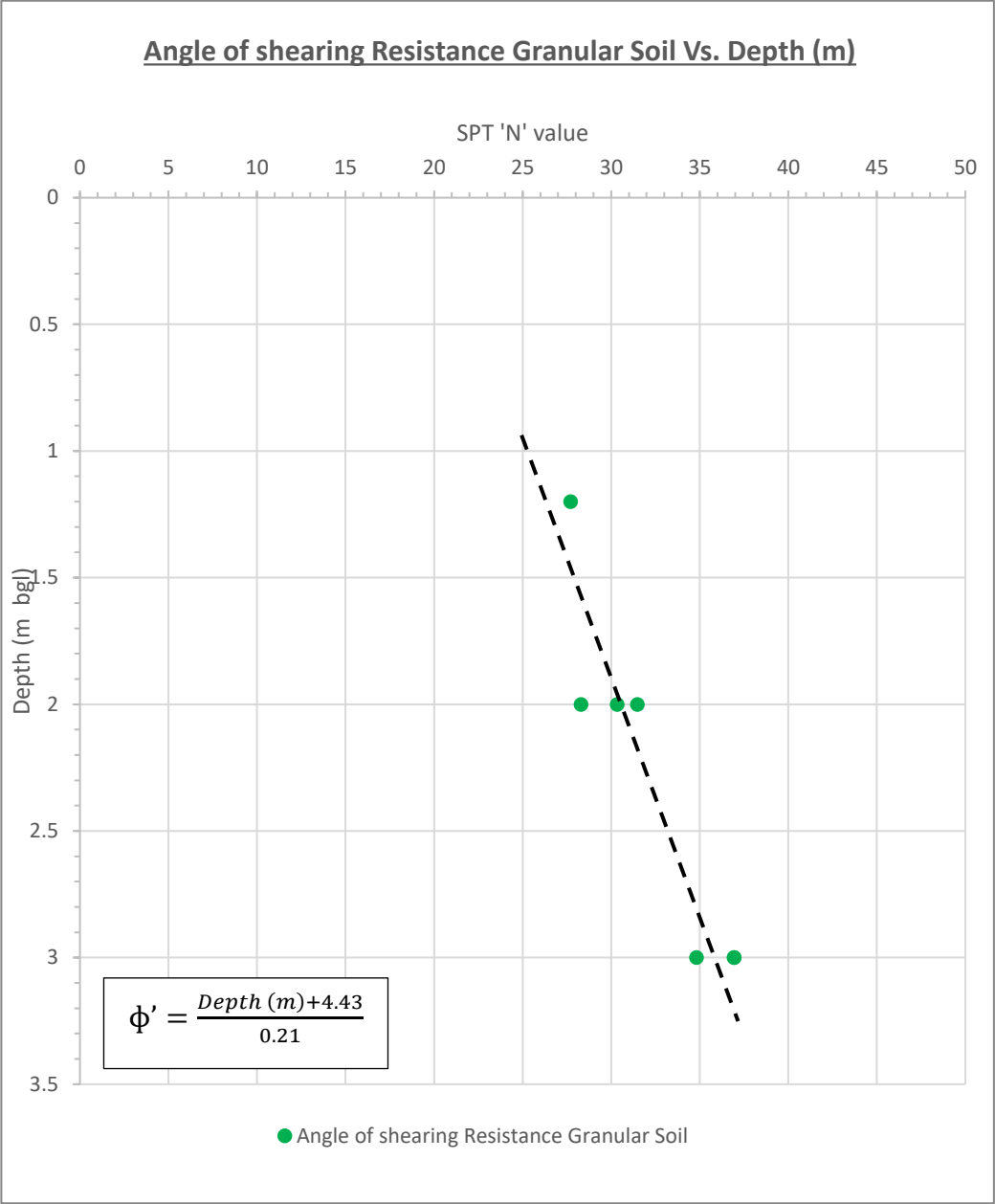


Figure 6.2.1b – Angle of Shearing Resistance Values vs. Depth between 0.00m and 3.50m

6.2.2 Cohesive

Limited geotechnical testing was undertaken on cohesive superficial strata. The results are summarised in *Table 6.2.2*.

Table 6.2.2 – Summary of geotechnical test results – superficial deposits

Parameter	No. of tests	Results
Moisture Content (%)	1	12
Liquid Limit (%)	1	33
Plastic Limit (%)	1	19
Plasticity Index (%)	1	14
Modified Plasticity Index (%) ⁽¹⁾	1	10.36
SPT 'N' Value ⁽²⁾	1	7
pH value	1	7.75
Water Soluble Sulphate (mg/l)	1	20

Due to the very limited Atterberg results and SPT 'N' values, the parameters for the cohesive strata have been determined from consulting the published values for representative material descriptions.

The Undrained Shear Strength (C_u) of the cohesive glacial till deposits has been determined based on the description of the strata recorded in the borehole logs. The clay was described as soft at 1.20 m -1.70 m bgl in BH101 which indicates a shear strength in the region of 20 - 40kPa indicating low strength clay.

The Coefficient of Consolidation (M_v) of a soft cohesive glacial till deposit is likely to be in the region of 0.10 – 0.30 m^2/MN indicating medium compressibility based on published values.

The values are summarised in *Table 6.4*.

6.3 Chester Formation

6.3.1 Residual Soils (Weathered Bedrock)

Table 6.3a summarises the geotechnical tests undertaken on the weathered bedrock deposits.

Table 6.3.1a – Summary of Geotechnical Testing, Weathered Bedrock

Parameter	No. of tests	Minimum	Maximum
pH	2	8.33	8.44
Water Soluble Sulphate (mg/l)	2	10	-
PSD (%)	3	0	0
Cobbles		0	7
Gravel		76	80
Sand		17	20
Silt/Clay			
SPT 'N' Value Granular ⁽¹⁾	3	50	-

Three SPT tests were undertaken within the weathered bedrock deposits, all recording values >50 (refusal). These are likely to represent striking bedrock.

A moderately conservative characteristic unit weight of 21kN/m³ is deemed suitable for predominantly dense to very dense granular residual soils (Ref. 10)

A moderately conservative characteristic Angle of Shearing Resistance (ϕ') of 40. has been derived from correlation with SPT 'N' values (Peck et al, 1967, Ref. 8) and a review of published values.

6.3.2 Chester Formation

The sandstone bedrock, underlying the weathered bedrock, was recorded as the Chester formation identified as the following:

- 1) Very weak reddish-brown medium to coarse grained sandstone;
- 2) Weak reddish-brown medium to coarse grained sandstone.

The borehole logs indicate the quality of the rock with depth remains very poor to depths of 10.00m bgl. The Rock Quality Parameters of the Chester Formation are presented in Figure 6.3.2a.

Ground Investigation

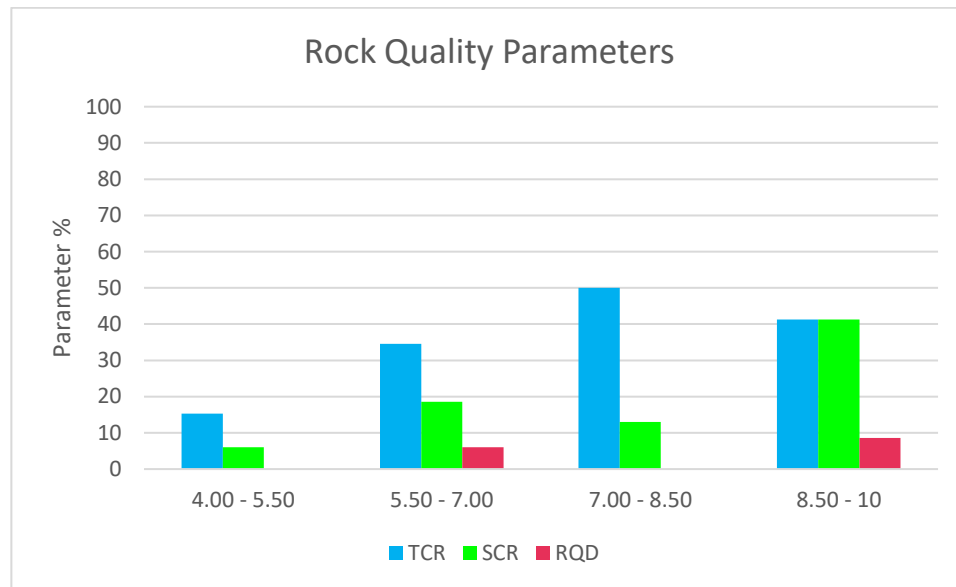


Figure 6.4.1a – Summary of Rock Quality Parameters – Chester Formation

A summary of the geotechnical testing results for the sandstone within the Chester Formation are presented in Table 6.4.2a. Full details of the geotechnical results can be found in Appendix D.

Table 6.4.2a – Summary of Geotechnical Test Results

	Parameter		No. of Tests	Summary of Results
Laboratory Test Results	Point Load Indices (Is50), MPa	Axial Plane	7	Min: 0.01 Max: 1.0 Average: 0.082
		Diametral Plane	5	Min: 0.02 Max: 0.08 Average: 0.05
	pH Value		4	Min: 7.7 Max: 8.32 Average: 7.98
	2:1 Water Soluble Sulphate Concentration (mg/l)		4	<10
Derived Parameters	Estimated UCS from Point Load Indices (Is50), MPa	Axial Plane	7	Min: 0.15 Max: 1.8 Average: 1.2
		Diametral Plane	5	Min: 0.3 Max: 1.2 Average: 0.75

Ground Investigation

Overall, 7 No. axial and 5 No. diametral PLTs were undertaken on selected samples of sandstone from rotary cores. Axial PLT (Is(50)) results ranged between 0.01MPa and 1.00MPa, whereas diametral plane PLT (Is(50)) test results ranged between 0.02MPa and 0.08MPa.

An approximation of the UCS of the rock may be derived from the following relationship, described in Equation 3:

$$UCS = PLT\ Is(50) \times f_1 \quad \text{Equation 3}$$

Where f_1 is derived from correlation between PLT Is(50) and UCS results

A correlation factor of 20 was derived from published values (Read, 1980) (Ref. 9)

Based on this relationship, estimated UCS values for sandstone range between 0.2MPa and 2.40MPa for axial tests and 0.4MPa and 1.60MPa for diametral tests, indicating the rock test is generally very poor. The results are presented in Figure 6.4.b.

These generally correlate with the strengths indicated during field descriptions, typically recorded as very weak to weak sandstone.

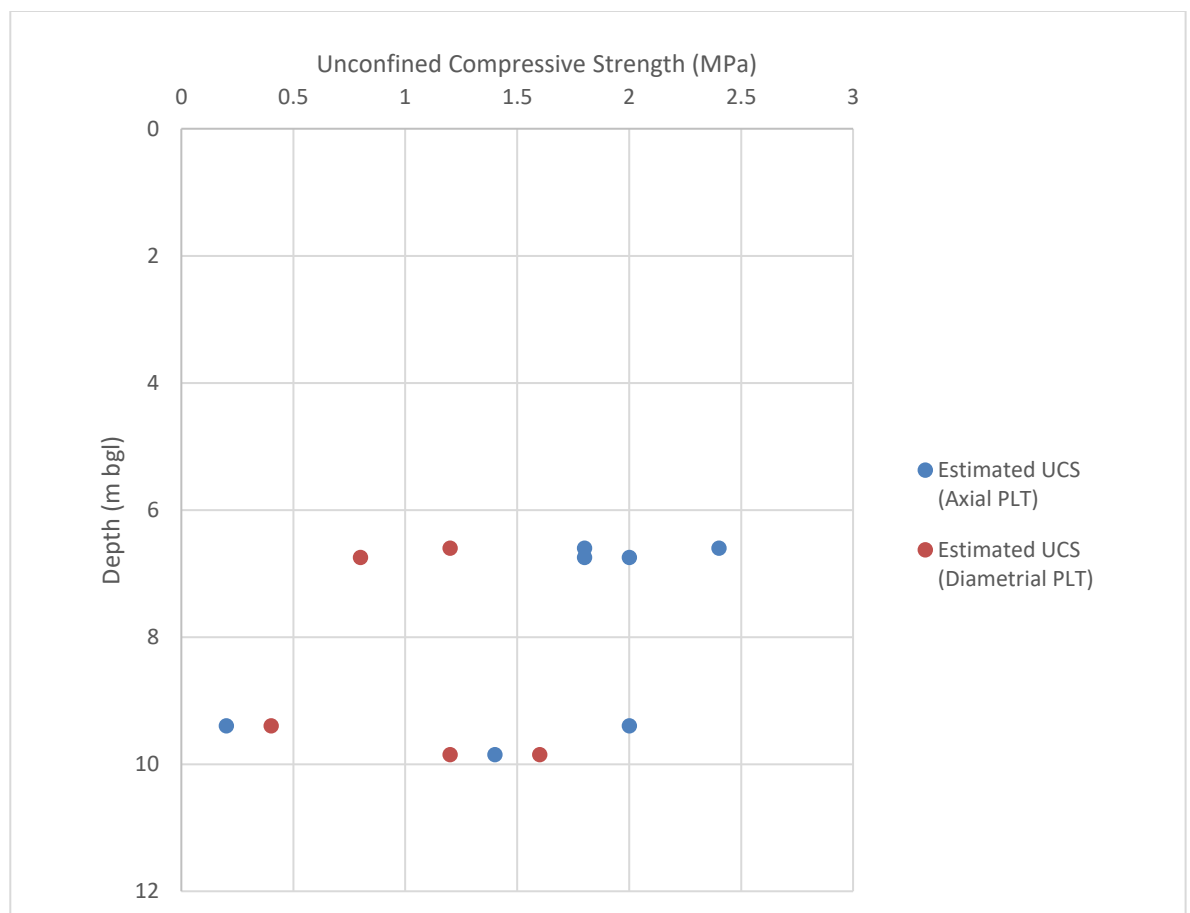


Figure 6.3.2.b – Estimated Unconfined Compressive Strength of Sandstone

A review of the estimated strengths of the sandstone bedrock indicates vertical variability, generally increasing with depth. It is advised that a location by location assessment of rock strength is undertaken for design purposes.

A review of the recorded strength and estimated strengths of the sandstone bedrock indicates significant lateral and vertical variability. As such it is advised that a location by location assessment of the rock strength is undertaken for the purposes of design.

Five SPT 'N' values of >50 blows for penetration between 40 and 125mm was recorded in the sandstone. This equates to an 'N' value of between 120 and 375. From this the strength of the bedrock may be approximated based on:

$$\sigma_c > 10N \text{ (kN/m}^2\text{)} \quad \textbf{Equation 4}$$

Where σ_c is UCS and N is the SPT 'N' value

This is derived from CIRIA Report 143 (Ref. 11) and is considered to characterised the lower bound value of UCS. On this basis, the lower bound strength of the sandstone is approximately 1.2MN/m²

6.4 Ground Model Summary

The characteristic parameters for each stratum recorded during this investigation are presented in *Table 6.4*.

Table 6.4 – Summary of Geotechnical Parameters for Design

Parameter	Value	Reference
Granular Superficial Soils		
Unit Weight, γ (kN/m ³)	19	Barnes, 2016 (Ref. 10)
Angle of Shearing Resistance, ϕ' (°)	0 – 3.5m bgl: $\phi' = \frac{\text{Depth (m)} + 4.43}{0.21}$	Peck et al, 1967 (Ref. 8)
Cohesive Superficial Soils		
Undrained Shear Strength, C_u (kPa)	30	Tomlinson, 2000 (Ref. 12)
Angle of Shearing Resistance, ϕ' (°)	22°	Peck et al, 1967 (Ref. 8)
Coefficient of volume compressibility, m_v (m ² /MN)	0.20	Tomlinson, 2000 (Ref. 12)
Residual Soils (Weathered Bedrock)		
Unit Weight, γ (kN/m ³)	21	Barnes, 2016 (Ref. 10)

Angle of Shearing Resistance, ϕ' (°)	40	Peck et al, 1967 (Ref. 8)
Chester Formation, Sandstone		
Unit Weight, γ (kN/m ³)	20	Read et al, 1980 (Ref. 9)

6.5 Aggressive Ground Conditions

The classification of the site in terms of concrete in aggressive ground is based on the guidance provided in Table C2 of the Building Research Establishment (BRE) Special Digest 1, 3rd edition of 2005 (Ref. 13). A summary of the results obtained as a part of the ground investigation are summarised in Table 6.6a, and Table 6.6b details the classification.

Table 6.6a – Aggressive Chemical Environment for Concrete (ACEC) Site Classification

Stratum	Test Type	Range
Made Ground	pH	7.8 - 9.84
	Water Soluble Sulphate (mg/l)	10 - 100
Superficial deposits	pH	7.72 - 8.98
	Water Soluble Sulphate (mg/l)	10 - 20
Residual Soils	pH	8.33 - 8.44
	Water Soluble Sulphate (mg/l)	<10
Chester Formation	pH	7.70 - 8.32
	Water Soluble Sulphate (mg/l)	<10

Table 6.6b – Aggressive Chemical Environment for Concrete (ACEC) Site Classification

Stratum	Design Sulphate Class	ACEC Class ⁽¹⁾
Made Ground	DS-1	AC-1
Superficial deposits	DS-1	AC-1
Residual Soils	DS-1	AC-1
Chester Formation	DS-1	AC-1

(1) ACEC assessment was based on the *mobile* groundwater condition in a *brownfield* scheme area

7.0 Ground and Groundwater Contamination Assessment

This section of the report includes the assessment of the potential contamination, solid, liquid and gas, identified on the subject site which may present a risk to the proposed end-users, associated utilities and the wider environment.

In guidance published by the Environment Agency, the risk to human health or controlled waters is determined through an assessment of pollutant linkages between a source of contamination (within the ground or groundwater either on or off site) and a sensitive receptor such as end-users of the site, building materials, edible plants grown in gardens or groundwater abstracted for drinking. This is termed a source-pathway-receptor relationship. The same model is applied to the assessment of risk arising from ground gases as detailed within BS8576:2013 (Ref.14).

These models have a common approach, which is one of a tiered assessment. At each stage of the assessment further detail can be applied to the conceptual site model to provide a detailed interpretation on a site by site basis. As part of the planning process this approach is adopted to establish either if the site is 'suitable for use' or whether additional work or else remedial work is required for the site to be deemed so.

The sub-sections hereafter therefore incorporate the first tier (Tier 1) of this approach otherwise referred to as the Generic Quantitative Risk Assessment (GQRA). The GQRA builds on the qualitative risk assessment presented in the Phase 1 Desk Study in conjunction with observations made during the ground investigation and is based solely on the results of the chemical and other testing data obtained as part of Curtins ground investigation. The GQRA is used to build/refine the Conceptual Site Model (CSM) for the site as detailed and presented in *Section 9.0* of this report.

The following sections present more detail on the risk assessment methodology rationale for the main receptors.

7.1 Human Health

Detailed guidance on human health risk assessment is available within several documents, published by both the Environment Agency and Defra. Guidance includes Contaminated Land Exposure Assessment (CLEA) v1.071 model (Ref. 15), Science Report 2 (Ref.16) and Science Report 3 (Ref. 17).

A generic quantitative risk assessment (GQRA) has been carried out for the Potential Contaminant Linkages (PCLs) investigated by screening of soil contamination data against relevant Generic Assessment Criteria (GAC) where available, including:

- i) **Soil Guideline Values (SGVs):** These have been published by the Environment Agency and are trigger values for screening out low risk areas of land contamination. SGV's give an indication of representative average concentrations of chemicals in soil, below which long-term health risks are likely to be minimal. SGVs have been published for several contaminants

including arsenic, cadmium, mercury, nickel, selenium, BTEX, phenols and dioxins, furans and dioxin-like PCB substances for land uses including residential, allotments and commercial. The SGVs have been developed for a sandy loam soil with 6% soil organic matter (SOM) content;

- ii) **Supplementary Screening Values (SSVs):** In addition to the SGVs developed by the EA, other third party organisations have derived SSVs for a wider range of contaminants and land uses using the CLEA Model. Curtins have adopted these numbers where applicable, including those developed by Atkins AtriskSoil™, the LQM/CIEH Suitable for Use Levels (S4UL) and EIC/AGS/CL:AIRE published thresholds;
- iii) **Category 4 Screening Levels (C4SLs):** In March 2014 Defra published C4SLs for arsenic, benzene, benzo(a)pyrene, cadmium, hexavalent chromium and lead. These values were derived to support the revised Part 2A Statutory Guidance issued in 2012 (Ref.18) in which four categories of contaminated land are included, ranging from Category 1 (significant/high risk) to Category 4 (low risk). C4SLs are not representative of significant possibility of significant harm (SPoSH) and are low risk levels which, and therefore where the C4SLs are not exceeded, land can be demonstrated to be in Category 4 and cannot be determined as contaminated land.

7.1.1 Adopted Soil Human Health GACs Screening Methodology

The proposed use of the site, noted as part four, part five and part six storey extension, is most analogous with a *Residential without Home Grown Produce* end-use scenario and so assessment has been undertaken against the following GACs, in order of preference:

1. Environment Agency Soil Guideline Values,
2. CL:AIRE, AGS, EIC. Soil Generic Assessment Criteria for Human Health Risk Assessments,
3. LQM/CIEH 2015 S4ULs for Human Health Risk Assessment, and
4. DEFRA Category 4 Screening Levels.

The soil organic matter (SOM) content has an influence on the volatilisation of organic contaminants (i.e. the higher the SOM, the lower the volatilisation rate and therefore inhalation exposure risk). Soil organic matter (SOM) values for the site soils ranged from 3% to 20%. The high organic content encountered in BH102 (0.45m) may be associated with high ash content in the made ground soil.

With consideration for a calculated geometric average, Made Ground soils determine a SOM of 7.2%. As such, a comparison against Generic Assessment Criteria (GAC) thresholds for a conservative SOM of 6.0% for *Residential without Home Grown Produce* end-use has been adopted for Made Ground. The adopted GAC's are listed in *Appendix E*.

7.1.2 Generic Assessment Criteria Screening of Soil Laboratory Results

The results of the environmental testing can be referred to in *Appendix C*.

There are no exceedances noted within any of the Made Ground tested when compared to the *Residential without Home Grown Produce GACs*.

No asbestos containing materials (ACMs) were identified during the investigation works. Asbestos screening of selected soil samples was undertaken. No asbestos was positively identified in any of the soil samples analysed.

7.2 Controlled Waters GQRA

All monitoring visits to date have recorded the boreholes to be dry therefore water samples have not been taken.

8.0 Ground Gas Assessment

The assessment of risk presented by ground gases is assessed with reference to guidance published by CIRIA (Assessing Risks Posed by Hazardous Ground Gases to Buildings, C665 (Ref.19), BSI Publication (Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings BS8485:2019 (Ref.20), NHBC Guidance on Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are Present, Report No. 04 (Ref. 21) and other broadly accepted references such as the Ground Gas Handbook 2009 (Ref. 22).

The gas risk assessment adopts a tiered approach. In the first instance this involves a re-evaluation of the Preliminary Conceptual Site Model and thereafter validating this conceptual model with the ground gas data, the semi-quantitative risk assessment.

8.1 Ground Gas Monitoring Results

To characterise the site's ground gas regime and validate the qualitative assessment of the ground gas risk standpipe installations were incorporated within BH101, BH102 and BH103 as detailed in *Section 3.3*.

An initial programme of six gas monitoring visits over three months between 27th February 2020 and 24th June 2020, with barometric pressure recorded between 994mb and 1029mb. Three visits recorded rising pressure (Visit 1, 2 and 6), two visits recorded steady (Visit 3 and 4) and Visit 5 recorded falling pressure. The results log sheets are contained within *Appendix E* and summarised in *Table 6.5.1*.

Table 6.5.1 – Summary of Ground Gas Monitoring Results

Borehole Ref.	Maximum CH ₄ Concentration (%)	Maximum CO ₂ Concentration (%)	Minimum Steady O ₂ Concentration (%)	Maximum air flow (l/hr)	
				Peak	Steady State
BH101 ⁽¹⁾	-	-	-	-	-
BH102	<0.1	2.4	18.1	-0.6	-0.6
BH103	<0.1	3.4	16.0	-37.4	-37.3

(1) Unable to access during monitoring visits.

Methane were recorded at concentrations below the limit of detection of the monitoring instrument.

A maximum concentration of carbon monoxide of 5 ppm was recorded in BH103 on the sixth visit. A maximum concentration of hydrogen sulphide of 2 ppm in BH102 and BH103 on the sixth visit.

A maximum concentration of carbon dioxide of 3.4% v/v was recorded in BH103 on the sixth visit.

The highest recorded peak flow was -37.4 l/hr within BH102 on the third monitoring visit and the highest steady state flow rate of -37.3 l/hr recorded within BH102 on the third monitoring visit.

8.2 Ground Gas Assessment

The Conceptual Site Model presented within the Phase 1 Preliminary Site Assessment (Ref. 1) identified possible Made Ground deposits as a potential source of ground gas generation both onsite and offsite resulting from historical development and land use. The report suggests no records of organic rich drift deposits (e.g. peat) being present. Noxious and asphyxiate gases were attributed to include, but not limited to, carbon dioxide, carbon monoxide, methane and hydrogen sulphide. The consequence was evaluated as Moderate/Low risk.

Made Ground soils were encountered to depths of between 0.60m and 1.90mbgl but with limited putrescible content generally. The ground investigation revealed a ground model generally consistent with the preliminary conceptual site model. Natural deposits were predominantly granular, with rare pockets of cohesive soils, all with limited organic/putrescible content. The superficial soils were underlain by a layer of granular weathered bedrock and sandstone bedrock.

In accordance with BS8485:2019 (Ref.20), consideration of the recorded soil gas flow rates, presented above, enables hazardous gas flow rates (Qhg) to be evaluated. Qhg can be derived for both 'representative' and 'worst case' scenarios and a comparison made in support of an appropriate assessment of ground gas risk. For a 'representative' scenario (highest hazardous gas flow rate that is realistically possible, i.e. in a single borehole) steady state flow rates and gas concentrations are adopted, whilst for a 'worst case' scenario (highest Qhg across the entire dataset irrespective of location and discrete monitoring events) peak flows and gas concentrations are adopted.

The highest peak and steady state flow rate of -37.4l/hr and -37.3 l/hr respectively were recorded in BH103 on Visit 3. Due to the flows, recorded in Visit 3, being a singular event, these flow rates are not deemed representative of the ground conditions pertaining to the site and have therefore been discounted from the following assessment. The remaining visits recorded a highest peak and steady state flow rate of -1.3l/hr and -0.6l/hr.

Evaluation of the 'representative' scenario (highest hazardous gas flow rate that is realistically possible, i.e. in a single borehole) recorded a maximum Qhg 0.0442 l/hr for carbon dioxide, using the flow rate from BH103 (12/06) and the maximum CO₂ concentrations from BH103 (24/06).

Based on the foregoing commentary, it is deemed that the gas regime is Characteristic Situation 1 (CS-1) requiring no gas protection measures.

The potential risks from ground gases to the excavations are to be dealt with by the Contractor, in accordance with the Confined Space Regulations, during construction. Appropriate ground gas monitoring and safety measures should be in place during the works, as the potential presence of ground gases could pose a risk in any confined spaces of deep excavations.

9.0 Revised Conceptual Site Model

The Preliminary Conceptual Site Model (PCSM) presented in the Phase 1 report (Ref.1) and discussed in *Section 2.6* of this report has been revised following the GQRA in *Section 7.0* and *Section 8.0*.

The CSM details the source-pathway-receptor linkages or potential pollutant linkages (PPL) that have been identified as relevant for the site. The GQRA details the associated level of risk relating to these potential pollutant linkages.

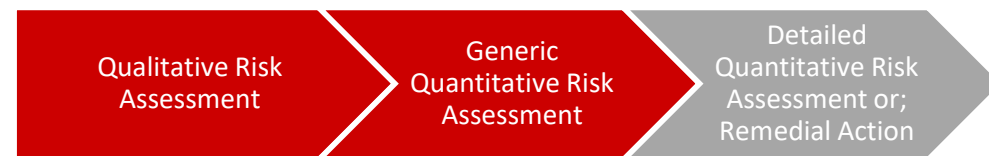
The CSM follows the framework outlined within CIRIA C552 (Ref.23) which is summarised within *Appendix G*.

The 'risk rating' within the CSM refers to the risk that the source, pathway, receptor linkage or PPL is complete. Unless specifically stated it does not necessarily refer to an immediate risk and is intended to be used as a tool to assess the necessity for further assessment/investigation.

Risks presented by Unexploded Ordnance is discussed and assessed in *Section 2.5*.

Under current health and safety legislation, employers are required to carry out their own appropriate risk assessments and mitigation to protect themselves and their employees, other human receptors and the environment from potential contamination. Such risks must be adequately mitigated by law, specifically the Construction Design Management (CDM) Regulations, 2015 (Ref.24) which require that potential risks to human health and the environment from construction activities are appropriately identified and all necessary steps taken to eliminate / manage that risk. It has been assumed that any future construction works onsite will be undertaken in compliance with these requirements. Reference should be given to the environmental testing results discussed within *Section 7.0* and presented within *Appendix C*.

Ground Investigation



- The table below represents the Second stage in the land quality risk assessment process; the Revised Conceptual Site Model following the Quantitative Risk Assessment.
- For a development site to be deemed 'suitable for use' the level of risk needs to be brought down to acceptable levels, i.e. low to very low risk. The purpose of each stage of risk assessment is ultimately to establish if there is a requirement for additional levels of assessment to be made to have enough confidence to support a risk characterisation or management decision, e.g. remedial action.
- In the absence of specific site data, a Generic Quantitative Risk Assessment is invariably recommended.

Conceptual Site Model			Generic Qualitative Risk Assessment			Comments	Action
Identified Source	Pathway(s)	Receptor(s)	Consequence	Likelihood of Occurrence	Risk Rating		
Organic and inorganic contaminants within made ground soils across the site.	Direct contact and dermal uptake, soil and dust ingestion, dust and migration inhalation (indoor & outdoor air)	Site end-users (Commercial end-use)	Medium	Unlikely	Low	Environmental chemical analysis did not record any exceedances with respect to a 'Residential without Home Grown Produce' end use scenario. No significant visual or olfactory evidence of contamination was identified in the site soils. No suspected asbestos containing materials (ACMs) were identified in exploratory hole logs and laboratory screening.	No further action required.
	Direct contact and dermal uptake, soil and dust ingestion, dust & migration inhalation (outdoor air)	Construction and maintenance workers	Medium	Unlikely (Standard Health & Safety precautions likely to be used by workers)	Low		Construction and maintenance workers should be provided with suitable PPE with respect to environmental chemical results presented herein.
	Soil dust ingestion/inhalation produced during construction (indoor and outdoor air)	Adjacent residents	Medium	Unlikely (Suitable construction management/environmental controls to be implemented)	Low		
	Vertical and horizontal migration through superficial deposits	Controlled Waters (Principal Aquifer)	Medium	Unlikely	Low	During the groundwater monitoring rounds, the monitoring wells have been recorded as dry. As no groundwater has been encountered and no exceedances were recorded, the risk to groundwater is considered Low.	No further action required
Organic matter and/or contamination as source material for the generation of ground gas.	Ground gas migration and inhalation	Site end-users	Medium	Unlikely	Low	Carbon Dioxide ground gas assessment records a maximum concentration of 3.4% v/v. Methane ground gas concentrations were recorded below the limit of detection 0.1% v/v. The highest gas flow rates pertaining to the development were recorded at -37.3 l/hr in BH103 on the third monitoring visit.	No further action required.
		Construction and maintenance workers	Mild	Unlikely (Standard Health & Safety precautions likely to be used by workers)	Very Low	The greatest representative gas flow rates were recorded at -1.3l/hr in BH103 on the fifth monitoring visit. The use of the representative GSV is deemed appropriate for the assessment resulting in a calculated GSV for carbon dioxide of 0.0442 l/hr.	Standard Health & Safety precautions likely to be used by workers.

9.1 Summary of Significant Pollutant Linkages

A **Low** risk rating is identified to end-users from direct contact, inhalation and ingestion of contaminants within Made Ground soils. No exceedances were recorded within analysed soil samples with respect to the nominated '*Residential without Home Grown Produce*' screening criteria.

The risk to maintenance and construction workers from direct contact and dermal uptake, soil and dust ingestion, dust and migration inhalation is considered to be **Low**, accounting for appropriate PPE and environmental management controls.

The risk presented to controlled waters was assessed as **Moderate** for groundwater and **Low** for surface water within the Phase 1 Desk Study. The ground conditions pertaining to the development site are consistent with the findings of the Phase 1 report, with no significant visual or olfactory evidence of contamination identified in site soils. As no groundwater was encountered and no exceedances were recorded, the risk presented to controlled waters (groundwater and surface water) are identified as **Low** and **Very Low** respectively.

A **Low** risk rating is identified to site end-users from ground gas arising from made ground and natural soils migrating into buildings and subsequent inhalation by on-site employees. This corresponds with a Characteristic Situation 1 (CS-1), requiring no gas protection measures.

10.0 Engineering Assessment and Recommendations

The recommendations provided within this section are based on a review of the historical and recent records of ground conditions encountered across the site, considering the geotechnical and geo-environmental limitations and hazards identified. The proposed development plan is contained within *Appendix A*.

It must be noted that at the time of writing this report, the structural details and loadings have not been provided. As such, any changes in the development of designs beyond the issue of this Ground Investigation Report to the client, should be further investigated by the Construction Designer.

10.1 Summary of Ground Conditions

The ground conditions at the site generally comprised Made Ground, overlying generally granular superficial soils, granular residual soils and the Chester Formation comprising sandstone.

The geotechnical parameters recommended for use in the design based on the ground conditions encountered are discussed in *Section 5.0* and *Section 6.0* and are summarised in *Table 10.1*.

Table 10.1 – Geotechnical Parameters

Parameter	Value	Reference
Granular Superficial Soils		
Unit Weight, γ (kN/m ³)	19	Barnes, 2016 (Ref. 10)
Angle of Shearing Resistance, ϕ' (°)	0.00 – 3.50m bgl: $\phi' = \frac{\text{Depth (m)} + (4.43)}{0.21}$	Peck et al. 1967 (Ref. 8)
Cohesive Superficial Soils		
Undrained Shear Strength, c_u (kPa) ⁽¹⁾	30	Tomlinson 2001 (Ref. 11)
Angle of Shearing Resistance, ϕ' (°)	22°	Peck et al. 1967 (Ref. 8)
Coefficient of volume compressibility, m_v (m ² /MN)	0.20	Tomlinson 2001 (Ref. 11)
Residual Soils		
Unit Weight, γ (kN/m ³)	21	Barnes, 2016 (Ref. 10)
Angle of Shearing Resistance, ϕ' (°)	40	Peck et al. 1967 (Ref. 8)
Chester Formation - Sandstone		
Unit Weight, γ (kN/m ³)	20	Read et al, 1980 (Ref. 9)

10.2 Foundation Solution

It is understood that the proposed development comprises a part 4 storey, part 5 storey and part 6 storey extension to the existing development. Structural loadings for the development are not currently available.

The shallow ground conditions on site comprises made ground overlying predominantly granular glacial till underlain by the Chester Formation. The made ground is not anticipated to provide a suitable founding stratum.

Due to the likely loads of the proposed development, it is considered that shallow spread foundation in the superficial deposits are unlikely to be suitable at the site. It is considered that a piled foundation solution be adopted transferring loads to the underlying Sandstone bedrock.

The carry capacity of piles depends not only on their size and the ground conditions but also on their method of installation.

Pile design and installation are continuing evolving processes; it is recommended that specialist piling contractors are contacted as to the suitability and carrying capacity of their piles in the ground conditions pertaining to the site.

10.3 Ground Floor Slabs

Based on observations onsite together with the results of laboratory tests, it is recommended that consideration is given to a suspended ground floor slab. As piled foundations are anticipated, a suspended slab is recommended to bear on the pile caps by a network of beams which will minimise any differential settlement between the floor and the piled structure.

10.4 Chemical Attack on Buried Concrete

The site has been classified in accordance with BRE Special Digest 1 (Ref. 13) and laboratory testing undertaken accordingly in *Section 6.6*. Based on the laboratory test results it is considered that a Design Sulphate Class may be taken as DS-1 with an ACEC class of AC-1 within Made Ground, the Superficial deposits, residual soils and the Chester Formation.

10.5 Excavation

Based on observations on site, together with the results of in-situ and laboratory tests, it is considered that excavations to <1.20m bgl should stand unsupported in the short term. Side support for safety purposes should of course be provided to all excavations which appear unstable, and those >1.20m deep, in accordance with Health and Safety Regulations.

Suitable side slope batters may be required. This must be designed by a suitably qualified temporary works contractor for any excavations.

Groundwater may be encountered as seepages in shallow excavations for foundations or services as perched water. It is considered that groundwater inflows, if encountered, may be controlled by pumping from sumps.

Excavations through made ground, superficial soils and residual soils should be feasible using conventional site plant.

All excavation temporary works shall be designed by a suitably qualified temporary works contractor for any excavations.

11.0 Conclusions & Recommendations

11.1 Conclusions

11.1.1 Ground and Groundwater Contamination

The environmental chemistry soil results have been compared with the Generic Assessment Criteria (GAC) for soils with respect to human health against 'Residential without Plant Home Grown Produce' thresholds.

With respect to the proposed end-use of the site GAC thresholds have not been exceeded in the Made Ground samples taken from any of the exploratory holes progressed during this investigation.

The risk presented to controlled waters was assessed as **Moderate** for groundwater and **Low** for surface water within the Phase 1 Desk Study. The ground conditions pertaining to the development site are consistent with the findings of the Phase 1 report, with no significant visual or olfactory evidence of contamination identified in site soils. As no groundwater was encountered and no chemical exceedances were recorded, the risk presented to controlled waters (groundwater and surface water) are identified as **Low** and **Very Low** respectively.

A **Low** risk rating is identified to site end-users from ground gas arising from made ground and natural soils migrating into buildings and subsequent inhalation by on-site employees. This corresponds with a Characteristic Situation 1 (CIRIA) classification requiring no gas protection measures.

11.1.2 Geotechnical Assessment

The shallow ground conditions on site comprises made ground overlying predominantly granular glacial till underlain by the Chester Formation. The made ground is not anticipated to provide a suitable founding stratum.

Due to the likely loads of the proposed development, it is considered that shallow spread foundation in the superficial deposits are unlikely to be suitable at the site. It is considered that a piled foundation solution be adopted transferring loads to the underlying Sandstone bedrock.

The carry capacity of piles depends not only on their size and the ground conditions but also on their method of installation.

Pile design and installation are continuing evolving processes; it is recommended that specialist piling contractors are contacted as to the suitability and carrying capacity of their piles in the ground conditions pertaining to the site.

Based on observations onsite together with the results of laboratory tests, it is recommended that consideration is given to a suspended ground floor slab. As piled foundations are anticipated, a suspended slab is recommended to bear on the pile caps by a network of beams which will minimize any differential settlement between the floor and the piled structure.

Based on the laboratory test results it is considered that Design Sulphate Classes and ACEC classes of DS-1 AC-1 are appropriate for the Superficial deposits, residual soils and the Helsby Formation.

11.1.3 Recommendations

Based on the findings of the ground investigation, the following recommendations are made:

- 1) Construction and maintenance workers should be provided with appropriate PPE for all groundworks with respect to the soil environmental chemistry results.
- 2) It is recommended that specialist piling contractors are to be consulted to establish suitable pile design.

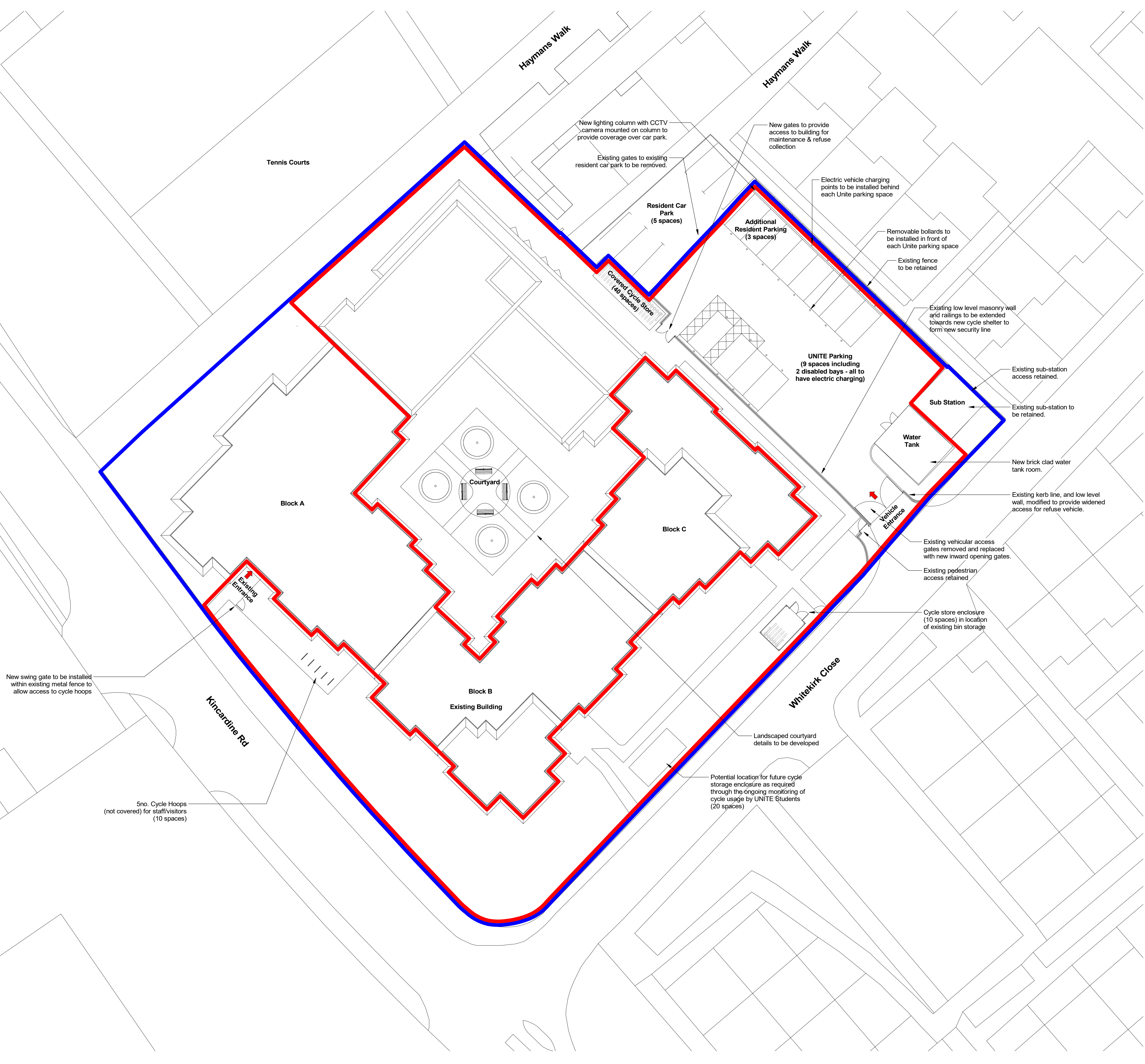
12.0 References

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Appendix A Drawings

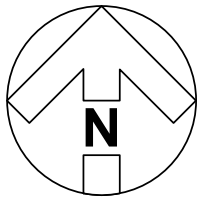
- Hadfield Cawkwell Davidson, Proposed Site Plan, S4a for Planning, Ref. 2017-044-HCD-ZZ-ZZ-DR-A-09-000
- Curtins (2020) Exploratory Hole Location Plan, Drawing Ref. 072071-CUR-00-XX-DR-GE-002-V01
- Curtins (2020) Foundation Pit Cross Sectional Sketches, Drawing Ref. 072071-CUR-00-XX-DR-003-V01



NOTES

DO NOT SCALE FROM THIS DRAWING. VERIFY ALL DIMENSIONS AND SETTING OUT ON SITE. NOTIFY ANY DISCREPANCIES TO THE ARCHITECT. FOR STRUCTURAL INFORMATION, REFER TO STRUCTURAL ENGINEER'S DRAWINGS. FOR M&E INFORMATION, REFER TO M&E ENGINEER'S AND SUB-CONTRACTORS' DRAWINGS. FOR HEALTH & SAFETY INFORMATION, REFER TO HEALTH & SAFETY RISK ASSESSMENTS.

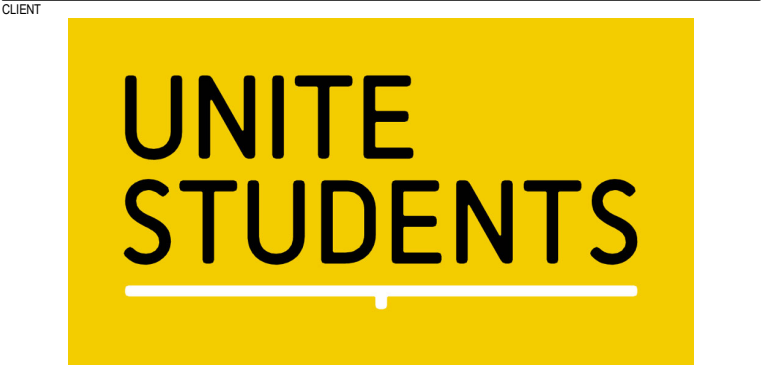
0 m 5 10 15 20
1:200



Blue line denotes Unite site ownership.
Red line denotes Application boundary.

REVISION P03 BY NH CHECKED JRP DATE 24/10/2019
Car parking and cycle storage provisions revised following initial feedback from MCC. Red line amended. Re-issued for planning.
REVISION P02 BY MDH CHECKED APS DATE 13/06/2019
Planning Issue.
REVISION P01 BY MDH CHECKED APS DATE 21/05/2019
First issue.

S4a | FOR PLANNING



KINCARDINE COURT MANCHESTER

Proposed Site Plan

Hadfield Cawkwell Davidson
Broomgrove Lodge, 13 Broomgrove Rd, Sheffield, S10 2LZ T 0114 266 8181 www.hcd.co.uk

HCD PROJECT NO. 2017-044	SCALE 1 : 200 @ A1	REV. P03
PROJECT NO. 2017-044	ORIGINATOR HCD	VOLUME ZZ
DATE 22	TYPE DR	ROLE - NUMBER A-09-000

C:\temp\17044-HCD-A0-ZZ-MS-A-20-001_Building_WS18_john.pedder.rvt | © HCD



PROPOSED SITE INVESTIGATION

-  BOREHOLE LOCATIONS
-  HAND EXCAVATED FOUNDATION PITS
-  INSTALLATION LOCATIONS

Rev:	Description:	Date:	By:	Chkd:
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Birmingham - Bristol - Cardiff - Douglas - Edinburgh - Kendal - Leeds - Liverpool - London - Manchester - Nottingham

Status:

INFORMATION

Project:

KINCARDINE COURT

Drg Title:

**PROPOSED EXPLORATORY HOLE LOCATION
PLAN**

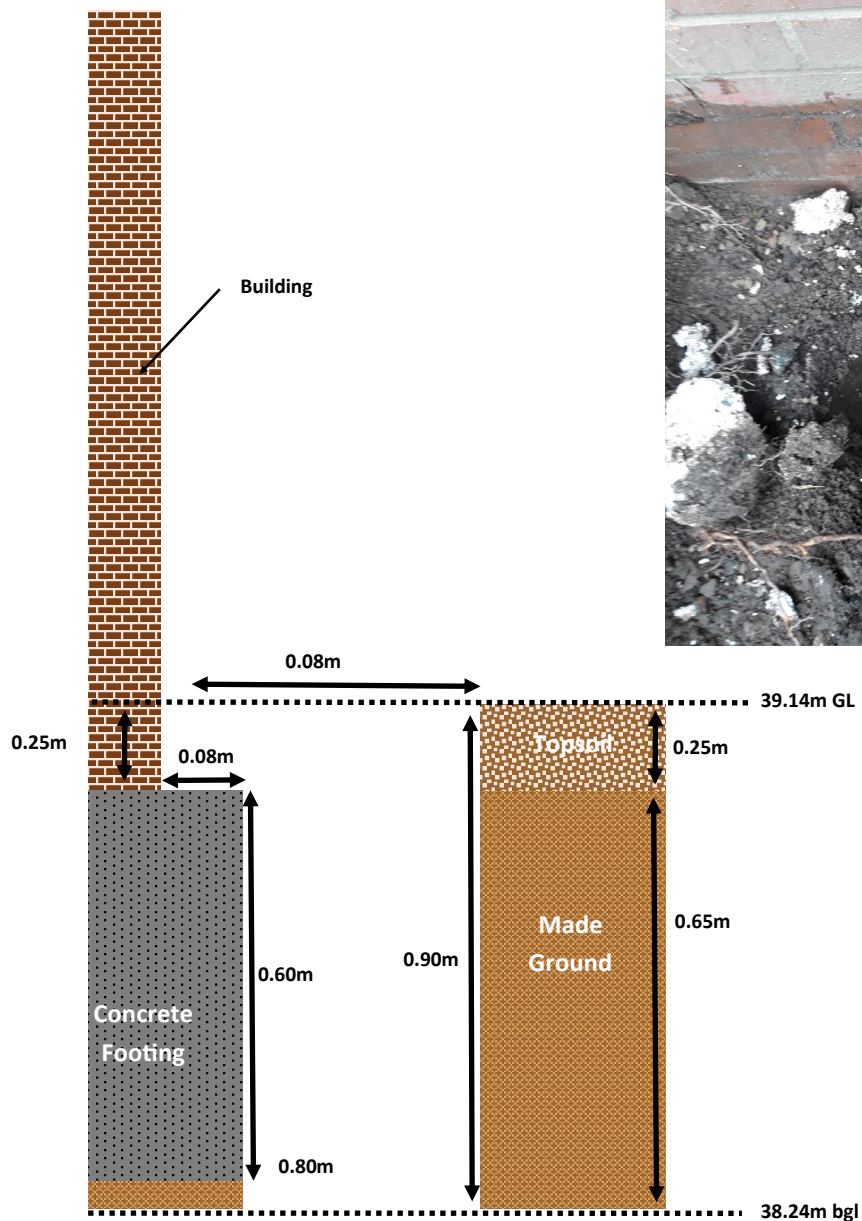
Scale:	Size:	First Issue:	Drawn:	Checked:
NTS	A3	10/02/2020	JL	SH

Drg No:	Rev:
072071-CUR-00-XX-DR-GE-002	V02

Kincardine Court

Foundation Pit Cross Sectional Sketches

FP01



Comments:

Not to scale.

Trial pit edge unstable in Made Ground.

Groundwater not encountered.

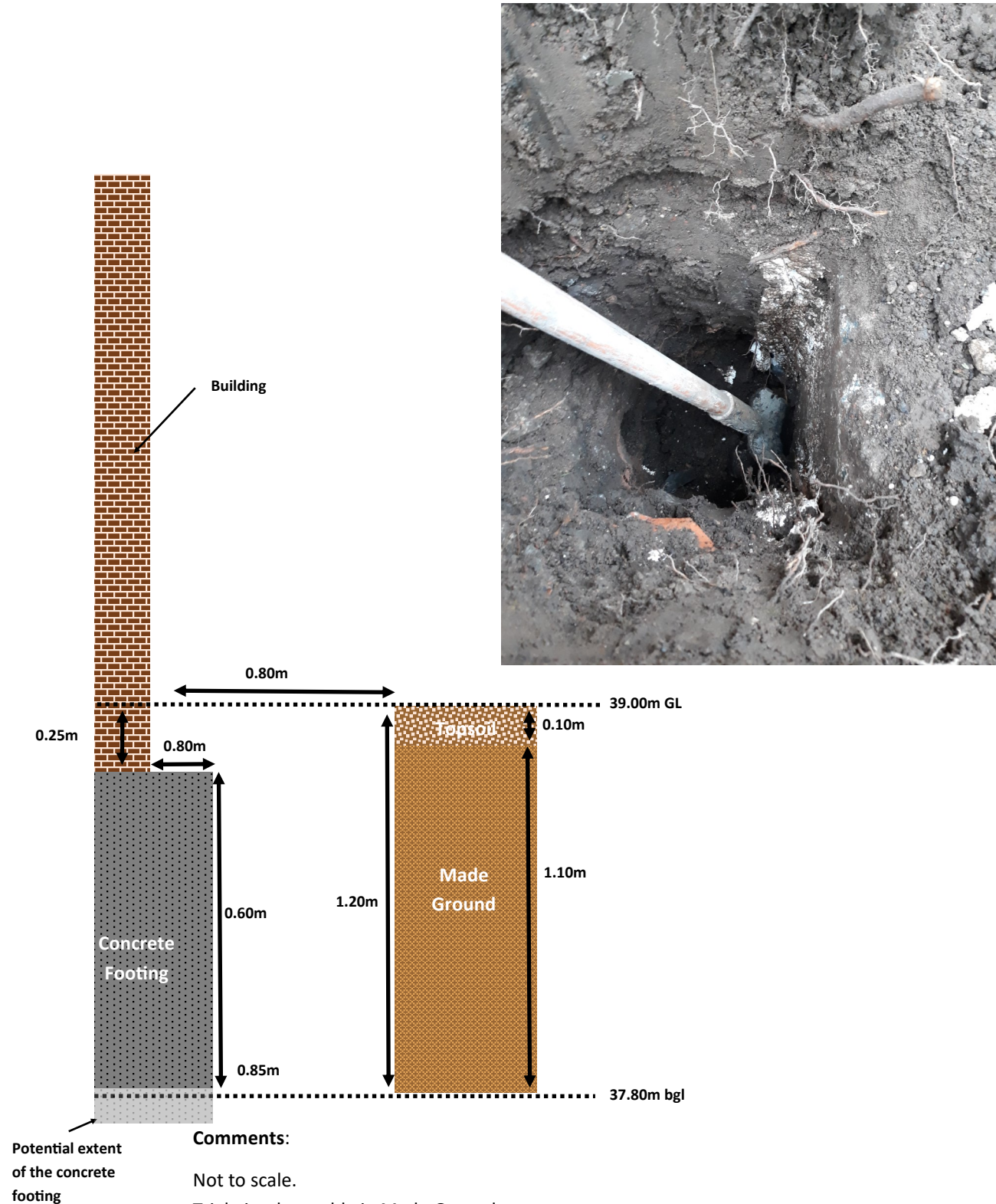
Further detailed information in log FP01

Terminated at 0.90m bgl due to base of foundation being encountered

Kincardine Court

Foundation Pit Cross Sectional Sketches

FP02



Comments:

Not to scale.

Trial pit edge stable in Made Ground.

Groundwater not encountered.

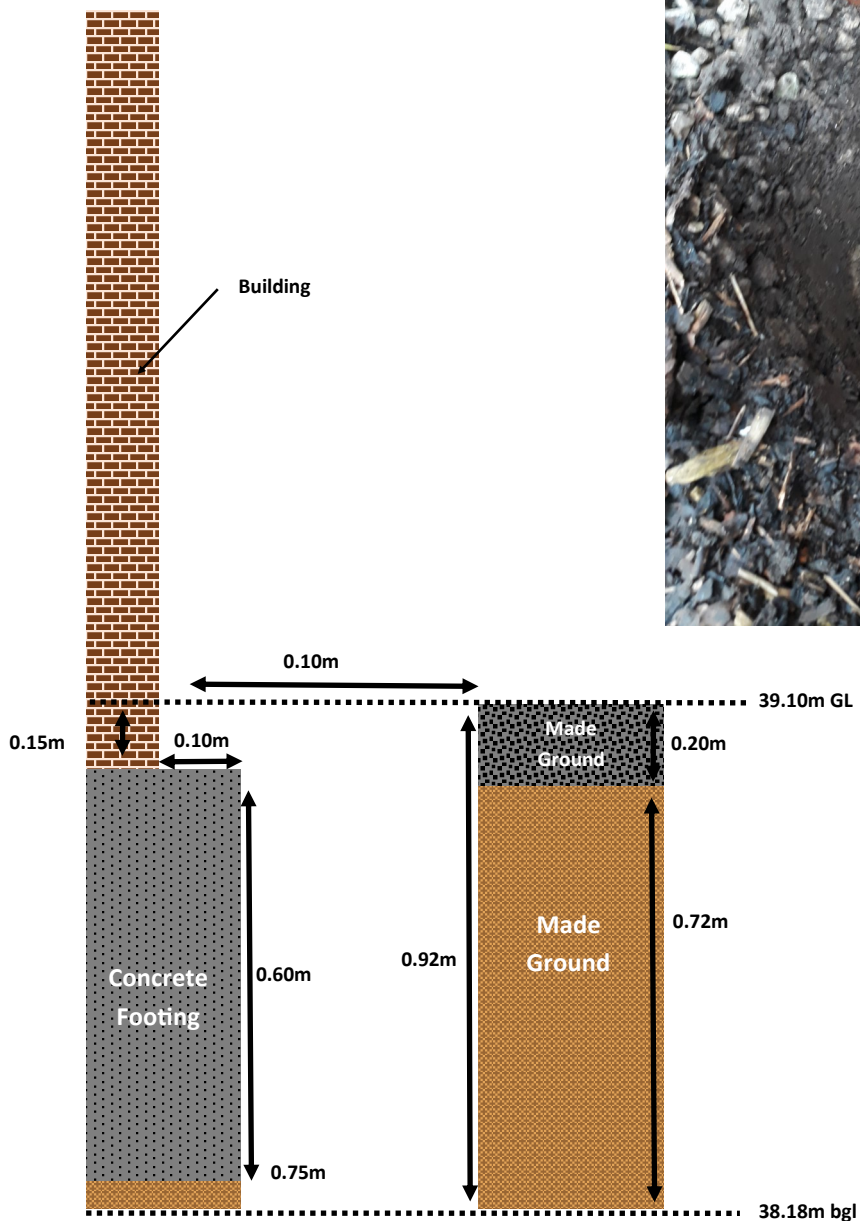
Further detailed information in log FP02

Terminated at 1.20m bgl due to inability to dig deeper. Base of foundation not encountered

Kincardine Court

Foundation Pit Cross Sectional Sketches

FP03



Comments:

Not to scale.

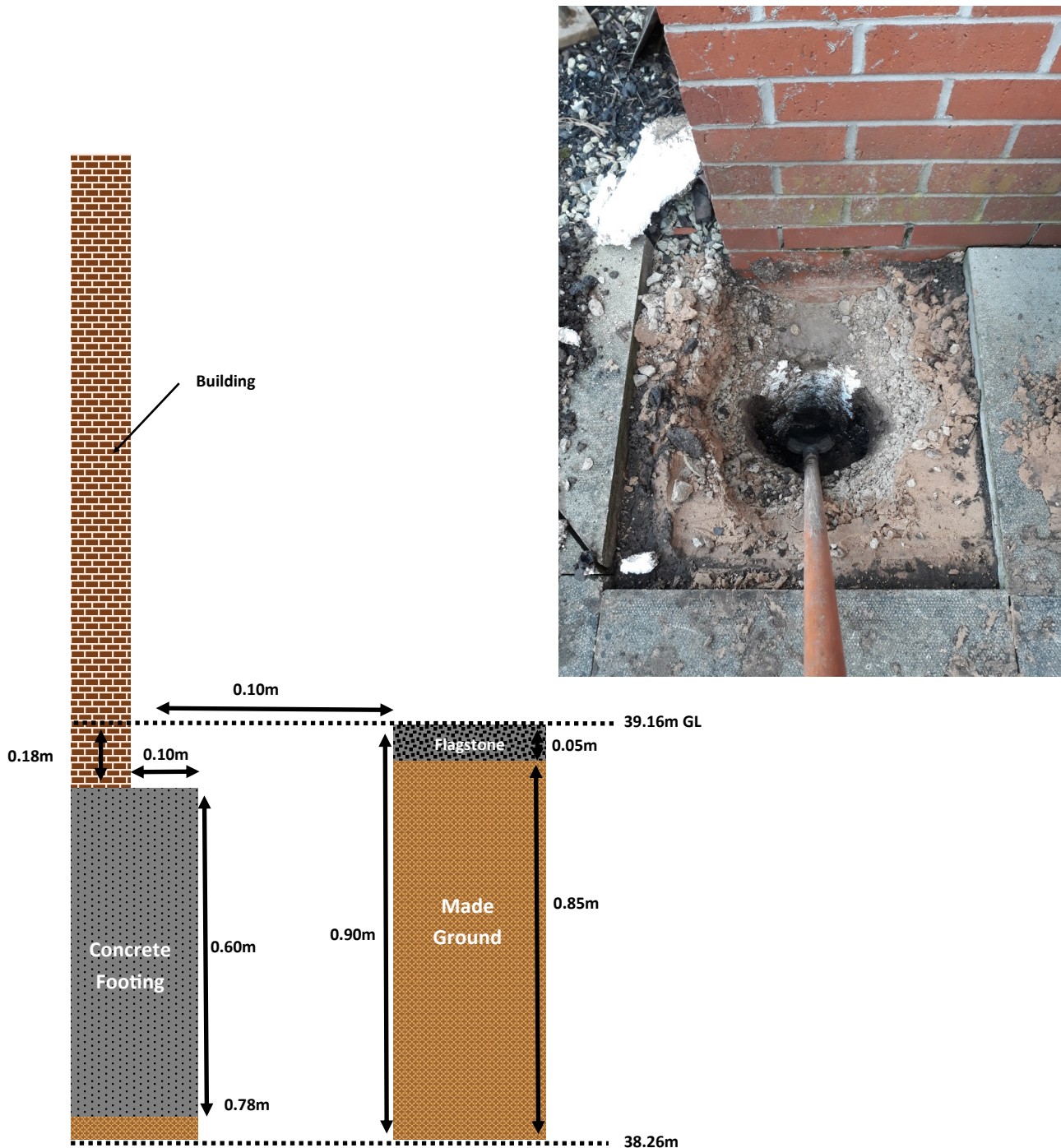
Trial pit edge stable in Made Ground.

Groundwater not encountered.

Further detailed information in log FP03

Terminated at 0.92m bgl due to base of foundation being encountered

FP04



Comments:

Not to scale.

Trial pit edge stable in Made Ground.

Groundwater not encountered.

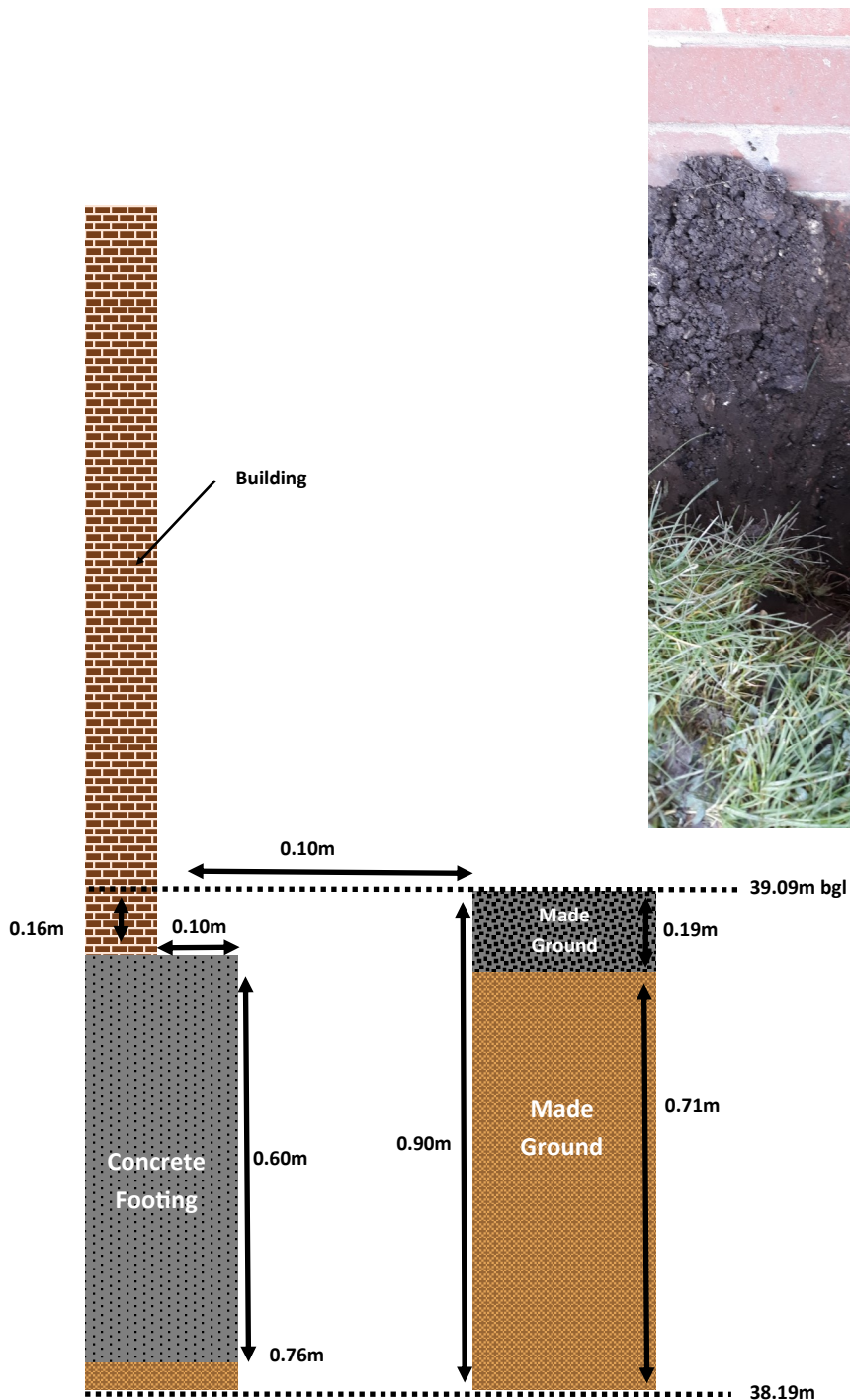
Further detailed information in log FP04

Terminated at 0.90m bgl due to base of foundation being encountered

Kincardine Court

Foundation Pit Cross Sectional Sketches

FP05



Comments:

Not to scale.

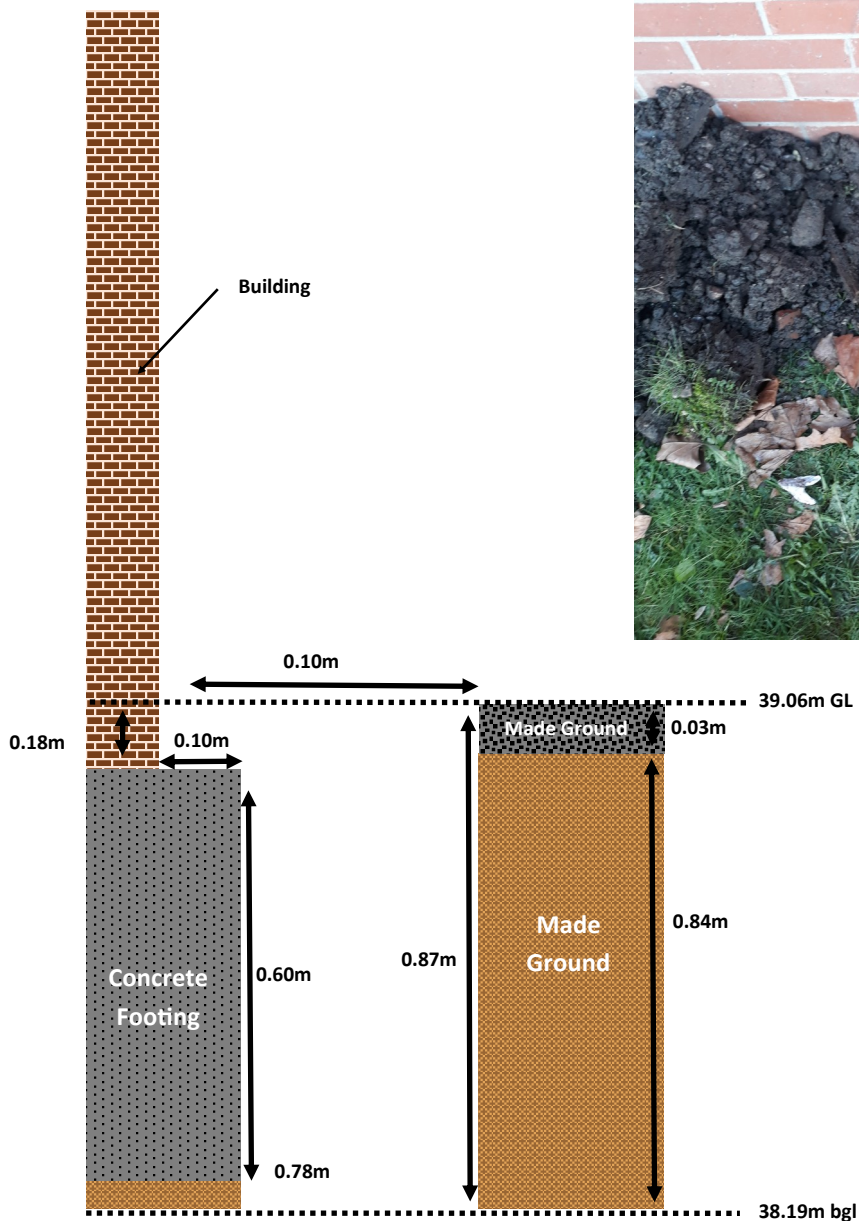
Trial pit edge stable in Made Ground.

Groundwater not encountered.

Further detailed information in log FP05

Terminated at 0.90m bgl due to base of foundation being encountered

FP06



Comments:

Not to scale.

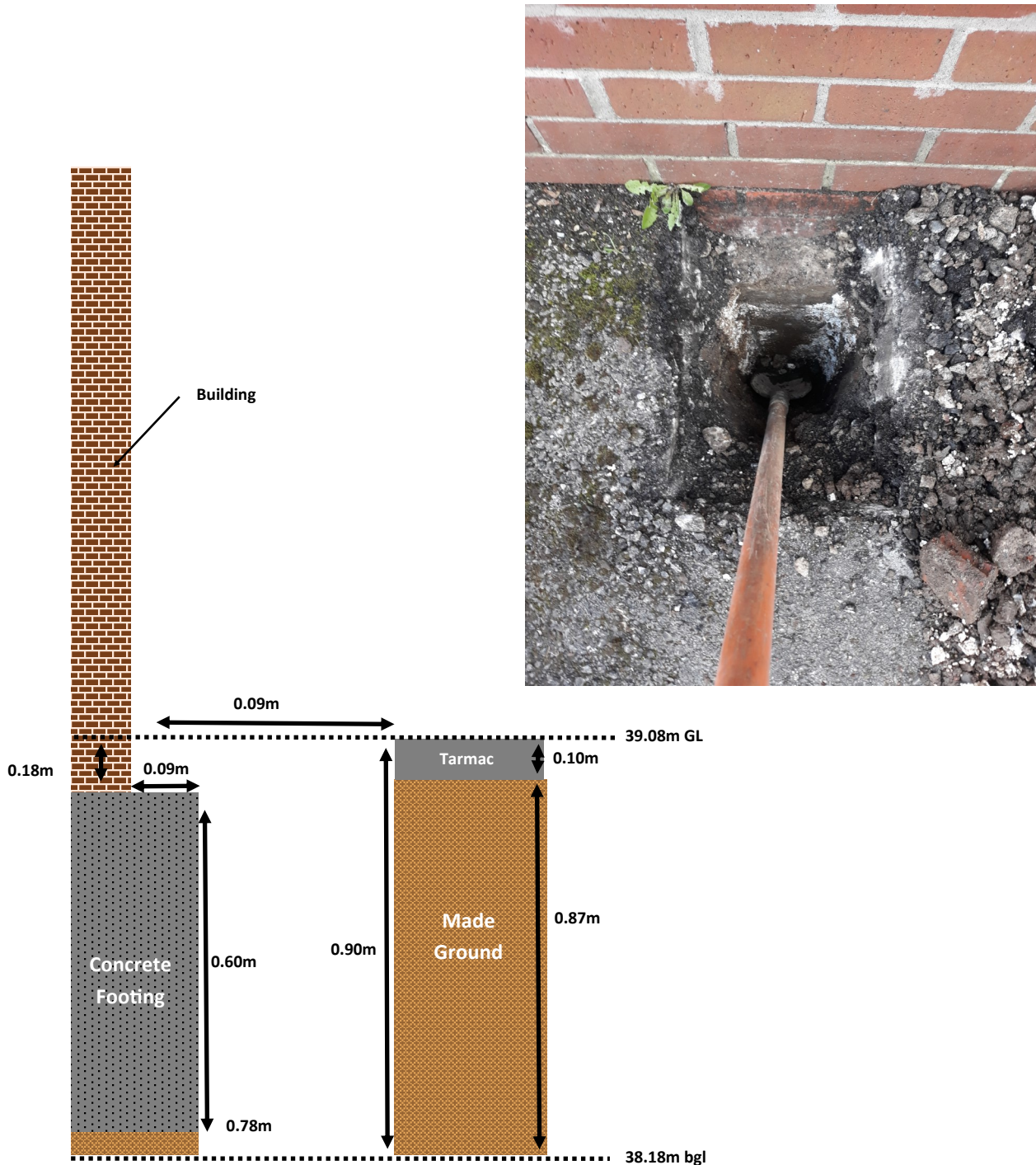
Trial pit edge stable in Made Ground.

Groundwater not encountered.

Further detailed information in log FP06

Terminated at 0.87m bgl due to base of foundation being encountered

FP07



Comments:

Not to scale.

Trial pit edge stable in Made Ground.

Groundwater not encountered.

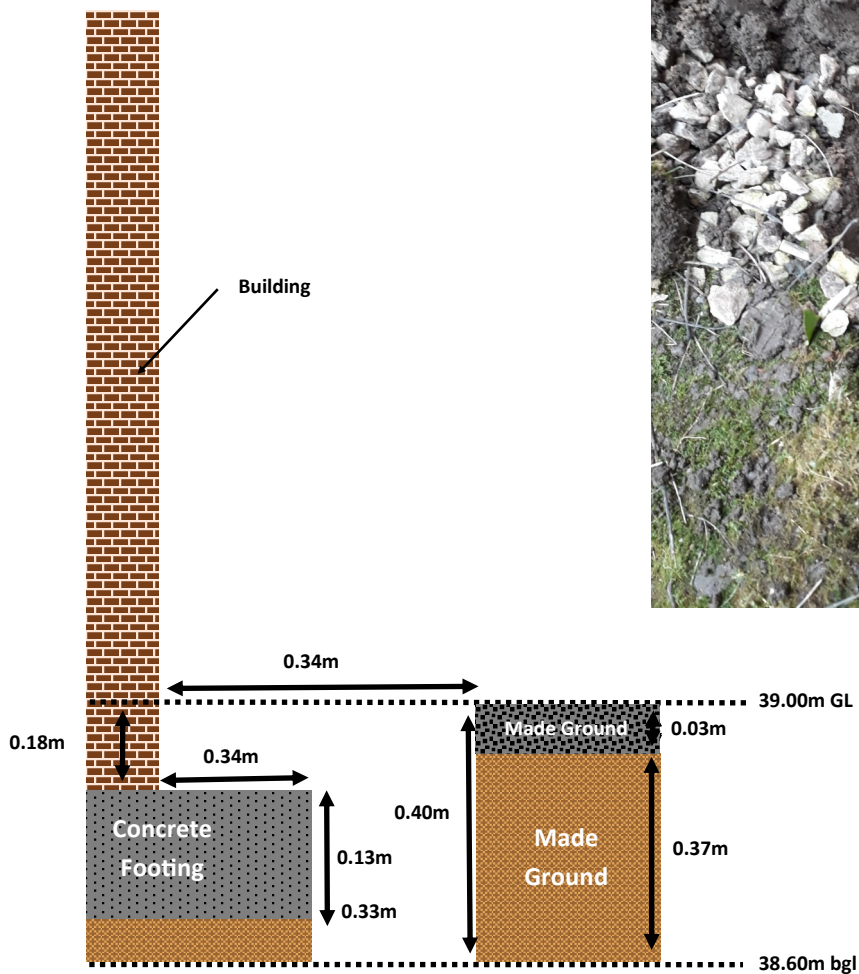
Further detailed information in log FP07

Terminated at 0.90m bgl due to base of foundation being encountered

Kincardine Court

Foundation Pit Cross Sectional Sketches

FP08



Comments:

Not to scale.

Trial pit edge stable in Made Ground.

Groundwater not encountered.

Further detailed information in log FP08

Terminated at 0.40m bgl due to base of foundation being encountered.

Appendix B Exploratory Hole Logs

- Dynamic Sampling Logs – BH101 and BH103
- Dynamic Sampling Logs and Rotary Core Logs – BH102
- Foundation Pit Logs – FP01 to FP08



Borehole Log

Borehole No.

BH101

Sheet 1 of 1

Project Name: Kincardine Court

Project No.
072071

Co-ords: -

Hole Type
WS

Location: Manchester

Level: 39.16

Scale
1:50

Client: Unite Students

Dates: 17/02/2020 - 18/02/2020

Logged By
PN

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10			0.10	39.06		TARMAC	
		0.40	ES		0.36	38.80		MADE GROUND: Light grey slightly sandy medium to coarse gravel. Sand is fine to medium. Gravel is angular to subangular of limestone with rare angular sandstone cobbles.	
		1.15	ES		0.70	38.46		MADE GROUND: Grey/black slightly sandy fine to coarse gravel with moderate ash content. Sand is medium to coarse. Gravel is angular to subangular of mixed lithologies including brick.	1
		1.20		N=7 (1,2/1,2,2,2)	1.20	37.96		MADE GROUND: Black/brown slightly gravelly slightly sandy clay. Sand is medium to coarse. Gravel is angular to subangular fine to coarse including brick and concrete.	
		1.40	D		1.70	37.46		Soft brown slightly sandy CLAY. Sand is fine.	2
		2.00		N=11 (3,3/2,3,3,3)				Medium dense light brown gravelly fine to coarse SAND. Gravel is subrounded to rounded fine to coarse of mixed lithologies including sandstone.	
		2.20 - 2.50	B						
		3.00		N=35 (7,6/6,8,7,14)					3
		3.30 - 3.40	D		3.16	36.00		Dense red brown fine SAND.	
		3.40 - 3.80	B		3.30	35.86		Stiff red brown slightly gravelly CLAY. Gravel is subrounded to rounded medium to coarse of sandstone.	
		4.00		N=50 (8,4/50 for 120mm)	3.40	35.76		Very dense red brown slightly gravelly clayey fine SAND. Gravel is rounded fine to medium of sandstone.	4
					4.62	34.54		End of borehole at 4.62 m	5
									6
									7
									8
									9
									10

Remarks

Service inspection pit hand excavated from GL to 1.20m. No groundwater encountered. Borehole terminated at 4.62m bgl due to SPT refusal.





Borehole Log

Borehole No.
BH102 (RC)

Sheet 1 of 2

Project Name: Kincardine Court

Project No.
072071

Co-ords: -

Hole Type
WS

Location: Manchester

Level: 39.38

Scale
1:50

Client: Unite Students

Dates: 17/02/2020 - 18/02/2020

Logged By
PN

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20			0.10	39.28		TARMAC	
		0.40			0.36	39.02		MADE GROUND: Light grey slightly sandy fine to coarse gravel. Sand is fine to medium. Gravel is angular to subangular of mixed lithologies including limestone, asphalt and brick.	
					0.60	38.78		MADE GROUND: Black slightly sandy fine to medium gravel with high ash content. Sand is medium to coarse. Gravel is angular to subangular of mixed lithologies including brick, terracotta and concrete.	1
		1.20		N=6 (1,1/1,2,1,2)	1.10	38.28		MADE GROUND: Brown slightly sandy medium to coarse gravel. Gravel is angular to subangular of mixed lithologies including brick.	
		2.00		N=15 (4,3/4,4,3,4)	1.90	37.48		MADE GROUND: Firm brown mottled grey slightly gravelly slightly silty clay. Gravel is angular to subrounded fine to coarse including brick and clinker.	2
		2.40 - 2.70			2.10	37.28		Dense light brown slightly gravelly fine to medium SAND. Gravel is subrounded to rounded fine to coarse of sandstone.	
		3.00		N=27 (5,7/6,7,7,7)	3.00	36.38		Dense reddish brown slightly sandy clayey fine to coarse GRAVEL. Sand is medium to coarse. Gravel is angular to subrounded fine to coarse of sandstone.	3
		3.60 - 3.90			3.58	35.80		Dense light brown slightly gravelly fine to medium SAND. Gravel is subrounded to rounded fine to coarse of sandstone.	
		4.00		N=50 (6,5/50 for 125mm)	4.00	35.38		Dense reddish brown slightly sandy fine to coarse GRAVEL. Sand is medium to coarse. Gravel is angular to subrounded fine to coarse of sandstone.	4
								Very dense red clayey fine to medium SAND. Very weak brownish red medium to coarse grained SANDSTONE.	5
								No recovery	
		5.50		N=50 (5,10/50 for 85mm)				Recovered as non-intact core (RANIC) of red brown sandy subangular gravel and cobbles of sandstone.	6
								No recovery	
								Recovered as non-intact core of red sandy subangular to subrounded gravel of sandstone.	
		7.00		N=50 (9,13/50 for 50mm)	7.00	32.38		Red brown fine grained sandstone recovered as non-intact core of angular gravel.	7
								Weak brownish red medium to coarse grained SANDSTONE.	
								Recovered as non-intact core of red brown subangular to subrounded gravel of sandstone.	
								No recovery	
		8.50		N=50 (25 for 115mm/50 for 80mm)					8
									9
					10.00	29.38		Discon Set 1: extremely closely spaced	10

Continued on next sheet

Remarks

Service inspection pit hand excavated from GL to 1.20m. Groundwater not encountered.





Borehole Log

Borehole No.
BH102 (RC)

Sheet 2 of 2

Project Name: Kincardine Court

Project No.
072071

Co-ords: -

Hole Type
WS

Location: Manchester

Level: 39.38

Scale
1:50

Client: Unite Students

Dates: 17/02/2020 - 18/02/2020

Logged By
PN

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.00		N=50 (25 for 105mm/50 for 40mm)				1 no. discon: incipient fracture extremely closely spaced planar End of borehole at 10.00 m	11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

Service inspection pit hand excavated from GL to 1.20m. Groundwater not encountered.





Rotary Core Log

Borehole No.
BH102 (RC)

Sheet 1 of 2

Project Name: Kincardine Court

Project No.
072071

Co-ords: -

Hole Type
RC

Location: Manchester

Level: 39.38

Scale
1:50

Client: Unite Students

Dates: 17/02/2020 - 18/02/2020

Logged By
PN

Well	Water Strikes	Depth (m)	Type / FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
		0.20					0.10	39.28		TARMAC	
		0.40					0.36	39.02		MADE GROUND: Light grey slightly sandy fine to coarse gravel. Sand is fine to medium. Gravel is angular to subangular of mixed lithologies including limestone, asphalt and brick.	
							0.60	38.78		MADE GROUND: Black slightly sandy fine to medium gravel with high ash content. Sand is medium to coarse. Gravel is angular to subangular of mixed lithologies including brick, terracotta and concrete.	1
							1.10	38.28		MADE GROUND: Brown slightly sandy medium to coarse gravel. Gravel is angular to subangular of mixed lithologies including brick.	
							1.90	37.48		MADE GROUND: Firm brown mottled grey slightly gravelly slightly silty clay. Gravel is angular to subrounded fine to coarse including brick and clinker.	2
		2.40 - 2.70					2.10	37.28		Dense light brown slightly gravelly fine to medium SAND. Gravel is subrounded to rounded fine to coarse of sandstone.	
							3.00	36.38		Dense reddish brown slightly sandy clayey fine to coarse GRAVEL. Sand is medium to coarse. Gravel is angular to subrounded fine to coarse of sandstone.	3
		3.60 - 3.90					3.20	36.18		Dense light brown slightly gravelly fine to medium SAND. Gravel is subrounded to rounded fine to coarse of sandstone.	
							3.58	35.80		Dense reddish brown slightly sandy fine to coarse GRAVEL. Sand is medium to coarse. Gravel is angular to subrounded fine to coarse of sandstone.	4
							4.00	35.38		Very dense red clayey fine to medium SAND. Very weak brownish red medium to coarse grained SANDSTONE.	5
		4.00 - 5.50	NR	15	6	0				No recovery	
			NI							Recovered as non-intact core (RANIC) of red brown sandy subangular gravel and cobbles of sandstone.	
			20							No recovery	
		5.50 - 7.00	NR	35	19	7				Recovered as non-intact core of red sandy subangular to subrounded gravel of sandstone.	6
			8							Red brown fine grained sandstone recovered as non-intact core of angular gravel.	7
			NI				7.00	32.38		Weak brownish red medium to coarse grained SANDSTONE.	
		7.00 - 8.50	12	24	13	0				Recovered as non-intact core of red brown subangular to subrounded gravel of sandstone.	
			NR							No recovery	8
		8.50 - 10.00		41	41	9					9
			17							Discon Set 1: extremely closely spaced	10
							10.00	29.38			

Continued on next sheet

Remarks

Service inspection pit hand excavated from GL to 1.20m. Groundwater not encountered.





Rotary Core Log

Borehole No.
BH102 (RC)

Sheet 2 of 2

Project Name: Kincardine Court	Project No. 072071	Co-ords: -	Hole Type RC
Location: Manchester		Level: 39.38	Scale 1:50
Client: Unite Students		Dates: 17/02/2020 - 18/02/2020	Logged By PN

Well	Water Strikes	Depth (m)	Type / Fl	Coring			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
										1 no. discon: incipient fracture extremely closely spaced planar End of borehole at 10.00 m	11
											12
											13
											14
											15
											16
											17
											18
											19
											20

Remarks
Service inspection pit hand excavated from GL to 1.20m. Groundwater not encountered.





Borehole Log

Borehole No.

BH103

Sheet 1 of 1

Project Name: Kincardine Court

Project No.
072071

Co-ords: -

Hole Type
WS

Location: Manchester

Level: 39.05

Scale
1:50

Client: Unite Students

Dates: 17/02/2020 - 18/02/2020

Logged By
PN

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.15	ES		0.10	38.95		TARMAC	
					0.30	38.75		MADE GROUND: Light brown slightly sandy fine to medium gravel. Sand is medium to coarse. Gravel is angular to subangular including limestone.	
		0.80	ES		0.60	38.45		MADE GROUND: Brown grey slightly sandy fine to coarse gravel with high ash content. Gravel is angular to subangular including sandstone, brick and concrete.	1
		1.20		N=2 (1,0/1,0,0,1)					
		1.40 - 1.80	B					Loose brown clayey slightly gravelly fine to medium SAND. Gravel is subangular to subrounded fine to coarse including sandstone.	
		2.00		N=4 (1,1/1,1,1,1)	1.80	37.25		Dense light brown clayey very sandy fine to coarse GRAVEL. Sand is medium to coarse. Gravel is subrounded to rounded including sandstone.	2
		2.30 - 2.70	B						
		3.00		N=35 (6,5/7,9,10,9)					3
		3.40 - 3.60	B		3.30	35.75		Very dense red fine to medium SAND.	
		4.00		50 (25 for 125mm/50 for 50mm)	4.09	34.96		End of borehole at 4.09 m	4
									5
									6
									7
									8
									9
									10

Remarks

Service inspection pit hand excavated from GL to 1.20m. Groundwater not encountered.





Trial Pit Log

Trialpit No

FP01

Sheet 1 of 1

Project Name: Kincardine Court

Project No.
072071Co-ords: -
Level: 39.14Date
17/02/2020

Location: Manchester

Dimensions
(m):

0.6

Depth
0.90

0.6

Scale
1:50Logged
PN

Client: Unite Students

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.25	38.89		TOPSOIL: Brown slightly sandy clay with rare brick gravel with frequent rootlets. Sand is fine to coarse.	
				0.85	38.29		MADE GROUND: Brown slightly sandy slightly gravelly clay with moderate ash content. Sand is fine to coarse. Gravel is angular to subangular fine to coarse including brick.	
				0.90	38.24		MADE GROUND: Black brown slightly gravelly clay with rare cobbles. Gravel is angular to subangular fine to coarse including brick and slate. Cobbles are angular of slate.	1
							End of pit at 0.90 m	2
								3
								4
								5
								6
								7
								8
								9
								10

Remarks: Hand excavated. Ground level estimated from topographic survey. See corresponding sketch for details of foundations identified.

Stability: Pit remained stable and open throughout.





Trial Pit Log

Trialpit No

FP02

Sheet 1 of 1

Project Name: Kincardine Court

Project No.
072071Co-ords: -
Level: 39.00Date
17/02/2020

Location: Manchester

Dimensions (m): 0.7

Client: Unite Students

Depth
1.20

0.8

Scale
1:50Logged
PN

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.10	38.90		TOPSOIL: Light brown slightly sandy clay with frequent rootlets. Sand is fine.	
							MADE GROUND: Light brown fine to medium sand.	
				0.60	38.40		MADE GROUND: Brown slightly gravelly clay with frequent intact bricks. Gravel is angular to subangular fine to coarse including brick, slate and concrete.	1
				1.20	37.80		End of pit at 1.20 m	2
								3
								4
								5
								6
								7
								8
								9
								10

Remarks: Hand excavated. Ground level estimated from topographic survey. See corresponding sketch for details of foundations identified.

Stability: Pit remained stable and open throughout.





Trial Pit Log

Trialpit No

FP03

Sheet 1 of 1

Project Name: Kincardine Court

Project No.
072071Co-ords: -
Level: 39.10Date
17/02/2020

Location: Manchester

Dimensions
(m):

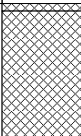
0.6

Depth
0.92

0.5

Scale
1:50Logged
PN

Client: Unite Students

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.05	39.05		MADE GROUND: Light grey medium to coarse gravel. Gravel is angular to subangular of limestone.
				0.92	38.18		MADE GROUND: Brown slightly clayey fine to coarse gravel. Gravel is angular to subangular of mixed lithologies.
							End of pit at 0.92 m
							1
							2
							3
							4
							5
							6
							7
							8
							9
							10

Remarks: Hand excavated. Ground level estimated from topographic survey. See corresponding sketch for details of foundations identified.

Stability: Pit remained stable and open throughout.





Trial Pit Log

Trialpit No

FP04

Sheet 1 of 1

Project Name: Kincardine Court

Project No.
072071Co-ords: -
Level: 39.16Date
17/02/2020

Location: Manchester

Dimensions
(m):

0.6

Client: Unite Students

Depth
0.90

0.6

Scale
1:50Logged
PN

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.05	39.11		CONCRETE FLAGSTONE	
				0.18	38.98		MADE GROUND: Light brown fine sand.	
				0.30	38.86		MADE GROUND: Light grey slightly sandy fine to coarse gravel. Gravel is angular to subangular of limestone.	
				0.90	38.26		MADE GROUND: Brown slightly sandy fine to coarse gravel. Sand is fine to medium. Gravel is angular to subrounded of mixed lithologies.	1
							End of pit at 0.90 m	
								2
								3
								4
								5
								6
								7
								8
								9
								10

Remarks: Hand excavated. Ground level estimated from topographic survey. See corresponding sketch for details of foundations identified.

Stability: Pit remained stable and open throughout.





Trial Pit Log

Trialpit No

FP05

Sheet 1 of 1

Project Name: Kincardine Court

Project No.
072071Co-ords: -
Level: 39.09Date
17/02/2020

Location: Manchester

Dimensions
(m):

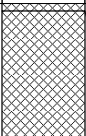
0.5

Depth
0.90

0.5

Scale
1:50Logged
PN

Client: Unite Students

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.05	39.04		MADE GROUND: Light grey medium to coarse gravel. Gravel is angular to subangular of limestone.
				0.90	38.19		MADE GROUND: Brown slightly clayey fine to coarse gravel. Gravel is angular to subangular of mixed lithologies.
							End of pit at 0.90 m
							1
							2
							3
							4
							5
							6
							7
							8
							9
							10

Remarks: Hand excavated. Ground level estimated from topographic survey. See corresponding sketch for details of foundations identified.

Stability: Pit remained stable and open throughout.





Trial Pit Log

Trialpit No

FP06

Sheet 1 of 1

Project Name: Kincardine Court

Project No.
072071Co-ords: -
Level: 39.06Date
17/02/2020

Location: Manchester

Dimensions
(m):

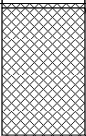
0.6

Depth
0.87

0.55

Scale
1:50Logged
PN

Client: Unite Students

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.03	39.03		MADE GROUND: Light grey medium to coarse gravel. Gravel is angular to subangular of limestone.
				0.87	38.19		MADE GROUND: Brown slightly sandy slightly gravelly clay. Sand is fine to medium. Gravel is angular to subangular fine to coarse including concrete, brick and sandstone.
							End of pit at 0.87 m
							1
							2
							3
							4
							5
							6
							7
							8
							9
							10

Remarks: Hand excavated. Ground level estimated from topographic survey. See corresponding sketch for details of foundations identified.

Stability: Pit remained stable and open throughout.





Trial Pit Log

Trialpit No

FP07

Sheet 1 of 1

Project Name: Kincardine Court

Project No.
072071Co-ords: -
Level: 39.08Date
17/02/2020

Location: Manchester

Dimensions
(m):

0.5

Depth
0.90

0.5

Scale
1:50Logged
PN

Client: Unite Students

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.10	38.98		TARMAC	
							MADE GROUND: Brown slightly sandy slightly gravelly clay. Sand is fine to medium. Gravel is angular to subangular fine to coarse including concrete, brick and sandstone.	
				0.90	38.18		----- End of pit at 0.90 m	1
								2
								3
								4
								5
								6
								7
								8
								9
								10

Remarks: Hand excavated. Ground level estimated from topographic survey. See corresponding sketch for details of foundations identified.

Stability: Pit remained stable and open throughout.



Appendix C Chemical Laboratory Testing Results

- Envirolab, Environmental Chemistry Analysis Results:
 - Soil – Certificate No. 20-01703-1

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 20/01703
Issue Number: 1
Date: 25 February, 2020

Client: Curtins Consulting (Manchester)
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: EBMA/Jonathan Lord/Philippa Neesham
Project Name: Kincardine Court
Project Ref: 072071
Order No: EBMA2287
Date Samples Received: 19/02/20
Date Instructions Received: 20/02/20
Date Analysis Completed: 25/02/20

Prepared by:



Melanie Marshall
Laboratory Coordinator

Approved by:



Danielle Brierley
Client Manager

Envirolab Job Number: 20/01703

Client Project Name: Kincardine Court

Client Project Ref: 072071

Lab Sample ID	20/01703/1	20/01703/2	20/01703/3	20/01703/4	20/01703/5	20/01703/6		Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH101	BH101	BH102	BH102	BH103	BH103				
Depth to Top	0.40	1.15	0.20	0.45	0.15	0.80				
Depth To Bottom										
Date Sampled	17-Feb-20	17-Feb-20	17-Feb-20	17-Feb-20	17-Feb-20	17-Feb-20				
Sample Type	Solid	Soil - ES	Solid	Solid	Solid	Soil - ES				
Sample Matrix Code	7	5AB	7	7	7	5AB				
% Stones >10mm _A	<0.1	4.2	<0.1	<0.1	<0.1	2.4		% w/w	0.1	A-T-044
pH _D ^{M#}	9.42	7.92	9.84	8.82	9.40	7.80		pH	0.01	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	0.10	<0.01	0.04	0.02	0.03	<0.01		g/l	0.01	A-T-026s
Cyanide (total) _A ^{M#}	<1	<1	<1	<1	<1	<1		mg/kg	1	A-T-042sTCN
Phenols - Total by HPLC _A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		mg/kg	0.2	A-T-050s
Organic matter _D ^{M#}	10.1	3.0	5.3	20.0	7.4	5.8		% w/w	0.1	A-T-032 OM
Arsenic _D ^{M#}	15	12	<1	10	5	10		mg/kg	1	A-T-024s
Boron (water soluble) _D ^{M#}	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0		mg/kg	1	A-T-027s
Cadmium _D ^{M#}	0.8	0.6	0.7	1.3	0.8	<0.5		mg/kg	0.5	A-T-024s
Copper _D ^{M#}	27	72	6	21	13	54		mg/kg	1	A-T-024s
Chromium _D ^{M#}	17	15	11	14	12	20		mg/kg	1	A-T-024s
Chromium (hexavalent) _D	<1	<1	<1	<1	<1	<1		mg/kg	1	A-T-040s
Lead _D ^{M#}	25	204	17	28	36	65		mg/kg	1	A-T-024s
Mercury _D	0.77	0.49	0.91	0.59	0.77	0.24		mg/kg	0.17	A-T-024s
Nickel _D ^{M#}	22	16	7	19	11	22		mg/kg	1	A-T-024s
Selenium _D ^{M#}	<1	<1	<1	<1	<1	<1		mg/kg	1	A-T-024s
Zinc _D ^{M#}	34	181	31	73	45	50		mg/kg	5	A-T-024s

Envirolab Job Number: 20/01703

Client Project Name: Kincardine Court

Client Project Ref: 072071

Lab Sample ID	20/01703/1	20/01703/2	20/01703/3	20/01703/4	20/01703/5	20/01703/6		Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH101	BH101	BH102	BH102	BH103	BH103				
Depth to Top	0.40	1.15	0.20	0.45	0.15	0.80				
Depth To Bottom										
Date Sampled	17-Feb-20	17-Feb-20	17-Feb-20	17-Feb-20	17-Feb-20	17-Feb-20				
Sample Type	Solid	Soil - ES	Solid	Solid	Solid	Soil - ES				
Sample Matrix Code	7	5AB	7	7	7	5AB				
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD	NAD	NAD	NAD	NAD	NAD				A-T-045
Asbestos ACM - Suitable for Water Absorption Test? _D	N/A	N/A	N/A	N/A	N/A	N/A				A-T-045

Envirolab Job Number: 20/01703

Client Project Name: Kincardine Court

Client Project Ref: 072071

Lab Sample ID	20/01703/1	20/01703/2	20/01703/3	20/01703/4	20/01703/5	20/01703/6		Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH101	BH101	BH102	BH102	BH103	BH103				
Depth to Top	0.40	1.15	0.20	0.45	0.15	0.80				
Depth To Bottom										
Date Sampled	17-Feb-20	17-Feb-20	17-Feb-20	17-Feb-20	17-Feb-20	17-Feb-20				
Sample Type	Solid	Soil - ES	Solid	Solid	Solid	Soil - ES				
Sample Matrix Code	7	5AB	7	7	7	5AB				
PAH-16MS										
Acenaphthene _A ^{M#}	<0.01	0.04	0.04	0.02	0.07	3.50		mg/kg	0.01	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	<0.01	<0.01	<0.01	<0.01	0.08		mg/kg	0.01	A-T-019s
Anthracene _A ^{M#}	<0.02	0.12	0.08	0.07	0.11	3.49		mg/kg	0.02	A-T-019s
Benzo(a)anthracene _A ^{M#}	0.05	0.52	0.40	0.23	0.51	3.71		mg/kg	0.04	A-T-019s
Benzo(a)pyrene _A ^{M#}	0.07	0.49	0.42	0.25	0.54	2.49		mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	0.07	0.50	0.47	0.27	0.53	2.74		mg/kg	0.05	A-T-019s
Benzo(ghi)perylene _A ^{M#}	<0.05	0.29	0.24	0.14	0.35	0.91		mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	0.21	0.16	0.10	0.20	1.03		mg/kg	0.07	A-T-019s
Chrysene _A ^{M#}	0.09	0.56	0.47	0.26	0.62	3.44		mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	<0.04	0.07	0.06	<0.04	0.09	0.24		mg/kg	0.04	A-T-019s
Fluoranthene _A ^{M#}	<0.08	1.01	0.76	0.43	0.91	11.7		mg/kg	0.08	A-T-019s
Fluorene _A ^{M#}	<0.01	0.02	0.03	0.01	0.06	2.66		mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	<0.03	0.30	0.27	0.16	0.35	1.11		mg/kg	0.03	A-T-019s
Naphthalene _A ^{M#}	<0.03	<0.03	<0.03	<0.03	0.05	2.00		mg/kg	0.03	A-T-019s
Phenanthrene _A ^{M#}	0.04	0.56	0.39	0.20	0.57	17.1		mg/kg	0.03	A-T-019s
Pyrene _A ^{M#}	0.10	1.02	0.75	0.41	0.91	10		mg/kg	0.07	A-T-019s
Total PAH-16MS _A ^{M#}	0.42	5.71	4.54	2.55	5.87	66.2		mg/kg	0.01	A-T-019s

Envirolab Job Number: 20/01703

Client Project Name: Kincardine Court

Client Project Ref: 072071

Lab Sample ID	20/01703/1	20/01703/2	20/01703/3	20/01703/4	20/01703/5	20/01703/6		Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH101	BH101	BH102	BH102	BH103	BH103				
Depth to Top	0.40	1.15	0.20	0.45	0.15	0.80				
Depth To Bottom										
Date Sampled	17-Feb-20	17-Feb-20	17-Feb-20	17-Feb-20	17-Feb-20	17-Feb-20				
Sample Type	Solid	Soil - ES	Solid	Solid	Solid	Soil - ES				
Sample Matrix Code	7	5AB	7	7	7	5AB				
TPH CWG										
Ali >C5-C6 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		mg/kg	0.01	A-T-022s
Ali >C6-C8 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	0.02		mg/kg	0.01	A-T-022s
Ali >C8-C10 _A	<5	<1	<1	1	<5	<5		mg/kg	1	A-T-055s
Ali >C10-C12 _A ^{M#}	<5	<1	<1	<1	<5	<5		mg/kg	1	A-T-055s
Ali >C12-C16 _A ^{M#}	<5	<1	<1	1	<5	<5		mg/kg	1	A-T-055s
Ali >C16-C21 _A ^{M#}	22	1	1	2	7	<5		mg/kg	1	A-T-055s
Ali >C21-C35 _A	1300	12	198	60	634	20		mg/kg	1	A-T-055s
Total Aliphatics _A	1320	13	200	65	641	20		mg/kg	1	A-T-055s
Aro >C5-C7 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		mg/kg	0.01	A-T-022s
Aro >C7-C8 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		mg/kg	0.01	A-T-022s
Aro >C8-C10 _A	7	1	2	3	10	17		mg/kg	1	A-T-055s
Aro >C10-C12 _A ^{M#}	<5	1	<1	2	5	60		mg/kg	1	A-T-055s
Aro >C12-C16 _A	10	6	2	5	10	183		mg/kg	1	A-T-055s
Aro >C16-C21 _A ^{M#}	46	25	7	6	29	374		mg/kg	1	A-T-055s
Aro >C21-C35 _A ^{M#}	812	93	157	54	607	553		mg/kg	1	A-T-055s
Total Aromatics _A	873	125	168	71	662	1190		mg/kg	1	A-T-055s
TPH (Ali & Aro >C5-C35) _A	2190	138	366	136	1300	1210		mg/kg	1	A-T-055s
BTEX - Benzene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		mg/kg	0.01	A-T-022s
BTEX - Toluene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		mg/kg	0.01	A-T-022s
BTEX - m & p Xylene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		mg/kg	0.01	A-T-022s
BTEX - o Xylene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		mg/kg	0.01	A-T-022s
MTBE _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		mg/kg	0.01	A-T-022s

REPORT NOTES

General

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

The results reported herein relate only to the material supplied to the laboratory.

The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.

Analytical results reflect the quality of the sample at the time of analysis only.

Opinions and interpretations expressed are outside the scope of our accreditation.

If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.

A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

Soil chemical analysis:

All results are reported as dry weight (<40°C).

For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.

For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts

All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:

Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:

Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:

Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.

Stones etc. are not removed from the sample prior to analysis.

Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:

1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.

Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.

Secondary Matrix Codes:

A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,

E = contains roots/twigs.

Key:

IS indicates Insufficient Sample for analysis.

US indicates Unsuitable Sample for analysis.

NDP indicates No Determination Possible.

NAD indicates No Asbestos Detected.

N/A indicates Not Applicable.

Superscript # indicates method accredited to ISO 17025.

Superscript "M" indicates method accredited to MCERTS.

Subscript "A" indicates analysis performed on the sample as received.

Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client:	Curtins Consulting (Manchester), Merchant Exchange, 17-19 Whitworth Street , Manchester, UK, M1 5WG	Project No:	20/01703
Project:	Kincardine Court	Date Received:	20/02/2020 (am)
Clients Project No:	072071	Cool Box Temperatures (°C):	9.8

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

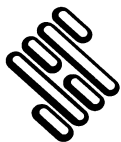
Appendix D Geotechnical Laboratory Testing Results

Soils

- Envirolab, Geotechnical Analysis Results, Test Report 20-01712-1
- Structural Soils Ltd. Test Report, 784377 R1

Rock

- Envirolab, Geotechnical Analysis Results, Test Report 20-01805-1
- Structural Soils Ltd. Test Report, 584232



STRUCTURAL SOILS LTD
TEST REPORT



Report No. 784377 R1

Date 11-March-2020 Contract 20/01712

Client Envirolab Ltd
Address Units 7 & 8 Sandpits Business Park
Mottram Road
Hyde
SK14 3AR

For the Attention of Iain Haslock

Samples submitted by client 20/02/2020
Testing Started 26/02/2020
Testing Completed 11/03/2020

Client Reference 20/01712
Client Order No. P0743099
Instruction Type Written

Tests marked 'Not UKAS Accredited' in this report are not included in the UKAS Accreditation Schedule for our Laboratory.

UKAS Accredited Tests Undertaken

Moisture Content (oven drying method) BS1377:Part 2:1990,clause 3.2
Liquid Limit (one point method) BS1377:Part 2:1990,clause 4.4
Plastic Limit BS1377:Part 2:1990,clause 5.3
Plasticity Index Derivation BS1377:Part 2:1990,clause 5.4
Particle Size Distribution BS1377:Part 2:1990,clause 9.2

* This clause of BS1377 is no longer the most up to date method due to the publication of ISO17892

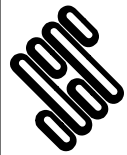
Please Note: Remaining samples will be retained for a period of one month from today and will then be disposed of.
Test were undertaken on samples 'as received' unless otherwise stated.
Opinions and interpretations expressed in this report are outside the scope of accreditation for this laboratory.

Structural Soils Ltd, The Potteries, Pottery Street, Castleford, WF10 1NJ Tel.01977 552255. E-mail luke.fisher@soils.co.uk

SUMMARY OF SOIL CLASSIFICATION TESTS

In accordance with clauses 3.2,4.3,4.4,5.3,5.4,7.2,8.2,8.3 of BS1377:Part 2:1990

Exploratory Position ID	Sample Ref	Sample Type	Depth (m)	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Description of Sample
BH101	20/01712/1	D	1.40	12	33	19	14	74	Brown slightly sandy slightly gravelly CLAY



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SOILS LTD

Contract:

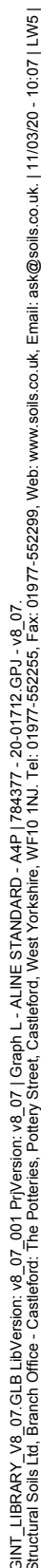
20/01712

Contract Ref:

784377

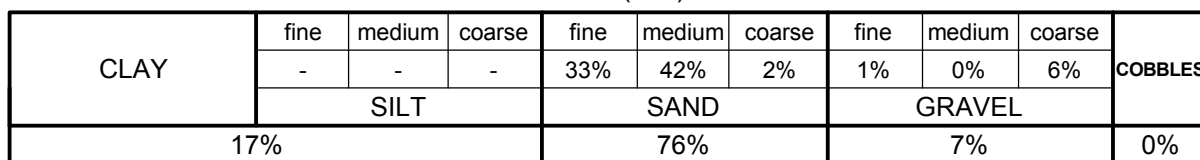


In accordance with BS5930:2015
Testing in accordance with BS1377-2:1990

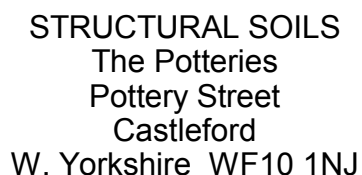


In accordance with clauses 9.2 of BS1377:Part 2:1990

Depth (m): **3.40**



Key: C_U = Uniformity coefficient. C_C = Coefficient of curvature as defined in BS EN ISO 14688-2



Date _____

11/03/20

784377



PARTICLE SIZE DISTRIBUTION TEST

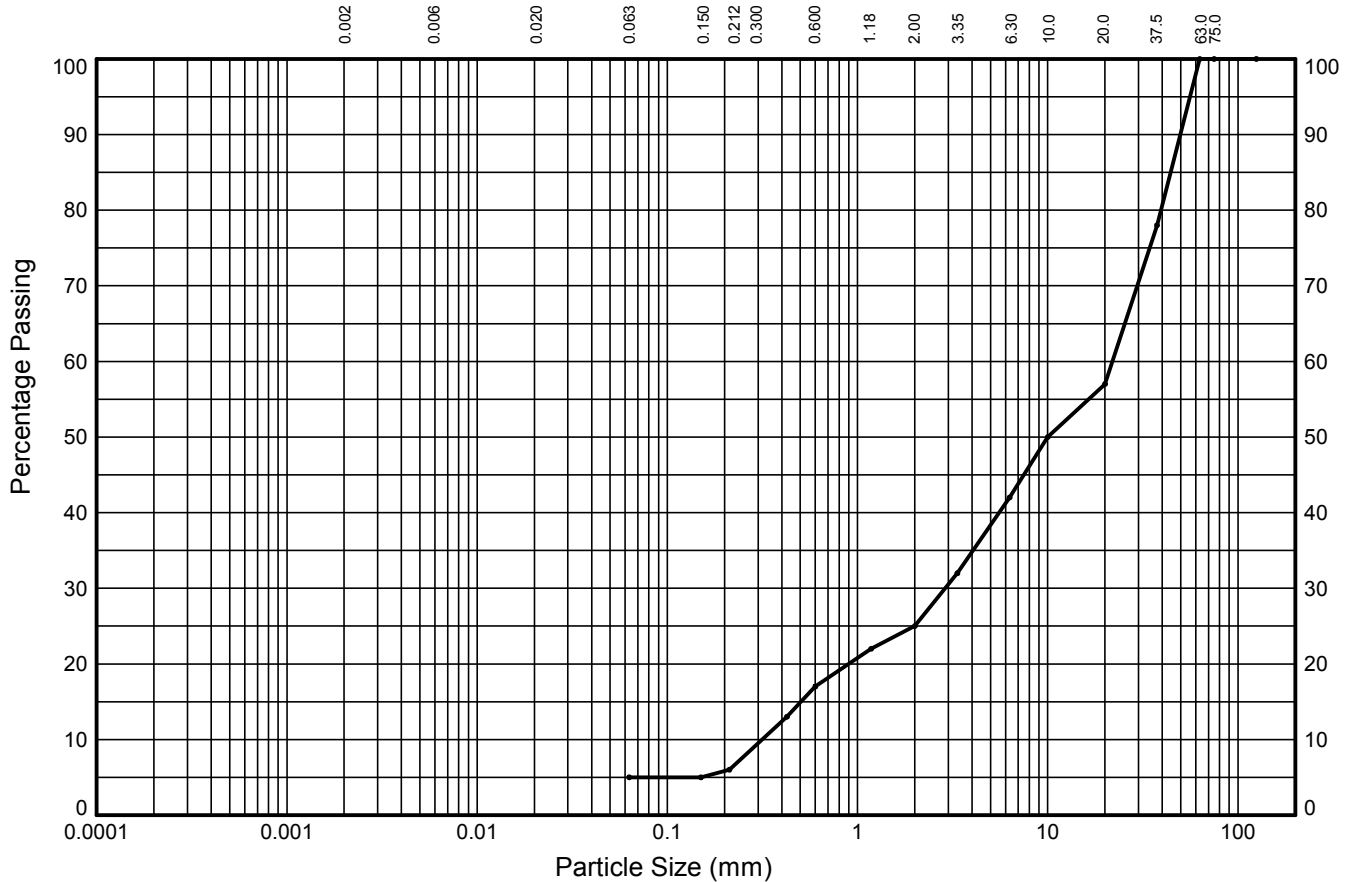
In accordance with clauses 9.2 of BS1377:Part 2:1990

Borehole: **BH102**

Sample Ref: **20/01712/3**

Sample Type: **D**

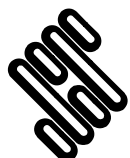
Depth (m): **2.40**



CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	COBBLES
	-	-	-	1%	11%	8%	17%	15%	43%	
	SILT			SAND			GRAVEL			
5%				20%			75%			0%

Test Sieve (mm)	Percent Passing (%)	Particle Diameter (mm)	Percent Passing (%)	Coefficients	
125.0	100			D ₁₀ (mm)	0.315
75.0	100			D ₁₅ (mm)	0.505
63.0	100			D ₃₀ (mm)	2.891
37.5	78			D ₅₀ (mm)	10.000
20.0	57			D ₆₀ (mm)	21.879
10.0	50			D ₈₅ (mm)	44.230
6.30	42			D ₉₀ (mm)	49.765
3.35	32			C _U	69
2.00	25			C _C	1
1.18	22			Sedimentation sample was not pre-treated Soil Description: Brown sandy clayey GRAVEL	
0.600	17				
0.425	13				
0.212	6				
0.150	5				
0.063	5				

Key: C_U = Uniformity coefficient. C_C = Coefficient of curvature as defined in BS EN ISO 14688-2



STRUCTURAL SOILS
The Potteries
Pottery Street
Castleford
W. Yorkshire WF10 1NJ

Compiled By

[Signature]

LORNA WHITWORTH

Date

11/03/20

Contract

20/01712

Contract Ref:

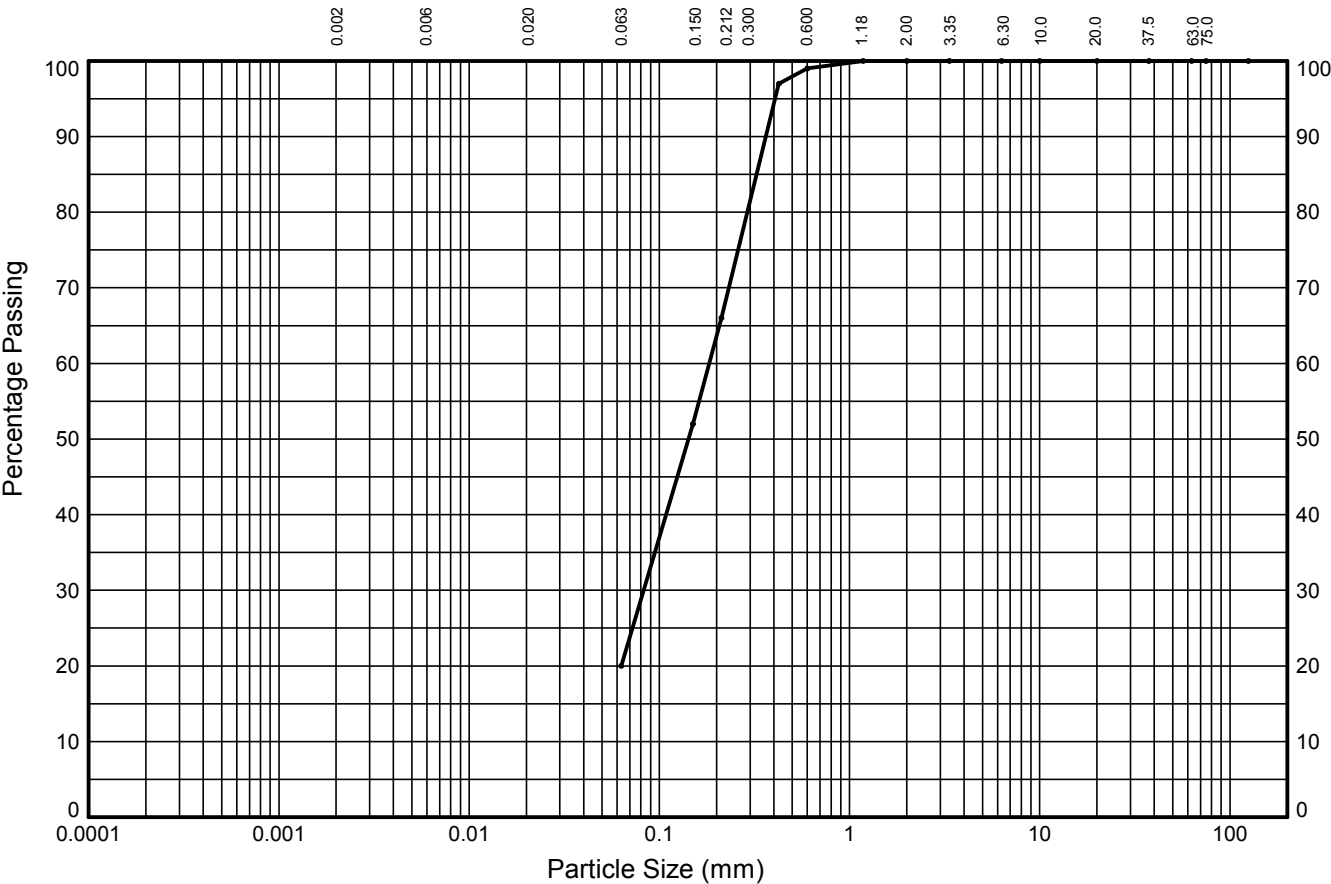
784377



PARTICLE SIZE DISTRIBUTION TEST

In accordance with clauses 9.2 of BS1377:Part 2:1990

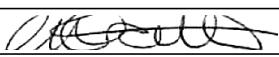
Borehole: **BH102** Sample Ref: **20/01712/4** Sample Type: **D** Depth (m): **3.60**



CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	COBBLES
	-	-	-	43%	36%	1%	0%	0%	0%	
	SILT			SAND			GRAVEL			
20%				80%			0%			0%

Test Sieve (mm)	Percent Passing (%)	Particle Diameter (mm)	Percent Passing (%)	Coefficients	
125.0	100			D ₁₀ (mm)	NA
75.0	100			D ₁₅ (mm)	NA
63.0	100			D ₃₀ (mm)	0.083
37.5	100			D ₅₀ (mm)	0.142
20.0	100			D ₆₀ (mm)	0.183
10.0	100			D ₈₅ (mm)	0.325
6.30	100			D ₉₀ (mm)	0.363
3.35	100			C _U	NA
2.00	100			C _C	NA
1.18	100			Soil Description: Brown red clayey SAND	
0.600	99				
0.425	97				
0.212	66				
0.150	52				
0.063	20				

Key: C_U = Uniformity coefficient. C_C = Coefficient of curvature as defined in BS EN ISO 14688-2

	Compiled By		Date
			11/03/20
	Contract		Contract Ref:
20/01712		784377	



PARTICLE SIZE DISTRIBUTION TEST

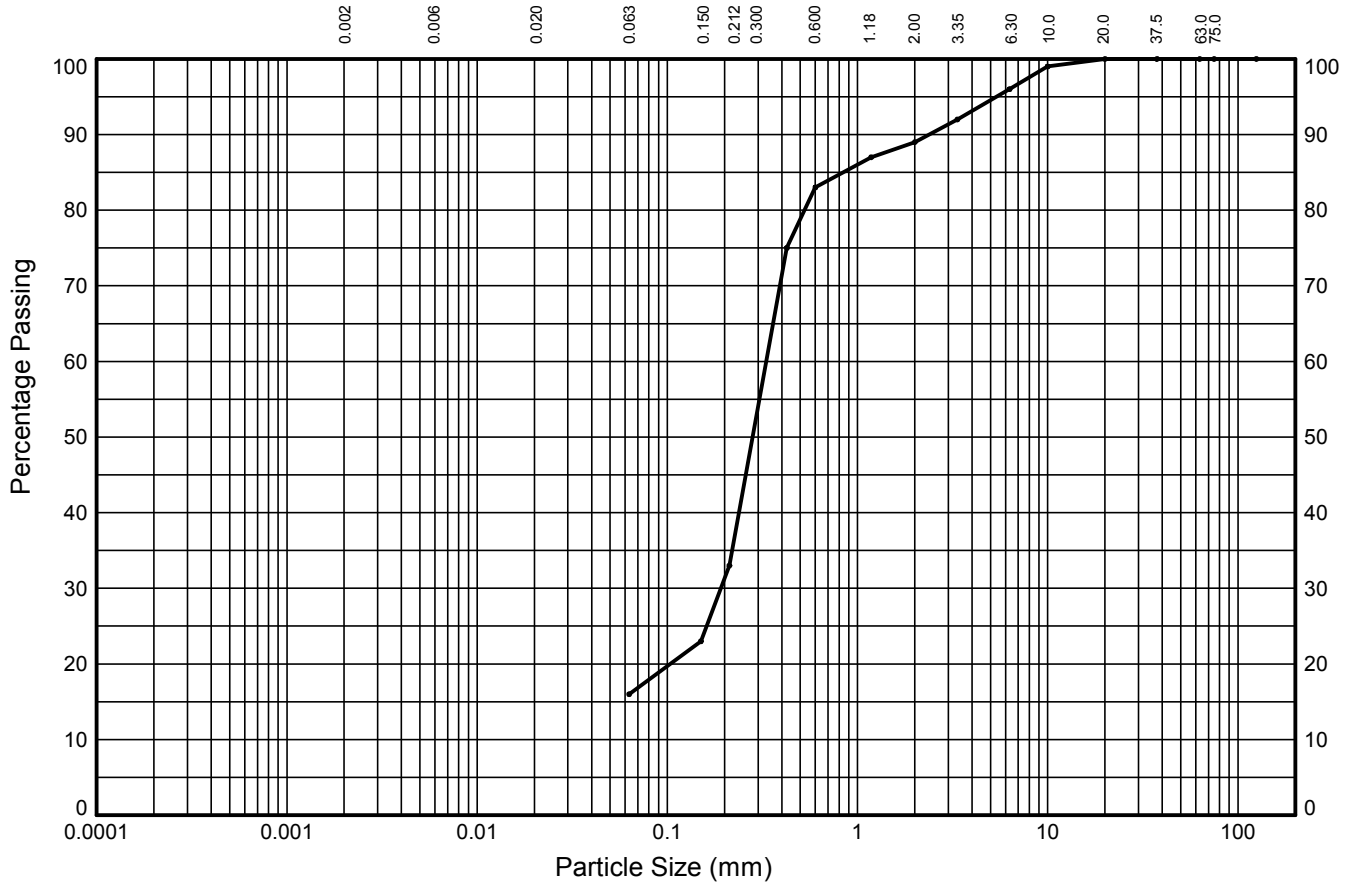
In accordance with clauses 9.2 of BS1377:Part 2:1990

Borehole: **BH103**

Sample Ref: **20/01712/5**

Sample Type: **D**

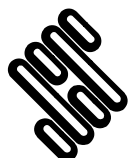
Depth (m): **1.40**



CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	COBBLES
	-	-	-	15%	52%	6%	7%	4%	0%	
	SILT			SAND			GRAVEL			
16%				73%			11%			0%

Test Sieve (mm)	Percent Passing (%)	Particle Diameter (mm)	Percent Passing (%)	Coefficients	
125.0	100			D ₁₀ (mm)	NA
75.0	100			D ₁₅ (mm)	NA
63.0	100			D ₃₀ (mm)	0.191
37.5	100			D ₅₀ (mm)	0.281
20.0	100			D ₆₀ (mm)	0.332
10.0	99			D ₈₅ (mm)	0.841
6.30	96			D ₉₀ (mm)	2.375
3.35	92			C _U	NA
2.00	89			C _C	NA
1.18	87			Sedimentation sample was not pre-treated Soil Description: Brown gravelly clayey SAND	
0.600	83				
0.425	75				
0.212	33				
0.150	23				
0.063	16				

Key: C_U = Uniformity coefficient. C_C = Coefficient of curvature as defined in BS EN ISO 14688-2



STRUCTURAL SOILS
The Potteries
Pottery Street
Castleford
W. Yorkshire WF10 1NJ

Compiled By

[Signature]

LORNA WHITWORTH

Date

11/03/20

Contract

20/01712

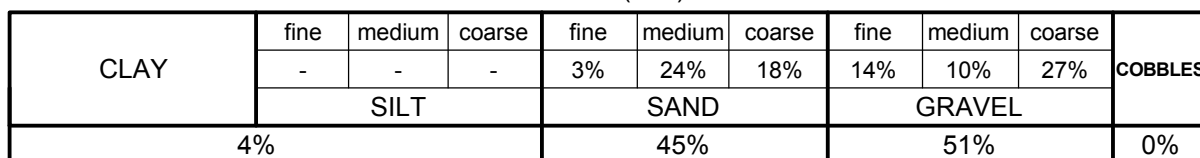
Contract Ref:

784377



In accordance with clauses 9.2 of BS1377:Part 2:1990

Depth (m): **2.30**



Particle Diameter (mm)	Percent Passing (%)
Sedimentation sample was not pre-treated	

Coefficients	
D ₁₀ (mm)	0.252
D ₁₅ (mm)	0.337
D ₃₀ (mm)	0.600
D ₅₀ (mm)	2.217
D ₆₀ (mm)	5.104
D ₈₅ (mm)	32.047
D ₉₀ (mm)	39.311
C _u	20
C _c	0.28

Brown slightly clayey very sandy GRAVEL



Date _____

11/03/20

784377



TESTING VERIFICATION CERTIFICATE



1774

The test results included in this report are certified as:-

ISSUE STATUS: **FINAL**

In accordance with the Structural Soils Ltd Laboratory Quality Management System, results sheets and summaries of results issued by the laboratory are checked by an approved signatory. The integrity of the test data and results are ensured by control of the computer system employed by the laboratory as part of the Software Verification Program as detailed in the Laboratory Quality Manual.

This testing verification certificate covers all testing compiled on or before the following datetime: **11/03/2020 14:07:31**.

Testing reported after this date is not covered by this Verification Certificate.

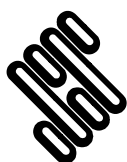
Approved Signatory
Luke Fisher (Materials Laboratory Manager)

(Head Office)
Bristol Laboratory
Unit 1A, Princess Street
Bedminster
Bristol
BS3 4AG

Castleford Laboratory
The Potteries, Pottery Street
Castleford
West Yorkshire
WF10 1NJ

Hemel Laboratory
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Tonbridge Laboratory
Anerley Court, Half Moon Lane
Hildenborough
Tonbridge
TN11 9HU



**STRUCTURAL
SOILS LTD**

Contract:

20/01712

Job No:

784377





STRUCTURAL SOILS LTD

TEST REPORT



Report No. 584232

1774

Date 18-March-2020 Contract B072071

Client Envirolab
Address Units 7-8
Sandpits Business Park
Mottram Road
Hyde
SK14 3AR

For the Attention of Iain Haslock

Samples submitted by client	02-March-2020	Client Reference	20/01805
Testing Started	12-March-2020	Client Order No.	n/a
Testing Completed	17-February-2020	Instruction Type	Written

Tests marked 'Not UKAS Accredited' in this report are not included in the UKAS Accreditation Schedule for our Laboratory.

UKAS Accredited Tests
10.06 Point Load Index ISRM 1974-2006

* This clause of BS1377 is no longer the most up to date method due to the publication of ISO17892

Please Note: Remaining samples will be retained for a period of one month from today and will then be disposed of .
Test were undertaken on samples 'as received' unless otherwise stated.
Opinions and interpretations expressed in this report are outside the scope of accreditation for this laboratory.

Structural Soils Ltd 18 Frogmore Rd Hemel Hempstead HP3 9RT Tel.01442 416661 e-mail dimitris.xirouchakis@soils.co.uk

TESTING VERIFICATION CERTIFICATE



1774

The test results included in this report are certified as:-

ISSUE STATUS: **FINAL**

In accordance with the Structural Soils Ltd Laboratory Quality Management System, results sheets and summaries of results issued by the laboratory are checked by an approved signatory. The integrity of the test data and results are ensured by control of the computer system employed by the laboratory as part of the Software Verification Program as detailed in the Laboratory Quality Manual.

This testing verification certificate covers all testing compiled on or before the following datetime: **18/03/2020 13:38:17**.

Testing reported after this date is not covered by this Verification Certificate.

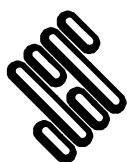
Approved Signatory
Sharon Cairns (Laboratory Manager)

(Head Office)
Bristol Laboratory
Unit 1A, Princess Street
Bedminster
Bristol
BS3 4AG

Castleford Laboratory
The Potteries, Pottery Street
Castleford
West Yorkshire
WF10 1NJ

Hemel Laboratory
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Tonbridge Laboratory
Anerley Court, Half Moon Lane
Hildenborough
Tonbridge
TN11 9HU



**STRUCTURAL
SOILS LTD**

Contract:

Envirolab B072071

Job No:

584232



DETERMINATION OF POINT LOAD STRENGTH

In accordance with ISRM 1974-2006

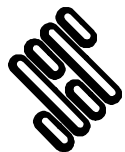
Exploratory Position ID	Sample Ref	Depth (m)	Type of Test	Width or Length (W or L) (mm)	Platen Separation (D) (mm)	Failure Load (P) (kN)	Equivalent Diameter (D _e) (mm)	Point Load (I _s) (MN/m ²)	Size Factor (F)	Point Load Index (I _{s(50)}) (MN/m ²)	Water Content (%)	Rock Type	Lab location
BH102	20/01805/1	6.60	D	60	83	0.344	83	0.05	1.26	0.06 (✓)	10	SANDSTONE	H
BH102	20/01805/1	6.60	A	83	61	0.602	80	0.09	1.24	0.12 (✓)	10	SANDSTONE	H
BH102	20/01805/1	6.60	A	83	50	0.394	73	0.07	1.18	0.09 (✓)	10	SANDSTONE	H

Results

I_s(50) Mean Axial tests = **0.1** MN/m²
I_s(50) Mean Diametral tests = **0.06** MN/m²
I_a(50) Strength Anisotropy Index = **1.62** (calculated from highest and lowest diametral and axial I_s(50) ratio)
Note: Size Correction Factor (F) calculated using $F = (D_e/50)^{0.45}$ (where D_e is equivalent core diameter).

Key

Type of Test column: A = Axial, D = Diametral, I = Irregular, B = Block, L = Parallel, P = Perpendicular, (NS) denotes Non-standard Test.
Point Load Index column: (✓) = included in mean calculations, (✗) = excluded from mean calculations
Lab location: B = Bristol (BS3 4AG), C = Castleford (WF10 1NU), H = Hemel Hempstead (HP3 9RT), T = Tonbridge (TN11 9HU)



STRUCTURAL SOILS
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Compiled By

SC

SHARON CAIRNS

Date

18.03.20

Contract Ref:

584232



Contract:

Envirolab B072071

DETERMINATION OF POINT LOAD STRENGTH

In accordance with ISRM 1974-2006

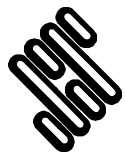
Exploratory Position ID	Sample Ref	Depth (m)	Type of Test	Width or Length (W or L) (mm)	Platen Separation (D) (mm)	Failure Load (P) (kN)	Equivalent Diameter (D _e) (mm)	Point Load (I _s) (MN/m ²)	Size Factor (F)	Point Load Index (I _{s(50)}) (MN/m ²)	Water Content (%)	Rock Type	Lab location
BH102	20/01805/2	6.75	D	52	83	0.236	83	0.03	1.26	0.04 (✓)	12	SANDSTONE	H
BH102	20/01805/2	6.75	A	80	41	0.338	65	0.08	1.12	0.09 (✓)	12	SANDSTONE	H
BH102	20/01805/2	6.75	A	81	43	0.402	67	0.09	1.14	0.10 (✓)	12	SANDSTONE	H

Results

I_s(50) Mean Axial tests = **0.1** MN/m²
I_s(50) Mean Diametral tests = **0.04** MN/m²
I_a(50) Strength Anisotropy Index = **2.25** (calculated from highest and lowest diametral and axial I_s(50) ratio)
Note: Size Correction Factor (F) calculated using $F = (D_e/50)^{0.45}$ (where D_e is equivalent core diameter).

Key

Type of Test column: A = Axial, D = Diametral, I = Irregular, B = Block, L = Parallel, P = Perpendicular, (NS) denotes Non-standard Test.
Point Load Index column: (✓) = included in mean calculations, (✗) = excluded from mean calculations
Lab location: B = Bristol (BS3 4AG), C = Castleford (WF10 1NU), H = Hemel Hempstead (HP3 9RT), T = Tonbridge (TN11 9HU)



STRUCTURAL SOILS
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Compiled By

SC

SHARON CAIRNS

Date

18.03.20

Contract Ref:

584232



Contract:

Envirolab B072071

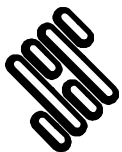
DETERMINATION OF POINT LOAD STRENGTH

In accordance with ISRM 1974-2006

[illegible]

$I_s(50)$ Mean Axial tests = **0.06** MN/m²
 $I_s(50)$ Mean Diametral tests = **0.02** MN/m²
 $I_a(50)$ Strength Anisotropy Index = **3.51** (calculated from highest and lowest diametral and axial $I_s(50)$ ratio)
Note: Size Correction Factor (F) calculated using $F = (D_e/50)^{0.45}$ (where D_e is equivalent core diameter).

Key
Type of Test column: A = Axial, D = Diametral, I = Irregular, B = Block, L = Parallel, P = Perpendicular, [NS] denotes Non-standard Test.
Point Load Index column: (✓) = included in mean calculations, (✗) = excluded from mean calculations
Lab location: B = Bristol (BS3 4AG), C = Castleford (WF10 1NJ), H = Hemel Hempstead (HP3 9RT), T = Tonbridge (TN11 9HU)



STRUCTURAL SOILS
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Compiled By

Date _____

Contract Ref:

56

SHARON CAIRNS

18.03.20

Contract:

Envirolab B072071

584232



DETERMINATION OF POINT LOAD STRENGTH

In accordance with ISRM 1974-2006

[illegible]
$$I_s(50) \text{ Mean Axial tests} = 0.07 \text{ MN/m}^2$$

$I_s(50)$ Mean Diametral tests = **0.07** MN/m²

$I_a(50)$ Strength Anisotropy Index = **1.04** (calculated from highest and lowest diametral and axial $I_s(50)$ ratio)

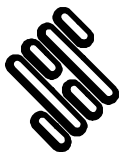
Note: Size Correction Factor (F) calculated using $F = (D_e/50)^{0.45}$ (where D_e is equivalent core diameter).

Key

Type of Test column: A = Axial, D = Diametral, I = Irregular, B = Block, L = Parallel, P = Perpendicular, [NS] denotes Non-standard Test.

Point Load Index column: (✓) = included in mean calculations, (✗) = excluded from mean calculations

Lab location: B = Bristol (BS3 4AG), C = Castleford (WF10 1NJ), H = Hemel Hempstead (HP3 9RT), T = Tonbridge (TN11 9HU)



STRUCTURAL SOILS
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Compiled By

Date _____

Contract Ref:

SHARON CAIRNS

18.03.20

Contract:

Envirolab B072071

584232



FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 20/01712
Issue Number: 1
Date: 11 March, 2020

Client: Curtins Consulting (Manchester)
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: Jonathan Lord/Philippa Neesham
Project Name: Kincardine Court
Project Ref: B072071
Order No: EBMA2288
Date Samples Received: 19/02/20
Date Instructions Received: 20/02/20
Date Analysis Completed: 11/03/20

Prepared by:



Richard Wong
Client Manager

Approved by:



Holly Neary-King
Administration & Client Services Supervisor

Envirolab Job Number: 20/01712

Client Project Name: Kincardine Court

Client Project Ref: B072071

Lab Sample ID	20/01712/1	20/01712/2	20/01712/3	20/01712/4	20/01712/5	20/01712/6		Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH101	BH101	BH102	BH102	BH103	BH103				
Depth to Top	1.40	3.40	2.40	3.60	1.40	2.30				
Depth To Bottom	1.50	3.80	2.70	3.90	1.80	2.70				
Date Sampled	17-Feb-20	17-Feb-20	18-Feb-20	18-Feb-20	18-Feb-20	18-Feb-20				
Sample Type	Solid	Soil - B	Solid	Soil - B	Soil - B	Solid				
Sample Matrix Code	7	4A	7	4A	4A	7				
% Stones >10mm _A	<0.1	6.3	<0.1	<0.1	<0.1	<0.1		% w/w	0.1	A-T-044
pH _D ^{M#}	7.75	8.33	8.98	8.44	7.72	8.28		pH	0.01	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	0.02	<0.01	0.02	<0.01	<0.01	<0.01		g/l	0.01	A-T-026s
1.02 Atterburg 4Pt BS1377 1990 pt2 cl4.4,5.3+5.4 _A [#]	Appended	-	-	-	-	-			1	Subcon SS
1.01 % Moisture BS1377 1990 pt2 cl3.2 _A [#]	Appended	-	-	-	-	-			0.1	Subcon SS
1.10a PSD (Grading/63um/sand fraction/wet sieve) BS1377 pt 2 1990 cl 9.2 _A [#]	-	Appended	Appended	Appended	Appended	Appended			0.1	Subcon SS

REPORT NOTES

General

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

The results reported herein relate only to the material supplied to the laboratory.

The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.

Analytical results reflect the quality of the sample at the time of analysis only.

Opinions and interpretations expressed are outside the scope of our accreditation.

If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.

A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

Soil chemical analysis:

All results are reported as dry weight (<40°C).

For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.

For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts

All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:

Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:

Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:

Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.

Stones etc. are not removed from the sample prior to analysis.

Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:

1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.

Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.

Secondary Matrix Codes:

A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,

E = contains roots/twigs.

Key:

IS indicates Insufficient Sample for analysis.

US indicates Unsuitable Sample for analysis.

NDP indicates No Determination Possible.

NAD indicates No Asbestos Detected.

N/A indicates Not Applicable.

Superscript # indicates method accredited to ISO 17025.

Superscript "M" indicates method accredited to MCERTS.

Subscript "A" indicates analysis performed on the sample as received.

Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client:	Curtins Consulting (Manchester), Merchant Exchange, 17-19 Whitworth Street , Manchester, UK, M1 5WG	Project No:	20/01712
Project:	Kincardine Court	Date Received:	20/02/2020 (am)
Clients Project No:	B072071	Cool Box Temperatures (°C):	10.1

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

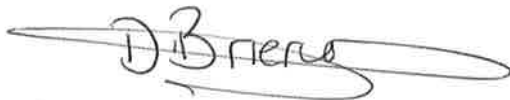
FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 20/01805
Issue Number: 1
Date: 24 March, 2020

Client: Curtins Consulting (Manchester)
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: Philippa Neesham
Project Name: Kincardine Court
Project Ref: B072071
Order No: EBMA2291
Date Samples Received: 21/02/20
Date Instructions Received: 24/02/20
Date Analysis Completed: 23/03/20

Prepared by:



Danielle Brierley
Client Manager

Approved by:



Sophie France
Client Service Manager

Envirolab Job Number: 20/01805

Client Project Name: Kincardine Court

Client Project Ref: B072071

Lab Sample ID	20/01805/1	20/01805/2	20/01805/3	20/01805/4				Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH102	BH102	BH102	BH102						
Depth to Top	6.60	6.75	9.40	9.85						
Depth To Bottom	6.70	6.85	9.55	9.95						
Date Sampled	18-Feb-20	18-Feb-20	18-Feb-20	18-Feb-20						
Sample Type	Solid	Solid	Solid	Solid						
Sample Matrix Code	7	7	7	7						
% Stones >10mm _A	<0.1	<0.1	<0.1	<0.1				% w/w	0.1	A-T-044
pH _D ^{M#}	7.70	7.92	8.01	8.32				pH	0.01	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	<0.01	<0.01	<0.01	<0.01				g/l	0.01	A-T-026s
10.03a Point Load (PL) Index of a Single Specimen (Rock Sample) ISRM SM 1974-2006 _A [#]	Appended	Appended	Appended	Appended						Subcon SS

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TPH analysis of water by method A-T-007:

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Stones etc. are not removed from the sample prior to analysis.

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Subscript "A" indicates analysis performed on the sample as received.

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Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: Curtins Consulting (Manchester), Merchant Exchange, 17-19 Whitworth Street , Manchester, UK, M1 5WG
Project: Kincardine Court
Clients Project No: B072071
Project No: 20/01805
Date Received: 24/02/2020 (am)
Cool Box Temperatures (°C): 10.6, 9.6

Lab Sample ID	20/01805/1	20/01805/2	20/01805/3	20/01805/4
Client Sample No				
Client Sample ID/Depth	BH102 6.60-6.70m	BH102 6.75-6.85m	BH102 9.40-9.55m	BH102 9.85-9.95m
Date Sampled	18/02/20	18/02/20	18/02/20	18/02/20
Deviation Code				
F	✓	✓	✓	✓

Key

F Maximum holding time exceeded between sampling date and analysis for analytes listed below

HOLDING TIME EXCEEDANCES

Lab Sample ID	20/01805/1	20/01805/2	20/01805/3	20/01805/4
Client Sample No				
Client Sample ID/Depth	BH102 6.60-6.70m	BH102 6.75-6.85m	BH102 9.40-9.55m	BH102 9.85-9.95m
Date Sampled	18/02/20	18/02/20	18/02/20	18/02/20
Sulphate (water sol 2:1)	✓	✓	✓	✓

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Appendix E Ground Gas and Groundwater Monitoring Results

- Visits 1 to 6

Curtins

Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG

Tel: 0161 236 2394

Fax: 0161 228 7902



GAS MONITORING LOG SHEET

Project:	Kincardine Court	Date:	27/02/2020
Job Number:	72071	Visit:	1
Client:	Unite Students	Weather:	Sunny
Barometric State:	Rising	Ground Conditions:	Wet

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
BH101													1
BH102	996	0.0	0.0	0.1	0.0	1.2	1.2	18.1	0	0	DRY	2.07	
BH103	994	-0.4	0.0	0.0	0.0	0.8	0.8	17.9	0	0	DRY	3.30	

Notes

1 Unable to open flush cover
 2
 3

Logged by

EM

1% gas volume = 10,000 ppm

Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.

All other gases recorded at 'steady state' unless otherwise stated

GAS MONITORING LOG SHEET

Project:	Kincardine Court	Date:	13/03/2020
Job Number:	72071	Visit:	2
Client:	Unite Students	Weather:	Sunny
Barometric State:	Rising	Ground Conditions:	Dry

[illegible]

Notes

1 Unable to open flush cover

Logged by

EM

1% gas volume = 10,000 ppm

Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.

All other gases recorded at 'steady state' unless otherwise stated

GAS MONITORING LOG SHEET

Project:	Kincardine Court	Date:	27/03/2020
Job Number:	72071	Visit:	3
Client:	Unite Students	Weather:	Sunny
Barometric State:	Steady	Ground Conditions:	Dry

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
BH101													1
BH102	1029	-0.6	-0.3	0.0	0.0	0.9	0.9	20.0	0	0	Dry	2.09	
BH103	1026	-37.4	-37.3	0.0	0.0	1.8	1.7	17.6	0	0	Dry	3.25	2

Notes

- 1 Unable to open flush cover
- 2 No change after 3 minutes
- 3

Logged by

ZH

1% gas volume = 10,000 ppm

Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.

All other gases recorded at 'steady state' unless otherwise stated

GAS MONITORING LOG SHEET

Project:	Kincardine Court	Date:	08/04/2020
Job Number:	72071	Visit:	4
Client:	Unite Students	Weather:	Sunny
Barometric State:	Stead	Ground Conditions:	Sunny

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
BH101	1021												1
BH102		0.0	0.0	0.0	0.0	1.3	1.2	19.7	0	0	Dry	2.10	
BH103		1023	-0.3	0.0	0.0	0.0	2.1	2.1	18.1	0	0	Dry	
									</				

Notes

1 Unable to open flush cover

Logged by

ZH

1% gas volume = 10,000 ppm

Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.

All other gases recorded at 'steady state' unless otherwise stated

GAS MONITORING LOG SHEET

Project:	Kincardine Court	Date:	12/06/2020
Job Number:	72071	Visit:	4
Client:	Unite Students	Weather:	Cloudy
Barometric State:	Falling	Ground Conditions:	Dry

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
BH101	1011												1
BH102		0.0	0.0	0.0	0.0	1.5	1.5	19.2	0	0	DRY	2.08	
BH103		-1.3	0.0	0.0	0.0	3.1	3.1	16.0	0	0	DRY	3.20	

Notes

1	Unable to open flush cover
2	Flow reduced to 0.0 after 30 seconds

Logged by

PN

1% gas volume = 10,000 ppm

Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.

All other gases recorded at 'steady state' unless otherwise stated

GAS MONITORING LOG SHEET

Project:	Kincardine Court	Date:	24/06/2020
Job Number:	72071	Visit:	4
Client:	Unite Students	Weather:	Clear/Warm
Barometric State:	Rising	Ground Conditions:	Dry

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
BH101	1015												1
BH102	1015	0.0	0.0	0.0	0.0	2.4	2.4	19.2	2	0	Dry	2.70	
BH103	1015	0.0	0.0	0.0	0.0	3.4	3.1	17.6	2	5	Dry	3.26	

Notes

1 Unable to open flush cover

Logged by

JL

1% gas volume = 10,000 ppm

Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.

All other gases recorded at 'steady state' unless otherwise stated

Appendix F GAC Screening Thresholds

- Curtins GAC Thresholds

Adopted Soil Generic Assessment Criteria
Sandy loam with 6% SOM



Contaminants	Residential <u>with</u> home grown produce	Residential <u>without</u> home grown produce	Allotments	Commercial	Public open space near residential housing POS _{resi}	Public park POS _{park}
Metals						
Beryllium	1.7	1.7	35	12	2.2	63
Boron	290	11,000	45	240,000	21,000	46,000
Cadmium	10⁽¹³⁾ 22	85⁽¹³⁾ 150	1.8 3.9	230 410	120 220	560 880
Chromium III	910	910	18,000	8,600	1,500	33,000
Chromium VI	6 21	6 21	1.8 170	33 49	7.7 21	220 250
Lead	200	310	80	2,300	630	1,300
Mercury (<i>elemental</i>)	1	1	26	26	16	26⁽⁸⁾ [30]
Mercury (<i>inorganic</i>)	170	240	80	3600	120	240
Nickel	130⁽¹⁰⁾	180⁽¹⁰⁾	53⁽¹¹⁾	980⁽¹⁰⁾	230	800
Vanadium	410	1200	91	9000	2000	5000
Copper	2400	7100	520	68000	12000	44000
Zinc	3700	40000	620	730000	81000	170000
Semi-Metals and non-metals						
Arsenic	32⁽¹²⁾ 37	35⁽¹²⁾ 40	43⁽¹²⁾ 49	640⁽¹²⁾ 640	79 79	170 170
Antimony		550		7500	1500	3300
Selenium	350	600	120	13000	1100	1800
Inorganic chemicals						
Cyanide	34	34	34	34	34	34
Organic contaminants						
<i>Aliphatic risk banded hydrocarbons - TPHCWG method</i>						
EC ₅₋₅ - EC ₆	160	160	3900	12000	600000	180000
EC ₅₋₆ - EC ₈	530	530	13000	40000	620000	320000
EC ₅₋₈ - EC ₁₀	150	150	1700	11000	13000	21000
EC ₁₀₋₁₀ - EC ₁₂	760	770	7300	47000	13000	24000
EC ₁₂₋₁₂ - EC ₁₆	4300	4400	13000	90000	13000	26000
EC ₅₋₁₆ - EC ₃₅	110000	110000	270000	1800000	250000	490000
EC ₃₅₋₃₅ - EC ₄₄	110000	110000	270000	1800000	250000	490000
<i>Aromatic risk banded hydrocarbons - TPHCWG method</i>						
EC ₅₋₅ - EC ₇	300	1400	57	86000	56000	92000
EC ₅₋₇ - EC ₈	660	3900	120	180000	56000	100000
EC ₅₋₈ - EC ₁₀	190	270	51	17000	5000	9300
EC ₁₀₋₁₀ - EC ₁₂	380	1200	74	34000	5000	10000
EC ₁₂₋₁₂ - EC ₁₆	660	2500	130	38000	5000	10000
EC ₅₋₁₆ - EC ₂₁	930	1900	260	28000	3800	7800
EC ₂₁₋₂₁ - EC ₃₅	1700	1900	1600	28000	3800	7900
EC ₃₅₋₃₅ - EC ₄₄	1700	1900	1600	28000	3800	7900
Aliph + Arom EC >44-70	1900	1900	3000	28000	3800	7900
Aromatic						
Benzene	0.33 0.87	1.0 3.3	0.07 0.18	95 98	73 140	110 230
Ethyl benzene	350	840	90	2800⁽⁸⁾ [66000]	2800⁽⁸⁾ [25000]	2800⁽⁸⁾ [27000]
Toluene	610	2700	120	4400⁽⁸⁾ [190000]	4400⁽⁸⁾ [56000]	4400⁽⁸⁾ [100000]
Xylene ⁽⁹⁾	230	290	160	2600⁽⁸⁾ [32000]	2600⁽⁸⁾ [43000]	2600⁽⁸⁾ [31000]
Phenol	420	520	280	3200⁽¹⁴⁾ (38000)	3200⁽¹⁴⁾ (10000)	3200⁽¹⁴⁾ (9300)
Polycyclic Aromatic Hydrocarbons (PAH)						
Naphthalene	13	13	24	1100	4900	3000
Acenaphthylene	920	6000	160	100000	15000	30000
Acenaphthene	1100	6000	200	100000	15000	30000
Fluorene	860	4500	160	71000	9900	20000
Phenanthrene	440	1500	90	23000	3100	6300
Anthracene	11000	37000	2200	540000	74000	150000
Fluoranthene	890	1600	290	23000	3100	6400
Pyrene	2000	3800	620	54000	7400	15000
Benz(a)anthracene	13	15	13	180	29	62
Chrysene	27	32	19	350	57	120
Benzo(b)fluoranthene	3.7	4.0	3.9	45	7.2	16.0
Benzo(k)fluoranthene	100	110	130	1200	190	440
Benzo(a)pyrene	3.0 5.0	3.2 5.3	3.5 5.7	36 77	5.7 10	13 21
Indeno(123cd)pyrene	41	46	39	510	82	180
Dibenzo(ah)anthracene	0.3	0.32	0.43	3.6	0.58	1.4
Benzo(ghi)perylene	350	360	640	4000	640	1600
Chlorinated Aliphatic Hydrocarbons						
Vinyl chloride	0.0014	0.0015	0.0018	0.12	3.5	5.4
Trichloroethene (TCE)	0.075	0.08	0.21	5.7	120	120
1,1,1,2 Tetrachlorethane	6.4	8.2	4.4	560	1400	2100
Tetrachlorethane (PCE)	0.90	0.92	3.6	95	1400	1500
1,1,1 Trichlorethane	39	40	240	3000	140000	100000

Notes

- All values above are in mg/kg
- Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters, numbers in italics are S4ULs, numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters and underlined numbers are C4SLs**
- Soil organic matter (SOM) is assumed to be 6% - DEFAULT VALUE
- Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
- For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalows change to more conservative bungalow setting in computer model
- For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, flat with living spaces changes setting in model accordingly
- For classrooms consider increasing the dust loading factor in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m⁻³
- Based on vapour saturation limit as suggested by EA / [] model value
- Lowest of o-, m- and p-xylene
- Based on comparison of inhalation exposure with inhalation TDI
- Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
- Based on a comparison of oral and dermal soil exposure with oral Index Dose only
- Averaged over and based on lifetime exposure
- Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
- NA: Not applicable

Adopted Soil Generic Assessment Criteria
Sandy loam with 2.5% SOM



Contaminants	Residential <u>with</u> home grown produce	Residential <u>without</u> home grown produce	Allotments	Commercial	Public open space near residential housing POS _{resi}	Public park POS _{park}
Metals						
Beryllium	1.7	1.7	35	12	2.2	63
Boron	290	11,000	45	240,000	21,000	46,000
Cadmium	10⁽¹³⁾ 22	85⁽¹³⁾ 150	1.8 3.9	230 410	120 220	560 880
Chromium III	910	910	18,000	8,600	1,500	33,000
Chromium VI	6 <u>21</u>	6 <u>21</u>	1.8 <u>170</u>	33 <u>49</u>	7.7 <u>21</u>	220 <u>250</u>
Lead	<u>200</u>	<u>310</u>	<u>80</u>	<u>2,300</u>	<u>630</u>	<u>1,300</u>
Mercury (elemental)	1	1	26	26	16	26 ⁽⁸⁾ [30]
Mercury (inorganic)	170	240	80	3600	120	240
Nickel	130 ⁽¹⁰⁾	180 ⁽¹⁰⁾	53 ⁽¹¹⁾	980 ⁽¹⁰⁾	230	800
Vanadium	410	1200	91	9000	2000	5000
Copper	2400	7100	520	68000	12000	44000
Zinc	3700	40000	620	730000	81000	170000
Semi-Metals and non-metals						
Arsenic	32⁽¹²⁾ 37	35⁽¹²⁾ 40	43⁽¹²⁾ 49	640⁽¹²⁾ 640	79 <u>79</u>	170 <u>170</u>
Antimony		550		7500	1500	3300
Selenium	350	600	120	13000	1100	1800
Inorganic chemicals						
Cyanide	34	34	34	34	34	34
Organic contaminants						
<i>Aliphatic risk banded hydrocarbons - TPHCWG method</i>						
EC ₅ - EC ₆	78	78	1700	5900	590000	130000
EC ₆ - EC ₈	230	230	5600	17000	610000	220000
EC ₈ - EC ₁₀	65	65	770	4800	13000	18000
EC ₁₀ - EC ₁₂	330	330	4400	23000	13000	23000
EC ₁₂ - EC ₁₆	2400	2400	13000	82000	13000	25000
EC ₁₆ - EC ₃₅	92000	92000	270000	1700000	250000	480000
EC ₃₅ - EC ₄₄	92000	92000	270000	1700000	250000	480000
<i>Aromatic risk banded hydrocarbons - TPHCWG method</i>						
EC ₅ - EC ₇	140	690	27	46000	56000	84000
EC ₇ - EC ₈	290	1800	51	110000	56000	95000
EC ₈ - EC ₁₀	83	110	21	8100	5000	8500
EC ₁₀ - EC ₁₂	180	590	31	28000	5000	9700
EC ₁₂ - EC ₁₆	330	2300	57	37000	5100	10000
EC ₁₆ - EC ₂₁	540	1900	110	28000	3800	7700
EC ₂₁ - EC ₃₅	1500	1900	820	28000	3800	7800
EC ₃₅ - EC ₄₄	1500	1900	820	28000	3800	7800
Aliph + Arom EC >44-70	1800	1900	2100	28000	3800	7800
<i>Aromatic</i>						
Benzene	0.16	0.49	0.035	50	72	100
Ethyl benzene	150	380	39	1200⁽⁸⁾ [35000]	1200⁽⁸⁾ [24000]	1200⁽⁸⁾ [22000]
Toluene	270	1300	51	1900⁽⁸⁾ [110000]	1900⁽⁸⁾ [56000]	1900⁽⁸⁾ [95000]
Xylene ⁽⁹⁾	98	120	70	1200⁽⁸⁾ [14000]	1200⁽⁸⁾ [42000]	1200⁽⁸⁾ [23000]
Phenol	290	420	140	1500⁽¹⁴⁾ (35000)	1500⁽¹⁴⁾ (10000)	1500⁽¹⁴⁾ (8300)
<i>Polycyclic Aromatic Hydrocarbons (PAH)</i>						
Naphthalene	5.6	5.6	10	460	4900	1900
Acenaphthylene	420	4600	69	97000	15000	30000
Acenaphthene	510	4700	85	97000	15000	30000
Fluorene	400	3800	67	68000	9900	20000
Phenanthrene	220	1500	38	22000	3100	6200
Anthracene	5400	35000	950	540000	74000	150000
Fluoranthene	560	1600	130	23000	3100	6300
Pyrene	1200	3800	270	54000	7400	15000
Benz(a)anthracene	11	14	6.5	170	29	56
Chrysene	22	31	9.4	350	57	110
Benzo(b)fluoranthene	3.3	4.0	2.1	44	7.2	15
Benzo(k)fluoranthene	93	110	75	1200	190	410
Benzo(a)pyrene	2.7	3.2	2	35	5.7	12
Indeno(123cd)pyrene	36	46	21	510	82	170
Dibenzo(ah)anthracene	0.28	0.32	0.27	3.6	0.57	1.3
Benzo(ghi)perylene	340	360	470	4000	640	1500
Chlorinated Aliphatic Hydrocarbons						
Vinyl chloride	0.00087	0.001	0.001	0.077	3.5	5
Trichloroethene (TCE)	0.034	0.036	0.091	2.6	120	91
1,1,1,2 Tetrachlorethane	2.8	3.5	1.9	250	1400	1800
Tetrachlorethane (PCE)	0.39	0.4	1.5	42	1400	1100
1,1,1 Trichlorethane	18	18	110	1300	140000	76000

Notes

- All values above are in mg/kg
- Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters, numbers in italics are S4ULs, numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters and underlined numbers are C4SLs
- Soil organic matter (SOM) is assumed to be 2.5% - DEFAULT VALUE
- Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
- For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalows change to more conservative bungalow setting in computer model
- For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, flat with living spaces changes setting in model accordingly
- For classrooms consider increasing the dust loading factor in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m⁻³
- Based on vapour saturation limit as suggested by EA / [] model value
- Lowest of o-, m- and p-xylene
- Based on comparison of inhalation exposure with inhalation TDI
- Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
- Based on a comparison of oral and dermal soil exposure with oral Index Dose only
- Averaged over and based on lifetime exposure
- Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
- NA: Not applicable

Adopted Soil Generic Assessment Criteria
Sandy loam with 1% SOM



Contaminants	Residential <u>with</u> home grown produce	Residential <u>without</u> home grown produce	Allotments	Commercial	Public open space near residential housing POS _{resi}	Public park POS _{park}
Metals						
Beryllium	1.7	1.7	35	12	2.2	63
Boron	290	11,000	45	240,000	21,000	46,000
Cadmium	10⁽¹³⁾ 22	85⁽¹³⁾ 150	1.8 3.9	230 410	120 220	560 880
Chromium III	910	910	18,000	8,600	1,500	33,000
Chromium VI	6 21	6 21	1.8 170	33 49	7.7 21	220 250
Lead	200	310	80	2,300	630	1,300
Mercury (<i>elemental</i>)	1	1	26	26	16	26⁽⁸⁾ [30]
Mercury (<i>inorganic</i>)	170	240	80	3600	120	240
Nickel	130 ⁽¹⁰⁾	180 ⁽¹⁰⁾	53 ⁽¹¹⁾	980 ⁽¹⁰⁾	230	800
Vanadium	410	1200	91	9000	2000	5000
Copper	2400	7100	520	68000	12000	44000
Zinc	3700	40000	620	730000	81000	170000
Semi-Metals and non-metals						
Arsenic	32⁽¹²⁾ 37	35⁽¹²⁾ 40	43⁽¹²⁾ 49	640⁽¹²⁾ 640	79 79	170 170
Antimony		550		7500	1500	3300
Selenium	350	600	120	13000	1100	1800
Inorganic chemicals						
Cyanide	34	34	34	34	34	34
Organic contaminants						
<i>Aliphatic risk banded hydrocarbons - TPHCWG method</i>						
EC ₅₋₅ - EC ₆	42	42	730	3200	570000	95000
EC ₆₋₆ - EC ₈	100	100	2300	7800	600000	150000
EC ₈₋₈ - EC ₁₀	27	27	320	2000	13000	14000
EC ₁₀₋₁₀ - EC ₁₂	130	130	2200	9700	13000	21000
EC ₁₂₋₁₂ - EC ₁₆	1100	1100	11000	59000	13000	25000
EC ₁₆₋₁₆ - EC ₃₅	65000	65000	260000	1600000	250000	450000
EC ₃₅₋₃₅ - EC ₄₄	65000	65000	260000	1600000	250000	450000
<i>Aromatic risk banded hydrocarbons - TPHCWG method</i>						
EC ₅₋₅ - EC ₇	70	370	13	26000	56000	76000
EC ₇₋₇ - EC ₈	130	860	22	56000	56000	87000
EC ₈₋₈ - EC ₁₀	34	47	8.6	3500	5000	7200
EC ₁₀₋₁₀ - EC ₁₂	74	250	13	16000	5000	9200
EC ₁₂₋₁₂ - EC ₁₆	140	1800	23	36000	5100	10000
EC ₁₆₋₁₆ - EC ₂₁	260	1900	46	28000	3800	7600
EC ₂₁₋₂₁ - EC ₃₅	1100	1900	370	28000	3800	7800
EC ₃₅₋₃₅ - EC ₄₄	1100	1900	370	28000	3800	7800
Aliph + Arom EC >44-70	1600	1900	1200	28000	3800	7800
Aromatic						
Benzene	0.08	0.3	0.017	28	72	90
Ethyl benzene	65	170	16	520⁽⁸⁾ [17000]	520⁽⁸⁾ [24000]	520⁽⁸⁾ [17000]
Toluene	120	610	22	860⁽⁸⁾ [59000]	860⁽⁸⁾ [56000]	860⁽⁸⁾ [87000]
Xylene ⁽⁹⁾	41	53	28	480⁽⁸⁾ [69000]	480⁽⁸⁾ [41000]	480⁽⁸⁾ [17000]
Phenol	180	310	66	760⁽¹⁴⁾ (31000)	760⁽¹⁴⁾ (10000)	760⁽¹⁴⁾ (7600)
Polycyclic Aromatic Hydrocarbons (PAH)						
Naphthalene	2.3	2.3	4.1	190	4900	1200
Acenaphthylene	170	2900	28	83000	15000	29000
Acenaphthene	210	3000	34	84000	15000	29000
Fluorene	170	2800	27	63000	9900	20000
Phenanthrene	95	1300	15	22000	3100	6200
Anthracene	2400	31000	380	520000	74000	150000
Fluoranthene	280	1500	52	23000	3100	6300
Pyrene	620	3700	110	54000	7400	15000
Benz(a)anthracene	7.2	11	2.9	170	29	49
Chrysene	15	30	4.1	350	57	93
Benzo(b)fluoranthene	2.6	3.9	0.99	44	7.1	13
Benzo(k)fluoranthene	77	110	37	1200	190	370
Benzo(a)pyrene	2.2	3.2	0.97	35	5.7	11
Indeno(123cd)pyrene	27	45	9.5	500	82	150
Dibenzo(ah)anthracene	0.24	0.31	0.14	3.5	0.57	1.1
Benzo(ghi)perylene	320	360	290	3900	640	1400
Chlorinated Aliphatic Hydrocarbons						
Vinyl chloride	0.00064	0.00077	0.00055	0.059	3.5	4.8
Trichloroethene (TCE)	0.016	0.017	0.041	1.2	120	70
1,1,1,2 Tetrachlorethane	1.2	1.5	0.79	110	1400	1500
Tetrachlorethane (PCE)	0.18	0.18	0.65	19	1400	810
1,1,1 Trichlorethane	8.8	9	48	660	140000	57000

Notes

- All values above are in mg/kg
- Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters, numbers in italics are S4ULs, numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters and underlined numbers are C4SLs
- Soil organic matter (SOM) is assumed to be 1% - DEFAULT VALUE
- Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
- For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalows change to more conservative bungalow setting in computer model
- For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, flat with living spaces changes setting in model accordingly
- For classrooms consider increasing the dust loading factor in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m⁻³
- Based on vapour saturation limit as suggested by EA / [] model value
- Lowest of o-, m- and p-xylene
- Based on comparison of inhalation exposure with inhalation TDI
- Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
- Based on a comparison of oral and dermal soil exposure with oral Index Dose only
- Averaged over and based on lifetime exposure
- Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
- NA: Not applicable

Appendix G Risk Assessment Methodology

The site-specific risk assessment, presented in this report, follows the principle of establishing whether there is a viable linkage between a contaminant source to a potential receptor, via an exposure pathway.

The risk assessment corresponds with the total site area and incorporates both descriptive (qualitative) and, where available, numerical (quantitative) lines of evidence.

Risk assessment is the process of collating known information on a hazard or set of hazards to estimate actual or potential risk to receptors. The receptor may be humans, a water resource, a sensitive local ecosystem or future construction materials. Receptors can be connected to the source by one or several exposure pathways such as direct contact for example. Risks are generally managed by isolating the receptor or intercepting the exposure pathway or by isolating or removing the hazard.

Without the three essential components of a source, pathway and receptor there can be no risk. Therefore, the presence of contaminant source on a site does not necessarily mean there is a risk.

The risk assessment considers the likelihood of an event taking place (accounting for the presence of the source and receptor and the viability of the exposure pathway) in conjunction with the severity of the potential consequence (accounting for the potential severity of the hazard and the sensitivity of the receptor).

In the risk assessment, the consequence of the hazard has been classified as severe or medium or mild or minor and the probability (likelihood) of the circumstances occurring classified as high likelihood or likely or low likelihood or unlikely.

The consequences and probabilities are subsequently cross-correlated to give a qualitative estimation of the risk using Department of the Environment risk classifications as detailed in the table below and as referenced in CIRIA C552.

		Consequence			
		Severe	Medium	Mild	Minor
Probability (Likelihood)	High Likelihood	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	Likely	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/Low Risk	Low Risk	Very Low Risk	Very Low Risk

Ground Investigation

In accordance with DoE guidance, the following categorisation of **consequence** has been developed.

Classification	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resource. Catastrophic damage to buildings/property. A short-term risk to an ecosystem or organisation forming part of such ecosystem.	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied).
Medium	Chronic damage to Human Health. Pollution of sensitive water resources. A significant change in an ecosystem or organism forming part of such ecosystem.	Concentration of a contaminant from site exceeds the generic or site-specific assessment criteria. Leaching of contaminants from a site to a Principal or Secondary A aquifer. Death of a species within a designated nature reserve. Lesser toxic and asphyxiate effects
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services. Damage to sensitive buildings/structures/services or the environment.	Pollution of non-classified groundwater (inc. Secondary B aquifers). Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing, etc). Easily repairable effects of damage to buildings, structures and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discoloration of concrete.

Ground Investigation

In accordance with DoE guidance, the following categorisation of **probability** has been developed.

Classification	Definition
High Likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low Likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place and is less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

In accordance with DoE guidance, the following categorisation of **risk** has been developed.

Classification	Definition
Very High Risk	There is a <i>high probability</i> that <i>severe harm</i> could arise to a designated receptor from an identified hazard at the site without appropriate further action.
High Risk	<i>Harm is likely to arise</i> to a designated receptor from an identified hazard at the site without appropriate further action.
Moderate Risk	<i>It is possible</i> that without appropriate further action <i>harm could arise</i> to a designated receptor. It is relatively <i>unlikely</i> that any such harm would be <i>severe</i> , and if any harm were to occur it is <i>more likely</i> that such harm would be <i>relatively mild</i> .
Low Risk	<i>It is possible</i> that <i>harm could arise</i> to a designated receptor from an identified hazard. It is <i>likely</i> that, at worst, if any harm was realised any effects would be <i>mild</i> .
Very Low Risk	The presence of an identified hazard does not give rise to the potential to cause harm to a designated receptor.

The term 'risk' in this instance refers to the risk that the source, pathway, receptor linkage for a given source of contamination is complete. It does not refer to immediate risk to individuals or features present on the site from potential contaminants and is intended to be used as a tool to assess the necessity of further investigation.

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