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GEO-ENVIRONMENTAL & GEOTECHNICAL ASSESSMENT (GROUND INVESTIGATION) REPORT

146-150 ROYAL COLLEGE STREET, LONDON NW1 0TA

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EXECUTIVE SUMMARY

Cumbrae Properties (1963) Limited commissioned Jomas Associates Ltd to undertake a Geo-environmental and Geotechnical ground investigation at the site located at 146-150 Royal College Street, London NW1 0TA.

The principal objectives of the study were as follows:

- To determine the nature and where possible, the extent of contaminants potentially present at the site;
- To establish the presence of significant pollutant linkages, in accordance with the procedures set out within the Environment Agency (EA) report R&D CLR11 and relevant guidance within the National Planning Policy Framework (NPPF);
- To assess whether the site is safe and suitable for the purpose for which it is intended, or can be made so by remedial action; and,
- To obtain geotechnical parameters to inform preliminary foundation design.

It should be noted that the table below is an executive summary of the findings of this report and is for briefing purposes only. Reference should be made to the main report for detailed information and analysis.

Site History and Ground Investigation	
Current Site Use	Private Car Parking.
Proposed Site Use	The proposed development includes site clearance and the construction of a 4-storey commercial development. No areas of soft landscaping are anticipated.
Desk Study Overview	A Desk Study report has been produced for the site and issued separately (Jomas – 2019). A brief overview of the desk study findings is presented below. Reference should be made to the full report for detailed information. A review of earliest available (1873) historical maps indicates that the site was comprised of 2 No. tenement style buildings. Along the eastern boundary a building linked to "Eagle Wharf" appears to intrude into the site. By 1891 these are labelled "Stable" and "Forage Warehouse". Grand Union/Regents Canal is located directly to the north of the study site. No changes occur on site up to the map dated 1965, when the site is cleared of features. By 1982 a small rectangular structure is noted in the north western section of the site, however no major changes then occur up to present day. The surrounding area has a history of light industry with a number of wharfs located within 100m of the site boundary. Eagle Wharf, located ca 50m southeast of the site, was potentially infilled by the 1960's. Other forms of historical industry noted within the vicinity of the site include a council depot, electricity board depot, a power generating station, builders' yard and joineries. The British Geological Survey indicates that the site is directly underlain solid deposits of the London Clay Formation, identified as an Unproductive aquifer. No artificial deposits are reported within the site. There are no artificial deposits within the site area. The underlying solid deposits of the London Clay Formation are identified as Unproductive. A review of the EnviroInsight Report indicates that there are no source protection zones within 500m of the site. There are no groundwater surface water or potable water abstractions reported within 1km of the site. The nearest detailed river entry is Grand Union/Regents Canal located directly to the north of the study site.

Site History and Ground Investigation	
	There are no Environment Agency Zone 2 or 3 floodplains reported within 250m of the site.
Intrusive Investigation	The ground investigation was undertaken on 02 December 2019, 03 December 2019 and 18 January 2020, and consisted of the following: • 1No. light cable percussive borehole, drilled up to 20.45m below ground level (bgl), with associated in situ testing and sampling; • 3No Windowless sampling boreholes, drilled to up to 6.00m bgl. with associated in situ testing and sampling; • 5No hand trial pits, of which 4No were to determine current foundations found on site.
Ground Conditions	The results of the ground investigation revealed a ground profile comprising a variable thickness of Made Ground (up to 1.9m bgl depth), overlying a stiff to very stiff brown clay (considered to represent the London Clay Formation), encountered to the base of the borehole (up to 20.45m bgl). The base of this deposit was not proven. Groundwater was not encountered during the ground investigation.
Environmental Considerations	Following generic risk assessments none of the determinands analysed were found to exceed their respective criteria. Asbestos was reported within 3No sample of 4No samples analysed. Quantification results indicated a maximum of 0.001% total asbestos within sample WS3 at 0.25m bgl. BH2 at 0.25m bgl and WS1 at 0.50m bgl both reported <0.001% totals asbestos in samples. The site proposal indicates that the site will remain covered by a combination of the proposed building footprint and hard surfacing. Where this is the case, no formal remedial measures are considered necessary in terms of human health, as the building and hard surfacing are expected to provide a barrier to potential receptors. Although no soft landscaping is envisioned, if alternations are made to the final design to include these features, it would be prudent to make an allowance for soft landscaping to be provided in isolated raised planters or to replace Made Ground with approximately 600mm of imported clean topsoil, placed on a membrane. A significant risk of pollution to controlled waters has not been identified during the desk study phase. Following a programme of gas monitoring and risk assessment, the site has been assigned as a gas characteristic situation 1, where no formal gas protection measures are considered necessary. Upgraded potable water supply pipes are likely to be required, which should be confirmed with the relevant service provider. As with any ground investigation, the presence of further hotspots between sampling points cannot be ruled out, and caution must be exercised during construction works. Should any contamination be encountered, a suitably qualified environmental consultant should be informed immediately, so that adequate measures may be recommended.
Geotechnical Considerations	It is considered that traditional strip/trench-fill footings of 1m breadth formed at a minimum depth of 1.5mbgl within the underlying London Clay Formation could be designed with an allowable bearing capacity of 105kPa. Total and differential settlements should be contained within tolerable limits. Foundations must be deepened and founded beneath any Made Ground (locally encountered to a maximum depth of 1.9m) and where building near existing or proposed trees in accordance with NHBC Standards, Chapter 4.2, for soils of high volume change potential.

Site History and Ground Investigation	
	As soils of high-volume change potential are present, heave precautions will be required against the side of foundations and ground beams in accordance with the requirements set out in NHBC Standards Chapter 4.2. Alternatively, if greater bearing capacities are required, a piled foundation solution is recommended. Indicative pile carrying capacities are provided herein. Suspended floor slabs are recommended due to the presence of shrinkable soils and due to the depths of Made Ground encountered. Groundwater was not encountered during the drilling process. Any potential groundwater encountered during construction works should be addressed by conventional pumping from a sump. Excavations during the intrusive works, although open for a relatively short period of time remained reasonably stable. However, it is recommended that the stability of all excavations should be assessed during construction. The sides of any excavations into which personnel are required to enter should be assessed and battered back to a safe angle. Based on the results of chemical testing, the required concrete class for the site is DS-1 assuming an Aggressive Chemical Environment for Concrete classification of AC-1 in accordance with the procedures outlined in BRE Special Digest 1. Results from SD-1 concrete class analysis for deeper clays indicates a concrete class of DS-4 assuming an Aggressive Chemical Environment for Concrete classification of AC-3
Recommended Further Work	The following works are recommended: • Seek approval of the Generic Quantitative Risk Assessment from the Local Authority, NHBC and other relevant stakeholders; • Seek confirmation of the water supply pipe requirements by the appropriate service provider.

1 INTRODUCTION

1.1 Terms of Reference

1.1.1 Cumbrae Properties (1963) Limited ("The Client") has commissioned Jomas Associates Ltd, to assess the risk of contamination posed by the ground conditions at a site referred to as 146-150 Royal College Street, London NW1 0TA and to provide indicative recommendations for foundation design prior to the redevelopment of the site.

1.1.2 To this end a Desk Study has been produced for the site and issued separately (Jomas, September 2019), followed by an intrusive investigation (detailed in this report).

1.1.3 A full list of previous reports undertaken for the site by Jomas are detailed in Table 1.1:

Table 1.1: Previous Reports - Jomas

Title	Author	Reference	Date
Desk Study/Preliminary Risk Assessment Report for 146-150 Royal College Street, London NW1 0TA	Jomas Associates Ltd	P2478J1873/AJH v1.0	26/11/2019

1.1.4 The intrusive investigation was undertaken in accordance with Jomas proposal dated 22 October 2019.

1.2 Proposed Development

1.2.1 The proposed development includes site clearance and the construction of a 4-storey commercial development. No areas of soft landscaping are anticipated.

1.2.2 For the purposes of the contamination risk assessment, the proposed development is classified as 'Commercial'.

1.2.3 For the purpose of geotechnical assessment, it is considered that the project could be classified as a Geotechnical Category (GC) 2 site in accordance with BS EN 1997. GC 2 projects are defined as involving:

- Conventional structures.
- Quantitative investigation and analysis.
- Normal risk.
- No difficult soil and site conditions.
- No difficult loading conditions.
- Routine design and construction methods.

1.3 Objectives

1.3.1 The objectives of Jomas' investigation were as follows:

- To conduct an intrusive investigation, to determine the nature and extent of contaminants potentially present at the site;
- To establish the presence of significant pollutant linkages, in accordance with the procedures set out within Part IIA of the Environmental Protection Act 1990, associated statutory guidance and current best practice including the EA report R&D CLR 11; and,
- To obtain geotechnical parameters to inform preliminary foundation design.

1.4 Scope of Works

1.4.1 The following tasks were undertaken to achieve the objectives listed above:

- Intrusive ground investigation to determine shallow ground conditions, and potential for contamination at the site;
- Undertaking of laboratory chemical and geotechnical testing upon samples obtained;
- The compilation of this report, which collects and discusses the above data, and presents an assessment of the site conditions, conclusions and recommendations.

1.5 Supplied Documentation

1.5.1 Jomas Associates have not been supplied with any previously produced reports at the time of writing this report.

1.6 Limitations

1.6.1 Jomas Associates Ltd has prepared this report for the sole use of Cumbrae Properties (1963) Limited, in accordance with the generally accepted consulting practices and for the intended purposes as stated in the agreement under which this work was completed. This report may not be relied upon by any other party without the explicit written agreement of Jomas Associates Limited. No other third party warranty, expressed or implied, is made as to the professional advice included in this report. This report must be used in its entirety.

1.6.2 The records search was limited to information available from public sources; this information is changing continually and frequently incomplete. Unless Jomas Associates Limited has actual knowledge to the contrary, information obtained from public sources or provided to Jomas Associates Limited by site personnel and other information sources, have been assumed to be correct. Jomas Associates Limited does not assume any liability for the misinterpretation of information or for items not visible, accessible or present on the subject property at the time of this study.

1.6.3 Whilst every effort has been made to ensure the accuracy of the data supplied, and any analysis derived from it, there may be conditions at the site that have not been disclosed by the investigation, and could not therefore be taken into account. As with any site, there may be differences in soil conditions between exploratory hole positions. Furthermore, it should be noted that groundwater conditions may vary due to seasonal and other effects and may at times be significantly different from those measured by the investigation. No liability can be accepted for any such variations in these conditions.

1.6.4 Any reports provided to Jomas Associates Limited have been reviewed in good faith. Jomas Associates Limited cannot be held liable for any errors or omissions in these reports, or for any incorrect interpretation contained within them.

1.6.5 This investigation and report has been carried out in accordance with the relevant standards and guidance in place at the time of the works. Future changes to these may require a re-assessment of the recommendations made within this report.

1.6.6 ***This report is not an engineering design and the figures and calculations contained in the report should be used by the Structural Engineer, taking note that variations may apply, depending on variations in design loading, in techniques used, and in site conditions. Our recommendations should therefore not supersede the Engineer's design.***

2 SITE SETTING

2.1 Site Information

2.1.1 The site location plan is appended to this report in Figure 1, Appendix 1.

Table 2.1: Site Information

Name of Site	-
Address of Site	146-150 Royal College Street London NW1 0TA
Approx. National Grid Ref.	529285,184069
Site Area (Approx)	0.0249ha
Site Occupation	Car park linked to neighbouring commercial development
Local Authority	London Borough of Camden
Proposed Site Use	Site clearance and construction of 4-storey commercial development.

2.2 Desk Study Overview

2.2.1 A Desk Study report has been produced for the site and issued separately (Jomas – 2019). A brief overview of the desk study findings is presented below. Reference should be made to the full report for detailed information.

2.2.2 A review of earliest available (1873) historical maps indicates that the site was comprised of 2 No. tenement style buildings. Along the eastern boundary a building linked to "Eagle Wharf" appears to intrude into the site. By 1891 these are labelled "Stable" and "Forage Warehouse". Grand Union/Regents Canal is located directly to the north of the study site. No changes occur on site up to the map dated 1965, when the site is cleared of features. By 1982 a small rectangular structure is noted in the north western section of the site, however no major changes then occur up to present day.

2.2.3 The surrounding area has a history of light industry with a number of wharfs located within 100m of the site boundary. Eagle Wharf, located ca 50m southeast of the site, was potentially infilled by the 1960's. Other forms of historical industry noted within the vicinity of the site include a council depot, electricity board depot, a power generating station, builders' yard and joineries.

2.2.4 The British Geological Survey indicates that the site is directly underlain solid deposits of the London Clay Formation, identified as an Unproductive aquifer. No artificial deposits are reported within the site.

2.2.5 There are no artificial deposits within the site area.

2.2.6 The underlying solid deposits of the London Clay Formation are identified as Unproductive.

2.2.7 A review of the EnviroInsight Report indicates that there are no source protection zones within 500m of the site.

2.2.8 There are no groundwater surface water or potable water abstractions reported within 1km of the site.

2.2.9 The nearest detailed river entry is Grand Union / Regents Canal located directly to the north of the study site.

2.2.10 There are no Environment Agency Zone 2 or 3 floodplains reported within 250m of the site.

2.2.11 An intrusive investigation was recommended to confirm the preliminary geo-environmental risks identified and to provide geotechnical information for use in design.

2.2.12 The investigation should assess the thickness of any Made Ground, and allow samples of made ground and natural soils to be taken for laboratory analysis.

2.2.13 Soil gas monitoring should be undertaken in accordance with CIRIA C665.

2.2.14 The conceptual site model is reproduced in Table 2.2 overleaf.

Table 2.2: Preliminary Risk Assessment for the Site

Sources	Pathways (P)	Receptors	Consequence of Impact	Probability of Impact	Risk Estimation	Hazard Assessment
• Potential for contaminated ground associated with previous site use – on site (S1) - Wharf • Current and previous industrial use – on and off site (S2) - Canal directly N - Joinery 30m E and 60m SW - Electricity Board depot 32m SE - Wharfs 50m SE, 50, W and 75m W - Builders Yard 60m W - Council Depot 65m W - Power generating station 125m SE • Potential infilled land – - Potentially infilled wharf 50m SE (S3)	• Ingestion and dermal contact with contaminated soil (P1) • Inhalation or contact with potentially contaminated dust and vapours (P2) • Permeation of water pipes and attack on concrete foundations by aggressive soil conditions (P6)	• Construction workers (R1) • Maintenance workers (R2) • Neighbouring site users (R3) • Future site users (R4) • Building foundations and on site buried services (water mains, electricity and sewer) (R5)	Medium	Low Likelihood	Moderate	GI – Ground Investigation
			Severe for Asbestos	Low Likelihood	Moderate for Asbestos	
	• Accumulation and migration of soil gases (P5)		Severe	Low Likelihood	Moderate	
	• Leaching through permeable soils, migration within the vadose zone (i.e., unsaturated soil above the water table) and/or lateral migration within surface water, as a result of cracked hardstanding or via service pipe/corridors and surface water runoff. (P3) • Horizontal and vertical migration of contaminants within groundwater (P4)	• Neighbouring site users (R3) • Building foundations and on site buried services (water mains, electricity and sewer) (R5)	Medium	Unlikely	Low	

3 GROUND INVESTIGATION

3.1 Rationale for Ground Investigation

3.1.1 The ground investigation was designed by Michael Alexander Consulting Engineers prior to Jomas undertaking the desk study and preliminary risk assessment.

3.1.2 The site investigation has been undertaken generally in accordance with BS5930, Contaminated Land Report 11, BS10175, NHBC Standards Chapter 4.1, and other associated Statutory Guidance. If required, further targeted investigations and remedial option appraisal would be dependent on the findings of this site investigation.

3.1.3 The soil sampling rationale for the site investigation was developed with reference to EA guidance 'Secondary Model Procedure for the Development of Appropriate Soil Sampling Strategies for Land Contamination' (Technical Report P5-066/TR).

3.1.4 The sampling proposal was designed in order to gather data representative of the site conditions.

3.2 Scope of Ground Investigation

3.2.1 The ground investigation was undertaken on 2nd, 3rd December 2019 and 18th January 2020.

3.2.2 The work was undertaken in accordance with BS5930 'Code of Practice for Ground Investigations' and BS10175 'Investigation of Potentially Contaminated Sites'. All works were completed without incident.

3.2.3 The investigation focused on collecting data on the following:

- Quality of Made Ground/ natural ground within the site boundaries;
- Presence of groundwater beneath the site (if any), perched or otherwise;
- Determination of the presence or absence of hazardous ground gases;
- Obtaining geotechnical parameters to allow initial design to take place.

3.2.4 A summary of the fieldwork carried out at the site, with justifications for exploratory hole positions, are offered in Table 3.1 below.

Table 3.1: Scope of Intrusive Investigation

Investigation Type	Number of Exploratory Holes Achieved	Exploratory Hole Designation	Depth Achieved	Justification
Cable Percussion Boreholes	1	BH2	Up to 20.45m bgl	Obtain deeper samples for laboratory contamination and geotechnical testing. To allow in-situ geotechnical testing.

Investigation Type	Number of Exploratory Holes Achieved	Exploratory Hole Designation	Depth Achieved	Justification
Windowless sampling borehole	3	WS1 – WS3	6.00m bgl	Obtain shallow samples for contamination and geotechnical testing. To allow in-situ geotechnical testing
Hand dug Trial Pits	4	TP1, TP1A, TP2, TP3 and TP4	Up to 1.2m bgl	Obtain shallow samples for contamination testing. To allow the inspection of the existing structure foundations.
Monitoring Wells	2	WS2 and WS3	Up to 6m bgl	Combined soil gas and groundwater monitoring wells.

3.2.5 The exploratory holes were completed to allow soil samples to be taken in the areas of interest identified in Table 3.1 above. In all cases, all holes were logged in accordance with BS5930:2015.

3.2.6 Exploratory hole positions were located approximately with reference to known features on site as shown in the exploratory hole location plan presented in Figure 2, Appendix 1. The exploratory hole records are included in Appendix 2.

3.2.7 Where monitoring well installations were not installed, the exploratory holes were backfilled with the arisings (in the reverse order in which they were drilled) and the ground surface was reinstated so that no depression was left.

3.3 In-situ Geotechnical Testing

3.3.1 In-situ geotechnical testing included Standard Penetration Tests. The determined 'N' values have been used to determine the relative density of granular materials and have been used with standard correlations to infer various other derived geotechnical parameters including the undrained shear strength of the cohesive strata. The results of the individual tests are on the appropriate exploratory hole logs in Appendix 2.

3.4 Sampling Rationale

3.4.1 Our soil sampling rationale for the site investigation was developed with reference to EA guidance 'Secondary Model Procedure for the Development of Appropriate Soil Sampling Strategies for Land Contamination' (Technical Report P5-066/TR).

3.4.2 The exploratory holes were positioned by applying a combined non-targeted sampling strategy, as well as sample locations positioned with reference to sources identified from the desk study.

3.4.3 Soil samples were taken from across the site at various depths as shown in the exploratory hole logs.

3.4.4 Jomas Associates Limited's engineers normally collect samples at appropriate depths based on field observations such as:

- appearance, colour and odour of the strata and other materials, and changes in these;
- the presence or otherwise of sub-surface features such as pipework, tanks, foundations and walls; and,
- areas of obvious damage, e.g. to the building fabric.

3.4.5 A number of the samples were taken from the top 0-1m to aid in the assessment of the pollutant linkages identified at the site. In addition, some deeper samples were taken to aid in the interpretation of fate and transport of any contamination identified.

3.4.6 Soil samples were taken from across the site at various depths as shown in the exploratory hole logs (copies of which are provided in Appendix 2). The methodology used and type of samples taken were chosen to allow the Sampling category to be A or B according to EN ISO 22475-1. This in turn allows suitable geotechnical testing to be carried out.

3.4.7 Groundwater strikes noted during drilling are recorded within the exploratory hole records in Appendix 2.

3.4.8 Samples were stored in cool boxes (<4°C) and preserved in accordance with laboratory guidance.

3.5 Drilling and Sampling Limitations

3.5.1 During the initial drilling process on 02 December 2019 to 03 December 2019, 3No windowless sample boreholes (WS1 – WS3) with ground gas/groundwater monitoring wells, a 15m cable percussive borehole (BH1) and 1No additional foundation inspection pit were proposed under the original scope of the investigation. However, it was not possible to undertake these due to significant site constraints encountered.

3.5.2 TP1 was terminated at 0.15m bgl to avoid possible damage to suspected buried utilities at this location.

3.5.3 During the initial investigation BH1 could not be undertaken, so as a replacement hand trial pit TP4 was undertaken to allow sampling of the near surface soils.

3.5.4 BH2, TP2 and TP4 were completed to the required depth.

3.5.5 After discussion with Michael Alexander Consulting Engineers, the windowless sampling, installation of ground gas/groundwater monitoring wells and additional foundation inspection pit were to be completed during a return visit.

3.5.6 As TP1 was not completed during the initial investigation this was fully re-excavated during the return visit and named TP1A.

3.5.7 TP3 was terminated at 1.0mbgl as the presence utilities prevented the effective identification of foundations.

3.6 Laboratory Analysis

3.6.1 A programme of laboratory testing, scheduled by Jomas Associates Limited, was carried out on selected samples of Made Ground and natural strata.

Chemical Testing

3.6.2 Soil samples were submitted to i2 Analytical (a UKAS and MCerts accredited laboratory), for analysis.

3.6.3 The samples were analysed for a wide range of contaminants as shown in Table 3.2:

Table 3.2: Chemical Tests Scheduled

	No. of tests	
Test Suite	**Made Ground / Topsoil**	**Natural**
Basic Suite S3	4	0
Total Organic Carbon	2	0
Water Soluble Sulphate	4	0
TPHCWG (inc BTEX)	2	0
VOC/SVOC	2	0
TPH	2	0
Asbestos Screen & ID	4	0
BRE-SD1	0	4

3.6.4 The determinands contained in the basic suite are as detailed in Table 3.3 below:

Table 3.3: Basic Suite of Determinands

DETERMINAND	LIMIT OF DETECTION (mg/kg)	UKAS ACCREDITATION	TECHNIQUE
Arsenic	1	Y (MCERTS)	ICPMS
Cadmium	0.2	Y (MCERTS)	ICPMS
Chromium	1	Y (MCERTS)	ICPMS
Chromium (Hexavalent)	4	Y (MCERTS)	Colorimetry
Lead	1	Y (MCERTS)	ICPMS
Mercury	0.3	Y (MCERTS)	ICPMS
Nickel	1	Y (MCERTS)	ICPMS
Selenium	1	Y (MCERTS)	ICPMS
Copper	1	Y (MCERTS)	ICPMS
Zinc	1	Y (MCERTS)	ICPMS
Boron (Water Soluble)	0.2	Y (MCERTS)	ICPMS
pH Value	0.1 units	Y (MCERTS)	Electrometric
Sulphate (Water Soluble)	0.0125g/l	Y (MCERTS)	Ion Chromatography
Total Cyanide	1	Y (MCERTS)	Colorimetry
Speciated/Total PAH	0.05/0.80	Y (MCERTS)	GCFID
Phenols	1	Y (MCERTS)	HPLC
Total Petroleum Hydrocarbons (banded)	-	N Y (MCERTS)	Gas Chromatography

3.6.5 To support the selection of appropriate tier 1 screening values, 3No. samples were analysed for total organic carbon.

3.6.6 Laboratory test results are summarised in Section 6, with raw laboratory data included in Appendix 3.

Geotechnical Laboratory Testing

3.6.7 In addition to the contamination assessment, soil samples were submitted to the UKAS Accredited laboratory of i2 Analytical Ltd. for a series of analyses.

3.6.8 This testing was specifically designed to:

- to classify the samples; and
- to obtain parameters (either directly or sufficient to allow relevant correlations to be used) relevant to the technical objectives of the investigation.

3.6.9 The following laboratory geotechnical testing (as summarised in Table 3.4) was carried out:

Table 3.4 Laboratory Geotechnical Analysis

BS 1377 (1990) Test Number	Test Description	Number of tests
Part 2		
3.2	Moisture Content Determination	6
4.3 and 5.3	Liquid and Plastic Limit Determination (Atterberg Limits)	6
8	Determination of the undrained shear strength in triaxial compression with single stage loading and without measurement of pore pressure	6

3.6.10 The water soluble sulphate and pH results obtained as part of the chemical analysis was used in combination with BRE Special Digest 1 to allow buried concrete to be classified.

3.6.11 It should be noted that the bulk density and the moisture content of the sample subjected to the analysis to determine the "undrained shear strength in triaxial compression with single stage loading and without measurement of pore pressure" was also determined as part of the analysis method to determine the undrained shear strength. These were determined using the methodologies laid out in BS 1377 (1990).

3.6.12 The results of the geotechnical laboratory testing are presented as Appendix 4 and discussed in Section 9 of this report.

4 GROUND CONDITIONS

4.1 Soil

4.1.1 Ground conditions were logged in accordance with the requirements of BS5930:2015. Detailed exploratory hole logs are provided in Appendix 2. The ground conditions encountered are summarised in Table 4.1 below, based on the strata observed during the investigation.

Table 4.1: Ground Conditions Encountered

Stratum and Description	Encountered from (m bgl)	Base of strata (m bgl)	Thickness range (m)
Brick paving, concrete. (MADE GROUND).	0.0	0.07 - >0.15	0.07 - >0.15
Dark grey slightly gravelly sand/clayey sandy gravel with cobbles. Gravel consists of brick, concrete, flint, slate, tile and metal. Cobbles consist of brick and concrete. (MADE GROUND) BH2, WS1, WS2, WS3, TP1A, TP4	0.10	0.75 – 1.90	0.50 – 1.80
Brown black silty/sandy gravelly clay with medium cobble content and occasional roots and rootlets. Gravel consists of fine to coarse angular to sub rounded brick, concrete, ceramic, slate, flint with occasional glass and metal. Cobbles consist of sub angular concrete. (MADE GROUND) BH2, WS2, TP2, TP3	0.07 – 0.80	>0.80 – 1.80	>0.45 – 1.42
Stiff to very stiff consistency brown CLAY. (LONDON CLAY FORMATION) Terminal depth of BH2, WS1, WS2 and WS3	1.25 - 1.8	>6.0 - 20.45	>4.1 - >18.65

4.1.2 Given the likely ground strata profile identified in the Desk Study and the BGS descriptions of the materials given in Section 3 of the Desk Study it is considered that the encountered strata represent Made Ground overlying the London Clay Formation.

4.2 Hydrogeology

4.2.1 Groundwater was not encountered in any of the exploratory holes during the course of the investigation.

4.3 Physical and Olfactory Evidence of Contamination

4.3.1 Visual or olfactory evidence of contamination was not observed during the course of the investigation.

5 RISK ASSESSMENT – ANALYTICAL FRAMEWORK

5.1 Context and Objectives

5.1.1 This section seeks to evaluate the level of risk pertaining to human health and the environment which may result from both the existing use and proposed future use of the site. It makes use of the site investigation findings, as described in the previous sections, to evaluate further the potential pollutant linkages identified in the desk study. A combination of qualitative and quantitative techniques is used, as described below.

5.1.2 The purpose of generic quantitative risk assessment is to compare concentrations of contaminants found on site against screening level generic assessment criteria (GAC) to establish whether there are actual or potential unacceptable risks. It also determines whether further detailed assessment is required. The approaches detailed all broadly fit within a tiered assessment structure in line with the framework set out in the Department of Environment, Food and Rural Affairs (DEFRA), EA and Institute for Environment and Health Publication, Guidelines for Environmental Risk Assessment and Management.

5.1.3 It should be noted that the statistical tests carried out in this report in accordance with CL:AIRE and CIEH (2008) recommendations, are for guidance purposes only and the conclusions of this report should be approved by the local authority prior to any redevelopment works being undertaken.

5.2 Analytical Framework – Soils

5.2.1 There is no single methodology that covers all the various aspects of the assessment of potentially contaminated land and groundwater. Therefore, the analytical framework adopted for this investigation is made up of a number of procedures, which are outlined below. All of these are based on a Risk Assessment methodology centred on the identification and analysis of Source – Pathway – Receptor linkages.

5.2.2 The CLEA model provides a methodology for quantitative assessment of the long term risks posed to human health by exposure to contaminated soils. Toxicological data have been used to calculate Soil Guideline Values (SGV) for individual contaminants, based on the proposed site use; these represent minimal risk concentrations and may be used as screening values.

5.2.3 In the absence of any published SGVs for certain substances, or where the assumptions made in generating the SGVs do not apply to the site, Jomas Associates Limited have obtained Tier 1 screening values for initial assessment of the soil, based on available current UK guidance including the LQM/CIEH S4ULs and DEFRA C4SL. Site-specific assessments are undertaken wherever possible and/or applicable. All assessments are carried out in accordance with the CLEA protocol.

5.2.4 CLEA requires a statistical treatment of the test results to take into account the normal variations in concentration of potential contaminants in the soil and allow comparisons to be made with published guidance.

5.2.5 The assessment criteria used for the screening of determinands within soils are identified within Table 5.1.

Table 5.1: Selected Assessment Criteria – Contaminants in Soils

Substance Group	Determinand(s)	Assessment Criteria Selected
Organic Substances		
Non-halogenated Hydrocarbons	Total Petroleum Hydrocarbons (TPHCWG banded)	S4UL
	Total Phenols	S4UL
Polycyclic Aromatic Hydrocarbons (PAH-16)	Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenzo(a,h)anthracene, Benzo(ghi)perylene	S4UL
Volatile Organic Compounds (VOCs/sVOCs).	Toluene, Ethylbenzene, Benzene, Xylenes	S4UL
Inorganic Substances		
Heavy Metals and Metalloids	Arsenic, Cadmium, Chromium, Lead, Mercury, Nickel, Selenium, Copper, Zinc	S4UL
	Copper, Zinc, Nickel	BS: 3882 (2015).
Cyanides	Free Cyanide	CLEA v1.06
Sulphates	Water Soluble Sulphate	BRE Special Digest 1:2005

5.2.6 As the published reports only offer the option of selecting a SOM value of 1%, 2.5% or 6%, a SOM value of 1% has been used for the selection of generic assessment criteria, as 0.95% was the mean value obtained from laboratory analysis.

5.2.7 It is understood that the site is to be converted to provide residential units with associated communal soft landscaping. As a result, the site has been assessed with regards to commercial end use scenario.

5.3 BRE

5.3.1 The BRE Special Digest 1:2005, 'Concrete in Aggressive Ground' is used with soluble sulphate and pH results to assess the aggressive chemical environment of future underground concrete structures at the site.

6 GENERIC QUANTITATIVE RISK ASSESSMENT

6.1 Screening of Soil Chemical Analysis Results – Human Health Risk Assessment

6.1.1 Laboratory analysis for soils are summarised in Tables 6.1 to 6.3. Raw laboratory data is included in Appendix 3.

Table 6.1: Soil Laboratory Analysis Results – Metals, Metalloids, Phenol, Cyanide

Determinand	Unit	No. samples tested	Screening Criteria		Min	Max	No. Exceeding
Arsenic	mg/kg	6	S4UL	640	5.8	21	0
Cadmium	mg/kg	6	S4UL	190	< 0.2	1.2	0
Chromium	mg/kg	6	S4UL	8600	< 4.0	< 4.0	0
Lead	mg/kg	6	C4SL	2330	78	980	0
Mercury	mg/kg	6	S4UL	320	< 0.3	1.7	0
Nickel	mg/kg	6	S4UL	980	7	23	0
Copper	mg/kg	6	S4UL	68000	17	95	0
Zinc	mg/kg	6	S4UL	730000	74	730	0
Total Cyanide [A]	mg/kg	6	CLEA v 1.06	33	<1	<1	0
Selenium	mg/kg	6	S4UL	12000	< 1.0	< 1.0	0
Boron Water Soluble	mg/kg	6	S4UL	240000	< 0.2	2.7	0
Phenols	mg/kg	6	S4UL	440	< 1.0	< 1.0	0

Notes: [A] Generic assessment criteria derived for free inorganic cyanide.

Table 6.2: Soil Laboratory Analysis Results – Polycyclic Aromatic Hydrocarbons (PAHs)

Determinand	Unit	No. Samples Tested	Screening Criteria		Min	Max	No. Exceeding
Naphthalene	mg/kg	4	S4UL	190	<0.05	<0.05	0
Acenaphthylene	mg/kg	4	S4UL	83000	<0.05	0.24	0
Acenaphthene	mg/kg	4	S4UL	84000	<0.05	0.18	0
Fluorene	mg/kg	4	S4UL	63000	<0.05	0.29	0
Phenanthrene	mg/kg	4	S4UL	22000	<0.05	5.0	0
Anthracene	mg/kg	4	S4UL	520000	<0.05	0.38	0
Fluoranthene	mg/kg	4	S4UL	23000	<0.05	7.4	0
Pyrene	mg/kg	4	S4UL	54000	<0.05	6.3	0
Benzo(a)anthracene	mg/kg	4	S4UL	170	<0.05	2.5	0
Chrysene	mg/kg	4	S4UL	350	<0.05	2.8	0

Determinand	Unit	No. Samples Tested	Screening Criteria		Min	Max	No. Exceeding
Benzo(b)fluoranthene	mg/kg	4	S4UL	44	<0.05	3.4	0
Benzo(k)fluoranthene	mg/kg	4	S4UL	1200	<0.05	1.5	0
Benzo(a)pyrene	mg/kg	4	S4UL	35	<0.05	2.6	0
Indeno(123-cd)pyrene	mg/kg	4	S4UL	500	<0.05	1.6	0
Dibenzo(ah)anthracene	mg/kg	4	S4UL	3.5	<0.05	0.49	0
Benzo(ghi)perylene	mg/kg	4	S4UL	3900	<0.05	1.8	0
Total PAH	mg/kg	4	-	-	<0.80	36.7	-

Table 6.3: Soil Laboratory Analysis Results – Total Petroleum Hydrocarbons (TPH)

TPH Band	Unit	No. Samples Tested	Screening Criteria		Min	Max	No. Exceeding
C_8-C_{10}	mg/kg	4	S4UL	2000	<0.1	<1	0
>C_{10}-C_{12}	mg/kg	4	S4UL	9700	< 2.0	11	0
>C_{12}-C_{16}	mg/kg	4	S4UL	36000	8.1	18	0
>C_{16}-C_{21}	mg/kg	4	S4UL	28000	3.2	150	0
>C_{21}-C_{35}	mg/kg	4	S4UL	28000	<10	510	0
Total TPH	mg/kg	4	-	-	<34.2	<689.1	-

Note: *The lower value of guidelines for Aromatic/Aliphatics has been selected

Table 6.4: Soil Laboratory Analysis Results – Total Petroleum Hydrocarbons (TPH)

TPH Band	Unit	No. Samples Tested	Screening Criteria		Min	Max	No. Exceeding
>C_5-C_6 Aliphatic	mg/kg	2	S4UL	3200	<0.001	<0.001	0
>C_6-C_8 Aliphatic	mg/kg	2	S4UL	7800	<0.001	<0.001	0
>C_8-C_{10} Aliphatic	mg/kg	2	S4UL	2000	<0.001	<0.001	0
>C_{10}-C_{12} Aliphatic	mg/kg	2	S4UL	9700	<1.0	<1.0	0
>C_{12}-C_{16} Aliphatic	mg/kg	2	S4UL	59000	<2.0	<2.0	0
>C_{16}-C_{35} Aliphatic	mg/kg	2	S4UL	1600000	<16.0	<16.0	0
>C_5-C_7 Aromatic	mg/kg	2	S4UL	26000	<0.001	<0.001	0
>C_7-C_8 Aromatic	mg/kg	2	S4UL	56000	<0.001	<0.001	0
>C_8-C_{10} Aromatic	mg/kg	2	S4UL	3500	<0.001	<0.001	0
>C_{10}-C_{12} Aromatic	mg/kg	2	S4UL	16000	<1.0	<1.0	0
>C_{12}-C_{16} Aromatic	mg/kg	2	S4UL	36000	<2.0	<2.0	0
>C_{16}-C_{21} Aromatic	mg/kg	2	S4UL	28000	<10	<10	0

TPH Band	Unit	No. Samples Tested	Screening Criteria		Min	Max	No. Exceeding
>C_{21}-C_{35} Aromatic	mg/kg	2	S4UL	28000	<10	38	0
Total TPH (Ali/Aro)	mg/kg	2	-	-	<20	<57	-

6.2 Volatile Organic Compounds

6.2.1 In addition to the suites outlined previously, 2No samples were tested for the presence of volatile organic compounds including BTEX compounds (benzene, toluene, ethylbenzene, xylene).

6.2.2 No VOC were reported above the detection limit of the laboratory method.

6.3 Asbestos in Soil

6.3.1 4No samples of the Made Ground were screened in the laboratory for the presence of asbestos. The results of the analysis are summarised below in Table 6.5 below.

Table 6.5: Asbestos Analysis – Summary

Sample	Screening result.	Quantification result (%)	Comments
TP2 – 0.40m bgl	None Detected	N/A	None
BH2 – 0.25m bgl	Detected	<0.001	Chrysotile and Crocidolite
WS1 – 0.50m bgl	Detected	<0.001	Chrysotile - Loose Fibres
WS3 – 0.25	Detected	0.001	Chrysotile - Loose Fibrous Debris

6.3.2 The results reported a maximum asbestos of 0.001% total asbestos content within sample WS3 at 0.25m bgl.

6.4 Screening for Water Pipes

6.4.1 The results of the analysis have been assessed for potential impact upon water supply pipes. Table 6.6 below summarises the findings of the assessment:

Table 6.6: Screening Guide for Water Pipes

Determinand	No. of tests	Threshold adopted for PE (mg/kg)	Value for site data (mg/kg)		No of Exceedances
			Min	Max	
EC5-EC10	4	1	<0.05	<0.05	None
EC10-EC16	4	10	<10.1	29	3No TP2 @ 0.40m bgl BH2 @ 0.25m bgl WS1 @ 0.50m bgl

Determinand	No. of tests	Threshold adopted for PE (mg/kg)	Value for site data (mg/kg)		No of Exceedances
			Min	Max	
EC16-EC40	4	500	24	660	TP2 @ 0.40m bgl
Naphthalene	4	5	<0.05	<0.05	None
Phenols	4	2	<1	<1	None

*Laboratory detection limit

6.4.3 Determinands marked "N/A" were not analysed for as no evidence of their presence was obtained from the Desk Study.

6.4.4 The above suggests that upgraded pipe work may be required.

6.4.5 Alternatively, it may be possible to utilise other protection methods including (but not limited to):

- diversion of the pipe,
- localised remediation
- embedding the pipe in a sufficient thickness of clean granular material

6.4.6 The water supply pipe requirements for this site should be discussed at an early stage with the relevant Utility provider.

6.5 Screening of Soil Chemical Analysis Results – Potential Risks to Plant Growth

6.5.1 Zinc, copper and nickel are phytotoxins and could therefore inhibit plant growth in soft landscaped areas. Concentrations measured in soil for these determinands have been compared with the pH dependent values given in BS: 3882 (2015).

6.5.2 Adopting a pH value of greater than 7, as indicated by the results of the laboratory analysis, the following is noted;

Table 6.7: Soil Laboratory Analysis Results – Phytotoxic Determinands

Determinand	Threshold level (mg/kg)	Min (mg/kg)	Max (mg/kg)	No. Exceeding
Nickel	110	7	23	0
Copper	200	17	95	0
Zinc	300	74	730	3No. TP2 @ 0.40 TP3 @ 0.50 WS1 @ 0.50

6.5.3 3No samples were noted to exceed the phyto-toxicity criteria for Zinc. While this result is not considered significant in terms of human health, certain species of plant may not thrive in this soil. This will also be addressed by the use of clean topsoil in proposed planting areas.

6.6 Waste Disposal

6.6.1 The classification of materials for waste disposal purposes was outside the scope of this report. Should quantities of material require off-site disposal, Waste Acceptance Criteria testing will be required.

7 SOIL GAS RISK ASSESSMENT

7.1 Soil Gas Results

7.1.1 Three return monitoring visits have been undertaken from 31 January 2020 to 12 February 2020, to monitor wells installed within boreholes at the site for soil gas concentrations and groundwater levels.

7.1.2 During these visits atmospheric pressure ranged between 1005mb and 1016mb. During these visits pressure trends observed were static and rising.

7.1.3 The results of the monitoring undertaken are summarised in Table 7.1 below, with the monitoring records presented in Appendix 6.

Table 7.1: Summary of Gas Monitoring Data

Hole No.	CH_4 (%)	CO_2 (%)	O_2 (%)	H_2S (ppm)	VOCs (ppm)	Steady Flow Rate (l/hr)	Peak Flow Rate (l/hr)	Depth to water (mbgl)	Depth of installation (mbgl)
WS2	0.1 - 0.3	0.9 – 1.7	19.8 – 20.5	0	0	0.1	0.1	1.25 – 1.30	5.00
WS3	0.1 - 0.3	0.6 – 0.9	20.2 – 20.7	0	0	0.1	0.1	1.90 – 2.85	5.24

7.2 Screening of Results

7.2.1 As shown in Table 7.1, no methane has been reported to date. Carbon dioxide has been reported to a maximum concentration of 1.7% v/v. Screening of the monitoring well headspaces with a photo-ionisation detector (PID) has did not detect Volatile Organic Compound (VOC) above the detection limit of the apparatus. A maximum flow rate of 0.1l/hr has been reported.

7.2.2 In the assessment of risks posed by hazardous ground gases and selection of appropriate mitigation measures, BS8485 (2015) + A1 (2019) identifies four types of development, termed Type A to Type D.

7.2.3 Type B buildings are defined as

> *" private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium size rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels."*

7.2.4 Type B has been adopted as the relevant category for the proposed development.

7.2.5 The soil gas assessment method is based on that proposed by Wilson & Card (1999), which was a development of a method proposed in CIRIA publication R149 (CIRIA, 1995). The method uses both gas concentrations and borehole flow rates to define a characteristic situation based on the limiting borehole gas volume flow for methane and carbon dioxide. In both these methods, the limiting borehole gas volume flow is renamed as the Gas Screening Value (GSV).

7.2.6 The Gas Screening Value (litres of gas per hour) is calculated by using the following equation

GSV = (Concentration/100) X Flow rate

Where concentration is measured in percent (%)
and flow rate is measured in litres per hour (l/hr)

7.2.7 The Characteristic Situation is then determined from Table 8.5 of CIRIA C665.

7.2.8 To accord with C665, worst case conditions are used in the calculation of GSVs for the site.

7.2.9 A worst case flow rate of 0.1l/hr (maximum reported) will be used in the calculation of GSVs for the site. The Characteristic Situation is then determined from Table 8.5 of CIRIA C665.

7.2.10 To accord with C665, worst case conditions are used in the calculation of GSVs for the site. These have been summarised below in Table 7.2

Table 7.2: Summary of Gas Monitoring Data

Gas	Concentration (v/v %)	Peak Flow Rate (l/hr)	GSV (l/hr)	Characteristic Situation (after CIRIA C665)
CO_2	1.7	0.1	**0.0017**	**1**
CH_4	0.3	0.1	**0.0003**	**1**

7.2.11 The methodology set out in BS 8485 (2015) has been used for determining the required gas protection measures. The outcomes from the gas risk assessment has concluded that the site is a CS-1, where no gas protection measures are considered necessary.

7.2.12 BS 8576:2013 has been used to derived threshold levels for carbon monoxide and volatile organic compounds.

7.2.13 Given the recorded levels it is not considered that additional protection measures need to be incorporated to protect end users from the recorded carbon monoxide concentrations.

7.2.14 PID screening of the monitoring well headspace did not report VOCs above the detection limit of the apparatus. Therefore, it is considered that the PID screening of monitoring well confirms the assessment that risks to human health receptors via vapour inhalation pathways are low.

8 SUMMARY OF RESULTS

8.1 Land Quality Impact Summary

8.1.1 Following the ground investigation, the following is noted:

- The proposed development includes site clearance and the construction of a 4-storey commercial development. No areas of soft landscaping are anticipated.
- Following generic risk assessments no elevated concentrations of determinands were detected in soils in excess of generic assessment criteria for the protection of human health within a commercial end-use scenario.
- Asbestos fibres were detected in 3No. sample analysed in the laboratory. Subsequent quantification of the asbestos samples reported a maximum of 0.001% total asbestos within sample WS3 at 0.25m bgl. BH2 at 0.25m bgl and WS1 at 0.50m bgl both reported <0.001% totals asbestos in samples.
- Any visual asbestos materials may be removed by hand, with extensive dust control measures required during the soil screening operations for the protection of site workers and nearby residents. It should be noted that asbestos fibres will not be visible to the naked eye.
- The site proposal indicates that the site will remain covered by a combination of the proposed building footprint and hard surfacing. Where this is the case, no formal remedial measures are considered necessary in terms of human health, as the building and hard surfacing are expected to provide a barrier to potential receptors.
- Although no soft landscaping is envisioned, if alternations are made to the final design to include these features, it would be prudent to make an allowance for soft landscaping to be provided in isolated raised planters or to replace Made Ground with approximately 600mm of imported clean topsoil, placed on a membrane.
- The site is directly underlain by solid deposits of the London Clay Formation, identified as an unproductive aquifer. There are no source protection zones within 500m of the site, and no groundwater, surface water or potable water abstractions within 1km of the site. Although Grand Union / Regents Canal is located directly adjacent to the site, is assumed that this will be lined and therefore not a sensitive receptor to any potential on site sources. As a result, the sensitivity of controlled waters is considered low.
- Upgraded potable water supply pipes are likely to be required, which should be confirmed with the relevant service provider.
- Following a programme of gas monitoring and risk assessment, the site has been assigned as a gas Characteristic Situation 1, where no formal gas protection measures are considered necessary.
- As with any ground investigation, the presence of further hotspots between sampling points cannot be ruled out. Should any contamination be encountered, a suitably

qualified environmental consultant should be informed immediately, so that adequate measures may be recommended.

8.1.2 The above conclusions are made subject to approval by the statutory regulatory bodies.

8.2 Review of Pollutant Linkages Following Site Investigation

8.2.1 The site CSM has been revised and updated from that suggested in the desk study in view of the ground investigation data, including soil laboratory analysis results. Table 8.1 highlights whether pollutant linkages identified in the original CSM are still relevant following the risk assessment, or whether pollutant linkages, not previously identified, exist.

Table 8.1: Plausible Pollutants Linkages Summary (Pre Remediation)

Potential Source (from desk study)	Pathway	Receptor	Relevant Pollutant Linkage?	Comment
• Potential for contaminated ground associated with previous site use – on site (S1) - Wharf • Current and previous industrial use – on and off site (S2) - Canal directly N - Joinery 30m E and 60m SW - Electricity Board depot 32m SE - Wharfs 50m SE, 50, W and 75m W - Builders Yard 60m W - Council Depot 65m W - Power generating station 125m SE • Potential infilled land (S3) - Potentially infilled wharf 50m SE	• Ingestion and dermal contact with contaminated soil (P1) • Inhalation or contact with potentially contaminated dust and vapours (P2) • Permeation of water pipes and attack on concrete foundations by aggressive soil conditions (P6)	• Construction workers (R1) • Maintenance workers (R2) • Neighbouring site users (R3) • Future site users (R4) • Building foundations and on site buried services (water mains, electricity and sewer) (R5)	**Y**	See section 8.1 above for remedial measures. The findings of this report should be included in the construction health and safety file, with adequate measures put in place for the protection of construction and maintenance workers. Contact should be made with relevant utility providers to confirm if upgraded materials are required. The concrete classification to protect buried concrete is discussed in Section 9.10
	• Accumulation and migration of soil gases (P5)		**N**	Gas protection measures not considered necessary.
	• Leaching through permeable soils, migration within the vadose zone (i.e., unsaturated soil above the water table) and/or lateral migration within surface water, as a result of cracked hardstanding or via service pipe/corridors and surface water runoff. (P3) • Horizontal and vertical migration of contaminants within groundwater (P4)	• Neighbouring site users (R3) • Building foundations and on site buried services (water mains, electricity and sewer) (R5)	**N**	A significant risk of impact to controlled waters has not been identified.

9 GEOTECHNICAL ENGINEERING RECOMMENDATIONS

9.1 Ground Investigation Summary

9.1.1 It is understood that the proposed development includes the construction of a 4-storey commercial building.

9.1.2 No detailed structural engineering design information, with respect to the type of construction and associated structural loadings, was provided at the time of preparing this report. Consequently, a detailed discussion of all the problems that may arise during the proposed redevelopment scheme is beyond the scope of this report.

9.1.3 Practical solutions to the difficulties encountered, both prior to, and during construction, are frequently decided by structural constraints or economic factors. For these reasons, this discussion is predominantly confined to remarks of a general nature, which are based on site conditions encountered during the intrusive investigations.

9.2 Geotechnical Classification

9.2.1 At the Desk Study stage this development was deemed to be a GC2 development in accordance with BS EN: 1997.

9.2.2 The findings of the investigation undertaken and discussed previously do not change this assessment.

9.3 Data Summary

9.3.1 The results of the ground investigation revealed a ground profile comprising a variable thickness of Made Ground (up to 1.9m bgl depth), overlying a stiff to very stiff brown clay (considered to represent the London Clay Formation), encountered to the base of the borehole (up to 20.45m bgl). The base of this deposit was not proven.

9.3.2 A summary of ground conditions obtained from the ground investigation and the derived geotechnical parameters, is provided in Table 9.1 below.

Strata	Depth Encountered (from-to) (mbgl)	SPT 'N' Value	Inferred Shear Strength (kPa)	Measured Shear Strength (kPa)	Moisture content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (corrected plasticity) (%)	NHBC Volume Change Classification
Brick paving, concrete overlying - dark grey slightly gravelly sand/clayey sandy gravel with cobbles. Gravel consists of brick, concrete, flint, slate, tile and metal. Cobbles consist of brick and concrete. (MADE GROUND) BH2, WS1, WS2, WS3, TP1A, TP4	GL to 0.75 – 1.90	9 - 27	-	-	-	-	-	-	-
Brown black silty/sandy gravelly clay with medium cobble content and occasional roots and rootlets. Gravel consists of fine to coarse angular to sub rounded brick, concrete, ceramic, slate, flint with occasional glass and metal. Cobbles consist of sub angular concrete. (MADE GROUND) BH2, WS2, TP2, TP3	0.07 – 0.80 to >0.80 – 1.80	6 - 15	68	-	24	57	26	31 (23.6)	Medium
Stiff to very stiff consistency brown CLAY. (LONDON CLAY FORMATION)	1.80 to 20.45	5 - 47	54 – 212	83 - 195	16-35*	71-76	27-32	42 – 46 (28.5 – 44)	Medium to High

Table 9.1: Ground Conditions and Derived Geotechnical Parameters

*Moisture content of 43% reported in sample described as "wet"

9.4 Undrained Shear Strength

9.4.1 Standard Penetration Tests were undertaken at regular intervals throughout the window sampler holes and cable percussive borehole. The results of the SPTs have been used to infer the undrained shear strength using the correlation suggested by Stroud (1974).

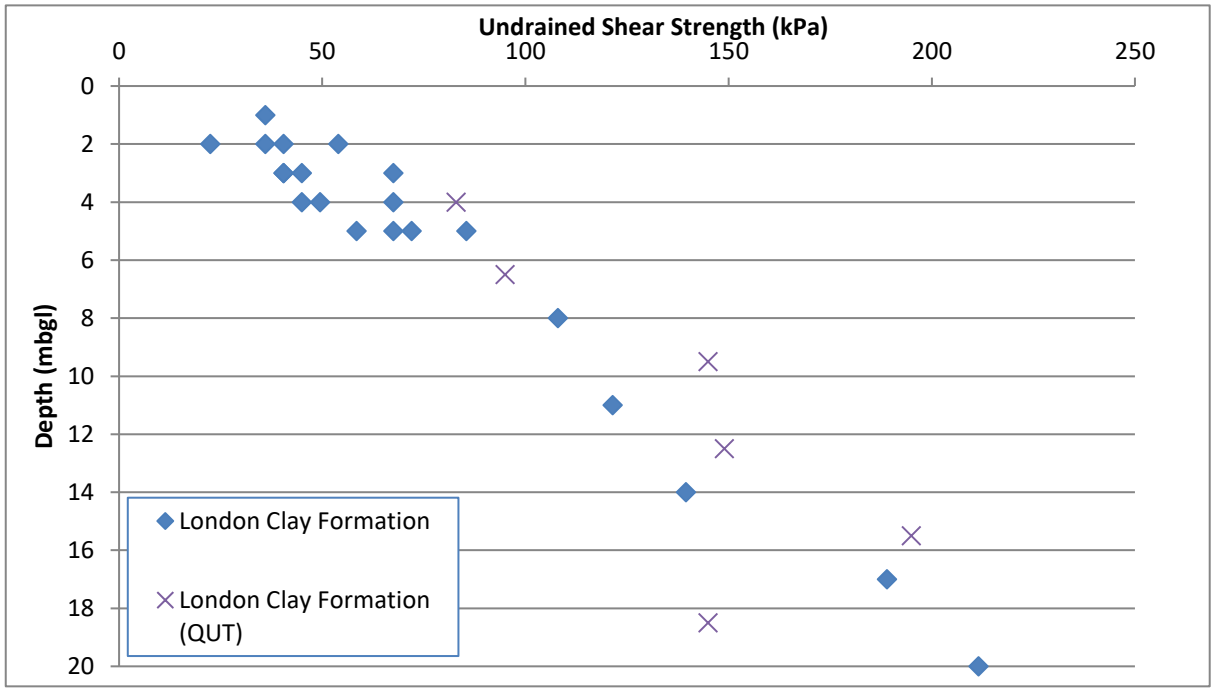
$c_u = f_1 \times N$ can be applied,

in which
c_u= mass shear strength (kN)
f_1 = constant
N= SPT Value achieved during boring operations

9.4.2 In the above equation f_1 is dependent on the plasticity of the material that the SPT is being carried out in. As the plasticity indices were shown to be greater than 27% a value for f_1 of 4.5 has been adopted after Tomlinson (2001).

9.4.3 The graph below shows the shear strength profile of the London Clay Formation encountered at the site, based on the SPT to shear strength correlation described above, as well as the results of undrained triaxial tests on undisturbed samples taken from the boreholes.

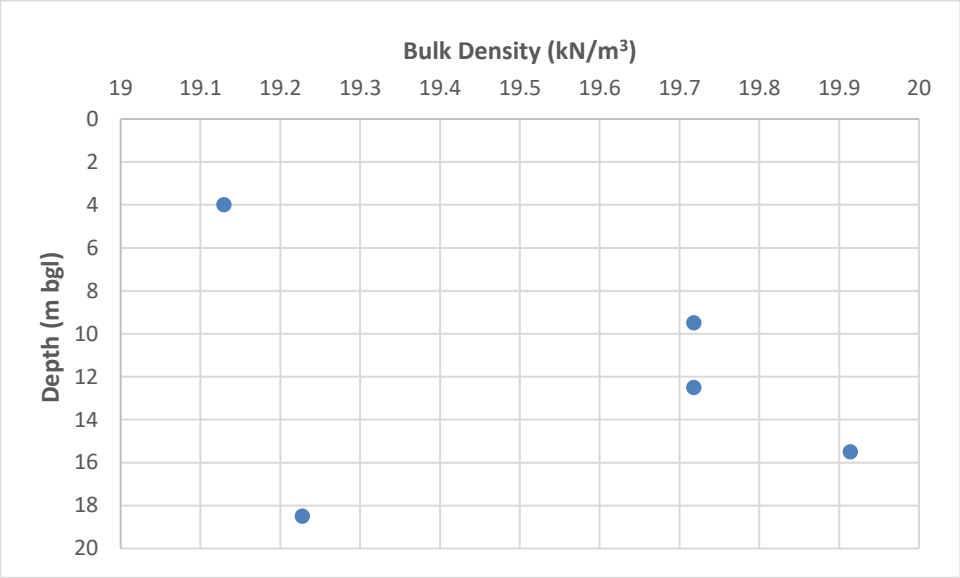
Figure 9.1: Undrained Shear Strength v Depth



9.5 Bulk Density

9.5.1 In order to calculate the undrained shear strength using the quick undrained triaxial methodology the bulk density of the materials has to be calculated. These values are provided on the quick undrained triaxial testing certificates provided in Appendix 4. These results are summarised in the figure below.

Figure 9.2: Bulk Density of the London Clay Formation v Depth



9.5.2 As can be seen on the graph above there appears to be two separate trendlines of bulk density v depth. It should be noted that the two lines are approximately parallel and therefore it suggests that the noted differences in bulk density is likely to be due to varying quantities of secondary constituents and not variations in the primary constituent.

9.6 Coefficient of Compressibility

9.6.1 Stroud and Butler (1974) developed a relationship between the coefficient of compressibility (m_v) and SPT 'N' value.

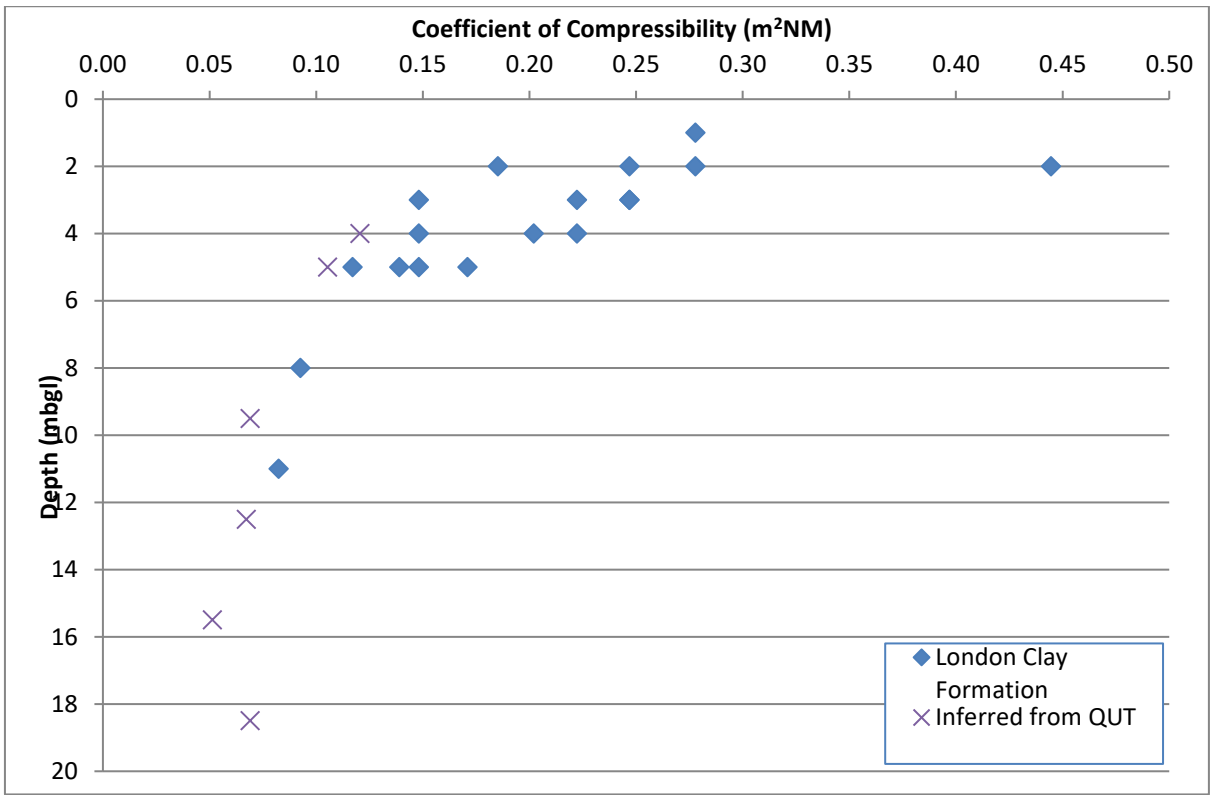
$m_v = 1/ f_2 \times N$ can be applied,

in which
m_v = coefficient of compressibility (m^2/MN)
f_2 = constant dependant on the plasticity index
N = SPT Value achieved during boring operations

9.6.2 Using the plasticity indices obtained (See Table 9.1) and the graphs provided in Tomlinson (2001) a value of f_2 of 0.45 has been taken and used with the SPT 'N' values to infer coefficient of compressibility (m_v).

9.6.3 Where the undrained shear strength of the clays was obtained using the quick undrained triaxial methodology the m_v value was used by rearranging the equations for f_1 and f_2 and the measured undrained shear strength. These are plotted against depth below in Figure 9.3.

Figure 9.3: Coefficient of Volume Compressibility (m_v) v Depth



9.6.4 As would be expected, the deeper results from the London Clay are generally of "low compressibility" with the majority of the near surface clays (above approximately 5m bgl) of "medium compressibility". This is considered to be due to the lack of overburden pressure allowing the clays to relax and so allow them to recompress slightly.

9.6.5 A single outlier of "high compressibility" is noted at 2.0m bgl.

9.7 Building Near Trees

9.7.1 The underlying soil conditions have been shown to be of medium to high volume change potential.

9.7.2 The Made Ground is noted to be of medium volume change potential. It is considered that the clay component of this material will be derived from the underlying natural London Clay Formation (which has been classified as medium to high volume change potential) with the variance being due to secondary constituents within the clay.

9.7.3 Using the geotechnical testing obtained (summarised in Table 9.1) and with reference to NHBC Standards Chapter 4.2 it can be seen that a minimum founding depth of 1.5m will be required. This would allow for restricted new planting.

9.7.4 Presence of existing and proposed trees may increase this minimum depth. It is recommended that a tree survey is carried out that should include: location, species and height of all trees on and near to the proposed development.

9.7.5 Guidance is also given in relation to other aspects of construction where the shrink / swell potential of the soils may be needed to take into consideration. This guidance is summarised in the appropriate sections below.

9.8 Foundations (Existing)

9.8.1 4No hand excavated trial pit was undertaken along the walls of the neighbouring structures where the proposed development will be located. As TP1 was not completed during the initial investigation due to time constraints, this was re-excavated during a return visit and named TP1A.

9.8.2 An additional trial pit named TP4 was undertaken however this pit was used for shallow chemical sampling purposes only and did not expose foundations.

9.8.3 TP3 was excavated to 1.0m bgl. Probing into the side of the pit, at a depth of 0.60m, 0.24m from the brick wall, showed an undercutting of the wall by 0.06m. However, no foundations could be exposed as wood planks, metal pipes and kerbstone obstructed digging. Depth and width of foundation could therefore be not proven.

9.8.4 When assessing the foundations, the following is assumed:

- Walls were constructed symmetrically and centrally on the strip footing to prevent overturning and eccentric loading.
- Where the width of the wall is not known, it is assumed to be 0.30m wide to take into account the walls and any cavity.

9.8.5 The findings and assessment of the foundation as exposed by the inspection pit are summarised in Table 9.2.

Table 9.2: Foundation Inspection Pit Summary

Hole	Location	Total Step Out (m)	Assumed Width (m)	Proven Depth (m bgl)	Founding Strata
TP1A	Western Wall	0.14	0.58	0.69	Made Ground
TP2	Eastern Wall	0.30	0.90	0.70	Made Ground
TP3	Southern Wall	-	-	-	-

9.8.6 It is likely that the foundations are formed in London Clay Formation but the stratum may have been disturbed by the formation of the foundations.

9.9 Foundations

<u>General Comments</u>

9.9.1 Foundations should not be formed in either the Made Ground or the Topsoil due to the unacceptable risk of total and differential settlement.

9.9.2 It should be noted that the demolition and removal of existing structures, foundations and services may increase the depth of Made Ground on the site.

9.9.3 The following comments are indicative only based on limited ground investigation data and should be confirmed once the remaining site investigation works have been completed.

9.9.4 Foundations should be designed by a suitably qualified Engineer. Once structural loads have been fully determined a full design check in accordance with BS EN 1997 should be undertaken to confirm suitability of foundation choice.

9.9.5 As soils of high-volume change potential are present, heave precautions will be required against the side of foundations and ground beams in accordance with the requirements set out in NHBC Standards Chapter 4.2.

Traditional Foundations

9.9.6 It is likely that traditional shallow foundations may be appropriate to support the proposed structure dependent on the proposed loadings.

9.9.7 Based on the findings of this investigation, it is considered that traditional strip/trench-fill footings of 1m breadth formed at a minimum depth of 1.5mbgl within the underlying London Clay Formation could be designed with an allowable bearing capacity of 105kPa. Total and differential settlements should be contained within tolerable limits.

9.9.8 Foundations must be deepened and founded beneath any Made Ground (encountered to a maximum depth of 1.8m) and where building near trees in accordance with NHBC Standards, Chapter 4.2, for soils of high volume change potential.

9.9.9 Where foundations need to change levels, the foundations should be stepped. These steps should be no deeper than half of the width of the foundation and each step should not exceed 0.5m. For practical purposes, steps are unlikely to be less than 0.15m deep. The steps should be suitably reinforced for an adequate distance either side of the step.

Piled Foundations

9.9.10 Based upon the information obtained to date, due to the depth of the Made Ground encountered within the site, and the anticipated loadings of the proposed structure, it is considered that a piled foundation solution extended into the underlying London Clay Formation may be preferable.

9.9.11 The piled foundations will carry their working load in a combination of skin friction along the sides of the pile and end bearing at the base of the pile. The piles should be designed by a suitably qualified and experienced piling specialist using a suitable factor of safety with the settlement at working load specified to meet any structural requirements. Table 9.4 provides some indicative capacities for a single pile for the diameter and depths shown.

9.9.12 In order to calculate the provided indicative allowable pile capacities, the following ground model and characteristic ground parameters, summarised in Table 9.3, were used.

Table 9.3: Characteristic Parameters Used to Calculate Allowable Indicative Pile Carry Capacities

Strata	Depth (m bgl)	Bulk Density (kN/m³)	Design c_u or N
Made Ground	GL to 2.0	16.0	-

Strata	Depth (m bgl)	Bulk Density (kN/m³)	Design c_u or N
London Clay Formation	2.0 to >20.0	19.5	$c_u = (z + 2.7647) / 0.1059$
Groundwater	21	9.81	

9.9.13 Made Ground was reported to 1.9m bgl, therefore a depth of 2.0m bgl has been used for the model due to the likelihood of the removal of foundations increasing the depth of Made Ground.

9.9.14 The undrained shear strength of the London Clay Formation has been derived from the results illustrated in Figure 9.1.

9.9.15 Bulk density within the London Clay Formation was determined using an average of reported bulk densities from laboratory results as illustrated in Figure 9.2.

9.9.16 As no groundwater was reported down to 20m bgl this has been modelled at 21m bgl.

Table 9.4: Indicative Piles Capacities (kN)

Pile toe depth (m bgl)	Pile diameter (m)				
	0.3	0.45	0.6	0.75	0.9
	Indicative Gross Allowable Pile Capacity (kN)				
9	100	170	250	340	445
10	115	190	275	380	495
11	125	205	305	415	540
12	135	225	330	450	580
13	145	240	355	480	625
14	155	255	375	510	665
15	165	275	400	545	705

9.9.17 It should be noted that the above assumes a bored piling system. Other methods of piling and equipment may provide different results.

9.9.18 To comply with BS EN 1997 and the guidance given by the Federation of Piling Specialists the ground must be proven to a minimum of 5m below the proposed toe of the piles. Consequently, the above table is limited to 15m bgl.

9.9.19 Should greater carrying capacity be required then groups of piles could be considered. However, if such an option is used then a pile efficiency or grouping factor will need to be applied. This factor will depend on a number of contributing issues that include (but are not limited to), the number of piles; the distance between the piles and the geometry of the pile group.

9.9.20 The use of a piling foundation solution will require the emplacement of an engineered granular piling mat to support the piling rig and prevent overturning. This should be designed and constructed in accordance with BRE 470.

9.10 Concrete in the Ground

9.10.1 Sulphate attack on building foundations occurs where sulphate solutions react with the various products of hydration in Ordinary Portland Cement (OPC) or converted High-Alumina Cement (HAC). The reaction is expansive, and therefore disruptive, not only due to the formation of minute cracks, but also due to loss of cohesion in the matrix.

9.10.2 In accordance with BRE Special Digest 1, the characteristic values of sulphate used to determine the concrete classification are determined using the methodology summarised in the table below.

9.10.3 BRE SD-1 analysis was scheduled for 4No deeper samples within the London Clay Formation.

Table 9.5: Concrete in the Ground Characteristic Value Determination

No. Samples in the dataset	Method for determining the sulphate characteristic value
1 - 4	Highest value
5-9	Mean of the top 2no. highest results
10 or greater	Mean of the top 20% highest results

9.10.4 Table 9.6 summarises the analysis of the aggressive nature of the ground for each of the strata encountered within the ground investigation.

Table 9.6: Concrete in the Ground Classes

Stratum	No. Samples	pH range	Characteristic WS Sulphate (mg/l)	Design Sulphate Class	ACEC Class
Made Ground	4	8.1 - 11	217	DS-1	AC-1
London Clay Formation	4	7.8 - 8.3	3620	DS-4	AC-3

9.10.5 It should be noted that the BGS description of the London Clay Formation notes that it includes “disseminated pyrite”. It is therefore common practice to ensure that buried concrete formed in London Clay Formation has a Design Sulphate Class of at least DS-2.

9.10.6 The concrete structures, including foundations, will need to be designed in accordance with BS EN 1992-1-1:2004+A1:2014.

9.11 Ground Floor Slabs

9.11.1 As Made Ground in excess of 600mm thickness has been reported, and due to the presence of cohesive ground with a high-volume change potential, in accordance with NHBC Chapter 4.2, a suspended floor slab is recommended. The depth of clear void beneath the suspended floor slab will be dependent on the floor type used.

9.11.2 Under suspended in-situ concrete ground floor a minimum void of 150mm is required. Whilst under suspended precast concrete and timber floors a minimum of 300mm is required.

9.11.3 The loadings from the suspended floor slab will need to be carried by the foundations, which will need to be designed to not only carry the structural loadings but the additional floor loadings.

9.11.4 If a piled foundation solution is adopted then a suspended floor slab will have to be used. If shallow foundations are used then as an alternative, a ground bearing floor slab, could be used if emplaced on a blanket of suitable granular materials. The granular blanket should be at least 50% of the foundation depth and no more than 1.25m deep (measured from ground level). Assuming that there the proposed and current trees do not increase the required depth for shallow foundations this would mean a blanket of granular material between 0.5m and 1.25m thick.

9.11.5 The granular blanket should extend beyond the edge of the foundation by a distance equal to its natural angle of repose, plus 0.5m. The angle of repose will depend on the material used.

9.11.6 It is possible that following simple sorting and processing that demolition waste could be used for this purpose.

9.12 Excavations

9.12.1 It is likely that some shallow excavations will be required at the site for services etc, in addition to larger excavations during construction works. These are anticipated to remain stable for the short term only.

9.12.2 The stability of all excavations should be assessed during construction. The sides of any excavations into which personnel are required to enter should be assessed and battered back to a safe angle.

9.12.3 Any vertically sided excavations require support to provide safe man access and to support the sides of the excavation. Supports should be installed as excavation proceeds. For service excavations, overlapping trench sheets could be used as close support in the Made Ground deposits to minimise ground loss. Alternatively, consideration could be given to the use of trench boxes provided excavations take place within the boxes.

9.13 Groundwater Control

9.13.1 Subject to seasonal variations, any groundwater encountered during site works could be readily dealt with by conventional pumping from a sump used to collate waters. Surface water or rainfall ingress could be similarly dealt with.

10 REFERENCES

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Ministry of Housing, Communities & Local Government: *National Planning Policy Framework*. February 2019.

NHBC Standards 2019. NHBC, Milton Keynes

APPENDICES

APPENDIX 1 – FIGURES

PROJECT NAME:	Royal College Street	**CLIENT:**	Cumbrae Properties (1963) Limited
TITLE:	Site Location Plan	**PROJECT NO.**	P2478J1837
DATE:	22/11/2019	**FIGURE:**	1

PROJECT NAME	146-150 Royal College Street, London NW1 0TA	**CLIENT**	Cumbrae Properties (1963) Limited
TITLE	Exploratory Hole Location Plan	**PROJECT NO.**	P2478J1837
DATE	February 2020	**FIGURE NO.**	2

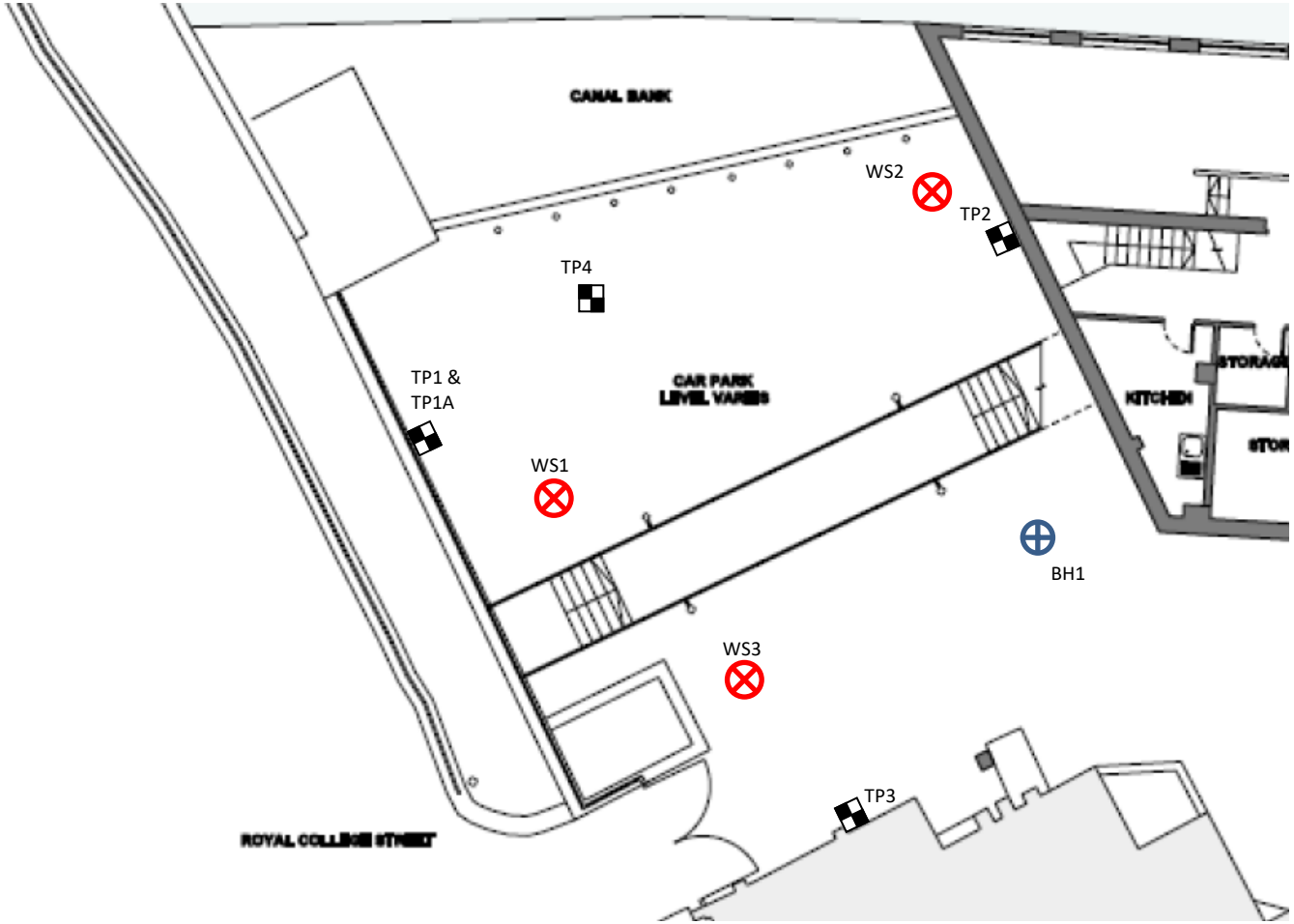
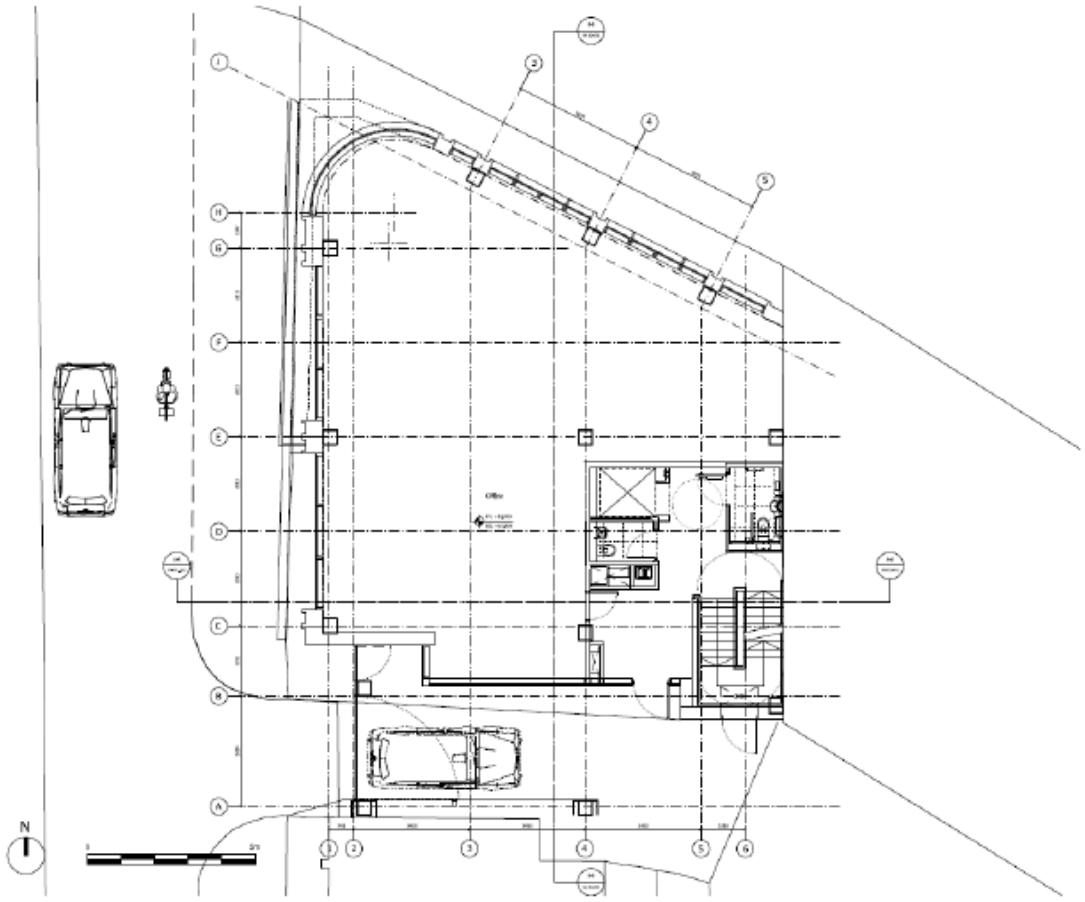


Figure 3



Proposed development

APPENDIX 2 – EXPLORATORY HOLE RECORDS

CABLE PERCUSSION BOREHOLE RECORD

		Exploratory Hole No:	BH2
Site Address:	146-150 Royal College Street, London NW1 0TA	Project No:	P2478J1837
Client:	Cumbrae Properties (1963) Limited	Ground Level:	
Logged By:	RT/JPB	Date Commenced:	03/12/2019
Checked By:	PSw	Date Completed:	03/12/2019
Type and diameter of equipment:	Dando 2000	Sheet No:	1 Of 5

Water levels recorded during boring, m

Date:						
Hole depth:						
Casing depth:						
Level water on strike:						
Water Level after 20mins:						

Remarks

1: Water added between 1.20m bgl to 20m bgl.

2: No water reported

3: * Field description

4:

Sample or Tests										Strata				
Type	Depth (mbgl)	Result								Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description	Installation
		75	75	75	75	75	75	N						
									0.00					
											0.10		Brick paving. (MADE GROUND)	
ES	0.20												Light brown gravelly sand with some cobbles. Sand is medium. Gravels consist of sub angular to rounded brick and flint. Cobbles consist of brick and metal. (MADE GROUND)	
											0.38			
ES	0.50								0.50				Brown grey clayey gravelly sand with some cobbles. Sand is fine. Gravel consists of sub angular to angular brick and concrete. Cobbles are concrete. (MADE GROUND)	
											0.75			
													Grey to dark grey silty sandy gravelly CLAY. Sand is medium. Gravel consists of sub angular brick and concrete. (MADE GROUND)	
ES+D	1.00								1.00					
S	1.20	1	0	1	2	5	7	15						
									1.50					
											1.80			
													Stiff consistency* brown CLAY. (LONDON CLAY FORMATION)	
S+D	2.00	2	2	2	3	4	3	12	2.00					
									2.50					
S+D	3.00	1	3	3	4	4	4	15	3.00					
									3.50					
U+D	4.00								4.00					
	50 blows for 450mm recovery													
									4.50					
S+D	5.00	3	4	4	5	4	6	19	5.00					

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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CABLE PERCUSSION BOREHOLE RECORD

		Exploratory Hole No:	BH2
Site Address:	146-150 Royal College Street, London NW1 0TA	Project No:	P2478J1837
Client:	Cumbrae Properties (1963) Limited	Ground Level:	
Logged By:	RT/JPB	Date Commenced:	03/12/2019
Checked By:	PSw	Date Completed:	03/12/2019
Type and diameter of equipment:	Dando 2000	Sheet No:	2 Of 5

Water levels recorded during boring, m

Date:						
Hole depth:						
Casing depth:						
Level water on strike:						
Water Level after 20mins:						

Remarks

1: Water added between 1.20m bgl to 20m bgl.
2: No water reported
3: * Field description
4:

Sample or Tests										Strata				
Type	Depth (mbgl)	Result								Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description	Installation
		75	75	75	75	75	75	N						
S+D	5.00	3	4	4	5	4	6	19	5.00				Stiff consistency* brown CLAY. (LONDON CLAY FORMATION)	
									5.50					
D	6.00								6.00					
U	6.50								6.50					
	55 blows for 405mm recovery													
D	7.00								7.00					
									7.50					
S+D	8.00	4	5	5	6	6	7	24	8.00					
									8.50					
D	9.00								9.00		9.00		Very stiff consistency* grey CLAY. (LONDON CLAY FORMATION)	
U	9.50								9.50					
	70 blows for 450mm recovery													
D	10.00								10.00					

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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CABLE PERCUSSION BOREHOLE RECORD

Exploratory Hole No:	BH2		
Site Address:	146-150 Royal College Street, London NW1 0TA	Project No:	P2478J1837
Client:	Cumbrae Properties (1963) Limited	Ground Level:	
Logged By:	RT/JPB	Date Commenced:	03/12/2019
Checked By:	PSw	Date Completed:	03/12/2019
Type and diameter of equipment:	Dando 2000	Sheet No:	3 Of 5

Water levels recorded during boring, m

Date:						
Hole depth:						
Casing depth:						
Level water on strike:						
Water Level after 20mins:						

Remarks

1: Water added between 1.20m bgl to 20m bgl.
2: No water reported
3: * Field description
4:

Sample or Tests										Strata				
Type	Depth (mbgl)	Result								Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description	Installation
		75	75	75	75	75	75	N						
D	10.00								10.00				Very stiff consistency* grey CLAY. (LONDON CLAY FORMATION)	
									10.50					
S+D	11.00	5	5	6	6	7	8	27	11.00					
									11.50					
D	12.00								12.00					
U	12.50								12.50					
	80 blows for 450mm recovery													
D	13.00								13.00					
									13.50					
S+D	14.00	5	6	6	7	8	10	31	14.00					
									14.50					
D	15.00								15.00					

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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CABLE PERCUSSION BOREHOLE RECORD

		Exploratory Hole No:	BH2
Site Address:	146-150 Royal College Street, London NW1 0TA	Project No:	P2478J1837
Client:	Cumbrae Properties (1963) Limited	Ground Level:	
Logged By:	RT/JPB	Date Commenced:	03/12/2019
Checked By:	PSw	Date Completed:	03/12/2019
Type and diameter of equipment:	Dando 2000	Sheet No:	4 Of 5

Water levels recorded during boring, m

Date:						
Hole depth:						
Casing depth:						
Level water on strike:						
Water Level after 20mins:						

Remarks

1: Water added between 1.20m bgl to 20m bgl.

2: No water reported

3: * Field description

4:

Sample or Tests										Strata				
Type	Depth (mbgl)	Result								Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description	Installation
		75	75	75	75	75	75	N						
D	15.00								15.00				Very stiff consistency* grey CLAY. (LONDON CLAY FORMATION)	
U	15.50								15.50					
	100 blows for 450mm recovery													
D	16.00								16.00					
									16.50					
S+D	17.00	5	8	8	10	12	12	42	17.00					
									17.50					
D	18.00								18.00					
U	18.50								18.50					
	100 blows for 450mm recovery													
D	19.00								19.00					
									19.50					
S+D	20.00	6	7	10	10	12	15	47	20.00					

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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CABLE PERCUSSION BOREHOLE RECORD

Exploratory Hole No:	BH2		
Site Address:	146-150 Royal College Street, London NW1 0TA	Project No:	P2478J1837
Client:	Cumbrae Properties (1963) Limited	Ground Level:	
Logged By:	RT/JPB	Date Commenced:	03/12/2019
Checked By:	PSw	Date Completed:	03/12/2019
Type and diameter of equipment:	Dando 2000	Sheet No:	5 Of 5

Water levels recorded during boring, m

Date:						
Hole depth:						
Casing depth:						
Level water on strike:						
Water Level after 20mins:						

Remarks

1: Water added between 1.20m bgl to 20m bgl.

2: No water reported

3: * Field description

4:

Sample or Tests									Strata				
Type	Depth (mbgl)	Result							Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description	Installation
		75	75	75	75	75	75	N					
S+D	20.00	6	7	10	10	12	15	47		20.45		Very stiff consistency* grey CLAY. (LONDON CLAY FORMATION)	

20.00
20.50
21.00
21.50
22.00
22.50
23.00
23.50
24.00
24.50
25.00

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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TRIAL PIT RECORD

Exploratory Hole No:	TP1		
Site Address:	146-150 Royal College Street, London NW1 0TA	Project No:	P2478J1837
Client:	Cumbrae Properties (1963) Limited	Ground Level:	
Logged By:	JW	Date Commenced:	02/12/2019
Checked By:	PSw	Date Completed:	02/12/2019
Type and diameter of equipment:	Hand Excavated	Sheet No:	1 Of 1

Pit Dimension:	Length:	0.50	Width:	0.50	Depth:	0.15

Remarks

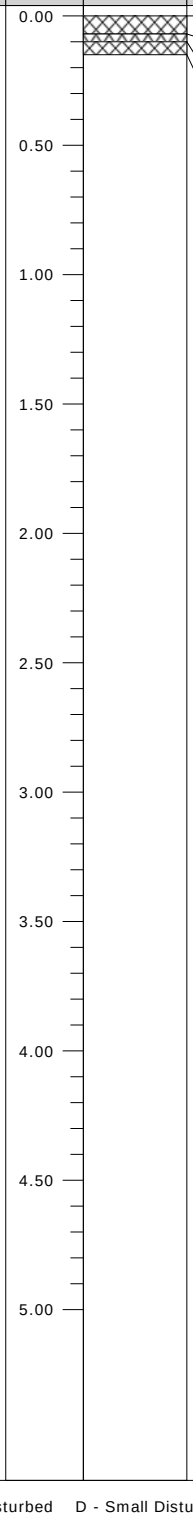
1: CAT signal traced along full length of wall

2: Trial pit aborted to avoid possible damage to identified buried services

3:

4:

Sample or Tests			Strata			
Type	Depth (mbgl)	Result	Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description
				0.07		Brick paving. (MADE GROUND)
				0.10		Yellow sand. Sand is fine. (MADE GROUND - Sub base)
				0.15		Concrete. (MADE GROUND)



Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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TRIAL PIT RECORD

Exploratory Hole No:	TP1A		
Site Address:	146-150 Royal College Street, London, NW1 0TA	Project No:	P2478J1837
Client:	Cumbrae Properties (1963) Limited	Ground Level:	
Logged By:	ST	Date Commenced:	18/01/2020
Checked By:	PSw	Date Completed:	18/01/2020
Type and diameter of equipment:	Hand Excavated	Sheet No:	1 Of 1

Pit Dimension:	Length:	0.50	Width:	0.50	Depth:	0.75

Remarks

1:

2:

3:

4:

Sample or Tests				Strata			
Type	Depth (mbgl)	Result		Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description
			0.00		0.10		Brick paving with sub base. (MADE GROUND)
					0.75		Slightly clayey sandy gravel with some cobbles. Gravel consists of brick, concrete and plastic. Cobbles consist of brick. (MADE GROUND)
			0.50				
			1.00				
			1.50				
			2.00				
			2.50				
			3.00				
			3.50				
			4.00				
			4.50				
			5.00				

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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TRIAL PIT RECORD

Exploratory Hole No:	TP2		
Site Address:	146-150 Royal College Street, London NW1 0TA	Project No:	P2478J1837
Client:	Cumbrae Properties (1963) Limited	Ground Level:	
Logged By:	JW	Date Commenced:	02/12/2019
Checked By:	PSw	Date Completed:	02/12/2019
Type and diameter of equipment:	Hand Excavated	Sheet No:	1 Of 1

Pit Dimension:	Length:	0.50	Width:	0.50	Depth:	0.80

Remarks

1: No water reported

2: * Field description

3:

4:

Sample or Tests			Strata			
Type	Depth (mbgl)	Result	Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description
				0.07		Brick paving. (MADE GROUND)
				0.13		Yellow sand. Sand is fine to coarse. (MADE GROUND)
ES	0.25					Soft consistency* very sandy very gravelly clay with medium cobble content and occasional roots and rootlets. Gravel consists of fine to coarse angular to sub rounded brick, concrete, flint with occasional glass and metal. Cobbles consist of sub angular concrete. (MADE GROUND)
ES	0.40					
ES	0.65			0.80		

0.00 — 0.50 — 1.00 — 1.50 — 2.00 — 2.50 — 3.00 — 3.50 — 4.00 — 4.50 — 5.00

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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TRIAL PIT RECORD

Exploratory Hole No:	TP3		
Site Address:	146-150 Royal College Street, London, NW1 0TA	Project No:	P2478J1837
Client:	Cumbrae Properties (1963) Limited	Ground Level:	
Logged By:	JW	Date Commenced:	18/01/2020
Checked By:		Date Completed:	18/01/2020
Type and diameter of equipment:	Hand dug	Sheet No:	1 Of 1

Pit Dimension:	Length:	0.50	Width:	0.50	Depth:	1.00

Remarks

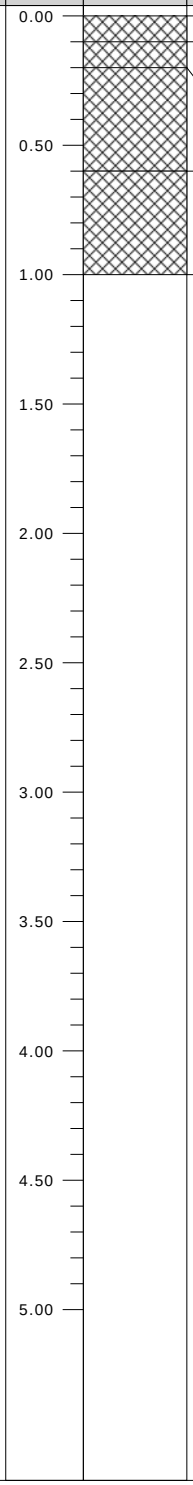
1: * Field description

2:

3:

4:

Sample or Tests			Strata			
Type	Depth (mbgl)	Result	Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description
				0.10		Concrete. (MADE GROUND)
				0.20		Yellow brown lightly gravelly sand. Sand is medium to coarse. Gravel consists of fine to medium sub angular to sub rounded flint. (MADE GROUND)
				0.60		Brown clayey very sandy gravel. Sand is medium to coarse. Gravel consists of fine to coarse angular to rounded brick, concrete and flint. (MADE GROUND)
				1.00		Firm consistency* brown black sandy gravelly clay with organic odour. Gravel consists of fine to medium sub angular to rounded flint, brick and concrete. (MADE GROUND)



Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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TRIAL PIT RECORD

Exploratory Hole No:	TP4		
Site Address:	146-150 Royal College Street, London NW1 0TA	Project No:	P2478J1837
Client:	Cumbrae Properties (1963) Limited	Ground Level:	
Logged By:	JPB	Date Commenced:	03/12/2019
Checked By:	PSw	Date Completed:	03/12/2019
Type and diameter of equipment:	Hand Excavated	Sheet No:	1 Of 1

Pit Dimension:	Length:	0.50	Width:	0.50	Depth:	1.20

Remarks

1: No water reported

2: Excavated at the proposed BH1 location due to time constraints

3:

4:

Sample or Tests			Strata			
Type	Depth (mbgl)	Result	Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description
				0.10		Brick paving. (MADE GROUND)
				0.15		Yellow sand. Sand is fine. (MADE GROUND)
ES	0.25					Brown grey very gravelly sand with high cobble content. Gravels consist of angular to sub angular brick, concrete, ceramic, metal and barbed wire. Cobbles consist of brick. (MADE GROUND)
ES	0.50					
ES	1.00			1.20		

0.00 — 0.50 — 1.00 — 1.50 — 2.00 — 2.50 — 3.00 — 3.50 — 4.00 — 4.50 — 5.00

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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WINDOW/WINDOWLESS SAMPLING BOREHOLE RECORD

		Exploratory Hole No:	WS1
Site Address:	146-150 Royal College Street, London, NW1 0TA	Project No:	P2478J1837
Client:	Cumbrae Properties (1963) Limited	Ground Level:	
Logged By:	ST	Date Commenced:	18/01/2020
Checked By:	PSw	Date Completed:	18/01/2020
Type and diameter of equipment:	Widowless sampler	Sheet No:	1 Of 2

Water levels recorded during boring, m						
Date:						
Hole depth:						
Casing depth:						
Level water on strike:						
Water Level after 20mins:						

Remarks

1: No water reported

2: * Field description

3: Pocket Penetrometer (PP) results converted to undrained shear strength.

4:

Sample or Tests										Strata				
Type	Depth (mbgl)	Result								Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description	Installation
		75	75	75	75	75	75	N	0.00					
											0.10		Brick paving over sub base. (MADE GROUND)	
ES	0.25												Dark grey slightly clayey sandy gravel with some cobbles. Gravel consists of brick, concrete, slate, tile and metal. Cobbles consist of brick. (MADE GROUND)	
ES	0.50								0.50					
ES+S	1.00	5	3	2	2	2	3	9	1.00					
									1.50		1.50			
											1.70		Brown very gravelly CLAY. Gravel is fine to medium sub angular to rounded flint. (LONDON CLAY FORMATION)	
S+D+PP	2.00	2	2	2	2	2	3	9	2.00				Stiff consistency* brown with grey veins slightly sandy CLAY and thinly spaced rootlets to 3mbgl. (LONDON CLAY FORMATION)	
	PP - 140 kPa													
									2.50					
S+D+PP	3.00	0	1	2	2	2	3	9	3.00					
	PP - 1500 kPa													
									3.50					
S+D+PP	4.00	0	1	2	2	3	4	11	4.00					
	PP - 160 kPa													
									4.50					
S+D+PP	5.00	2	2	2	4	4	5	15	5.00					
	PP - 220 kPa													

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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WINDOW/WINDOWLESS SAMPLING BOREHOLE RECORD

Exploratory Hole No:	WS1		
Site Address:	146-150 Royal College Street, London, NW1 0TA	Project No:	P2478J1837
Client:	Cumbrae Properties (1963) Limited	Ground Level:	
Logged By:	ST	Date Commenced:	18/01/2020
Checked By:	PSw	Date Completed:	18/01/2020
Type and diameter of equipment:	Widowless sampler	Sheet No:	2 Of 2

Water levels recorded during boring, m						
Date:						
Hole depth:						
Casing depth:						
Level water on strike:						
Water Level after 20mins:						

Remarks

1: No water reported

2: * Field description

3: Pocket Penetrometer (PP) results converted to undrained shear strength.

4:

Sample or Tests										Strata				
Type	Depth (mbgl)	Result								Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description	Installation
		75	75	75	75	75	75	N						
S+D+PP	5.00	2	2	2	4	4	5	15	5.00				Stiff consistency* brown with grey veins slightly sandy CLAY and thinly spaced rootlets to 3mbgl. (LONDON CLAY FORMATION)	
	PP - 220 kPa													
									5.50					
D+PP	6.00								6.00		6.00			
	PP - 200 kPa													
									6.50					
									7.00					
									7.50					
									8.00					
									8.50					
									9.00					
									9.50					
									10.00					

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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WINDOW/WINDOWLESS SAMPLING BOREHOLE RECORD

Exploratory Hole No:	WS2		
Site Address:	146-150 Royal College Street, London, NW1 0TA	Project No:	P2478J1837
Client:	Cumbrae Properties (1963) Limited	Ground Level:	
Logged By:	JW	Date Commenced:	18/01/2020
Checked By:	PSw	Date Completed:	18/01/2020
Type and diameter of equipment:	Widowless sampler	Sheet No:	1 Of 2

Water levels recorded during boring, m						
Date:						
Hole depth:						
Casing depth:						
Level water on strike:						
Water Level after 20mins:						

Remarks

1: No water reported
2: * Field description
3:
4:

Sample or Tests										Strata				
Type	Depth (mbgl)	Result								Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description	Installation
		75	75	75	75	75	75	N						
									0.00		0.10		Brick paving over sub base. (MADE GROUND)	
ES	0.25												Brown clayey very sandy gravel with high cobble content. Sand is medium to coarse. Gravel consists of fine to coarse angular to sub rounded brick, concrete and flint. Cobbles consists of sub angualr brick and concrete. (MADE GROUND)	
ES	0.50								0.50					
											0.80			
ES+S	1.00	0	1	1	2	2	2	7	1.00				Brown black sandy gravelly clay. Sand is fine to medium. Gravel consists of fine to coarse angular to sub rounded flint, brick, concrete and roofing slate. (MADE GROUND)	
											1.25			
													Soft to stiff consistency* brown mottled grey silty CLAY with occasional selenite crystals. (LONDON CLAY FORMATION)	
									1.50					
S+D	2.00	1	1	1	1	2	1	5	2.00					
									2.50					
S+D	3.00	0	0	2	2	2	3	9	3.00					
									3.50					
S+D	4.00	2	2	3	3	4	5	15	4.00					
									4.50					
S+D	5.00	1	2	2	3	3	5	13	5.00					

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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WINDOW/WINDOWLESS SAMPLING BOREHOLE RECORD

		Exploratory Hole No:	WS2
Site Address:	146-150 Royal College Street, London, NW1 0TA	Project No:	P2478J1837
Client:	Cumbrae Properties (1963) Limited	Ground Level:	
Logged By:	JW	Date Commenced:	18/01/2020
Checked By:	PSw	Date Completed:	18/01/2020
Type and diameter of equipment:	Widowless sampler	Sheet No:	2 Of 2

Water levels recorded during boring, m						
Date:						
Hole depth:						
Casing depth:						
Level water on strike:						
Water Level after 20mins:						

Remarks

1: No water reported

2: * Field description

3:

4:

Sample or Tests										Strata				
Type	Depth (mbgl)	Result								Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description	Installation
		75	75	75	75	75	75	N						
S+D	5.00	1	2	2	3	3	5	13	5.00				Soft to stiff consistency* brown mottled grey silty CLAY with occasional selenite crystals. (LONDON CLAY FORMATION)	
									5.50					
D	6.00								6.00		6.00			
									6.50					
									7.00					
									7.50					
									8.00					
									8.50					
									9.00					
									9.50					
									10.00					

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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		WINDOW/WINDOWLESS SAMPLING BOREHOLE RECORD	
		Exploratory Hole No:	WS3
Site Address:	146-150 Royal College Street, London, NW1 0TA	Project No:	P2478J1837
Client:	Cumbrae Properties (1963) Limited	Ground Level:	
Logged By:	ST	Date Commenced:	18/01/2020
Checked By:	PSw	Date Completed:	18/01/2020
Type and diameter of equipment:	Widowless sampler	Sheet No:	1 Of 2

Water levels recorded during boring, m						
Date:						
Hole depth:						
Casing depth:						
Level water on strike:						
Water Level after 20mins:						

Remarks

1: No water reported

2: * Field description

3: Pocket Penetrometer (PP) results converted to undrained shear strength.

4:

Sample or Tests										Strata				Installation
Type	Depth (mbgl)	Result								Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description	
		75	75	75	75	75	75	N						
									0.00		0.10		Brick paving over sub base. (MADE GROUND)	
ES	0.25												Yellow orange dark brown sandy slightly clayey gravel. Gravel consists of brick. (MADE GROUND)	
ES	0.50								0.50					
ES+S	1.00	6	6	6	5	8	8	27	1.00		1.10			
													Cream and red gravel and cobbles. Gravel and cobbles recovered as fine to coarse angular brick. (MADE GROUND)	
									1.50		1.90			
S+D+PP	2.00	1	1	1	2	2	3	8	2.00				Stiff consistency* brown withg grey veins sandy CLAY with thinly spaced rootlets to 2.5m bgl. (LONDON CLAY FORMATION)	
	PP - 75 kPa													
S+D	2.20													
									2.50					
S+D+PP	3.00	1	2	2	2	3	3	10	3.00					
	PP - 140 kPa													
									3.50					
S+D+PP	4.00	2	2	2	2	3	3	10	4.00					
	PP - 145 kPa													
									4.50					
S+D+PP	5.00	2	3	3	4	4	5	16	5.00					
	PP - 150 kPa													

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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WINDOW/WINDOWLESS SAMPLING BOREHOLE RECORD

		Exploratory Hole No:	WS3
Site Address:	146-150 Royal College Street, London, NW1 0TA	Project No:	P2478J1837
Client:	Cumbrae Properties (1963) Limited	Ground Level:	
Logged By:	ST	Date Commenced:	18/01/2020
Checked By:	PSw	Date Completed:	18/01/2020
Type and diameter of equipment:	Widowless sampler	Sheet No:	2 Of 2

Water levels recorded during boring, m						
Date:						
Hole depth:						
Casing depth:						
Level water on strike:						
Water Level after 20mins:						

Remarks

1: No water reported

2: * Field description

3: Pocket Penetrometer (PP) results converted to undrained shear strength.

4:

Sample or Tests										Strata				
Type	Depth (mbgl)	Result								Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description	Installation
		75	75	75	75	75	75	N						
S+D+PP	5.00	2	3	3	4	4	5	16	5.00				Stiff consistency* brown withg grey veins sandy CLAY with thinly spaced rootlets to 2.5m bgl. (LONDON CLAY FORMATION)	
	PP - 150 kPa													
									5.50					
S+D	6.00								6.00		6.00			
	PP - 200 kPa													
									6.50					
									7.00					
									7.50					
									8.00					
									8.50					
									9.00					
									9.50					
									10.00					

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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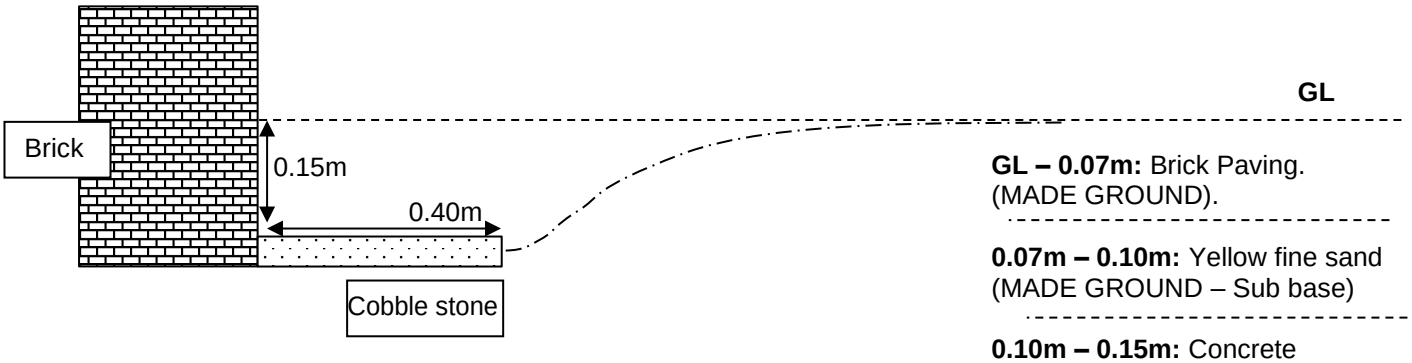
Job No.:	P2478J1837	**Issue Date:**	December 2019
Project:	Royal College Road	**Reference:**	P2478J1837/AJH
Subject:	Foundation Inspection Pit Sketch	**Prepared by:**	AJH

TP1



GL – 0.07m: Brick Paving. (MADE GROUND).

0.07m – 0.10m: Yellow fine sand (MADE GROUND – Sub base)

0.10m – 0.15m: Concrete (MADE GROUND).

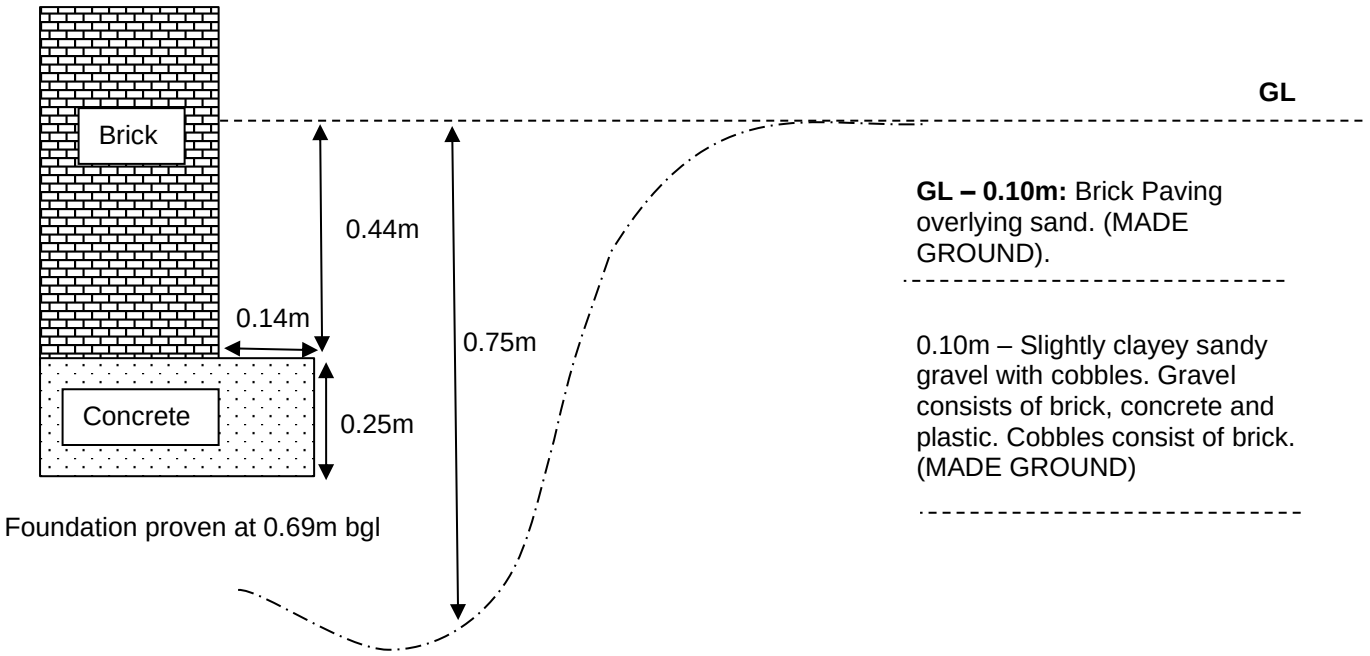
Trial pit terminated due to trace of utilities and time constraints

(Not to scale)

Depth and width of foundation unable to be proven

Job No.:	P2478J1837	**Issue Date:**	January 2020
Project:	Royal College Street	**Reference:**	P2478J1837/AJH
Subject:	Foundation Inspection Pit Sketches	**Prepared by:**	JLW

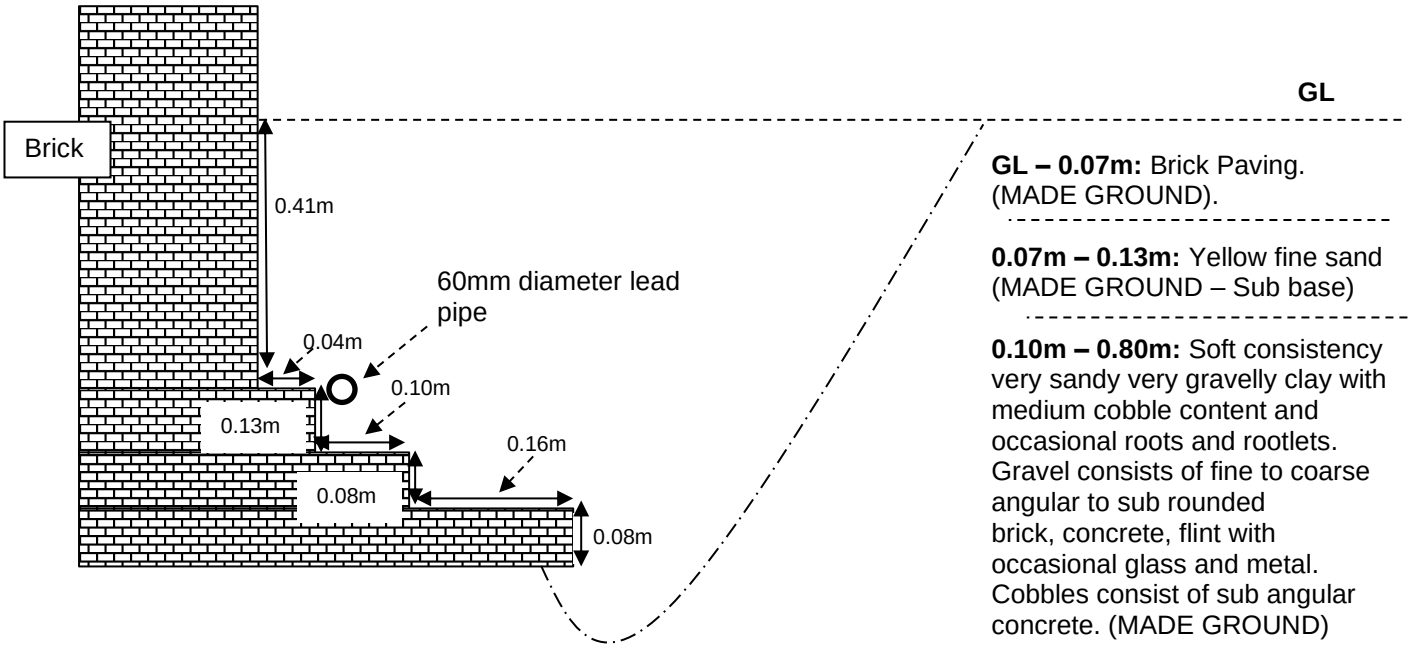
TP1A



(Not to scale)

Job No.:	P2478J1837	**Issue Date:**	December 2019
Project:	Royal College Road	**Reference:**	P2478J1837/AJH
Subject:	Foundation Inspection Pit Sketch	**Prepared by:**	AJH

TP2

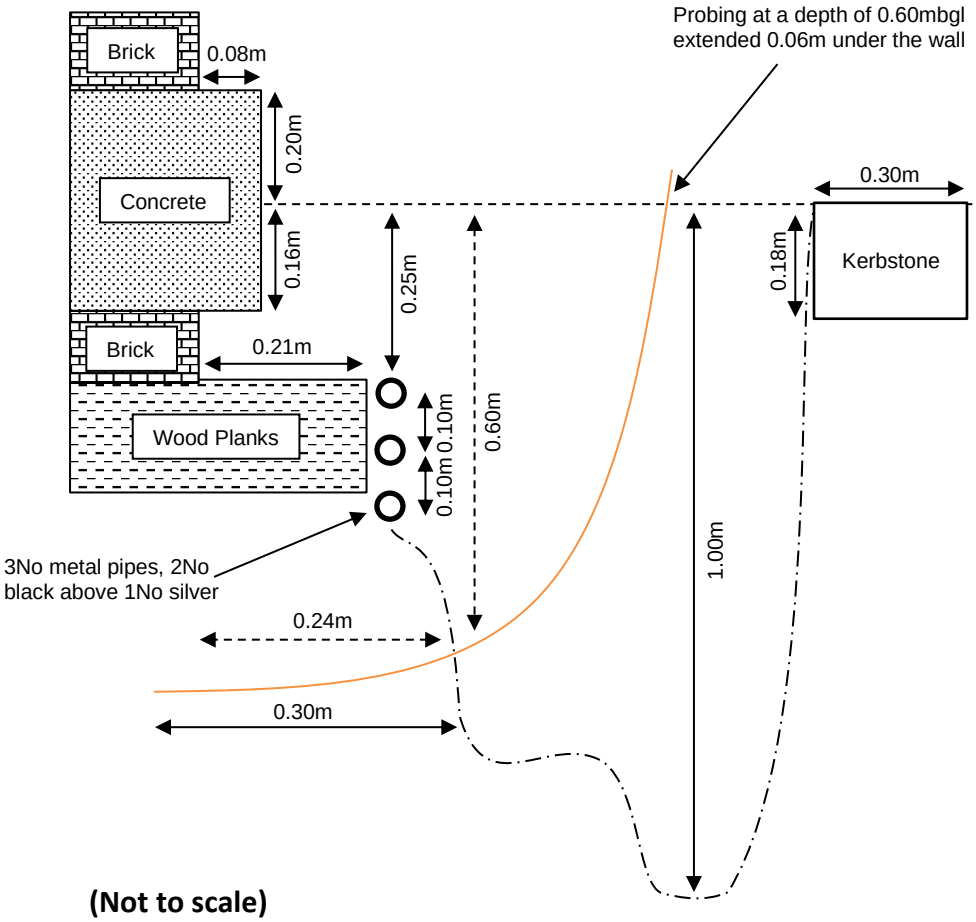


(Not to scale)

Depth and width of foundation proven at 0.70m bgl

Job No.:	P2478J1837	**Issue Date:**	January 2020
Project:	Royal College Road	**Reference:**	P2478J1837/AJH
Subject:	Foundation Inspection Pit Sketch	**Prepared by:**	AJH

TP3



(Not to scale)

GL – 0.08m: Concrete. (MADE GROUND)

0.08m – 0.18m: Yellow brown slightly gravelly sand. Sand is medium to coarse. Gravel consists of fine to medium, sub-angular to sub-rounded flint. (MADE GROUND – Sub base)

0.18m – 0.60m: Brown clayey very sandy gravel. Sand is medium to coarse. Gravel consists of fine to coarse, angular to rounded brick, concrete and flint, with occasional wood fragments. (MADE GROUND)

0.60m – 1.00m: Firm consistency* brown to black sandy gravelly clay. Sand is fine to coarse. Gravel consists of fine to medium, sub-angular to rounded flint, with occasional brick and concrete. (MADE GROUND).

*Field description.

Depth and width of foundation not proven. Probing into the side of the pit, at a depth of 0.60m, 0.24m from the brick wall, showed an undercutting of the wall by 0.06m. However, no foundations could be exposed as wood planks, metal pipes and kerbstone obstructed digging.

APPENDIX 3 – CHEMICAL LABORATORY TEST RESULTS

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Jomas Associates Ltd
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UB11 1BD

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Croxley Green
Business Park,
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Herts,
WD18 8YS

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e: reception@i2analytical.com

Analytical Report Number : 20-82599

Replaces Analytical Report Number : 20-82599, issue no. 1

Additional analysis undertaken.

Project / Site name:	146-150 Royal College Street, London NW1 0TA	**Samples received on:**	22/01/2020
Your job number:	JJ1837	**Samples instructed on:**	22/01/2020
Your order number:	P2478JJ1837.9	**Analysis completed by:**	13/02/2020
Report Issue Number:	2	**Report issued on:**	13/02/2020
Samples Analysed:	2 soil samples		

Signed:

Will Fardon

Technical Reviewer (CS Team)
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

Analytical Report Number: 20-82599

Project / Site name: 146-150 Royal College Street, London NW1 0TA
Your Order No: P2478JJ1837.9

Lab Sample Number				1419785	1419786			
Sample Reference				WS1	WS3			
Sample Number				None Supplied	None Supplied			
Depth (m)				0.50	0.25			
Date Sampled				18/01/2020	18/01/2020			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1			
Moisture Content	%	N/A	NONE	15	10			
Total mass of sample received	kg	0.001	NONE	1.3	1.3			
Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	Chrysotile	Chrysotile			
Asbestos in Soil	Type	N/A	ISO 17025	Detected	Detected			
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	< 0.001	0.001			
Asbestos Quantification Total	%	0.001	ISO 17025	< 0.001	0.001			
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	9.6	9.3			
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1			
Total Sulphate as SO_4	mg/kg	50	MCERTS	2900	980			
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.19	0.052			
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	186	52.0			
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0			
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Acenaphthylene	mg/kg	0.05	MCERTS	0.24	< 0.05			
Acenaphthene	mg/kg	0.05	MCERTS	0.18	< 0.05			
Fluorene	mg/kg	0.05	MCERTS	0.29	< 0.05			
Phenanthrene	mg/kg	0.05	MCERTS	5.0	1.1			
Anthracene	mg/kg	0.05	MCERTS	0.38	0.13			
Fluoranthene	mg/kg	0.05	MCERTS	7.4	1.8			
Pyrene	mg/kg	0.05	MCERTS	6.3	1.7			
Benzo(a)anthracene	mg/kg	0.05	MCERTS	2.5	0.81			
Chrysene	mg/kg	0.05	MCERTS	2.8	0.73			
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	3.4	0.98			
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	1.5	0.45			
Benzo(a)pyrene	mg/kg	0.05	MCERTS	2.6	0.74			
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	1.6	0.60			
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.49	0.19			
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	1.8	0.64			
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	36.7	9.78			

Analytical Report Number: 20-82599

Project / Site name: 146-150 Royal College Street, London NW1 0TA
Your Order No: P2478JJ1837.9

Lab Sample Number				1419785	1419786			
Sample Reference				WS1	WS3			
Sample Number				None Supplied	None Supplied			
Depth (m)				0.50	0.25			
Date Sampled				18/01/2020	18/01/2020			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	21	9.2			
Boron (water soluble)	mg/kg	0.2	MCERTS	0.7	0.3			
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.9	0.4			
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0			
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	31	17			
Copper (aqua regia extractable)	mg/kg	1	MCERTS	70	22			
Lead (aqua regia extractable)	mg/kg	1	MCERTS	980	240			
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	1.7	< 0.3			
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	23	14			
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0			
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	460	130			
Petroleum Hydrocarbons								
Petroleum Range Organics (C6 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1			
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	< 2.0			
TPH (C12 - C16)	mg/kg	4	MCERTS	8.4	< 4.0			
TPH (C16 - C21)	mg/kg	1	MCERTS	26	3.2			
TPH (C21 - C40)	mg/kg	10	MCERTS	100	< 10			

Analytical Report Number: 20-82599
Project / Site name: 146-150 Royal College Street, London NW1 0TA
Your Order No: P2478JJ1837.9

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

The samples were analysed qualitatively for asbestos by polarising light and dispersion staining as described by the Health and Safety Executive in HSG 248.

Quantitative Analysis

The analysis was carried out using our documented in-house method A006 based on HSE Contract Research Report No: 83/1996: Development and Validation of an analytical method to determine the amount of asbestos in soils and loose aggregates (Davies et al, 1996) and HSG 248. Our method includes initial examination of the entire representative sample, then fractionation and detailed analysis of each fraction, with quantification by hand picking and weighing.

The limit of detection (reporting limit) of this method is 0.001 %.

The method has been validated using samples of at least 100 g, results for samples smaller than this should be interpreted with caution.

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
1419785	WS1	0.50	123	Loose Fibres	**Chrysotile**	< 0.001	**< 0.001**
1419786	WS3	0.25	122	Loose Fibrous Debris	**Chrysotile**	0.001	**0.001**

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

Analytical Report Number : 20-82599

Project / Site name: 146-150 Royal College Street, London NW1 0TA

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

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

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1419785	WS1	None Supplied	0.50	Brown sand with rubble and brick.
1419786	WS3	None Supplied	0.25	Light brown sand with brick and rubble.

Analytical Report Number : 20-82599

Project / Site name: 146-150 Royal College Street, London NW1 0TA

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in house method based on references.	HSE Report No: 83/1996, HSG 248, HSG 264 & SCA Blue Book (draft).	A006-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
PRO (Soil)	Determination of hydrocarbons C6-C10 by headspace GC-MS.	In-house method based on USEPA8260	L088-PL	W	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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Analytical Report Number : 19-75928

Replaces Analytical Report Number : 19-75928, issue no. 3

Additional analysis undertaken.

Project / Site name:	146-150 Royal College Street, London NW1 0TA	**Samples received on:**	03/12/2019
Your job number:	JJ1837	**Samples instructed on:**	05/12/2019
Your order number:	P2478JJ1837.4	**Analysis completed by:**	11/02/2020
Report Issue Number:	4	**Report issued on:**	12/02/2020
Samples Analysed:	4 soil samples		

Signed:

Zina Abdul Razzak
Senior Quality Specialist

For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

Analytical Report Number: 19-75928

Project / Site name: 146-150 Royal College Street, London NW1 0TA
Your Order No: P2478JJ1837.4

Lab Sample Number				1383542	1383543	1383544	1383545	
Sample Reference				BH2	TP2	TP4	BH2	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				1.00	0.40	0.50	0.25	
Date Sampled				03/12/2019	02/12/2019	03/12/2019	03/12/2019	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	
Moisture Content	%	N/A	NONE	23	16	11	10	
Total mass of sample received	kg	0.001	NONE	0.61	1.3	1.1	1.4	
Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	-	Chrysotile & Crocidolite	
Asbestos in Soil	Type	N/A	ISO 17025	-	Not-detected	-	Detected	
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	-	-	< 0.001	
Asbestos Quantification Total	%	0.001	ISO 17025	-	-	-	< 0.001	
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	8.1	8.9	9.2	11.0	
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	
Total Sulphate as SO_4	mg/kg	50	MCERTS	5300	1000	2200	990	
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.19	0.12	0.22	0.061	
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	188	124	217	61.0	
Total Organic Carbon (TOC)	%	0.1	MCERTS	-	1.7	-	0.2	
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	0.21	< 0.05	< 0.05	< 0.05	
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	
Phenanthrene	mg/kg	0.05	MCERTS	0.43	0.35	0.48	< 0.05	
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	
Fluoranthene	mg/kg	0.05	MCERTS	0.28	0.92	0.83	< 0.05	
Pyrene	mg/kg	0.05	MCERTS	0.20	0.97	0.81	< 0.05	
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.20	0.66	0.55	< 0.05	
Chrysene	mg/kg	0.05	MCERTS	0.14	0.60	0.53	< 0.05	
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.76	0.48	< 0.05	
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.42	0.33	< 0.05	
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	0.54	0.36	< 0.05	
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	0.49	0.21	< 0.05	
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	0.54	0.26	< 0.05	
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	1.46	6.25	4.84	< 0.80	
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	16	19	14	5.8	
Boron (water soluble)	mg/kg	0.2	MCERTS	2.7	0.3	< 0.2	0.3	
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	1.2	0.5	0.2	
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	34	150	20	12	
Copper (aqua regia extractable)	mg/kg	1	MCERTS	57	95	21	17	
Lead (aqua regia extractable)	mg/kg	1	MCERTS	180	550	300	78	
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	0.7	1.2	< 0.3	< 0.3	
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	23	22	16	7.0	
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	98	730	300	74	

Analytical Report Number: 19-75928

Project / Site name: 146-150 Royal College Street, London NW1 0TA
Your Order No: P2478JJ1837.4

Lab Sample Number				1383542	1383543	1383544	1383545	
Sample Reference				BH2	TP2	TP4	BH2	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				1.00	0.40	0.50	0.25	
Date Sampled				03/12/2019	02/12/2019	03/12/2019	03/12/2019	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Monoaromatics & Oxygenates								
Benzene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
Toluene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
p & m-xylene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
o-xylene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
Petroleum Hydrocarbons								
Petroleum Range Organics (C6 - C10)	mg/kg	0.1	MCERTS	-	< 0.1	-	< 0.1	
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	-	< 2.0	-	
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0	-	< 8.0	-	
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	< 8.0	-	< 8.0	-	
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	-	< 10	-	
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	-	< 2.0	-	
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10	-	< 10	-	
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	< 10	-	38	-	
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	-	47	-	
TPH (C10 - C12)	mg/kg	2	MCERTS	-	11	-	< 2.0	
TPH (C12 - C16)	mg/kg	4	MCERTS	-	18	-	8.1	
TPH (C16 - C21)	mg/kg	1	MCERTS	-	150	-	9.0	
TPH (C21 - C40)	mg/kg	10	MCERTS	-	510	-	15	

Analytical Report Number: 19-75928

Project / Site name: 146-150 Royal College Street, London NW1 0TA
Your Order No: P2478JJ1837.4

Lab Sample Number				1383542	1383543	1383544	1383545	
Sample Reference				BH2	TP2	TP4	BH2	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				1.00	0.40	0.50	0.25	
Date Sampled				03/12/2019	02/12/2019	03/12/2019	03/12/2019	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
VOCs								
Chloromethane	µg/kg	1	ISO 17025	< 1.0	-	< 1.0	-	
Chloroethane	µg/kg	1	NONE	< 1.0	-	< 1.0	-	
Bromomethane	µg/kg	1	ISO 17025	< 1.0	-	< 1.0	-	
Vinyl Chloride	µg/kg	1	NONE	< 1.0	-	< 1.0	-	
Trichlorofluoromethane	µg/kg	1	NONE	< 1.0	-	< 1.0	-	
1,1-Dichloroethene	µg/kg	1	NONE	< 1.0	-	< 1.0	-	
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	1	ISO 17025	< 1.0	-	< 1.0	-	
Cis-1,2-dichloroethene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
1,1-Dichloroethane	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
2,2-Dichloropropane	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
Trichloromethane	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
1,1,1-Trichloroethane	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
1,2-Dichloroethane	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
1,1-Dichloropropene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
Trans-1,2-dichloroethene	µg/kg	1	NONE	< 1.0	-	< 1.0	-	
Benzene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
Tetrachloromethane	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
1,2-Dichloropropane	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
Trichloroethene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
Dibromomethane	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
Bromodichloromethane	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
Cis-1,3-dichloropropene	µg/kg	1	ISO 17025	< 1.0	-	< 1.0	-	
Trans-1,3-dichloropropene	µg/kg	1	ISO 17025	< 1.0	-	< 1.0	-	
Toluene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
1,1,2-Trichloroethane	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
1,3-Dichloropropane	µg/kg	1	ISO 17025	< 1.0	-	< 1.0	-	
Dibromochloromethane	µg/kg	1	ISO 17025	< 1.0	-	< 1.0	-	
Tetrachloroethene	µg/kg	1	NONE	< 1.0	-	< 1.0	-	
1,2-Dibromoethane	µg/kg	1	ISO 17025	< 1.0	-	< 1.0	-	
Chlorobenzene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
1,1,1,2-Tetrachloroethane	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
p & m-Xylene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
Styrene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
Tribromomethane	µg/kg	1	NONE	< 1.0	-	< 1.0	-	
o-Xylene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
1,1,2,2-Tetrachloroethane	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
Isopropylbenzene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
Bromobenzene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
n-Propylbenzene	µg/kg	1	ISO 17025	< 1.0	-	< 1.0	-	
2-Chlorotoluene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
4-Chlorotoluene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
1,3,5-Trimethylbenzene	µg/kg	1	ISO 17025	< 1.0	-	< 1.0	-	
tert-Butylbenzene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
1,2,4-Trimethylbenzene	µg/kg	1	ISO 17025	< 1.0	-	< 1.0	-	
sec-Butylbenzene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
1,3-Dichlorobenzene	µg/kg	1	ISO 17025	< 1.0	-	< 1.0	-	
p-Isopropyltoluene	µg/kg	1	ISO 17025	< 1.0	-	< 1.0	-	
1,2-Dichlorobenzene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
1,4-Dichlorobenzene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
Butylbenzene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
1,2-Dibromo-3-chloropropane	µg/kg	1	ISO 17025	< 1.0	-	< 1.0	-	
1,2,4-Trichlorobenzene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
Hexachlorobutadiene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	-	
1,2,3-Trichlorobenzene	µg/kg	1	ISO 17025	< 1.0	-	< 1.0	-	

Analytical Report Number: 19-75928
Project / Site name: 146-150 Royal College Street, London NW1 0TA
Your Order No: P2478JJ1837.4

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

The samples were analysed qualitatively for asbestos by polarising light and dispersion staining as described by the Health and Safety Executive in HSG 248.

Quantitative Analysis

The analysis was carried out using our documented in-house method A006 based on HSE Contract Research Report No: 83/1996: Development and Validation of an analytical method to determine the amount of asbestos in soils and loose aggregates (Davies et al, 1996) and HSG 248. Our method includes initial examination of the entire representative sample, then fractionation and detailed analysis of each fraction, with quantification by hand picking and weighing.

The limit of detection (reporting limit) of this method is 0.001 %.

The method has been validated using samples of at least 100 g, results for samples smaller than this should be interpreted with caution.

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
1383545	BH2	0.25	135	Loose Fibres	**Chrysotile & Crocidolite**	< 0.001	**< 0.001**

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

Analytical Report Number : 19-75928

Project / Site name: 146-150 Royal College Street, London NW1 0TA

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

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

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1383542	BH2	None Supplied	1.00	Brown loam and clay with gravel and vegetation.
1383543	TP2	None Supplied	0.40	Brown loam and clay with gravel and vegetation.
1383544	TP4	None Supplied	0.50	Brown clay and sand with gravel and vegetation.
1383545	BH2	None Supplied	0.25	Brown clay and sand with gravel and vegetation.

The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number : 19-75928

Project / Site name: 146-150 Royal College Street, London NW1 0TA

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in house method based on references.	HSE Report No: 83/1996, HSG 248, HSG 264 & SCA Blue Book (draft).	A006-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
PRO (Soil)	Determination of hydrocarbons C6-C10 by headspace GC-MS.	In-house method based on USEPA8260	L088-PL	W	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	MCERTS

Analytical Report Number : 19-75928

Project / Site name: 146-150 Royal College Street, London NW1 0TA

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS
Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Emma Hucker
Jomas Associates Ltd
Lakeside House
1 Furzeground Way
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e: Jomas Associates -

i2 Analytical Ltd.
7 Woodshots Meadow,
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Watford,
Herts,
WD18 8YS

t: 01923 225404
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Analytical Report Number : 19-79218

Project / Site name:	146-150 Royal College Street, London NW1 0TA	**Samples received on:**	03/12/2019
Your job number:	JJ1837	**Samples instructed on:**	23/12/2019
Your order number:	P2478JJ1837.5	**Analysis completed by:**	08/01/2020
Report Issue Number:	1	**Report issued on:**	08/01/2020
Samples Analysed:	4 soil samples		

Signed: Karoline Marek

Karolina Marek
Technical Reviewer (Reporting Team)

For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

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

Analytical Report Number: 19-79218

Project / Site name: 146-150 Royal College Street, London NW1 0TA
Your Order No: P2478JJ1837.5

Lab Sample Number				1402658	1402659	1402660	1402661	
Sample Reference				BH2	BH2	BH2	BH2	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				2.00	7.00	14.00	19.00	
Date Sampled				03/12/2019	03/12/2019	03/12/2019	03/12/2019	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	
Moisture Content	%	N/A	NONE	23	21	19	18	
Total mass of sample received	kg	0.001	NONE	2.0	2.0	2.0	2.0	
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	8.3	7.8	8.3	8.1	
Total Sulphate as SO_4	%	0.005	MCERTS	0.038	1.28	0.206	0.120	
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.063	3.6	0.65	0.44	
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	63.3	3620	645	436	
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	68	79	93	69	
Total Sulphur	%	0.005	MCERTS	0.037	0.370	0.380	0.258	
Ammonium as NH_4	mg/kg	0.5	MCERTS	< 0.5	2.1	2.8	5.0	
Ammonium as NH4 (10:1 leachate equivalent)	mg/l	0.05	MCERTS	< 0.05	0.21	0.28	0.50	
Water Soluble Nitrate (2:1) as NO_3	mg/kg	2	NONE	< 2.0	< 2.0	< 2.0	< 2.0	
Water Soluble Nitrate (2:1) as NO_3 (leachate equivalent)	mg/l	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	
Heavy Metals / Metalloids								
Magnesium (water soluble)	mg/kg	5	NONE	28	840	160	72	
Magnesium (leachate equivalent)	mg/l	2.5	NONE	14	420	80	36	

Analytical Report Number : 19-79218

Project / Site name: 146-150 Royal College Street, London NW1 0TA

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

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

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1402658	BH2	None Supplied	2.00	Brown clay.
1402659	BH2	None Supplied	7.00	Brown clay.
1402660	BH2	None Supplied	14.00	Brown clay.
1402661	BH2	None Supplied	19.00	Brown clay.

Analytical Report Number : 19-79218

Project / Site name: 146-150 Royal College Street, London NW1 0TA

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammonium as NH4 in soil	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method, 10:1 water extraction.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	MCERTS
Chloride, water soluble, in soil	Determination of Chloride colorimetrically by discrete analyser.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests. 2:1 extraction.	L082-PL	D	MCERTS
Magnesium, water soluble, in soil	Determination of water soluble magnesium by extraction with water followed by ICP-OES.	In-house method based on TRL 447	L038-PL	D	NONE
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In-house method based on BS1377 Part 2, 1990, Classification tests	L019-UK/PL	W	NONE
Nitrate, water soluble, in soil	Determination of nitrate by reaction with sodium salicylate and colorimetry.	In-house method based on Examination of Water and Wastewatern & Polish Standard Method PN-82/C-04579.08, 2:1 extraction.	L078-PL	D	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Total Sulphate in soil as %	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L038-PL	D	MCERTS
Total Sulphur in soil as %	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, and MEWAM 2006 Methods for the Determination of Metals in Soil	L038-PL	D	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

APPENDIX 4 – GEOTECHNICAL LABORATORY TEST RESULTS

TEST CERTIFICATE

Liquid and Plastic Limits

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

4041

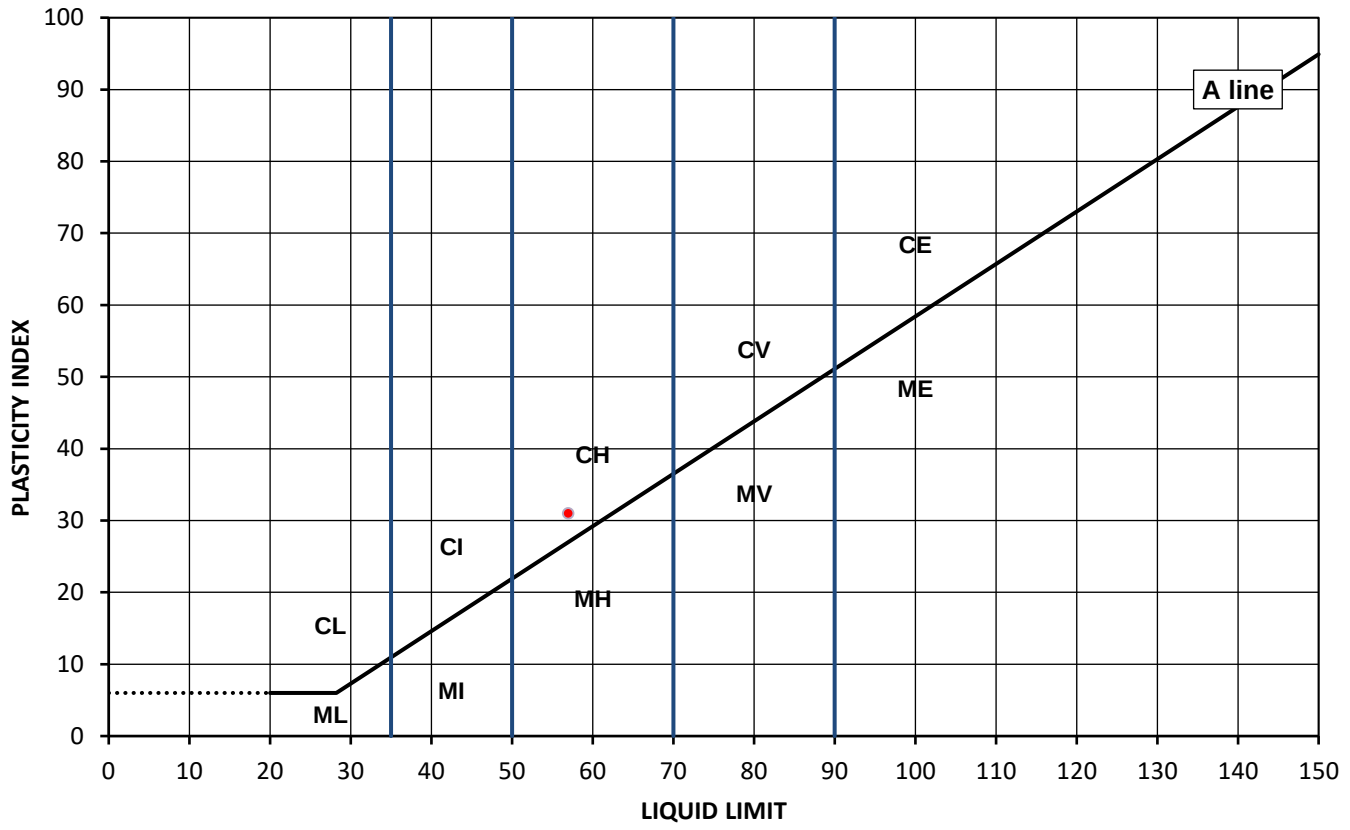
Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	Jomas Associates Ltd	Client Reference:	JJ1837
Client Address:	Lakeside House, 1 Furzeground Way, Stockley Park, UB11 1BD	Job Number:	19-75853
		Date Sampled:	Not Given
		Date Received:	03/12/2019
Contact:	Adam Hines	Date Tested:	10/12/2019
Site Name:	146-150 Royal College Street, London NW1 0TA	Sampled By:	Not Given
Site Address:	Not Given		

Test Results:

Laboratory Reference:	1383225	Depth Top [m]:	1.00
Hole No.:	BH2	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Soil Description:	Greyish brown slightly gravelly slightly sandy CLAY		
Sample Preparation:	Tested after washing to remove >425um		

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
24	57	26	31	76



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Approved: Dariusz Piotrowski
PL Geotechnical Laboratory Manager
Date Reported: 19/12/2019

Signed: Darren Berrill
Geotechnical General Manager
for and on behalf of i2 Analytical Ltd **GF 236.5**

TEST CERTIFICATE

Liquid and Plastic Limits

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

4041

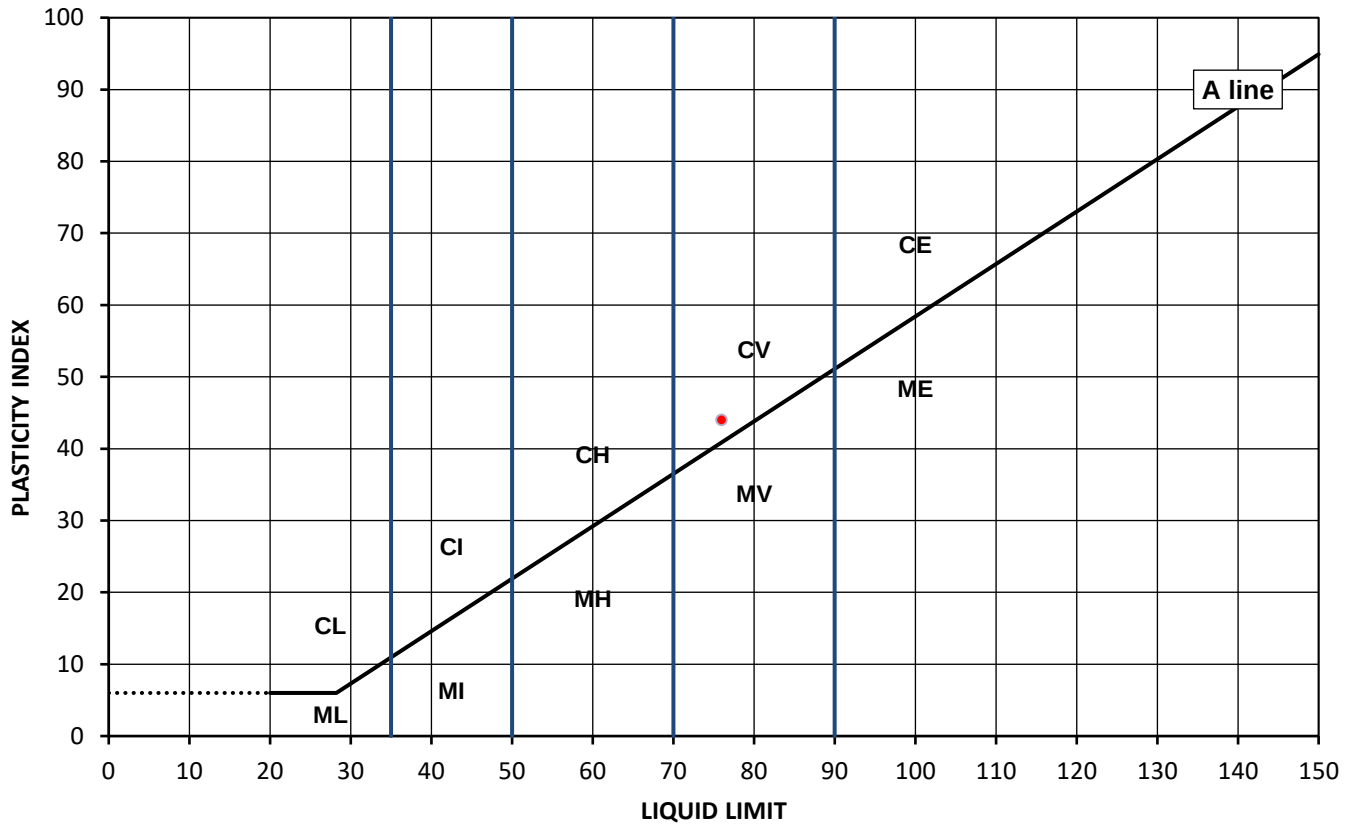
Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	Jomas Associates Ltd	Client Reference:	JJ1837
Client Address:	Lakeside House, 1 Furzeground Way, Stockley Park, UB11 1BD	Job Number:	19-75853
		Date Sampled:	Not Given
		Date Received:	03/12/2019
Contact:	Adam Hines	Date Tested:	10/12/2019
Site Name:	146-150 Royal College Street, London NW1 0TA	Sampled By:	Not Given
Site Address:	Not Given		

Test Results:

Laboratory Reference:	1383226	Depth Top [m]:	3.00
Hole No.:	BH2	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Soil Description:	Greyish brown slighty gravelly CLAY		
Sample Preparation:	Tested after >425um removed by hand		

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
34	76	32	44	99



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Approved: Dariusz Piotrowski
PL Geotechnical Laboratory Manager
Date Reported: 19/12/2019

Signed: Darren Berrill
Geotechnical General Manager
for and on behalf of i2 Analytical Ltd **GF 236.5**

TEST CERTIFICATE

Liquid and Plastic Limits

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

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

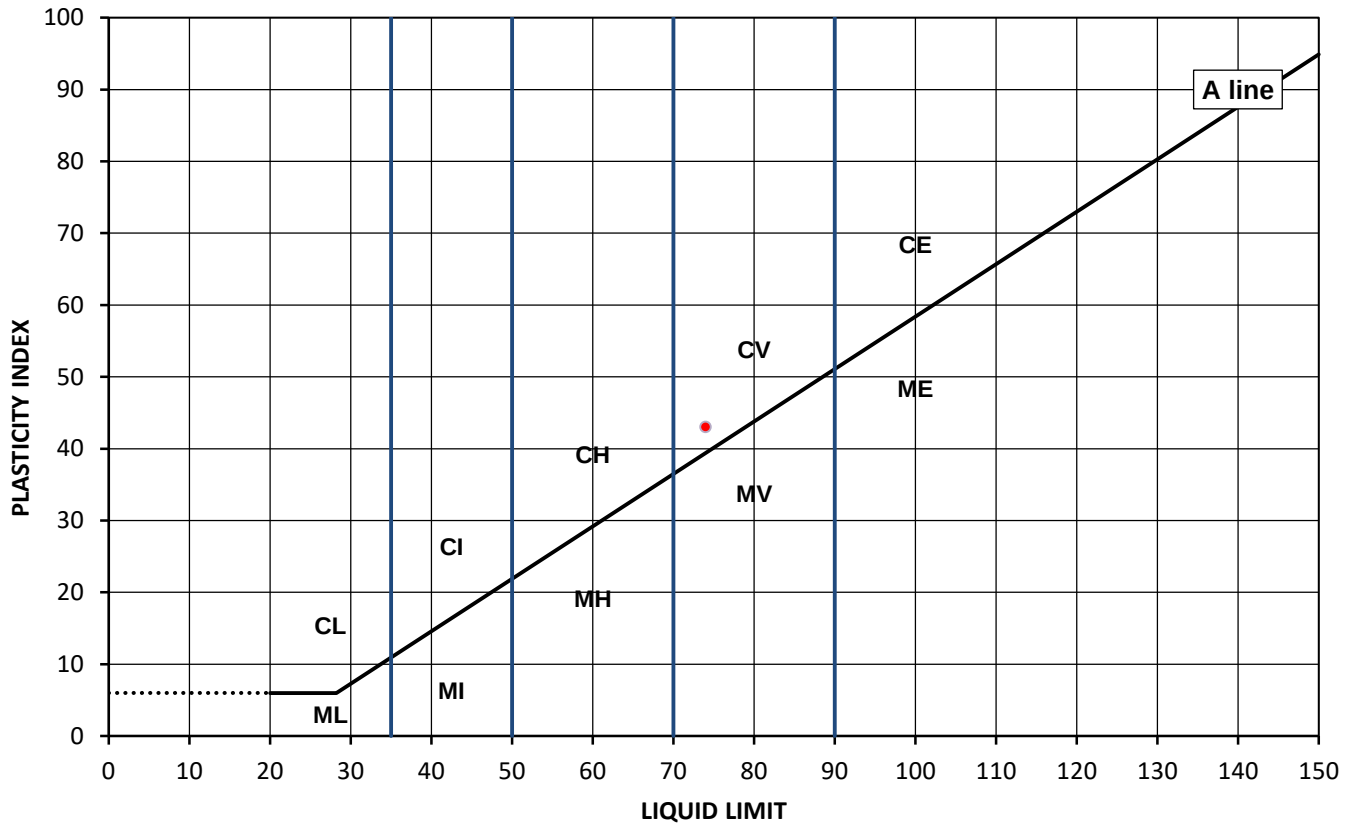
Client:	Jomas Associates Ltd	Client Reference:	JJ1837
Client Address:	Lakeside House, 1 Furzeground Way, Stockley Park, UB11 1BD	Job Number:	19-75853
		Date Sampled:	Not Given
		Date Received:	03/12/2019
Contact:	Adam Hines	Date Tested:	10/12/2019
Site Name:	146-150 Royal College Street, London NW1 0TA	Sampled By:	Not Given
Site Address:	Not Given		

Test Results:

Laboratory Reference:	1383227	Depth Top [m]:	5.00
Hole No.:	BH2	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Soil Description:	Greenish grey CLAY		

Sample Preparation: Tested in natural condition

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
32	74	31	43	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Approved: Dariusz Piotrowski
PL Geotechnical Laboratory Manager
Date Reported: 19/12/2019

Signed: Darren Berrill
Geotechnical General Manager
for and on behalf of i2 Analytical Ltd GF 236.5

TEST CERTIFICATE

Liquid and Plastic Limits

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

4041

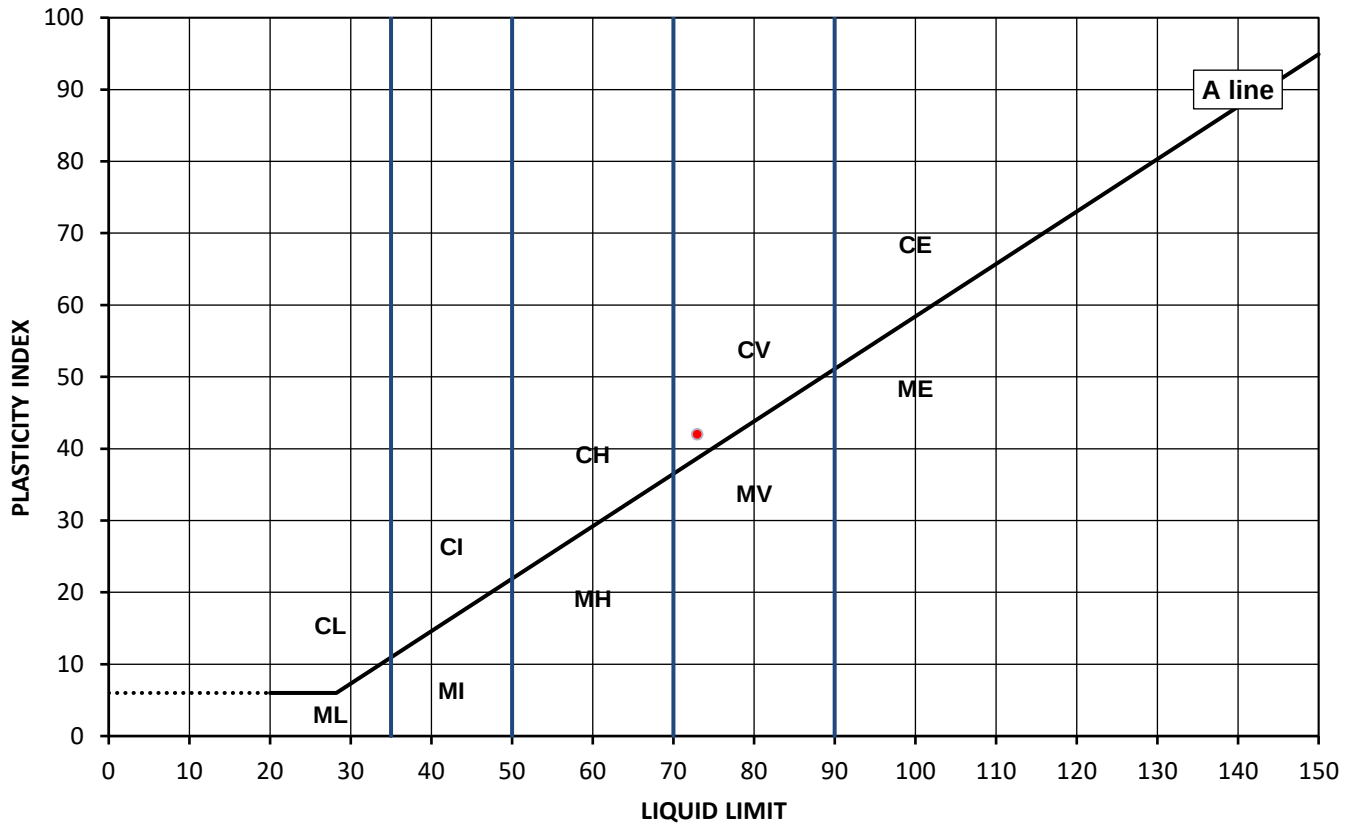
Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	Jomas Associates Ltd	Client Reference:	JJ1837
Client Address:	Lakeside House, 1 Furzeground Way, Stockley Park, UB11 1BD	Job Number:	19-75853
		Date Sampled:	Not Given
		Date Received:	03/12/2019
Contact:	Adam Hines	Date Tested:	10/12/2019
Site Name:	146-150 Royal College Street, London NW1 0TA	Sampled By:	Not Given
Site Address:	Not Given		

Test Results:

Laboratory Reference:	1383234	Depth Top [m]:	2.00
Hole No.:	BH2	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Soil Description:	Greyish brown slightly gravelly CLAY		
Sample Preparation:	Tested after >425um removed by hand		

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
35	73	31	42	99



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Approved: Dariusz Piotrowski
PL Geotechnical Laboratory Manager
Date Reported: 19/12/2019

Signed: Darren Berrill
Geotechnical General Manager
for and on behalf of i2 Analytical Ltd **GF 236.5**

SUMMARY REPORT

Summary of Classification Test Results

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

UKAS TESTING 4041

Environmental Science

Tested in Accordance with:

MC by BS 1377-2: 1990: Clause 3.2; WC by BS EN 17892-1: 2014; Atterberg by BS 1377-2: 1990: Clause 4.3, Clause 4.4 and 5; PD by BS 1377-2: 1990: Clause 8.2

Client: Jomas Associates Ltd

Client Address: Lakeside House, 1 Furzeground Way, Stockley Park, UB11 1BD

Contact: Adam Hines

Site Name: 146-150 Royal College Street, London NW1 0

Site Address: Not Given

Client Reference: JJ1837

Job Number: 19-75853

Date Sampled: Not Given

Date Received: 03/12/2019

Date Tested: 10/12/2019

Sampled By: Not Given

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	MC	WC	Atterberg				Density			Total Porosity#		
		Reference	Depth Top m	Depth Base m	Type			%	%	% Passing 425um %	LL %	PL %	PI %	bulk Mg/m3	dry Mg/m3	PD Mg/m3	%		
1383225	BH2	Not Given	1.00	Not Given	D	Greyish brown slightly gravelly slightly sandy CLAY	Atterberg 4 Point	24		76	57	26	31						
1383234	BH2	Not Given	2.00	Not Given	D	Greyish brown slightly gravelly CLAY	Atterberg 4 Point	35		99	73	31	42						
1383226	BH2	Not Given	3.00	Not Given	D	Greyish brown slighty gravelly CLAY	Atterberg 4 Point	34		99	76	32	44						
1383227	BH2	Not Given	5.00	Not Given	D	Greenish grey CLAY	Atterberg 4 Point	32		100	74	31	43						

Note: # Non accredited; NP - Non plastic

Comments:

Approved: Dariusz Piotrowski
PL Geotechnical Laboratory Manager
Date Reported: 19/12/2019

Signed: Darren Berrill
Geotechnical General Manager
for and on behalf of i2 Analytical Ltd **GF 238.7**

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

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

UKAS TESTING 4041

Environmental Science

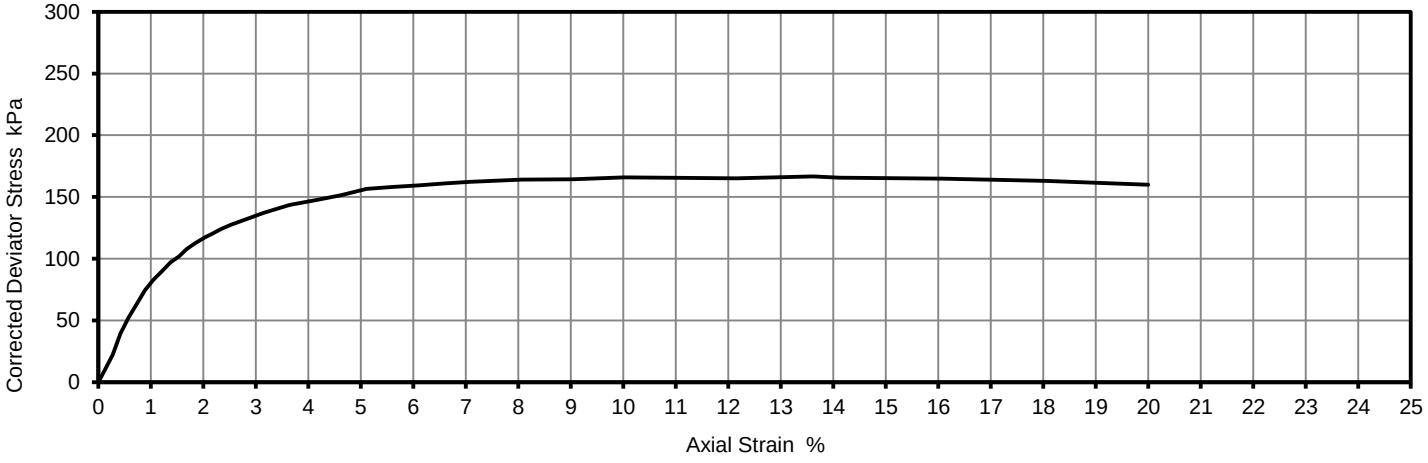
Client:	Jomas Associates Ltd	Client Reference:	JJ1837
Client Address:	Lakeside House, 1 Furzeground Way, Stockley Park, UB11 1BD	Job Number:	19-75853
		Date Sampled:	Not Given
		Date Received:	03/12/2019
Contact:	Adam Hines	Date Tested:	12/12/2019
Site Name:	146-150 Royal College Street, London NW1 0TA	Sampled By:	Not Given
Site Address:	Not Given		

Test Results:

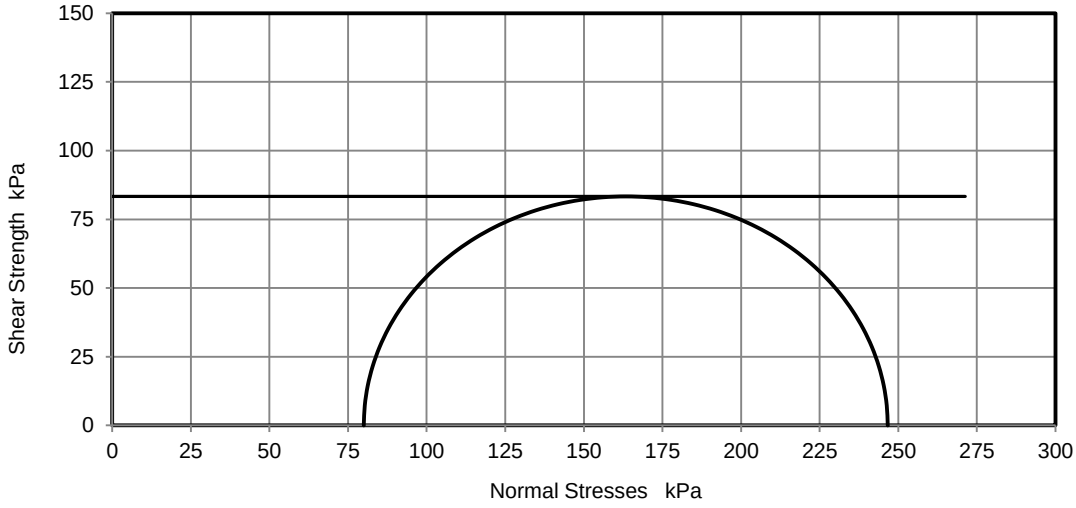
Laboratory Reference:	1383228	Depth Top [m]:	4.00
Hole No.:	BH2	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	U
Sample Description:	Brown slightly sandy CLAY		

Test Number	1		Rate of Strain	1.99	%/min	
Length	201.30	mm	Cell Pressure	80	kPa	
Diameter	101.60	mm	Axial Strain at failure	13.6	%	
Bulk Density	1.95	Mg/m3	Deviator Stress, (σ1 - σ3)f	167	kPa	
Moisture Content	29	%	Undrained Shear Strength, cu	83	kPa	½(σ1 - σ3)f
Dry Density	1.51	Mg/m3	Mode of Failure	Compound		
Membrane Correction	0.64	kPa	Membrane thickness	0.23	mm	

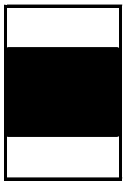
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Approved: Dariusz Piotrowski
PL Geotechnical Laboratory Manager
Date Reported: 19/12/2019

Signed: Darren Berrill
Geotechnical General Manager
for and on behalf of i2 Analytical Ltd **GF 184.7**

"Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation.
This report may not be reproduced other than in full without the prior written approval of the issuing laboratory.
The results included within the report are representative of the samples submitted for analysis.
The analysis was carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland."

"Any assessment of compliance with specifications based the analytical results in a report take in to account no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request."

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

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

UKAS TESTING
4041

Environmental Science

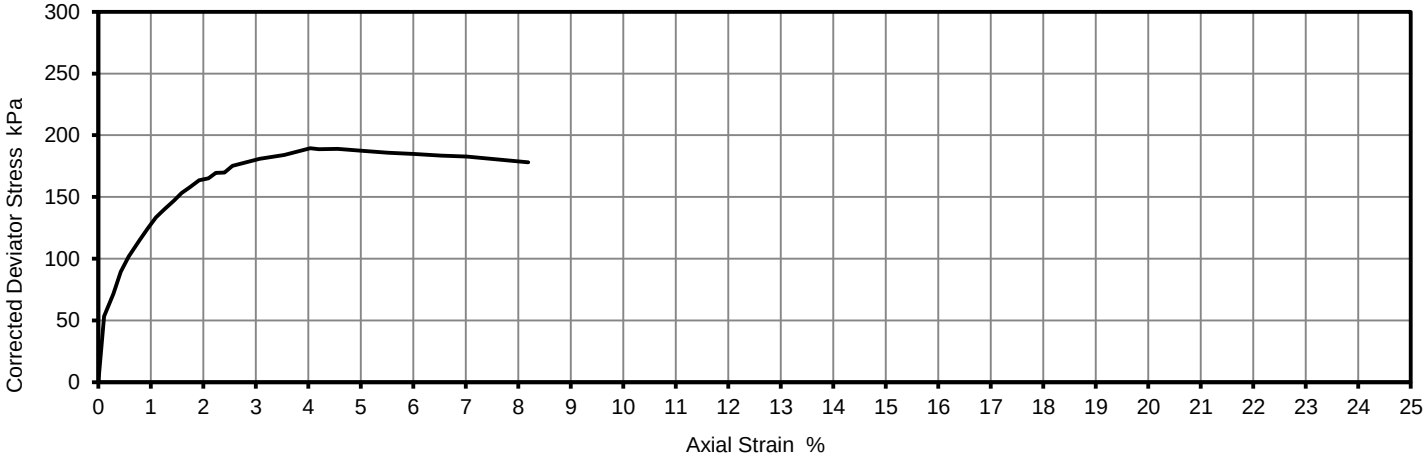
Client:	Jomas Associates Ltd	Client Reference:	JJ1837
Client Address:	Lakeside House, 1 Furzeground Way, Stockley Park, UB11 1BD	Job Number:	19-75853
		Date Sampled:	Not Given
		Date Received:	03/12/2019
Contact:	Adam Hines	Date Tested:	12/12/2019
Site Name:	146-150 Royal College Street, London NW1 0TA	Sampled By:	Not Given
Site Address:	Not Given		

Test Results:

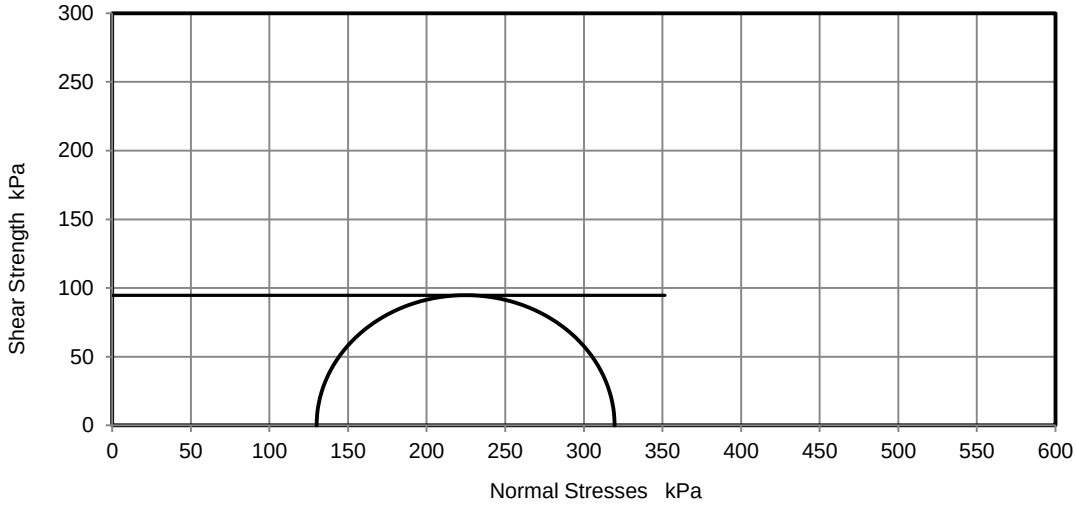
Laboratory Reference:	1383229	Depth Top [m]:	6.50
Hole No.:	BH2	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	U
Sample Description:	Brown slightly sandy CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	98.30	mm	Cell Pressure	130	kPa	
Diameter	49.10	mm	Axial Strain at failure	4.0	%	
Bulk Density	1.89	Mg/m3	Deviator Stress, (σ1 - σ3)f	190	kPa	
Moisture Content	27	%	Undrained Shear Strength, cu	95	kPa	½(σ1 - σ3)f
Dry Density	1.49	Mg/m3	Mode of Failure	Brittle		
Membrane Correction	0.50	kPa	Membrane thickness	0.22	mm	

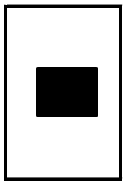
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Approved: Dariusz Piotrowski
PL Geotechnical Laboratory Manager
Date Reported: 19/12/2019

Signed: Darren Berrill
Geotechnical General Manager
for and on behalf of i2 Analytical Ltd **GF 184.7**

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

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

UKAS TESTING
4041

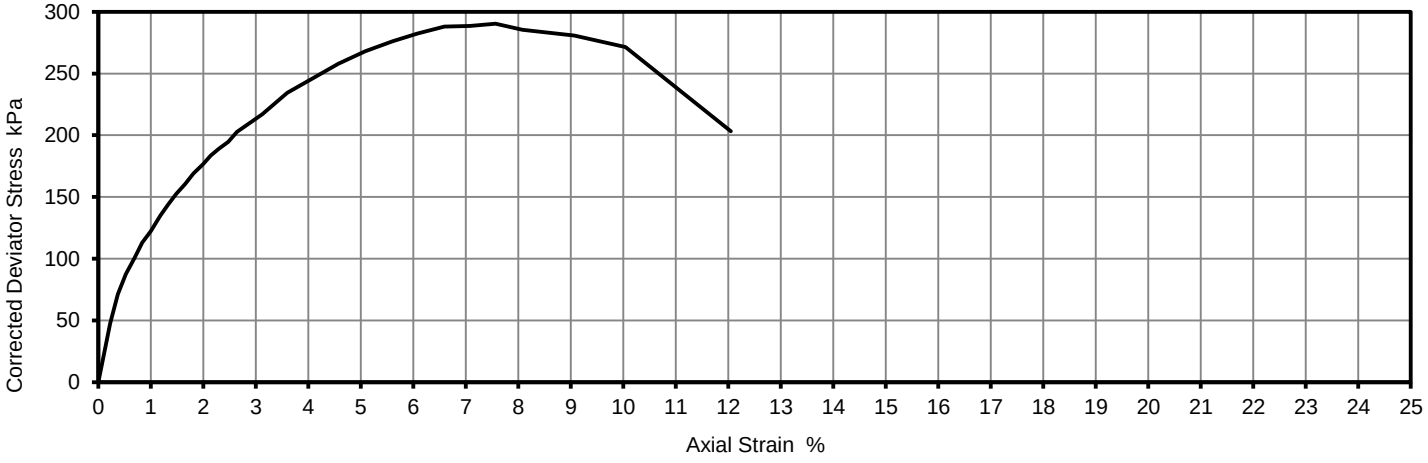
Client:	Jomas Associates Ltd	Client Reference:	JJ1837
Client Address:	Lakeside House, 1 Furzeground Way, Stockley Park, UB11 1BD	Job Number:	19-75853
		Date Sampled:	Not Given
		Date Received:	03/12/2019
Contact:	Adam Hines	Date Tested:	12/12/2019
Site Name:	146-150 Royal College Street, London NW1 0TA	Sampled By:	Not Given
Site Address:	Not Given		

Test Results:

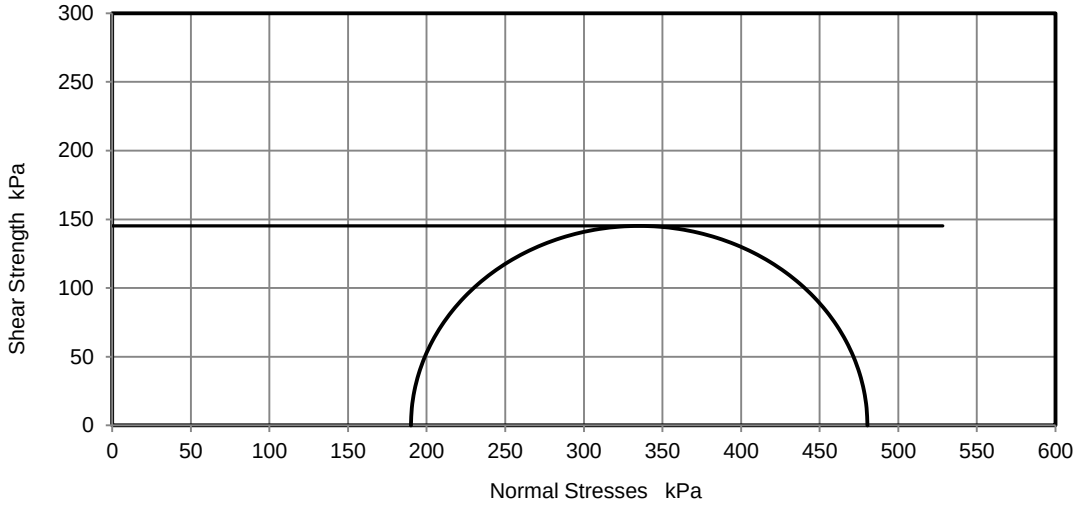
Laboratory Reference:	1383230	Depth Top [m]:	9.50
Hole No.:	BH2	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	U
Sample Description:	Brown slightly sandy CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	97.30	mm	Cell Pressure	190	kPa	
Diameter	49.00	mm	Axial Strain at failure	7.6	%	
Bulk Density	2.01	Mg/m3	Deviator Stress, (σ1 - σ3)f	290	kPa	
Moisture Content	23	%	Undrained Shear Strength, cu	145	kPa	½(σ1 - σ3)f
Dry Density	1.63	Mg/m3	Mode of Failure	Brittle		
Membrane Correction	0.79	kPa	Membrane thickness	0.21	mm	

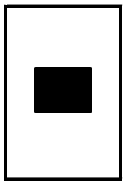
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Approved: Dariusz Piotrowski
PL Geotechnical Laboratory Manager
Date Reported: 19/12/2019

Signed: Darren Berrill
Geotechnical General Manager
for and on behalf of i2 Analytical Ltd **GF 184.7**

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

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

UKAS TESTING 4041

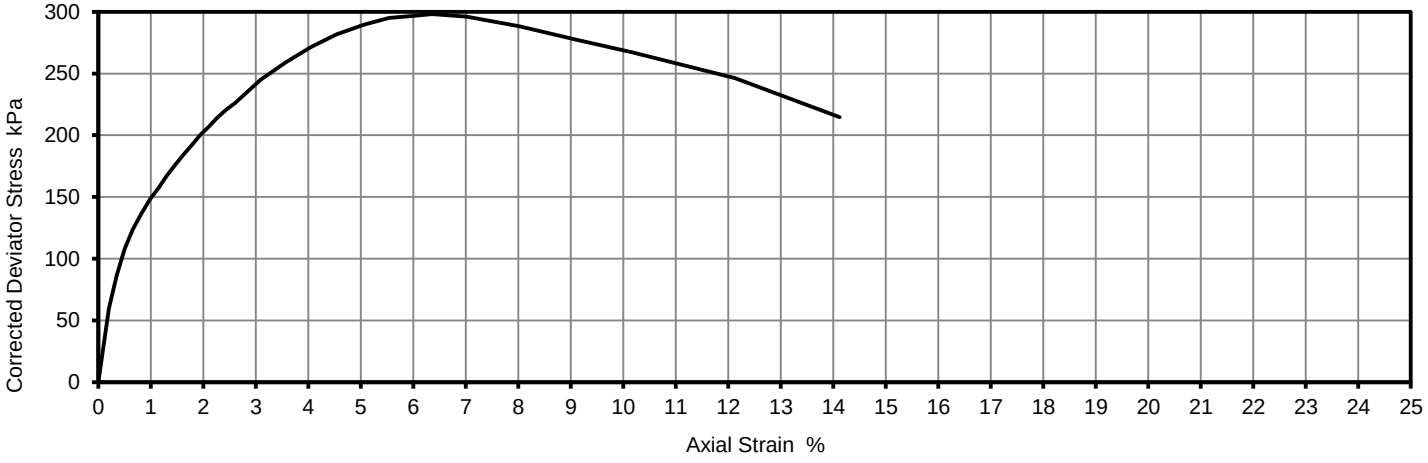
Client:	Jomas Associates Ltd	Client Reference:	JJ1837
Client Address:	Lakeside House, 1 Furzeground Way, Stockley Park, UB11 1BD	Job Number:	19-75853
		Date Sampled:	Not Given
		Date Received:	03/12/2019
Contact:	Adam Hines	Date Tested:	12/12/2019
Site Name:	146-150 Royal College Street, London NW1 0TA	Sampled By:	Not Given
Site Address:	Not Given		

Test Results:

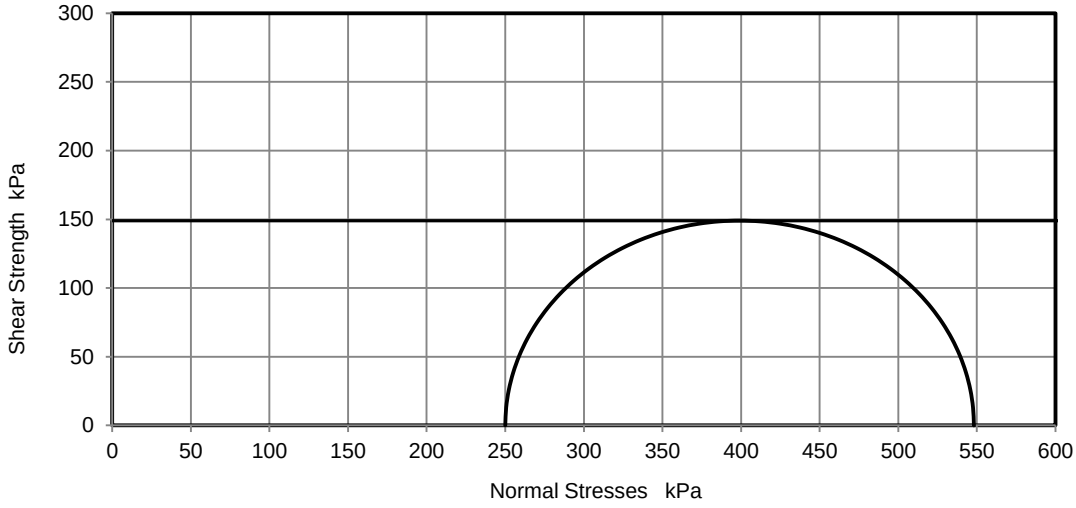
Laboratory Reference:	1383231	Depth Top [m]:	12.50
Hole No.:	BH2	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	U
Sample Description:	Brown CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	200.10	mm	Cell Pressure	250	kPa	
Diameter	102.30	mm	Axial Strain at failure	6.4	%	
Bulk Density	2.01	Mg/m3	Deviator Stress, (σ1 - σ3)f	298	kPa	
Moisture Content	23	%	Undrained Shear Strength, cu	149	kPa	½(σ1 - σ3)f
Dry Density	1.63	Mg/m3	Mode of Failure	Compound		
Membrane Correction	0.38	kPa	Membrane thickness	0.24	mm	

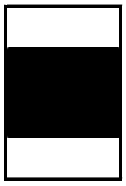
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Approved: Dariusz Piotrowski
PL Geotechnical Laboratory Manager
Date Reported: 19/12/2019

Signed: Darren Berrill
Geotechnical General Manager
for and on behalf of i2 Analytical Ltd **GF 184.7**

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

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

UKAS TESTING
4041

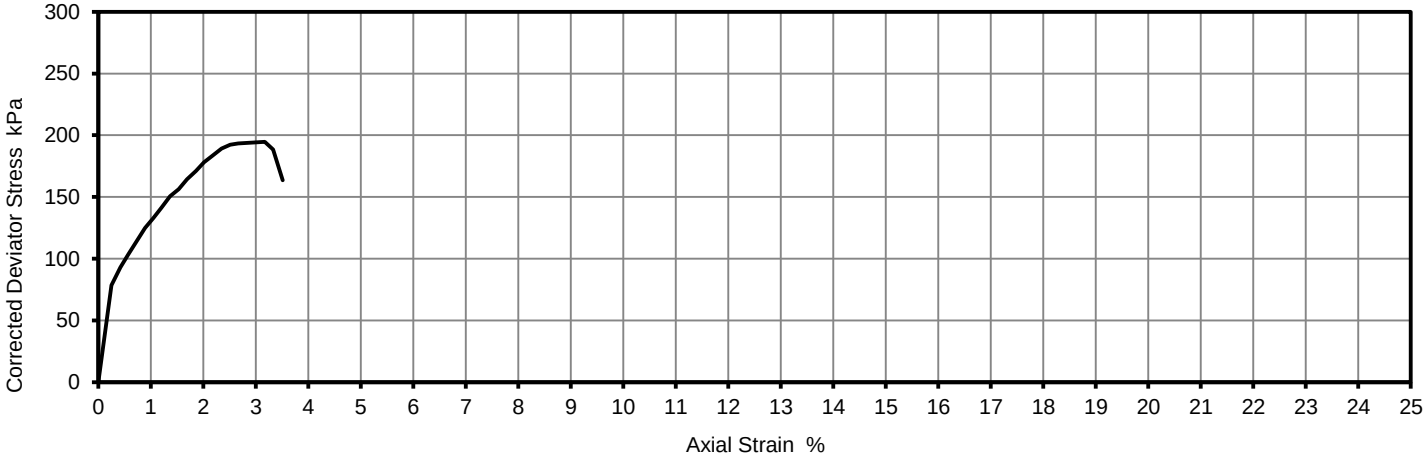
Client:	Jomas Associates Ltd	Client Reference:	JJ1837
Client Address:	Lakeside House, 1 Furzeground Way, Stockley Park, UB11 1BD	Job Number:	19-75853
		Date Sampled:	Not Given
		Date Received:	03/12/2019
Contact:	Adam Hines	Date Tested:	12/12/2019
Site Name:	146-150 Royal College Street, London NW1 0TA	Sampled By:	Not Given
Site Address:	Not Given		

Test Results:

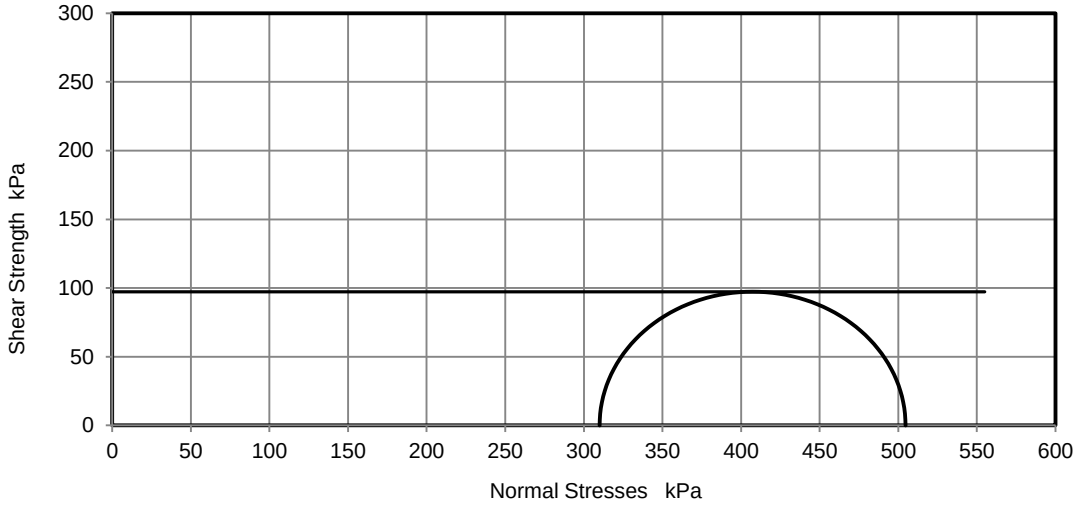
Laboratory Reference:	1383232	Depth Top [m]:	15.50
Hole No.:	BH2	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	U
Sample Description:	Brown CLAY		

Test Number	1		Rate of Strain	1.99	%/min	
Length	200.70	mm	Cell Pressure	310	kPa	
Diameter	102.50	mm	Axial Strain at failure	3.2	%	
Bulk Density	2.03	Mg/m3	Deviator Stress, (σ1 - σ3)f	195	kPa	
Moisture Content	26	%	Undrained Shear Strength, cu	97	kPa	½(σ1 - σ3)f
Dry Density	1.61	Mg/m3	Mode of Failure	Brittle		
Membrane Correction	0.18	kPa	Membrane thickness	0.21	mm	

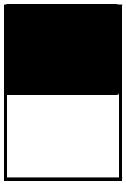
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Approved: Dariusz Piotrowski
PL Geotechnical Laboratory Manager
Date Reported: 19/12/2019

Signed: Darren Berrill
Geotechnical General Manager
for and on behalf of i2 Analytical Ltd **GF 184.7**

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

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

UKAS TESTING
4041

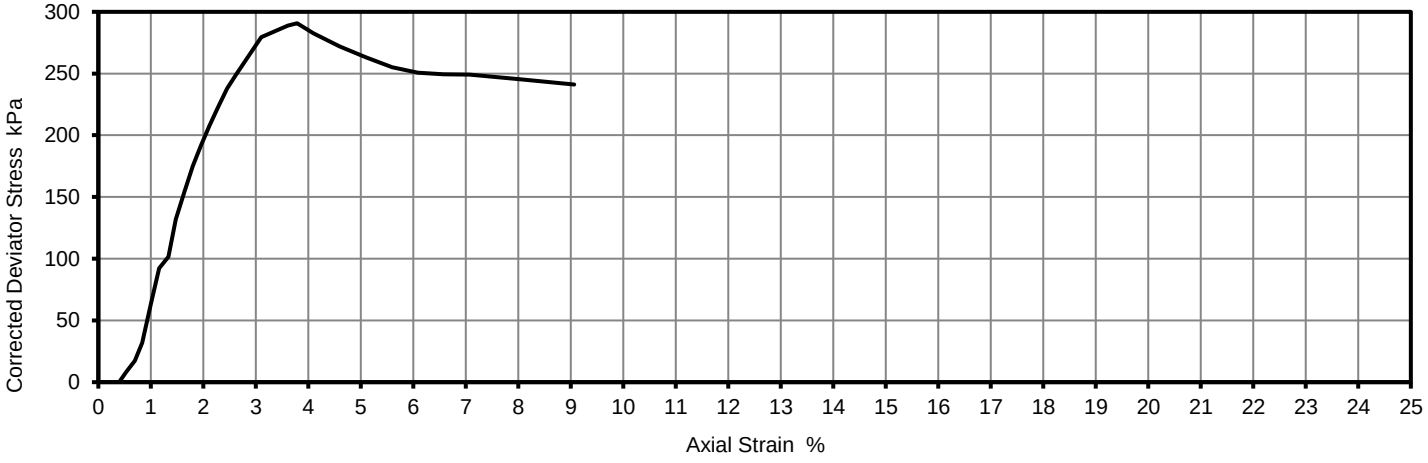
Client:	Jomas Associates Ltd	Client Reference:	JJ1837
Client Address:	Lakeside House, 1 Furzeground Way, Stockley Park, UB11 1BD	Job Number:	19-75853
		Date Sampled:	Not Given
		Date Received:	03/12/2019
Contact:	Adam Hines	Date Tested:	12/12/2019
Site Name:	146-150 Royal College Street, London NW1 0TA	Sampled By:	Not Given
Site Address:	Not Given		

Test Results:

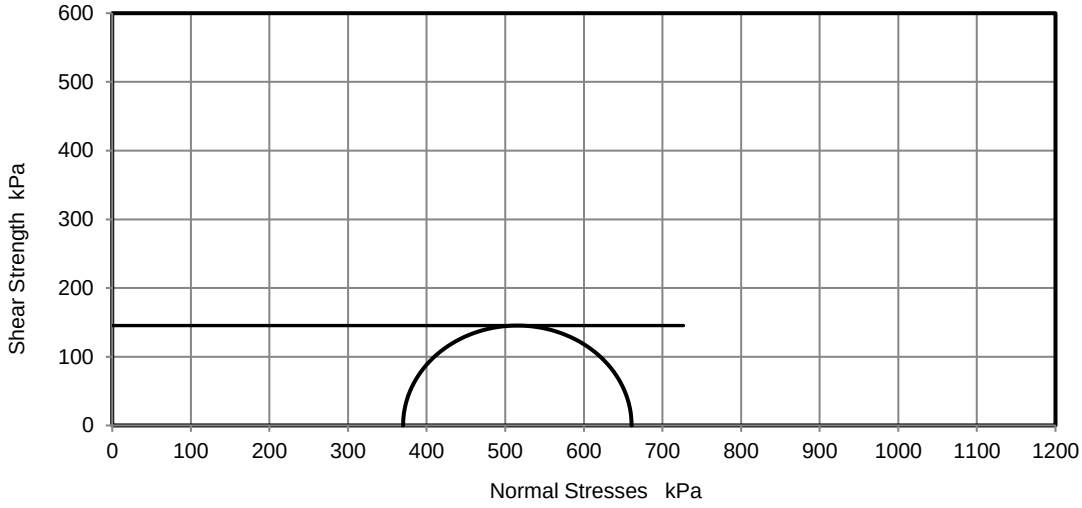
Laboratory Reference:	1383233	Depth Top [m]:	18.50
Hole No.:	BH2	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	U
Sample Description:	Brown slightly sandy CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	98.30	mm	Cell Pressure	370	kPa	
Diameter	49.10	mm	Axial Strain at failure	3.8	%	
Bulk Density	1.96	Mg/m3	Deviator Stress, (σ1 - σ3)f	291	kPa	
Moisture Content	23	%	Undrained Shear Strength, cu	145	kPa	½(σ1 - σ3)f
Dry Density	1.59	Mg/m3	Mode of Failure	Brittle		
Membrane Correction	0.44	kPa	Membrane thickness	0.21	mm	

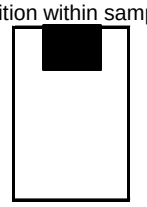
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Approved: Dariusz Piotrowski
PL Geotechnical Laboratory Manager
Date Reported: 19/12/2019

Signed: Darren Berrill
Geotechnical General Manager
for and on behalf of i2 Analytical Ltd **GF 184.7**

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	Jomas Associates Ltd	Client Reference:	JJ1837
Client Address:	Lakeside House, 1 Furzeground Way, Stockley Park, UB11 1BD	Job Number:	20-82811
		Date Sampled:	18/01/2020
		Date Received:	22/01/2020
Contact:	Adam Hines	Date Tested:	29/01/2020
Site Address:	146-150 Royal College Street, London NW1 0TA	Sampled By:	Not Given

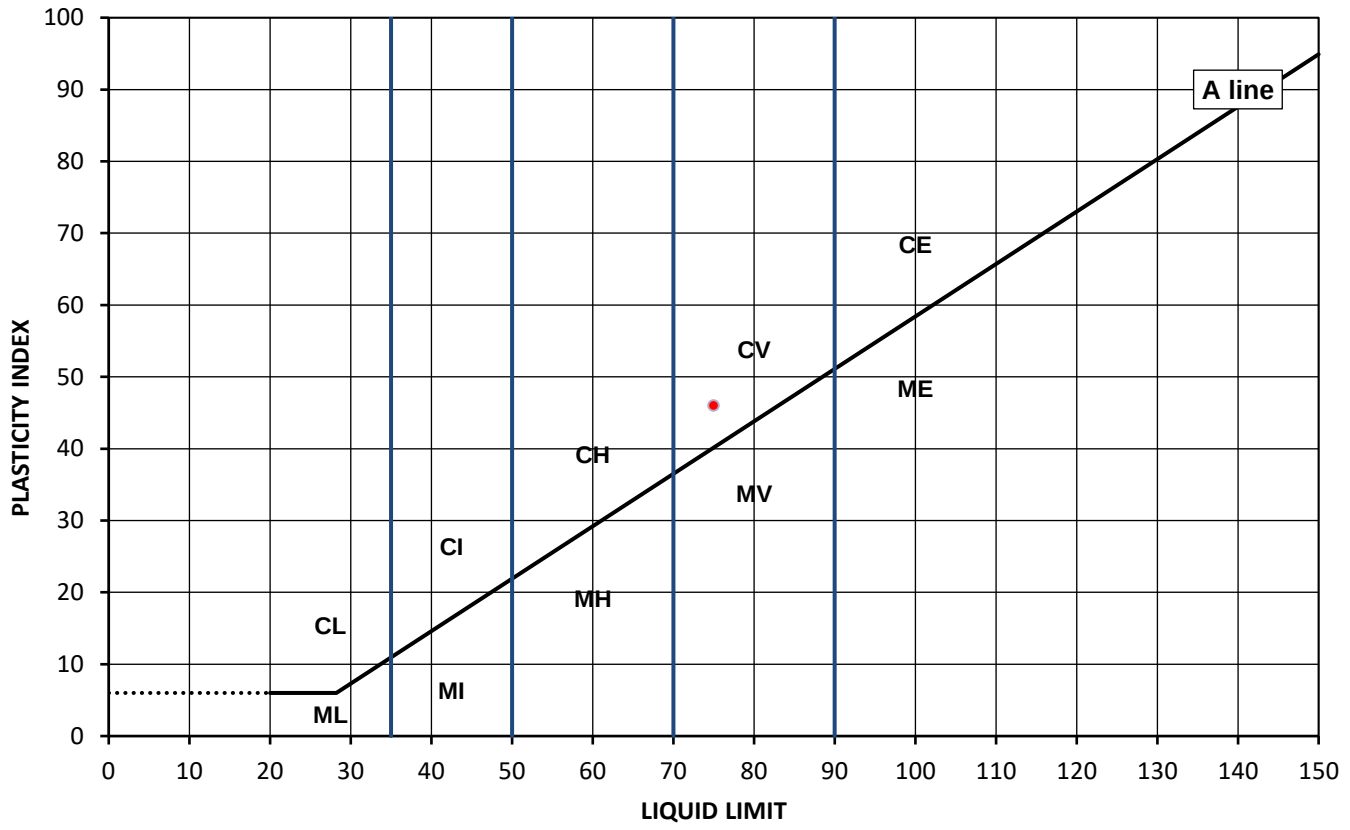
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1420917	Depth Top [m]:	2.00
Hole No.:	WS1	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Soil Description:	Brown sandy gravelly CLAY		

Sample Preparation: Tested after washing to remove >425um

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
16	75	29	46	62



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed: Dariusz Piotrowski
PL Geotechnical Laboratory Manager
for and on behalf of i2 Analytical Ltd

Date Reported: 04/02/2020

GF 236.6

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

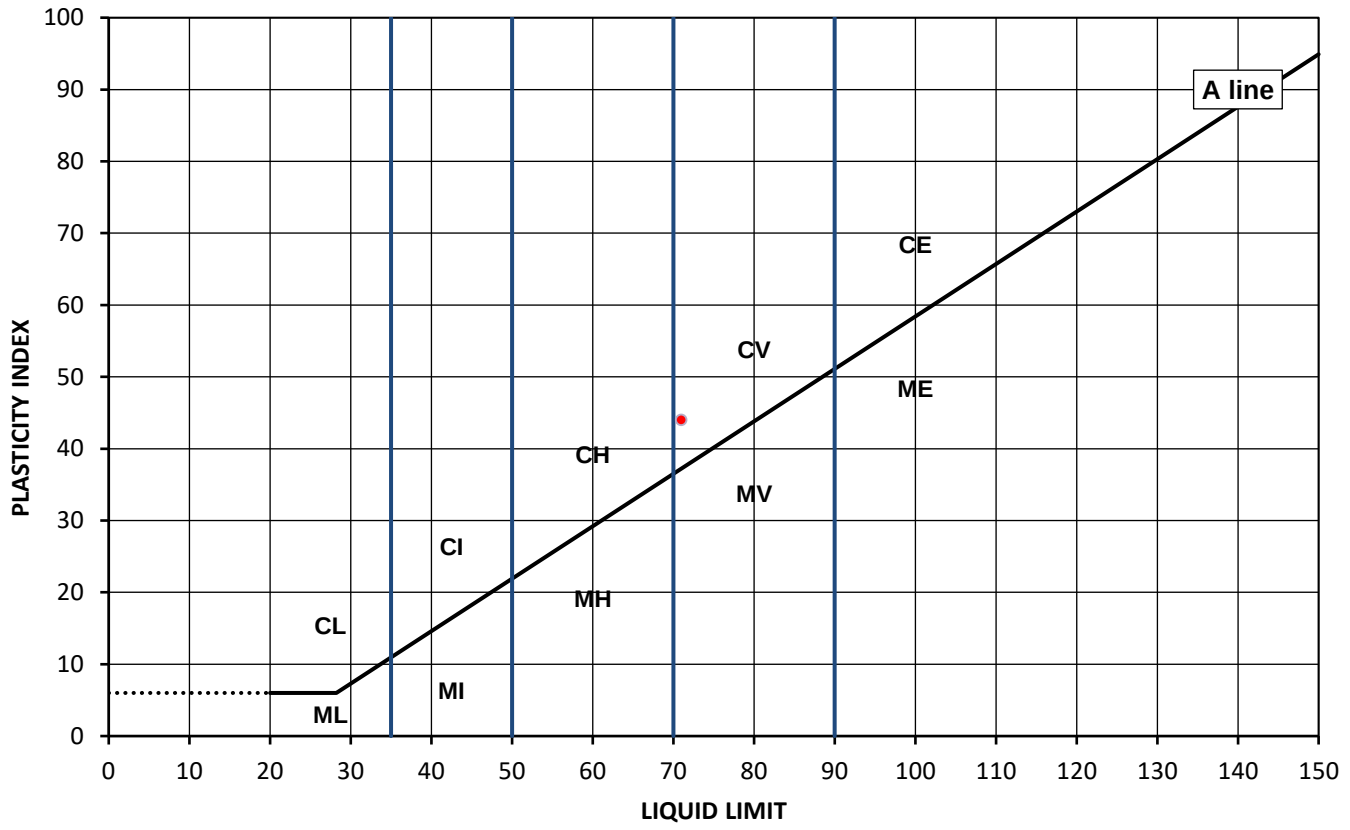
Client:	Jomas Associates Ltd	Client Reference:	JJ1837
Client Address:	Lakeside House, 1 Furzeground Way, Stockley Park, UB11 1BD	Job Number:	20-82811
		Date Sampled:	18/01/2020
		Date Received:	22/01/2020
Contact:	Adam Hines	Date Tested:	29/01/2020
Site Address:	146-150 Royal College Street, London NW1 0TA	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1420918	Depth Top [m]:	3.00
Hole No.:	WS2	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Soil Description:	Brownish grey slightly gravelly CLAY		
Sample Preparation:	Tested after washing to remove >425um		

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
43*	71	27	44	92



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks: * Sample is wet

Signed: Dariusz Piotrowski
PL Geotechnical Laboratory Manager
for and on behalf of i2 Analytical Ltd

Date Reported: 04/02/2020

GF 236.6

SUMMARY REPORT

Summary of Classification Test Results

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with:

MC by BS 1377-2: 1990: Clause 3.2; WC by BS EN 17892-1: 2014; Atterberg by BS 1377-2: 1990: Clause 4.3, Clause 4.4 and 5; PD by BS 1377-2: 1990: Clause 8.2

Client: Jomas Associates Ltd

Client Address: Lakeside House, 1 Furzeground Way, Stockley Park, UB11 1BD

Contact: Adam Hines

Site Address: 146-150 Royal College Street, London NW1 0

Client Reference: JJ1837
Job Number: 20-82811
Date Sampled: 18/01/2020
Date Received: 22/01/2020
Date Tested: 29/01/2020
Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	MC	WC	Atterberg				Density			Total Porosity#		
		Reference	Depth Top	Depth Base	Type					% Passing 425um	LL	PL	PI	bulk	dry	PD			
			m	m				%	%	%	%	%	%	Mg/m3	Mg/m3	Mg/m3	%		
1420917	WS1	Not Given	2.00	Not Given	D	Brown sandy gravelly CLAY	Atterberg 4 Point	16		62	75	29	46						
1420918	WS2	Not Given	3.00	Not Given	D	Brownish grey slightly gravelly CLAY	Atterberg 4 Point	43*		92	71	27	44						

Note: # Non accredited; NP - Non plastic

Comments: * Sample is wet

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Signed: Dariusz Piotrowski
PL Geotechnical Laboratory Manager
for and on behalf of i2 Analytical Ltd

Date Reported: 04/02/2020

GF 238.8

APPENDIX 5 – SOIL GAS MONITORING TEST RESULTS

GAS AND GROUNDWATER MONITORING BOREHOLE RECORD SHEET

Site: Royal College Street	**Operative(s):** JPB	**Date:** 31/01/20	**Time:** 10:10	**Round:** 1	**Page: 1**

MONITORING EQUIPMENT

Instrument Type	Instrument Make	Serial No.	Date Last Calibrated
Analox	GA5000	G501805	29/01/2019
PID	Phocheck tiger	T-106448	04/10/2018
Dip Meter	GeoTech		

MONITORING CONDITIONS

Weather Conditions: Cloudy	**Ground Conditions:** Dry	**Temperature:** 11 °C
Barometric Pressure (mbar): 1005	**Barometric Pressure Trend (24hr):** Steady	**Ambient Concentration:** 0.3 %CH_4, 0.2 %CO_2, 21.3 %O_2

MONITORING RESULTS

Monitoring Point Location	Flow		Atmospheric Pressure (mbar)	CH_4 %	CH_4 % LEL	CO_2 %	O_2 %	VOC (ppm)		H_2S (ppm)	CO (ppm)	Depth to product (mbgl)	Depth to water (mbgl)	Depth to Base of well (mbgl)
	Peak	Steady						Peak	steady					
WS2	+0.1	+0.1	1005	0.3	/	1.7	19.8	0	0	0	1	/	1.25	5.00
WS3	+0.1	+0.1	1006	0.3	/	0.9	20.2	0	0	0	0	/	2.85	5.24

Red dipmeter.

GAS AND GROUNDWATER MONITORING BOREHOLE RECORD SHEET

Site: Royal College Street	**Operative(s):** JPB	**Date:** 04//02/20	**Time:** 09:10	**Round:** 2	**Page: 1**

MONITORING EQUIPMENT

Instrument Type	Instrument Make	Serial No.	Date Last Calibrated
Analox	GA5000	G501805	29/01/2019
PID	Phocheck tiger	T-106448	04/10/2018
Dip Meter	GeoTech		

MONITORING CONDITIONS

Weather Conditions: Cloudy, windy	**Ground Conditions:** Dry	**Temperature:** 7 °C
Barometric Pressure (mbar): 1016	**Barometric Pressure Trend (24hr):** Rising	**Ambient Concentration:** 0.3 %CH_4, 0.2 %CO_2, 21.2 %O_2

MONITORING RESULTS

Monitoring Point Location	Flow		Atmospheric Pressure (mbar)	CH_4 %	CH_4 % LEL	CO_2 %	O_2 %	VOC (ppm)		H_2S (ppm)	CO (ppm)	Depth to product (mbgl)	Depth to water (mbgl)	Depth to Base of well (mbgl)
	Peak	Steady						Peak	steady					
WS2	+0.1	+0.1	1017	0.3	/	0.9	20.5	/	/	0	0	/	1.25	5.00
WS3	+0.1	+0.1	1016	0.3	/	0.6	20.7	/	/	0	0	/	2.49	5.24

Red dipmeter.

GAS AND GROUNDWATER MONITORING BOREHOLE RECORD SHEET

Site: Royal College Street	**Operative(s):** JPB	**Date:** 12//02/20	**Time:** 11:45	**Round:** 3	**Page: 1**

MONITORING EQUIPMENT

Instrument Type	Instrument Make	Serial No.	Date Last Calibrated
Analox	GA5000	G501805	29/01/2019
PID	Phocheck tiger	T-106448	04/10/2018
Dip Meter	GeoTech		

MONITORING CONDITIONS

Weather Conditions: Clear, windy	**Ground Conditions:** Dry	**Temperature:** 6 °C
Barometric Pressure (mbar): 1014	**Barometric Pressure Trend (24hr):** Rising	**Ambient Concentration:** 0.2 %CH_4, 0.1 %CO_2, 20.8 %O_2

MONITORING RESULTS

Monitoring Point Location	Flow		Atmospheric Pressure (mbar)	CH_4 %	CH_4 % LEL	CO_2 %	O_2 %	VOC (ppm)		H_2S (ppm)	CO (ppm)	Depth to product (mbgl)	Depth to water (mbgl)	Depth to Base of well (mbgl)
	Peak	Steady						Peak	steady					
WS2	+0.1	+0.1	1014	0.1	/	0.9	20.0	0	0	0	0	/	1.90	5.00
WS3	0.0	0.0	1014	0.1	/	0.9	20.0	0	0	0	0	/	1.30	5.24

Red dipmeter.

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