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GEO-ENVIRONMENTAL & GEOTECHNICAL ASSESSMENT (GROUND INVESTIGATION) REPORT FOR

**TAVISTOCK HOUSE
5 ROCKINGHAM ROAD
UXBRIDGE,
UB8 2UB**



JOMAS ASSOCIATES LTD

6-9 The Square, Stockley Park, Uxbridge, UB11 1FW

www.jomasassociates.com 0843-289-2187 info@jomasassociates.com

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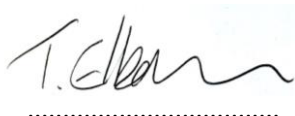
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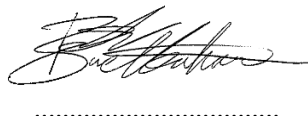
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Prepared by: JOMAS ASSOCIATES LTD **For:** ADVANCE BUSINESS EQUIPMENT HOLDINGS LTD

Prepared by
Tom Elbourne BSc (Hons), FGS
Geo-environmental Engineer



Reviewed by
Peter Swettenham BSc (Hons)
MSc PgCert CEnv MEnvSc
Principal Geotechnical Engineer



Approved by
Suneel Law BSc (Hons), MSc,
FGS
Principal Geo-environmental
Engineer



Should you have any queries relating to this report, please contact

JOMAS ASSOCIATES LTD

www.jomasassociates.com

0843 289 2187 info@jomasassociates.com

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EXECUTIVE SUMMARY

Advance Business Equipment Holdings Ltd commissioned Jomas Associates Ltd to undertake a Geo-environmental and Geotechnical ground investigation at the site Tavistock House, 5 Rockingham Road, Uxbridge, UB8 2UB.

The principle 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	Commercial use building with offices at first floor level and undercroft car park.
Proposed Site Use	It is understood that the proposed development comprises conversion of the existing building to provide residential apartments. The existing built space is predominantly at first floor level with car parking areas at ground floor; it is understood that ground floor apartments will be added beneath the existing structure within the current car park area. In addition, it is proposed that existing hardstanding within the car park area will be removed to provide communal soft landscaping.
Desk Study Overview	A Desk Study report has been produced for the site and issued separately (Jomas, September 2016). 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 historical maps indicates the presence of buildings within the site from at least 1866, at which point the site also includes an unidentified circular structure, possibly a tank (which is no longer shown by 1896). The buildings within the site frequently alter in footprint, and at points appear to form part of an adjacent wharf, although no specific use is identified from mapping. By 1980 these buildings are no longer shown, with the site occupied by a single building identified as Dolphin House. This building remains in place until the map dated 1988, when this building is no longer shown and the site appears broadly as it does today. The surrounding area has been utilised for a combination of residential and commercial uses, with uses of note including a Wharf immediately west of the site, and various works immediately north. The British Geological Survey indicates that the site is directly underlain by superficial deposits of alluvium. These superficial deposits are underlain by solid deposits of the Lambeth Group. No artificial deposits are reported within the site. The superficial and solid deposits underlying the site are identified as Secondary A Aquifers. A review of the EnviroInsight Report indicates that there are no source protection zones within 500m of the site. The nearest surface water abstraction is reported 803m west of the site, for spray irrigation. No groundwater or potable water abstractions reported within 1km of the site.

Site History and Ground Investigation	
	The nearest detailed river entry is reported 34m west of the site, identified as a canal. The River Colne is reported 81m west of site. Nearest surface water feature reported 26m west of the site (no details provided but assumed from mapping to also represent the canal).
Intrusive Investigation	The ground investigation was undertaken on 8th May 2019, and consisted of the following: • 3No window sampling boreholes, drilled up to 3.45m below ground level (bgl), with associated in situ testing and sampling; • Laboratory analysis for chemical and geotechnical purposes, • 4No return visits to monitor ground gas concentrations and groundwater levels have been completed.
Ground Conditions	The results of the ground investigation revealed a ground profile comprising a variable thickness of Made Ground (up to 3.0mbgl depth), overlying a grey-brown sandy gravelly clay to a maximum depth of 1.80m bgl (where the Made Ground is sufficiently thin) overlying light brown to grey clayey gravelly sand to a maximum depth of 2.10mbgl, overlying brown to black sandy gravel to the base of the boreholes at a maximum depth of 3.45mbgl. During the investigation groundwater was reported within windowless sampler boreholes WS1, WS2 and WS3 between 1.80mbgl and 2.70mbgl depth. During return monitoring groundwater was reported at depths of between 1.56m and 1.75mbgl. 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.
Environmental Considerations	Following generic risk assessments and statistical analysis, elevated concentrations of cyanide, naphthalene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene, dibenzo(ah)anthracene and aromatic C16-C21 and C21-C35 fractions were detected in soils in excess of generic assessment criteria for the protection of human health within a “residential without plant uptake” end-use scenario. The elevated levels of naphthalene are also considered to pose a potential vapour risk. Asbestos fibres in the form of chrysotile and amosite were detected within 2No samples out of 6No screened. Both samples were quantified as containing <0.001% asbestos fibres by weight, below the threshold at which arisings would be considered hazardous for the purposes of waste disposal. It should be borne in mind that no level of asbestos contamination can be considered safe with regards to human health. The historic map review undertaken as part of the desk study indicated the presence a tank, potentially a gas holder, on site during the mid to late 19th century. The gas holder/ tank location correlates with the evidence of hydrocarbon impact identified by this investigation, and therefore is the most likely source. Neighbouring industrial site use may also be a contributing factor. Groundwater analysis has reported elevated concentrations of metals, polyaromatic and petroleum hydrocarbons within the groundwater on site when compared to both environmental quality and human health standards. In addition, there is evidence of a tarry liquid, possibly floating on the groundwater, within WS2. Although samples were obtained by low flow methodology the slow recharge rates mean that the samples are likely to contain more sediment than would usually be the case, possibly increasing the reported contaminant levels. The site is underlain by Secondary A aquifers within the superficial and bedrock deposits, but no potable abstractions are located within 1km of the site and the site is not located within a Source Protection Zone. The nearest surface water feature is identified 34m west of site as a canal, assumed to be lined and therefore not at risk from contaminants migrating within the groundwater; however, the River Colne is reported 81m west of site and could be a potential receptor, therefore risks to controlled waters require further assessment.

Site History and Ground Investigation	
	It is recommended that further investigation of the site is undertaken to further investigate the extent of hydrocarbon impacted soils and groundwater. The additional works should include the installation of further monitoring wells to greater depth to ensure a substantial depth of groundwater is available for sampling – such depths could not be achieved during this investigation due to the ground conditions present and therefore any future investigations should be suitably prepared to overcome such issues. This may require cable percussion drilling or the use of casing to prevent collapse of the granular materials. Further investigation of vapour risk to the proposed end users of the development and adjacent site users is recommended, including installation of subsurface vapour monitoring wells and quantitative assessment of analytical vapour data. Ground gas monitoring has been undertaken and calculation of the Gas Screening Value using worst-case results indicates that the site may be considered “Characteristic Situation 1” and therefore no formal gas protection measures are required. However, given the significant variation in flow rates observed during monitoring, it is recommended that a further 2No gas monitoring events are undertaken to confirm the assessment.
Geotechnical Considerations	2No hand excavated trial pits were undertaken, one on the corner of the existing ground floor structure and one on one of the support pillars. The exposed foundations appeared to be pads/strip foundations. HTP1 exposed a concrete strip at 0.71mbgl, which extended >1m from the edge of the structure. The founding depth could not be proven. HTP2 exposed a strip footing at 0.55mbgl, greater than 0.65m thick and therefore the founding depth was not proven but is in excess of 1.2mbgl the strip was proven to be 0.38m wide and greater than 1.50m long. The conversion of the structure to residential use should be anticipated to increase the loading of the structure compared to the current commercial use. Although the bases of the foundations were not proven, they were proven to be in excess of 1.2mbgl. Based on the information obtained by this investigation and assuming a founding depth of at least 1.5mbgl, an allowable bearing capacity of 150kPa could be expected. 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. Attention is also drawn to the provisions of the Health and Safety at Work Regulations, which state that the sides of any excavations greater than 1.2m depth, into which personnel are required to enter, should be fully supported or 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.

1 INTRODUCTION

1.1 Terms of Reference

1.1.1 Advance Business Equipment Holdings Ltd ("The Client") has commissioned Jomas Associates Ltd, to assess the risk of contamination posed by the ground conditions at a site referred to as Tavistock House, 5 Rockingham Road, Uxbridge, UB8 2UB and to provide indicative for foundation recommendations 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 2016), 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
Geo-environmental Desk Study / Preliminary Risk Assessment For Tavistock House, 5 Rockingham Road, Uxbridge	Jomas Associates Ltd	P9651J926 Final V1.1	20 th September 2019

1.1.4 The intrusive investigation was undertaken in accordance with Jomas proposal dated 26 April 2019.

1.2 Proposed Development

1.2.1 It is understood that the proposed developed comprises conversion of the existing building to provide residential apartments. The existing built space is predominantly at first floor level is with car parking areas at ground floor; it is understood that ground floor apartments will be added beneath the existing structure within the current car park area. In addition, it is proposed that existing hardstanding within the car park area will be removed to provide communal soft landscaping.

1.2.2 For the purposes of the contamination risk assessment, the proposed development is classified as 'residential without plant uptake'.

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 Limitations

1.5.1 Jomas Associates Ltd has prepared this report for the sole use of Advance Business Equipment Holdings Ltd, 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.

1.5.2 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.

1.5.3 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.

1.5.4 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.

1.5.5 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.

- 1.5.6** *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 as Figure 1.

Table 2.1: Site Information

Name of Site	Tavistock House
Address of Site	5 Rockingham Road, Uxbridge UB8 2UB
Approx. National Grid Ref.	504988, 183879
Site Area (Approx.)	0.08ha
Site Ownership	Unknown
Site Occupation	Disused office building with associated vehicle parking
Local Authority	London Borough of Hillingdon
Proposed Site Use	Change of use to residential (maintaining existing buildings)

2.2 Desk Study Overview

- 2.2.1 A Desk Study report has been produced for the site and issued separately (Jomas, September 2016). 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 historical maps indicates the presence of buildings within the site from at least 1866, at which point the site also includes an unidentified circular structure, possibly a tank or gasholder (which is no longer shown by 1896). The buildings within the site frequently alter in footprint, and at points appear to form part of an adjacent wharf, although no specific use is identified from mapping. By 1980 these buildings are no longer shown, with the site occupied by a single building identified as Dolphin House. This building remains in place until the map dated 1988, when this building is no longer shown and the site appears broadly as it does today.
- 2.2.3 The surrounding area has been utilised for a combination of residential and commercial uses, with uses of note including a Wharf immediately west of the site, and various works immediately north.
- 2.2.4 The British Geological Survey indicates that the site is directly underlain by superficial deposits of Alluvium. These superficial deposits are underlain by solid deposits of the Lambeth Group. No artificial deposits are reported within the site. The superficial and solid deposits underlying the site are identified as Secondary A Aquifers.
- 2.2.5 A review of the EnviroInsight Report indicates that there are no source protection zones within 500m of the site. The nearest surface water abstraction is reported 803m west of the site, for spray irrigation. No groundwater or potable water abstractions reported within 1km of the site.
- 2.2.6 The nearest detailed river entry is reported 34m west of the site, identified as a canal. The River Colne is reported 81m west of site. Nearest surface water feature reported 26m west of the site (no details provided but assumed from mapping to also represent the canal).

The conceptual site model is reproduced in Table 2.2 overleaf. A ground investigation including ground gas monitoring was recommended.

SECTION 2 SITE SETTING



Table 2.2: Preliminary Risk Assessment for the Site

Sources	Pathways (P)	Receptors	Consequence	Probability of pollutant linkage	Risk Estimation	Hazard Assessment
- Potential for contaminated ground associated with previous site use – on site (S1) - Potential for Made Ground associated with previous development operations – on site (S2) - Potential impacted ground associated with possible former tank from historical mapping – on site (S3) - Potential asbestos impacted ground from demolition of previous buildings – on site (S4) - Current and previous industrial use – on and off site (S5) - Potential ground gas generation within underlying alluvial deposits and infilled ground – on site and off site (S6)	- 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 Severe for Asbestos	~~Low~~ (Site to be covered entirely with hardstanding) Likely	Moderate High for Asbestos	GI – Ground Investigation
	Accumulation and migration of soil gases (P5)		Medium	~~Unlikely~~ (ventilated ground floor parking proposed) Low	~~Low~~ 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) - Controlled Waters (Aquifer) (R6) - Building foundations and on site buried services (water mains, electricity and sewer) (R5)	Medium	Likely	Moderate	

2.2.7

It should be noted that our understanding of the development proposal has changed since the publication of the Desk Study Report and soft cover is now proposed at ground floor level and ground floor apartments are proposed. The assessment of risks as published in the Desk Study has therefore been revised in Table 2.2. above. The previous assessment is indicated by the strikethrough text.

3 GROUND INVESTIGATION

3.1 Rationale for Ground Investigation

- 3.1.1 The site investigation has been undertaken generally in accordance with 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.
- 3.1.2 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).
- 3.1.3 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 8th May 2019.
- 3.2.2 The work was undertaken in accordance with BS: 5930 'Code of Practice for Site Investigation' and BS: 10175 '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 (m BGL)	Justification
Window Sample Boreholes	3	WS1-WS3	Up to 3.45mbgl	Obtain shallow samples for laboratory contamination and geotechnical testing. To allow in-situ geotechnical testing. WS1 – non targeted, for general site conditions WS2 – targeting location of former tank indicated on historic mapping/Groundsure

Investigation Type	Number of Exploratory Holes Achieved	Exploratory Hole Designation	Depth Achieved (m BGL)	Justification
				WS3 – non targeted, for general site conditions.
Monitoring Wells	3	WS1-WS3	Up to 3.00mbgl	Combined soil gas and groundwater monitoring wells. WS1 - response zone in Made Ground, gravelly clay, and gravelly sand. (Made Ground, alluvium and Taplow Gravel Formation). WS2 - response zone in Made Ground WS3 – response zone in gravelly clay and gravelly sand (alluvium and Taplow Gravel Formation).
Hand dug Trial Pits	2	HTP1 - 2	Up to 0.71mbgl	To allow the inspection of the existing foundations.

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 BS: 5930 (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 as Figure 2. 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 BS EN ISO 22475-1. This in turn allows suitable geotechnical testing to be carried out.
- 3.4.7 During return groundwater monitoring visits where groundwater samples were taken, they were obtained by low flow methodology to remove stagnant groundwater from the monitoring well prior to obtaining the sample for testing without removing significant quantities of sediment.
- 3.4.8 Groundwater strikes noted during drilling are recorded within the exploratory hole records in Appendix 2.
- 3.4.9 Samples were stored in cool boxes (<4°C) and preserved in accordance with laboratory guidance.
- 3.5 Sampling Limitations**
- 3.5.1 HTP1 was moved to the opposite corner of the structure from where it was originally proposed due to access limitations.
- 3.5.2 The remaining boreholes were drilled to the proposed depths.
- 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 below:

Table 3.2: Chemical Tests Scheduled

Test Suite	No. of tests	
	Made Ground / Topsoil	Natural
Basic Suite 3	4	-
Basic Suite 5	1	1
Total Organic Carbon	5	-
Water Soluble Sulphate	5	2
TPHCWG (inc BTEX)	1	1
VOC/SVOC	1	1
Asbestos Screen & ID	5	1

- 3.6.4 The determinands contained in the Basic Suite 3 are as detailed in Table 3.3. Basic Suite 5 contains the same determinands but without the hydrocarbon compounds to avoid overlapping with the extended hydrocarbon testing (TPHCWG / VOC).

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, 5No. samples were analysed for total organic carbon.

3.6.6 In addition to the soil analysis, samples of groundwater taken from the installed groundwater wells were also analysed for a similar suite of determinands as the soil samples.

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

Geotechnical Laboratory Testing

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

3.6.9 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.

3.6.10 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	4
4.3 and 5.3	Liquid and Plastic Limit Determination (Atterberg Limits)	4
9.2 and 9.3	Particle Size Distribution - Sieving	2

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

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 (mbgl)	Base of strata (mbgl)	Thickness range (m)
Asphalt over concrete (WS1, WS2)	GL	0.12-0.40	0.12-0.40
Soft to firm consistency grey-brown sandy slightly gravelly clay / gravelly sand. Gravel consists of fine to coarse angular to sub-rounded flint, brick and concrete. (MADE GROUND).	0.12-0.40	0.90-1.40	0.78-1.00
Dark brown sandy gravel/sandy gravelly clay. Gravel consists of fine to medium angular to sub-rounded flint and brick. (MADE GROUND).	0.20	3.00	2.80
Strong hydrocarbon odour from 1.10-1.70mbgl in WS2.			
Soft to firm consistency grey- brown sandy gravelly CLAY. Gravel consists of fine sub-rounded to sub-angular flint. (Alluvium).	0.90-1.40	1.10-1.80	0.20-0.40
Very dense light brown to grey clayey slightly gravelly SAND. Sand is fine to medium. Gravel consists of fine sub-angular to sub-rounded flint. (TAPLOW GRAVEL MEMBER - GRANULAR)	1.10-1.80	1.50-2.10	0.30-0.40
Very dense brown - black sandy GRAVEL. Gravel consists of fine to coarse sub-angular to sub-rounded flint. Strong hydrocarbon odour reported in WS2. (TAPLOW GRAVEL MEMBER – GRANULAR)	1.50-3.00	>3.15- >3.45	>0.15- >1.65

- 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 cohesive alluvial deposits, overlying granular deposits of the Taplow Gravel Member. No deposits believed to represent the Lambeth Group were reported.

4.2 Hydrogeology

- 4.2.1 Groundwater strikes and groundwater monitoring are summarised below.

Table 4.2: Groundwater Strikes During Drilling

Exploratory Hole ID	Depth Encountered (mbgl)	Stratum
WS1	1.80	Alluvium/Taplow Gravel
WS2	2.70	Made Ground
WS3	1.90	Taplow Gravel Member
HTP1		No Strike
HTP2		No Strike

4.2.2 4No return groundwater monitoring visits were undertaken between 17/05/2019 and 03/06/2019. The results are summarised below.

Table 4.3: Groundwater Monitoring Records

Exploratory Hole ID	Depth Encountered (m bgl)	Depth to Base of Well (m bgl)	Strata targeted by response zone
WS1	1.56-1.75	2.00	Made Ground / Alluvium / Taplow Gravel Member
WS2	1.56-1.70	2.83	Made Ground
WS3	1.63-1.75	1.82	Alluvium / Taplow Gravel Member

4.2.3 The results indicate a shallow water table to be present within the Alluvium and Taplow Gravel Deposits.

4.3 Physical and Olfactory Evidence of Contamination

4.3.1 A strong hydrocarbon odour was reported within WS2 from 1.10-1.70mbgl within the Made Ground and between 3.00 and >3.45mbgl in the natural gravel deposits. The deeper gravels were also described as “black”.

4.3.2 A hydrocarbon odour and sheen was observed on the water sample obtained from WS2, and whilst dipping with an oil interface probe did not indicate separate phase product, the probed when retrieved was found to be covered in a thick tarry liquid.

4.3.3 A slight hydrocarbon odour was reported from the groundwater sample obtained from WS3.

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
<u>Organic Substances</u>		
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
<u>Inorganic Substances</u>		
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 1.04% 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 a residential without plant uptake 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.

5.4 Analytical Framework – Groundwater and Leachate

5.4.1 The requirement to protect groundwater from pollution is outlined in Groundwater protection: Principles and practice (GP3, EA, August 2013, v1.1).

- 5.4.2 Where undertaken, the groundwater quality analysis comprises a Level 1 assessment in accordance with the EA Remedial Targets Methodology Document (EA, 2006).
- 5.4.3 The criteria used by Jomas' in the Level 1 assessment of groundwater and leachate quality are shown in Table 5.2.

Table 5.2: Selected Assessment Criteria – Contaminants in Water

Substance Group	Determinand(s)	Assessment Criteria Selected
Metals	Arsenic, Copper, Cyanide, Mercury, Nickel, Lead, Zinc, Chromium	EQS/DWS
	Selenium	DWS
PAHs	Sum of Four – benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, indeno(1,2,3-c,d)pyrene	DWS
PAHs	Benzo(a)pyrene,	DWS
PAHs	Remainder	LEC
Total Petroleum Hydrocarbons	Aliphatic C5-C6, Aliphatic >C6-C8, Aliphatic >C8-C10. Aliphatic >C10-C12, Aliphatic >C12-C16, Aliphatic >C16-C21, Aromatic C5-C7, Aromatic >C7-C8, Aromatic >C8-C10, Aromatic >C10-C12, Aromatic >C12-C16, Aromatic >C16-C21, Aromatic > C21-C35	DWS/WHO
Benzene	Benzene	DWS
Toluene	Toluene	EQS
Ethylbenzene	Ethylbenzene	EQS
Xylene	Xylene	EQS
Oxygen Demand	Chemical Oxygen Demand and Biological Oxygen Demand	Urban Waste Water Treatment (England and Wales) Regulations

Environmental Quality Standards EQS

Environmental Quality Standards (EQS) have been released by the EA for dangerous substances, as identified by the EC Dangerous Substances Directive. EQS can vary for each substance, for the hardness of the water and can be different for fresh, estuarine or coastal waters.

Lowest Effect Concentration (LEC)

These criteria relate to the concentration of PAHs in groundwater. They are taken from the EA R&D Technical Report P45 – Polycyclic Aromatic Hydrocarbons (PAH): Priorities for Environmental Quality Standard Development (2001).

WHO Health

These screening criteria have been taken from the World Health Organisation Guidelines for Drinking Water Quality (1984). The health value is a guideline value representing the concentration of a contaminant that does not result in any significant risk to the receptor over a lifetime of exposure.

Further criteria have been obtained from 'Petroleum Products in Drinking-water' - Background document for development of WHO Guidelines for Drinking-water Quality (2005).

UK Drinking Water Standards (DWS)

These comprise screening criteria provided by the Drinking Water Inspectorate (DWI) in the Water Supply (Water Quality) Regulations 2006,

Urban Waste Water Treatment (England and Wales) Regulations - UWWT Regs

The Urban Waste Water Treatment (England and Wales) Regulations SI/1994/2841 as amended by SI/2003/1788 sets down minimum standards for the discharge of treated effluent from waste water treatment works to inland surface waters, groundwater, estuaries or coastal waters. Standards of (125mg/L) COD and (25mg/L) BOD have been set.

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 6.5. Raw laboratory data is included in Appendix 7.

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	40 S4UL	4.9	20	0
Cadmium	mg/kg	6	85 S4UL	<0.2	0.5	0
Chromium	mg/kg	6	910 S4UL	<4.0	<0.4	0
Lead	mg/kg	6	310 C4SL	9.3	310	0
Mercury	mg/kg	6	56 S4UL	<0.3	1.0	0
Nickel	mg/kg	6	180 S4UL	13	24	0
Copper	mg/kg	6	7100 S4UL	8.9	390	0
Zinc	mg/kg	6	40000 S4UL	33	180	0
Total Cyanide ^A	mg/kg	6	33 CLEA v 1.06	<1	63	1No (WS2@3.40mbgl)
Selenium	mg/kg	6	430 S4UL	<1.0	1.5	0
Boron Water Soluble	mg/kg	6	11000 S4UL	0.7	5.1	0
Phenols	mg/kg	6	440 S4UL	<1.0	1.2	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	6	S4UL 2.3	<0.05	19	2No (WS2@1.50mbgl, WS2@3.40mbgl)
Acenaphthylene	mg/kg	6	S4UL 2900	<0.05	38	0
Acenaphthene	mg/kg	6	S4UL 3000	<0.05	23	0
Fluorene	mg/kg	6	S4UL 2800	<0.05	97	0
Phenanthrene	mg/kg	6	S4UL 1300	<0.05	280	0
Anthracene	mg/kg	6	S4UL 2300	<0.05	73	0
Fluoranthene	mg/kg	6	S4UL 1500	0.40	160	0
Pyrene	mg/kg	6	S4UL 3700	0.40	100	0

Determinand	Unit	No. Samples Tested	Screening Criteria	Min	Max	No. Exceeding
Benzo(a)anthracene	mg/kg	6	S4UL	11.0	0.33	73 1No (WS3@0.40mbgl)
Chrysene	mg/kg	6	S4UL	30	0.31	45 1No (WS2@3.40mbgl)
Benzo(b)fluoranthene	mg/kg	6	S4UL	3.9	0.36	40 2No (WS2@3.40mbgl, WS3@0.50mbgl)
Benzo(k)fluoranthene	mg/kg	6	S4UL	110	0.18	25 0
Benzo(a)pyrene	mg/kg	6	S4UL	3.2	0.38	43 2No (WS2@3.40mbgl, WS3@0.50mbgl)
Indeno(123-cd)pyrene	mg/kg	6	S4UL	45	<0.05	14 0
Dibenzo(ah)anthracene	mg/kg	6	S4UL	0.31	<0.05	5.8 2No (WS2@3.40mbgl, WS3@0.50mbgl)
Benzo(ghi)perylene	mg/kg	6	S4UL	360	<0.05	13 0
Total PAH	mg/kg	6	-	-	2.36	1050 -

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	27	<0.1	<0.1 0
>C ₁₀ -C ₁₂	mg/kg	4	S4UL	130	<2.0	<2.0 0
>C ₁₂ -C ₁₆	mg/kg	4	S4UL	1100	<4.0	<4.0 0
>C ₁₆ -C ₂₁	mg/kg	4	S4UL	1900	4.7	63 0
>C ₂₁ -C ₃₅	mg/kg	4	S4UL	1900	36	310 0
Total TPH	mg/kg	4	-	-		

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

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

TPH Band	Unit	No. Samples Tested	Screening Criteria	Min	Max	No. Exceeding
>C ₅ -C ₆ Aliphatic	mg/kg	2	S4UL	42	<0.001	<0.001 0
>C ₆ -C ₈ Aliphatic	mg/kg	2	S4UL	100	<0.001	<0.001 0
>C ₈ -C ₁₀ Aliphatic	mg/kg	2	S4UL	27	<0.001	<0.001 0
>C ₁₀ -C ₁₂ Aliphatic	mg/kg	2	S4UL	130	<1.0	21 0

TPH Band	Unit	No. Samples Tested	Screening Criteria		Min	Max	No. Exceeding
>C ₁₂ -C ₁₆ Aliphatic	mg/kg	2	S4UL	1100	<2.0	210	0
>C ₁₆ -C ₃₅ Aliphatic	mg/kg	2	S4UL	65000	<16.0	1030	0
>C ₅ -C ₇ Aromatic	mg/kg	2	S4UL	370	<0.001	<0.01	0
>C ₇ -C ₈ Aromatic	mg/kg	2	S4UL	860	<0.001	0.079	0
>C ₈ -C ₁₀ Aromatic	mg/kg	2	S4UL	47	0.27	3.8	0
>C ₁₀ -C ₁₂ Aromatic	mg/kg	2	S4UL	250	13	130	0
>C ₁₂ -C ₁₆ Aromatic	mg/kg	2	S4UL	1800	47	1200	0
>C ₁₆ -C ₂₁ Aromatic	mg/kg	2	S4UL	1900	74	2400	1No (WS2@3.40mbgl)
>C ₂₁ -C ₃₅ Aromatic	mg/kg	2	S4UL	1900	130	2400	1No (WS2@3.40mbgl)
Total TPH (Ali/Aro)	mg/kg	2	-	-	40.7	7400	-

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 The VOCs reported above laboratory detection limit are summarised in the table below, with screening criteria where available.

Table 6.5: Soil Laboratory Analysis Results –Volatile Organic Compounds (VOCs)

TPH Band	Unit	No. Samples Tested	Screening Criteria		Min	Max	No. Exceeding
Benzene	µg/kg	2	S4UL	380	<1.0	16	0
Toluene	µg/kg	2	S4UL	880000	<1.0	79	0
Ethylbenzene	µg/kg	2	S4UL	83000	10	87	0
P & m-xylene	µg/kg	2	S4UL*	79000	73	620	0
O-xylene	µg/kg	2	S4UL	88000	29	2000	0
Isopropylbenzene	µg/kg	2	CL:AIRE	12000	<1.0	29	0
1,3,5-trimethylbenzene	µg/kg	2	-	-	64	1200	-
1,2,4-trimethylbenzene	µg/kg	2	CL:AIRE	410	99	1600	0
p-isopropyltoluene	µg/kg	2	-	-	<1.0	59	-

*Lowest criteria for either compound selected

6.3 Vapour Risk Assessment from a Soil Source

6.3.1 As outlined in Table 6.2, a number of polycyclic aromatic hydrocarbons have been found in excess of their generic screening criteria for the protection of human health within a 'residential without plant uptake' end-use scenario. The generic screening criteria consider all possible pathways between the source and the receptor. In order to assess potential risks from inhalation of vapour, each organic compound that has been found in excess of its GAC will be assessed in terms of the contribution to total exposure from vapour inhalation inside a structure as reported within the LQM/CIEH S4UL document. Where a significant proportion of the total exposure is reported from vapour inhalation, there could be a potential risk from vapour inhalation.

Table 6.6: Soil Laboratory Analysis Results – Contribution to Total Exposure from Vapour Inhalation (Indoor)

Compound	Contribution of Vapour Inhalation to Total Exposure (indoors) (%)	Screening Criteria (mg/kg)	Maximum recorded value (mg/kg)	Potential Vapour Risk?
Naphthalene	64.7	2.3	19	✓
Benzo(a)anthracene	0.1	11.0	73	X
Chrysene	<0.1	30	45	X
Benzo(b)fluoranthene	<0.1	3.9	40	X
Dibenzo(ah)anthracene	<0.1	0.31	5.8	X

6.3.2 As shown in the table above, naphthalene was reported greatly in excess of its screening criteria, and derives a significant proportion of its exposure from vapour inhalation and therefore the elevated levels of naphthalene must be considered a potential vapour risk.

6.4 Asbestos in Soil

6.4.1 No samples of the Made Ground were screened in the laboratory for the presence of asbestos. The results of the analysis is summarised below in Table 6.7 below

Table 6.7: Asbestos Analysis – Summary

Sample	Screening result.	Quantification result (%)	Comments
WS1 – 0.50mbgl	Detected	<0.001	Chrysotile – loose fibres
WS2 – 0.50mbgl	Not detected	-	-
WS3 – 0.25mbgl	Detected	<0.001	Chrysotile, amosite – loose fibres
WS3 – 0.50mbgl	Not detected	-	-
HTP1 – 0.25mbgl	Not detected	-	-
HTP2 – 0.50mbgl	Not detected	-	-

6.4.2 The results reported an asbestos content of below 0.1%, the fibre content at which arisings are considered hazardous for the purpose of disposal.

6.4.3 It should be noted that for the purposes of human health assessment there is no level of asbestos below which it is deemed the materials are “safe”.

6.5 Screening of Groundwater Chemical Analysis Results

6.5.1 Samples of groundwater obtained from the borehole installations installed within exploratory locations WS1, WS2, WS3 were submitted for chemical analysis.

6.5.2 The samples were obtained by means of low flow methodology in order to minimise sediment uptake and provide the most representative samples possible; however, it should be noted that due to slow recharge rates it was not possible to stabilise all parameters prior to sampling and therefore the samples may contain higher sediment content.

6.5.3 Due to the slow recharge rates, it was not possible to obtain enough sample from WS3 to undertake the full testing suite, and therefore not all determinands were tested for on this sample. Due to the observations of potential hydrocarbon contamination, hydrocarbon testing was prioritised over other determinands.

6.5.4 The results of the laboratory testing are summarised in Tables 6.8 to 6.9 below, with the raw chemical testing data presented in Appendix 3.

Table 6.6: Groundwater Laboratory Analysis Results

Determinand	Unit	No. samples tested	Screening Criteria		Min	Max	No of Exceedances
Arsenic	µg/l	2	10	DWS	0.54	75	1No (WS2)
			50	EQS	0.54	75	1No (WS2)
Cadmium	µg/l	2	5	DWS	0.03	1.1	0
Chromium	µg/l	2	50	DWS	1.2	11	0
Lead	µg/l	2	10	DWS	<0.2	570	1No (WS2)
			1.2*	EQS	<0.2	570	1No (WS2)
Nickel	µg/l	2	20	DWS	2.4	27	1No (WS2)
			4*	EQS	2.4	27	1No (WS2)
Copper	µg/l	2	12	EQS	4.7	64	1No (WS2)
			2000	DWS	4.7	64	0
Zinc	µg/l	2	5000	DWS	1.5	95	0
			12.9**	EQS	1.5	95	1No (WS2)
Mercury	µg/l	2	1	DWS	<0.05	<0.05	0
Selenium	µg/l	2	10	DWS	5.6	6.3	0
Boron	µg/l	3	1000	DWS	84	150	0
			2000	EQS	84	150	0
Cyanide (Total)	µg/l	3	50	DWS	27	350	2No (WS2, WS3)

Table 6.6: Groundwater Laboratory Analysis Results

Determinand	Unit	No. samples tested	Screening Criteria		Min	Max	No of Exceedances
			1	EQS	27	350	3No (WS1, WS2, WS3)
Phenols (Total)	µg/l	3	7.7	EQS	<10	5400	1No (WS2)

* bioavailable concentration

**bioavailable concentration + ambient background concentration dissolved for Thames Groundwater (2 µg/L)

Table 6.7: Groundwater Analysis Results – Polycyclic Aromatic Hydrocarbons (PAHs)

Determinand	Unit	No. samples tested	Screening Criteria		Min.	Max.	No. of Exceedances
Naphthalene	µg/l	3	2.4	EQS	<0.01	56.4	2No (WS2, WS3)
Acenaphthylene	µg/l	3	-	-	0.47	7.96	-
Acenaphthene	µg/l	3	-	-	<0.01	5.01	-
Fluorene	µg/l	3	-	-	<0.01	12.3	-
Phenanthrene	µg/l	3	-	-	<0.01	40.3	-
Anthracene	µg/l	3	0.1	EQS	<0.01	11.3	2No (WS1, WS2)
Fluoranthene	µg/l	3	0.0063	EQS	<0.01	25.2	2No (WS1, WS2)
Pyrene	µg/l	3	-	-	<0.01	19.2	-
Benzo(a)anthracene	µg/l	3	-	-	<0.01	9.91	-
Chrysene	µg/l	3	-	-	<0.01	7.88	-
Sum of four Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(ghi)perylene Indeno(123-cd)pyrene	µg/l	3	0.1	DWS	<0.04	9.98	2No (WS1, WS2)
Benzo(a)pyrene	µg/l	3	0.01	DWS	<0.01	3.80	2No (WS1, WS2)
Dibenzo(ah)anthracene	µg/l	3	0.00017	EQS	<0.01	0.26	1No (WS2)

Table 6.8: Groundwater Analysis Results – TPHCWG – Controlled Waters

Determinand	Unit	No. Samples tested	Screening Criteria		Min.	Max.	No. of Exceedances
>C5-C6 Aliphatic	µg/l	3	15000	WHO	<1.0	<1.0	0
>C6-C8 Aliphatic	µg/l	3	15000	WHO	<1.0	<1.0	0
>C8-C10 Aliphatic	µg/l	3	300	WHO	<1.0	<1.0	0

Determinand	Unit	No. Samples tested	Screening Criteria		Min.	Max.	No. of Exceedances
>C10-C12 Aliphatic	µg/l	3	300	WHO	<10	<10	0
>C12-C16 Aliphatic	µg/l	3	300	WHO	<10	<10	0
>C16-C21 Aliphatic	µg/l	3	-	-	<10	<10	0
>C21-C35 Aliphatic	µg/l	3	90	WHO	<10	<10	0
Total Aliphatic (C5-C35)	µg/l	3	-	-	<10	<10	-
>C5-C7 Aromatic	µg/l	3	10	WHO	<1.0	2600	1No (WS2)
>C7-C8 Aromatic	µg/l	3	700	WHO	<1.0	1100	1No (WS2)
>C8-C10 Aromatic	µg/l	3	300	WHO	<1.0	3600	1No (WS2)
>C10-C12 Aromatic	µg/l	3	90	WHO	<10	72	0
>C12-C16 Aromatic	µg/l	3	90	WHO	<10	300	1No (WS2)
>C16-C21 Aromatic	µg/l	3	90	WHO	<10	400	1No (WS2)
>C21-C35 Aromatic	µg/l	3	90	WHO	<10	500	1No (WS2)
Total Aromatic (C5-C35)	µg/l	3	-	-	<10	8600	-

Table 6.9: Groundwater Analysis Results –Volatile Organic Compounds – Controlled Waters

Determinand	Unit	No. Samples tested	Screening Criteria		Min.	Max.	No. of Exceedances
Cis-1,2-dichloroethene	µg/l	3	WHO	50	<1.0	61.6	1No (WS2)
Benzene	µg/l	3	DWS	1	<1.0	2600	1No (WS2)
			EQS	10	<1.0	2600	1No (WS2)
Trichloroethene	µg/l	3	DWS	10	<1.0	27.2	1No (WS3)
Toluene	µg/l	3	EQS	74	<1.0	1060	1No (WS2)
			WHO	700	<1.0	1060	1No (WS2)
Ethylbenzene	µg/l	3	EQS	300	<1.0	202	0
			WHO	300	<1.0	202	0
P & M-xylene	µg/l	3	WHO	500*	<1.0	1840	1No (WS2)
O-xylene	µg/l	3	WHO	500*	<1.0	448	0
Xylenes (total)	µg/l	3	EQS	30	<2.0	2042	1No (WS2)

Determinand	Unit	No. Samples tested	Screening Criteria		Min.	Max.	No. of Exceedances
Isopropylbenzene	µg/l	3	-	-	<1.0	10.4	-
1,3,5-Trimethylbenzene	µg/l	3	-	-	<1.0	506	-
1,2,4-Trimethylbenzene	µg/l	3	-	-	<1.0	619	-

*Xylenes total screening criteria

6.5.5 As shown in the tables above, several hydrocarbon compounds as well as metals have been reported in excess of screening criteria protective of both drinking water and environmental controlled waters receptors.

6.5.6 Given the observations of impacted soils and the elevated contaminant levels reported within soil samples, further assessment of risks to controlled waters receptors is likely to be required.

6.6 Groundwater Vapour Risk Assessment - Human Health Receptors

6.6.1 Due to the presence of contaminants recorded in water samples on site, an assessment has been undertaken to determine whether the contaminants pose a threat to end users in terms of vapour risk from a groundwater source.

6.6.2 The table below compares the results of groundwater analysis with criteria produced by the Society for Brownfield Risk Assessment (SoBRA, 2017) for assessing vapour risks to human health from groundwater in a residential setting. Only contaminants recorded above detection limits have been assessed.

Table 6.10: Groundwater Vapour Risk Analysis Results

Determinand	Unit	No. samples tested	Screening Criteria	Min.	Max.	No. of Exceedances
Naphthalene	µg/l	3	220	<0.01	56.4	0
Acenaphthylene	µg/l	3	220000	0.47	7.96	0
Acenaphthene	µg/l	3	170000	<0.01	5.01	0
Fluorene	µg/l	3	210000	<0.01	12.3	0
Phenanthrene	µg/l	3	Insufficiently volatile	<0.01	40.3	0
Anthracene	µg/l	3	Insufficiently volatile	<0.01	11.3	0
Fluoranthene	µg/l	3	Insufficiently volatile	<0.01	25.2	0
Pyrene	µg/l	3	Insufficiently volatile	<0.01	19.2	0
Benzo(a)anthracene	µg/l	3	Insufficiently volatile	<0.01	9.91	0
Dibenzo(ah)anthracene	µg/l	3	Insufficiently volatile	<0.01	0.26	0
Sum of Four Benzo(b)fluoranthene Benzo(k)fluoranthene	µg/l	3	Insufficiently volatile	<0.04	9.98	0

Determinand	Unit	No. samples tested	Screening Criteria	Min.	Max.	No. of Exceedances
Benzo(ghi)perylene						
Indeno(123-cd)pyrene						
Benzo(a)pyrene	µg/l	3	Insufficiently volatile	<0.01	3.80	0
Aromatic EC5-7	µg/l	3	210000	<1.0	2600	0
Aromatic EC7-8	µg/l	3	220000	<1.0	1100	0
Aromatic EC 8-10	µg/l	3	1900	<1.0	3600	1No (WS2)
Aromatic EC10-12	µg/l	3	6800	<10	72	0
Aromatic EC12-16	µg/l	3	39000	<10	300	0
Aromatic EC16-21	µg/l	3	Insufficiently volatile	<10	400	0
Aromatic EC21-C35	µg/l	3	Insufficiently volatile	<10	500	0
Cis-1,2-dichloroethene	µg/l	3	130	<1.0	61.6	0
Benzene	µg/l	3	210	<1.0	2600	1No (WS2)
Trichloroethene	µg/l	3	5.7	<1.0	27.2	2No (WS2, WS3)
Toluene	µg/l	3	230000	<1.0	1060	0
Ethylbenzene	µg/l	3	10000	<1.0	202	0
P & M-xylene	µg/l	3	9500	<1.0	1840	0
O-xylene	µg/l	3	12000	<1.0	448	0
Isopropylbenzene	µg/l	3	850	<1.0	10.4	0
1,3,5-Trimethylbenzene	µg/l	3	-	<1.0	506	-
1,2,4-Trimethylbenzene	µg/l	3	24	<1.0	619	1No (WS2)

6.6.3 As summarised above, several petroleum compounds have been found in excess of their relevant vapour assessment criteria and therefore a potential risk from vapour inhalation from a groundwater source must be considered to exist.

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

6.7.1 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).

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

Table 6.11: Soil Laboratory Analysis Results – Phytotoxic Determinands

Determinand	Threshold level (mg/kg)	Min (mg/kg)	Max (mg/kg)	No. Exceeding
Zinc	300	33	280	0
Copper	200	8.9	310	1No (WS3@0.25mbgl)
Nickel	110	13	24	0

6.8 Screening for Water Pipes

- 6.8.1 Based on the soil results obtained to date, upgraded utility pipework is likely to be required due to the elevated hydrocarbons reported in soils.
- 6.8.2 The water supply pipe requirements for this site should be discussed at an early stage with the relevant utility provider.

6.9 Waste Disposal

- 6.9.1 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 Four return monitoring visits have been undertaken from 17 May 2019 to 3 June 2019, to monitor wells installed within boreholes at the site for soil gas concentrations and groundwater levels.
- 7.1.2 During the return monitoring visits these visits pressure trends observed were static and falling.
- 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 ₂ S (ppm)	VOCs (ppm)	Steady Flow Rate (l/hr)	Peak Flow Rate (l/hr)	Depth to water (mbgl)	Depth of installation (mbgl)
WS1	0.0-0.2	0.2-0.6	19.2-20.9	0	0.3	-0.1-0.0	-0.1-0.0	1.69-1.75	2.00
WS2	0.1-0.1	0.1-0.6	18.7-18.9	0	18.7	-0.1-+4.0	-0.1-+4.0	1.56-1.66	2.83
WS3	0.0-0.1	0.3-1.2	19.9-20.7	0	0.4	-0.1-+0.3	-0.1-+0.3	1.63-1.70	1.82

7.2 Screening of Results

- 7.2.1 As shown in Table 7.1, methane has been reported to a maximum concentration of 0.2% to date. Carbon dioxide has been reported to a maximum concentration of 1.2% v/v. Screening of the monitoring well headspaces with a photo-ionisation detector (PID) has detected maximum volatile organic compound (VOC) concentrations of 18.7ppm. A maximum flow rate of 4.0l/hr has been reported.
- 7.2.2 In the assessment of risks posed by hazardous ground gases and selection of appropriate mitigation measures, BS: 8485 (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

$$\text{GSV} = (\text{Concentration}/100) \times \text{Flow rate}$$

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 2.0l/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	1.2	4.0	0.048	1
CH ₄	0.2	4.0	0.008	1

7.2.11 The methodology set out in BS 8485 (2015) has been used for determining the required gas protection measures. For a Type B development on a CS1 site no formal gas protection measures are considered necessary. However, given the variance observed in flow rates, it is recommended that a further 2No gas monitoring visits are undertaken to confirm this assessment.

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 has revealed maximum concentrations of VOCs of 18.7ppm. Although this reading alone is not particularly high, in light of the potential vapour risk from both soil and groundwater sources discussed earlier in the report further assessment of vapour risk is required.

8 SUMMARY OF RESULTS

8.1 Land Quality Impact Summary

8.1.1 Following the ground investigation, the following is noted:

- It is understood that the proposed development comprises conversion of the existing building to provide residential apartments. It is understood that ground floor apartments will be added beneath the existing structure and existing hardstanding will be removed to provide public soft landscaping.
- Following generic risk assessments and statistical analysis, elevated concentrations of cyanide, naphthalene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene, dibenzo(ah)anthracene and aromatic C16-C21 and C21-C35 fractions were detected in soils in excess of generic assessment criteria for the protection of human health within a “residential without plant uptake” end-use scenario. The elevated levels of naphthalene are also considered to pose a potential vapour risk.
- Asbestos fibres in the form of chrysotile and amosite were detected within 2No samples out of 6No screened. Both samples were quantified as containing <0.001% asbestos fibres by weight, below the threshold at which arisings would be considered hazardous for the purposes of waste disposal. It should be borne in mind that no level of asbestos contamination can be considered safe with regards to human health.
- The historic map review undertaken as part of the desk study indicated the presence a tank, potentially a gas holder, on site during the mid to late 19th century. The gas holder/ tank location correlates with the evidence of hydrocarbon impact identified by this investigation, and therefore is the most likely source. Neighbouring industrial site use may also be a contributing factor.
- Groundwater analysis has reported elevated concentrations of metals, polyaromatic and petroleum hydrocarbons within the groundwater on site when compared to both environmental quality and human health standards. In addition, there is evidence of a tarry liquid, possibly floating on the groundwater, within WS2. Although samples were obtained by low flow methodology the slow recharge rates mean that the samples are likely to contain more sediment than would usually be the case, possibly increasing the reported contaminant levels.
- The site is underlain by Secondary A aquifers within the superficial and bedrock deposits, but no potable abstractions are located within 1km of the site and the site is not located within a Source Protection Zone. The nearest surface water feature is identified 34m west of site as a canal, assumed to be lined and therefore not at risk from contaminants migrating within the groundwater; however, the River Colne is reported 81m west of site and could be a potential receptor, therefore risks to controlled waters require further assessment.
- It is recommended that further investigation of the site is undertaken to further investigate the extent of hydrocarbon impacted soils and groundwater. The additional works should include the installation of further monitoring wells to greater depth to ensure a substantial depth of groundwater is available for sampling – such depths could not be achieved during this investigation due to the ground conditions present and therefore any future investigations should be suitably prepared to

overcome such issues. This may require cable percussion drilling or the use of casing to prevent collapse of the granular materials.

- Further investigation of vapour risk to the proposed end users of the development and adjacent site users is recommended, including installation of subsurface vapour monitoring wells and quantitative assessment of analytical vapour data.
- Ground gas monitoring has been undertaken and calculation of the Gas Screening Value using worst-case results indicates that the site may be considered “Characteristic Situation 1” and therefore no formal gas protection measures are required. However, given the significant variation in flow rates observed during monitoring, it is recommended that a further 2No gas monitoring events are undertaken to confirm the assessment.

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) - Potential for Made Ground associated with previous development operations – on site (S2) - Potential impacted ground associated with possible former tank from historical mapping – on site (S3) - Potential asbestos impacted ground from demolition of previous buildings – on site (S4) - Current and previous industrial use – on and off site (S5) - Potential ground gas generation within underlying alluvial deposits and infilled ground – on site and off site (S6)	- 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) - Accumulation and migration of soil gases (P5) - 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)	- 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) - Neighbouring site users (R3) - Building foundations and on site buried services (water mains, electricity and sewer) (R5) - Controlled Waters (Aquifer) (R6)	Y X Y	Further investigation required. See 8.1 for details. 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. No formal gas protection measures are considered necessary. Further assessment of risks to controlled waters required. Contact should be made with relevant utility providers to confirm if upgraded materials are required.

9 GEOTECHNICAL ENGINEERING RECOMMENDATIONS

9.1 Ground Investigation Summary

- 9.1.1 It is understood that the proposed development comprises conversion of the existing building to provide residential apartments. It is understood that ground floor apartments will be added beneath the existing structure and existing hardstanding will be removed to provide public soft landscaping.
- 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: 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 3.0mbgl depth), overlying a grey-brown sandy gravelly clay to a maximum depth of 1.80mbgl (where the Made Ground is sufficiently thin) overlying light brown to grey clayey gravelly sand to a maximum depth of 2.10mbgl, overlying brown to black sandy gravel to the base of the boreholes at a maximum depth of 3.45mbgl.
- 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.

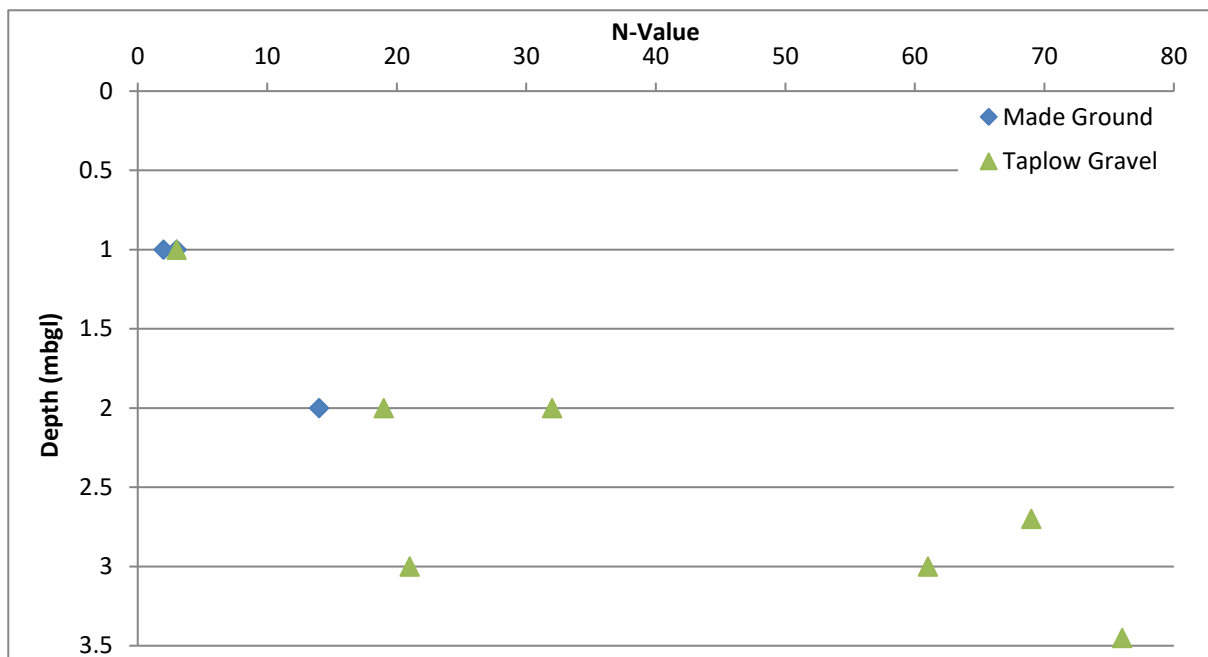
Table 9.1: Ground Conditions and Derived Geotechnical Parameters

Strata	Depth Encountered (from-to) (mbgl)	SPT 'N' Value	Moisture content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (corrected plasticity) (%)	NHBC Volume Change Classification
Soft to firm consistency grey-brown sandy slightly gravelly clay/gravelly sand. Gravel consists of fine to coarse angular to sub-rounded flint, brick and concrete. (MADE GROUND).	0.12-0.40 To 0.90-3.00	2-14	21-28	44-53	27-30	14-26 (6.02-15.08)	None - Low
Soft to firm consistency grey- brown sandy gravelly CLAY. Gravel consists of fine sub-rounded to sub-angular flint. (ALLUVIUM).	0.90-1.40 To 1.10-1.80	-	26-31	45-58	22	23-36 (19.09-36)	Low - Medium
Very dense light brown to grey clayey slightly gravelly SAND. Sand is fine to medium. Gravel consists of fine sub-angular to sub-rounded flint. (TAPLOW GRAVEL MEMBER - GRANULAR)	1.10-1.80 To 1.50-2.10	3-69	-	-	-	-	-
Very dense brown - black sandy GRAVEL. Gravel consists of fine to coarse sub-angular to sub-rounded flint. (TAPLOW GRAVEL MEMBER – GRANULAR)	1.50-3.00 To >3.15-3.45	21-76	-	-	-	-	-

9.4 Standard Penetration Tests

- 9.4.1 Standard Penetration Tests were undertaken at regular intervals throughout the window sampler boreholes. The results of the SPTs are plotted against depth in Figure 9.1 below.
- 9.4.2 The strata have been grouped into “Made Ground” and “Taplow Gravel”. No tests were undertaken in the Alluvium materials due to the thin and inconsistent nature of these materials.
- 9.4.3 N_{equi} results have been calculated for both strata where the SPT crossed strata boundaries or where the full 300mm of penetration could not be achieved for 50 or fewer blows.

Figure 9.1: SPT ‘N’ Value v Depth



- 9.4.4 As would be expected, the SPT N-values increase sharply with depth within the Taplow Gravel Member deposits.
- 9.5 Building Near Trees**
- 9.5.1 The underlying near surface Alluvium soil conditions have been shown to be of medium volume change potential.
- 9.5.2 Using the geotechnical testing obtained (summarised in Table 9.1) and with reference to NHBC Chapter 4.2 it can be seen that a minimum founding depth of 1.25m will be required. This would allow for restricted new planting. Based on the current proposed development, no new foundations are anticipated.
- 9.5.3 Presence of existing and proposed trees may increase this minimum depth. It is recommended that a tree survey that should include: location, species and height of all trees on and near to the proposed development is recommended.

9.5.4 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.

9.6 Foundations (Existing)

9.6.1 2No hand excavated trial pits were undertaken, one on the corner of the existing ground floor structure and one on one of the support pillars.

9.6.2 The exposed foundations appeared to be pads/strip foundations. HTP1 exposed a concrete strip at 0.71mbgl, which extended >1m from the edge of the structure. The founding depth could not be proven.

9.6.3 HTP2 exposed a strip footing at 0.55mbgl, greater than 0.65m thick and therefore the founding depth was not proven but is in excess of 1.2mbgl the strip was proven to be 0.38m wide and greater than 1.50m long.

9.7 Foundations (Proposed)

9.7.1 The conversion of the structure to residential use should be anticipated to increase the loading of the structure compared to the current commercial use.

9.7.2 Although the bases of the foundations were not proven, they were proven to be in excess of 1.2mbgl. Based on the information obtained by this investigation and assuming a founding depth of at least 1.5mbgl and within the Taplow Gravel, an allowable bearing capacity of 125kPa could be expected.

9.8 Concrete in the Ground

9.8.1 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.

9.8.2 In accordance with BRE Special Digest 1, as there are fewer than 10 results in the data set the highest value has been taken.

9.8.3 Table 9.3 summarises the analysis of the aggressive nature of the ground for each of the strata encountered within the ground investigation.

Table 9.3: Concrete in the Ground Classes

Stratum	No. Samples	pH range	Highest WS Sulphate (mg/l)	Design Sulphate Class	ACEC Class
Made Ground	6	7.8-10.9	133	DS-1	AC-1
Alluvium	1	8.1	27	DS-1	AC-1
Taplow Gravel Member	2	8.5-8.7	127	DS-1	AC-1

9.9 Excavations

- 9.9.1 It is likely that some shallow excavations will be required at the site for services etc, in addition to larger excavations during the remediation works. These are anticipated to remain stable for the short term only.
- 9.9.2 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 where necessary, fully supported or battered back to a safe angle.
- 9.9.3 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.
- 9.9.4 Attention is also drawn to the provisions of the Health and Safety at Work Regulations, which state that the sides of any excavations greater than 1.2m depth, into which personnel are required to enter, should be fully supported or battered back to a safe angle.

9.10 Groundwater Control

- 9.10.1 During the investigation groundwater was reported within windowless sampler boreholes WS1, WS2 and WS3 between 1.80m bgl and 2.70m bgl depth.
- 9.10.2 During return monitoring groundwater was reported at depths of between 1.56m and 1.75mbgl. 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.
- 9.10.3 Surface water or rainfall ingress is likely to freely drain through the granular materials. If this does not occur then they too could be dealt with by traditional sump and pump.

10 REFERENCES

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APPENDICES

APPENDIX 1 – FIGURES

APPENDIX 2 – EXPLORATORY HOLE RECORDS

APPENDIX 3 – CHEMICAL LABORATORY TEST RESULTS

APPENDIX 4 – GEOTECHNICAL LABORATORY TEST RESULTS

APPENDIX 5 – SOIL GAS MONITORING TEST RESULTS



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Website: www.jomasassociates.com

Tel: 0843-289-2187

Fax: 0872-115-4505

Email: info@jomasassociates.com

APPENDICES

APPENDIX 1 – FIGURES

PROJECT NAME	Tavistock House	FIGURE NUMBER	1
PROJECT NO.	P9651J926b	DATE	May 2019
TITLE	Proposed Exploratory Holes	AUTHOR	TE



PROJECT NAME	Tavistock House	FIGURE NUMBER	2
PROJECT NO.	P9651J926b	DATE	May 2019
TITLE	Proposed Exploratory Holes	AUTHOR	TE

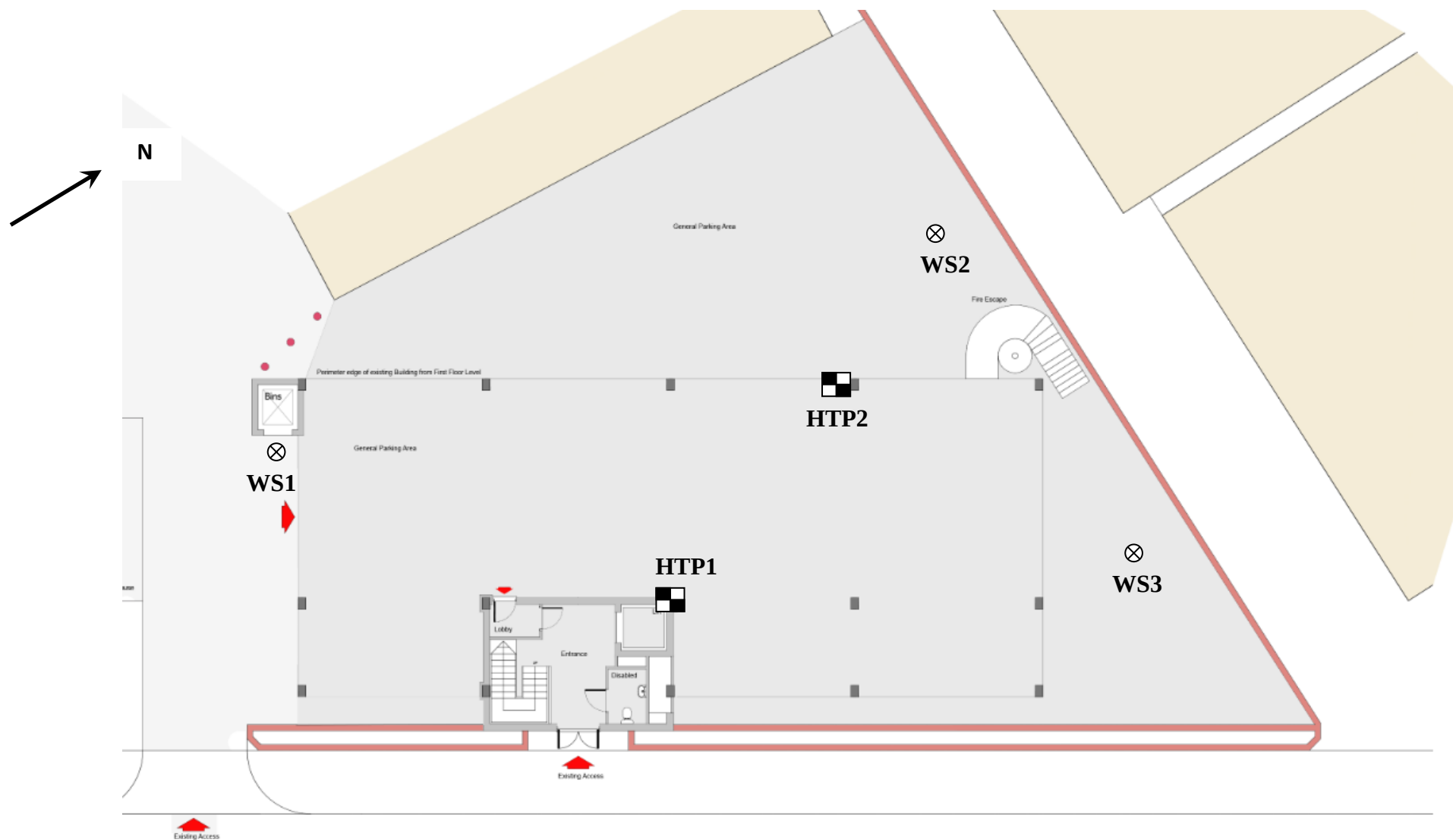
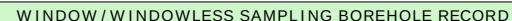


Figure 3



APPENDIX 2 – EXPLORATORY HOLE RECORDS



Exploratory Hole No:

WS1

Site Address:	Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge UB8 2U
---------------	---

Project No:

P9651J926b

Client:	Advance Business Equipment Holdings Ltd
---------	---

Ground Level:

Logged By:

Date Commenced:

08/05/2019

Checked By:	TE
-------------	----

Date Completed:

08/05/201

Water levels recorded during boring, m

Date:	08/0
Hole depth:	3.45

Casing depth:

Level water on strike:

Water Level after 20mins:

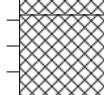
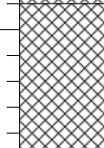
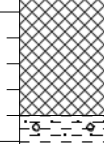
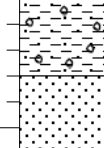
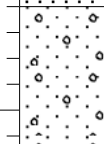
Remarks

1: *Field description

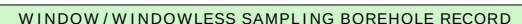
2: Refusal at 3.45m bgl on very dense gravel deposits.

3:

4:

Sample or Tests										Strata			Strata Description	Installation		
Type	Depth (mbgl)	Result								Legend	Depth (mbgl)	Water Strikes (mbgl)				
		75	75	75	75	75	75	N								
ES	0.25								0.00		0.08		Asphalt. (MADE GROUND)			
												Concrete. (MADE GROUND - Sub-base)				
ES	0.50								0.50				Soft to firm consistency* brown sandy gravelly clay. Gravel consists of fine to coarse angular to sub-rounded flint, brick and concrete fragments. (MADE GROUND)			
SPT ES	1.00	0	1	0	1	1	1	3	1.00							
D	1.50								1.50		1.40		Soft to firm consistency* brown sandy slightly gravelly CLAY. Gravel consists of fine sub-rounded to rounded flint. (ALLUVIUM)			
SPT D	2.00	5	6	7	8	8	9	32	2.00		2.10		Very dense light brown to grey clayey slightly gravelly SAND. Sand is fine to medium. Gravel consists of fine sub-rounded to sub-angular flint. (TAPLOW GRAVEL MEMBER)			
SPT D	3.00	7	9	11	14	17	19	61	2.50				Very dense brown sandy GRAVEL. Gravel consists of fine to coarse sub-angular to sub-rounded. (TAPLOW GRAVEL MEMBER)			
									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
 Jomas Associates Ltd - Lakeside House, 1 Furzeground Way, Stockley Park, UB11 1BD
 T: 0843 289 2187 E: info@jomasassociates.com W: www.jomasassociates.com



WS2

B Project No:	P9651J926b
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Ground Level:	
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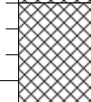
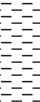
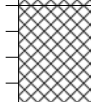
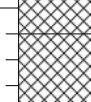
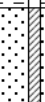
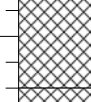
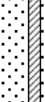
Date Commenced:	08/05/2019
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Date Completed:	08/05/2019
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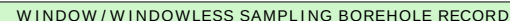
Sheet No:	1 Of 1
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Date:	08/05/2019					
Hole depth:	3.45					
Casing depth:						
Level water on strike:	2.70					
Water Level after 20mins:						

1: *Field description
2: Strong hydrocarbon odours noted between 1.10m and 1.70m bgl, and between 3.00m and 3.45m bgl.
3: Refusal at 3.45m bgl on very dense gravel deposits.

Sample or Tests										Strata			Strata Description	Installation	
Type	Depth (mbgl)	Result								Legend	Depth (mbgl)	Water Strikes (mbgl)			
		75	75	75	75	75	75	N							
ES	0.25								0.00		0.06		Asphalt. (MADE GROUND)		
									0.20			Concrete. (MADE GROUND - Sub-base)			
ES	0.50								0.50		0.60		Dark brown sandy gravel. Gravel consists of fine to coarse sub-angular to sub-rounded flint and occasional brick fragments. (MADE GROUND)		
SPT ES	1.00	1	0	1	0	0	1	2	1.00		1.10		Soft consistency* brown sandy slightly gravelly clay. Gravel consists of fine to medium angular to sub-rounded flint and occasional brick fragments. (MADE GROUND)		
ES	1.50								1.50		1.70		Firm consistency* black sandy gravelly clay. Gravel consists of fine to medium angular to sub-angular flint and occasional brick fragments. Strong hydrocarbon odour noted. (MADE GROUND)		
									2.00		1	2	3		
SPT ES	3.00	2	4	5	5	6	5	21	2.50		3.00		Very dense black slightly clayey sandy GRAVEL. Gravel consists of fine to coarse angular to sub-angular flint. Strong hydrocarbon odour noted. (TAPLOW GRAVEL MEMBER)		
									3.50						
SPT (c)	3.45	14	19	15	20	20	21	76	3.50		3.45				
									4.00						
									4.50						
									5.00						

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample
 Jomas Associates Ltd - Lakeside House, 1 Furze ground Way, Stockley Park, UB11 1BD
 T: 0843 289 2187 E: info@jomasassociates.com W: www.jomasassociates.com



Exploratory Hole No:

WS3

Site Address:	Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge UB8 2UP
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Project No:	P9651J926b
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Client:	Advance Business Equipment Holdings Ltd
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Ground Level:	
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Logged By:	JN
------------	----

Date Commenced:	08/05/2019
-----------------	------------

Checked By:	TE
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Date Completed:	08/05/2019
-----------------	------------

Type and diameter of equipment:	Windowless Sampler
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Sheet No:	1 Of 1
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Water levels recorded during boring, m

Date:	08/05/2019
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Hole depth:	3.1
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Casing depth:

Level water on strike:	1.90
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Water Level after 20mins:

Remarks

1: *Field description
2: Refusal at 3.15m bgl on very dense gravel deposits.

3

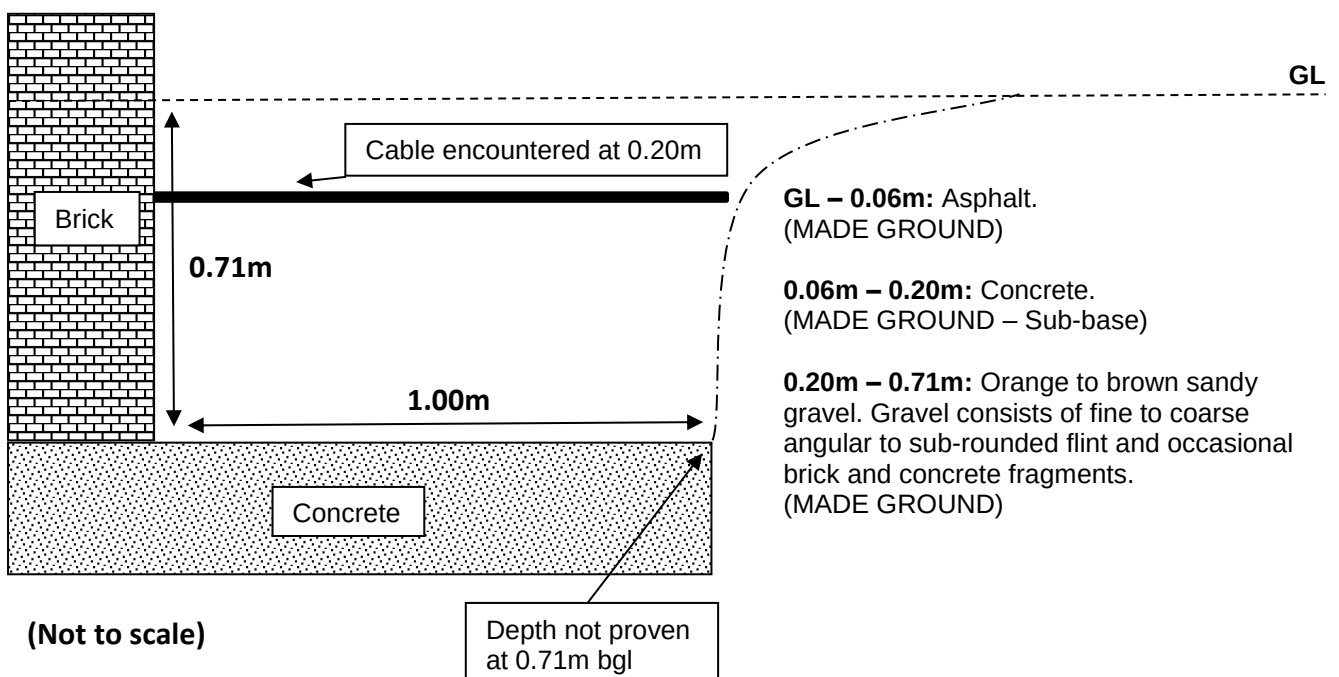
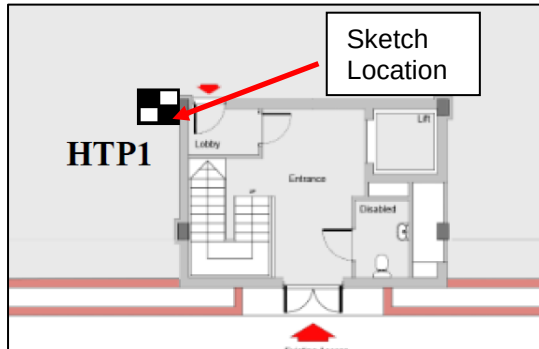
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Sample or Tests										Strata			Strata Description	Installation	
Type	Depth (mbgl)	Result								Legend	Depth (mbgl)	Water Strikes (mbgl)			
		75	75	75	75	75	75	N							
ES	0.25								0.00		0.05		Asphalt. (MADE GROUND)		
	ES	0.50							0.12			Concrete. (MADE GROUND - Sub-base)			
ES		1.00	0	1	1	0	1	1	3	0.45		Grey to brown very gravelly sand. Sand is fine to coarse. Gravel consists of fine to medium angular to rounded flint, brick and concrete fragments. (MADE GROUND)			
	0.90										Firm consistency* grey to brown slightly sandy gravelly clay. Gravel consists of fine to coarse sub-rounded to sub-angular flint and occasional brick fragments. (MADE GROUND)				
SPT	1.40								1.00		1.10		Firm consistency* grey to brown sandy gravelly CLAY. Gravel consists of fine sub-rounded to sub-angular flint. (ALLUVIUM)		
D	2.00	3	4	4	4	4	7	19	1.50			Grey slightly clayey slightly gravelly SAND. Sand is fine to medium. Gravel consists of fine to medium angular to sub-angular flint. (TAPLOW GRAVEL MEMBER)			
D	2.70	9	11	14	19	16	20	69	3.15			Medium becoming very dense light brown very gravelly SAND. Sand is fine to coarse. Gravel consists of fine to medium sub-angular to sub-rounded flint. (TAPLOW GRAVEL MEMBER)			
									3.50						
									4.00						
									4.50						
									5.00						

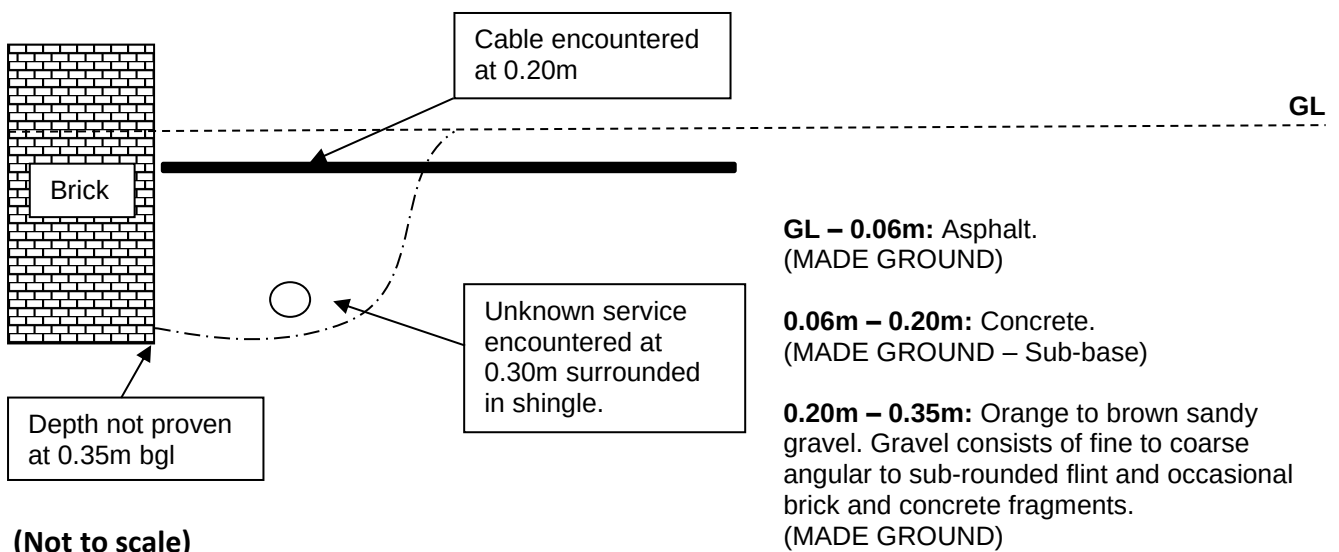
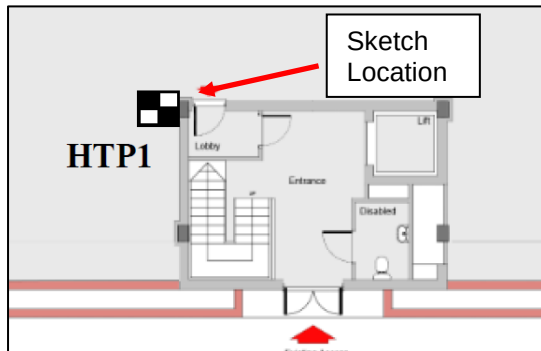
Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample
 Jomas Associates Ltd - Lakeside House, 1 Furzground Way, Stockley Park, UB11 1BD
 T: 0843 289 2187 E: info@jomasassociates.com W: www.jomasassociates.com

Job No:	P9651J926b	Issue Date:	May 2019
Project:	Tavistock House, 5 Rockingham Road, Uxbridge, UB2 2UB	Reference:	P9651J926b/TE
Subject:	Foundation Inspection Pit Sketches	Prepared by:	AMM

HTP1A

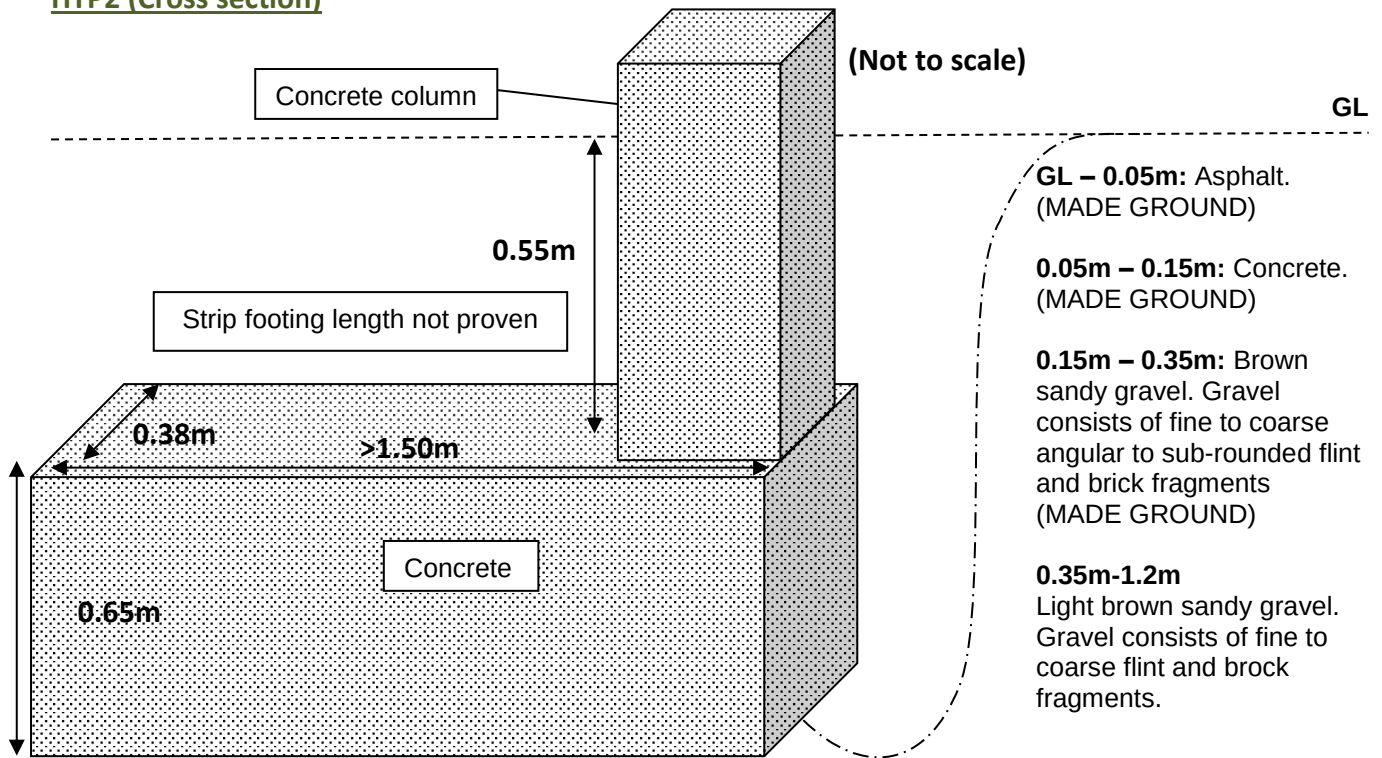


HTP1B



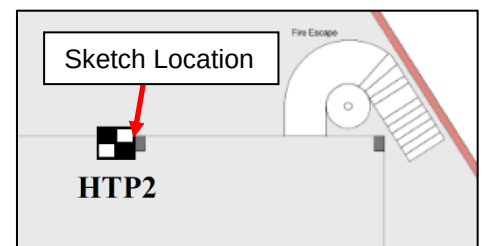
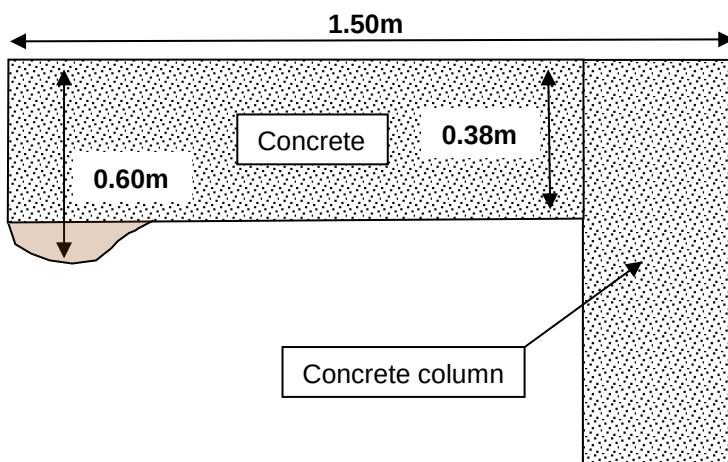
Pit terminated due to presence of service.

HTP2 (Cross section)



Not under strip at 1.2mbgl

HTP2 (Plan view)



APPENDIX 3 – CHEMICAL LABORATORY TEST RESULTS



Emma Hucker

Jomas Associates Ltd
Lakeside House
1 Furzeground Way
Stockley Park
UB11 1BD

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

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

e: Jomas Associates -

Analytical Report Number : 19-40925

Replaces Analytical Report Number : 19-40925, issue no. 1

Project / Site name:	Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge UB8 2UB	Samples received on:	10/05/2019
Your job number:	J926B	Samples instructed on:	13/05/2019
Your order number:	P9651J926B.2	Analysis completed by:	07/06/2019
Report Issue Number:	2	Report issued on:	07/06/2019
Samples Analysed:	12 soil samples		

Signed: 

Katarzyna Lewicka
Head of Reporting Section
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.

Iss No 19-40925-2 Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge UB8 2UB J926B

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

Page 1 of 14

Analytical Report Number: 19-40925

Project / Site name: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge UB8 2UB

Your Order No: P9651J926B.2

Lab Sample Number	1219933	1219934	1219935	1219936	1219937
Sample Reference	WS1	WS1	WS1	WS2	WS2
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.50	1.00	1.50	1.50	3.40
Date Sampled	09/05/2019	09/05/2019	09/05/2019	09/05/2019	09/05/2019
Time Taken	None Supplied	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
Moisture Content	%	N/A	NONE	19	18
Total mass of sample received	kg	0.001	NONE	1.4	1.4

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	Chrysotile	-	-	-	-
Asbestos in Soil	Type	N/A	ISO 17025	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	7.8	8.1	8.5	8.7
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	-	< 1	63
Total Sulphate as SO ₄	mg/kg	50	MCERTS	740	660	-	350	310
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.074	0.056	0.027	0.11	0.13
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	74.3	56.3	-	105	127
Total Organic Carbon (TOC)	%	0.1	MCERTS	1.8	1.6	-	-	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	1.2
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	8.7	19
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	0.78	38
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	1.5	23
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	3.7	97
Phenanthrene	mg/kg	0.05	MCERTS	0.68	< 0.05	-	8.8	280
Anthracene	mg/kg	0.05	MCERTS	0.31	< 0.05	-	2.2	73
Fluoranthene	mg/kg	0.05	MCERTS	2.2	0.40	-	5.2	160
Pyrene	mg/kg	0.05	MCERTS	2.2	0.40	-	4.0	100
Benzo(a)anthracene	mg/kg	0.05	MCERTS	1.8	0.33	-	2.6	73
Chrysene	mg/kg	0.05	MCERTS	1.4	0.31	-	1.7	45
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	2.0	0.36	-	2.0	40
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.67	0.18	-	0.73	25
Benzo(a)pyrene	mg/kg	0.05	MCERTS	1.7	0.38	-	1.8	43
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.76	< 0.05	-	0.80	14
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	< 0.05	5.8
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.80	< 0.05	-	0.80	13

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	14.6	2.36	-	45.4	1050
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Analytical Report Number: 19-40925

Project / Site name: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge UB8 2UB

Your Order No: P9651J926B.2

Lab Sample Number	1219933	1219934	1219935	1219936	1219937
Sample Reference	WS1	WS1	WS1	WS2	WS2
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.50	1.00	1.50	1.50	3.40
Date Sampled	09/05/2019	09/05/2019	09/05/2019	09/05/2019	09/05/2019
Time Taken	None Supplied	None Supplied	None Supplied	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	20	19	-	5.6	4.9
Boron (water soluble)	mg/kg	0.2	MCERTS	5.1	5.1	-	2.6	0.7
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.3	0.3	-	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	-	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	23	23	-	20	21
Copper (aqua regia extractable)	mg/kg	1	MCERTS	110	47	-	11	8.9
Lead (aqua regia extractable)	mg/kg	1	MCERTS	290	290	-	27	9.3
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	1.0	0.6	-	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	24	22	-	17	13
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	180	96	-	33	34

Monoaromatics & Oxygenates

Benzene	µg/kg	1	MCERTS	-	-	-	< 1.0	16
Toluene	µg/kg	1	MCERTS	-	-	-	< 1.0	79
Ethylbenzene	µg/kg	1	MCERTS	-	-	-	10	87
p & m-xylene	µg/kg	1	MCERTS	-	-	-	73	620
o-xylene	µg/kg	1	MCERTS	-	-	-	29	200
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	-	-	-
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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	21
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	-	< 2.0	210
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	-	-	-	< 8.0	280
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	-	-	-	< 8.0	750
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	-	< 10	1300

TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	-	-	-	< 0.001	0.016
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	-	-	-	< 0.001	0.079
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	-	0.27	3.8
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	-	13	130
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	-	47	1200
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	-	-	-	74	2400
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	-	-	-	130	2400
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	-	260	6100

TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	< 2.0	-	-	-
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0	< 4.0	-	-	-
TPH (C16 - C21)	mg/kg	1	MCERTS	16	4.7	-	-	-
TPH (C21 - C40)	mg/kg	10	MCERTS	60	36	-	-	-



Analytical Report Number: 19-40925

Project / Site name: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge UB8 2UB

Your Order No: P9651J926B.2

Lab Sample Number	1219933	1219934	1219935	1219936	1219937
Sample Reference	WS1	WS1	WS1	WS2	WS2
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.50	1.00	1.50	1.50	3.40
Date Sampled	09/05/2019	09/05/2019	09/05/2019	09/05/2019	09/05/2019
Time Taken	None Supplied	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	16
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	79
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	-	-	-	10	87
p & m-Xylene	µg/kg	1	MCERTS	-	-	-	73	620
Styrene	µg/kg	1	MCERTS	-	-	-	< 1.0	< 1.0
Tribromomethane	µg/kg	1	NONE	-	-	-	< 1.0	< 1.0
o-Xylene	µg/kg	1	MCERTS	-	-	-	29	190
1,1,2,2-Tetrachloroethane	µg/kg	1	MCERTS	-	-	-	< 1.0	< 1.0
Isopropylbenzene	µg/kg	1	MCERTS	-	-	-	< 1.0	29
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	-	-	-	64	1200
tert-Butylbenzene	µg/kg	1	MCERTS	-	-	-	< 1.0	< 1.0
1,2,4-Trimethylbenzene	µg/kg	1	ISO 17025	-	-	-	99	1600
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	59
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: 19-40925

Project / Site name: Tavistock House, 5 Rockingham Wharf, Rockingham
Your Order No: P9651J926B.2

Lab Sample Number	1219938	1219939	1219940	1219941	1219942
Sample Reference	WS2	WS3	WS3	HTP1	HTP2
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.50	0.25	0.50	0.25	0.50
Date Sampled	09/05/2019	09/05/2019	09/05/2019	09/05/2019	09/05/2019
Time Taken	None Supplied	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
Moisture Content	%	N/A	NONE	-	10
Total mass of sample received	kg	0.001	NONE	-	1.3

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	Chrysotile & Amosite	-	-	-
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Detected	Not-detected	Not-detected	Not-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	-	10.9	8.3	-	-
Total Cyanide	mg/kg	1	MCERTS	-	< 1	2	-	-
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-	2300	1000	-	-
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	-	0.13	0.039	-	-
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-	133	38.5	-	-
Total Organic Carbon (TOC)	%	0.1	MCERTS	-	0.9	0.8	< 0.1	-

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	-	< 0.05	< 0.05	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	-	< 0.05	0.74	-	-
Acenaphthene	mg/kg	0.05	MCERTS	-	< 0.05	< 0.05	-	-
Fluorene	mg/kg	0.05	MCERTS	-	< 0.05	0.50	-	-
Phenanthrene	mg/kg	0.05	MCERTS	-	1.3	5.2	-	-
Anthracene	mg/kg	0.05	MCERTS	-	0.43	3.0	-	-
Fluoranthene	mg/kg	0.05	MCERTS	-	2.9	11	-	-
Pyrene	mg/kg	0.05	MCERTS	-	2.5	8.4	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	1.9	6.6	-	-
Chrysene	mg/kg	0.05	MCERTS	-	1.5	5.4	-	-
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	2.1	7.0	-	-
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	0.74	2.6	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	1.8	6.3	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	0.93	2.7	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	< 0.05	1.1	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	0.95	2.9	-	-

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	-	16.9	63.4	-	-
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Analytical Report Number: 19-40925

Project / Site name: Tavistock House, 5 Rockingham Wharf, Rockingham
Your Order No: P9651J926B.2

Lab Sample Number				1219938	1219939	1219940	1219941	1219942
Sample Reference				WS2	WS3	WS3	HTP1	HTP2
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.50	0.25	0.50	0.25	0.50
Date Sampled				09/05/2019	09/05/2019	09/05/2019	09/05/2019	09/05/2019
Time Taken				None Supplied	None Supplied	None Supplied	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	-	14	14	-	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-	1.9	1.3	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-	0.5	0.3	-	-
Chromium (hexavalent)	mg/kg	4	MCERTS	-	< 4.0	< 4.0	-	-
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	19	18	-	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-	390	42	-	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-	290	310	-	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-	< 0.3	< 0.3	-	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-	18	18	-	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-	< 1.0	1.5	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-	280	150	-	-

Monoaromatics & Oxygenates

Benzene	µg/kg	1	MCERTS	-	-	-	-	-
Toluene	µg/kg	1	MCERTS	-	-	-	-	-
Ethylbenzene	µg/kg	1	MCERTS	-	-	-	-	-
p & m-xylene	µg/kg	1	MCERTS	-	-	-	-	-
o-xylene	µg/kg	1	MCERTS	-	-	-	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	-	-	-	-

Petroleum Hydrocarbons

Petroleum Range Organics (C6 - C10)	mg/kg	0.1	MCERTS	-	< 0.1	< 0.1	-	-
TPH-CWG - Aliphatic >EC5 - EC6								
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC5 - EC7								
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	-	-	-
TPH (C10 - C12)								
TPH (C12 - C16)	mg/kg	4	MCERTS	-	14	13	-	-
TPH (C16 - C21)	mg/kg	1	MCERTS	-	49	63	-	-
TPH (C21 - C40)	mg/kg	10	MCERTS	-	310	180	-	-



Analytical Report Number: 19-40925

Project / Site name: Tavistock House, 5 Rockingham Wharf, Rockingham
Your Order No: P9651J926B.2

Lab Sample Number				1219938	1219939	1219940	1219941	1219942
Sample Reference				WS2	WS3	WS3	HTP1	HTP2
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.50	0.25	0.50	0.25	0.50
Date Sampled				09/05/2019	09/05/2019	09/05/2019	09/05/2019	09/05/2019
Time Taken				None Supplied	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	-	-	-	-	-
Chloroethane	µg/kg	1	NONE	-	-	-	-	-
Bromomethane	µg/kg	1	ISO 17025	-	-	-	-	-
Vinyl Chloride	µg/kg	1	NONE	-	-	-	-	-
Trichlorofluoromethane	µg/kg	1	NONE	-	-	-	-	-
1,1-Dichloroethene	µg/kg	1	NONE	-	-	-	-	-
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	1	ISO 17025	-	-	-	-	-
Cis-1,2-dichloroethene	µg/kg	1	MCERTS	-	-	-	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	-	-	-	-
1,1-Dichloroethane	µg/kg	1	MCERTS	-	-	-	-	-
2,2-Dichloropropane	µg/kg	1	MCERTS	-	-	-	-	-
Trichloromethane	µg/kg	1	MCERTS	-	-	-	-	-
1,1,1-Trichloroethane	µg/kg	1	MCERTS	-	-	-	-	-
1,2-Dichloroethane	µg/kg	1	MCERTS	-	-	-	-	-
1,1-Dichloropropene	µg/kg	1	MCERTS	-	-	-	-	-
Trans-1,2-dichloroethene	µg/kg	1	NONE	-	-	-	-	-
Benzene	µg/kg	1	MCERTS	-	-	-	-	-
Tetrachloromethane	µg/kg	1	MCERTS	-	-	-	-	-
1,2-Dichloropropane	µg/kg	1	MCERTS	-	-	-	-	-
Trichloroethene	µg/kg	1	MCERTS	-	-	-	-	-
Dibromomethane	µg/kg	1	MCERTS	-	-	-	-	-
Bromodichloromethane	µg/kg	1	MCERTS	-	-	-	-	-
Cis-1,3-dichloropropene	µg/kg	1	ISO 17025	-	-	-	-	-
Trans-1,3-dichloropropene	µg/kg	1	ISO 17025	-	-	-	-	-
Toluene	µg/kg	1	MCERTS	-	-	-	-	-
1,1,2-Trichloroethane	µg/kg	1	MCERTS	-	-	-	-	-
1,3-Dichloropropane	µg/kg	1	ISO 17025	-	-	-	-	-
Dibromochloromethane	µg/kg	1	ISO 17025	-	-	-	-	-
Tetrachloroethene	µg/kg	1	NONE	-	-	-	-	-
1,2-Dibromoethane	µg/kg	1	ISO 17025	-	-	-	-	-
Chlorobenzene	µg/kg	1	MCERTS	-	-	-	-	-
1,1,1,2-Tetrachloroethane	µg/kg	1	MCERTS	-	-	-	-	-
Ethylbenzene	µg/kg	1	MCERTS	-	-	-	-	-
p & m-Xylene	µg/kg	1	MCERTS	-	-	-	-	-
Styrene	µg/kg	1	MCERTS	-	-	-	-	-
Tribromomethane	µg/kg	1	NONE	-	-	-	-	-
o-Xylene	µg/kg	1	MCERTS	-	-	-	-	-
1,1,2,2-Tetrachloroethane	µg/kg	1	MCERTS	-	-	-	-	-
Isopropylbenzene	µg/kg	1	MCERTS	-	-	-	-	-
Bromobenzene	µg/kg	1	MCERTS	-	-	-	-	-
n-Propylbenzene	µg/kg	1	ISO 17025	-	-	-	-	-
2-Chlorotoluene	µg/kg	1	MCERTS	-	-	-	-	-
4-Chlorotoluene	µg/kg	1	MCERTS	-	-	-	-	-
1,3,5-Trimethylbenzene	µg/kg	1	ISO 17025	-	-	-	-	-
tert-Butylbenzene	µg/kg	1	MCERTS	-	-	-	-	-
1,2,4-Trimethylbenzene	µg/kg	1	ISO 17025	-	-	-	-	-
sec-Butylbenzene	µg/kg	1	MCERTS	-	-	-	-	-
1,3-Dichlorobenzene	µg/kg	1	ISO 17025	-	-	-	-	-
p-Isopropyltoluene	µg/kg	1	ISO 17025	-	-	-	-	-
1,2-Dichlorobenzene	µg/kg	1	MCERTS	-	-	-	-	-
1,4-Dichlorobenzene	µg/kg	1	MCERTS	-	-	-	-	-
Butylbenzene	µg/kg	1	MCERTS	-	-	-	-	-
1,2-Dibromo-3-chloropropane	µg/kg	1	ISO 17025	-	-	-	-	-
1,2,4-Trichlorobenzene	µg/kg	1	MCERTS	-	-	-	-	-
Hexachlorobutadiene	µg/kg	1	MCERTS	-	-	-	-	-
1,2,3-Trichlorobenzene	µg/kg	1	ISO 17025	-	-	-	-	-

Analytical Report Number: 19-40925

Project / Site name: Tavistock House, 5 Rockingham Wharf, Rockingham
Your Order No: P9651J926B.2

Lab Sample Number	1219943			1219944				
Sample Reference	WS2			WS3				
Sample Number	None Supplied			None Supplied				
Depth (m)	2.00			1.40				
Date Sampled	09/05/2019			09/05/2019				
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	17	14			
Total mass of sample received	kg	0.001	NONE	0.50	0.50			

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-			
Asbestos in Soil	Type	N/A	ISO 17025	-	-			
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	-			
Asbestos Quantification Total	%	0.001	ISO 17025	-	-			

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.6	8.5			
Total Cyanide	mg/kg	1	MCERTS	-	-			
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-	-			
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.39	0.0097			
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-	-			
Total Organic Carbon (TOC)	%	0.1	MCERTS	-	-			

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-	-			
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	-	-			
Acenaphthylene	mg/kg	0.05	MCERTS	-	-			
Acenaphthene	mg/kg	0.05	MCERTS	-	-			
Fluorene	mg/kg	0.05	MCERTS	-	-			
Phenanthrene	mg/kg	0.05	MCERTS	-	-			
Anthracene	mg/kg	0.05	MCERTS	-	-			
Fluoranthene	mg/kg	0.05	MCERTS	-	-			
Pyrene	mg/kg	0.05	MCERTS	-	-			
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-			
Chrysene	mg/kg	0.05	MCERTS	-	-			
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	-			
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	-			
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-			
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-			
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-			
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-			

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	-	-			
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Analytical Report Number: 19-40925

Project / Site name: Tavistock House, 5 Rockingham Wharf, Rockingham
Your Order No: P9651J926B.2

Lab Sample Number				1219943	1219944			
Sample Reference				WS2	WS3			
Sample Number				None Supplied	None Supplied			
Depth (m)				2.00	1.40			
Date Sampled				09/05/2019	09/05/2019			
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	-	-			
Boron (water soluble)	mg/kg	0.2	MCERTS	-	-			
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-	-			
Chromium (hexavalent)	mg/kg	4	MCERTS	-	-			
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	-			
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-	-			
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-	-			
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-	-			
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-	-			
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-	-			
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-	-			

Monoaromatics & Oxygenates

Benzene	µg/kg	1	MCERTS	-	-			
Toluene	µg/kg	1	MCERTS	-	-			
Ethylbenzene	µg/kg	1	MCERTS	-	-			
p & m-xylene	µg/kg	1	MCERTS	-	-			
o-xylene	µg/kg	1	MCERTS	-	-			
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	-			

Petroleum Hydrocarbons

Petroleum Range Organics (C6 - C10)	mg/kg	0.1	MCERTS	-	-			
TPH-CWG - Aliphatic >EC5 - EC6								
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	-	-			
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-			
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	-	-			
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	-	-			
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	-	-			
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	-	-			
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-			
TPH-CWG - Aromatic >EC5 - EC7								
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	-	-			
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-			
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	-	-			
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	-	-			
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	-	-			
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	-	-			
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-			
TPH (C10 - C12)								
TPH (C12 - C16)	mg/kg	4	MCERTS	-	-			
TPH (C16 - C21)	mg/kg	1	MCERTS	-	-			
TPH (C21 - C40)	mg/kg	10	MCERTS	-	-			



Analytical Report Number: 19-40925

Project / Site name: Tavistock House, 5 Rockingham Wharf, Rockingham
Your Order No: P9651J926B.2

Lab Sample Number				1219943	1219944			
Sample Reference				WS2	WS3			
Sample Number				None Supplied	None Supplied			
Depth (m)				2.00	1.40			
Date Sampled				09/05/2019	09/05/2019			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
VOCs								
Chloromethane	µg/kg	1	ISO 17025	-	-			
Chloroethane	µg/kg	1	NONE	-	-			
Bromomethane	µg/kg	1	ISO 17025	-	-			
Vinyl Chloride	µg/kg	1	NONE	-	-			
Trichlorofluoromethane	µg/kg	1	NONE	-	-			
1,1-Dichloroethene	µg/kg	1	NONE	-	-			
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	1	ISO 17025	-	-			
Cis-1,2-dichloroethene	µg/kg	1	MCERTS	-	-			
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	-			
1,1-Dichloroethane	µg/kg	1	MCERTS	-	-			
2,2-Dichloropropane	µg/kg	1	MCERTS	-	-			
Trichloromethane	µg/kg	1	MCERTS	-	-			
1,1,1-Trichloroethane	µg/kg	1	MCERTS	-	-			
1,2-Dichloroethane	µg/kg	1	MCERTS	-	-			
1,1-Dichloropropene	µg/kg	1	MCERTS	-	-			
Trans-1,2-dichloroethene	µg/kg	1	NONE	-	-			
Benzene	µg/kg	1	MCERTS	-	-			
Tetrachloromethane	µg/kg	1	MCERTS	-	-			
1,2-Dichloropropane	µg/kg	1	MCERTS	-	-			
Trichloroethene	µg/kg	1	MCERTS	-	-			
Dibromomethane	µg/kg	1	MCERTS	-	-			
Bromodichloromethane	µg/kg	1	MCERTS	-	-			
Cis-1,3-dichloropropene	µg/kg	1	ISO 17025	-	-			
Trans-1,3-dichloropropene	µg/kg	1	ISO 17025	-	-			
Toluene	µg/kg	1	MCERTS	-	-			
1,1,2-Trichloroethane	µg/kg	1	MCERTS	-	-			
1,3-Dichloropropane	µg/kg	1	ISO 17025	-	-			
Dibromochloromethane	µg/kg	1	ISO 17025	-	-			
Tetrachloroethene	µg/kg	1	NONE	-	-			
1,2-Dibromoethane	µg/kg	1	ISO 17025	-	-			
Chlorobenzene	µg/kg	1	MCERTS	-	-			
1,1,1,2-Tetrachloroethane	µg/kg	1	MCERTS	-	-			
Ethylbenzene	µg/kg	1	MCERTS	-	-			
p & m-Xylene	µg/kg	1	MCERTS	-	-			
Styrene	µg/kg	1	MCERTS	-	-			
Tribromomethane	µg/kg	1	NONE	-	-			
o-Xylene	µg/kg	1	MCERTS	-	-			
1,1,2,2-Tetrachloroethane	µg/kg	1	MCERTS	-	-			
Isopropylbenzene	µg/kg	1	MCERTS	-	-			
Bromobenzene	µg/kg	1	MCERTS	-	-			
n-Propylbenzene	µg/kg	1	ISO 17025	-	-			
2-Chlorotoluene	µg/kg	1	MCERTS	-	-			
4-Chlorotoluene	µg/kg	1	MCERTS	-	-			
1,3,5-Trimethylbenzene	µg/kg	1	ISO 17025	-	-			
tert-Butylbenzene	µg/kg	1	MCERTS	-	-			
1,2,4-Trimethylbenzene	µg/kg	1	ISO 17025	-	-			
sec-Butylbenzene	µg/kg	1	MCERTS	-	-			
1,3-Dichlorobenzene	µg/kg	1	ISO 17025	-	-			
p-Isopropyltoluene	µg/kg	1	ISO 17025	-	-			
1,2-Dichlorobenzene	µg/kg	1	MCERTS	-	-			
1,4-Dichlorobenzene	µg/kg	1	MCERTS	-	-			
Butylbenzene	µg/kg	1	MCERTS	-	-			
1,2-Dibromo-3-chloropropane	µg/kg	1	ISO 17025	-	-			
1,2,4-Trichlorobenzene	µg/kg	1	MCERTS	-	-			
Hexachlorobutadiene	µg/kg	1	MCERTS	-	-			
1,2,3-Trichlorobenzene	µg/kg	1	ISO 17025	-	-			



Analytical Report Number: 19-40925
Project / Site name: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge UB8 2UB
Your Order No: P9651J926B.2

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
1219933	WS1	0.50	121	Loose Fibres	Chrysotile	< 0.001	< 0.001
1219939	WS3	0.25	125	Loose Fibres	Chrysotile& Amosite	< 0.001	< 0.001

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



Analytical Report Number : 19-40925

Project / Site name: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge UB8 2UB

* 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 *
1219933	WS1	None Supplied	0.50	Brown clay and sand.
1219934	WS1	None Supplied	1.00	Brown clay and sand.
1219935	WS1	None Supplied	1.50	Brown clay.
1219936	WS2	None Supplied	1.50	Brown clay and sand with gravel.
1219937	WS2	None Supplied	3.40	Brown clay and sand with tar.
1219938	WS2	None Supplied	0.50	-
1219939	WS3	None Supplied	0.25	Brown clay and sand with gravel.
1219940	WS3	None Supplied	0.50	Brown clay and sand with gravel.
1219941	HTP1	None Supplied	0.25	Light brown clay and sand with gravel and rubble.
1219942	HTP2	None Supplied	0.50	-
1219943	WS2	None Supplied	2.00	Grey clay with brick and gravel.
1219944	WS3	None Supplied	1.40	

Analytical Report Number : 19-40925

Project / Site name: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge UB8 2UB

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 dphenylcarbazine 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.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	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 based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	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 based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	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 based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	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 based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	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

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

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Analytical Report Number : 19-40925

Project / Site name: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge UB8 2UB

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
Stockley Park
UB11 1BD

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

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

e: Jomas Associates -

Analytical Report Number : 19-43018

Project / Site name:	Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge UB8 2UB	Samples received on:	28/05/2019
Your job number:	J926B	Samples instructed on:	28/05/2019
Your order number:	P9651J926B.4	Analysis completed by:	03/06/2019
Report Issue Number:	1	Report issued on:	03/06/2019
Samples Analysed:	3 water 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: 19-43018

Project / Site name: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge UB8 2UB

Your Order No: P9651J926B.4

Lab Sample Number	1231327	1231328	1231329		
Sample Reference	WS1	WS2	WS3		
Sample Number	None Supplied	None Supplied	None Supplied		
Depth (m)	None Supplied	None Supplied	None Supplied		
Date Sampled	24/05/2019	24/05/2019	24/05/2019		
Time Taken	None Supplied	None Supplied	None Supplied		
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status		

General Inorganics

pH	pH Units	N/A	ISO 17025	8.1	9.6	7.6		
Electrical Conductivity at 20 °C	µS/cm	10	ISO 17025	540	880	520		
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	27	350	170		
Sulphate as SO ₄	µg/l	45	ISO 17025	66400	95400	35800		
Ammonium as NH ₄	µg/l	15	ISO 17025	470	230000	73		
Hardness - Total	mgCaCO ₃ /l	1	ISO 17025	235	529	264		

Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	5400	< 10		
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Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	56.4	44.2		
Acenaphthylene	µg/l	0.01	ISO 17025	0.47	7.96	0.59		
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	5.01	0.62		
Fluorene	µg/l	0.01	ISO 17025	< 0.01	12.3	< 0.01		
Phenanthrene	µg/l	0.01	ISO 17025	0.71	40.3	< 0.01		
Anthracene	µg/l	0.01	ISO 17025	0.34	11.3	< 0.01		
Fluoranthene	µg/l	0.01	ISO 17025	2.96	25.2	< 0.01		
Pyrene	µg/l	0.01	ISO 17025	2.31	19.2	< 0.01		
Benzo(a)anthracene	µg/l	0.01	ISO 17025	1.33	9.91	< 0.01		
Chrysene	µg/l	0.01	ISO 17025	0.96	7.88	< 0.01		
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	1.36	6.33	< 0.01		
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	0.59	2.23	< 0.01		
Benzo(a)pyrene	µg/l	0.01	ISO 17025	1.02	3.80	< 0.01		
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	0.34	0.83	< 0.01		
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	0.26	< 0.01		
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	0.27	0.59	< 0.01		

Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	12.7	210	45.4		
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Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	0.15	ISO 17025	0.54	75.0	I/S		
Boron (dissolved)	µg/l	10	ISO 17025	100	150	84		
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.03	1.1	I/S		
Calcium (dissolved)	mg/l	0.012	ISO 17025	89	200	100		
Chromium (dissolved)	µg/l	0.2	ISO 17025	1.2	11	I/S		
Copper (dissolved)	µg/l	0.5	ISO 17025	4.7	64	I/S		
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	570	I/S		
Magnesium (dissolved)	mg/l	0.005	ISO 17025	3.3	8.4	3.3		
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	I/S		
Nickel (dissolved)	µg/l	0.5	ISO 17025	2.4	27	I/S		
Selenium (dissolved)	µg/l	0.6	ISO 17025	6.3	5.6	I/S		
Zinc (dissolved)	µg/l	0.5	ISO 17025	1.5	95	I/S		



Analytical Report Number: 19-43018

Project / Site name: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge UB8 2UB

Your Order No: P9651J926B.4

Lab Sample Number	1231327	1231328	1231329		
Sample Reference	WS1	WS2	WS3		
Sample Number	None Supplied	None Supplied	None Supplied		
Depth (m)	None Supplied	None Supplied	None Supplied		
Date Sampled	24/05/2019	24/05/2019	24/05/2019		
Time Taken	None Supplied	None Supplied	None Supplied		
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status		

Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	2600	< 1.0		
Toluene	µg/l	1	ISO 17025	< 1.0	1060	< 1.0		
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	202	< 1.0		
p & m-xylene	µg/l	1	ISO 17025	< 1.0	1840	< 1.0		
o-xylene	µg/l	1	ISO 17025	< 1.0	448	< 1.0		
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10		

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	2600	< 1.0		
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	1100	< 1.0		
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	3600	< 1.0		
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	72	44		
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	300	< 10		
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	400	< 10		
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	500	< 10		
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	8600	44		



Analytical Report Number: 19-43018

Project / Site name: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge UB8 2UB

Your Order No: P9651J926B.4

Lab Sample Number				1231327	1231328	1231329		
Sample Reference				WS1	WS2	WS3		
Sample Number				None Supplied	None Supplied	None Supplied		
Depth (m)				None Supplied	None Supplied	None Supplied		
Date Sampled				24/05/2019	24/05/2019	24/05/2019		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Water Analysis)				Units	Limit of detection	Accreditation Status		

VOCs

Chloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Chloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Bromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Vinyl Chloride	µg/l	1	NONE	< 1.0	< 1.0	< 1.0		
Trichlorofluoromethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0		
1,1-Dichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Cis-1,2-dichloroethene	µg/l	1	ISO 17025	< 1.0	61.6	10.5		
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,1-Dichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
2,2-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Trichloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,1,1-Trichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,2-Dichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,1-Dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Trans-1,2-dichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Benzene	µg/l	1	ISO 17025	< 1.0	2600	< 1.0		
Tetrachloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,2-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Trichloroethene	µg/l	1	ISO 17025	< 1.0	9.4	27.2		
Dibromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Bromodichloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Cis-1,3-dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Trans-1,3-dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Toluene	µg/l	1	ISO 17025	< 1.0	1060	< 1.0		
1,1,2-Trichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,3-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Dibromochloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Tetrachloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,2-Dibromoethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Chlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,1,1,2-Tetrachloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	202	< 1.0		
p & m-Xylene	µg/l	1	ISO 17025	< 1.0	1840	< 1.0		
Styrene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Tribromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
o-Xylene	µg/l	1	ISO 17025	< 1.0	448	< 1.0		
1,1,2,2-Tetrachloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Isopropylbenzene	µg/l	1	ISO 17025	< 1.0	10.4	< 1.0		
Bromobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
n-Propylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
2-Chlorotoluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
4-Chlorotoluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,3,5-Trimethylbenzene	µg/l	1	ISO 17025	< 1.0	506	< 1.0		
tert-Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,2,4-Trimethylbenzene	µg/l	1	ISO 17025	< 1.0	619	< 1.0		
sec-Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,3-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
p-Isopropyltoluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,2-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,4-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,2-Dibromo-3-chloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,2,4-Trichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Hexachlorobutadiene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
1,2,3-Trichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		

U/S = Unsuitable Sample I/S = Insufficient Sample

Iss No 19-43018-1 Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge UB8 2UB J926B

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



Analytical Report Number : 19-43018

Project / Site name: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge UB8 2UB

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 NH ₄ in water	Determination of Ammonium/Ammonia/Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Boron in water	Determination of boron in water by acidification followed by ICP-OES. Accredited matrices: SW PW GW	In-house method based on MEWAM	L039-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L0738-PL	W	ISO 17025
Electrical conductivity at 20oC of water	Determination of electrical conductivity in water by electrometric measurement. Accredited Matrices SW, GW, PW	In-house method	L031-PL	W	ISO 17025
Low level total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 *for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Sulphate in water	Determination of sulphate in water by acidification followed by ICP-OES. Accredited matrices: SW PW GW, PrW.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Total Hardness of water	Determination of hardness in waters by calculation from calcium and magnesium. Accredited Matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L045-PL	W	ISO 17025
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE
Volatile organic compounds in water	Determination of volatile organic compounds in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L0738-PL	W	ISO 17025

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.

Sample ID	Other ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
WS1		W	19-43018	1231327	c	Ammoniacal Nitrogen as N in water	L082-PL	c
WS1		W	19-43018	1231327	c	Ammonium as NH ₄ in water	L082-PL	c
WS1		W	19-43018	1231327	c	Electrical conductivity at 20oC of water	L031-PL	c
WS1		W	19-43018	1231327	c	pH at 20oC in water (automated)	L099-PL	c
WS2		W	19-43018	1231328	c	Ammoniacal Nitrogen as N in water	L082-PL	c
WS2		W	19-43018	1231328	c	Ammonium as NH ₄ in water	L082-PL	c
WS2		W	19-43018	1231328	c	Electrical conductivity at 20oC of water	L031-PL	c
WS2		W	19-43018	1231328	c	pH at 20oC in water (automated)	L099-PL	c
WS3		W	19-43018	1231329	c	Ammoniacal Nitrogen as N in water	L082-PL	c
WS3		W	19-43018	1231329	c	Ammonium as NH ₄ in water	L082-PL	c
WS3		W	19-43018	1231329	c	Electrical conductivity at 20oC of water	L031-PL	c
WS3		W	19-43018	1231329	c	pH at 20oC in water (automated)	L099-PL	c

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

Contact: Tom Elbourne

Site Name: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge

Site Address: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge

Client Reference: J926B

Job Number: 19-41034

Date Sampled: 09/05/2019

Date Received: 10/05/2019

Date Tested: 17/05/2019

Sampled By: Not Given

Test Results:

Laboratory Reference: 1220409

Hole No.: WS1

Sample Reference: Not Given

Soil Description: Brown slightly gravelly sandy CLAY

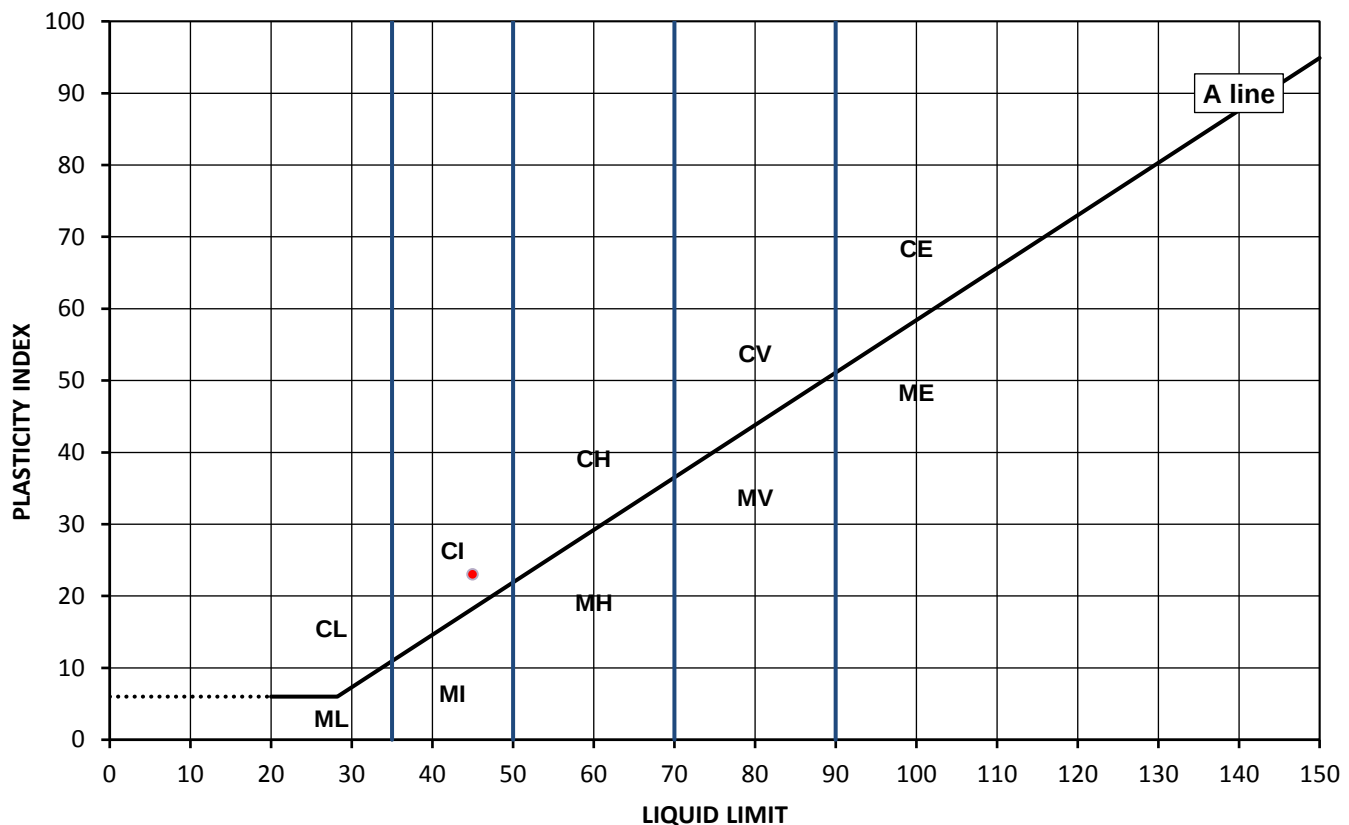
Depth Top [m]: 1.50

Depth Base [m]: Not Given

Sample Type: D

Sample Preparation: Tested after washing to remove >425um

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
26	45	22	23	83



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

C	Clay	Plasticity	Liquid Limit
M	Silt	L	Low
		I	Medium
		H	High
		V	Very high
		E	Extremely high
			below 35
			35 to 50
			50 to 70
			70 to 90
			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: 23/05/2019

Signed: Maria Chandler
Geotechnical Site Manager Northampton
for and on behalf of i2 Analytical Ltd GF 236.5

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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.*



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: J926B

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

Job Number: 19-41034

Date Sampled: 09/05/2019

Date Received: 10/05/2019

Contact: Tom Elbourne

Date Tested: 17/05/2019

Site Name: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge

Sampled By: Not Given

Site Address: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge

Test Results:

Laboratory Reference: 1220411

Depth Top [m]: 2.00

Hole No.: WS2

Depth Base [m]: Not Given

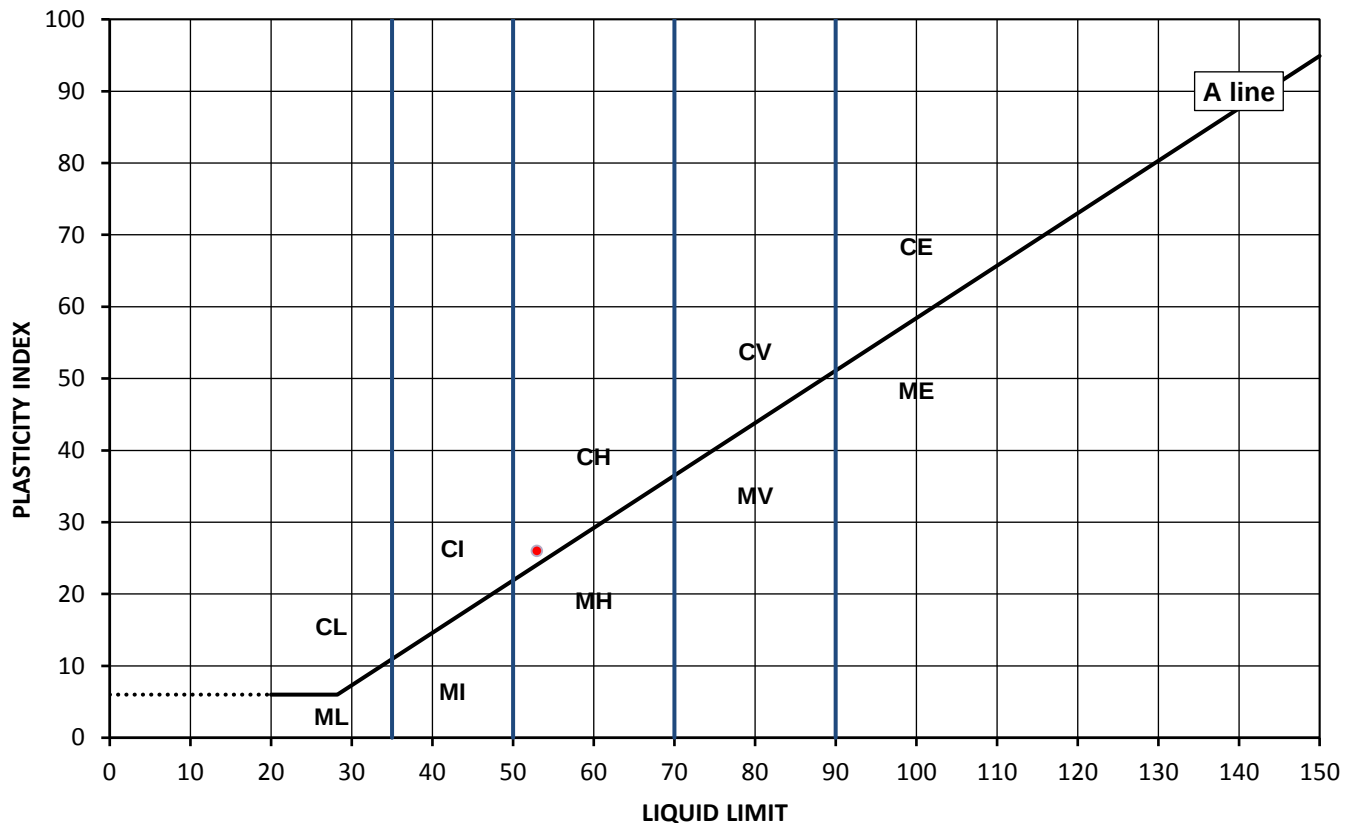
Sample Reference: Not Given

Sample Type: D

Soil Description: Black gravelly slightly sandy CLAY

Sample Preparation: Tested after >425um removed by hand

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
28	53	27	26	58



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

C	Clay	Plasticity	Liquid Limit
M	Silt	L	Low
		I	Medium
		H	High
		V	Very high
		E	Extremely high
			below 35
			35 to 50
			50 to 70
			70 to 90
			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: 23/05/2019

Signed: Maria Chandler
Geotechnical Site Manager Northampton
for and on behalf of i2 Analytical Ltd GF 236.5

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TEST CERTIFICATE

Liquid and Plastic Limits

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



Environmental Science

4041

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

Client: Jomas Associates Ltd
Client Address: Lakeside House, 1 Furzeground Way,
Stockley Park, UB11 1BD
Contact: Tom Elbourne
Site Name: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge
Site Address: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge

Client Reference: J926B
Job Number: 19-41034
Date Sampled: 09/05/2019
Date Received: 10/05/2019
Date Tested: 17/05/2019
Sampled By: Not Given

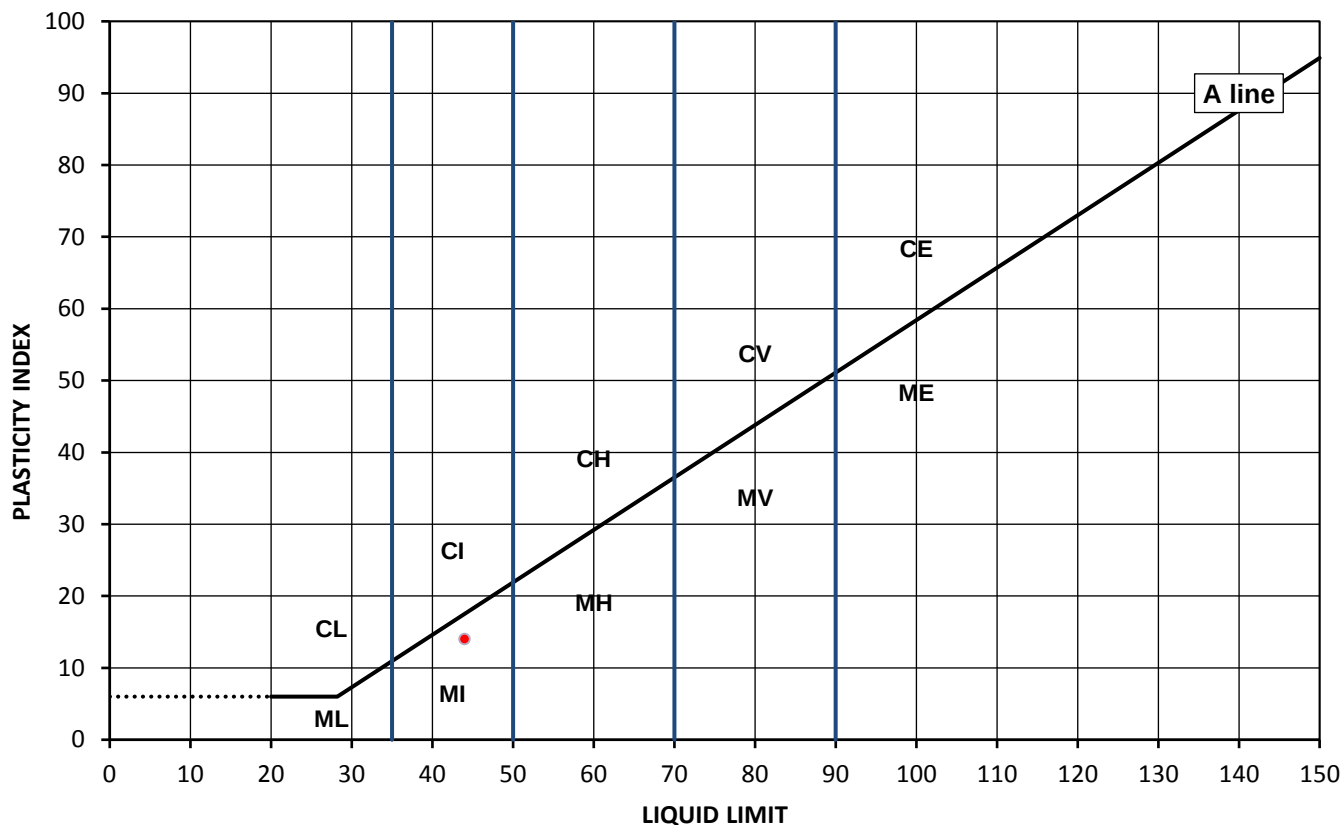
Test Results:

Laboratory Reference: 1220412
Hole No.: WS2
Sample Reference: Not Given
Soil Description: Black gravelly sandy CLAY

Depth Top [m]: 3.00
Depth Base [m]: Not Given
Sample Type: D

Sample Preparation: Tested after washing to remove >425um

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
21	44	30	14	43



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

C	Clay	Plasticity	Liquid Limit
M	Silt	L	Low
		I	Medium
		H	High
		V	Very high
		E	Extremely high
			below 35
			35 to 50
			50 to 70
			70 to 90
			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: 23/05/2019

Signed: Maria Chandler
Geotechnical Site Manager Northampton
for and on behalf of i2 Analytical Ltd GF 236.5

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Any assessment of compliance with specifications based on 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

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 Address: Lakeside House, 1 Furzeground Way,
Stockley Park, UB11 1BD
Contact: Tom Elbourne
Site Name: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge
Site Address: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge

Client Reference: J926B
Job Number: 19-41034
Date Sampled: 09/05/2019
Date Received: 10/05/2019
Date Tested: 17/05/2019
Sampled By: Not Given

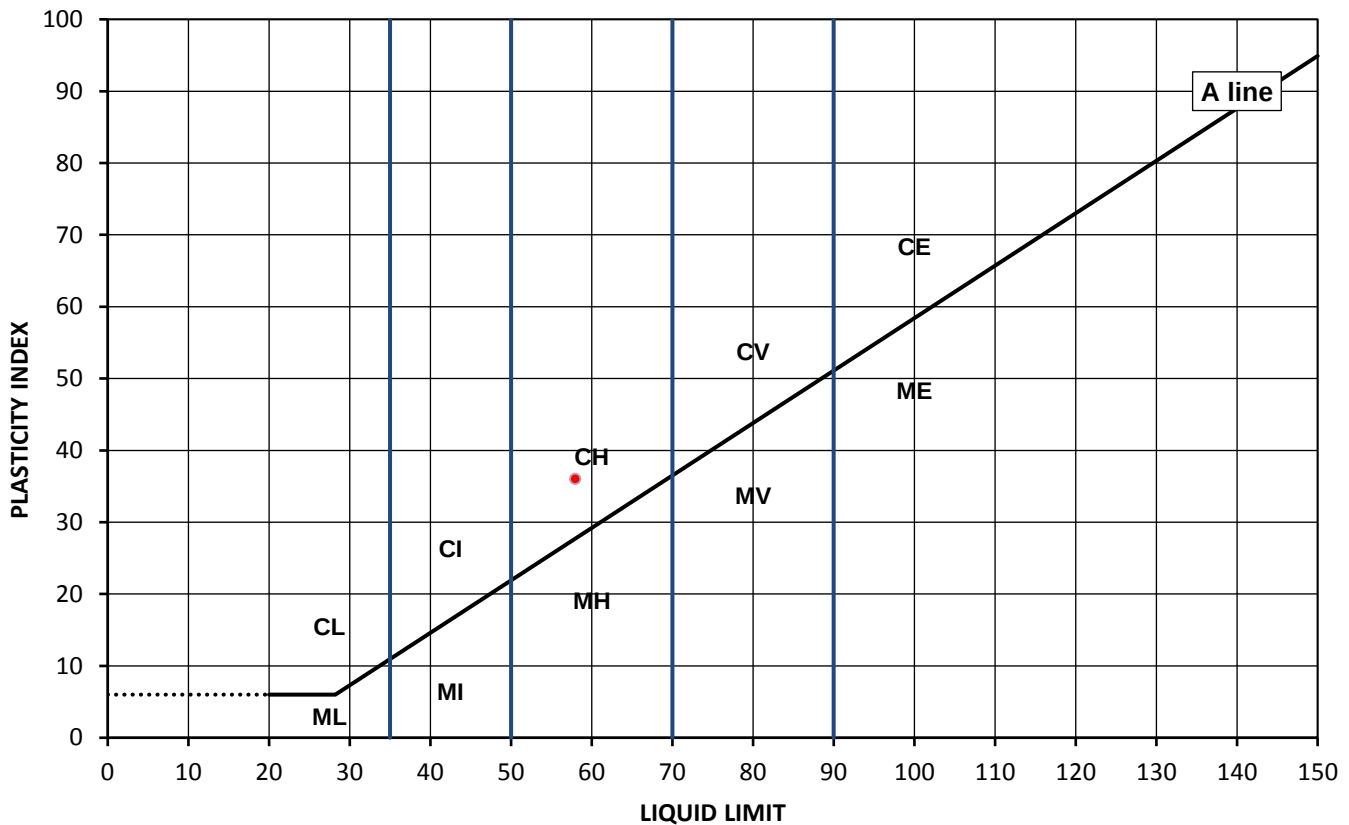
Test Results:

Laboratory Reference: 1220414
Hole No.: WS3
Sample Reference: Not Given
Soil Description: Bluish grey slightly sandy CLAY

Depth Top [m]: 1.00
Depth Base [m]: Not Given
Sample Type: D

Sample Preparation: Tested in natural condition

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
31	58	22	36	100



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

C	Clay	Plasticity	Liquid Limit
M	Silt	L	Low
		I	Medium
		H	High
		V	Very high
		E	Extremely high
			below 35
			35 to 50
			50 to 70
			70 to 90
			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: 23/05/2019

Signed: Maria Chandler
Geotechnical Site Manager Northampton
for and on behalf of i2 Analytical Ltd GF 236.5

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4041

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

Contact: Tom Elbourne
 Site Name: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge
 Site Address: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge

SUMMARY REPORT

Summary of Classification Test Results

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

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



Client Reference: J926B

Job Number: 19-41034

Date Sampled: 09/05/2019

Date Received: 05/10/2019

Date Tested: 17/05/2019

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			
1220409	WS1	Not Given	1.50	Not Given	D	Brown slightly gravelly sandy CLAY	Atterberg 4 Point	26		83	45	22	23						
1220411	WS2	Not Given	2.00	Not Given	D	Black gravelly slightly sandy CLAY	Atterberg 4 Point	28		58	53	27	26						
1220412	WS2	Not Given	3.00	Not Given	D	Black gravelly sandy CLAY	Atterberg 4 Point	21		43	44	30	14						
1220414	WS3	Not Given	1.00	Not Given	D	Bluish grey slightly sandy CLAY	Atterberg 4 Point	31		100	58	22	36						

Note: # Non accredited; NP - Non plastic

Comments:

Approved: Dariusz Piotrowski
 PL Geotechnical Laboratory Manager
 Date Reported: 23/05/2019

Signed: Maria Chandler
 Geotechnical Site Manager Northampton
 for and on behalf of i2 Analytical Ltd

GF 238.7

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TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

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



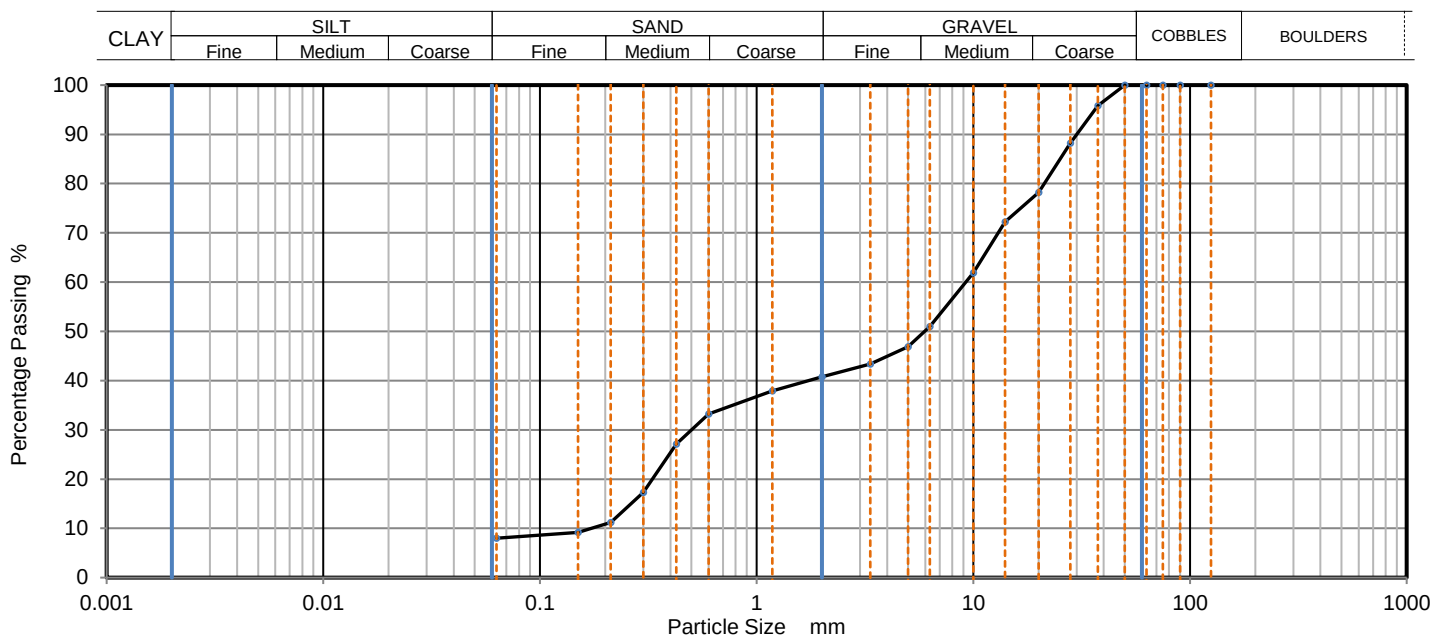
Client: Jomas Associates Ltd
Client Address: Lakeside House, 1 Furzeground Way,
Stockley Park, UB11 1BD
Contact: Tom Elbourne
Site Name: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge
Site Address: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge

Client Reference: J926B
Job Number: 19-41034
Date Sampled: 09/05/2019
Date Received: 10/05/2019
Date Tested: 17/05/2019
Sampled By: Not Given

Test Results:

Laboratory Reference: 1220410
Hole No.: WS1
Sample Reference: Not Given
Sample Description: Brown slightly clayey very sandy GRAVEL. Gravel is flintstone

Depth Top [m]: 2.00
Depth Base [m]: Not Given
Sample Type: D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	96		
28	88		
20	78		
14	72		
10	62		
6.3	51		
5	47		
3.35	43		
2	41		
1.18	38		
0.6	33		
0.425	27		
0.3	17		
0.212	11		
0.15	9		
0.063	8		

Dry Mass of sample [g]: 1625

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	59.20
Sand	32.50
Fines <0.063mm	8.30

Grading Analysis		
D100	mm	50
D60	mm	9.22
D30	mm	0.5
D10	mm	0.173
Uniformity Coefficient		53
Curvature Coefficient		0.16

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks: The material submitted - fails to meet the minimum mass requirements as stated in BS1377 Part 2 Table 3

Approved: Dariusz Piotrowski
PL Geotechnical Laboratory Manager
Date Reported: 23/05/2019

Signed: Maria Chandler
Geotechnical Site Manager Northampton
for and on behalf of i2 Analytical Ltd GF 100.11



TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

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



Environmental Science

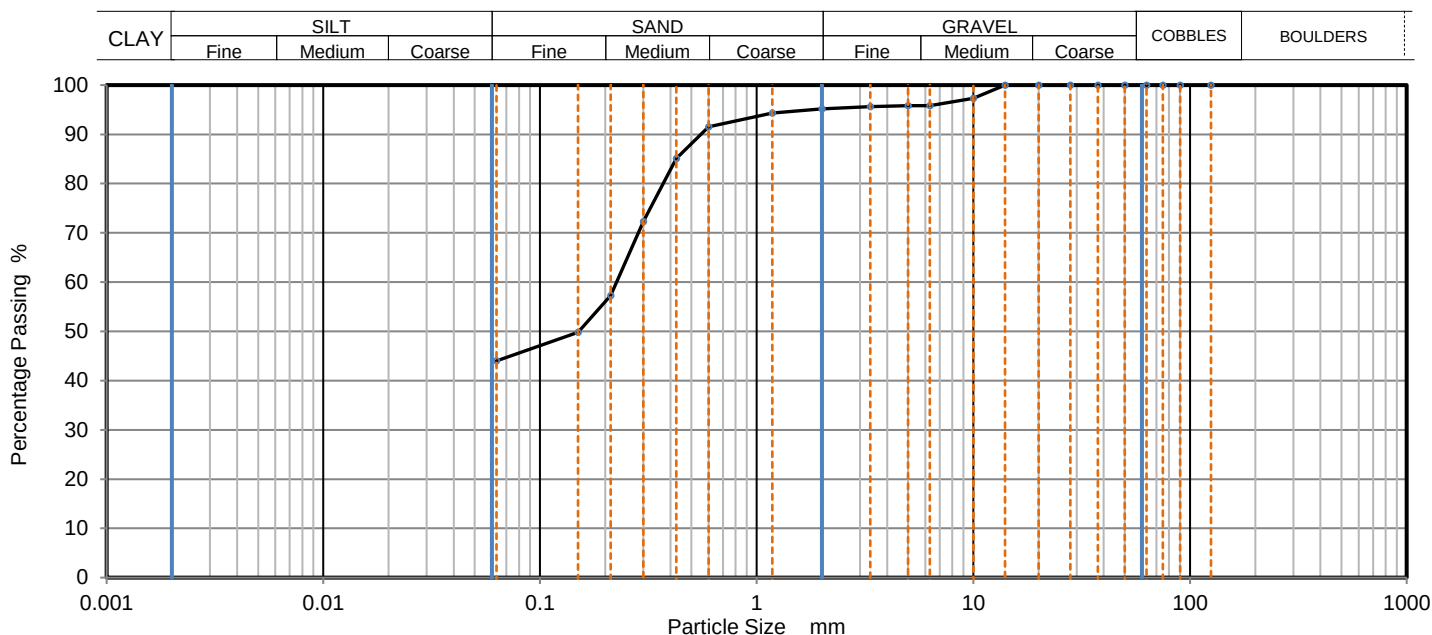
Client: Jomas Associates Ltd
Client Address: Lakeside House, 1 Furzeground Way,
Stockley Park, UB11 1BD
Contact: Tom Elbourne
Site Name: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge
Site Address: Tavistock House, 5 Rockingham Wharf, Rockingham Road, Uxbridge

Client Reference: J926B
Job Number: 19-41034
Date Sampled: 09/05/2019
Date Received: 10/05/2019
Date Tested: 17/05/2019
Sampled By: Not Given

Test Results:

Laboratory Reference: 1220413
Hole No.: WS3
Sample Reference: Not Given
Sample Description: Brown slightly gravelly very clayey SAND

Depth Top [m]: 1.40
Depth Base [m]: Not Given
Sample Type: D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	97		
6.3	96		
5	96		
3.35	96		
2	95		
1.18	94		
0.6	92		
0.425	85		
0.3	72		
0.212	57		
0.15	50		
0.063	44		

Dry Mass of sample [g]: 283

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	4.80
Sand	50.90
Fines <0.063mm	44.40

Grading Analysis		
D100	mm	14
D60	mm	0.226
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

Approved: Dariusz Piotrowski
PL Geotechnical Laboratory Manager
Date Reported: 23/05/2019

Signed: Maria Chandler
Geotechnical Site Manager Northampton
for and on behalf of i2 Analytical Ltd GF 100.11

*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 on 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.

APPENDIX 5 – SOIL GAS MONITORING TEST RESULTS

GAS AND GROUNDWATER MONITORING BOREHOLE RECORD SHEET					
Site: Tavistock House	Operative(s): JWT	Date: 17/05/19	Time: 08:40	Round: 1	Page:
MONITORING EQUIPMENT					
Instrument Type	Instrument Make	Serial No.	Date Last Calibrated		
Analox	GA5000	G501805	04/10/2018		
PID	Phocheck tiger	T-106448	17/05/2019		
Dip Meter	GeoTech				
MONITORING CONDITIONS					
Weather Conditions: Overcast		Ground Conditions: Dry		Temperature: 12 °C	
Barometric Pressure (mbar): 1007		Barometric Pressure Trend (24hr): Falling		Ambient Concentration: 0.1 %CH ₄ , 0.1 %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 ₂ S (ppm)	CO (ppm)	Depth to product (mbgl)	Depth to water (mbgl)	Depth to Base of well (mbgl)
	Peak	Steady						Peak	steady					
WS1	-0.1	-0.1	1007	0.2	/	0.6	19.2	0.3	0.3	0	0	/	1.69	2.00
WS2	+4.0*	+4.0*	1007	0.1	/	0.1	18.7	18.7	18.7	0	2	/**	1.56	2.83
WS3	+0.3	+0.3	1007	0.0	/	0.3	20.7	0.4	0.4	0	1	/	1.63	1.82

*Bung removed for 2 mins and retested at +3.8 l/hr.

** No product detected with the interface probe but was covered in thick black tar like liquid with strong HC odour

GAS AND GROUNDWATER MONITORING BOREHOLE RECORD SHEET					
Site: Tavistock House	Operative(s): JLW	Date: 23/05/19	Time: 08:45	Round: 2	Page:
MONITORING EQUIPMENT					
Instrument Type	Instrument Make	Serial No.	Date Last Calibrated		
Analox	GA5000	G501805	04/10/2018		
PID	Phocheck tiger	T-106448	17/05/2019		
Dip Meter	GeoTech				
MONITORING CONDITIONS					
Weather Conditions: CLEAR		Ground Conditions: DRY		Temperature: 19 °C	
Barometric Pressure (mbar): 1015		Barometric Pressure Trend (24hr): Falling		Ambient Concentration: 0.1 %CH ₄ , 0.1 %CO ₂ , 21.1%O ₂	

MONITORING RESULTS														
Monitoring Point Location	Flow		Atmospheric Pressure (mbar)	CH ₄ %	CH ₄ % LEL	CO ₂ %	O ₂ %	VOC (ppm)		H ₂ S (ppm)	CO (ppm)	Depth to product (mbgl)	Depth to water (mbgl)	Depth to Base of well (mbgl)
	Peak	Steady						Peak	steady					
WS1	0.0	0.0	1016	0.1	/	0.4	20.4	/	/	0	0	/	1.75	1.99
WS2	+0.1	+0.1	1015	0.1	/	0.2	18.9	/	/	0	1	/	1.56	2.80
WS3	0.0	0.0	1016	0.1	/	0.9	19.9	/	/	0	0	/	1.70	1.82*

- Very silty.

GAS AND GROUNDWATER MONITORING BOREHOLE RECORD SHEET					
Site: Tavistock House	Operative(s): JPB	Date: 29/05/19	Time: 12:20	Round: 3	Page:
MONITORING EQUIPMENT					
Instrument Type	Instrument Make	Serial No.	Date Last Calibrated		
Analox	GA5000	G501805	04/10/2018		
PID	Phocheck tiger	T-106448	17/05/2019		
Dip Meter	GeoTech				
MONITORING CONDITIONS					
Weather Conditions: Overcast/ raining		Ground Conditions: Damp		Temperature: 16	
Barometric Pressure (mbar): 1017		Barometric Pressure Trend (24hr): Steady		Ambient Concentration: 0.1 %CH ₄ , 0.1 %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 ₂ S (ppm)	CO (ppm)	Depth to product (mbgl)	Depth to water (mbgl)	Depth to Base of well (mbgl)
	Peak	Steady						Peak	steady					
WS1	0.0	0.0	1017	0	/	0.5	20.2	/	/	0	0	/	1.74	1.98
WS2	-0.1	-0.1	1018	0.1	/	0.5	18.7	/	/	0	3	/	1.66	2.83
WS3	-0.1	-0.1	1018	0	/	1.2	20.0	/	/	0	1	/	1.69	1.86

GAS AND GROUNDWATER MONITORING BOREHOLE RECORD SHEET					
Site: Tavistock House	Operative(s): JPB	Date: 03/06/19	Time: 13:00	Round: 4	Page:
MONITORING EQUIPMENT					
Instrument Type	Instrument Make	Serial No.	Date Last Calibrated		
Analox	GA5000	G501805	04/10/2018		
PID	Phocheck tiger	T-106448	17/05/2019		
Dip Meter	GeoTech				
MONITORING CONDITIONS					
Weather Conditions: Sunny		Ground Conditions: Dry		Temperature: 18	
Barometric Pressure (mbar): 1010		Barometric Pressure Trend (24hr): Steady		Ambient Concentration: 0.1 %CH ₄ , 0.1 %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 ₂ S (ppm)	CO (ppm)	Depth to product (mbgl)	Depth to water (mbgl)	Depth to Base of well (mbgl)
	Peak	Steady						Peak	steady					
WS1	0.0	0.0	1010	0.1	/	0.2	20.9	/	/	0	0	/	1.75	1.98
WS2	0.0	0.0	1010	0.1	/	0.6	18.2	/	/	0	2	/	1.63	2.81
WS3	+0.1	+0.1	1010	0.1	/	1.2	18.8	/	/	0	1	/	1.68	1.82

WS2 – dip covered in black hydrocarbon smelling silt.

LOW FLOW GROUNDWATER MONITORING BOREHOLE RECORD SHEET					
Site: Tavistock	Operative(s): JLW	Date: 23/05/19	Time: 09:15	Round: 1	Page: 1 of
MONITORING EQUIPMENT					
Instrument Type	Instrument Make	Serial No.	Date Last Calibrated		
SmarTROLL MP	In-Situ				
Dip Meter	In-Situ				
MONITORING CONDITIONS					
Weather Conditions: Clear		Ground Conditions: Dry		Temperature: 12 C	

Hole ID	Temperature (°C)	Specific Conductivity (µS/cm)	pH	(ORP) Oxidation-Reduction Potential (mV)	(RDO) Rugged Dissolved Oxygen Concentration (mg/L)	Water Level (Start of testing)	Water Level (End of testing)	Hole Depth	Comments
WS1	Grab sample – Full set including one silty bottle.					1.75	1.75	1.99	Slightly turbid, no odour no sheen 1 bottle from base is very turbid very silty.
WS2	Grab sample taken					1.56	1.56	2.80	Grab sample taken due to not recharging and very turbid strong oil, hydrocarbon odour and obvious sheen.
WS3	Grab sample – 2 vials and ½ bottle					1.70	1.70	1.82	Very turbid, silty slight hydrocarbon odour.

Specific Conductivity ($\mu\text{S}/\text{cm}$)

This is a measure of the capability of a solution such as water in a stream to pass an electric current. This is an indicator of the concentration of dissolved electrolyte ions in the water. It doesn't identify the specific ions in the water. However, significant increases in conductivity may be an indicator that polluting discharges have entered the water.

Every creek will have a baseline conductivity depending on the local geology and soils. Higher conductivity will result from the presence of various ions including nitrate, phosphate, and sodium.

The basic unit of measurement for conductivity is micromhos per centimeter ($\mu\text{mhos}/\text{cm}$) or microsiemens per centimeter ($\mu\text{S}/\text{cm}$). Either can be used, they are the same. It is a measure of the inverse of the amount of resistance an electric charge meets in traveling through the water. Distilled water has a conductivity ranging from 0.5 to 3 $\mu\text{S}/\text{cm}$, while most streams range between 50 to 1500 $\mu\text{S}/\text{cm}$. Freshwater streams ideally should have a conductivity between 150 to 500 $\mu\text{S}/\text{cm}$ to support diverse aquatic life.

pH

A measure of a solution's acidity. In water, small numbers of water molecules (H_2O) will break apart or disassociate into hydrogen ions (H^+) and hydroxide ions (OH^-). Other compounds entering the water may react with these, leaving an imbalance in the numbers of hydrogen and hydroxide ions. When more hydrogen ions react, more hydroxide ions are left in solution and the water is basic; when more hydroxide ions react, more hydrogen ions are left and the water is acidic. pH is a measure of the number of hydrogen ions and thus a measure of acidity.

pH is measured on a logarithmic scale between 1 and 14 with 1 being extremely acid, 7 neutral, and 14 extremely basic. Because it is a logarithmic scale there is a ten fold increase in acidity for a change of one unit of pH, e.g. 5 is 100 times more acid than 7 on the pH scale. The largest variety of freshwater aquatic organisms prefer a pH range between 6.5 to 8.0.

(RDO) Rugged Dissolved Oxygen Concentration (mg/L)

Dissolved oxygen is oxygen gas molecules (O_2) present in the water. Plants and animals cannot directly use the oxygen that is part of the water molecule (H_2O), instead depending on dissolved oxygen for respiration. Oxygen enters streams from the surrounding air and as a product of photosynthesis from aquatic plants. Consistently high levels of dissolved oxygen are best for a healthy ecosystem.

Levels of dissolved oxygen vary depending on factors including water temperature, time of day, season, depth, altitude, and rate of flow. Water at higher temperatures and altitudes will have less dissolved oxygen. Dissolved oxygen reaches its peak during the day. At night, it decreases as photosynthesis has stopped while oxygen consuming processes such as respiration, oxidation, and respiration continue, until shortly before dawn.

Human factors that affect dissolved oxygen in streams include addition of oxygen consuming organic wastes such as sewage, addition of nutrients, changing the flow of water, raising the water temperature, and the addition of chemicals.

Dissolved oxygen is measured in mg/L.

0-2 mg/L: not enough oxygen to support life.
2-4 mg/L: only a few fish and aquatic insects can survive.
4-7 mg/L: good for many aquatic animals, low for cold water fish
7-11 mg/L: very good for most stream fish

(ORP) Oxidation- Reduction Potential (mV)

ORP is a measure of the cleanliness of the water & its ability to break down contaminants". It has a range of -2,000 to + 2,000 and units are in "mV" (millivolts).



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JOMAS ASSOCIATES LTD

6-9 The Square,
Stockley Park,
Uxbridge,
UB11 1FW

CONTACT US

Website: www.jomasassociates.com

Tel: 0843-289-2187

Fax: 0872-115-4505

Email: info@jomasassociates.com