

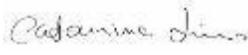
PHASE II GEO-ENVIRONMENTAL & GEOTECHNICAL SITE INVESTIGATION

**LAND OFF JACQUES WAY,
WREXHAM**

REC REFERENCE: 108157P2R0

REPORT PREPARED FOR: CASTLEMEAD GROUP LIMITED



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EXECUTIVE SUMMARY		
Site Address	Land off Jacques Way, Wrexham, LL11 2BY	
Grid Reference	332859, 350642	
Site Area	Approximately 0.51 hectares	
Current Site Use	The site is currently on an area of disused land bounded between two railway lines.	
Proposed Use	Construction of a mix of terrace, semi-detached, detached and apartments, with private gardens, parking spaces and access roadways.	
Site Investigation Findings	Geology	The site is underlain by Made ground to a maximum proven depth of 5.80m. (Made ground was found to be shallower at 2.80mbgl in a single location located to the east boundary).
	Groundwater	Groundwater was encountered during site works between 6.0mbgl and 8.50mbgl in natural strata.
Revised Conceptual Site Model (CSM)	Human Health	Exceedances associated with chrysotile asbestos fibres, PAHs and lead in Made Ground were identified across the site.
	Ground Water	No risk from to groundwater was identified onsite.
	Ground Gases	Ground gas monitoring to date indicate the site is within values for Characteristic Situation 1.
Conclusions	Contaminated Land The results of the Phase II Geo-Environmental Site Investigation and laboratory analyses identified exceedances for lead and PAHs and identification of low level asbestos fibres within the Made ground across the site. It is advised that these materials are not incorporated into soft standing and that they are placed either beneath hardstanding or a cover system of 600mm with a demarcation membrane. Based on ground gas monitoring, no risk from ground gases was identified onsite. As such, no further measures are deemed necessary. Geotechnical A piled foundation solution is recommended on this site due to presence of deep Made ground. alternatively, ground improvements methods such vibro replacement can be considered. Groundwater was identified during site works at between 6.00mbgl and 8.50mbgl. The use of soakaways is not advised due to depth of Made ground. Concrete foundations should be designed in line with sulphate class DS-1/AC-1(s).	
Recommendations	A Remediation Strategy is recommended to address the issues arising from exceedances in Made ground. A Piling Risk Assessment may be necessary should this foundation solution be adopted. Further testing is recommended in spoil heap areas onsite if they are proposed to be used within the development or alternatively disposed of to landfill to classify the waste. In addition, installation of deep monitoring wells is suggested for groundwater monitoring and testing (identified during site works at between 6.00mbgl and 8.50mbgl). This information would assist in adequate design of deep foundations.	



TABLE OF CONTENTS

1.0	INTRODUCTION	1
1.1	Background	1
1.2	Proposed Development	1
1.3	Previous Reports	1
1.4	Objectives & Scope	1
1.5	Confidentiality and Limitations	2
2.0	SITE SETTING	3
2.1	Site Details	3
2.2	Geology	3
2.3	Desk Study Information	3
3.0	SITE INVESTIGATION	4
3.1	Site Investigation Rationale	4
3.2	Standard Penetration Tests	4
3.3	Chemical Analysis	4
3.4	Geotechnical Laboratory Analysis	5
3.5	Gas and Groundwater Monitoring	5
4.0	GROUND AND GROUNDWATER CONDITIONS	6
4.1	Ground Conditions	6
4.2	Consistency and Density	6
4.3	Soil Plasticity	8
4.4	pH and Sulphate	8
4.5	Particle Size Distribution (PSD)	8
4.6	Groundwater Conditions	9
4.7	Soakaway Testing	9
4.8	Groundwater Elevation and Groundwater Monitoring	9
5.0	TIER II GENERIC QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT	11
5.1	Risk Assessment	11
5.2	Discussion of Soil Results	13
5.3	Ground Gas	13
5.4	Revised Conceptual Site Model	14
6.0	GEOTECHNICAL ASSESSMENT	15
6.1	Proposed Development	15
6.2	Summary of Ground and Groundwater Conditions	15
6.3	Foundation Conditions and Bearing Capacity	15
6.4	Concrete Durability	16
6.5	Excavations & Stability	16
6.6	Floor Slabs	16
6.7	Infiltration testing	16
7.0	CONCLUSIONS & RECOMMENDATIONS	17
7.1	Contaminated Land	17
7.2	Geotechnical	17
7.3	Recommendations	17



APPENDICES

Appendix I	Limitations
Appendix II	Glossary
Appendix III	Drawings Drawing No 108157 - 001 – Site Location Plan Drawing No 108157 - 002 – Proposed Site Plan Drawing No 108157 - 003 – Exploratory Hole Location Plan
Appendix IV	Exploratory Hole Logs
Appendix V	Chemical Testing Results
Appendix VI	Geotechnical Testing results
Appendix VII	Photographs
Appendix VIII	Soakaway Calculations



1.0 INTRODUCTION

1.1 Background

Resource and Environmental Consultants Ltd (REC) was commissioned by Castlemead Group Limited ("the Client") to undertake a Phase II Geo-Environmental & Geotechnical Assessment for the land off Jacques Way, Wrexham, LL11 2BY (hereinafter referred to as the 'site'). A site location plan is provided as 108157-001 in Appendix III.

1.2 Proposed Development

The proposed development is residential including a mix of terrace, semi-detached, detached and apartments, with private gardens, parking spaces and access roadways. A proposed development plan (drawing ref 108157-002) is shown in Appendix III.

1.3 Previous Reports

REC completed a Phase I Desk Study which was provided as part of the planning application and included the area beneath the hotel (located directly to the north of the site):

- ▶ Geo-Environmental Site Assessment, Land off Jacques Way, Wrexham: REC ref 102904p1r1 dated October 2018.

This report should be read in conjunction with the existing report which was utilised in the design of this phase of works.

1.4 Objectives & Scope

The development is subject to pre-commencement conditions imposed in the Planning Application No, WRO P/2018/0898, dated 07/06/2019. In relation to this proposal the following planning conditions apply:

9. No development shall take place until a phased site investigation of the nature and extent of contamination has been carried out and submitted to and approved in writing by the Local Planning Authority. If any contamination is found during site investigations, no part of the development shall commence until a scheme specifying the measures that will be taken to remediate the site to render it suitable for the development hereby permitted has been submitted to and approved in writing by the Local Planning Authority. The site shall therefore be remediated in accordance with the approved scheme. If during the course of the development any contamination is found that has not been identified in the site investigation, no further development shall take place in those parts of the site where that contamination has been found until an additional scheme of remediation has been submitted to and approved in writing by the Local Planning Authority for those parts of the site. The relevant parts of the site shall thereafter be remediated in accordance with the additional scheme of remediation.

In addition, item 8 of the planning conditions includes:



8. No part of the development shall commence until a scheme for the comprehensive and integrated drainage of the site indicating provision for foul water, surface water and land drainage has been submitted and approved in writing by the Local Planning Authority.

The objectives of the geo-environmental investigation are set out in line with the above planning conditions and include the following points:

- ▶ Undertake an intrusive investigation with sampling and analysis to provide an overview of environmental issues identified;
- ▶ Confirm the depths of Made Ground / fill material across the site and investigate the geotechnical properties of the underlying natural strata;
- ▶ Assess the implications of potential environmental risks, liabilities and development constraints associated with the site in relation to the future use of the site and in relation to off-site receptors;
- ▶ Undertake soakaway testing to confirm their viability as a drainage solution; and
- ▶ Provide recommendations regarding future works required.

In addition, REC was provided with information from the structural engineer that a proposed piling solution was being considered and as such a number of deep boreholes were included to provide geotechnical information.

1.5 Confidentiality and Limitations

REC has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from REC. The full limitations of this report are presented in Appendix I.



2.0 SITE SETTING

2.1 Site Details

A Site Location Plan (Drawing Ref: 108157-001 is presented within Appendix III. Key details are summarised in Table 2.1. All acronyms used within this report are defined in the Glossary presented in Appendix II.

Table 2.1 Site Setting

Site Address	Land off Jacques Way, Wrexham, LL11 2BY
National Grid Reference	332859, 350642
Site Area	0.51 hectares

The site is located to the south of Jacques Way in Wrexham, and is currently an area of unused land with a known historic use as a scrapyard. Active railway tracks are to the east, west and south of the site, and a Premier Inn is directly to the north. There are occasional areas of dense vegetation containing Japanese Knotweed, particularly towards the western and southern site boundaries. Two spoil heaps were identified in the north west area of the site, in front of an entrance to site. Slight changes in elevation can be seen in the western and southern areas where the site slopes slightly towards the railway track.

2.2 Geology

The site is reported to be underlain by the geological sequence in Table 2.2. In addition, it is expected that Made Ground is present to a notable depth overlying the superficial geology

Table 2.2 Summary of Geological and Hydrogeological Data

Geological Unit	Classification	Aquifer Classification	Permeability	Sensitivity
Superficial	Glaciofluvial Sand and Gravel and Alluvium	Secondary A	Moderate	Moderate
Bedrock	Etruria Formation	Secondary A	Moderate	Moderate

2.3 Desk Study Information

Potential contamination sources have been identified from the desk study and these are listed in Table 2.3 below. A full Conceptual site model (CSM) is provided within the Phase 1 Contamination Assessment (REC Reference: 102904p1r1, dated October 2018).

Table 3.1 Summary of Potential Contaminant Sources

On-Site / Off-Site	Potential Source	Potential Contaminants	Potential Impact
On-site	Made Ground associated with historical use as a scrapyard	Chemical contamination (heavy metals & hydrocarbons); asbestos fibres; ground gases	Human health, controlled waters and buildings
Off-site	Made ground associated with risk posed by adjacent railway land	Ground gases	Human health



3.0 SITE INVESTIGATION

3.1 Site Investigation Rationale

The ground investigation has been designed based on the scope provided by the client's structural engineer with respect to the geotechnical elements and the findings of the preliminary desk study produced by REC with respect to contaminated land. Exploratory holes have been advanced to target specific depths, in order to determine the underlying ground conditions, with recovery of selected soil samples for subsequent geotechnical and chemical analysis.

Exploratory fieldwork was completed between the 9th and 11th October 2019. A selection of site photographs are presented in Appendix IX and the works are summarised in Table 3.1.

Table 3.1 Summary of Fieldwork

Hole Location	Potential Source / Rationale	Type	Maximum Depth (mbgl)
TP101 – TP105	Identification of ground conditions, collection of geo-environmental samples and soakaway testing	Machine excavated Trial Pit	3.00
WS101 – WS105	Obtaining samples for chemical and geotechnical testing and installation of combined ground gas and groundwater monitoring wells.	Window Sample Borehole	5.00
CP101 – CP103	Identification of ground conditions for deep foundations and in-situ geotechnical testing.	Cable Percussion Borehole	19.95

Notes: mbgl – metres below ground level

All samples were collected using appropriate PPE and sampling equipment that was cleaned at each sampling location. The spoil heaps present on site did not form part of this investigation.

Exploratory hole locations were restricted to areas outside a Japanese knotweed exclusion area and were also positioned to take account of onsite obstructions such as stockpiled soils. Furthermore, the investigation was conducted to avoid underground services running through the site. Exploratory hole locations are shown on the Exploratory Hole Location plan (Drawing ref. 108157-003) presented within Appendix III.

3.2 Standard Penetration Tests

Standard Penetration Tests (SPT) were carried out within each borehole at 1.2m bgl at the base of the hand pit and at 1m intervals thereafter from 2m to 5m bgl, and every 1.5m thereafter. The testing was carried out to provide validation of ground consistency/relative density and strength observations. The results of the in-situ testing are presented on the exploratory hole logs in Appendix IV.

3.3 Chemical Analysis

A total of 6no. samples were submitted to a UKAS accredited laboratory, i2 Analytical and analysed for a range of chemical determinants including:

- ▶ Asbestos identification (Made Ground only);
- ▶ Soil Organic Matter;
- ▶ Metals, total cyanide and total phenols;
- ▶ Total and speciated Polycyclic Aromatic Hydrocarbons; and,
- ▶ Total Petroleum Hydrocarbons Criteria Working Group



The results of the chemical analyses are included in Appendix V. Samples that screened positive for asbestos were subject to quantification.

3.4 Geotechnical Laboratory Analysis

Selected soil samples were submitted to UKAS accredited Professional Soils Laboratory (PSL) Ltd of Doncaster and analysed for a range of geotechnical tests including:

- ▶ Atterberg Limits Determinations;
- ▶ BREs (pH and Sulphate); and
- ▶ Particle Size Distribution (wet sieve)

The results of the chemical analysis are presented in Appendix V and are discussed in Section 6.

3.5 Gas and Groundwater Monitoring

Following the intrusive phase of site works, four return ground gas and groundwater monitoring visits were completed between 21/10/2019 and 25/11/2019. All data is provided in Section 4 and discussed in Section 5.

Concentrations of methane (CH₄), carbon dioxide (CO₂), oxygen (O₂), hydrogen sulphide (H₂S) and carbon monoxide (CO) were measured using an infra-red gas analyser (GFM436), calibrated to a reference standard (before and after each survey). Gas flow rates were measured using an attached flow pod. Gas measurements were recorded for a minimum of sixty seconds at each location, and until concentrations had stabilised, at which point the maximum concentration of CH₄, CO₂, H₂S and CO together with the lowest concentration of O₂ were recorded.

Groundwater monitoring was undertaken using an electronic dip meter and interface probe to record the depth to groundwater and the thickness of any free phase hydrocarbon product, if present.



4.0 GROUND AND GROUNDWATER CONDITIONS

4.1 Ground Conditions

The ground investigation identified and detailed the ground conditions summarised below. Full descriptions of the strata with associated depths are shown on the Exploratory Hole Logs, presented in Appendix IV.

Made Ground

Made ground was encountered at every location and found to be relatively homogeneous across the site, varying from very gravelly sand to slightly clayey gravelly sand, with varying degrees of cobble content. Gravel consisted of angular to sub rounded fine to coarse brick and concrete. Cobbles of brick, concrete and mudstone are present. The Made Ground was also found to contain slate, plastic, glass and metal.

The thickness of Made Ground where proven was typically between 5.00m bgl (CP102) and 5.80m bgl (CP103). Shallow Made ground was identified in TP105 to a maximum depth of 2.80mbgl.

Glaciofluvial Deposits

Glaciofluvial deposits were encountered under the Made ground in all. These were encountered to a maximum depth explored depth of 19.95m bgl (CP103) and typically consisted of gravelly silty clays, dense sand and gravels and clayey gravelly sands.

Eturia Formation

Bedrock was not encountered at any location.

4.2 Consistency and Density

In-situ SPTs were undertaken within all strata in the boreholes and window samples and is summarised in Table 4.1 and included within exploratory hole logs included within Appendix IV.

Table 4.1 In-Situ Standard Penetration Results

Location	Start Depth (m bgl)	Stratum	Soil Principal Constituent	SPT 'N' Value	Density/Consistency & Strength Descriptor
CP101	1.20	Made Ground	Sand	26	Medium Dense
	2.00		Sand	19	
	3.00		Sand	14	
	4.00		Sand	40	Dense
	5.00		Sand	28	Medium Dense
	6.00	Glaciofluvial Deposits	Sandy gravel	50	Very Dense
	7.50			50	Very Dense
	9.00			50	Very Dense
	10.50		Sand	41	Dense
	12.00			50	Very Dense
	13.50			50	
	16.50		Clay	50	Very Stiff
CP102	1.20	Made Ground	Sand	23	Medium Dense
	2.00			24	



	3.00			42	Dense
	4.00			39	
	5.00			50	Very Dense
	6.00	Glaciofluvial Deposits	Silty gravel	50	Very Dense
	7.50			50	
	9.00			50	
	10.50		Clay	50	Very Stiff
	12.00			50	
	13.50			50	
	15.00			50	
	18.00			50	
	19.00			50	
CP103	1.20	Made Ground	Sand	11	Medium Dense
	2.00			14	
	3.00			14	
	4.00			16	
	5.00			15	
	6.00	Glaciofluvial Deposits	Silty gravel	32	Dense
	7.50			50	Very Dense
	9.00			50	
	10.50			50	
	13.50		Clay	50	Very Stiff
	15.00		Sandy clay	50	
	18.00			50	
	19.50		Gravel	50	Very Dense
WS101	1.20	Made Ground	Sand	15	Medium Dense
WS102	1.20	Made Ground	Sand	7	Loose
	2.00			10	Medium Dense
	3.00			5	Loose
	4.00			50	Very Dense
WS103	1.20	Made Ground	Sand	17	Medium Dense
	2.00			7	Loose
	3.00			8	
	4.00			4	
WS104	1.00	Made Ground	Sand	14	Medium Dense
	2.00			10	
	3.00			6	Loose
	4.00			7	
	5.00			9	
WS105	1.00	Made Ground	Sand	20	Medium Dense
	2.00			19	
	3.00			50	Very Dense



4.3 Soil Plasticity

Atterberg Limit determinations, summarised in Table 4.2, characterised the natural deposits to be of low plasticity with medium volume change potential. The test certificate is presented in Appendix VI.

Table 4.2 Summary of Plasticity Index Test Results

Location	Depth (m)	Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Percentage passing 425µm sieve (%)	Modified Plasticity Index (%)	Volume Change Potential
CP101	14.90	12	34	17	17	78	13	Low
CP102	18.00	13	32	16	16	74	12	

4.4 pH and Sulphate

Chemical analyses for pH and water-soluble sulphate content contained in Appendix V and summarised in Table 4.3 below indicated that the Made ground and superficial meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1 in accordance with BRE Special Digest 1 (2005).

Table 4.3 Summary of pH and Sulphate Data

Location	Depth (m)	pH Value	Water soluble SO ₄ (mg/l)	Concrete Classification
WS101	0.20	8.1	39.8	DS-1 (AC -1)
WS102	0.10	8.6	86.5	
WS103	0.40	9.2	117	
WS104	0.20	8.9	87	
TP104	0.20	8.4	42	
TP105	0.20	8.3	59	
CP101	5.00	8.7	110	
CP102	10.50	8.0	66	
CP103	15.00	8.3	52	
CP103	19.50	8.6	34	

4.5 Particle Size Distribution (PSD)

Results of Particle Size Distribution tests by wet sieve analysis, carried out on select samples of natural soils, are summarised as Table 4.4. The test certificate is presented in Appendix VI.

Table 4.4 Summary of Particle Size Distribution (PSD)

Location	Depth (m)	Granulometric Composition (%)			
		Cobbles	Gravel	Sand	Silt / Clay
CP101	6.00	0	66	22	12
CP102	10.00	0	21	40	39
CP103	6.00	0	66	19	15
CP103	15.00	0	6	13	81

The results generally confirmed the on-site engineer's soil descriptions.



4.6 Groundwater Conditions

During the ground investigation, groundwater was encountered, with records summarised within Table 4.5 and presented on the Exploratory Hole Logs in Appendix IV.

Table 4.5 Summary of Groundwater Strikes

Location	Depth to Strike (mbgl)	Depth to Water after 20 minutes (mbgl)
CP101	8.50	8.00
CP102	7.00	6.00
CP103	8.00	7.00

4.7 Soakaway Testing

Soakaway testing was undertaken at four locations. Results are shown in Table 4.6 below. Due to the significant depth of Made Ground.

Table 4.6 Infiltration Rate

Location	Depth	Strata	Result
TP102	2.0	Made Ground	Water drained instantly – no measurement
TP103	3.0		
TP104	2.0		
TP105	3.0	Glaciofluvial	1.93E-03 m/s

The results obtained for TP102-TP104 suggest the Made ground encountered beneath the site would be a suitable receptor body for a soakaway drainage system as water drained faster than could be measures. However, in accordance with guidance in BRE 365 Soakaway Design, soakaways should not be constructed in Made ground due to its potential heterogenous composition and consequent difficulty in identifying variances in ground conditions and, in this particular case, the presence of contaminants in Made ground across the site.

A small area of Glaciofluvial deposits within TP105, indicate a design Soil Infiltration Rate of 1.93E-03 m/s (calculations for soakaway in TP105 are shown in Appendix VII).

Window samples and boreholes conducted across the whole site indicate that if finished ground levels are to be similar to current levels that either very deep soakaways would be required or that they are not a viable method.

4.8 Groundwater Elevation and Groundwater Monitoring

The recorded ground gas and groundwater levels are summarised in Table 4.7 overleaf.



Table 4.7 Summary of Ground Gas and Groundwater Monitoring Results

Location	Date	CH ₄ Max %v/v	CH ₄ Steady %v/v	CO ₂ Max %v/v	CO ₂ Steady %v/v	O ₂ %v/v	Flow Max (l/hr)	Flow Steady (l/hr)	Depth to Base (mbgl)	Screening section (m bgl)	Depth to Water (m bgl)
WS102	21/10/19	<0.1	<0.1	0.8	0.8	19.3	<0.1	<0.1	2.40	0.5 – 2.5	Dry
	28/10/19	<0.1	<0.1	0.8	0.8	19.4	<0.1	<0.1	2.40		
	14/11/19	<0.1	<0.1	0.8	0.8	19.6	<0.1	<0.1	2.40		
	25/11/19	<0.1	<0.1	0.7	0.7	19.9	<0.1	<0.1	2.40		
WS103	21/10/19	<0.1	<0.1	2.0	2.0	18.6	<0.1	<0.1	1.72	0.5 – 2.0	
	28/10/19	<0.1	<0.1	1.9	1.9	18.9	<0.1	<0.1	1.75		
	14/11/19	<0.1	<0.1	1.6	1.6	19.3	<0.1	<0.1	1.70		
	25/11/19	<0.1	<0.1	1.2	1.2	19.6	<0.1	<0.1	1.77		
WS105	21/10/19	<0.1	<0.1	0.1	0.1	20.7	<0.1	<0.1	2.15	0.5 – 2.5	
	28/10/19	<0.1	<0.1	0.9	0.9	18.5	<0.1	<0.1	2.15		
	14/11/19	<0.1	<0.1	0.6	0.6	19.7	<0.1	<0.1	2.15		
	25/11/19	<0.1	<0.1	0.1	0.1	20.5	<0.1	<0.1	2.15		



5.0 TIER II GENERIC QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT

5.1 Risk Assessment

At a Tier II stage, the long term (chronic) risk to human health is assessed by utilising appropriate and conservative generic assessment criteria (GAC) to determine whether there are potentially unacceptable risks present.

To undertake the Tier II assessment within the context of the development proposal, the most appropriate GAC values available will be those based upon a residential with gardens end use.

The following assessment summarised in Table 5.1 below and overleaf, has primarily adopted the S4UL (Suitable for Use Levels reference values published by LQM/CIEH in 2015, the S4ULs). Currently, no published GAC value is available for cyanide and therefore REC has utilised the Environmental Agency Contaminated Land Exposure Assessment Tool (CLEA v1.06) to derive the relevant GAC for this proposed land use. Due to the absence of a published lead GAC for direct use within the planning regime, the 2014 Defra C4SL (Category 4 Screening Level) has been used as this value is considered to incorporate the latest toxicological, bio-accessibility and exposure modelling research to date.

Six samples were analysed for Soil Organic Matter (SOM). The average SOM value was 3.9%, therefore the soil results have been compared with a GACs for a soil with 2.5% SOM to be appropriately conservative.

Table 5.1 Summary of Human Health Risk Assessment for Resi End Use with Plant Uptake (2.5% SOM)

Determinand	Units	GAC	GAC Source	Primary Pathway	n	[mc]	Assessment
Inorganics							
Arsenic	mg/kg	37	(i)	1	6	18	No Further Action
Antimony	mg/kg	99	(i)	1	6	13	
Barium	mg/kg	1200	(i)	1	6	590	
Cadmium	mg/kg	11	(i)	1	6	3.0	
Beryllium	mg/kg	1.7	(i)	1	6	1.0	
Boron	mg/kg	290	(i)	1	6	1.4	
Chromium	mg/kg	910	(i)	1	6	3.0	
Chromium (VI)	mg/kg	6.0	(i)	1	6	<1.2	
Copper	mg/kg	2400	(i)	1	6	250	
Lead	mg/kg	200	(iv)	1	6	650	See Discussion
Mercury [Inorganic]	mg/kg	40	(i)	1	6	3.1	No Further Action
Nickel	mg/kg	180	(i)	1	6	28	
Selenium	mg/kg	250	(i)	1	6	<1.0	
Vanadium	mg/kg	410	(i)	1	6	43	
Zinc	mg/kg	3700	(i)	1	6	760	
Cyanide	mg/kg	3.4	(v)	1	6	<1	See Discussion
Asbestos	-	D.	-	1, 2	6	Detected	
Organics – PAHs and Phenol							
Phenols	mg/kg	550	(ii)	5	6	<1	



Determinand	Units	GAC	GAC Source	Primary Pathway	n	[mc]	Assessment
Naphthalene	mg/kg	5.6	(ii)	4	6	0.25	No Further Action
Acenaphthylene	mg/kg	420	(ii)	1	6	0.23	
Acenaphthene	mg/kg	510	(ii)	1	6	0.26	
Fluorene	mg/kg	400	(ii)	1	6	0.27	
Phenanthrene	mg/kg	220	(ii)	1	6	2.8	No further Action
Anthracene	mg/kg	5400	(ii)	1	6	0.76	
Fluoranthene	mg/kg	560	(ii)	1	6	6.0	
Pyrene	mg/kg	1200	(ii)	1	6	6.1	
Benzo(a)anthracene	mg/kg	11	(ii)	1	6	3.3	
Chrysene	mg/kg	22	(ii)	1	6	3.3	
Benzo(b)fluoranthene	mg/kg	3.3	(ii)	1	6	4.9	See Discussion
Benzo(k)fluoranthene	mg/kg	93	(ii)	1	6	2.1	No Further Action
Benzo(a)Pyrene	mg/kg	2.7	(ii)	1	6	3.9	See Discussion
Indeno(123-cd)Pyrene	mg/kg	36	(ii)	1	6	2.1	No Further Action
Dibenzo(a,h)anthracene	mg/kg	0.28	(ii)	1	6	0.52	See Discussion
Benzo(ghi)perylene	mg/kg	340	(ii)	1	6	2.6	No further Action
Organics – TPHs							
TPH Aliphatic C5-C6 ali	mg/kg	78	(iii)	4	6	<0.001	No Further Action
TPH Aliphatic C6-C8 ali	mg/kg	230	(iii)	4	6	<0.001	
TPH Aliphatic C8-C10 ali	mg/kg	65	(iii)	4	6	<0.001	
TPH Aliphatic C10-C12 ali	mg/kg	330	(iii)	4	6	7.5	
TPH Aliphatic C12-C16 ali	mg/kg	2400	(iii)	1, 4	6	17	
TPH Aliphatic C16-C35 ali	mg/kg	92000	(iii)	1	6	220	
TPH Aromatic C6-C7 aro	mg/kg	140	(iii)	1	6	<0.001	
TPH Aromatic C7-C8 aro	mg/kg	290	(iii)	1	6	<0.001	
TPH Aromatic C8-C10 aro	mg/kg	83	(iii)	1	6	<0.001	
TPH Aromatic C10-C12 aro	mg/kg	180	(iii)	1	6	<1.0	
TPH Aromatic C12-C16 aro	mg/kg	330	(iii)	1	6	3.0	
TPH Aromatic C16-C21 aro	mg/kg	540	(iii)	1	6	39	
TPH Aromatic C21-C35 aro	mg/kg	1500	(iii)	1	6	180	
Benzene	mg/kg	0.17	(iii)	4	6	<1.0	
Toluene	mg/kg	290	(iii)	1	6	<1.0	
EthylBenzene	mg/kg	110	(iii)	1	6	<1.0	
M/P Xylene	mg/kg	140	(iii)	1	6	<1.0	
O Xylene	mg/kg	140	(iii)	1	6	<1.0	
Methyl tert-Butyl Ether	mg/kg	130	(iii)	1	6	<1.0	
Key [mc] Maximum Concentration Recorded D. Detected N.D. None Detected (Limit of Detection = <0.0001%) Primary Pathways 1 Ingestion of soil and indoor dust and / or oral background exposure; 2 Consumption of home-grown produce and attached soil; 3 Inhalation of dust (background and indoor); 4 Inhalation of vapour (background and indoor); 5 Direct dermal / skin contact.							



Determinand	Units	GAC	GAC Source	Primary Pathway	n	[mc]	Assessment
Generic Assessment Criteria (GAC) Source							
(i)		LQM/CIEH Suitable for Use Level (S4UL) (2015);					
(ii)		S4UL – Conservative Assessment Approach of 6% SOM;					
(iii)		S4UL – 2.5% SOM and assumed worst case aliphatic / aromatic compound;					
(iv)		Defra Category 4 Screening Level (2014);					
(v)		CLEA 1.06 Derived Value.					

5.2 Discussion of Soil Results

Referring to Table 5.1, the results of this direct comparison indicates that the screening values have been exceeded for lead in six samples and PAHs in five samples, and asbestos in WS102, WS103, WS104 and TP105. All samples were retrieved from shallow Made Ground. Results are indicative of potential widespread contamination.

All five samples of asbestos were submitted for quantification with all results reported as <0.001 % (the limit of detection) chrysotile fibres. As such it is considered that this presents a relatively low risk and should materials be removed as a waste would not be classified as hazardous waste.

Lead concentrations ranged from 280 – 650 mg/kg and are therefore notably elevated above the screening value of 200 mg/kg.

Benzo(b)fluoranthene concentrations ranged from 3.3 to 4.9 mg/kg and are therefore consistent across the site and marginally exceed the screening value of 3.3 mg/kg.

It is recommended that the contamination found on the site within the Made Ground can be mitigated through the removal of the viable exposure pathway in the proposed development. Areas beneath the footprint of the proposed buildings or access roads will break the exposure pathway. In areas of soft standing a cover system can be utilised to ensure adequate thickness of a suitable growing medium is present.

Alternatively Made Ground materials could be removed from site.

5.3 Ground Gas

The potential impact on the development from ground gases has been assessed with reference to standards and guidelines published within BS 8485:2015+A1:2019. Made Ground was generally granular with inclusions of brick, slate and tile and very little ashy material and therefore is unlikely to generate hazardous ground gases.



Four return monitoring visits were undertaken at periods of both rising and falling pressure. A summary of results and calculated Gas Screening Values (GSV) are given as Table 5.2.

Table 5.2 Summary of Ground Gas Risk Assessment

Location	Max Steady Flow Rate (L/hr)	Maximum Steady CH ₄ (%)	Maximum Steady CO ₂ (%)	CH ₄ Qhg (L/hr)	CO ₂ Qhg (L/hr)	Implied CH ₄ CS	Implied CO ₂ CS
WS102	<0.1	<0.1	0.8	0.0001	0.0008	1	1
WS103	<0.1	<0.1	2.0	0.0001	0.0020	1	1
WS105	<0.1	<0.1	0.9	0.0001	0.0009	1	1

CS: Characteristic Situation

Qhg: Hazardous gas flow rate

The implied characteristic situation for the boreholes has been calculated by combining the maximum observed steady flow rate and maximum observed steady concentrations for each borehole during all monitoring events. This methodology provides a 'worst case scenario' in order to characterise the highest potential risk to human health from ground gas at the site.

Based on the results obtained, the site is characterised as Characteristic Situation 1 (CS1) in accordance with BS8485:2015. As such, no gas protection measures are considered necessary.

5.4 Revised Conceptual Site Model

The results of the Phase II ground investigation and laboratory analyses identified an outstanding potential risk from PAHs, lead and detection of asbestos fibres within the Made ground with respect to future residential receptors.

Based on ground gas monitoring, no risk from ground gases was identified onsite. As such, no further measures are deemed necessary.

No visual or olfactory evidence of contamination was noted that is likely to impact groundwaters and no ongoing source of contamination was recorded that could leach contaminants to groundwater.



6.0 GEOTECHNICAL ASSESSMENT

6.1 Proposed Development

The proposed development includes the construction of a mix of terrace and semi-detached and detached dwellings and apartments, with private gardens, parking and access roadways. A proposed development plan (drawing ref 108157-002) is provided in Appendix III.

6.2 Summary of Ground and Groundwater Conditions

Ground conditions, as summarised in Section 4, comprised Made Ground to a maximum proven depth of 5.80m bgl (CP103) overlying glaciofluvial deposits of sand and gravel between 5.80mbgl and 14.80mbgl in CP101 and silty clay with varying compositions of sand and gravel. Groundwater was encountered between 6.00m bgl (CP102) and 8.50m bgl (CP101) within coarse grained glaciofluvial deposits.

6.3 Foundation Conditions and Bearing Capacity

Due to the presence of deep made ground, shallow foundations are not considered suitable nor economically viable for the scheme. As such, a piled foundation solution is more likely to be suitable.

Given the thickness of the Made Ground, construction of a working platform will be required for safe construction of piles. A working platform should be designed to suitably support the proposed piling plant. Consideration could be given to the implementation of a geo-grid layer into construction to reduce engineered fill thickness and associated construction costs.

A choice of pile types of various lengths and diameters can be designed to bear into the natural strata encountered beneath the site. However, general site conditions, environs and proximity to adjacent structures and foundations are all influential in the choice of piling system.

Table 6.1 below outlines preliminary calculated carrying capacities of piles at various depths and pile diameters based on the following parameters:

- ▶ Beta values limited to 0.80 within coarse fraction strata;
- ▶ Alpha values assumed as 0.45 for fine grained strata;
- ▶ Worst case groundwater level of 6m bgl;
- ▶ Worst case geology of Made Ground to 6m bgl with fine grained material thereafter;
- ▶ Assumption of no positive nor negative skin friction from the overlying Made Ground;
- ▶ Factors of safety of 1.5 on side resistance and 3.0 on base resistance; and
- ▶ Global Factor of safety of 2.5.

Table 6.1 Preliminary Pile Carrying Capacities

Depth (mbgl)	Pile Carrying Capacity (kN)		
	300 mm diameter	450 mm diameter	600 mm diameter
10.0	180	315	475
15.0	370	600	855
20.0	560	885	1240

The above preliminary capacities allow for bearing into the superficial deposits. All foundations should be designed by suitably qualified structural engineers.



6.4 Concrete Durability

Chemical analyses for pH and water-soluble sulphate (2:1 aqueous extract) summarised in Section 4 indicate that the materials on site meet class DS-1/AC-1(s) in accordance with BRE Special Digest 1 (2005).

6.5 Excavations & Stability

Excavations are likely to be undertaken through the Made Ground, which is inherently unstable. Therefore, temporary works will need to be designed appropriately particularly if excavations are planned to great depth to prevent collapse, particularly during wet conditions.

6.6 Floor Slabs

Given that a piled foundation solution is likely to be adopted for the scheme it is recommended that floor slabs are suspended in order to limit effects of any potential differential settlements. Consideration will however be required with respect to issues of condensation building beneath the slab which will need to be designed into any such solution.

6.7 Infiltration testing

Although infiltration characteristics are suitable for soakaways, in accordance with guidance in BRE 365 Soakaway Design, soakaways should not be constructed in Made ground due to its potential heterogeneous composition and consequent difficulty in identifying variances in ground conditions and, in this particular case, the presence of contaminants in Made ground across the site.

6.8 Roads and Pavements

A CBR of 2% is assumed for roads and pavements on this scheme due to depth of Made ground. A geo-grid may be employed to assist in addressing varying density in underlying Made ground for use in a roadway construction.



7.0 CONCLUSIONS & RECOMMENDATIONS

7.1 Contaminated Land

The results of the Phase II Geo-Environmental Site Investigation and laboratory analyses identified exceedances for lead and PAHs and identification of low level asbestos fibres within the Made ground across the site. It is advised that these materials are not incorporated into soft standing and that they are placed either beneath hardstanding or a cover system of 600mm with a demarcation membrane.

Based on ground gas monitoring, no risk from ground gases was identified onsite. As such, no further measures are deemed necessary.

7.2 Geotechnical

A piled foundation solution is recommended on this site due to presence of deep Made ground. alternatively, ground improvements methods such vibro replacement can be considered. Groundwater was identified during site works at between 6.00mbgl and 8.50mbgl.

The use of soakaways is not advised due to depth of Made ground.

Concrete foundations should be designed in line with sulphate class DS-1/AC-1(s).

7.3 Recommendations

A Remediation Strategy is recommended to address the issues arising from exceedances in Made ground. A Piling Risk Assessment may be necessary should this foundation solution be adopted.

Further testing is recommended in spoil heap areas onsite if they are proposed to be used within the development or alternatively disposed of to landfill to classify the waste.

In addition, installation of deep monitoring wells is suggested for groundwater monitoring and testing (identified during site works at between 6.00mbgl and 8.50mbgl). This information would assist in adequate design of deep foundations.

END OF REPORT

APPENDIX I

LIMITATIONS



1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between REC Ltd and the Client.
2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information, it has been assumed it is correct. No attempt has been made to verify the information.
3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.
4. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.
5. In addition to the above REC Ltd note that when investigating, or developing, potentially contaminated land it is important to recognise that sub-surface conditions may vary spatially and also with time. The absence of certain ground, ground gas, and contamination or groundwater conditions at the positions tested is not a guarantee that such conditions do not exist anywhere across the site. Due to the presence of existing buildings and structures access could not be obtained to all areas. Additional contamination may be identified following the removal of the buildings or hard standing.
6. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.
7. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials this is for indicative purposes only and do not constitute or replace full and proper surveys.
8. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.
9. This report presents an interpretation of the geotechnical information established by excavation, observation and testing. Whilst every effort is made in interpretative reporting to assess the soil conditions over the Site it should be noted that natural strata vary from point to point and that man made deposits are subject to an even greater diversity. Groundwater conditions are dependent on seasonal and other factors. Consequently, there may be conditions present not revealed by this investigation.
10. REC can not be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by REC is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by REC in this connection without their explicit written agreement there to by REC.
11. This investigation has been undertaken to reasonably characterise existing sub-surface conditions and the findings of this study are our best interpretation of the data collected, within the scope of work and agreed budget. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.



Phase II Geo-Environmental &
Geotechnical Site Investigation
Land off Jacques Way
Castlemead Group Limited
108157p2r0
November 2019

APPENDIX II

GLOSSARY



TERMS

AST	Above Ground Storage Tank
BGS	British Geological Survey
BSI	British Standards Institute
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CIEH	Chartered Institute of Environmental Health
CIRIA	Construction Industry Research Association
CLEA	Contaminated Land Exposure Assessment
CSM	Conceptual Site Model
DNAPL	Dense Non-Aqueous Phase Liquid (chlorinated solvents, PCB)
DWS	Drinking Water Standard
EA	Environment Agency
EQS	Environmental Quality Standard
GAC	General Assessment Criteria
GL	Ground Level
GSV	Gas Screening Value
HCV	Health Criteria Value
ICSM	Initial Conceptual Site Model
LNAPL	Light Non-Aqueous Phase Liquid (petrol, diesel, kerosene)
ND	Not Detected
LMRL	Lower Method Reporting Limit
NR	Not Recorded
PAH	Poly Aromatic Hydrocarbon
PCB	Poly-Chlorinated Biphenyl
PID	Photo Ionisation Detector
QA	Quality Assurance
SGV	Soil Guideline Value
SPH	Separate Phase Hydrocarbon
Sp.TPH (CWG)	Total Petroleum Hydrocarbon (Criteria Working Group)
SPT	Standard Penetration Test
SVOC	Semi Volatile Organic Compound
UST	Underground Storage Tank
VCCs	Vibro Concrete Columns
VOC	Volatile Organic Compound
WTE	Water Table Elevation



Phase II Geo-Environmental &
Geotechnical Site Investigation
Land off Jacques Way
Castlemead Group Limited
108157p2r0
November 2019

APPENDIX III

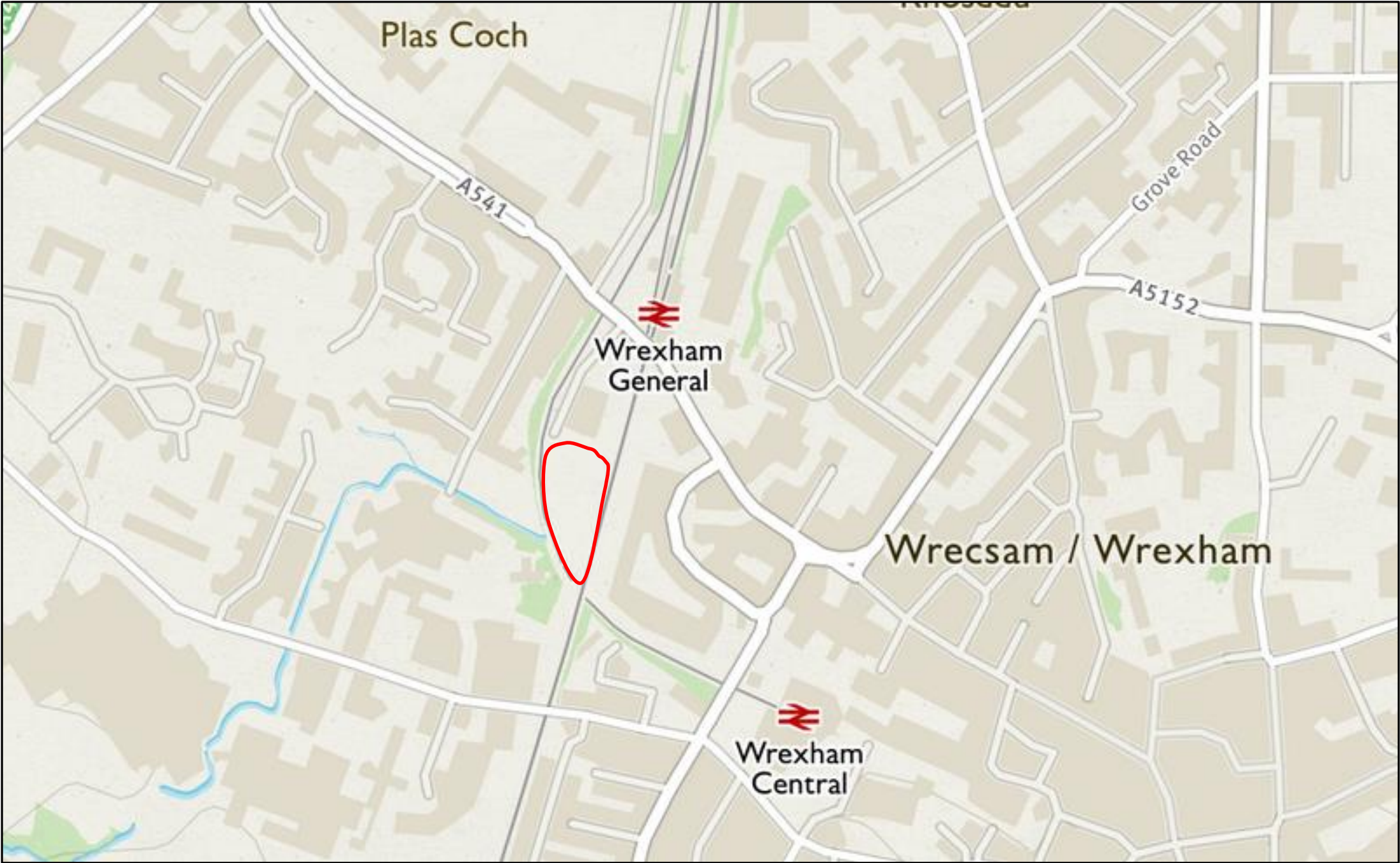
DRAWINGS

KEY:



 Site Boundary

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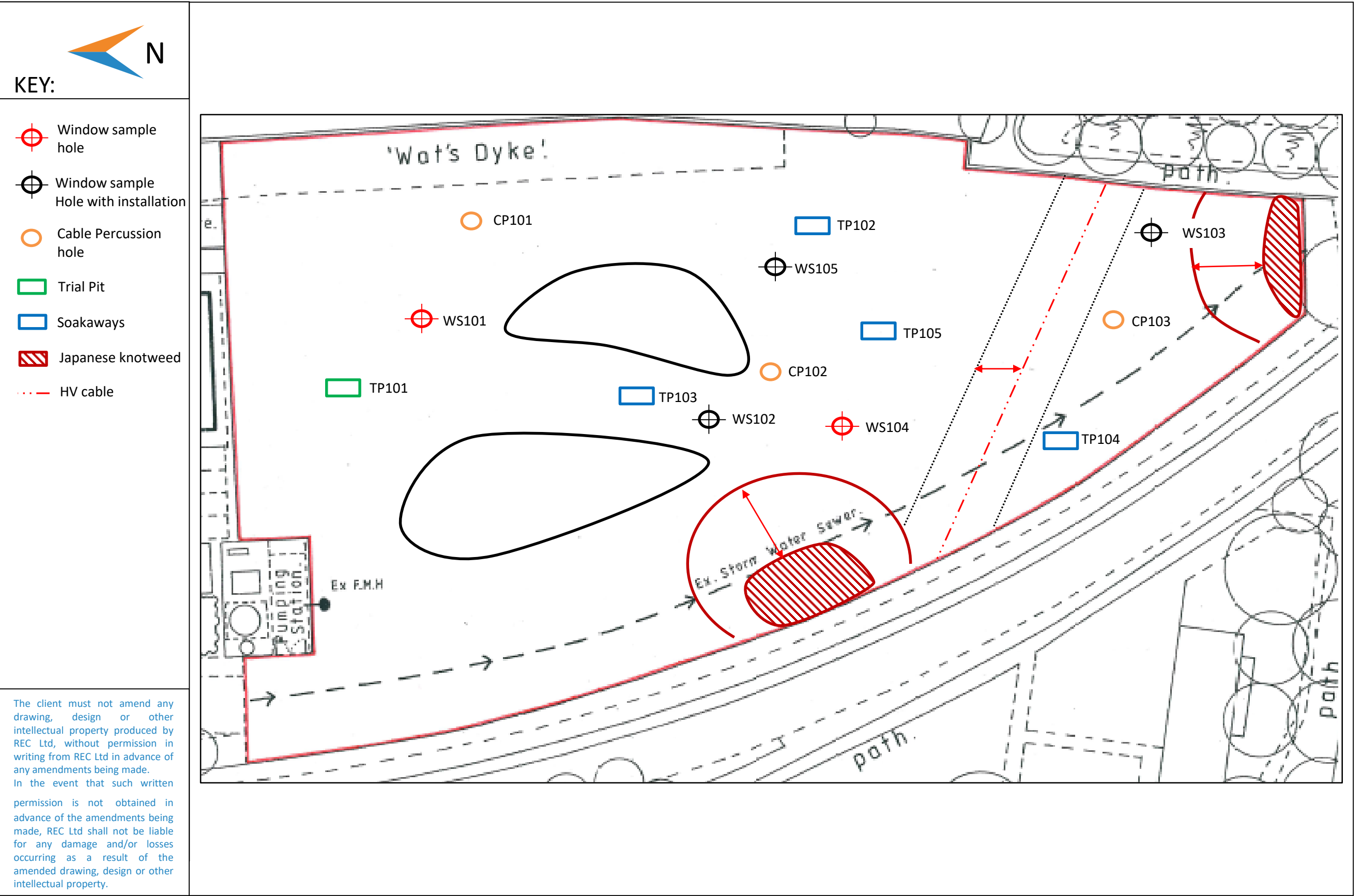


 REC Ltd Osprey House, Pacific Quay, Broadway, Manchester, M50 2UE T: +44 161 868 1300 recld.co.uk	Job Title: Land off Jacques Way	Client: Castlemead Group	Job No: 108157	Notes: NOT TO SCALE	Drawing Title: 001 – Site Location Plan
			Drawn By: CL		
			Approved by: ML		

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Job Title:	Client:	Job No: 108157	Notes:	Drawing Title:
Land off Jacques Way	Castlemead Group	Drawn by: CL		
		Approved by: ML		
			NOT TO SCALE	002 – Proposed Development Plan



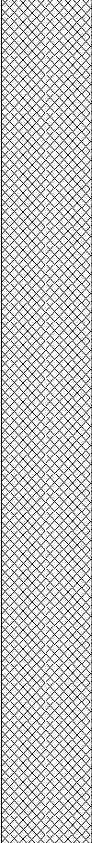
	REC Ltd Osprey House, Pacific Quay, Broadway, Manchester, M50 2UE T: +44 161 868 1300 recLtd.co.uk	Job Title: Land off Jacques Way	Client: Castlemead Group	Job No: 108157	Notes: NOT TO SCALE	Drawing Title: 003 - Borehole Location Plan
				Drawn By: CL		
				Approved by: ML		



Phase II Geo-Environmental &
Geotechnical Site Investigation
Land off Jacques Way
Castlemead Group Limited
108157p2r0
November 2019

APPENDIX IV

EXPLORATORY HOLE LOGS

   		Borehole Log			Borehole No. CP101 Sheet 1 of 2				
Project Name: Land off Jacques Way		Proj. ID: 108157		Easting: Northing:		Hole Type CP			
Location: Jacques Way, Wrexham, LL11 2BY		Plant: Dando 2000		Level (m AOD): Final Depth (m): 16.95		Scale: 1:50			
Client: Castlemead Group Limited		Crew: Vincent Cameron Drilling		Start Date: 09/10/2019 End Date: 10/10/2019		REC Engineer: CL			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.00 - 1.20	B					Grey very gravelly SAND with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse brick and concrete. [MADE GROUND]	
		1.20 - 1.65 1.20	D SPT	N=26 (2,4/6,7,6,7)					1
		2.00 - 2.45 2.00	D SPT	N=19 (8,7/7,3,5,4)					2
		3.00 - 3.45 3.00	B SPT	N=14 (2,3/3,4,3,4)					3
		4.00 - 4.45 4.00	D SPT	N=40 (6,8/9,10,11,10)					4
		5.00 - 5.45 5.00	D SPT	N=28 (4,7/7,8,7,6)					5
		5.60 - 5.80	B		5.60				
		6.00 - 6.45 6.00 - 6.45 6.00	B D SPT	N=50 (8,8/8,15,17,10)	5.80			Soft brown very gravelly thinly laminated silty CLAY. Gravel is angular to rounded fine to coarse mudstone. [GLACIOFLUVIAL] Very dense multicoloured clayey very sandy GRAVEL. Sand is fine to coarse. Gravel is very angular to subrounded fine to coarse mudstone and sandstone. [GLACIOFLUVIAL]	6
		7.50 - 7.95 7.50	D SPT	50 (8,12/16,20,14,)					7
		9.00 - 9.45 9.00	D SPT	N=50 (6,10/12,12,15,11)					9
				10.00			Continued on Next Sheet	10	

Remarks:

Location cleared for buried services using Cable Avoidance Tool (CAT). Hand inspection pit advanced to 1.20mbgl. Groundwater encountered at 8.50mbgl rising to 8.00mbgl after 20mins. Borehole terminated at 16.95mbgl following complications advancing casing. Hole backfilled with arisings upon completion.

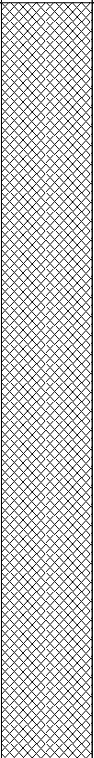
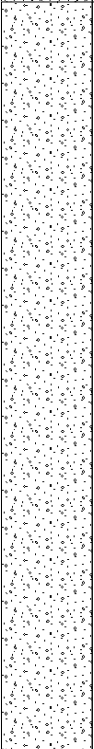


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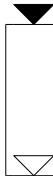
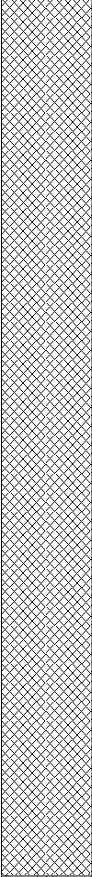
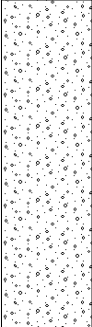
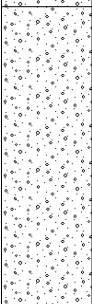
   		Borehole Log			Borehole No. CP101 Sheet 2 of 2				
Project Name: Land off Jacques Way		Proj. ID: 108157		Easting: Northing:		Hole Type CP			
Location: Jacques Way, Wrexham, LL11 2BY		Plant: Dando 2000		Level (m AOD): Final Depth (m): 16.95		Scale: 1:50			
Client: Castlemead Group Limited		Crew: Vincent Cameron Drilling		Start Date: 09/10/2019 End Date: 10/10/2019		REC Engineer: CL			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.50 - 10.95 10.50	D SPT	N=41 (5,7/9,11,11,10)	14.80			Dense to very dense brown gravelly SAND. Sand is fine to coarse. Gravel is angular to rounded fine to coarse sandstone. [GLACIOFLUVIAL]	11
		12.00 - 12.45 12.00	D SPT	N=50 (4,8/13,13,13,11)					12
		13.50 - 13.95 13.50	D SPT	N=50 (6,13/14,15,15,6)					13
		14.90 15.00 - 15.45	B U100	Ublow=60					14
		15.50	D						15
		16.00	B						16
		16.50 16.50	D SPT	N=50 (14,11/28,22,0,0)					17
				16.95			End of Borehole at 16.95m	18	
								19	
								20	

Remarks:
 Location cleared for buried services using Cable Avoidance Tool (CAT). Hand inspection pit advanced to 1.20mbgl. Groundwater encountered at 8.50mbgl rising to 8.00mbgl after 20mins. Borehole terminated at 16.95mbgl following complications advancing casing. Hole backfilled with arisings upon completion.



   		Borehole Log			Borehole No. CP102 Sheet 1 of 2				
Project Name: Land off Jacques Way		Proj. ID: 108157		Easting: Northing:		Hole Type CP			
Location: Jacques Way, Wrexham, LL11 2BY		Plant: Dando 2000		Level (m AOD): Final Depth (m): 19.00		Scale: 1:50			
Client: Castlemead Group Limited		Crew: Vincent Cameron Drilling		Start Date: 10/10/2019 End Date: 10/10/2019		REC Engineer: LM			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		1.20 - 1.65 1.20	B SPT	N=23 (4,6/7,5,3,8)	5.00			Dark brown very gravelly SAND. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse brick and concrete. [MADE GROUND]	1
		2.00 - 2.45 2.00	D SPT	N=24 (4,7/7,6,5,6)					2
		3.00 - 3.45 3.00	D SPT	N=42 (6,10/8,13,9,12)					3
		4.00 - 4.45 4.00	D SPT	N=39 (4,12/10,10,8,11)					4
		5.00 - 5.45 5.00	B SPT	50 (7,16/20,18,12,)					5
			6.00 - 6.45 6.00	D SPT	50 (10,15/16,16,18,)	10.00		Very dense grey clayey sandy GRAVEL with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse mudstone and sandstone. Cobbles are subangular to subrounded mudstone and sandstone. [GLACIOFLUVIAL]	6
			7.50	SPT	50 (4,12/19,20,11,)				7
			9.00 - 9.45 9.00	D SPT	50 (6,18/22,22,6,)				9
			9.50 - 9.95	D					
			10.00	B					
Continued on Next Sheet								10	
Remarks: Location cleared for buried services using Cable Avoidance Tool (CAT). Hand inspection pit advanced to 1.20mbgl. Groundwater encountered at 7.00mbgl rising to 6.00mbgl after 20mins. Borehole terminated at scheduled depth of 19.00mbgl. Hole backfilled with arisings on completion.									 CONCEPT LIFE SCIENCES DELIVERING SCIENCE

REC DELIVERING SOLUTIONS				ISO 9001 QUALITY ASSURANCE MANAGEMENT SYSTEM	ISO 14001 ENVIRONMENTAL MANAGEMENT SYSTEM	OHSAS 18001 HEALTH, SAFETY & ENVIRONMENTAL MANAGEMENT SYSTEM	Borehole Log				Borehole No. CP102 Sheet 2 of 2	
Project Name: Land off Jacques Way						Proj. ID: 108157		Easting: Northing:		Hole Type CP		
Location: Jacques Way, Wrexham, LL11 2BY						Plant: Dando 2000		Level (m AOD): Final Depth (m): 19.00		Scale: 1:50		
Client: Castlemead Group Limited						Crew: Vincent Cameron Drilling		Start Date: 10/10/2019 End Date: 10/10/2019		REC Engineer: LM		
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description				
		Depth (m)	Type	Results								
		10.50 - 10.95 10.50	D SPT	N=50 (4,9/13,14,15,8)	12.00			Very stiff multicoloured sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse mudstone and sandstone. [GLACIOFLUVIAL]		11		
		12.00 - 12.45 12.00	D SPT	N=50 (6,10/12,15,15,8)				Very stiff brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse mudstone and sandstone. [GLACIOFLUVIAL]		12		
		13.50 - 13.95 13.50	D SPT	N=50 (5,8/10,13,13,14)						13		
		15.00 - 15.45 15.00	D SPT	N=50 (7,9/12,14,15,9)						15		
		16.40 16.50 - 16.95	B U100	Ublow=75	16.40			Very stiff sandy slightly gravelly thinly laminated CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse mudstone and sandstone. [GLACIOFLUVIAL]		16		
		17.00	D							17		
		18.00 - 18.45 18.00	D SPT	N=50 (9,10/12,14,14,10)						18		
				19.00 - 19.45 19.00	D SPT	N=50 (10,15/27,23,0,0)	19.00			End of Borehole at 19.00m		19
										20		
Remarks: Location cleared for buried services using Cable Avoidance Tool (CAT). Hand inspection pit advanced to 1.20mbgl. Groundwater encountered at 7.00mbgl rising to 6.00mbgl after 20mins. Borehole terminated at scheduled depth of 19.00mbgl. Hole backfilled with arisings on completion.											CONCEPT LIFE SCIENCES DELIVERING SCIENCE	

   		Borehole Log			Borehole No. CP103 Sheet 1 of 2				
Project Name: Land off Jacques Way		Proj. ID: 108157		Easting: Northing:		Hole Type CP			
Location: Jacques Way, Wrexham, LL11 2BY		Plant: Dando 2000		Level (m AOD): Final Depth (m): 19.95		Scale: 1:50			
Client: Castlemead Group Limited		Crew: Vincent Cameron Drilling		Start Date: 10/10/2019 End Date: 11/10/2019		REC Engineer: LM			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		1.20 - 1.65 1.20	B SPT	N=11 (3,2/3,2,3,3)	5.80			Dark brown very gravelly SAND. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse brick and concrete. [MADE GROUND]	1
		2.00 - 2.45 2.00	D SPT	N=14 (3,3/4,3,4,3)				2	
		3.00 - 3.45 3.00	D SPT	N=14 (2,3/4,4,3,3)				3	
		4.00 - 4.45 4.00	D SPT	N=16 (2,3/4,4,4,4)				4	
		5.00 - 5.45 5.00	D SPT	N=15 (3,4/4,3,4,4)				5	
		6.00 - 6.45 6.00	B SPT	N=32 (5,6/8,8,8,8)	8.00		Dense brown sandy clayey GRAVEL with low cobble content. Gravel is subangular to subrounded fine to coarse sandstone. Cobbles are subangular to subrounded sandstone. [GLACIOFLUVIAL]	6	
		7.50 - 7.95 7.50	D SPT	N=50 (7,12/14,15,15,6)			Very dense brown clayey sandy GRAVEL with high cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse sandstone. Cobbles are subangular to subrounded sandstone. [GLACIOFLUVIAL]	7	
		9.00 - 9.45 9.00	D SPT	50 (5,10/15,18,17.)				8	
		10.00	B					9	
								Continued on Next Sheet	10

Remarks:

Location cleared for buried services using Cable Avoidance Tool (CAT). Hand inspection pit advanced to 1.20mbgl. Groundwater encountered at 8.00mbgl rising to 7.00mbgl after 20mins. Hole backfilled with arisings on completion. Borehole terminated at scheduled depth of 19.50mbgl.



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   		Borehole Log			Borehole No. CP103 Sheet 2 of 2				
Project Name: Land off Jacques Way		Proj. ID: 108157		Easting: Northing:		Hole Type CP			
Location: Jacques Way, Wrexham, LL11 2BY		Plant: Dando 2000		Level (m AOD): Final Depth (m): 19.95		Scale: 1:50			
Client: Castlemead Group Limited		Crew: Vincent Cameron Drilling		Start Date: 10/10/2019 End Date: 11/10/2019		REC Engineer: LM			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.50 - 10.95 10.50	D SPT	N=50 (8,9/10,12,17,11)					11
		12.00 - 12.45 12.50	U100 D	Ublow=100	12.00			Very stiff brown slightly gravelly CLAY with low cobble content. Gravel is subangular to subrounded sandstone. Cobbles are subangular to subrounded sandstone. [GLACIOFLUVIAL]	12
		13.50 - 13.95 13.50 - 13.95 13.50	B D SPT	50 (11,12/18,18,14,)	13.50			Very stiff brown very gravelly CLAY. Gravel is subangular to subrounded fine to coarse sandstone. [GLACIOFLUVIAL]	13
		15.00 - 15.45 15.00 - 15.45 15.00	B D SPT	N=53 (7,10/12,15,17,9)	15.00			Very stiff brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse mudstone. [GLACIOFLUVIAL]	14
		16.50 - 16.95 17.00	U100 D	Ublow=76					15
		18.00 - 18.45 18.00	D SPT	N=50 (9,10/14,16,17,3)					16
		19.50 - 19.95 19.50	D SPT	50 (18,7/21,26,3,)	19.50			Very dense GRAVEL. Gravel is subangular to subrounded fine to coarse sandstone. [GLACIOFLUVIAL]	17
					19.95				18
								End of Borehole at 19.95m	19
									20
Remarks: Location cleared for buried services using Cable Avoidance Tool (CAT). Hand inspection pit advanced to 1.20mbgl. Groundwater encountered at 8.00mbgl rising to 7.00mbgl after 20mins. Hole backfilled with arisings on completion. Borehole terminated at scheduled depth of 19.50mbgl.									
									

   			Trial Pit Log				Borehole No. TP101 Sheet 1 of 1		
Project Name: Land off Jacques Way			Proj. ID: 108157		Easting: Northing:		Hole Type TP		
Location: Jacques Way, Wrexham, LL11 2BY			Plant: JCB 3CX		Level (m AOD): Final Depth (m): 2.90		Scale: 1:20		
Client: Castlemead Group Limited			Crew: PT Ithell		Start Date: 10/10/2019 End Date: 10/10/2019		REC Engineer: LM		
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					2.90			Grass overlying dark brown very gravelly SAND with high cobble content and low boulder content. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse brick, concrete, slate, plastic and metal. Cobbles are subangular to subrounded sandstone. boulders are very angular to angular concrete. [MADE GROUND]	1
								End of Borehole at 2.90m	2
									3
									4
Remarks: Location cleared for buried services using Cable Avoidance Tool (CAT). No groundwater encountered. Pit backfilled with arisings on completion.							Pit Dimensions Length: 2.80 Width: 0.70 Depth: 2.90		 CONCEPT LIFE SCIENCES DELIVERING SCIENCE
Stability: Stable									

		  		Trial Pit Log				Borehole No. TP103	
Project Name: Land off Jacques Way		Proj. ID: 108157		Easting: Northing:		Hole Type TP			
Location: Jacques Way, Wrexham, LL11 2BY		Plant: JCB 3CX		Level (m AOD): Final Depth (m): 3.00		Scale: 1:20			
Client: Castlemead Group Limited		Crew: PT Ithell		Start Date: 10/10/2019 End Date: 10/10/2019		REC Engineer: LM			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.60			Grass overlying dark brown very gravelly SAND with low cobble content. Sand is fine to coarse. Gravel is very angular to rounded fine to coarse brick, concrete and rebar fragments. [MADE GROUND]	1
								Light grey slightly gravelly SAND with low cobble content and low boulder content with putrid odour. Sand is fine to coarse. Gravel is angular to rounded fine to coarse brick glass concrete and mudstone. Cobbles are angular to rounded concrete and mudstone. Boulders are very angular to angular concrete. [MADE GROUND]	
					3.00			At 1.80mbgl: Clay bands	2
								End of Borehole at 3.00m	
									4

Remarks:
Location cleared for buried services using Cable Avoidance Tool (CAT). No groundwater encountered. Pit backfilled with arisings on completion.

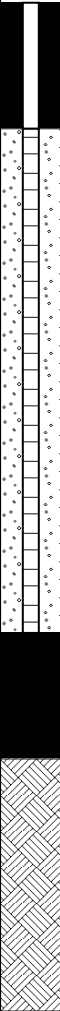
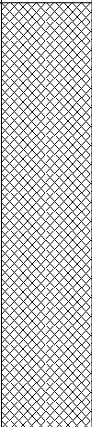
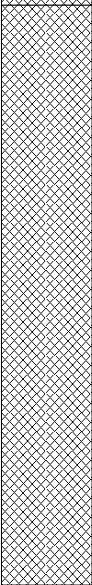
Stability: Stable

Pit Dimensions
(m)
Length: 2.80
Width: 0.70
Depth: 3.00


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		  		Trial Pit Log			Borehole No. TP105	
Project Name: Land off Jacques Way		Proj. ID: 108157		Easting: Northing:		Hole Type TP		
Location: Jacques Way, Wrexham, LL11 2BY		Plant: JCB 3CX		Level (m AOD): Final Depth (m): 3.00		Scale: 1:20		
Client: Castlemead Group Limited		Crew: PT Ithell		Start Date: 10/10/2019 End Date: 10/10/2019		REC Engineer: LM		
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES					Grass overlying dark brown very gravelly SAND with high cobble content. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse brick glass, plastic and sandstone. Cobbles are angular to subangular brick and sandstone. [MADE GROUND]
					2.80			
					3.00			Firm brown sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded to rounded fine to coarse brick, plastic, mudstone and sandstone. [GLACIOFLUVIAL]
								End of Borehole at 3.00m
Remarks: Location cleared for buried services using Cable Avoidance Tool (CAT). No groundwater encountered. Pit backfilled with arisings on completion.								Pit Dimensions Length: 2.40 Width: 0.70 Depth: 3.00
Stability: Stable								 CONCEPT LIFE SCIENCES DELIVERING SCIENCE

		  		Borehole Log			Borehole No. WS101 Sheet 1 of 1		
Project Name: Land off Jacques Way		Proj. ID: 108157		Easting: Northing:		Hole Type WS			
Location: Jacques Way, Wrexham, LL11 2BY		Plant: Dando Terrier		Level (m AOD): Final Depth (m): 1.30		Scale: 1:30			
Client: Castlemead Group Limited		Crew: Vincent Cameron Drilling		Start Date: 08/10/2019 End Date: 08/10/2019		REC Engineer: LM			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		1.30			Dark brown very gravelly SAND with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse brick, concrete and sandstone. [MADE GROUND]	1
		1.20 1.20	D SPT	N=15 (3,3/3,4,4,4)					
								End of Borehole at 1.30m	2
									3
									4
									5
									6
Remarks: Location cleared for buried services using Cable Avoidance Tool (CAT). Hand inspection pit advanced to 1.20mbgl. Location terminated upon encountering a refusal at 1.30mbgl. Hole backfilled with arisings and moved to WS102.									 CONCEPT LIFE SCIENCES DELIVERING SCIENCE

		  		Borehole Log			Borehole No. WS102 Sheet 1 of 1		
Project Name: Land off Jacques Way		Proj. ID: 108157		Easting: Northing:		Hole Type WS			
Location: Jacques Way, Wrexham, LL11 2BY		Plant: Dando Terrier		Level (m AOD): Final Depth (m): 4.00		Scale: 1:30			
Client: Castlemead Group Limited		Crew: Vincent Cameron Drilling		Start Date: 09/10/2019 End Date: 09/10/2019		REC Engineer: LM			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	ES		1.70			Grey very gravelly SAND. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse brick and concrete. [MADE GROUND]	1
	1.20 1.20	D SPT	N=7 (1,1/1,2,2,2)						
	2.00 2.00	D SPT	N=10 (2,1/1,3,3,3)				Brown ashy slightly clayey gravelly SAND. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse brick and sandstone. [MADE GROUND]	2	
	3.00 3.00	D SPT	N=5 (2,1/1,1,1,2)						
		4.00 4.00	D SPT	N=50 (6,8/50 for 255mm)	4.00			End of Borehole at 4.00m	4
									5
									6

Remarks:
 Location cleared for buried services using Cable Avoidance Tool (CAT). Hand inspection pit advanced to 1.20mbgl. No groundwater encountered. Location terminated upon encountering a refusal at 4.00mbgl. Borehole installed with combined groundwater and ground gas monitoring standpipes.


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		  		Borehole Log			Borehole No. WS103 Sheet 1 of 1		
Project Name: Land off Jacques Way		Proj. ID: 108157		Easting: Northing:		Hole Type WS			
Location: Jacques Way, Wrexham, LL11 2BY		Plant: Dando Terrier		Level (m AOD): Final Depth (m): 4.00		Scale: 1:30			
Client: Castlemead Group Limited		Crew: Vincent Cameron Drilling		Start Date: 09/10/2019 End Date: 09/10/2019		REC Engineer: LM			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	ES		0.50		Dark brown gravelly SAND. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse brick, slate and porcelain. [MADE GROUND]		
		1.20 1.20	D SPT	N=17 (2,3/3,6,4,4)			Light grey very gravelly SAND. Sand is fine to coarse. Gravel is very angular to subangular fine to coarse quartzite concrete and mudstone. [MADE GROUND]	1	
		2.00 2.00	D SPT	N=7 (2,1/1,2,2,2)				2	
		3.00 3.00	D SPT	N=8 (2,2/2,2,2,2)				3	
		4.00	SPT	N=4 (6,9/1,1,1,1)		4.00	End of Borehole at 4.00m	4	
								5	
								6	

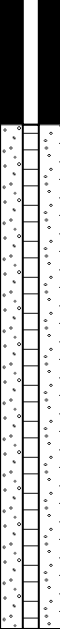
Remarks:
 Location cleared for buried services using Cable Avoidance Tool (CAT). Hand inspection pit advanced to 1.20mbgl. No groundwater encountered. Location terminated upon encountering a refusal at 4.00mbgl. Borehole installed with combined groundwater and ground gas monitoring standpipes.


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		  		Borehole Log			Borehole No. WS104 Sheet 1 of 1		
Project Name: Land off Jacques Way				Proj. ID: 108157		Easting: Northing:		Hole Type WS	
Location: Jacques Way, Wrexham, LL11 2BY				Plant: Dando Terrier		Level (m AOD): Final Depth (m): 5.00		Scale: 1:30	
Client: Castlemead Group Limited				Crew: Vincent Cameron Drilling		Start Date: 09/10/2019 End Date: 09/10/2019		REC Engineer: LM	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.50	ES		1.10			Dark brown gravelly SAND. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse brick, slate and sandstone. [MADE GROUND]	1
		1.00	SPT	N=14 (5,6/3,3,4,4)					
		1.20	D					Light grey very gravelly SAND. Sand is fine to coarse. Gravel is very angular to subangular fine to coarse brick, concrete and mudstone. [MADE GROUND]	
		2.00	D						2
		2.00	SPT	N=10 (2,2/3,3,2,2)					
		3.00	SPT	N=6 (1,1/1,2,1,2)					
4.00	SPT	N=7 (1,1/1,2,2,2)					4		
5.00	SPT	N=9 (2,2/3,2,2,2)							
					5.00			End of Borehole at 5.00m	5
									6

Remarks:
 Location cleared for buried services using Cable Avoidance Tool (CAT). Hand inspection pit advanced to 1.20mbgl. No groundwater encountered. Hole backfilled with arisings on completion.



		  		Borehole Log			Borehole No. WS105 Sheet 1 of 1		
Project Name: Land off Jacques Way				Proj. ID: 108157		Easting: Northing:		Hole Type WS	
Location: Jacques Way, Wrexham, LL11 2BY				Plant: Dando Terrier		Level (m AOD): Final Depth (m): 3.00		Scale: 1:30	
Client: Castlemead Group Limited				Crew: Vincent Cameron Drilling		Start Date: 09/10/2019 End Date: 09/10/2019		REC Engineer: LM	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES				Dark brown gravelly SAND. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse brick. [MADE GROUND]		
		1.00	SPT	N=20 (3,4/4,5,5,6)	1.00				1
		1.20	D					Light grey very gravelly SAND. Sand is fine to coarse. Gravel is very angular to subangular fine to coarse quartzite concrete and mudstone. [MADE GROUND]	
		2.00 2.00	D SPT	N=19 (3,4/5,5,4,5)					2
		3.00	SPT	N=50 (7,10/50 for 260mm)	3.00			End of Borehole at 3.00m	3
									4
									5
									6

Remarks:
 Location cleared for buried services using Cable Avoidance Tool (CAT). Hand inspection pit advanced to 1.20mbgl. No groundwater encountered. Location terminated upon encountering a refusal at 3.00mbgl. Borehole installed with combined groundwater and ground gas monitoring standpipes.


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Phase II Geo-Environmental &
Geotechnical Site Investigation
Land off Jacques Way
Castlemead Group Limited
108157p2r0
November 2019

APPENDIX V

CHEMICAL TESTING RESULTS

**Catarina Lima**

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Analytical Report Number : 19-65900

Replaces Analytical Report Number : 19-65900, issue no. 2

Project / Site name:	Jacques Way, Wrexham	Samples received on:	10/10/2019
Your job number:	108157	Samples instructed on:	14/10/2019
Your order number:		Analysis completed by:	08/11/2019
Report Issue Number:	3	Report issued on:	08/11/2019
Samples Analysed:	6 soil samples		


Signed:

Rachel Bradley

Deputy Quality Manager
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 19-65900-3 Jacques Way, Wrexham 108157

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

Page 1 of 9

Analytical Report Number: 19-65900

Project / Site name: Jacques Way, Wrexham

Lab Sample Number				1330917	1330918	1330919	1330920	1330921
Sample Reference				WS01	WS102	WS103	WS104	TP104
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	0.10	0.40	0.20	0.20
Date Sampled				08/10/2019	08/10/2019	08/10/2019	08/10/2019	09/10/2019
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	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	8.8	9.1	9.3	9.8	11
Total mass of sample received	kg	0.001	NONE	1.2	1.2	1.1	0.85	1.2

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	Chrysotile	Chrysotile	Chrysotile	Chrysotile
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Detected	Detected	Detected	Detected
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos Quantification Total	%	0.001	ISO 17025	-	< 0.001	< 0.001	< 0.001	< 0.001

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.1	8.6	9.2	8.9	8.4
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	1	< 1	< 1
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	80	170	230	170	85
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.040	0.087	0.12	0.087	0.042
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	39.8	86.5	117	87.0	42.3
Organic Matter	%	0.1	MCERTS	3.6	2.5	2.7	3.3	3.9
Fraction Organic Carbon (FOC)	N/A	0.001	MCERTS	0.021	0.015	0.016	0.019	0.022

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	0.25	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	0.22	< 0.05	< 0.05	< 0.05	0.23
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	0.26	< 0.05	< 0.05	0.26
Fluorene	mg/kg	0.05	MCERTS	0.27	0.21	< 0.05	< 0.05	0.23
Phenanthrene	mg/kg	0.05	MCERTS	2.8	2.4	1.7	1.3	2.4
Anthracene	mg/kg	0.05	MCERTS	0.76	0.59	0.52	0.48	0.69
Fluoranthene	mg/kg	0.05	MCERTS	5.4	4.4	4.3	3.9	6.0
Pyrene	mg/kg	0.05	MCERTS	5.3	4.6	4.3	4.1	6.1
Benzo(a)anthracene	mg/kg	0.05	MCERTS	3.3	2.9	2.4	2.2	3.3
Chrysene	mg/kg	0.05	MCERTS	2.5	2.5	2.4	2.2	3.3
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	3.9	3.3	3.5	3.6	4.9
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	2.1	1.5	0.96	1.5	1.5
Benzo(a)pyrene	mg/kg	0.05	MCERTS	3.5	2.8	2.6	3.1	3.9
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	2.0	1.4	1.4	1.9	2.1
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.52	0.43	0.40	0.50	0.52
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	2.6	1.8	1.7	2.5	2.5

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	35.4	29.1	26.2	27.2	37.9
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Analytical Report Number: 19-65900

Project / Site name: Jacques Way, Wrexham

Lab Sample Number	1330917	1330918	1330919	1330920	1330921
Sample Reference	WS01	WS102	WS103	WS104	TP104
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.20	0.10	0.40	0.20	0.20
Date Sampled	08/10/2019	08/10/2019	08/10/2019	08/10/2019	09/10/2019
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

Antimony (aqua regia extractable)	mg/kg	1	ISO 17025	8.1	8.9	12	13	7.1
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	9.9	5.8	18	13	12
Barium (aqua regia extractable)	mg/kg	1	MCERTS	250	260	590	450	290
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.79	0.62	1.0	0.93	1.0
Boron (water soluble)	mg/kg	0.2	MCERTS	1.0	0.9	1.2	0.7	1.4
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	1.7	1.6	2.5	3.0	1.5
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	47	23	70	47	60
Copper (aqua regia extractable)	mg/kg	1	MCERTS	170	75	94	250	110
Lead (aqua regia extractable)	mg/kg	1	MCERTS	280	310	650	440	340
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	1.7	1.8	3.1	2.8	2.6
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	24	18	23	28	24
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	27	21	43	29	28
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	620	410	610	760	560

Monoaromatics & Oxygenates

Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	4.4	< 1.0	< 1.0	5.8	7.5
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	3.6	< 2.0	< 2.0	7.7	17
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	12	< 8.0	< 8.0	16	34
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	110	< 8.0	< 8.0	71	220
TPH-CWG - Aliphatic > EC35 - EC44	mg/kg	8.4	NONE	72	< 8.4	< 8.4	17	110
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	130	< 10	< 10	100	280
TPH-CWG - Aliphatic (EC5 - EC44)	mg/kg	10	NONE	200	< 10	< 10	120	390

TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	3.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	19	18	12	12	39
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	150	41	20	57	180
TPH-CWG - Aromatic > EC35 - EC44	mg/kg	8.4	NONE	290	52	< 8.4	48	140
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	170	58	33	68	220
TPH-CWG - Aromatic (EC5 - EC44)	mg/kg	10	NONE	460	110	33	120	360

Analytical Report Number: 19-65900

Project / Site name: Jacques Way, Wrexham

Lab Sample Number				1330922				
Sample Reference				TP105				
Sample Number				None Supplied				
Depth (m)				0.20				
Date Sampled				09/10/2019				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1				
Moisture Content	%	N/A	NONE	8.5				
Total mass of sample received	kg	0.001	NONE	1.2				

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	8.3				
Total Cyanide	mg/kg	1	MCERTS	< 1				
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	120				
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.059				
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	59.0				
Organic Matter	%	0.1	MCERTS	3.4				
Fraction Organic Carbon (FOC)	N/A	0.001	MCERTS	0.020				

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	< 0.05				
Acenaphthylene	mg/kg	0.05	MCERTS	0.21				
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05				
Fluorene	mg/kg	0.05	MCERTS	0.20				
Phenanthrene	mg/kg	0.05	MCERTS	1.9				
Anthracene	mg/kg	0.05	MCERTS	0.58				
Fluoranthene	mg/kg	0.05	MCERTS	5.4				
Pyrene	mg/kg	0.05	MCERTS	5.7				
Benzo(a)anthracene	mg/kg	0.05	MCERTS	3.4				
Chrysene	mg/kg	0.05	MCERTS	2.9				
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	4.5				
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	2.2				
Benzo(a)pyrene	mg/kg	0.05	MCERTS	4.0				
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	2.5				
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.66				
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	3.0				

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	37.1				
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Analytical Report Number: 19-65900

Project / Site name: Jacques Way, Wrexham

Lab Sample Number				1330922				
Sample Reference				TP105				
Sample Number				None Supplied				
Depth (m)				0.20				
Date Sampled				09/10/2019				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Heavy Metals / Metalloids								
Antimony (aqua regia extractable)	mg/kg	1	ISO 17025	7.7				
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	13				
Barium (aqua regia extractable)	mg/kg	1	MCERTS	320				
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.67				
Boron (water soluble)	mg/kg	0.2	MCERTS	1.0				
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	1.9				
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2				
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	39				
Copper (aqua regia extractable)	mg/kg	1	MCERTS	130				
Lead (aqua regia extractable)	mg/kg	1	MCERTS	500				
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	4.3				
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	23				
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0				
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	24				
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	650				

Monoaromatics & Oxygenates

Benzene	µg/kg	1	MCERTS	< 1.0				
Toluene	µg/kg	1	MCERTS	< 1.0				
Ethylbenzene	µg/kg	1	MCERTS	< 1.0				
p & m-xylene	µg/kg	1	MCERTS	< 1.0				
o-xylene	µg/kg	1	MCERTS	< 1.0				
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0				

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001				
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001				
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001				
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	6.2				
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	19				
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	32				
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	270				
TPH-CWG - Aliphatic > EC35 - EC44	mg/kg	8.4	NONE	170				
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	330				
TPH-CWG - Aliphatic (EC5 - EC44)	mg/kg	10	NONE	500				
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001				
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001				
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001				
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	3.1				
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	7.0				
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	45				
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	340				
TPH-CWG - Aromatic > EC35 - EC44	mg/kg	8.4	NONE	390				
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	390				
TPH-CWG - Aromatic (EC5 - EC44)	mg/kg	10	NONE	780				



Analytical Report Number: **19-65900**
Project / Site name: **Jacques Way, Wrexham**
Your Order No:

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
1330918	WS102	0.10	122	Loose Fibres	Chrysotile	< 0.001	< 0.001
1330919	WS103	0.40	126	Loose Fibres	Chrysotile	< 0.001	< 0.001
1330920	WS104	0.20	132	Loose Fibres	Chrysotile	< 0.001	< 0.001
1330921	TP104	0.20	129	Loose Fibres	Chrysotile	< 0.001	< 0.001
1330922	TP105	0.20	134	Loose Fibres	Chrysotile	< 0.001	< 0.001

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

Analytical Report Number : 19-65900

Project / Site name: Jacques Way, Wrexham

* 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 *
1330917	WS01	None Supplied	0.20	Brown loam and sand with gravel and vegetation.
1330918	WS102	None Supplied	0.10	Brown loam and sand with gravel and brick.
1330919	WS103	None Supplied	0.40	Brown loam and sand with rubble and brick.
1330920	WS104	None Supplied	0.20	Brown loam and sand with gravel.
1330921	TP104	None Supplied	0.20	Brown loam and sand with gravel and vegetation.
1330922	TP105	None Supplied	0.20	Brown loam and sand with gravel and vegetation.

Analytical Report Number : 19-65900

Project / Site name: Jacques Way, Wrexham

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
Fraction of Organic Carbon in soil	Determination of fraction of organic carbon 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
Hexavalent chromium in soil (Lower Level)	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphénylcarbazine followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In-house method based on BS1377 Part 2, 1990, Classification 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
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	BS1377 Part 3, 1990, Chemical and Electrochemical Tests"	L009-PL	D	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
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
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	NONE
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

Iss No 19-65900-3 Jacques Way, Wrexham 108157

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

Page 8 of 9



Analytical Report Number : 19-65900

Project / Site name: Jacques Way, Wrexham

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
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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.



Phase II Geo-Environmental &
Geotechnical Site Investigation
Land off Jacques Way
Castlemead Group Limited
108157p2r0
November 2019

APPENDIX VI

GEOTECHNICAL TESTING RESULTS



LABORATORY REPORT



4043

Contract Number: PSL19/6431

Report Date: 19 November 2019

Client's Reference: 108157

Client Name: REC Manchester
Osprey House
Pacific Quay
Broadway
Manchester
M50 2UE

For the attention of: Catarina Lima

Contract Title: Jacques Way, Wrexham

Date Received: 23/10/2019

Date Commenced: 23/10/2019

Date Completed: 19/11/2019

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson
(Director)

S Royle
(Laboratory Manager)

A Watkins
(Director)

S Eyre
(Senior Technician)

R Berriman
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Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

[illegible]

PSL
Professional Soils Laboratory

Jacques Way, Wrexham

Contract No:

PSL19/6431

Client Ref:

108157

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

[illegible]

SYMBOLS : NP : Non Plastic

*** : Liquid Limit and Plastic Limit Wet Sieved.**



4043

PSL
Professional Soils Laboratory

Jacques Way, Wrexham

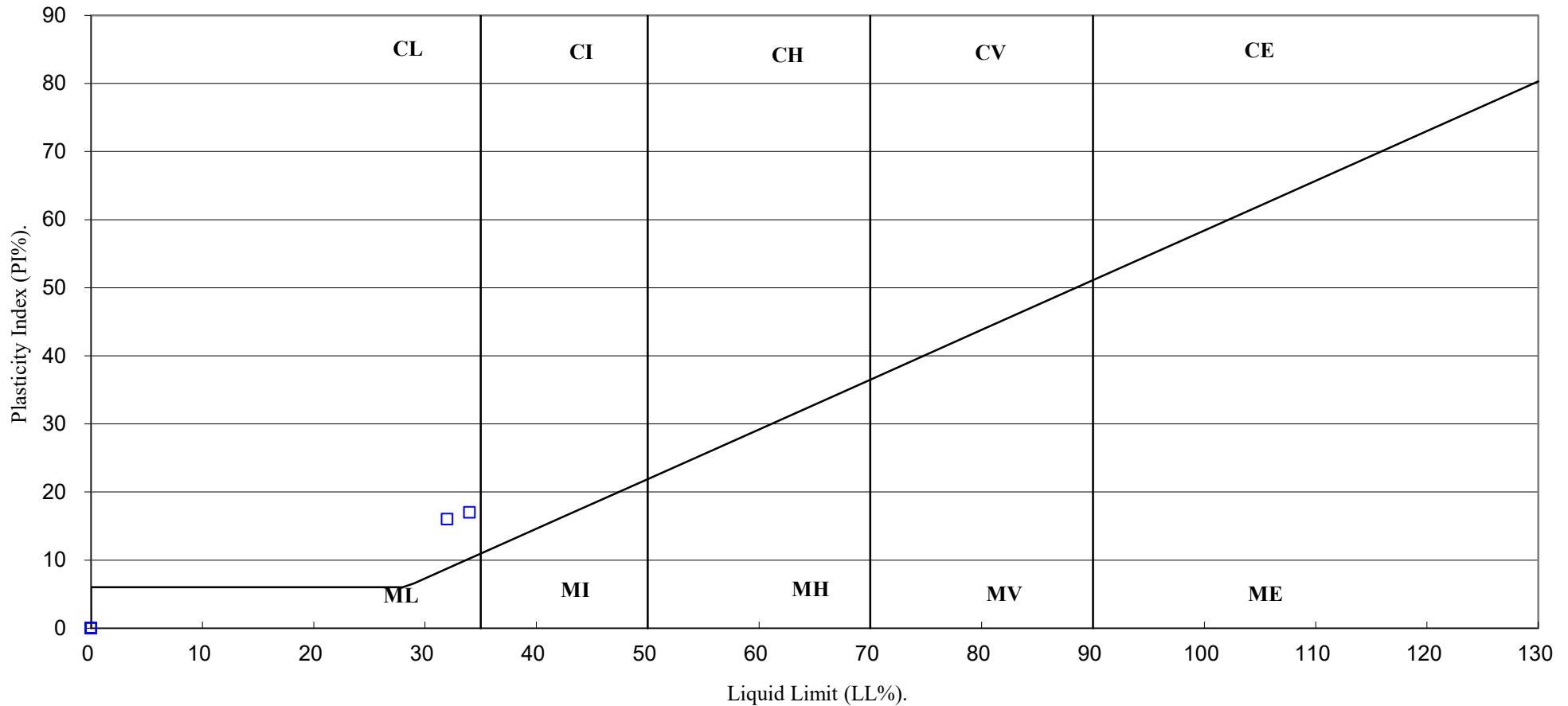
Contract No:

PSL19/6431

Client Ref:

108157

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



4043

PSL

Professional Soils Laboratory

Jacques Way, Wrexham

Contract No:

PSL19/6431

Client Ref:

108157

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

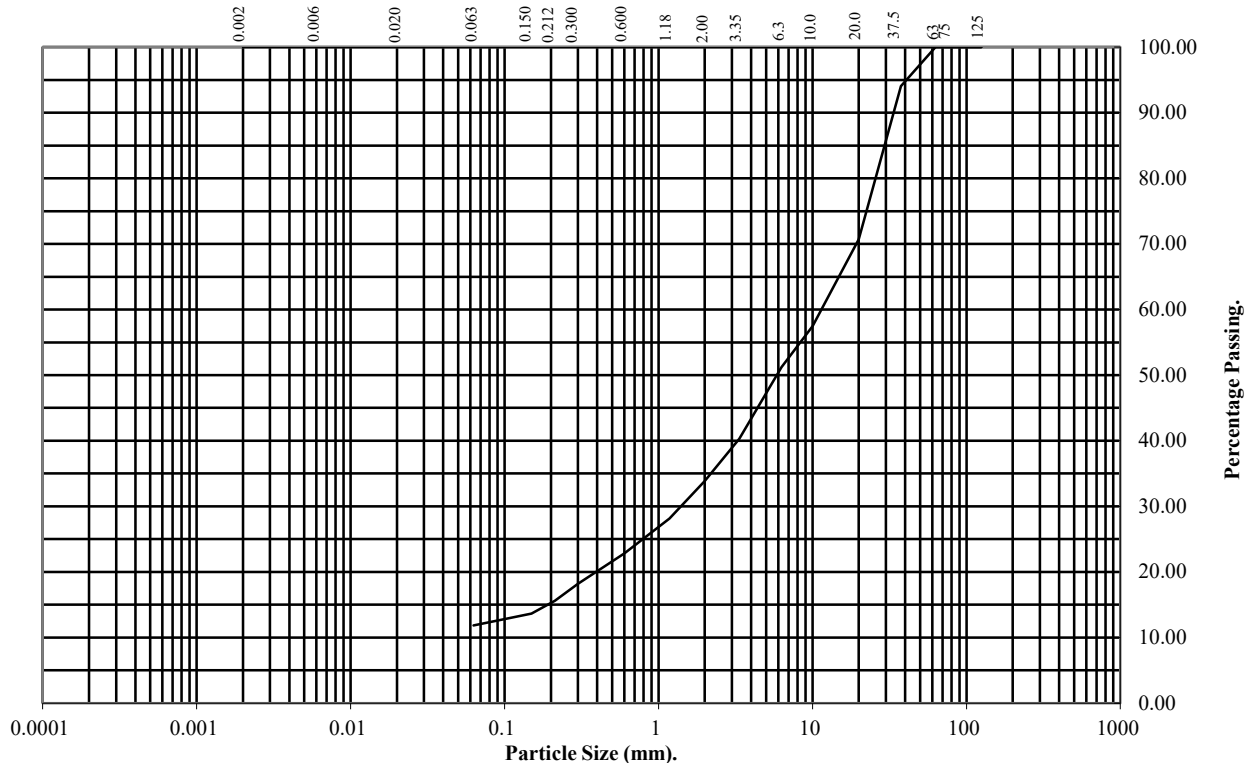
Hole Number: CP101

Top Depth (m): 6.00

Sample Number:

Base Depth(m):

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	94
20	71
10	57
6.3	51
3.35	40
2	34
1.18	28
0.6	23
0.3	18
0.212	16
0.15	14
0.063	12

Soil Fraction	Total Percentage
Cobbles	0
Gravel	66
Sand	22
Silt/Clay	12

Remarks:

See Summary of Soil Descriptions



PSL
Professional Soils Laboratory

Jacques Way, Wrexham

Contract No:
PSL19/6431
Client Ref:
108157

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:

CP102

Top Depth (m):

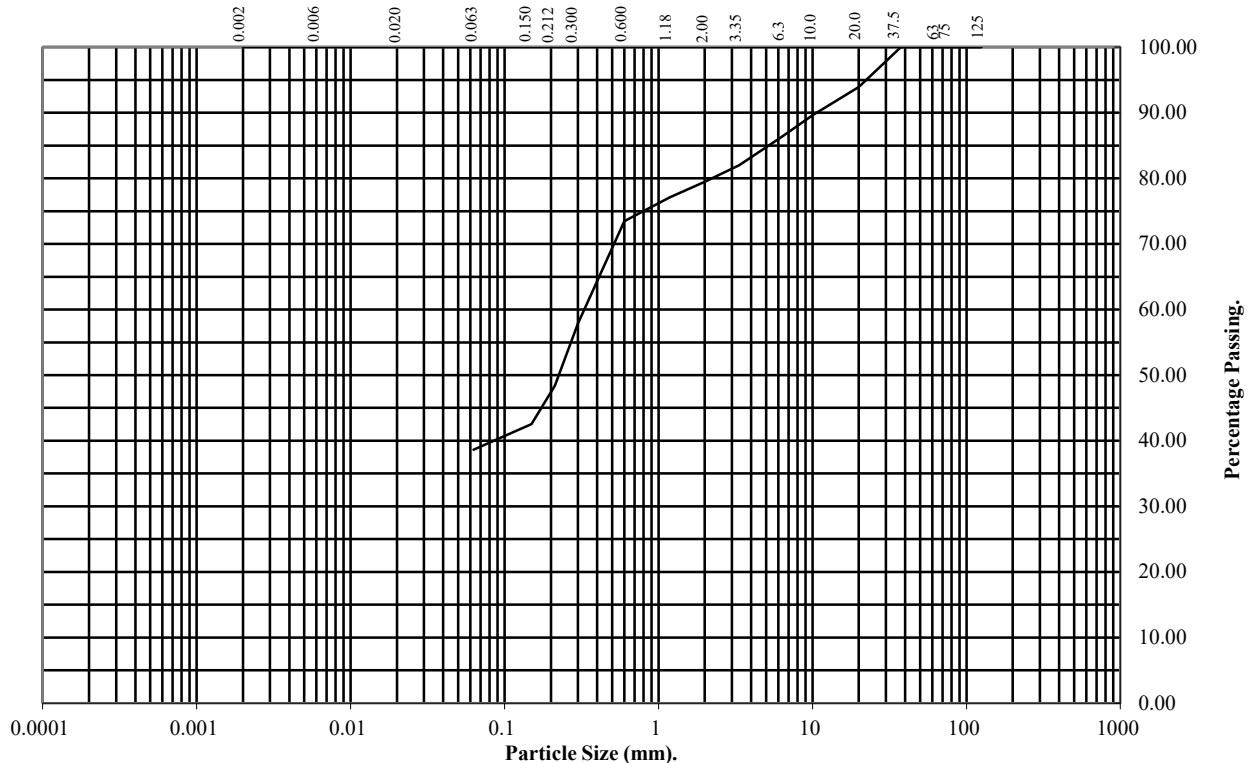
10.00

Sample Number:

Base Depth(m):

Sample Type:

B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	94
10	90
6.3	86
3.35	82
2	79
1.18	77
0.6	73
0.3	58
0.212	48
0.15	43
0.063	39

Soil Fraction	Total Percentage
Cobbles	0
Gravel	21
Sand	40
Silt/Clay	39

Remarks:

See Summary of Soil Descriptions



PSL
Professional Soils Laboratory

Jacques Way, Wrexham

Contract No:

PSL19/6431

Client Ref:

108157

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:

CP103

Top Depth (m):

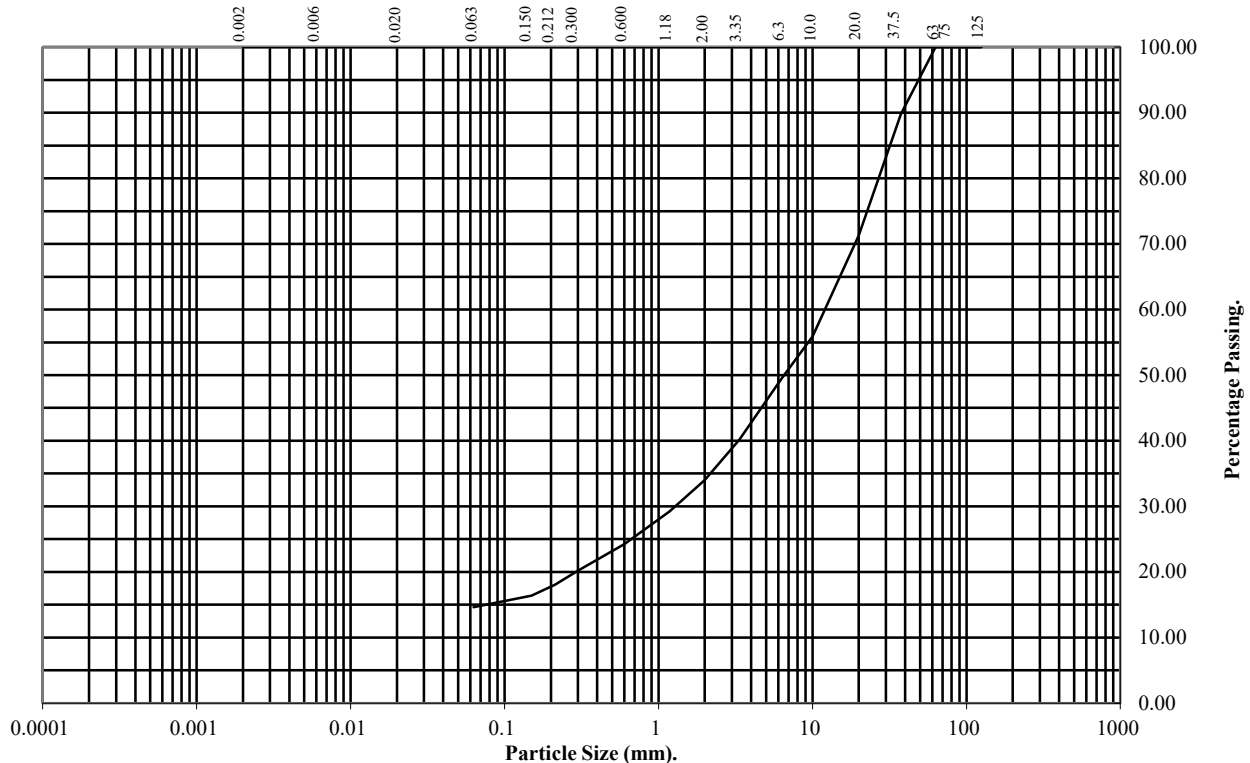
6.00

Sample Number:

Base Depth(m):

Sample Type:

B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	90
20	71
10	56
6.3	49
3.35	40
2	34
1.18	29
0.6	24
0.3	20
0.212	18
0.15	16
0.063	15

Soil Fraction	Total Percentage
Cobbles	0
Gravel	66
Sand	19
Silt/Clay	15

Remarks:

See Summary of Soil Descriptions



PSL
Professional Soils Laboratory

Jacques Way, Wrexham

Contract No:

PSL19/6431

Client Ref:

108157

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

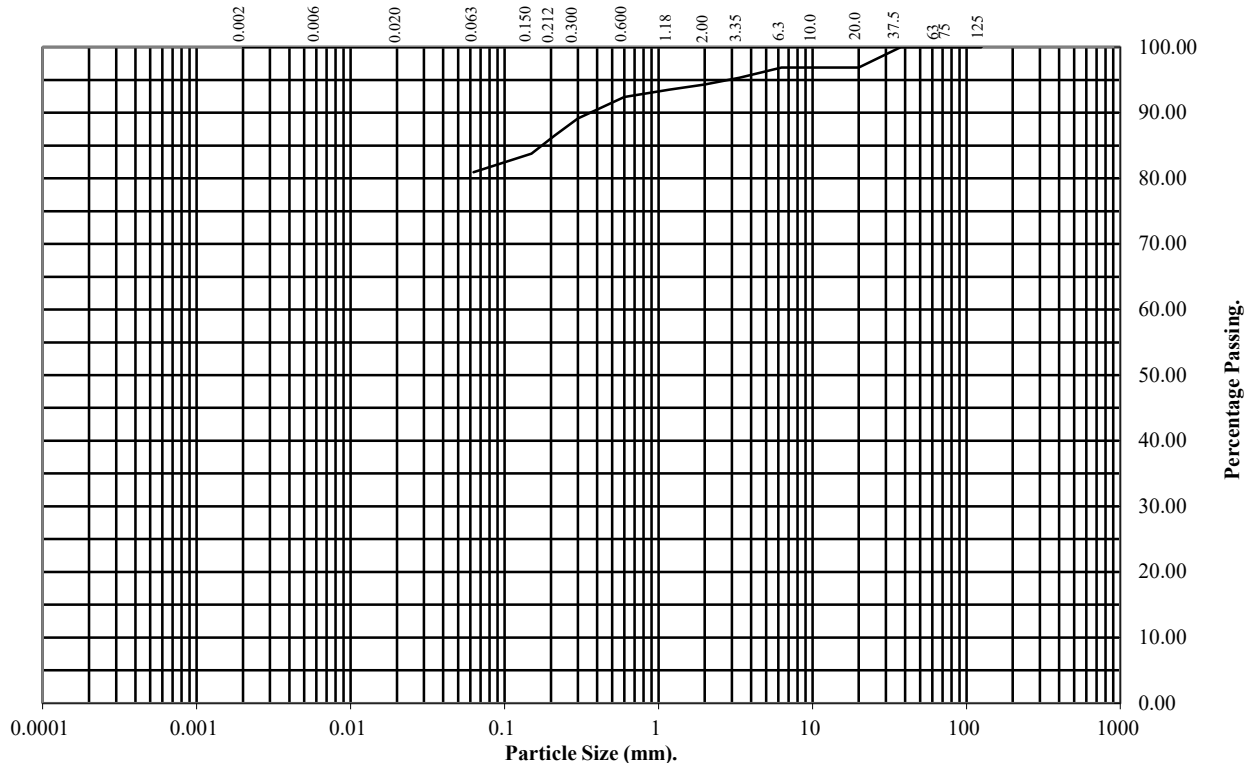
Hole Number: CP103

Top Depth (m): 15.00

Sample Number:

Base Depth(m):

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	97
10	97
6.3	97
3.35	95
2	94
1.18	94
0.6	92
0.3	89
0.212	87
0.15	84
0.063	81

Soil Fraction	Total Percentage
Cobbles	0
Gravel	6
Sand	13
Silt/Clay	81

Remarks:

See Summary of Soil Descriptions



PSL
Professional Soils Laboratory

Jacques Way, Wrexham

Contract No:
PSL19/6431
Client Ref:
108157



Certificate of Analysis

Certificate Number 19-22559

12-Nov-19

Client Professional Soils Laboratory Ltd
5/7 Hexthorpe Road
Hexthorpe
DN4 0AR

Our Reference 19-22559

Client Reference PSL19/6431

Order No (not supplied)

Contract Title Jacques Way Wrexham

Description 4 Soil samples.

Date Received 07-Nov-19

Date Started 07-Nov-19

Date Completed 12-Nov-19

Test Procedures Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Adam Fenwick
Contracts Manager



Summary of Chemical Analysis

Soil Samples

Our Ref 19-22559

Client Ref PSL19/6431

Contract Title Jacques Way Wrexham

Lab No	1593855	1593856	1593857	1593858
Sample ID	CP101	CP102	CP103	CP103
Depth	5.00	10.50-10.95	15.00-15.45	19.50
Other ID				
Sample Type	D	D	D	D
Sampling Date	05/11/19	05/11/19	05/11/19	05/11/19
Sampling Time	n/s	n/s	n/s	n/s

Test	Method	LOD	Units				
Inorganics							
pH	DETSC 2008#		pH	8.7	8.0	8.3	8.6
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	110	66	52	34

Information in Support of the Analytical Results

Our Ref 19-22559
 Client Ref PSL19/6431
 Contract Jacques Way Wrexham

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1593855	CP101 5.00 SOIL	05/11/19	PT 500ml		
1593856	CP102 10.50-10.95 SOIL	05/11/19	PT 500ml		
1593857	CP103 15.00-15.45 SOIL	05/11/19	PT 500ml		
1593858	CP103 19.50 SOIL	05/11/19	PT 500ml		

Key: P-Plastic T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months



Phase II Geo-Environmental &
Geotechnical Site Investigation
Land off Jacques Way
Castlemead Group Limited
108157p2r0
November 2019

APPENDIX VII

PHOTOGRAPHS



Plate 1: Trial Pit 1 – head of pit



Plate 2: Trial Pit 1 – spoil



Plate 3: Trial Pit 1 – side of pit



Plate 4: Trial Pit 2 – head of pit



Plate 5: Trial Pit 2 – spoil



Plate 6: Trial Pit 2 – spoil



Plate 7: Trial Pit 3 – head of pit



Plate 8: Trial Pit 3 – spoil



Plate 9: Trial Pit 4 – side of pit



Plate 10: Trial Pit 4 – head of pit



Plate 11: Trial Pit 4 – side of pit



Plate 12: Trial Pit 5 – head of pit



Plate 13: Trial Pit 5 – spoil



Plate 14: Trial Pit 5 – side of pit



Phase II Geo-Environmental &
Geotechnical Site Investigation
Land off Jacques Way
Castlemead Group Limited
108157p2r0
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APPENDIX VIII

SOAKAWAY CALCULATIONS

		Site Jacques Way		Trial Pit Number..... TP105	
		Job Number 108157		Length..... 2.40 m	
		Date of Test 10/10/2019		Width..... 0.70 m	
				Depth..... 3.00 m	
				Groundwater Level..... Not encountered m	
Remarks - Test completed during the day. Ground description 0.00-2.80 Dark brown very gravelly SAND 2.80-3.00 Brown sandy gravelly CLAY	TEST 1		TEST 2		TEST 3
	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min) Depth to Water (m)
	0	2.03			
	1	2.06			
	2	2.10			
	3	2.11			
	4	2.12			
	5	2.13			
	6	2.13			
	7	2.14			
	8	2.15			
	9	2.16			
	10	2.17			
	11	2.30			
	12	2.60			
	13	2.91			
	14	3.00			
Effective Storage Depth	m	0.97			
75% Effective Storage Depth	m	0.73			
(i.e. depth below GL)	m	2.27			
25% Effective Storage Depth	m	0.24			
(i.e. depth below GL)	m	2.76			
Effective Storage Depth 75%-25%	m	0.49			
Time to fall to 75% effective depth	mins	11.00			
Time to fall to 25% effective depth	mins	12.50			
V (75%-25%)	m3	0.81			
a (50%)	m2	4.69			
t (75%-25%)	mins	1.50			
SOIL INFILTRATION RATE	m/s	1.93E-03	-	-	-

DESIGN SOIL INFILTRATION RATE, f	1.93E-03
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