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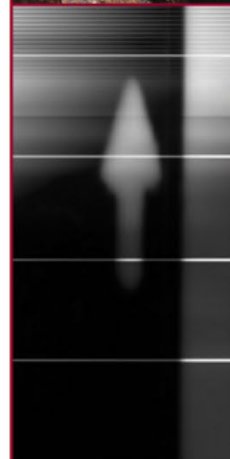
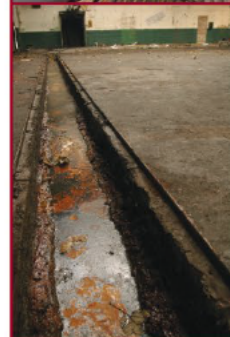
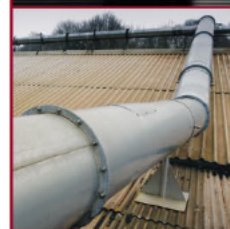
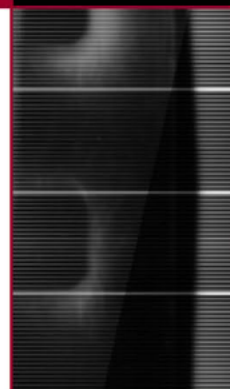
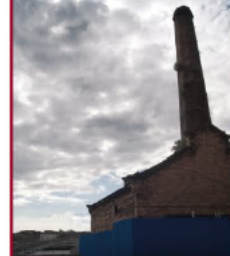


**PHASE II
GEOENVIRONMENTAL ASSESSMENT**

**AREA B2
OVERTON-ON-DEE, WREXHAM**

Report No: 19148/3
Date: September 2019

Prepared for
PICKSTOCK HOMES LIMITED



Innovative Land Development Solutions

**PROJECT QUALITY ASSURANCE
INFORMATION SHEET**

**PHASE II
GEOENVIRONMENTAL ASSESSMENT**

**AREA B2
OVERTON-ON-DEE, WREXHAM**

Report Status:	Final
Report No:	19148/3
Issue Date:	September 2019
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EXECUTIVE SUMMARY

PHASE II GEOENVIRONMENTAL ASSESSMENT

AREA B2 OVERTON-ON-DEE, WREXHAM

Georisk Management Limited has been commissioned to carry out a Phase II Geoenvironmental Assessment of the above site which is being considered for residential development.

Phase I	Comments
Phase I	For Phase I Desk Study information, reference should be made to Georisk Report reference 19148/1 dated August 2019.
Phase II	Comments
Ground Conditions	Topsoil was encountered across the site to depths of between 0.1 and 0.4 m begl and generally consisted of a dark brown slightly silty to silty slightly gravelly sandy material with the gravel content being quartzite and mudstone. Subsoil was encountered beneath the topsoil to depths of between 0.4 and 0.75 m begl and was described as brown locally slightly clayey slightly gravelly sand/silt. Glaciofluvial Deposits were recorded beneath the topsoil/subsoil to a maximum penetrated depth of 5.0 m begl. These typically comprised light brown and grey loose to medium dense locally slightly clayey locally slightly silty locally slightly gravelly sand with secondary thin bands of clay recorded from 0.4 to 0.95 m begl in TP6 and from 0.55 to 0.8 m begl in WS12.
Groundwater	During the fieldwork, groundwater was not encountered in the trial pits or boreholes; however, 'running sand' was recorded at 2.9 m begl in TP11. Monitoring standpipes of installed in WS1 and WS5 has recorded standing water levels between 1.7 and 2.0 m begl.
Contamination	No visual or olfactory evidence of potential significant contamination was observed during the site investigation.
Soil-Gas	No methane was recorded in the borehole installations during the monitoring carried out and steady state carbon dioxide levels range from 1.6 to 4.4 % by volume (v/v). A maximum positive gas flow of 0.1 l/hr was recorded and ambient atmospheric pressures ranged from 997 to 1017 mb during the monitoring programme.
Environmental Assessment	Comments
Soil Contamination	All test results for the contaminants of concern are below the relevant C4SL/S4UL/SSV.
Risk Evaluation: Human Health	No remediation is considered necessary for the proposed development at the site. Site-won topsoil should be retained in all gardens and areas of soft landscaping to provide a clean growing medium. During site preparation works, all topsoil should be stripped, stockpiled separately for future re-use and tested to ensure compliance with BS:3882 (2015).
Risk Evaluation: Soil-Gas	Gas protection not considered necessary for the proposed development.
Statutory Consultation	This report should be submitted for approval to the Local Authority and NHBC in advance of any development works starting on site.

Geotechnical Assessment	Comments
Foundations	This investigation has identified topsoil and subsoil overlying Glaciofluvial Deposits that typically comprise loose and medium dense sand to a depth of 4.0 m begl. Groundwater monitoring has recorded standing groundwater levels of between 1.7 and 2.0 m begl. Given the presence of near-surface loose granular material to a depth of 4.0 m begl across much of the site, traditional spread foundations are not considered viable for the proposed type of and consideration will need to be given to an abnormal foundation solution. Ground improvement with vibro-stone columns to facilitate the use of a reinforced footing could be considered subject to agreement with specialist contractors. This technique could 'improve' the bearing capacity of the near-surface soil to around 125 to 150 kN/m². As the loose Glaciofluvial Deposits are no more than 4.0 m thick, this technique could be viable as full depth treatment of the near-surface soil could be achieved. Piling is another potential option; however, discussions would need to be held with specialist contractors to determine the most suitable pile design and the piling scheme. As the load bearing characteristics of piles are dependent upon the type of pile used, method of installation, construction and workmanship, it is recommended that detailed discussions are held with suitably experienced piling contractors prior to finalising design. Further ground investigation comprising deeper cable percussive boreholes may be required for pile design purposes. The bulk of the Glaciofluvial Deposits are granular and considered to be non-shrinkable and; therefore, tree influence would not be of concern. Thin bands of clay in the Glaciofluvial Deposits were recorded at shallow depth in TP6 and WS6. There are mature trees and hedgerows along the boundaries and, where clay is present at formation level, foundations may need to be deepened and heave protection measures adopted in accordance with NHBC Standards Chapter 4.2 'Building Near Trees'. These aspects should be considered further at detailed design stage and a detailed tree/hedgerow survey will be required to assist with foundation design.
Floor Slabs	Based on the ground conditions encountered and to comply with NHBC guidance on soil-gas risk, the use of a suspended floor slab design (cast in situ or 'beam and block' with underfloor void) is recommended.
Pavement Design	Final road and pavement levels to be adopted are not known at this stage, however, for preliminary design purposes a long term CBR value of 2 % (based on average construction conditions) could be assumed for the near-surface Glaciofluvial Deposits. The proposed formation should be proof rolled and caution would need to be exercised to ensure that any soft/loose areas within the formation are excavated and filled with suitably compacted granular fill. Once road alignments and levels have been finalised, in situ CBR tests should be undertaken to allow detailed design of road formations to be made.
Buried Concrete	A Design Sulphate Class of DS-1 and an ACEC class of AC-1 apply at the site.
Dewatering	Based on the findings of this investigation, significant groundwater ingress is unlikely in temporary shallow excavations; however, it is envisaged that any such ingress should be controllable by sump pumping.
Excavations	Conventional mechanical excavation should prove suitable through the near-surface soil profile. It should be noted that collapse of trial pit sides was encountered across the site and; therefore, instability of deep and open excavations should be anticipated and; therefore, trench support should be allowed for.
Soakaways	Infiltration testing was carried out in general accordance with BRE:365 (2016) in TP9 to assess the potential use of soakaway drainage at the site. There was insufficient infiltration recorded to calculate a soil permeability value in strict accordance with BRE:365; however, by extrapolating the results, an approximate value of $2 \times 10^{-6} \text{ ms}^{-1}$ has been calculated. These results and the relatively consistent ground conditions recorded across the site suggest that the use of soakaway drainage could be viable; however, it would be prudent to carry out further tests targeting specific areas where soakaway drains are proposed.
Additional Work	Comments
Various	Issue report to all appropriate regulators for comment and approval prior to any development works starting on site.

The above summary is intended for reference purposes only and specific details should be obtained by reading the entire report.

FOREWORD

This report has been prepared for the sole internal use and reliance of the Client(s) named on the Project Quality Assurance Information Sheet. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Georisk Management Ltd (Georisk). If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

The report should be read in its entirety, including all associated drawings and appendices. Georisk cannot be held responsible for any misinterpretations arising from the use of extracts that are taken out of context.

The findings and opinions conveyed in this report are based on information obtained from a variety of sources as detailed within this report and which Georisk believes is reliable. All reasonable care and skill has been applied in examining the information obtained, nevertheless, Georisk cannot and does not guarantee the authenticity or reliability of the information it has relied upon.

The report represents the findings and opinions of experienced geoenvironmental consultants. Georisk does not provide legal advice and the advice of lawyers may also be required.

Any recommendations made or opinions expressed in the Report are based on the exploratory hole records, an examination of samples and the results of the site and laboratory tests. No liability can be accepted for conditions not revealed by the exploratory holes particularly between positions. Whilst every effort is made to ensure accuracy of data supplied any opinion expressed as to the possible configuration of strata between or below investigation locations is for guidance only and no responsibility is accepted as to its accuracy.

Unless otherwise specifically stated, this report assumes that ground levels will not change significantly from those existing at present and that the proposed development will be of three storey construction. If this is not to be the case, some modifications to this report may be required.

The groundwater conditions entered on the borehole records and from any monitoring programme are those observed at the time of the investigation. Groundwater levels are susceptible to seasonal fluctuations and may be higher during wetter periods than those encountered during this investigation.

Where the report refers to the potential presence of invasive plant species, such as Japanese Knotweed, or the presence of possible asbestos containing materials, it should be noted that the observations are for information purposes only and should be verified by a suitably qualified expert.

Georisk reserves the right to amend the conclusions and recommendations made in this report in the light of any further or more detailed information that may become available.

**PHASE II
GEOENVIRONMENTAL ASSESSMENT**

**AREA B2
OVERTON-ON-DEE, WREXHAM**

1. INTRODUCTION

- 1.1 Georisk Management Limited (Georisk) has been instructed by Pickstock Homes Limited (Pickstock) to carry out a Phase II Geoenvironmental Assessment of a parcel of land, known as Area B2, to the east of St Mary's Avenue in Overton-on-Dee near Wrexham. The work was carried out in accordance with Georisk's offer letter reference 19021/LO.002/AMG dated 17 June 2019.
- 1.2 A Phase I Desk Study has been prepared by Georisk, report reference 19148/1 dated August 2019. This provides an Initial Conceptual Model for the site and provides recommendations for a subsequent intrusive site investigation. The Phase I Report should be referred to for background and supporting information.
- 1.3 It is understood that the site is being considered for residential development and; therefore, the principal aims of this subsequent Phase II assessment are as follows:
- to determine the prevalent ground and groundwater conditions at the site;
 - to provide an assessment of the concentrations of a range of potential contaminants of concern within the near surface soils, including Phase II evaluation of risk to human health and environmental receptors;
 - to identify any potential geoenvironmental constraints or opportunities associated with the development of the site for a residential end use;
 - to provide geotechnical design recommendations for the proposed development scheme.
- 1.4 This report presents the factual data obtained from the programme of fieldwork, monitoring and laboratory testing implemented by Georisk, together with an assessment of the contamination status of the near surface soils and general engineering considerations for the proposed development scheme.

2. INFORMATION SOURCES

- 2.1 The information sources used in the production of this report were as follows:
- background information contained in Georisk Phase I Desk Study, report reference 19148/1, dated August 2019;
 - information gained with respect to the ground and groundwater conditions established in the programme of fieldwork and monitoring carried out by Georisk;
 - appraisal of laboratory data resulting from chemical and geotechnical testing scheduled by Georisk;
 - 'Site Location Plan' by J-Ross Developments Limited, drawing No. 1522_F_GA_01, dated November 2015;
 - topographical survey of the site by Battlefield Surveys Limited, reference 11793 dated July 2019.

3. REFERENCE SOURCES

3.1 This report has been prepared with regard to the following sources of reference and guidance:

- *Investigation of Potentially Contaminated Sites – Code of Practice. British Standards Institute BS10175 (2011);*
- *Code of Practice for Site Investigations. BS5930 (2015);*
- *The LQM/CIEH S4ULs for Human Health Risk Assessment; CIEH/LQM (2015);*
- *Human health toxicological assessment of contaminants in soil. Science Report SC050021/SR2 EA (2009);*
- *Updated technical background to the CLEA Model. Science Report SC050021/SR3 EA (2009);*
- *Model Procedures for the Management of Land Contamination. CLR11, DEFRA and EA (2004);*
- *Guidance on Comparing Soil Contamination Data with a Critical Concentration. CIEH and CL:AIRE (2008);*
- *Guidance for the Safe Development of Housing on Land Affected by Contamination. R & D Publication 66, NHBC, Environment Agency and CIEH (2008);*
- *Concrete in Aggressive Ground. BRE Special Digest 1: Part 1 Assessing the aggressive chemical environment. Building Research Establishment (2005);*
- *Code of practice for the characterization and remediation from ground gas in affected developments. BS8485 (2015+A1:2019);*
- *Guidance on Evaluation of Development Proposals on sites where Methane and Carbon Dioxide are Present. NHBC report Edition No. 4 (2007);*
- *Assessing Risks Posed by Hazardous Ground Gases to Buildings. CIRIA Report C665 (2006);*
- *Site preparation and resistance to moisture. The Building Regulations 2000 Approved Document C (2004 edition);*
- *Specification for topsoil requirements for use (BS 3882:2015);*
- *NHBC Standards (2017).*

4. THE SITE

- 4.1 The site comprises land to the east of Overton-on-Dee and can be located approximately by National Grid Reference 337611, 341755. The general site layout is indicated on Drawing No. 19148/3, entitled 'Exploratory Hole Location Plan', included in Appendix A and on the satellite image presented overleaf.
- 4.2 Area B2 comprises a parcel of undeveloped agricultural land with the site boundaries formed by mature trees and hedgerows.
- 4.3 It is bound by a school and existing housing to the west, north-west and south with undeveloped agricultural land to the north-east and east.
- 4.4 No visual evidence of potential significant contamination was observed during the site visit.



5. FIELDWORK, MONITORING AND LABORATORY TESTING

5.1 Fieldwork

5.1.1 The fieldwork was carried out on 25 and 26 July 2019 and comprised the following elements:

- 7 No. dynamic sampling boreholes, designated WS6 to WS12, put down to a maximum depth of 5.0 m below existing ground level (begl);
- in-situ Standard Penetration Tests (SPT) in WS6 to WS12;
- construction of 50 mm diameter combined soil-gas and groundwater monitoring wells in WS7 and WS11;
- 7 No. trial pits, designated TP6 to TP12, excavated by JCB 3CX to a maximum depth of 2.95 m begl;
- infiltration testing carried out in general accordance with BRE:365 (2016) in TP9.

5.1.2 The fieldwork was supervised by Georisk. All soil description and sample logging was carried out in general accordance with BS 5930 (2015) and the exploratory hole records are presented in Appendix B.

5.1.3 The positions of the exploratory holes were set out by Georisk and the locations are shown on the Exploratory Hole Location Plan included as Drawing No. 19148/3 in Appendix A.

5.1.4 Small disturbed samples were recovered from the exploratory holes as necessary to facilitate sample description and for subsequent laboratory testing.

- 5.1.5 Observations of groundwater encountered during the fieldwork are included on the relevant exploratory hole records included in Appendix B.
- 5.1.6 Infiltration testing was carried out in TP9 in general accordance with BRE:365 (2016). The test results are presented in Appendix C and discussed in Section 9.

5.2 Soil-Gas and Groundwater Monitoring

- 5.2.1 Combined soil-gas and groundwater monitoring installations were constructed in WS7 and WS11 as shown on the exploratory hole records included in Appendix B. Monitoring has been carried out on three occasions between 6 August and 3 September 2019 and the following measurements were taken in sequence:

- atmospheric pressure (mb);
- relative pressure (mb);
- flow monitoring (l/hr);
- measurement of CO₂, CH₄ and O₂ gas concentrations (% by volume; v/v);
- groundwater level; m below existing ground level (m begl).

- 5.2.2 The results of the soil-gas and groundwater monitoring are presented in Appendix D and discussed in Section 8.

5.3 Chemical Testing

- 5.3.1 A programme of chemical testing was scheduled by Georisk on selected soil samples retrieved from the exploratory holes. The testing was carried out at an independent UKAS accredited laboratory for the potential contaminants of concern as identified in Georisk Phase I Desk Study Report. The chemical test results are presented in Appendix E.

5.4 Geotechnical Testing

- 5.4.1 Routine geotechnical testing comprising moisture content and Atterberg Limit determinations were carried out on selected samples. The testing was carried out in accordance with BS1377 (1990) at an independent UKAS accredited laboratory and the results are presented in Appendix F.

6. GROUND AND GROUNDWATER CONDITIONS

Full details of the ground conditions encountered by Georisk are presented on the exploratory hole records included in Appendix B; however, a summary is presented in the following sections.

6.1 Topsoil and Subsoil

- 6.1.1 Topsoil was encountered across the site to depths of between 0.1 and 0.4 m begl and generally consisted of a dark brown slightly silty to silty slightly gravelly sandy material with the gravel content being quartzite and mudstone.
- 6.1.2 Subsoil was encountered beneath the topsoil to depths of between 0.4 and 0.75 m begl and was described as brown locally slightly clayey slightly gravelly sand/silt.

6.2 Glaciofluvial Deposits

- 6.2.1 Glaciofluvial Deposits were recorded beneath the topsoil/subsoil to a maximum penetrated depth of 5.0 m begl.
- 6.2.2 These deposits typically comprised light brown and grey loose to medium dense locally slightly clayey locally slightly silty locally slightly gravelly sand with secondary thin bands of clay recorded from 0.4 to 0.95 m begl in TP6 and from 0.55 to 0.8 m begl in WS12.
- 6.2.3 The results of 32 No. Standard Penetration Tests (SPT) carried out in Glaciofluvial Deposits at depths of between 1.0 and 5.0 m begl returned 'N' values of between 3 and 36, which are summarised in Table 1.

Depth (m begl)	Minimum SPT 'N' value	Maximum SPT 'N' value	Material Description
1.0	6	16	Loose and medium dense SAND
2.0	3	15	Very loose, loose and medium dense SAND
3.0	9	15	Loose and medium dense SAND
4.0	9	30	Loose and medium dense SAND
5.0	12	36	Medium dense SAND

Table 1: Summary of SPT 'N' Values in Glaciofluvial Deposits

- 6.2.4 Three samples of clay Glaciofluvial Deposits were scheduled for Atterberg Limit determinations and natural moisture content tests. The test results are summarised in Table 2 and presented on a Plasticity Chart included as Drawing No. 19148/4 in Appendix A.

Test	Minimum (%)	Maximum (%)
Liquid Limit	26	32
Plastic Limit	14	19
Plasticity Index	12	13
Moisture Content	14	23
Plasticity	Low	-
Volume Change Potential	Low	-

Table 2: Summary of Atterberg Limit Tests on Glaciofluvial Deposits

6.3 Excavation Stability

- 6.3.1 Excavation instability was noted in the following trial pits during the fieldwork:

- TP6: complete collapse of side wall below 0.9 m begl;
- TP7: complete collapse of side wall below 0.9 m begl;
- TP8: side walls collapsed below 1.2 m begl at 2.7 m begl depth;
- TP10: side walls collapsed below 1.1 m begl at 2.9 m begl depth.

6.4 Groundwater

- 6.4.1 During the fieldwork, groundwater was not encountered in the trial pits or boreholes; however, 'running sand' was recorded at 2.9 m begl in TP11.

- 6.4.2 Groundwater monitoring standpipes were installed in WS7 and WS11 and have been monitored on three occasions between 6 August and 3 September 2019. The results of the groundwater monitoring are included in Appendix D and summarised in Table 3.

Exploratory Hole	Standing Groundwater Level (m begl)	
	Shallowest	Deepest
WS7	2.4	3.2
WS11	2.0	2.9

Table 3: Summary of Groundwater Level Monitoring Results

6.5 Soil-Gas

- 6.5.1 The results of the soil-gas monitoring programme are presented in Appendix D and discussed in Section 8 of this report.

6.6 Evidence of Potential Contamination

- 6.6.1 No visual or olfactory evidence of potential significant contamination was observed during the site investigation.

6.7 Development of Conceptual Model

- 6.7.1 Based on the ground and groundwater conditions revealed by the ground investigation carried out and detailed above, the preliminary conceptual model described in Georisk Report No. 19148/1 is representative of the actual site conditions in relation to the proposed development.

7. HUMAN HEALTH RISK ASSESSMENT

7.1 General

- 7.1.1 The UK approach to the assessment of contaminated land is based upon the principles of risk assessment, which is founded on the use of “*source-pathway-target*” principles in order to establish the potential presence of “*pollutant linkage*”. The main legislative driver for dealing with historical land affected by contamination is Part 2A of the Environmental Protection Act 1990. Under Part 2A, land is considered to be contaminated if it is determined that there is a ‘*Significant Possibility of Significant Harm*’ (SPOSH) to human health.
- 7.1.2 Georisk adopts a tiered approach to risk assessment in accordance with current UK guidance and good practice. The initial step of this process, known as Tier 1, is the comparison of site-derived data with relevant guideline levels.
- 7.1.3 Should the adopted criteria be exceeded then two courses of action are available. The first is to break the pollutant linkage by undertaking remedial works such as removing or treating the contaminated soil. Alternatively, a more detailed risk assessment can be carried out to determine whether a contamination risk actually exists.
- 7.1.4 The UK approach to the assessment of human health risk from contaminated land is set out in the CLEA (Contaminated Land Exposure Assessment) framework, which was first published in 2002 by the Department for Environment, Food and Rural Affairs (DEFRA) and the EA. The original guidance was withdrawn and revised guidance issued in 2009, which is set out in the following documents published by the EA:

- *Human health toxicological assessment of contaminants in soil.* Science Report SC050021/SR2;
- *Updated technical background to the CLEA Model.* Science Report SC050021/SR3.

- 7.1.5 The CLEA model uses generic assumptions about the fate and transport of chemicals in the environment and a generic conceptual model for site conditions together with human behaviour to estimate long term human exposure to soil contaminants.
- 7.1.6 Soil Guideline Values (SGV) were derived using the CLEA Model by comparing estimated exposure with 'Health Criteria Values' (HCV) that represent a tolerable risk to health from chronic exposure. SGVs are scientifically based 'generic assessment criteria' that can be used to simplify the assessment of risk to human health from chronic exposure to contaminants in soil. SGVs are a screening tool for the 'generic quantitative risk assessment' of land contamination.
- 7.1.7 Since revised SGVs were developed in 2009, revised Part 2A statutory guidance was then published in 2012. The revised Part 2A statutory guidance introduces a four category system for classifying land under Part 2A for cases of SPOSH to human health. Category 4 applies to land where the level of risk posed is acceptably low. DEFRA appointed CL:AIRE to develop '*Category 4 Screening Levels*' (C4SL), which would provide a simple test for deciding when land is suitable for use and definitely not contaminated. In March 2014, C4SLs were published for a limited number of contaminants.
- 7.1.8 Further to this, Suitable for Use Levels (S4UL) published by the Chartered Institute of Environmental Health (CIEH) and Land Quality Management (LQM) were issued in January 2015. These provide a comprehensive update of previous GAC published by CIEH. The S4UL are derived from the CLEA software produced by the EA and are based upon the concept of either 'tolerable' risk (where the relevant health criteria value is a tolerable daily intake), or 'minimal' risk (where the health criteria is an index dose).
- 7.1.9 The following hierarchy has been adopted by Georisk for determining which assessment criteria to be followed:
- Suitable 4 Use Levels (S4UL) developed by LQM/CIEH (2015);
 - Category 4 Screening Levels (C4SL);
 - Soil Screening Values developed by Atkins AtRisk.

7.2 Human Health Risk Assessment Design

Proposed Development

- 7.2.1 It is understood that the type of development proposed will be housing with private gardens together with hardstanding for access roads and parking.

Assessment Criteria

7.2.2 The assessment criteria used for the screening of contaminants is summarised in Table 4.

Contaminant Group	Determinands	Assessment Criteria Selected
ORGANIC CONTAMINANTS		
Non-halogenated hydrocarbons	Phenol	LQM/CIEH S4UL
Polyaromatic Hydrocarbons (PAH)	USEPA 16 priority compounds	LQM/CIEH S4UL
INORGANIC CONTAMINANTS		
Metals	Lead	C4SL
	Arsenic, Cadmium, Chromium, Copper, Mercury, Nickel, Selenium, Zinc	LQM/CIEH S4UL
Non-metals	Cyanide	Atkins AtRisk Soil Screening Value (SSV)

Table 4: Human Health Risk Assessment Criteria

7.2.3 It should be noted that there is no S4UL for lead and that the SGV for lead has been withdrawn. As such, the only available authoritative published criteria for lead is the DEFRA C4SL. The C4SL for lead is considerably more conservative than the former SGV and is therefore considered appropriate for use.

End Use

7.2.4 In view of the proposed development, a 'residential – with home grown produce' with 1 % soil organic matter content end use conceptual model is considered appropriate for the site.

Statistical Analysis

7.2.5 Given the unbiased nature of the sampling, it is considered appropriate to assess contaminant levels by comparing test results directly with the relevant S4UL, C4SL or SSV.

Contaminants of Concern

7.2.6 The potential contaminants of concern are detailed in Georisk Desk Study Report No. 19148/1 and these contaminants have subsequently been targeted for chemical analysis.

7.3 Generic Quantitative Human Health Risk Assessment

7.3.1 The results of the chemical testing are attached in Appendix E. A summary of those results is included in Table 5.

Contaminant of Concern	Measured Concentration*		Critical Concentration (C4SL/S4UL/SSV*)	Number of test results that exceed C4SL/S4UL/SSV
	Min	Max		
Arsenic	9	16	37	0 (7)
Cadmium	<0.1	0.22	11	0 (7)
Chromium	19	25	910	0 (7)
Copper	5	30	2400	0 (7)
Cyanide	<0.5	-	34	0 (7)
Lead	22	150	200	0 (7)
Mercury	<0.1	0.12	40	0 (7)
Nickel	17	22	130	0 (7)
Phenol	<0.3	-	120	0 (7)
Selenium	<0.2	0.24	250	0 (7)
Zinc	48	87	3700	0 (7)
PAH Compounds				
Acenaphthene	<0.1	-	210	0 (7)
Acenaphthylene	<0.1	-	170	0 (7)
Anthracene	<0.1	0.25	2400	0 (7)
Benzo(a)anthracene	<0.1	0.61	7.2	0 (7)
Benzo(a)pyrene	<0.1	0.29	2.2	0 (7)
Benzo(b)fluoranthene	<0.1	0.68	2.6	0 (7)
Benzo(ghi)perylene	<0.1	-	320	0 (7)
Benzo(k)fluoranthene	<0.1	0.27	77	0 (7)
Chrysene	<0.1	0.44	15	0 (7)
Dibenz(ah)anthracene	<0.1	-	0.24	0 (7)
Fluoranthene	<0.1	2.1	280	0 (7)
Fluorene	<0.1	-	170	0 (7)
Indeno(123-cd) pyrene	<0.1	-	27	0 (7)
Naphthalene	<0.1	-	2.3	0 (7)
Phenanthrene	<0.1	1.2	95	0 (7)
Pyrene	<0.1	2.4	620	0 (7)
* Concentration expressed in mg/kg except where stated.				

Table 5: Summary of Chemical Test Results

- 7.3.2 All test results for the contaminants of concern are below the relevant C4SL/S4UL/SSV.
- 7.3.3 On this basis, no remediation is considered necessary for the proposed development at the site. Site-won topsoil should be retained in all gardens and areas of soft landscaping to provide a clean growing medium. During site preparation works, all topsoil should be stripped, stockpiled separately for future re-use and tested to ensure compliance with BS:3882 (2015).
- 7.3.4 Should any areas of previously unidentified potentially contaminated soil be encountered during construction works, we would recommend consultation with Georisk to ensure that our recommendations continue to apply. Any potentially contaminated soils should be left in situ pending further assessment.
- 7.3.5 During the redevelopment of the site, construction workers are likely to be in direct contact with near-surface soils and appropriate Health and Safety measures will need to be implemented based on the findings of this investigation.
- 7.3.6 It is recommended that a copy of this report is supplied to utility companies and that their recommendations relating to appropriate supply pipes are adhered to.
- 7.3.7 This report should be issued to the Local Authority and NHBC for approval in advance of any irrecoverable development works starting on site.

8. SOIL-GAS RISK ASSESSMENT

8.1 Risk Assessment Protocol

- 8.1.1 Current best practice for the assessment of soil-gas risk to low-rise housing developments is provided in NHBC Report Edition No. 4 entitled *'Guidance on Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are Present'* dated March 2007 and BS8485 (2015+A1:2019) *'Code of practice for the characterization and remediation from ground gas in affected developments'*.
- 8.1.2 The NHBC has derived a series of 'Traffic Lights' to assess soil-gas risk for housing developments. It is a risk-based approach designed to allow design of gas protection for housing development by comparing measured gas emission rates to generic 'Traffic Lights'.
- 8.1.3 The 'Traffic Lights' include 'Typical Maximum Concentrations' provided for initial screening purposes and risk-based Gas Screening Values (GSVs) for considering situations where the 'Typical Maximum Concentrations' are exceeded.
- 8.1.4 The 'Traffic Lights' have been related to appropriate remedial measures, which can be applied to conventional residential developments.

8.2 Monitoring Results

- 8.2.1 Gas monitoring installations were constructed in WS1 and WS5 and have been monitored on three occasions between 6 August and 3 September 2019. The results of the soil-gas monitoring are presented in Appendix D and are summarised in Table 6 (in terms of maximum gas concentrations for methane and steady-state concentrations for carbon dioxide):

Well	Methane Concentrations (% v/v)	Carbon Dioxide Concentrations (% v/v)	Positive Flow Rates (l/hr)	Methane Gas Screening Value (GSV) (l/hr)	Carbon Dioxide Gas Screening Value (GSV) (l/hr)
WS7	0.0	1.6 – 3.6	0.0	n/a	0.0036
WS11	0.0	3.6 – 4.4	0.1	n/a	0.0044

Table 6: Summary of Soil-Gas Monitoring Results

- 8.2.2 No methane was recorded in the borehole installations during the monitoring carried out.
- 8.2.3 Steady state carbon dioxide levels range from 1.6 to 4.4 % by volume (v/v).
- 8.2.4 A maximum positive gas flow of 0.1 l/hr was recorded and ambient atmospheric pressures ranged from 997 to 1017 mb during the monitoring programme.
- ### 8.3 Assessment and Protection Strategy Recommendations
- 8.3.1 For a 'Green' classification, the 'Typical Maximum Concentrations' for methane (1 % v/v) and carbon dioxide (5 % v/v) have not been exceeded.

- 8.3.2 To provide a further detailed level of assessment, Gas Screening Values (GSV) have also been determined (see Table 6 above). The GSV is calculated by multiplying the borehole flow rate and gas concentration (in terms of % v/v) and the GSV is then used to determine the level of gas protection necessary to protect future users of the proposed development. Where no positive gas flow has been recorded, an assumed flow rate of 0.05 l/hr has been used to calculate GSV.
- 8.3.3 From the monitoring results for carbon dioxide, a maximum GSV of 0.0044 l/hr has been calculated. This is significantly below the NHBC GSV of 0.78 l/hr for a 'Green' classification.
- 8.3.4 The GSV's calculated from the monitoring results are indicative of a 'Green' classification and as the 'Typical Maximum Concentrations' for a 'Green' classification have not been exceeded in the boreholes, it is considered appropriate to adopt a 'Green' classification for the proposed residential development at the site. On this basis, no specific gas protection measures are considered necessary, which is supported by the geoenvironmental setting and established ground conditions.
- 8.3.5 In our opinion, no further monitoring is required; however, these recommendations should be agreed with the Local Authority and NHBC in advance of site clearance works commencing.
- 8.3.6 Radon protection is not required for the proposed type of development at the site.

9. ENGINEERING CONSIDERATIONS

9.1 Foundation Design

- 9.1.1 This investigation has identified topsoil and subsoil overlying Glaciofluvial Deposits that typically comprise loose and medium dense sand to a depth of 4.0 m begl.
- 9.1.2 Groundwater monitoring has recorded standing groundwater levels of between 1.7 and 2.0 m begl.
- 9.1.3 Given the presence of near-surface loose granular material to a depth of 4.0 m begl across much of the site, traditional spread foundations are not considered viable for the proposed type of and consideration will need to be given to an abnormal foundation solution.
- 9.1.4 Ground improvement with vibro-stone columns to facilitate the use of a reinforced footing could be considered subject to agreement with specialist contractors. This technique could 'improve' the bearing capacity of the near-surface soil to around 125 to 150 kN/m². As the loose Glaciofluvial Deposits are no more than 4.0 m thick, this technique could be viable as full depth treatment of the near-surface soil could be achieved.
- 9.1.5 Piling is another potential option; however, discussions would need to be held with specialist contractors to determine the most suitable pile design and the piling scheme. As the load bearing characteristics of piles are dependent upon the type of pile used, method of installation, construction and workmanship, it is recommended that detailed discussions are held with suitably experienced piling contractors prior to finalising design. In any event, positive assurances should be sought from the piling contractor in respect of performance and a representative number of piles should be subject to pile loading tests. Further ground investigation comprising deeper cable percussive boreholes may be required for pile design purposes.
- 9.1.6 Vibration control measures may be needed to ensure that pile installation does not impact adjacent buildings.

- 9.1.7 The bulk of the Glaciofluvial Deposits are granular and considered to be non-shrinkable and; therefore, tree influence would not be of concern. As reported in Section 6.2 above, thin bands of clay in the Glaciofluvial Deposits were recorded at shallow depth in TP6 and WS6. There are mature trees and hedgerows along the boundaries and, where clay is present at formation level, foundations may need to be deepened and heave protection measures adopted in accordance with NHBC Standards Chapter 4.2 'Building Near Trees'. These aspects should be considered further at detailed design stage and a detailed tree/hedgerow survey will be required to assist with foundation design.

9.2 Floor Slabs

- 9.2.1 Based on the ground conditions encountered and to comply with NHBC guidance on soil-gas risk, the use of a suspended floor slab design (cast in situ or 'beam and block' with underfloor void) is recommended.

9.3 Buried Concrete Requirements

- 9.3.1 For the near-surface soils, water soluble sulphate testing results (expressed as SO₄ in a 2:1 water:soil extract) are <0.01 to 0.55 g/l with pH values of 5.7 to 7.5. Following the guidance given in the BRE Special Digest 1 (2005) and assuming 'mobile' groundwater conditions for a 'natural ground' site, the Aggressive Chemical Environment for Concrete (ACEC) classification has been determined. These results indicate a Design Sulphate Class of DS-1 and an ACEC class of AC-1 apply at the site.

9.4 Excavations

- 9.4.1 Conventional mechanical excavation should prove suitable through the near-surface soil profile. It should be noted that collapse of trial pit sides was encountered across the site and; therefore, instability of deep and open excavations should be anticipated and; therefore, trench support should be allowed for.
- 9.4.2 Based on the findings of this investigation, significant groundwater ingress is unlikely in temporary shallow excavations; however, it is envisaged that any such ingress should be controllable by sump pumping.

9.5 Road/Pavement Design

- 9.5.1 Final road and pavement levels to be adopted are not known at this stage, however, for preliminary design purposes a long term CBR value of 2 % (based on average construction conditions) could be assumed for the near-surface Glaciofluvial Deposits.
- 9.5.2 The proposed formation should be proof rolled and caution would need to be exercised to ensure that any soft/loose areas within the formation are excavated and filled with suitably compacted granular fill. Once road alignments and levels have been finalised, in situ CBR tests should be undertaken to allow detailed design of road formations to be made.

9.6 Soakaways

9.6.1 Infiltration testing was carried out in general accordance with BRE:365 (2016) in TP9 to assess the potential use of soakaway drainage at the site. The test results are included as Appendix C and also summarised in Table 7.

Test Location	Test Number	Depth of Test (m begl)	Material Type	Soil Infiltration Rate (ms ⁻¹)
TP9	1	0.82 – 1.47	Slightly clayey/silty SAND	2.3x10 ⁻⁶ (extrapolated)
TP9	2	1.70 – 1.15	Slightly clayey/silty SAND	3.0x10 ⁻⁶ (extrapolated)

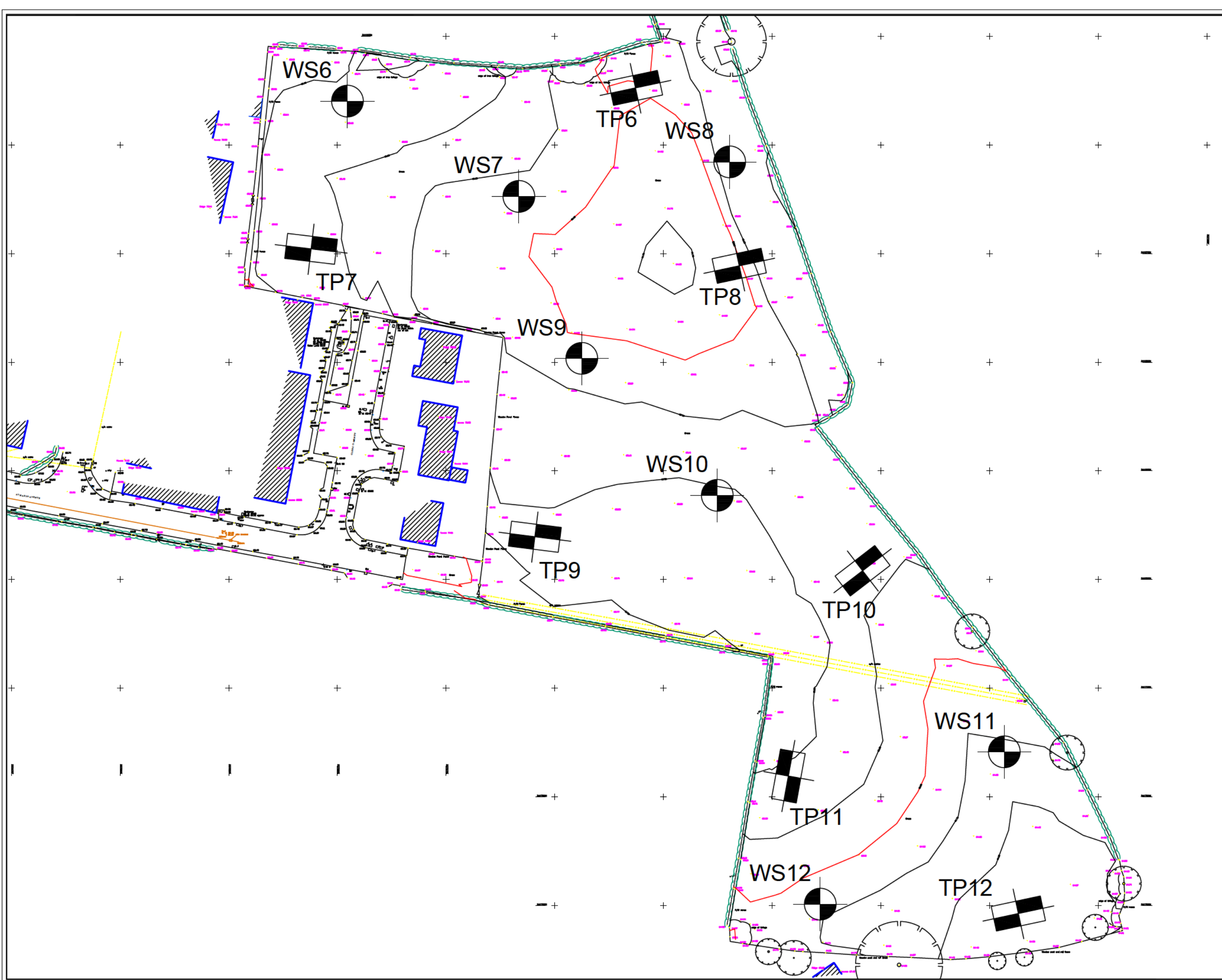
Table 7: Summary of Infiltration Test Results

9.6.2 There was insufficient infiltration recorded to calculate a soil permeability value in strict accordance with BRE:365; however, by extrapolating the results, an approximate value of 2x10⁻⁶ ms⁻¹ has been calculated.

9.6.3 These results and the relatively consistent ground conditions recorded across the site suggest that the use of soakaway drainage could be viable; however, it would be prudent to carry out further tests targeting specific areas where soakaway drains are proposed.

**APPENDIX A
DRAWINGS**

Drawing No.	Drawing Title
19148/3	Exploratory Hole Location Plan
19148/4	Plasticity Chart – Glaciofluvial Deposits



Notes

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This drawing is to be read in conjunction with all development drawings, and designers risk assessments.

This drawing must not be scaled. Work to figured dimensions only.

KEY

 WS1 Dynamic Percussive Sampling Borehole

 TP1 Trial Pit

Rev	Date	Description	Initials

Client

PICKSTOCK HOMES LIMITED

georisk
MANAGEMENT

Summit Point, Summit Crescent, Smeethwick, Birmingham B66 1BT
T: 0121 553 4044, F: 0121 553 1112
www.georisk-uk.com, email: enquiries@georisk-uk.com

Contract

AREA B2
OVERTON-ON-DEE, WREXHAM

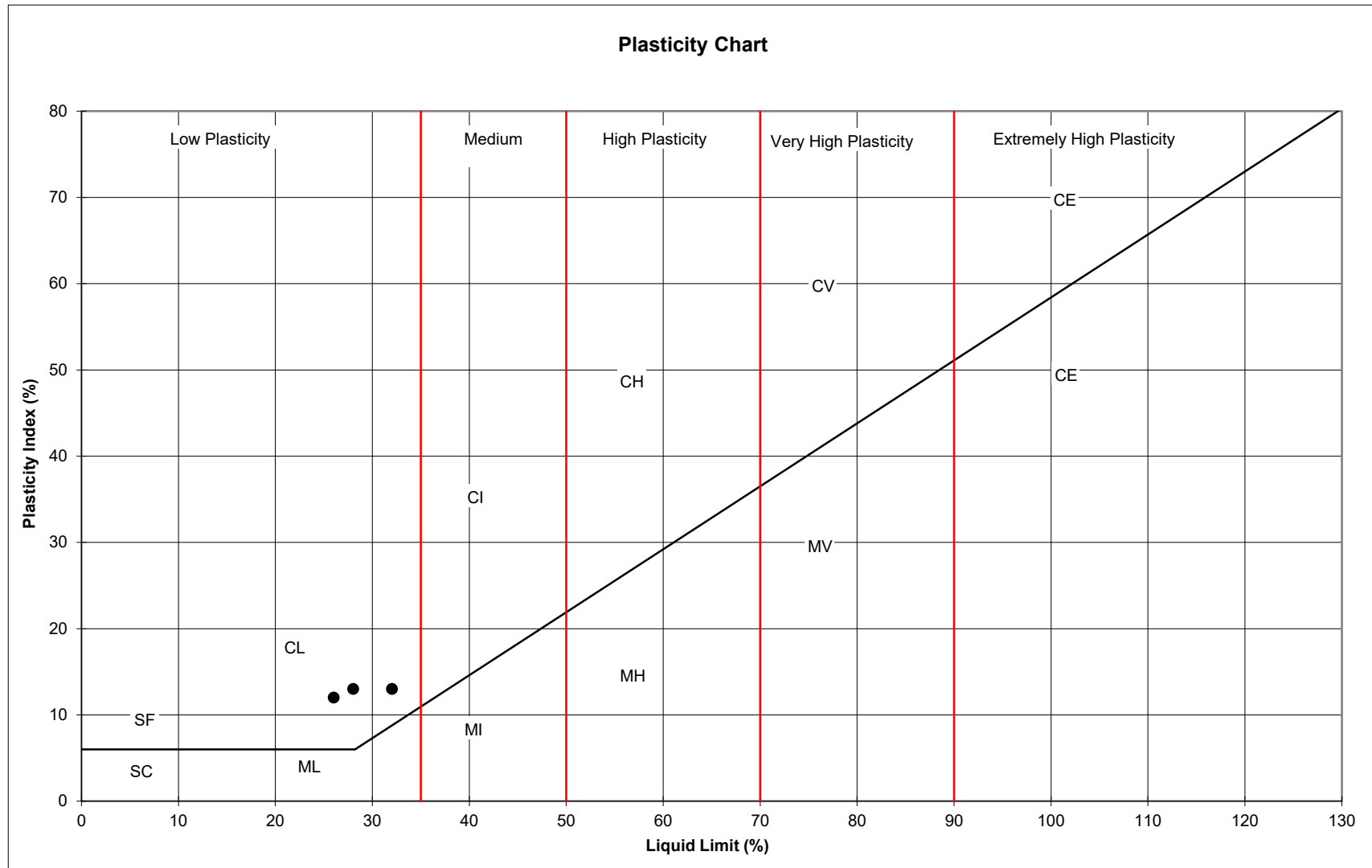
Drawing Title

EXPLORATORY HOLE
LOCATION PLAN

Drawing Status

FINAL

Drawn By	ERW	Date	28/08/19
Checked/Approved	AMG	Date	28/08/19
Scale	NTS	Drawing Number	19148/3



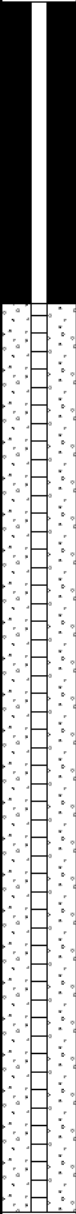
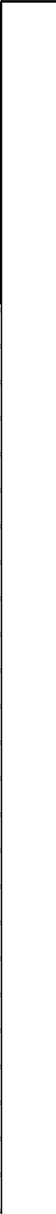
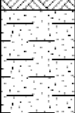
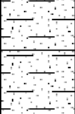
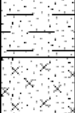
APPENDIX B
EXPLORATORY HOLE RECORDS

Project Name Land at Overton-on-Dee, Wrexham	Project No. 19148	Co-ords: -	Hole Type WS
Equipment: Dynamic Percussive Sampling Rig		Level: -	Scale 1:25
Client: Pickstock Homes Limited		Dates: 26-07-2019 - 26-07-2019	Logged By AEB

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	D1		0.35			Grass over brown silty fine sand, with occasional subrounded, fine to medium gravel of mudstone. (TOPSOIL)	
								Light yellowish brown clayey fine SAND, with occasional subangular to subrounded, fine to coarse mudstone and quartzite. (GLACIOFLUVIAL DEPOSITS)	
		1.00	CPT	N=10 (1,1/2,3,2,3)	1.00 1.10			Firm orangish brown and yellowish brown sandy CLAY. (GLACIOFLUVIAL DEPOSITS) Medium dense light yellowish brown and greyish brown slightly clayey medium SAND. (GLACIOFLUVIAL DEPOSITS)	1
		2.00	CPT	N=11 (1,2/2,3,3,3)	1.80			Medium dense brownish grey and occasionally yellowish brown medium SAND, with rare subrounded, fine to medium gravel of mudstone. (GLACIOFLUVIAL DEPOSITS)	2
		3.00 3.00	D2 CPT	N=15 (1,1/2,3,5,5)	2.90			(Damp) Medium dense greyish brown fine SAND. (GLACIOFLUVIAL DEPOSITS)	3
		4.00	CPT	N=17 (1,2/3,3,5,6)					4
		5.00	CPT	N=36 (4,8/8,9,9,10)	5.00			End of Borehole at 5 00 m	

Remarks: Groundwater not encountered during drilling.
Backfilled with arisings upon completion.

Project Name Land at Overton-on-Dee, Wrexham	Project No. 19148	Co-ords: -	Hole Type WS
Equipment: Dynamic Percussive Sampling Rig		Level: -	Scale 1:25
Client: Pickstock Homes Limited		Dates: 26-07-2019 - 26-07-2019	Logged By AEB

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	D1					Grass over brown silty fine sand, with occasional subangular to subrounded, fine to medium gravel of mudstone and rare brick. (TOPSOIL)	
					0.40			Light yellowish brown clayey fine SAND, with occasional subangular to subrounded, fine to medium gravel of mudstone and quartzite. (GLACIOFLUVIAL DEPOSITS)	
		1.00	CPT	N=10 (1,1/2,2,3,3)	0.90			Medium dense light grey and occasionally yellowish brown clayey fine SAND. (GLACIOFLUVIAL DEPOSITS)	1
		1.10	D2		1.30			Loose grey slightly silty fine SAND, with occasional pockets of clayey sand. (GLACIOFLUVIAL DEPOSITS)	
		2.00	CPT	N=9 (1,1/2,2,3,2)	2.70			Medium dense brownish grey medium SAND, with rare subangular to rounded, fine to medium gravel of mudstone. (GLACIOFLUVIAL DEPOSITS)	2
		3.00	CPT	N=12 (1,2/2,3,3,4)					3
		3.50	D3						
		4.00	CPT	N=30 (2,5/8,7,7,8)	4.00				4
								End of Borehole at 4.00 m	
			Type	Results					

Remarks: Groundwater not encountered during drilling.
Gas and groundwater monitoring point installed upon completion.

Project Name

Land at Overton-on-Dee, Wrexham

Project No.

19148

Co-ords: -

Hole Type

WS

Equipment: Dynamic Percussive Sampling Rig

Level: -

Scale

1:25

Client: Pickstock Homes Limited

Dates: 26-07-2019 - 26-07-2019

Logged By

AEB

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	D1		0.35			Grass over brown silty fine sand, with occasional subangular to subrounded, fine to medium gravel of mudstone and quartzite. (TOPSOIL)	
					0.75			Light yellowish brown slightly clayey SILT, with rare subangular to subrounded, fine to medium gravel of mudstone and quartz. (SUBSOIL)	
		1.00	CPT	N=7 (1,1/1,2,2,2)				(Damp from 1.3 m) Loose light grey and occasionally yellowish brown slightly silty fine SAND, with occasional slightly clayey pockets. (GLACIOFLUVIAL DEPOSITS)	1
		2.00	CPT	N=8 (1,0/1,2,2,3)	2.00			(Damp) Loose light grey slightly silty fine SAND. (GLACIOFLUVIAL DEPOSITS)	2
		2.60	D2		2.55			(Damp) Medium dense grey medium SAND, with occasional clayey pockets. (GLACIOFLUVIAL DEPOSITS)	
		3.00	CPT	N=12 (1,2/3,3,3,3)					3
					3.40			(Damp) Loose grey medium SAND, with occasional subrounded to rounded, fine to coarse gravel of mudstone. Occasional clayey pockets (GLACIOFLUVIAL DEPOSITS)	
		4.00	CPT	N=9 (1,2/2,2,2,3)					4
		4.70	D3		4.60			Medium dense grey fine to medium SAND. (GLACIOFLUVIAL DEPOSITS)	
		5.00	CPT	N=17 (3,3/3,4,4,6)	5.00			End of Borehole at 5.00 m	

Remarks: Groundwater not encountered during drilling.
Backfilled with arisings upon completion.

Project Name

Land at Overton-on-Dee, Wrexham

Project No.

19148

Co-ords: -

Hole Type

WS

Equipment: Dynamic Percussive Sampling Rig

Level: -

Scale

1:25

Client: Pickstock Homes Limited

Dates: 26-07-2019 - 26-07-2019

Logged By

AEB

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	D1					Grass over brown silty fine SAND, with occasional subangular to subrounded, fine to medium gravel of mudstone and quartz.	
					0.25			(TOPSOIL)	
		0.40	D2					Light brown fine SAND, with occasional subangular to subrounded, fine to medium gravel of mudstone and quartz.	
					0.50			(SUBSOIL)	
								Light yellowish brown slightly clayey silty fine SAND, with rare subrounded, fine to medium gravel of quartzite.	
					0.90			(GLACIOFLUVIAL DEPOSITS)	
		1.00	CPT	N=11 (1,2/2,3,3,3)				(Damp from 1.4 m) Medium dense light grey and occasionally yellowish brown fine SAND.	1
								(GLACIOFLUVIAL DEPOSITS)	
		2.00	D3		1.95			(Damp) Medium dense grey medium to coarse SAND.	2
		2.00	CPT	N=10 (1,2/3,3,2,2)				(GLACIOFLUVIAL DEPOSITS)	
					2.40			(Damp) Loose to medium dense grey fine SAND, with occasional slightly clayey pockets.	
								(GLACIOFLUVIAL DEPOSITS)	
		3.00	CPT	N=9 (1,1/2,2,2,3)					3
		3.40	D4						
		4.00	CPT	N=11 (1,1/2,2,3,4)	4.00				4
								End of Borehole at 4 00 m	
			Type	Results					

Remarks: Groundwater not encountered during drilling.
Backfilled with arisings upon completion.

Project Name

Land at Overton-on-Dee, Wrexham

Project No.

19148

Co-ords: -

Hole Type

WS

Equipment: Dynamic Percussive Sampling Rig

Level: -

Scale

1:25

Client: Pickstock Homes Limited

Dates: 26-07-2019 - 26-07-2019

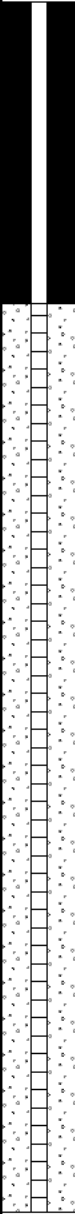
Logged By

AEB

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20			Grass over dark brown slightly silty fine sand, with rare subangular to subrounded, fine to medium gravel of mudstone.	
					0.40			(TOPSOIL) Light brown slightly silty slightly gravelly fine SAND. Gravel is subangular to subrounded, fine to medium mudstone.	
								(SUBSOIL) Medium dense light yellowish brown and grey clayey SAND, with occasional subrounded, fine to coarse gravel of mudstone, quartzite and rare coal.	
								(GLACIOFLUVIAL DEPOSITS)	
		1.00 1.00	D1 CPT	N=16 (1,2/3,4,4,5)					1
					1.25			Medium dense grey and light yellowish brown slightly silty fine SAND.	
								(GLACIOFLUVIAL DEPOSITS)	
		2.00	CPT	N=15 (4,5/4,3,4,4)					2
					2.10			Medium dense grey slightly silty fine SAND, with rare subangular to subrounded, fine to medium gravel of mudstone and rare coal.	
								(GLACIOFLUVIAL DEPOSITS)	
					2.65			Medium dense grey slightly silty, slightly gravelly fine SAND. Gravel is subangular to rounded, fine to medium mudstone, quartzite and coal.	
								(GLACIOFLUVIAL DEPOSITS)	
		3.00 3.00	D2 CPT	N=14 (1,3/4,3,3,4)					3
					3.30			Medium dense grey fine SAND, with occasional subrounded, fine gravel of mudstone and quartzite.	
								(GLACIOFLUVIAL DEPOSITS)	
		4.00	CPT	N=17 (1,2/4,4,4,5)					4
		5.00	CPT Type	N=22 (4,5/5,5,6,6) Results	5.00			End of Borehole at 5 00 m	

Remarks: Groundwater not encountered during drilling.
Backfilled with arisings upon completion.

Project Name Land at Overton-on-Dee, Wrexham	Project No. 19148	Co-ords: -	Hole Type WS
Equipment: Dynamic Percussive Sampling Rig		Level: -	Scale 1:25
Client: Pickstock Homes Limited		Dates: 26-07-2019 - 26-07-2019	Logged By AEB

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	D1		0.12			Grass over brown slightly silty fine sand, with occasional subangular to subrounded, fine to medium gravel of mudstone and rare brick.	
								(TOPSOIL)	
								Brown clayey SAND.	
								(SUBSOIL)	
					0.70			Loose grey and occasionally yellowish brown clayey SAND.	
								(GLACIOFLUVIAL DEPOSITS)	
		1.00 1.10	CPT D2	N=6 (1,1/1,1,2,2)	1.30			Loose grey and occasionally yellowish brown slightly silty fine SAND, with rare subrounded, fine to medium gravel of mudstone.	
								(GLACIOFLUVIAL DEPOSITS)	
		2.00	CPT	N=7 (1,1/1,2,2,2)	2.00			(Damp) Loose to medium dense grey slightly silty fine SAND.	
								(GLACIOFLUVIAL DEPOSITS)	
		3.00 3.00	D3 CPT	N=10 (1,1/2,2,3,3)					
		4.00	CPT	N=11 (1,2/2,3,3,3)	4.00				
			Type	Results					
End of Borehole at 4.00 m									

Remarks: Groundwater not encountered during drilling.
Gas and groundwater monitoring point installed upon completion.

Remarks: Groundwater not encountered during drilling.
Backfilled with arisings upon completion.

Project Name

Land at Overton-on-Dee, Wrexham

Project No.

19148

Co-ords: -

Level: -

Date _____

25-07-2019

Equipment: JCB 3CX

Dimensions:

Depth:

2.40 m

Scale

1:25

Logged By

ERW

Client: Pickstock Homes Limited

Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
	Depth (m)	Type	Results				
	0.15	D1		0.25			Brown slightly silty slightly gravelly sandy TOPSOIL.
							Light brown slightly clayey slightly gravelly SAND. Gravel is quartzite.
							(SUBSOIL) Firm to stiff light grey mottled orangish brown very sandy CLAY.
							(GLACIOFLUVIAL DEPOSITS)
							Light grey slightly clayey SAND. Occasional gravel of quartzite.
							(GLACIOFLUVIAL DEPOSITS)
							Grey slightly silty fine SAND. Occasional gravel of quartzite.
							(GLACIOFLUVIAL DEPOSITS)
							End of Trial Pit at 2.40 m
							

Type	Results
Groundwater not encountered during excavation.	

Remarks:

Backfilled with arisings upon completion.

Stability:

Complete side wall collapse below 0.9 m begl.

Project Name

Land at Overton-on-Dee, Wrexham

Project No.

19148

Co-ords:

-

Level:

-

Date

25-07-2019

Equipment: JCB 3CX

Dimensions:

-

Depth:

2.80 m

Scale

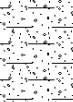
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Logged By

ERW

Client:

Pickstock Homes Limited

Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
	Depth (m)	Type	Results					
	0.40	D1		0.25			Brown slightly clayey slightly gravelly sandy TOPSOIL. Gravel is quartzite.	
				0.55			Light brown slightly clayey slightly gravelly SAND. Gravel is quartzite. (SUBSOIL)	
				1.00			Orangish brown and light grey slightly gravelly clayey SAND. Gravel is quartzite. (GLACIOFLUVIAL DEPOSITS)	
				2.30			Reddish brown orangish brown and grey slightly gravelly silty SAND. Gravel is mixed lithologies. (GLACIOFLUVIAL DEPOSITS)	1
	2.70	D2		2.80			Grey slightly silty slightly gravelly fine SAND. Gravel is mixed lithologies. (GLACIOFLUVIAL DEPOSITS)	2
							End of Trial Pit at 2.80 m	3
								4

Groundwater not encountered during excavation.

Remarks:

Backfilled with arisings upon completion.

Stability:

Side wall collapsed below 0.9 m begl.

Project Name

Land at Overton-on-Dee, Wrexham

Project No.

19148

Co-ords: -

Level: -

Date _____

25-07-2019

Equipment: JCB 3CX

Dimensions:

1

Depth:

2.70 m

Scale

1:25

Logged By

ERW

Client:

Pickstock Homes Limited

Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
	Depth (m)	Type	Results				
	0.50	D1		0.25			Dark brown slightly silty slightly gravelly sandy TOPSOIL. Gravel is quartzite.
							Light brown slightly clayey slightly silty SAND. Rare gravel of quartzite.
							(SUBSOIL) Brown and light grey clayey SAND. Occasional gravel of quartzite.
							(GLACIOFLUVIAL DEPOSITS) Grey silty fine SAND.
	1.20	D2		0.65			(GLACIOFLUVIAL DEPOSITS)
							(GLACIOFLUVIAL DEPOSITS)
							
							
							
							
			2.70			End of Trial Pit at 2.70 m	
							
							
							
							
							
		Type	Results				

Type	Results				
Groundwater not encountered during excavation.					

Remarks:

Backfilled with arisings upon completion.

Stability:

Side walls collapsed at 2.7 begl, below 1.2 m begl.

Project Name

Land at Overton-on-Dee, Wrexham

Project No.

19148

Co-ords:

-

Level:

-

Date

25-07-2019

Equipment: JCB 3CX

Dimensions:

-

Depth:

1.44 m

Scale

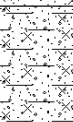
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Logged By

ERW

Client:

Pickstock Homes Limited

Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
	Depth (m)	Type	Results					
	0.20	D1		0.25			Dark brown slightly clayey slightly gravelly sandy TOPSOIL. Gravel is quartzite.	
				0.40			Brown slightly clayey slightly gravelly SAND. Gravel is quartzite.	
							(SUBSOIL) Light brown clayey silty SAND. Rare gravel of quartzite. (GLACIOFLUVIAL DEPOSITS)	
				0.90			Light brown slightly clayey slightly silty gravelly SAND. Gravel is mixed lithologies. (GLACIOFLUVIAL DEPOSITS)	1
				1.30			Brown and greyish brown silty SAND.	
				1.44			(GLACIOFLUVIAL DEPOSITS)	
							End of Trial Pit at 1.44 m	
								2
								3
								4

Groundwater not encountered during drilling.

Remarks:

Infiltration test undertaken; see separate sheet.

Stability:

Pit sides stable.

Project Name

Land at Overton-on-Dee, Wrexham

Project No.

19148

Co-ords:

-

Level:

-

Date

25-07-2019

Equipment: JCB 3CX

Dimensions:

-

Depth:

2.90 m

Scale

1:25

Logged By

ERW

Client:

Pickstock Homes Limited

Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
	Depth (m)	Type	Results					
	0.35	D1		0.20			Dark brown slightly clayey slightly gravelly sandy TOPSOIL.	
				0.40			Light brown slightly clayey silty SAND. Rare gravel of quartzite.	
							(SUBSOIL)	
							Brown clayey SAND. Occasional gravel of quartzite.	
							(GLACIOFLUVIAL DEPOSITS)	
	1.00	D2		0.80			Grey and orangish brown clayey SAND. Occasional pockets of firm to stiff sandy clay.	1
							(GLACIOFLUVIAL DEPOSITS)	
				1.10			Greyish brown and orangish brown slightly silty SAND.	
							(GLACIOFLUVIAL DEPOSITS)	
				1.60			Grey slightly silty fine SAND.	2
							(GLACIOFLUVIAL DEPOSITS)	
				2.90			End of Trial Pit at 2.90 m	3
								4

Groundwater not encountered during excavation.

Remarks:

Backfilled with arisings upon completion.

Stability:

Side wall collapsed at 2.9 m begl below 1.1 m begl.

Project Name

Land at Overton-on-Dee, Wrexham

Project No.

19148

Co-ords:

-

Level:

-

Date

25-07-2019

Equipment: JCB 3CX

Dimensions:

-

Depth:

2.95 m

Scale

1:25

Logged By

ERW

Client:

Pickstock Homes Limited

Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
	Depth (m)	Type	Results					
	0.10	D1					Dark brown slightly clayey slightly gravelly sandy TOPSOIL. Gravel is quartzite.	
				0.30			Light brown slightly silty slightly clayey SAND. Rare gravel of quartzite.	
				0.50			(SUBSOIL) Orangish brown and light grey slightly silty SAND. (GLACIOFLUVIAL DEPOSITS)	
	1.70	D2					Grey slightly silty fine SAND. (GLACIOFLUVIAL DEPOSITS)	
				2.20				
				2.95			End of Trial Pit at 2.95 m	
		Type	Results					

Remarks: Running sands encountered at 2.9 m begl.
Backfilled with arisings upon completion.

Stability: Pit sides stable.

Project Name

Land at Overton-on-Dee, Wrexham

Project No.

19148

Co-ords:

-

Level:

-

Date

25-07-2019

Equipment: JCB 3CX

Dimensions:

-

Depth:

2.50 m

Scale

1:25

Logged By

ERW

Client: Pickstock Homes Limited

Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
	Depth (m)	Type	Results					
	0.35	D1		0.20			Dark brown slightly clayey slightly gravelly sandy TOPSOIL. Gravel is quartzite.	
				0.60			Orangish and greyish brown silty SAND. Occasional pockets of firm to stiff orangish and greyish brown clay. (SUBSOIL)	
				0.90			Grey and orangish brown slightly silty SAND. (GLACIOFLUVIAL DEPOSITS)	
							Grey slightly silty fine SAND. (GLACIOFLUVIAL DEPOSITS)	1
				2.50			End of Trial Pit at 2.50 m	2
								3
								4

Groundwater not encountered during excavation.

Remarks:

Backfilled with arisings upon completion.

Stability:

Complete side wall collapse below 0.8 m begl.

APPENDIX C
INFILTRATION TEST RESULTS

SOIL INFILTRATION RATE IN ACCORDANCE WITH BRE DIGEST 365: 2016

Client: Pickstock Homes Limited
Job Name: Area B2, Overton-on-Dee, Wrexham
Job No.: 19148_2

Date: 25/07/2019

Trial Pit No.	TP9
Test No.	1

Time	Elapsed Time	Depth to water from ground level	
	(min)	(m)	(mm)
	0	0.49	490
	2	0.52	520
	4	0.55	550
	8	0.58	580
	10	0.60	595
	14	0.63	625
	17	0.64	640
	21	0.66	660
	23	0.67	670
	27	0.69	690
	39	0.74	740
	46	0.77	770
	66	0.83	830
	101	0.91	910
	135	0.98	980
	185	1.06	1060

Soakaway Dimensions		(m)	(mm)
Length	=	2.50	2500
Width	=	0.60	600
Depth	=	1.79	1790

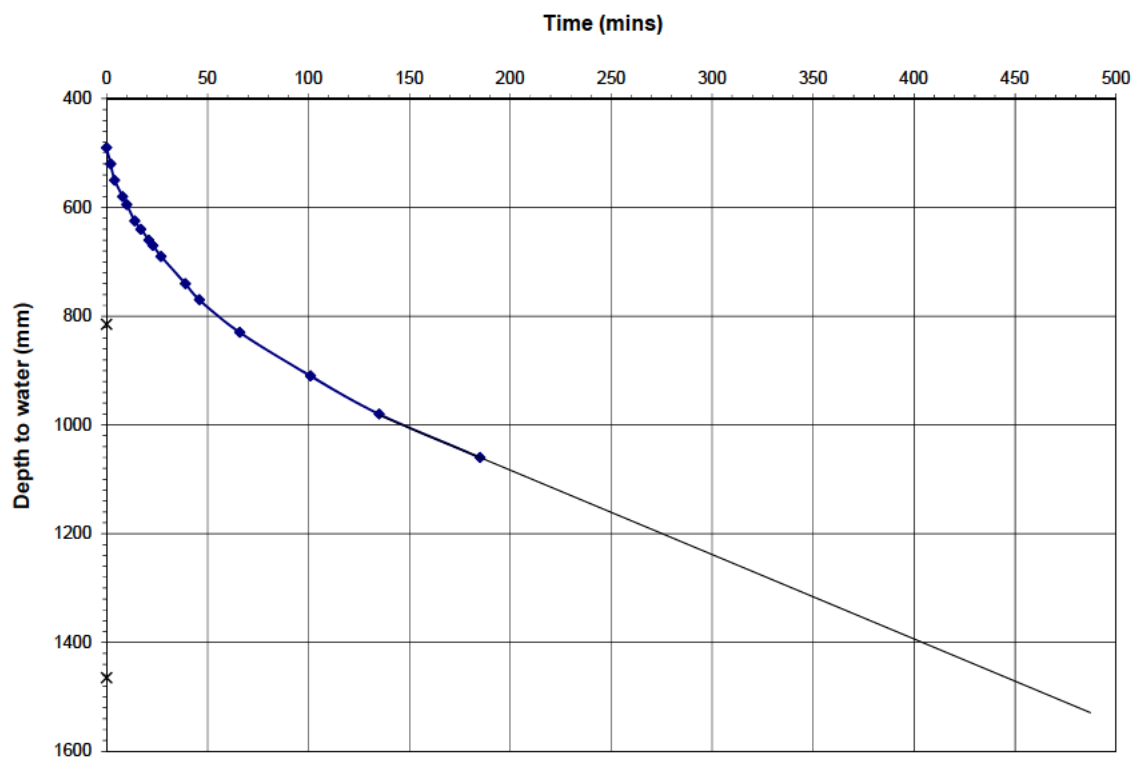
Effective depth (empty)		mm	m
75%	=	1465.0	1.47
50%	=	1140.0	1.14
25%	=	815.0	0.82

Depth at start of test (mm)	=	490
Depth at end of test (mm)	=	1060

Base area of pit	=	1.5
a_{p50} - 50% internal surface area inc. base	=	5.530
V_{p75-25} - Volume 75 - 25%	=	0.2925

Read from the graph:		
t_{p75} (min)	=	60
t_{p25} (min)	=	445

extrapolated



Soil infiltration rate, f , (m/s) = 2.29E-06 (extrapolated)

SOIL INFILTRATION RATE IN ACCORDANCE WITH BRE DIGEST 365: 2016

Client: Pickstock Homes Limited
 Job Name: Area B2, Overton-on-Dee, Wrexham
 Job No.: 19148

Date: 25/07/2019

Trial Pit No.	TP9
Test No.	2

Time	Elapsed Time	Depth to water from ground level	
	(min)	(m)	(mm)
	0	0.47	470
	3	0.49	490
	12	0.54	540
	20	0.57	570
	26	0.60	600
	42	0.65	650
	63	0.71	710
	83	0.77	770
	104	0.83	830
	120	0.86	860
	151	0.92	920
	183	0.97	970

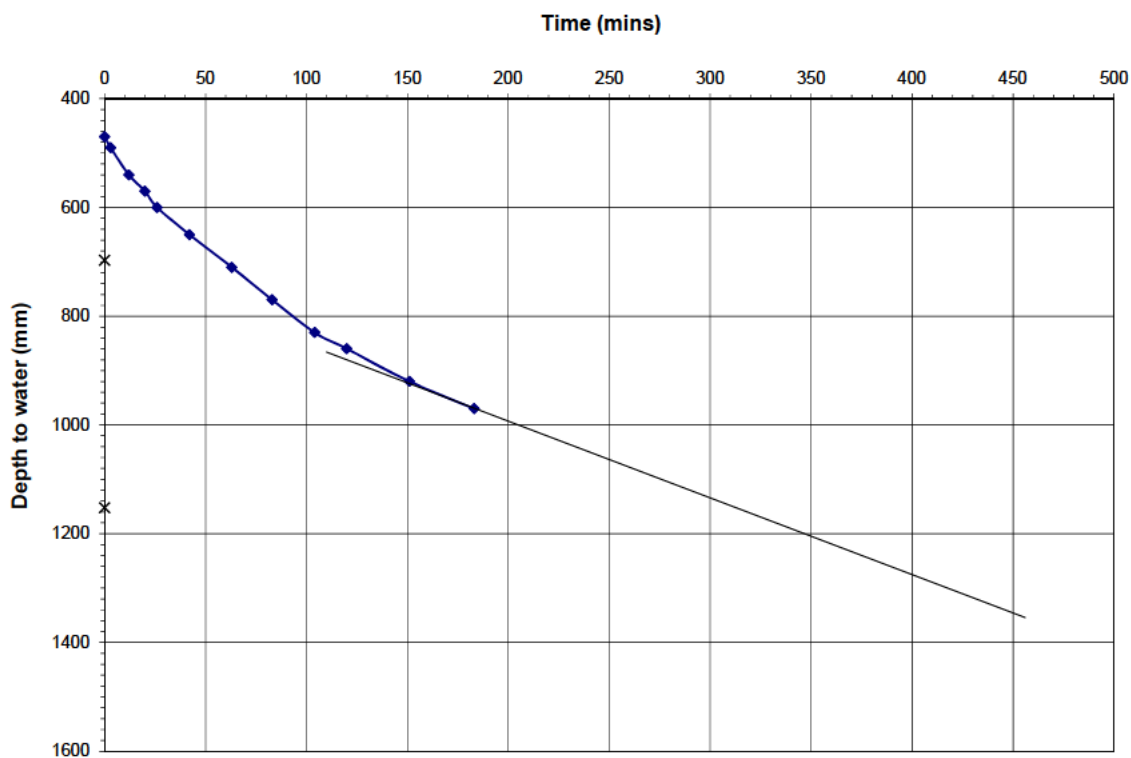
Soakaway Dimensions		(m)	(mm)
Length	=	2.50	2500
Width	=	0.60	600
Depth	=	1.38	1380

Effective depth (empty)		mm	m
75%	=	1152.5	1.15
50%	=	925.0	0.93
25%	=	697.5	0.70

Depth at start of test (mm)	=	470
Depth at end of test (mm)	=	970

Base area of pit	=	1.5
a_{p50} - 50% internal surface area inc. base	=	4.321
V_{p75-25} - Volume 75 - 25%	=	0.20475

Read from the graph:		
t_{p75} (min)	=	60
t_{p25} (min)	=	320 extrapolated



Soil infiltration rate, f , (m/s) = 3.04E-06 (extrapolated)

APPENDIX D
SOIL-GAS AND GROUNDWATER MONITORING RESULTS

Soil-Gas and Groundwater Monitoring Results

Monitoring Visit No. 1		Date 06/08/2019				Barometric Pressure (mb) - 997								
Weather Conditions:		Clear												
Surface Ground Conditions:		Dry												
Ambient Concentration (% Volume):		Bal: 78.8		CH ₄ : 0.0			CO ₂ : 0.1			O ₂ : 21.1				
Monitoring Point		Gas Concentration										Gas Flow		
		Highest					Steady				(Lowest)	Gas Flow Rate	Relative Pressure	
Ref:	GWL	CH ₄		CO ₂	CO	H ₂ S	CH ₄		CO ₂	CO	H ₂ S			O ₂
	(m) bgl	% lel	% v/v	(%)	ppm	ppm	% lel	% v/v	(%)	ppm	ppm	(%)	litre/hr	mb
WS7	3.14	0.0	0.0	1.7	0	1	0.0	0.0	1.6	0	1	19.1	-0.1	0.10
WS11	2.93	0.0	0.0	3.6	0	0	0.0	0.0	3.6	0	0	17.9	-0.1	0.09

Monitoring Visit No.		2		Date				20/08/2019				Barometric Pressure (mb) -				1016			
Weather Conditions:				Clear															
Surface Ground Conditions:				Dry															
Ambient Concentration (% Volume):				Bal:		78.9		CH ₄ :		0.0		CO ₂ :		0.1		O ₂ :		21.1	
Monitoring Point		Gas Concentration											Gas Flow						
		Highest						Steady				(Lowest)	Gas Flow Rate	Relative Pressure					
		CH ₄		CO ₂	CO	H ₂ S	CH ₄		CO ₂	CO	H ₂ S								
Ref:	GWL	CH ₄		CO ₂	CO	H ₂ S	CH ₄		CO ₂	CO	H ₂ S	O ₂	litre/hr	mb					
	(m) bgl	% lel	% v/v	(%)	ppm	ppm	% lel	% v/v	(%)	ppm	ppm	(%)							
WS7	3.17	0.0	0.0	3.6	0	0	0.0	0.0	3.6	0	0	15.9	0.0	0.02					
WS11	2.21	0.0	0.0	4.4	0	0	0.0	0.0	4.4	0	0	14.5	0.0	0.25					

Monitoring Visit No. 3		Date 03/09/2019				Barometric Pressure (mb) - 1017								
Weather Conditions:		Clear												
Surface Ground Conditions:		Dry												
Ambient Concentration (% Volume):		Bal: 78.9		CH ₄ : 0.0			CO ₂ : 0.1			O ₂ : 21.1				
Monitoring Point		Gas Concentration										Gas Flow		
		Highest					Steady				(Lowest)	Gas Flow Rate	Relative Pressure	
		CH ₄		CO ₂	CO	H ₂ S	CH ₄		CO ₂	CO	H ₂ S			O ₂
Ref:	GWL	CH ₄		CO ₂	CO	H ₂ S	CH ₄		CO ₂	CO	H ₂ S	O ₂		
	(m) bgl	% lcl	% v/v	(%)	ppm	ppm	% lcl	% v/v	(%)	ppm	ppm	(%)	litre/hr	mb
WS7	2.39	0.0	0.0	3.3	0	0	0.0	0.0	3.2	0	0	15.5	0.1	0.64
WS11	2.02	0.0	0.0	4.2	0	0	0.0	0.0	4.2	0	0	14.7	0.0	0.07

Equipment Used: Geotechnical Instruments (GI) and Solinst		Notes
GI - GA5000 Gas Concentration/Atmospheric Pressure		(m) bgl - metres below ground level
GI - GA5000 Borehole Gas Flow Rate/Borehole Pressure		
Solinst combined dip meter and interface meter - Groundwater Level (GWL)		
	Job Title:	Job No:
	Area B2, Overton-on-Dee, Wrexham	19148
	Client:	Table Number:
	Pickstock Homes Limited	1

APPENDIX E
CHEMICAL TEST RESULTS



Amended Report

Report No.: 19-25630-3

Initial Date of Issue: 07-Aug-2019 **Date of Re-Issue:** 28-Aug-2019

Client Georisk Management Limited

Client Address: Summit Point
Summit Crescent Industrial Est
Smethwick
Birmingham
B66 1BT

Contact(s): Emily Webb

Project 19148_2 'Area B2', Overton-on-Dee,
Wrexham

Quotation No.: **Date Received:** 31-Jul-2019

Order No.: 19148 **Date Instructed:** 31-Jul-2019

No. of Samples: 10

Turnaround (Wkdays): 5 **Results Due:** 06-Aug-2019

Date Approved: 07-Aug-2019

Approved By:



Details: Martin Dyer, Laboratory Manager

Results - Soil

Project: 19148 Overton-on-Dee, Wrexham

Client: Georisk Management Limited	Chemtest Job No.: 19-25630					19-25630	19-25630	19-25630	19-25630	19-25630	19-25630	19-25630	19-25630
Quotation No.:	Chemtest Sample ID.: 865976					865977	865978	865979	865980	865981	865982	865986	865987
	Sample Location: TP6					TP7	TP8	TP9	TP10	TP11	TP12	TP12	WS7
	Sample Type: SOIL					SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m): 0.15					0.40	0.50	0.20	0.35	0.10	0.35	2.30	1.10
	Date Sampled: 25-Jul-2019					25-Jul-2019	25-Jul-2019	25-Jul-2019	25-Jul-2019	25-Jul-2019	25-Jul-2019	25-Jul-2019	25-Jul-2019
Determinand	Accred.	SOP	Units	LOD									
Moisture	N	2030	%	0.020	15	11	13	12	10	11	14	16	11
Stones and Removed Materials	N	2030	%	0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020		
pH	U	2010		N/A	6.0	7.0	7.0	5.7	7.0	5.8	7.1	7.5	7.5
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40	< 0.40	< 0.40	0.42	< 0.40	0.64	< 0.40		
Sulphate (2:1 Water Soluble) as SO ₄	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.021	< 0.010	< 0.010	0.055
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50		
Arsenic	U	2450	mg/kg	1.0	13	8.7	10	13	9.2	13	16		
Cadmium	U	2450	mg/kg	0.10	0.19	< 0.10	< 0.10	0.22	0.13	0.21	< 0.10		
Chromium	U	2450	mg/kg	1.0	24	19	21	24	21	25	23		
Copper	U	2450	mg/kg	0.50	25	11	11	30	17	21	5.0		
Mercury	U	2450	mg/kg	0.10	0.11	< 0.10	< 0.10	0.16	< 0.10	0.12	< 0.10		
Nickel	U	2450	mg/kg	0.50	22	18	16	22	17	22	19		
Lead	U	2450	mg/kg	0.50	72	26	24	120	150	70	22		
Selenium	U	2450	mg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20	0.29	0.24	< 0.20		
Zinc	U	2450	mg/kg	0.50	83	48	57	87	63	85	53		
Naphthalene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10		
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10		
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10		
Fluorene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10		
Phenanthrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	1.2	< 0.10	< 0.10		
Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.25	< 0.10	< 0.10		
Fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.27	2.1	0.23	< 0.10		
Pyrene	U	2700	mg/kg	0.10	0.12	< 0.10	< 0.10	0.36	2.4	0.22	< 0.10		
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.61	< 0.10	< 0.10		
Chrysene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.44	< 0.10	< 0.10		
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.68	< 0.10	< 0.10		
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.27	< 0.10	< 0.10		
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.29	< 0.10	< 0.10		
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10		
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10		
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10		
Total Of 16 PAH's	U	2700	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	8.2	< 2.0	< 2.0		
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30		

Project: 19148 Overton-on-Dee, Wrexham

Client: Georisk Management Limited		Chemtest Job No.:		19-25630	
Quotation No.:		Chemtest Sample ID.:		865988	
		Sample Location:		WS11	
		Sample Type:		SOIL	
		Top Depth (m):		1.10	
		Date Sampled:		25-Jul-2019	
Determinand	Accred.	SOP	Units	LOD	
Moisture	N	2030	%	0.020	9.8
Stones and Removed Materials	N	2030	%	0.020	
pH	U	2010		N/A	7.5
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	
Sulphate (2:1 Water Soluble) as SO ₄	U	2120	g/l	0.010	< 0.010
Cyanide (Total)	U	2300	mg/kg	0.50	
Arsenic	U	2450	mg/kg	1.0	
Cadmium	U	2450	mg/kg	0.10	
Chromium	U	2450	mg/kg	1.0	
Copper	U	2450	mg/kg	0.50	
Mercury	U	2450	mg/kg	0.10	
Nickel	U	2450	mg/kg	0.50	
Lead	U	2450	mg/kg	0.50	
Selenium	U	2450	mg/kg	0.20	
Zinc	U	2450	mg/kg	0.50	
Naphthalene	U	2700	mg/kg	0.10	
Acenaphthylene	U	2700	mg/kg	0.10	
Acenaphthene	U	2700	mg/kg	0.10	
Fluorene	U	2700	mg/kg	0.10	
Phenanthrene	U	2700	mg/kg	0.10	
Anthracene	U	2700	mg/kg	0.10	
Fluoranthene	U	2700	mg/kg	0.10	
Pyrene	U	2700	mg/kg	0.10	
Benzo[a]anthracene	U	2700	mg/kg	0.10	
Chrysene	U	2700	mg/kg	0.10	
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	
Benzo[a]pyrene	U	2700	mg/kg	0.10	
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	
Total Of 16 PAH's	U	2700	mg/kg	2.0	
Total Phenols	U	2920	mg/kg	0.30	

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Alkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[gh]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.

Report Information

Key

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

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

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

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

All Asbestos testing is performed at the indicated laboratory

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

Sample Deviation Codes

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

Sample Retention and Disposal

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

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

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com

APPENDIX F
GEOTECHNICAL TEST RESULTS



TEST CERTIFICATE

Liquid and Plastic Limits

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



Environmental Science

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.4 and 5

Client: Georisk Management Limited
Client Address: Summit Point, Summit Crescent,
Smethwick, Birmingham,
B66 1BT
Contact: Emily Webb
Site Name: Land Of Overton-on-Dee, Wrexham
Site Address: Not Given

Client Reference: 19148_2
Job Number: 19-52470
Date Sampled: 25/07/2019
Date Received: 31/07/2019
Date Tested: 02/08/2019
Sampled By: Not Given

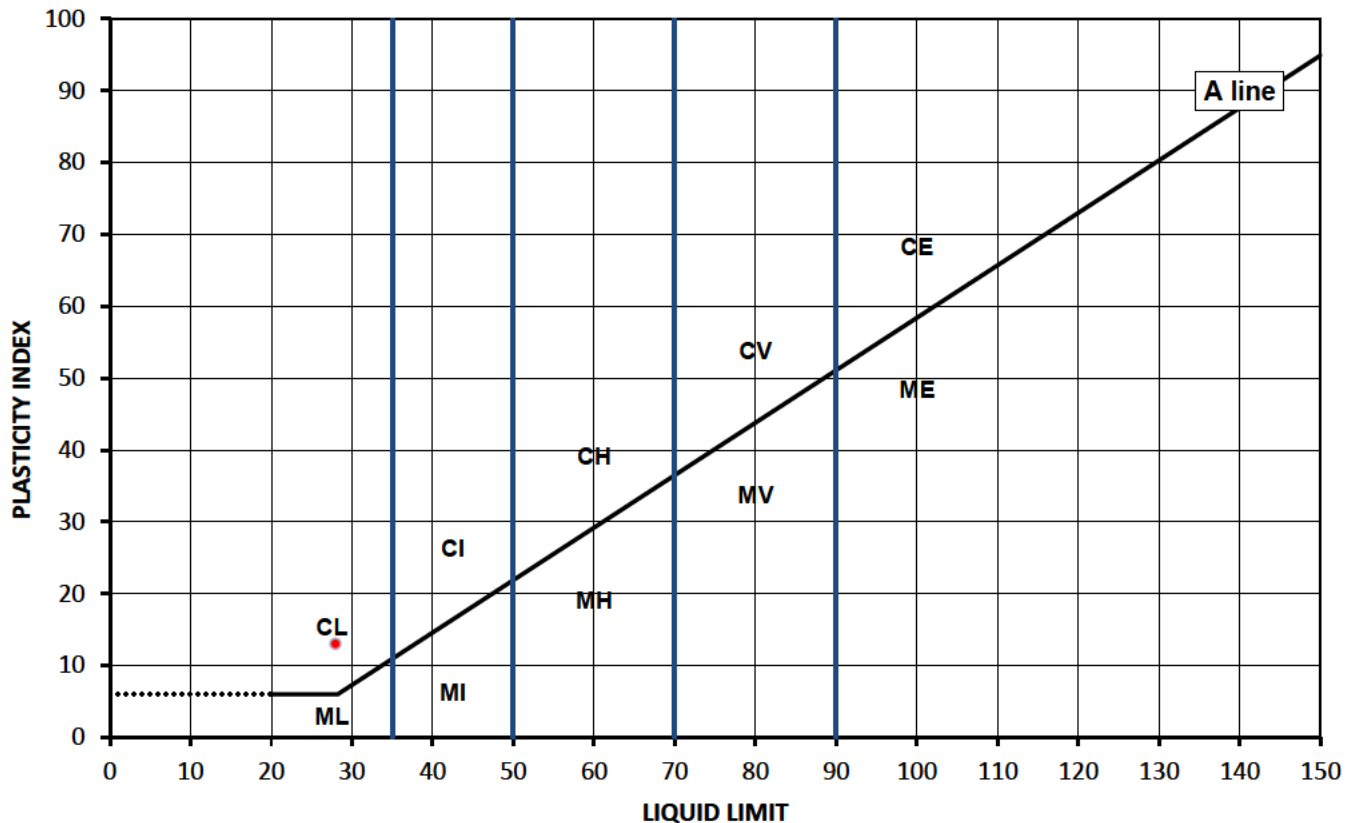
Test Results:

Laboratory Reference: 1280751
Hole No.: TP8
Sample Reference: Not Given
Soil Description: Dark grey very sandy CLAY

Depth Top [m]: 1.20
Depth Base [m]: Not Given
Sample Type: D

Sample Preparation: Tested in natural condition

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
11	28	15	13	100



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

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

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

Remarks:

Approved: Dariusz Piotrowski
PL Geotechnical Laboratory Manager
Date Reported: 29/08/2019

Signed: Darren Berrill
Geotechnical General Manager
for and on behalf of i2 Analytical Ltd GF 232.5

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

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



TEST CERTIFICATE

Liquid and Plastic Limits

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



Environmental Science

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.4 and 5

Client: Georisk Management Limited
Client Address: Summit Point, Summit Crescent,
Smethwick, Birmingham,
B66 1BT
Contact: Emily Webb
Site Name: Land Of Overton-on-Dee, Wrexham
Site Address: Not Given

Client Reference: 19148_2
Job Number: 19-52470
Date Sampled: 25/07/2019
Date Received: 31/07/2019
Date Tested: 02/08/2019
Sampled By: Not Given

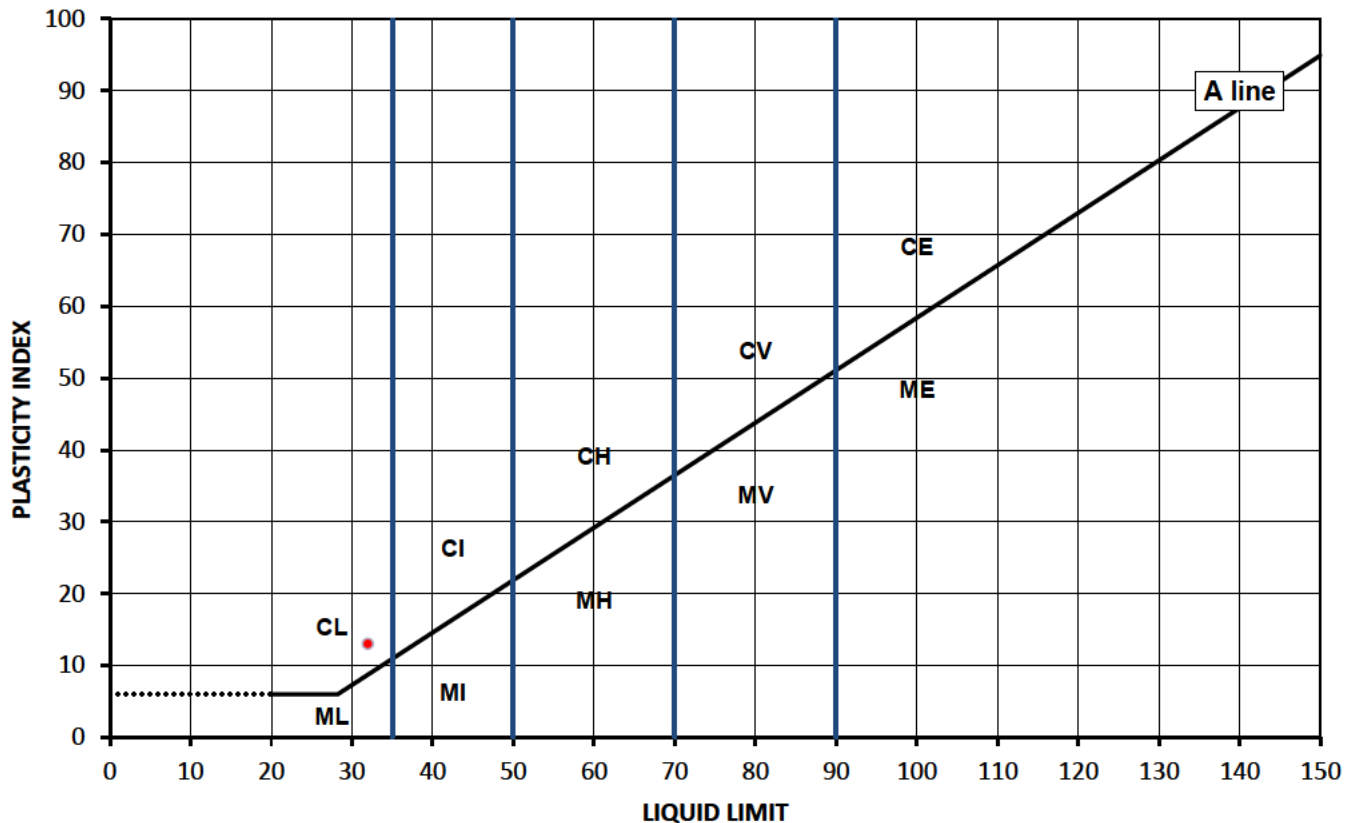
Test Results:

Laboratory Reference: 1280752
Hole No.: TP10
Sample Reference: Not Given
Soil Description: Brownish grey slightly gravelly very sandy CLAY

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

Sample Preparation: Tested after washing to remove >425um

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
17	32	19	13	93



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

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

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

Remarks:

Approved: Dariusz Piotrowski
PL Geotechnical Laboratory Manager
Date Reported: 29/08/2019

Signed: Darren Berrill
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TEST CERTIFICATE

Liquid and Plastic Limits

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



Environmental Science

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.4 and 5

Client: Georisk Management Limited
Client Address: Summit Point, Summit Crescent,
Smethwick, Birmingham,
B66 1BT
Contact: Emily Webb
Site Name: Land Of Overton-on-Dee, Wrexham
Site Address: Not Given

Client Reference: 19148_2
Job Number: 19-52470
Date Sampled: 25/07/2019
Date Received: 31/07/2019
Date Tested: 02/08/2019
Sampled By: Not Given

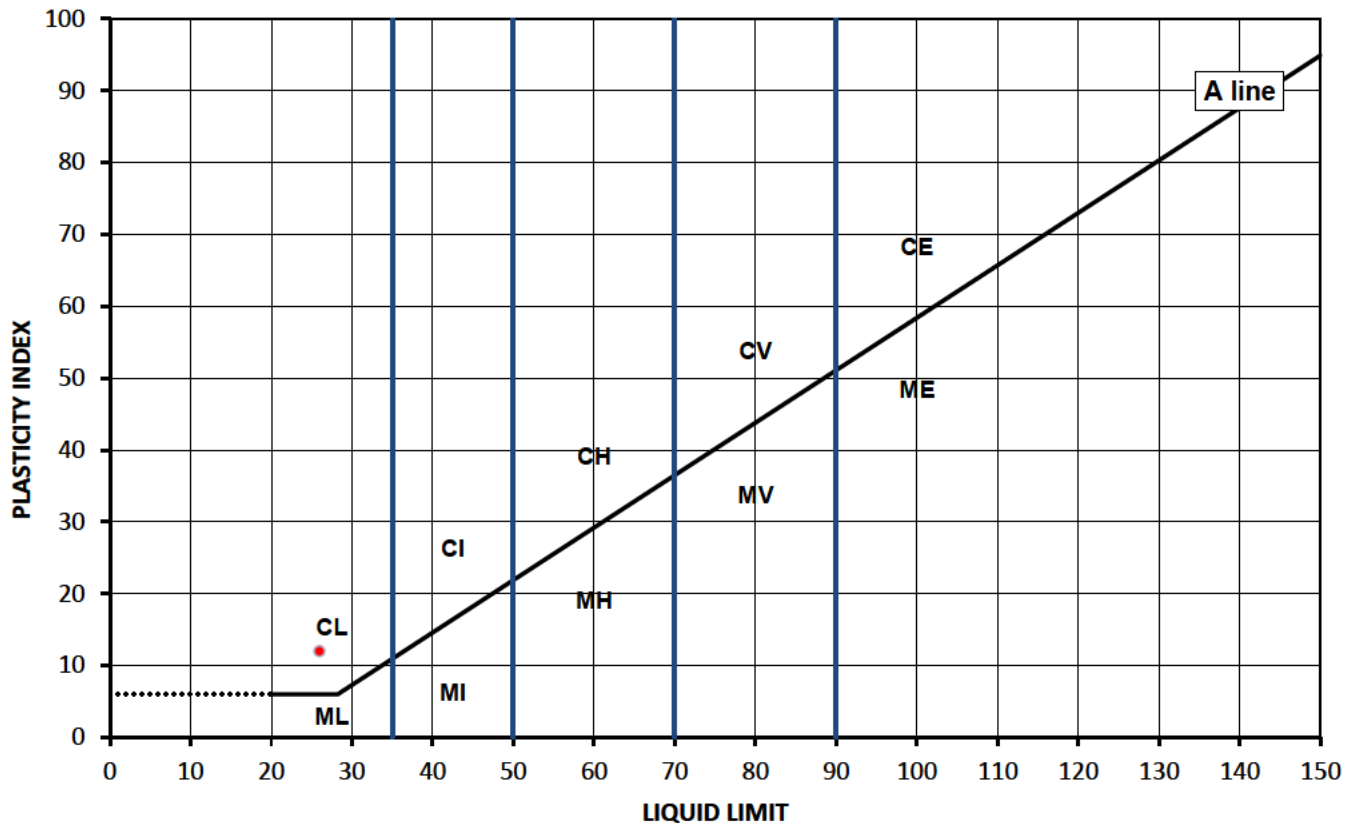
Test Results:

Laboratory Reference: 1280756
Hole No.: WS12
Sample Reference: Not Given
Soil Description: Brown very sandy CLAY

Depth Top [m]: 0.60
Depth Base [m]: Not Given
Sample Type: D

Sample Preparation: Tested in natural condition

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
19	26	14	12	100



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

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

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

Remarks:

Approved: Dariusz Piotrowski
PL Geotechnical Laboratory Manager
Date Reported: 29/08/2019

Signed: Darren Berrill
Geotechnical General Manager
for and on behalf of i2 Analytical Ltd GF 232.5

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4041

Client: Georisk Management Limited
 Client Address: Summit Point, Summit Crescent,
 Smethwick, Birmingham,
 B66 1BT
 Contact: Emily Webb
 Site Name: Land Of Overton-on-Dee, Wrexham
 Site Address: Not Given

SUMMARY REPORT

Summary of Classification Test Results

Tested in Accordance with:

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

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



Environmental Science

Client Reference: 19148_2
 Job Number: 19-52470
 Date Sampled: 25/07/2019
 Date Received: 31/07/2019
 Date Tested: 02/08/2019
 Sampled By: Not Given

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	MC	WC	Atterberg				Density			Total Porosity#		
		Reference	Depth Top m	Depth Base m	Type					% Passing 425um	LL	PL	PI	bulk Mg/m3	dry Mg/m3	PD Mg/m3			
1280752	TP10	Not Given	1.00	Not Given	D	Brownish grey slightly gravelly very sandy CLAY	Atterberg 1 Point	17		93	32	19	13						
1280751	TP8	Not Given	1.20	Not Given	D	Dark grey very sandy CLAY	Atterberg 1 Point	11		100	28	15	13						
1280756	WS12	Not Given	0.60	Not Given	D	Brown very sandy CLAY	Atterberg 1 Point	19		100	26	14	12						

Note: # Non accredited; NP - Non plastic

Comments:

Approved: Dariusz Piotrowski
 PL Geotechnical Laboratory Manager
 Date Reported: 29/08/2019

Signed: Darren Berrill
 Geotechnical General Manager
 for and on behalf of i2 Analytical Ltd GF 234.7

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