Report prepared at
Land at Sullivan Crescent
Harefield
UB9 6NL

On behalf of
Bugler Developments Limited

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Prepared by
Aviron Associates Limited

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Contents

1.0 PROJECT AND SITE INFORMATION 1
2.0 DESK STUDY REVIEW 4
3.0 REGULATORY INFORMATION, CONSULTATIONS AND OTHER 13
4.0 PRELIMINARY RISK ASSESSMENT 16
5.0 SITE INVESTIGATION WORK 24
6.0 LABORATORY ANALYSIS 29
7.0 ENVIRONMENTAL INTERPRETATIVE GUIDANCE 31
8.0 ASSESSMENT OF GEOCHEMICAL SOIL RESULTS 33
9.0 HAZARDOUS GROUND GAS MONITORING 35
10.0 REVISED RISK ASSESSMENT 38
11.0 GEOTECHNICAL ASSESSMENT 43
12.0 CONCLUSIONS AND RECOMMENDATIONS 53
13.0 PROJECT INSTRUCTION AND LIMITATIONS 56
14.0 REFERENCES AND OTHER SOURCES OF INFORMATION 59

Figures

1 Site Location Plan

2 Pre-Clearance Site Layout Plan

3 Existing Site Layout Plan

4 Site Photographs

5 Proposed Development Plan

6 Exploratory Hole Location Plan - Existing Site Layout

7 Exploratory Hole Location Plan - Proposed Development

8 Made Ground Contamination Identification Plan

Appendices

I	Envirocheck Database Reports
II	Exploratory Hole Logs and Photographs
III	Field Monitoring Results
IV	Soil Contamination Results and Assessment Criteria
V	Soil Geotechnical Results

1.0 PROJECT AND SITE INFORMATION

1.1 APPOINTMENT

Aviron Associates Limited (Aviron) was retained by Bugler Developments Limited (the "Client") to prepare a tier 1 Preliminary Risk Assessment (PRA) and complete a Site Investigation (SI) leading towards a tier 2 Generic Quantitative Risk Assessment (GQRA) of the following premises:

Land at Sullivan Crescent, Harefield, UB9 6NL (hereafter referred to as the "site").

The PRA forms a tier 1 assessment by completing a desk-based study with site walkover to identify potential areas of contaminative concern associated with the proposed development of the site. The PRA will then form a preliminary Conceptual Site Model (CSM) with recommendations for any further investigation or risk assessment.

The SI will investigate the pollutant linkages established within the PRA in order to produce suitable data for the preparation of a tier 2 GQRA to refine the CSM and as necessary provide recommendations for any further investigation or tier 3 Detailed Quantitative Risk Assessment (DQRA). Alternatively, it may be possible to make remediation recommendations immediately following the GQRA.

In addition, geotechnical issues shall be investigated to provide recommendations for new foundations, drainage and pavement design.

Aviron has relied upon information received from the Client and their agents as accurate, unless contradicted by written documentation or site observations.

1.2 THE SITE

Table 1.2 provides a summary of site details and surrounding area.

Table 1.2: Site Details	
Site Location	The site is located off Sullivan Crescent, via gated access between numbers 40 and 42-44, on the south-eastern outskirts of Harefield, equidistant between Chalfont St Peter and Northwood. **Figure 1** is presented as a Site Location Plan.
National Grid Ref.	Centred at approximately 505870 190415.
Current Land Use	The site comprises a recently cleared parcel of land, previously occupied by a series of lock-up garages. The garages have been cleared to ground level. **Figure 2** is presented as the Pre-Clearance Site Layout Plan. **Figure 3** is presented as the Existing Site Layout Plan. **Figure 4** is presented as the Site Photographs.

Table 1.2: Site Details	
Surrounding Land Use	The site is located on the edge of a rural area with homes of Ash Grove to the north and Sullivan Crescent to the west, and open agricultural fields to the east.
Proposed Land Use	The proposed development comprises the construction of six new semi-detached homes with private gardens set around a new access road and a number of parking bays. **Figure 5** is presented as the Proposed Development Plan.

1.3 SITE WALKOVER SURVEY

A site walkover survey was undertaken on 27 September 2023 and included an inspection of the site and surrounding area, where safe and accessible. The purpose of the survey is to identify any potential on-site or nearby contaminative activities or potential sources of land contamination.

Additionally, as part of the survey any features which may affect site re-development in terms of physical site and ground conditions were noted.

Table 1.3 provides a description of site features observed during the walkover survey and also current Ordnance Survey maps made available at the time of report writing.

Table 1.3: Summary of Site Walkover Survey	
Physical Site Characteristics	
Existing Structures	None observed.
Basements	None observed.
Visual Topography and Site Surfacing	The site is generally level and situated between approximately 85.9 and 86.5 metres (m) above Ordnance Datum (AOD), as noted on the topographical survey drawing by Midland Survey Ltd (reference U03102, dated August 2019) supplied by the Client. The site is almost entirely covered in hardstanding including the former concrete floor slabs of the lock-up garages with tarmac surfacing in between. An area of soft landscaping is located in the north-west of the site adjacent the residential premises of 42-44 Sullivan Crescent.
Retaining Structures and Slopes	None observed.
Drainage Issues	None observed.
Surface Waters	None observed.
Trees and Hedges	Mature trees, including an oak and an ash are located adjacent the northern and south-western boundaries of the site respectively. A number of smaller trees are located along the site boundaries.
Made and Infilled Ground	Made ground should be anticipated beneath the hardstanding.

Table 1.3: Summary of Site Walkover Survey	
Contaminative Characteristics	
Above or Underground Storage Tanks and Drums	None observed.
Fuel Interceptors	Three-chambered interceptor located within the entrance in the north-west of the site, noted to be some 2.5m in depth. The interceptor is noted to connect to a storm water sewer (450mm diameter) that runs inside the eastern boundary of the site, connecting to a junction with an invert level noted to be some 2.7m below ground level, before exiting the site to the south-east.
Waste Storage and Disposal	None observed.
Hazardous Material Storage and Use	None observed.
Asbestos Containing Materials (ACMs)	None observed but may have been used in the fabric of the former lock-up garages in the form of cement sheeting.
Boiler Houses	None observed.
Sub-stations	None observed.
Surface Staining	None observed.
Potentially Contaminative Activities	Contaminative activities associated with the former use of the site as lock-up garages, and possible ACMs with the fabric of the former garages.

1.3.1 Summary of Physical Site Characteristics

Consideration should be made towards the make-up and competency of the underlying strata and the influence of trees on the proposed development buildings.

A branch of the storm water sewer that connects to the interceptor in the north-west of the site is noted to be some 2.3m below the ground level at the location of the proposed semi-detached development buildings in Plots 3 and 4. Information from the client indicates that the foundations beneath the development buildings at this location are expected to bridge the sewer on piles.

1.3.2 Summary of Contaminative Site Characteristics

Evidence of potentially contaminative activities observed at the site include the former use of the site as lock-up garages and possible ACMs.

2.0 DESK STUDY REVIEW

Historical Ordnance Survey (OS) maps were obtained as part of the Envirocheck database search within report package reference 317445078 dated 26 September 2023, included within **Appendix I**. Database information within the Envirocheck report also includes reference to the hydrogeology, hydrology, subsidence and mining risk and ground gas hazards in the site area and is summarised in the following sections. A summary of the ground hazards for construction purposes is also included.

2.1 HISTORICAL REVIEW

Historical Ordnance Survey (OS) maps were reviewed, and the historical development of the site and the surrounding land is summarised in the following table.

Table 2.1: History of the Site and Surrounding Land

Date (scale)	Site History	Surrounding Land History
1868 (1:10,560) 1883 (1:10,560) 1890 (1:2,500) 1895 (1:2,500) 1897 (1:10,560) 1899 (1:2,500) 1900 (1:10,560) 1914 (1:2,500) 1916 (1:10,560)	The earliest historical mapping indicates that the site comprised undeveloped agricultural land or pasture at this time. The northern and eastern extents of the site are defined by tree lined field boundaries.	The earliest historical mapping indicates that the site was surrounded by agricultural land or pasture. A footpath is located outside the eastern boundary of the site. Knightscote Farm is located some 250m to the south of the site and Harefield some 500m to the west. A number of water wells are marked in the wider site area.
1934 (1:2,500)	No notable changes identified at the site.	Linear residential development noted along Northwood Road 225m to the north of the site, and allotment gardens 120m to the north-west.
1948 (aerial photograph 1:10,560) 1950 (1:10,560)	No notable changes identified at the site.	No notable changes identified in the nearby surrounding area.
1960 (1:2,500) 1965 (1:10,000)	No notable changes identified at the site.	Extensive residential development immediately north of the site as Ash Grove and further to the north-west as Leys Close.
1968 (1:2,500) 1976 (1:10,000) 1978 (1:2,500) 1990 (1:2,500) 1992 (1:2,500)	By the time of the 1968 mapping edition the site is shown to have been developed as a series of lock-up garages along two terraces in the north and east, and three garages in the south-west. Access is available via Sullivan Crescent in the north-west.	Extensive residential development immediately north-west and west of the site as Sullivan Crescent and further to the north-west as Gilbert Road. Knightscote noted immediately to the south-west.

Table 2.1: History of the Site and Surrounding Land		
Date (scale)	**Site History**	**Surrounding Land History**
1994 (1:2,500) 1999 (1:10,000)		
1999 (aerial photograph) 2003 (1:10,000)	No notable changes identified at site. Trees are evident along the northern and eastern boundaries of the site.	No notable changes identified in the nearby surrounding area.
2006-2009 (1:10,000) inclusive	No notable changes identified at site.	Replacement residential development at the location of the former Knightscote immediately south-west of the site.
2013-2016 (1:10,000)	The two main terraces of lock-up garages are shown to have been removed.	No notable changes identified in the nearby surrounding area.
2019 topographical survey 2023 (aerial photograph) 2023 current edition	The last remaining three lock-up garages are noted to have been removed by the time of the topographical survey drawing of 2019.	No notable changes identified in the nearby surrounding area.
Note: All distances are approximate.		

2.1.1 Summary of Historical Landuses

A review of the historical Ordnance Survey maps show that the site remained undeveloped agricultural land or pasture from the late 19th century until the late 1960s when a series of lock-up garages were constructed within the site.

The site layout remained essentially unchanged until the more recent clearance of the lock-up garages.

The surrounding area comprises agricultural land or pasture to the east. Extensive residential development occurred immediately north and north-west/west of the site by 1960 and 1968 in the form of Ash Grove and Sullivan Crescent respectively.

2.2 GEOLOGY, HYDROGEOLOGY AND HYDROLOGY

2.2.1 Anticipated Geology

Relevant geological information has been determined using the British Geological Survey (BGS) extract sheet 256 of North London, which have been summarised in table 2.1.1 below.

Table 2.2.1: Anticipated Geology

Stratum	Age	Possible Thickness (m)	Typical Description	Aquifer Status
Artificial/Made Ground None indicated on site	N/A	N/A	N/A	N/A
Superficial Gerrards Cross Gravel	Cromerian - Anglian	1 - 10 m, average 4 m thick.	Sand and gravel, locally with lenses of silt, clay or peat and organic material	Secondary (A) aquifer
Solid London Clay Formation	Ypresian	Up to 150m	Laminated, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay	Unproductive strata

The Envirocheck report indicates that there are no references to artificial ground, made ground, landslips or faults recorded within 500m of the site.

2.2.2 Ground Conditions – BGS Borehole and Trial Pit Records

There are no BGS recorded logs for historical drilling or excavation work located within 500m of the site.

The arisings from a relevant BGS borehole record in the wider site area, at a location some 660m to the west of the site are summarised in table 2.2.2, where the ground conditions encountered are similar to the anticipated geology expected beneath the site.

Table 2.2.2: Borehole and Trial Pit Records

BGS ID (distance and direction from site, m)	Depth of borehole (bgl)	Lithological sequence	Other notes/ Aquifer Status
TQ09SE31 (663m (W)	20.0m	GRAVEL, GRAVEL/SAND to 4.6m (expected to represent the Gerrards Cross Gravel). Firm becoming stiff and very stiff silty CLAY to 16.8m (London Clay Formation). Very stiff to hard silty CLAY to 20.0m (Reading	Standing water at 2.6m bgl (December 1980)

Table 2.2.2: Borehole and Trial Pit Records			
BGS ID (distance and direction from site, m)	**Depth of borehole (bgl)**	**Lithological sequence**	**Other notes/ Aquifer Status**
		Formation).	

2.2.3 Hydrogeology

The hydrogeology of the site has been determined by the superficial geology and the solid geology of the Gerrards Cross Gravel and the London Clay Formation which are classified by the Environment Agency as a secondary (A) aquifer and unproductive strata respectively.

Secondary (A) aquifers comprise permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers. Unproductive strata comprise rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

The groundwater vulnerability beneath the site is noted as classified as 'secondary superficial aquifer, low vulnerability'.

Both the Envirocheck report and the Environment Agency website (October 2023) indicate that the site is located within an Environment Agency Outer Zone II source protection zone (SPZ2).

The Envirocheck report indicates that the site is located in a groundwater flooding susceptibility area, where there is 'limited potential for groundwater flooding to occur'.

The Envirocheck report indicates that there are a number of references to groundwater abstraction licences for premises within 2000m of the site. The nearest references Harefield Hospital NHS Trust, at a location 870m to the north-west, where the abstraction is noted as 'Hospitals: Drinking; Cooking; Sanitary; Washing; (Small Garden)'. The nearest licences for 'potable water supply' is located 1873m to the east of the site.

2.2.3 Hydrology

The Envirocheck report indicates that there are no surface water features located within 250m of the site. The nearest water feature comprises what appears to be a pond 289m to the south.

The Envirocheck report indicates that there are no references to surface water abstraction licences for premises within 2000m of the site, including potable water supply.

The Envirocheck report indicates that there is one reference to a discharge consent (Sewage Discharges - Final/Treated Effluent - Not Water Company) within 250m of the site, at a location 245m to the south.

The Envirocheck report indicates that there are no references to pollution incidents to controlled waters within 250m of the site.

The site is not located in an area that is at risk of 'extreme flooding' or 'flooding' from rivers or sea without defences. The site is not located in a flood water storage area or in an area that benefits from flood defences.

The site is noted to be located in a surface water 1 in 100 and a 1 in 1000 year flood extent.

2.3 LANDFILLS AND BIO-GROUND GAS

The Envirocheck report indicates that there are no historical landfills, no Local Authority recorded Landfills, no references to potentially infilled land (non-water or water), no registered landfills, registered waste treatment or transfer facilities within 250m of the site.

Table 2.3 summarises the gas risk for the site, based on the above information gained through the desk-based research. In accordance with current guidance (CIRIA C665), the gas generation potential for each source has been individually assessed, with references to potential gassing risk made according to the following definitions: Negligible, Very Low, Low, Moderate, High and Very High. The definitions are explained in Section 10.0 of the guidance.

The objective of this exercise is to determine if potentially unacceptable ground gas risks exist, and whether further investigation and assessment is necessary.

Table 2.3: Preliminary Bio-Ground Gas Risk Assessment

Potential Source	Risk	Risk Rating	Rationale
Made Ground (CO_2 + CH_4)	Human health Explosion	Very low	Nominal Made Ground is anticipated due to the development of the site as lock-up garages. However, it is not anticipated that sufficiently thick units of organic Made Ground exist and thus a very low risk of ground gas production is considered. The site is underlain by the superficial strata of the Gerrards Cross Gravel above the solid geological strata of the London Clay Formation.
Alluvial Strata (CO_2 + CH_4)	Human health Explosion	Negligible	No alluvium noted within 250m of the site.
Landfills	Human health	Negligible	No landfill sites noted within 500m of the site.

(CO_2 + CH_4)	Explosion		
Infilled Ground + Burial Sites (CO_2 + CH_4)	Human health Explosion	Negligible	No infilled ground noted within 250m of the site.
Coal Mining (CO_2 + CH_4)	Human health Explosion	Negligible	Not located in a coal mining area.
Soil Vapours	Human health Explosion	Very Low	Soil vapour risks identified associated with potential for small-scale hydrocarbon storage and spillages, and maintenance of vehicles at the lock-up garages across the site, as well as the three chambered interceptor in the north-west of the site.
COMBINED RISK RATING = VERY LOW			

A VERY LOW combined risk is considered in relation to bio-ground gas ingress into the new homes, and bio-ground gas monitoring would be considered prudent.

2.4 RADON GAS

The Envirocheck report indicates that the property is in a 'lower' probability radon area (less than 1% of homes are estimated to be at or above the Action Level), and that no radon protection measures are required.

The UK Health Security Agency (HSA) has also published reports containing Radon Affected Area maps for the whole of the United Kingdom, and (in October 2023) the site is noted to be located in an area where 'some parts of this 1km grid square are in bands of elevated radon potential. Maximum radon potential is 1-3%. Check the radon potential of individual addresses at ukradon.org'.

Notwithstanding the above, a Radon report is recommended immediately prior to the re-development as radon guidance periodically changes and the above advice may be outdated by the time of any re-development. The UK HSA website (ukradon.org) can be used to purchase radon reports.

2.5 GROUND STABILITY, NATURAL CAVITIES AND MINING HAZARDS

Table 2.5 indicates potential ground stability, natural cavities and mining hazards identified within the Envirocheck report for the site.

These will be considered in terms of the proposed development and detailed in the following section 2.5, Preliminary Ground Hazards Summary.

Table 2.5: Ground Stability, Natural Cavities and Mining	
Hazard	**Ground Stability and Natural Cavities Hazard Potential**
Potential for Collapsible Ground Stability	Very Low
Potential for Compressible Ground Stability	No Hazard
Potential for Ground Dissolution	No Hazard
Landslides	Very Low
Running Sands	Very Low
Shrink-Swell Clay	No Hazard
Natural Cavities	None within 500m
Hazard	**Mining Hazard Potential**
BGS recorded mineral sites	None within 500m
Coal mining affected areas	No Hazard
Mining instability	No Hazard
Man-made mining cavities	No Hazard
Non coal mining areas of Great Britain	No Hazard
Potential mining areas	No Hazard
Infilled Land	No potentially infilled land (non-water or water) noted in the Envirocheck report within the site extents or within 250m of the site.
Other mining/quarrying	No surface workings indicated within the site extents, or within the immediate vicinity.

Information from the Envirocheck report indicates that there is no potentially infilled land (non-water or water) within the site extents. The Envirocheck report also indicates that there are no references to made ground or artificial ground within the site extents.

The site is not affected by man-made mining cavities, nor is it located in a coal mining affected area. The site is not located within a non-coal mining area of Great Britain.

2.6 PRELIMINARY GROUND HAZARDS SUMMARY

The following Table 2.6 provides a summary of the preliminary ground hazards identified with the ground and groundwater conditions and historical site use as determined from the desk-based information accumulated within the PRA.

Table 2.6: Preliminary Ground Hazards Summary		
Ground Hazard	**Plausible**	**Description**
Topographic		
Site constraints	❍	Restricted site access and substantial hard surfacing.
Slopes, embankments, cuttings	❍	Foundation type and construction difficulties. Remedial measures to stabilise slopes, embankments and cuttings, and mitigate risks of landslides.
Man-made		
Filled ground/ made ground/ infilled basements	❍	Foundation type and construction difficulties.
Existing foundations and below ground structures	❍	Foundation type and construction difficulties. Obstructions to new construction. Influence of existing and adjacent foundations to new construction. Vibration associated with the construction technique.
Mining instability	❍	Foundation type and construction difficulties. Appropriate mining investigation.
Ground chemistry	❍	Sulphate and sulphide attack on buried concrete. Design to BRE DS-1. Expansive blast furnace slag.
Unexploded Ordnance	❍	Detailed unexploded ordnance (UXO) risk assessment did not form part of our project instruction.
Geological		
Frost action	❍	Susceptibility of soils affected at pavement and foundation formation. Provision of non-frost susceptible materials.
Lateral soil instability	❍	Foundation type and construction difficulties. Provision of temporary works – shoring.
Soft clays, silts and compressible soils	❍	Foundation type and construction difficulties. Sufficient bearing resistance to support the proposed construction.
Shrinkable soils	❍	Foundation type and construction difficulties. Influence of trees on foundation depths. Potential for desiccation to have occurred and heave protection. NHBC Standards Chapter 4.2, Building Near Trees.
Ground dissolution of soluble rocks	❍	Foundation type and construction difficulties. Dynamic probing, torque readings.

Table 2.6: Preliminary Ground Hazards Summary		
Ground Hazard	**Plausible**	**Description**
Ground chemistry	❍	Naturally occurring sulphate and sulphide attack on buried concrete. Design to BRE DS-1.
Hydrogeological/Hydrological		
Elevated or rising groundwater	❍	Foundation type and construction difficulties. Provision of temporary works – dewatering (possibly well-points) in shallow excavations. Provision of temporary works – shoring. Running sand. Reduced bearing resistance. Ongoing serviceability of basements. Effectiveness of soakaway drainage.
Fluvial or coastal scour/erosion	❍	Foundation type and construction difficulties. Remedial or preventative measures.
❍ - Further action required. Potentially plausible hazard. ❍ - Unlikely to represent a hazard, no further consideration required.		

Due to the potential for seasonal elevated groundwater in the Gerrards Cross Gravel, the required bearing resistance of the proposed buildings, the influence of trees, and the presence of a moderately deep three-chambered interceptor and surface water sewer, a conventional shallow foundation solution may not be appropriate. Consideration may therefore need be given to supporting the proposed buildings on piled foundations.

A suitable ground investigation would confirm an appropriate foundation solution.

Shallow soakaway drainage may be successful given the potential for permeable coarse soils anticipated at shallow depth, subject to seasonal groundwater monitoring and soil infiltration testing.

3.0 REGULATORY INFORMATION, CONSULTATIONS AND OTHER

Unless otherwise stated regulatory database information has been obtained from the Envirocheck report included as **Appendix I.**

3.1 STATUTORY REGISTERS AND AUTHORISATIONS

Table 3.1 includes the statutory registers and authorisations that relate to the site and surrounding area. Pertinent registers and authorisations will be used in conjunction with the desk-based review to determine the preliminary environmental risk.

Table 3.1: Statutory Registers and Authorisations

Item	0 – 250m	251 – 500m
Contaminated Land Register Entries and Notices	0	0
Records of Licensed Discharge Consents	245m S - Sewage Discharges - Final/Treated Effluent - Not Water Company	0
Prosecutions Relating to Controlled Waters	0	0
Enforcements and Prohibition Notices	0	0
Integrated Pollution Controls	0	0
Integrated Pollution Prevention and Control	0	0
Local Authority Integrated Pollution Prevention and Control	0	0
Local Authority Pollution Prevention and Controls	0	0
Local Authority Pollution Prevention and Control Enforcements	0	0
Pollution Incidents to Controlled Waters	0	1
Substantiated Pollution Incident	0	0
Prosecutions Relating to Authorised Processes	0	0
Registered Radioactive Substances	0	0
Records of Water Industry Act Referrals	0	0

Table 3.1: Statutory Registers and Authorisations		
Item	**0 – 250m**	**251 – 500m**
Explosive Sites	0	0
Planning Hazardous Substance Consents/Planning Hazardous Substance Enforcements	0	0
Notification of Installations Handling Hazardous Substances (NIHHS) Facilities and Control of Major Accident Hazards Facilities (COMAH)	0	0
Fuel Stations	0	0
Contemporary Trade Directory Entries	No Contemporary Trade Directory Entries within the site. The nearest entries within 250m are as follows: 21m SW - Pestbusters - Pest & Vermin Control - Inactive 185m N – Marble Plus - Fireplaces & Mantelpieces - Inactive 236m NE – Upgrade Pest Control Services - Pest & Vermin Control - Inactive	
National Grid High Voltage Underground Electricity Transmission Cables	0	0
National Grid High Pressure Gas Transmission Pipelines	0	0
Item	**Immediate Vicinity**	
Sensitive Land Uses	The land immediately east of the site is located in an Area of Adopted Green Belt. The site is located in a nitrate vulnerable zone. Ancient woodland is located 149m and 178m to the east and south-east of the site respectively.	

3.2 CONSULTEES

3.2.1 Local Authority - Contaminated Land Officer

The Local Environmental Health Department has not been contacted as part of our project instruction.

3.2.2 Local Authority - Building Control Officer

The Local Planning Authority Building Control Officer has not been contacted as part of our project instruction.

3.2.3 Local Authority - Petroleum Officer

The Local Planning Authority Petroleum Officer has not been contacted as part of our project instruction.

3.2.4 Environment Agency - Contaminated Land and Groundwater

The Contaminated Land and Groundwater Team of Environment Agency has not been contacted as part of our project instruction.

3.2.5 Coal Authority and Mining Searches UK

The Coal Authority and Mining Searches UK have not been contacted as part of our project instruction.

4.0 PRELIMINARY RISK ASSESSMENT

4.1 METHODOLOGY

A tier 1 PRA and CSM have been prepared in accordance with the technical approach on Land Contamination Risk Management (LCRM), which replaced 'CLR11'. Possible hazards identified by a potential source of contamination and sensitive receptors have been assessed via a source-pathway-receptor (SPR) model in accordance with current UK protocols. A risk may only exist where a plausible SPR linkage is viable and where the quantity or concentration of a contaminant (source) is sufficient to cause harm. Under the statutory definition "Contamination" may only exist where contaminants pose a risk of harm to a receptor. Risk may be defined as a function of the likelihood and severity of any adverse effects resulting from a contamination event in accordance with CIRIA C552. A summary of how risk is derived and the associated definition is presented in tables 4.1.1 and 4.1.2.

Table 4.1.1: Risk Ratings Matrix

	Consequence			
Probability	**Severe**	**Medium**	**Mild**	**Minor**
High Likelihood	Very high risk	High risk	Moderate Risk	Moderate/low risk
Likely	High risk	Moderate Risk	Moderate/low risk	Low risk
Low Likelihood	Moderate Risk	Moderate/low risk	Low risk	Very low risk
Unlikely	Moderate/low risk	Low risk	Very low risk	Very low risk

Table 4.1.2: Risk Ratings Definition

Risk Rationale	Definition
Very high risk	A high probability that severe harm could occur to determined receptor from identified contaminant - OR - evidence exists that severe harm to receptor is currently occurring. Urgent investigation and remediation should be considered. If demonstrated this risk is likely to result in substantial liability.
High risk	Harm is likely to occur to determined receptor from identified contaminant. Urgent investigation and short-term risk minimisation remediation followed by longer term fit for purpose remediation should be considered. If demonstrated this risk is likely to result in substantial liability.
Moderate Risk	It is possible that harm could occur to a determined receptor from identified contaminant. It is relatively unlikely that any harm would be severe or should harm occur it is likely to be relatively mild.
Moderate/low risk	It is possible that harm could occur to a determined receptor from identified contaminant. It is unlikely that any harm would be severe or should harm occur it is probable to be relatively mild.
Low risk	It is possible that harm could occur to a determined receptor from identified contaminant. It is unlikely that such harm, if indeed present, would at worst be mild.
Very low risk	There is a low possibility that harm could occur to a receptor. In such event the harm would not be severe.

4.2 POTENTIAL SOURCES OF CONTAMINATION

Based on the desk-study and walkover survey completed, table 4.2 presents a summary of the potential sources identified.

Table 4.2: Potential Sources		
Source	**Description**	**Key Contaminants of Concern**
1. Site-wide soil contamination	Risk of soil contamination within the site associated with historical lock-up garage use and the presence of Made Ground.	Metals, hydrocarbons (TPH/PAH), asbestos.
2. Local soil contamination	Risk of soil contamination from the interceptor chamber.	Hydrocarbons (TPH)/PAH)
3. Asbestos	Risk of Asbestos Containing Soils (ACS) and Asbestos Containing Materials (ACMs) from former buildings.	Asbestos.
4. Groundwater	Metals, hydrocarbons (TPH/PAH).	Site is underlain by a secondary (A) aquifer.
5. Ground gases/vapours	Very low risk of hazardous ground gases is anticipated.	Hazardous ground gas. Complete monitoring.
TPH – Total Petroleum Hydrocarbons PAH – Polycyclic Aromatic Hydrocarbons		

4.3 PATHWAYS

A pathway is one or more routes or means that a receptor can be exposed to, or affected by, a contaminant.

Table 4.3: Plausible Pathways
On-Site and Locally
Direct contact; to humans and infrastructure
Underlying geology/*hydrogeology; shallow solid geology comprising secondary (A) aquifer above unproductive strata*
Inhalation and ingestion
Surface run-off/drainage

4.4 RECEPTORS

A receptor is either a living organism, a group of organisms, an ecological system, controlled waters or property that could be harmed or polluted by a contaminant. Table 4.4 examines the potential receptors.

Table 4.4: Potential Receptors			
Receptor	**Description**	**Comments**	**Plausible**
Construction workers	Groundworkers and general construction works	Construction works proposed within the site	Yes
End users	Occupants of the proposed development	Gardens proposed across the site.	Yes
Adjacent land users	Occupants of surrounding residencies	Adjacent residential dwellings which could be affected by run-off or migration.	Yes
Soft landscaping	Areas of new planting including lawns	Gardens proposed across the site.	Yes
Water supply pipes	Plastic pipework for potable water supply to housing may be affected if laid in contaminated soils	New supply required for redevelopment.	Yes
Buildings & infrastructure	Buried concrete for new foundations may be in contact with aggressive ground (sulphur attack)	New building works proposed.	Yes
Groundwater	Controlled waters (aquifers) beneath the site	Site underlain by a secondary (A) aquifer above unproductive strata. Site is located in an SPZ2. Hospitals: Drinking; Cooking; Sanitary; Washing; (Small Garden) groundwater abstraction point 870m north-west.	Yes
Surface waters	Controlled water such as lakes, streams, rivers or coastal waters	No rivers within the immediate vicinity.	No
Ecological receptors	Sensitive areas of ecological significance defined under Part 2A of EPA 1990	Site is located on the edge of an urban area adjacent an Area of Adopted Green Belt.	Yes

4.5 SUMMARY OF POLLUTANT LINKAGES FOR PROPOSED LAND USE - INITIAL CSM

The initial CSM is based upon the proposed site end use and the information currently consulted relating to various risk sources and plausible pollutant linkages and is presented within table 4.5.

Table 4.5: Initial Conceptual Site Model (for plausible pollutant linkage pathways)						
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Risk & Justification**	**Linkage No.**
Source 1 Site-wide soil contamination	Construction workers	Direct contact	Likely	Medium	Moderate *Note 1*: Site previously in use as lock-up garages. Potential for asbestos arising from the building materials and possibly hydrocarbons from vehicle usage.	1
	End users	Direct contact	Likely	Medium	Moderate *See Note 1/*	2
	Adjacent land users	Direct contact via run-off	Low likelihood	Medium	Moderate/Low *Note 2*. The site is underlain by a Secondary Aquifer. Former lock-up garages on site as noted above. Site mostly covered in hardstanding (garage floor slabs and tarmac).	3
	Soft landscaping	Root uptake	Likely	Medium	Moderate *See Note 1* and in addition; limited vegetation cover at the site for comparison, but no significant die-back observed.	4
	Water supply pipes	Direct contact	Likely	Medium	Moderate *See Note 1.*	5
	Buildings & infrastructure	Direct contact	Likely	Medium	Moderate *See Note 1.*	6
	Groundwater	Vertical migration through hydrogeology	Low likelihood	Mild	Low *Note 3:* The site is underlain by a Secondary (A) Aquifer. Sources of contamination expected to be shallow in the form of local spills, though no evidence of spills observed. Site previously in use as lock-up garages.	7
	Surface waters	Vertical and lateral migration through	Unlikely	Mild	Very Low *Note 4*. Site underlain by a secondary (A) aquifer above unproductive strata. No	8

Table 4.5: Initial Conceptual Site Model (for plausible pollutant linkage pathways)						
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Risk & Justification**	**Linkage No.**
		hydrogeology			surface water or main rivers noted within 250m of the site.	
	Ecological receptors	Run-off. Direct contact.	Low likelihood	Mild	Low *Note 5*. Possible ecological receptors in the immediate vicinity	9
Source 2 Local soil contamination	Construction workers	Direct contact	Unlikely	Mild	Very Low *Note 6.* Limited risk potential in the event interceptor chambers are removed.	10
	End users	Direct contact	Unlikely	Mild	Very Low *See Note 6* and in addition the area of the interceptor chambers shall be covered by the new access road.	11
	Adjacent land users	Direct contact via run-off	Unlikely	Mild	Very Low *See Note 6.*	12
	Soft landscaping	Root uptake	Unlikely	Mild	Very Low *See Note 6.*	13
	Water supply pipes	Direct contact	Likely	Medium	Moderate *See Note 6* and in addition new water supply may pass area of interceptors.	14
	Buildings & infrastructure	Direct contact	Unlikely	Mild	Very Low *See Note 6.*	15
	Groundwater	Vertical migration through hydrogeology	Low likelihood	Medium	Moderate/Low *See Note 6* and in addition should interceptors have leaked local contamination may be expected.	16
	Surface waters	Vertical and lateral migration through hydrogeology	Unlikely	Mild	Very Low *See Note 4*.	17
	Ecological receptors	Run-off. Direct	Unlikely	Mild	Very Low *See Note 6.*	18

Table 4.5: Initial Conceptual Site Model (for plausible pollutant linkage pathways)						
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Risk & Justification**	**Linkage No.**
		contact.				
Source 3 Asbestos	Construction workers	Inhalation	Low likelihood	Mild	Low *Note 7*. Asbestos may be present should this have been used in the former garage construction.	19
	End users	Inhalation	Low likelihood	Mild	Low *See Note 7.*	20
	Adjacent land users	Inhalation	Unlikely	Mild	Very Low *See Note 7* though risk reduced due to distance to receptor.	21
Source 4 Groundwater	Construction workers	Direct contact	Unlikely	Mild	Low *Note 8*. Groundwater contamination possible due to lock-up garages, though potential sources of limited and local. No viable pathway.	22
	End users	Direct contact	Unlikely	Mild	Very Low *See Note 8.*	23
	Adjacent land users	Direct contact	Unlikely	Mild	Very Low *See Note 8.*	24
	Soft landscaping	Root uptake	Unlikely	Mild	Very Low *See Note 8.*	25
	Water supply pipes	Direct contact	Unlikely	Mild	Very Low *See Note 8.*	26
	Groundwater	Lateral migration through hydrogeology	Low likelihood	Mild	Low *See Note 8.*	27
Source 5 Ground gases and Soil vapours (on/off site	Construction workers	Inhalation of vapours/gas	Low likelihood	Minor	Very Low *Note 9.* Limited of ground gas and vapours identified on-site. Site is underlain by Gerrards Cross Gravel which may enable migrating ground	28

Table 4.5: Initial Conceptual Site Model (for plausible pollutant linkage pathways)						
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Risk & Justification**	**Linkage No.**
source)					gases due to its permeability. Risk reduced due to dispersion in outdoor air.	
	End users	Inhalation of vapours/gas	Low likelihood	Minor	Very Low *See Note 9.*	29

The overall environmental risk classification for the site is considered to be generally **MODERATE/LOW** and as such pollutant linkages resulting in a low risk or greater should be investigated in a suitable manner. Where risks are considered to be very low, further investigation is not considered necessary.

4.5 CONSIDERATIONS FOR SITE INVESTIGATION

Table 4.5 provides a summary risk to outline further investigation in order complete the risk assessment.

Table 4.5: Environment Risk Actions		
Media	**Investigative Action**	**Risk Summary**
Soils	Complete site-wide soil contamination and soil asbestos testing.	Risk to construction workers, end users and adjacent land users in the event of soil contamination. Construction workers should wear appropriate PPE.
		Risk to soft landscaping in the event of physically unsuitable strata and phytotoxic elements.
		Risk to water supply in the event of soil contamination.
		Risk to buildings and infrastructure from sulphate attack.
Local Soils	Complete soil contamination testing adjacent the contaminative features of interest.	Risk to construction workers, end users and adjacent land users in the event of soil contamination. Construction workers should wear appropriate PPE.
		Risk to soft landscaping in the event of physically unsuitable strata and phytotoxic elements.
		Risk to water supply in the event of soil contamination.
		Risk to buildings and infrastructure from sulphate attack.
Groundwater	Complete water contamination testing where required, following soil screening.	Risk to secondary (A) aquifer
Ground Gas	Install monitoring wells and complete precautionary hazardous ground gas and vapour	Risk to end users.

Table 4.5: Environment Risk Actions		
Media	**Investigative Action**	**Risk Summary**
	monitoring.	

To assess the Moderate/Low risk the following analysis should be completed:

- Aviron's "**ES-1**" of laboratory analysis shall be applied to future site investigations which includes; arsenic, barium, cadmium, total chromium, copper, nickel, zinc, lead, mercury, selenium, water soluble boron, total cyanide, total sulphate, water soluble sulphide, speciated Polycyclic Aromatic Hydrocarbons (PAH), speciated Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethylbenzene, Xylenes (BTEX) and Methyl Tert-Butyl Ether (MTBE), organic matter, total phenols, pH and asbestos. **Provides broad analysis of common soil contaminants.**

The listed suite of analysis is considered suitable and will provide a screening for the majority of commonly found soil contaminants, which shall be followed through into the site investigation.

5.0 SITE INVESTIGATION WORK

5.1 METHOD STATEMENT AND SITE INVESTIGATION APPROACH

A method statement detailing how the site investigation was to be conducted was produced in accordance with current statuary guidance, best practices and the Client's instructions.

A health and safety plan was completed before site work commenced. Site investigation staff were briefed on the potential contaminants likely to be encountered, and the appropriate personal protective equipment (PPE) to be adopted for this type of investigation.

The site investigation was conducted in accordance with British Standards; BS5930:2015+A1 'Code of Practice for Ground Investigation', BS1377-1:2016 'Methods of test for soils for Civil Engineering Purposes' and BS10175:2011+A2:2017 'Investigation of Potentially Contaminated sites'.

5.2 SITE INVESTIGATION METHODS

Section 4.5 prepared an initial CSM where pollutant linkages with a greater risk than low would require suitable investigation. Table 5.2 presents what it considered to be a suitable method and rationale of investigation which was completed on 27 September 2023 and 2 October 2023.

Table 5.2: Rationale of Site Investigation Positions

Location	Rationale	Monitoring Well
	Window Sample (WS) Boreholes	
WS1	Southern end of the site beneath the building in Plot 6, to determine ground conditions and enable soil sampling. Positioned for spatial coverage. The window sample borehole was also located in close proximity to a nearby ash tree.	Gas and groundwater monitoring well installed to 2.0m.
WS2	Southern end of the site beneath the building in Plot 5, to determine ground conditions and enable soil sampling. Positioned for spatial coverage.	Not installed.
WS3	Southern end of the site beneath the front elevation of the building in Plot 5, to determine ground conditions and enable soil sampling. Positioned for spatial coverage. The window sample borehole was also located in close proximity to a nearby ash tree.	Gas and groundwater monitoring well installed to 2.3m.
WS4	North-east of the site beneath the side elevation of the building in Plot 4, to determine ground conditions and enable soil sampling. Positioned for spatial coverage.	Not installed.
WS5	Northern end of the site beneath the rear elevation of the building in Plot 2, to determine ground conditions and enable soil sampling. Positioned for	Gas and groundwater monitoring well installed to 2.0m.

	spatial coverage. The window sample borehole was also located in close proximity to a nearby oak tree.	
WS6	Northern end of the site between the frontages of Plots 2 and 3, to determine ground conditions and enable soil sampling. Positioned for spatial coverage.	Not installed.
	Cable Percussion Borehole (BH)	
BH1	Positioned in the centre of the site to determine ground conditions at increased depth to enable piled foundation design if required.	Not installed.

Exploratory Hole Location Plans are enclosed as **Figures 6** and **7.**

All intrusive locations were pre-cleared prior to the ground investigation works using a Cable Avoidance Tool (CAT) and tracing of manhole covers, which was completed to endeavour service avoidance during this exercise.

5.2.1 Window Sample Drilling

Window sample boreholes WS1 to WS6 were drilled to depths of 5.0m bgl using an Archway Dart drilling rig.

The purpose of the window sampling was to evaluate ground conditions at shallow depths, collect soil samples for geochemical and geotechnical laboratory analysis and to determine soil strength by means of SPTs.

The action of window sampling also enables the installation of monitoring wells to determine standing groundwater levels and ground gas testing.

Standard Penetration Tests were undertaken at 1m intervals to depths of 5.0m bgl within the boreholes in accordance with BS EN SO 22476-3 “Standard Penetration Test 2005”. Drilling refusal (SPT > 50 blow counts) occurred locally in the overlying dense SAND soils where the drilling was terminated to prevent damage to the drilling rig and tooling.

Disturbed soil samples were also collected from bored arisings for geochemical and geotechnical laboratory tests which are further discussed within section 6.0.

5.2.2 Cable and Percussion Borehole

A cable and percussion borehole (BH1) was drilled using a Pilcon 1500 drilling rig to a depth of 25.0m bgl in the centre of the site.

The purpose of the cable and percussion borehole was to evaluate ground conditions to a depth suitable to enable piled foundation design, collect soil samples for geochemical and geotechnical laboratory analysis and

to determine soil strength by means of Standard Penetration Testing (SPTs).

The borehole was drilled using 150mm diameter casing and tooling to attain the required depth of 25.0m bgl.

Standard Penetration Tests were undertaken at 1m intervals to 10m bgl and at 2m intervals below within the borehole in accordance with BS EN SO 22476-3 "Standard Penetration Test 2005".

Undisturbed and disturbed soil samples were also collected from bored arisings for geochemical and geotechnical laboratory tests which are further discussed within section 3.5.

5.2.3 Dynamic Cone Penetrometer (DCP/TRL)

Five Dynamic Cone Penetrometer (DCP) tests (DCP1-DCP5) were undertaken to determine design parameters (California Bearing Ratio, or CBR) for road pavement construction in accordance with the Transport Research Laboratory (TRL), commencing at ground level, to a depth of 0.9 m bgl.

The tests were undertaken at the locations included in **Figures 6** and **7**.

5.3 GROUND CONDITIONS

The exploratory hole logs and photographs are presented within **Appendix II**.

Detailed strata descriptions are shown on the respective exploratory hole logs though in general ground conditions comprise:

- Concrete hardstanding, to depths of up to 0.25m bgl.
- MADE GROUND noted routinely across the site to depths of between 0.4m and 0.9m bgl.
- Overlying natural horizon of medium dense and dense becoming locally very dense slightly clayey becoming gravelly and very gravelly SAND (Gerrards Cross Gravel) to depths of between 1.9m and 2.5m bgl.
- Firm and stiff, high strength, becoming very stiff, becoming fissured silty CLAY (London Clay Formation) to the termination depth of BH1 at 25.0m bgl.
- Claystone was noted between 9.7m and 9.9m bgl.

5.3.1 Field Observations

No discernible evidence of contamination, including odours or staining noted during the site investigation

work.

No significant roots or rootlets were recorded during the site investigation work.

5.4 GROUNDWATER LEVELS

5.4.1 Groundwater Levels: During Site Investigation Works

Groundwater was encountered during the site investigation works completed on 27 September 2023 and 2 October 2023 at the depths detailed in table 5.4.1 below.

Table 5.4.1: Groundwater During Investigation		
Location	**Depth – bgl (during GI)**	**Comments**
WS1	Seepage at 1.5m, borehole wet at base.	The seepage may represent perched water held in the overlying SAND horizons or as fissure flow held within the London Clay Formation.
WS2	Seepage at 1.0m	
WS3	Dry to 2.3m	
WS4	Dry to 3.0m	
WS5	Dry to 2.0m	
WS6	Seepage at 2.1m	
BH1	Dry to 25.0m bgl	

5.4.2 Groundwater and Gas Monitoring Wells

Selected boreholes were converted to monitoring wells to enable standing groundwater level monitoring and ground gas monitoring. Wells were installed into 101mm diameter window sample boreholes using 63mm external diameter and 50mm internal diameter HDPE standpipe.

Table 5.4.2 describes the construction of the wells.

Table 5.4.2: Monitoring Well Construction			
Location	**Depth of plain pipe and bentonite seal (m)**	**Response zone; depth of slotted pipe with gravel screen (m)**	**Depth of install (m)**
WS1	Ground level (GL)-1.0	1.0-2.0	2.0
WS3	GL-1.0	1.0-2.3	2.3
WS5	GL-1.0	1.0-2.0	2.0

5.4.3 Groundwater and Gas Post-Investigation Monitoring

In all instances and prior to completing groundwater monitoring and field measurements bulk ground gases and soil vapours were monitored using a GFM 435 Gas Analyser and miniRAE Photon-Ionisation Detector (PID) on the dates shown in table 5.4.3, which provides standing level groundwater 'dips' during post-investigation monitoring.

Table 5.4.3: Groundwater Monitoring Depths

Location / Date	Depth – bgl WS1	Depth – bgl WS3	Depth – bgl WS5
3 October 2023	Unable to access well	1.34m	0.85m
10 October 2023	Unable to access well	1.24m	1.82m
19 October 2023	Unable to access well	1.02m	1.63m

Further to comments regarding groundwater made within table 5.4.1 it is likely the water encountered is perched within the overlying SAND horizon (secondary (A) aquifer) or fissure flow locally held within the London Clay Formation.

Ground gas monitoring is discussed in section 9.0 of this report.

Field monitoring sheets are enclosed in **Appendix III**.

6.0 LABORATORY ANALYSIS

6.1 SOIL GEOCHEMICAL TESTING

Table 6.1 details the soil samples which were collected and submitted for geochemical analysis.

Table 6.1: Soil Geochemical Testing

Location	Strata Sampled	Objective	Analysis
WS1 (0.4m)	Made Ground	Shallow sample to determine baseline concentrations of Made Ground (southern coverage).	ES-1
WS2 (0.3m)	Made Ground	Shallow sample to determine baseline concentrations of Made Ground (southern coverage).	ES-1
WS3 (0.5m)	Made Ground	Shallow sample to determine baseline concentrations of Made Ground (southern coverage).	ES-1
WS4 (1.0m)	Natural Sand	Deeper sample to determine baseline concentrations of natural Sand (north-east coverage).	ES-1
WS5 (0.3m)	Made Ground	Shallow sample to determine baseline concentrations of Made Ground (northern coverage).	ES-1
WS6 (0.3m)	Made Ground	Shallow sample to determine baseline concentrations of Made Ground (northern coverage).	ES-1

Chemical sampling and testing targeted the overlying units of Made Ground and natural Sand strata whereby virtue of surface deposition historical contaminants are most likely to be recorded. The purpose of sampling slightly deeper natural strata is to generate a baseline understanding of natural soil chemistry and to understand phytotoxic elements at depths of root growth.

The analytical suites were chosen to provide a suitable screening in accordance with the potential contaminants identified within the site conceptualisation presented within section 4.5.

Soil samples for environmental quality analysis were sent to i2 Analytical Limited.

6.2 SOIL GEOTECHNICAL TESTING

A programme of geotechnical laboratory testing was undertaken at K4 Soils Laboratory and i2 Analytical Limited. Testing was completed on the fine and coarse soils encountered beneath the site. The test procedures used were generally in accordance with the methods described in BS1377:1990. Details of testing used are provided in table 6.2.

Table 6.2: Soil Geotechnical Testing		
Test	**Standard**	**Number of Samples**
Atterberg Limits (and Moisture Content) *The objective of Atterberg limits and moisture content testing is to determine plasticity and volume change potential of fine (clay and silt) soils and the potential for desiccation to have occurred*	BS1377: 1990: Part 2: Clause 3.2, 4.5, 5.0	6 (6)
Particle Size Distribution (PSD) *The objective of PSD testing is to determine grading of coarse (sand and gravel) soils*	BS1377: 1990: Part 2: Clause 9.2	3
Undrained Triaxial (TXL) *The objective of TXL testing is to determine shear strength of fine (clay and silt) soils*	BS1377: 1990: Part 7: Clause 8 or 9	3
Aviron LC Suite - pH, water soluble sulphate, total sulphate & total sulphur *To enable concrete classification to be specified*	UKAS accredited	10 (including 6 within the Suite 1 analysis)

6.3 SOIL SAMPLING PROTOCOL

All soil samples were collected from bored or excavated arisings using a trowel and following Aviron's standard protocols for soil sampling. To avoid cross contamination, the sampling equipment was cleaned using de-ionised water after each sample was retrieved.

Clean latex gloves were used each time a soil sample was collected, and all samples were placed into clean sterilised jars for submission to the UKAS/MCERTS accredited laboratory.

All sample containers were labelled on-site immediately prior to filling. These samples were identified by a label placed on the body of each container and the following information was recorded; site name, date collected, unique sample number, soil sample depth.

Samples for geochemical analysis were then placed into a cool box containing ice packs to maintain refrigerated conditions following collection and transport to the laboratory. Ice packs were changed every twenty-four hours where necessary to maintain cool conditions and suppress volatiles.

7.0 ENVIRONMENTAL INTERPRETATIVE GUIDANCE

7.1 GENERIC QUANTITATIVE RISK ASSESSMENT

The purpose of a tier 2 GQRA is to determine the suitability of the site for proposed development and end use.

The site investigation shall collect soil samples whereby determinant chemical measured in the soil through laboratory analysis have been compared with guidance values which are appropriate to the receptor under consideration. The guidance values or screening criteria applied shall be industry adopted generic values which following a screening of the laboratory analysis shall determine whether or not a site is contaminated, as defined under Part IIA of the EPA 1990 and specification in regard of the proposed development and identified receptors.

Where exceedances of guidance values or recorded a GQRA is can be used to appraise risk and make recommendations in regard of further investigation, remediation and/or tier 3 Detailed Quantitative Risk Assessment (DQRA).

7.2 GUIDANCE USED FOR ASSESSING SOIL CONTAMINATION

Aviron has followed the technical approach on Land Contamination Risk Management (LCRM), accessed on gov.uk website and other available guidance to assess contaminant concentrations.

Details of the methodology and Aviron's position on the adoption of guidance values is outlined below.

The available chemical data, from soil samples tested, is sorted into appropriate datasets depending on sampling regime and ground conditions. An initial GQRA is completed using the relevant and industry available screening criteria and where appropriate, statistical modelling. Risks to human health shall be initially assessed by comparing soil chemical data against various published screening criteria. These have been sourced from the following and in order of preference:

- Category 4 Screening Levels (C4SLs) prepared by the Department of Environmental Food and Rural Affairs (DEFRA) and published March 2014.
- Phase 2 C4SLs prepared by CL:AIRE and published May 2021.
- Suitable 4 Use Levels (S4ULs) prepared by Land Quality Management/Chartered Institute of Environmental Health (LQM/CEIH) and published December 2014. LQM acknowledgement for use of S4ULs. *"Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3275. All rights reserved".*

- Soil Guidance Values (SGVs) prepared by the Environment Agency (EA)/DEFRA and published 2009.
- Soil Generic Assessment Criteria (GAC) prepared by Environment Industries Commission (EIC)/Association of Geotechnical and Geoenvironmental Specialists (AGS)/Contaminated Land: Application In Real Environments (CL:AIRE) and published 2010.

Aviron have adopted the above hierarchy in response to LCRM recommendations.

7.3 GUIDANCE USED FOR THE ASSESSMENT OF HAZARDOUS GROUND GAS

The principal influence for causing the migration of landgas in the ground is changes to barometric pressure. The most onerous landgas emission conditions on a site are usually observed following days of low or rapidly falling barometric pressure below 1000 millibars (mb).

Monitoring is usually performed over a period of several weeks or months in order to increase the chances of visiting the site on days when the conditions for monitoring worst-case results are correct. Gas monitoring results collected solely during high pressure conditions (>1000mb) may not provide a true value for worst case emission rates from the site.

Methane is produced by a number of processes, which can be biological or chemical in nature. The principal process is from the biogenic decay of organic material and is commonly found associated with landfill and organic marsh deposits or river silts. Methane can also be found associated with coal workings. It is explosive at concentrations of between 5 and 15%, with 5% being termed the lower explosive limit (LEL).

In assessing the risks from hazardous ground gas, reference has been made to the guidance from BS 8485:2015 'Code of Practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings' and CIRIA Report C665 'Assessing risks posed by hazardous ground gases to buildings' 2007 which adopts a risk characterisation strategy based on the maximum flow (L/hour) and maximum steady stated concentration (% v/v) of methane and carbon dioxide from a site to derive gas screening values (GSV) in litres/hour which are comparable with the Modified Wilson and Card classification (shown in Table 8.5 of C665) for any site which isn't intended to be developed as low-rise housing with vented underfloor void.

8.0 ASSESSMENT OF GEOCHEMICAL SOIL RESULTS

Development proposed include predominantly private gardens and therefore the residential with homegrown produce from the guidance listed in section 7.2 shall be selected.

In order to select the appropriate Soil Organic Matter (SOM) value for appraisal of PAH and TPH the mean average SOM value was determined from the laboratory dataset and accordingly the 1% SOM value was selected.

Laboratory certificates of chemical analysis are presented in **Appendix IV** along with the chemical assessment criteria.

8.1 ASSESSMENT OF SOIL GEOCHEMICAL RESULTS

Table 8.1 provides a summary of the results for each sample analysed when compared to the relevant assessment criteria.

Table 8.1 : Summary of Geochemical Results

Location	Strata	Determinant	Measured Conc. (mg/kg)	Guidance Conc. (mg/kg)
WS1 (0.4m)	Made Ground	Benzo(b)fluoranthene	4	2.6
		Benzo(a)pyrene	3.1	2.2
		Dibenz(a,h)anthracene	0.36	0.24
WS2 (0.3m)	Made Ground	All determinants recorded at acceptable concentrations	n/a	n/a
WS3 (0.5m)	Made Ground	All determinants recorded at acceptable concentrations	n/a	n/a
WS4 (1.0m)	Natural Sand	All determinants recorded at acceptable concentrations	n/a	n/a
WS5 (0.3m)	Made Ground	All determinants recorded at acceptable concentrations	n/a	n/a
WS6 (0.3m)	Made Ground	All determinants recorded at acceptable concentrations	n/a	n/a

Notes:

Barium EIC Generic Acceptance Criteria (EIC GAC) is 1300mg/kg (Residential)

Chromium is assumed to be chromium II (not chromium IV).

Waste soil classification should be confirmed by submitting all chemical results to a licensed waste management operator for formal waste classification.

8.2 DISCUSSION OF SOIL GEOCHEMICAL EXCEEDANCES

With the exception of PAH in WS1 (0.4m) all concentrations of all chemical soil determinants, including metals, semi-metals, TPH determinants are acceptable. Asbestos was also not detected.

Elevated concentrations of three PAH were detected in the Made Ground at position WS4 where the source of the PAH is most likely local ashy deposits within the soil (Made Ground) matrix.

Figure 8 is enclosed as a Soil Contamination Identification Plan.

It is recommended to remove the 'WS1' hotspot of soil contamination and confirm by means of suitable in-situ (and also site-wide) verification that soil contamination no longer remains within the area of the hotspot and also overlying soils.

A suitable Remediation Action Plan should be prepared for approval by the Local Planning Authority.

9.0 HAZARDOUS GROUND GAS MONITORING

9.1 STRATEGY

As previously presented within table 5.4.2 monitoring well installations were constructed in order to provide ground gas monitoring following the outcome of the preliminary ground gas assessment within section 2.3.

The installation of the monitoring wells have suitable response zones to enable the capture of ground gases which may possibly migrate through granular and fractured units beneath proposed homes. Each monitoring well was completed with a 1m thick bentonite seal from ground level to prevent atmospheric influence.

9.2 MONITORING

The presence of soil vapours was determined prior to bulk ground gas monitoring using a MiniRAE Photon Ionisation Detector (PID) from RAEs Systems. The presence of hazardous bio-gases including methane (CH4), carbon dioxide (CO2) and oxygen (O2) was determined using a GFM Infra-Red Gas Analyser from Ribble Enviro Limited. The flow rate and atmospheric pressure, in millibars (mb), was also measured during the monitoring process. Depth to groundwater was measured using an electronic dip meter.

Monitoring work was completed on the dates specified within table 9.2 which also summarises weather conditions and atmosphere pressure. To determine rising or falling pressures local 'online' weather trends from the Met Offic`e and/or the monitoring apparatus were consulted.

Table 9.2: Background Gas Monitoring Data

Date	Atmospheric Pressure	Rising/Falling Pressure?	Worst Case Conditions?	Groundwater above response zone?
3 October 2023	1012mB	Falling	No	Yes (WS5)
10 October 2023	1010mB	Falling	No	No
19 October 2023	974mB	Falling	Yes	No

Note 2 of C665 indicates 'worst case' conditions occur during falling and sub-1000mB atmospheric pressures. Section 5.5.1 of C665 indicates 'worst case' conditions are likely to occur during weather conditions such as rainfall, frost or dry weather.

9.3 MONITORING

Table 9.3 summaries the results obtained which are enclosed in **Appendix III**.

Table 9.3: Summary of Monitoring Results			
Gas	**Measured Conc. Range (% v/v)**		**Comments**
	Low	**High**	
CH_4	0.0 (<0.1)	0.0 (<0.1)	Methane was not detected (<0.1%) and thus is below the guidance value of 1% at which point the characteristic situation is advised to increase to CS2.
CO_2	0.1	13.1	Carbon dioxide has been detected at concentrations above the guidance value of 5%, within all monitoring well. When carbon dioxide is above 5% it is advised to increase characteristic situation to CS2.
O_2	4.4	18.5	Oxygen has been recorded at depleted concentrations (in WS1 and WS6), below 16% the point where it is considered there is potential for asphyxiation. The depleted oxygen concentrations coincide the elevated carbon dioxide.
Vapour*	0.0	2.7	Very low (PID) concentrations have been recorded. This concurs with the ground conditions and geochemical laboratory results suggesting the absence of soil vapour risk to new homes.

*vapour concentration in parts per million (ppm)

Monitoring positions remained constant and intact. No replacement monitoring positions were installed during the period of this project. No damage was observed to the monitoring wells during works.

It is considered the integrity of the monitoring wells has not been compromised as there is no evidence of surface damage which may affect the underlying installations. There is a bentonite seal within the bored annulus preventing escape of ground gases and entry of atmospheric gases. The gas valve remained closed prior to all monitoring occasions so passive venting of ground gas is unlikely to have occurred as site visits were unannounced.

9.4 INTERPRETATION OF DATA

Under normal use of the site (i.e. above ground), the risk presented by methane and carbon dioxide is dependent on both the concentrations and the rate of flow. In accordance with Wilson and Card methodology specified in the CIRIA C655 document, Gas Screening Values (GSV) were determined using the formula below.

GSV =	(Maximum steady concentration / 100) x Flow rate
GSV measured in litres per hour (l/hr)	Maximum steady concentration measured in percent (%) Flow rate measured in l/hr.

Based on the maximum concentrations and flows recorded, the **GSV** for **methane** was **0.0 L/hr** and the **GSV** for **carbon dioxide** was **0.0l/hr**.

However, elevated carbon dioxide (>5%) and depleted oxygen (<16%) has been recorded. Whilst there is an absence of flow from the ground, suggestive that the poor gaseous ground gas conditions will not mobilise to the surface and into new homes, it is the advice of C665 that the characteristic situation is increased to CS2.

In light of the technical requirements to prolong the gas risk assessment to gather additional data in the pursuit of reducing the situation to CS1, professional opinion suggests it more prudent to install gas protection to CS2 in accordance with BS8485.

10.0 REVISED RISK ASSESSMENT

10.1 REVISED SOURCES OF CONTAMINATION

Following completion of the site investigation and interpretation of test results the following sources of contamination are considered to exist.

Table 10.1: Potential Sources

Source	Description	Key Contaminants of Concern
1. Local soil contamination WS1 PAH Hotspot Interceptor Chamber	*Local PAH hotspot of soil/Made Ground condition at WS1.* *Risk of soil contamination from the interceptor chamber should it have leaked.*	*PAH and TPH.* *Prepare Remediation Action Plan and enact watching brief and discovery/remediation strategy in the event of removal.*
2. Ground gases/vapours	Very low risk of hazardous ground gases is anticipated.	Carbon dioxide.
The below are no longer considered sources, however, should be managed via a watching brief/discovery strategy.		
Site-wide soil contamination	Risk of soil contamination within the site associated with historical lock-up garage use and the presence of Made Ground.	No evidence of site-wide contamination. Remain vigilant and enact watching brief.
Asbestos	Risk of Asbestos Containing Soils (ACS) and Asbestos Containing Materials (ACMs) from former buildings.	Asbestos not detected within soils samples or observed on-site. Remain vigilant and enact watching brief.
Groundwater	Metals, hydrocarbons (TPH/PAH).	No evidence of groundwater contamination, natural ground conditions are unstained and groundwater observations are unsmeared. Remain vigilant and enact watching brief.
TPH – Total Petroleum Hydrocarbons PAH – Polycyclic Aromatic Hydrocarbons		

10.2 REVISED CONCEPTUAL SITE MODEL

Following interpretation of the laboratory results, site dynamics and the revision of potential soil contaminants within table 10.1 a revised conceptual model has been prepared and is presented in table 10.2.

Table 10.2: Refined Conceptual Site Model (for viable pollutant linkage pathways)						
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Risk & Justification**	**Linkage No.**
Source 1 Local soil contamination WS1 PAH Hotspot Interceptor	Construction workers	Direct contact	Unlikely	Mild	Very Low *Note 10.* Local hotspot of PAH contamination and potential for TPH contamination surrounding the interceptor not considered to present a health risk to adult construction workers. **Action. Nonetheless wear Personal Protective Equipment (PPE).**	10
	End users	Direct contact	Likely	Medium	Moderate *Note 11.* Local hotspot of PAH contamination and potential for TPH contamination surrounding the interceptor. However, Interceptor shall be beneath the new access road. **Action. Remove PAH hotspot and if interceptor is to be removed, remove any as yet undiscovered potential TPH soil contamination. Prepare Remediation Action Plan.**	11
	Adjacent land users	Direct contact via run-off	Unlikely	Mild	Very Low *See Note 11*	12
	Soft landscaping	Root uptake	Likely	Mild	Moderate/Low *See Note 12.* **Action. Replace hotspot removal at WS1 with suitable Topsoil where excavation impedes garden area.**	13
	Water supply pipes	Direct contact	Likely	Medium	Moderate *Note 13.* **Action. Consult water authority given the presence of an interceptor about the**	14

Table 10.2: Refined Conceptual Site Model (for viable pollutant linkage pathways)						
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Risk & Justification**	**Linkage No.**
					site entrance.	
	Buildings & infrastructure	Direct contact	Unlikely	Mild	Very Low *Note 14. However concrete class could be AC-2 DS-2, see section 11.7.*	15
	Groundwater	Vertical migration through hydrogeology	Low likelihood	Mild	Low *Note 15.* No evidence of groundwater contamination. **Action. If interceptor is to be removed, remove any as yet undiscovered potential TPH soil contamination. Prepare Remediation Action Plan.**	16
	Surface waters	Vertical and lateral migration through hydrogeology	Unlikely	Mild	Very Low *See Note 4.*	17
	Ecological receptors	Run-off. Direct contact.	Unlikely	Mild	Very Low *See Note 6.*	18
Source 2 Ground gases and Soil vapours (on/off site source)	Construction workers	Inhalation of vapours/gas	Low likelihood	Minor	Very Low *Note 16.* Elevated carbon dioxide and depleted oxygen, however risk reduced when working in outdoor well ventilated air space.	28
	End users	Inhalation of vapours/gas	Low likelihood	Medium	Low *See Note 16,* though indoor occupancy increases risk. **Action. Install gas protection to CS2 in accordance with BS8485.**	29

10.3 RISK COMMENTARY

10.3.1 Contamination Risk from Soil to Human Health – Construction Workers

Soil determinants are unlikely to present a short-term exposure risk to adult construction workers, specifically from the dermal contact, ingestion and inhalation pathways. Nonetheless it is customary to advise that groundworkers should ensure suitable PPE is worn as a precaution during development which would include:

- Gloves to prevent dermal contact with any contaminated soils. It is advised that disposable latex gloves are worn beneath the outer 'work' gloves.
- To prevent ingestion of contaminated soils construction workers should avoid putting hands or objects in their mouth whilst on-site.
- To prevent ingestion of contaminated soils prior to eating or drinking, construction workers should ensure their hands are properly washed, rinsed and dried.

10.3.2 Contamination Risk from Soil to Human Health – End Users

A local exceedances of three PAH species has been recorded within the Made Ground at position WS1.

It is recommended the hotspot of soil contamination is removed and the excavation is verified by means of suitable local and also site-wide verification to ensure that soil contamination no longer remains within the overlying soils.

A Discovery Strategy, Remediation Action Plan and Verification Plan should be prepared.

10.3.3 Contamination Risk from Soil to Human Health – Domestic Water Supply

Special design for domestic water supply are unlikely. However, to be certain, it is advised that the report should be provided to the local water authority to ensure the correct materials are chosen for water supply pipes. Following the formal withdrawal of WRAS Guidance Note No. 9-04-03 (October 2002), it is recommended that the following reference should be consulted:

Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites" (Ref 10/WM/03/21 by the UK Water Industry Research Ltd (UKWIR); ISBN: 1 84057 5697

Generally, all services should be placed within dedicated runs, and then backfilled with clean imported material.

10.3.4 Contamination Risk from Soils to Controlled Waters

It is unlikely soil present a risk to controlled waters. However, ***in the event the interceptor is to be removed a suitable Discovery Strategy should be prepared.***

10.3.5 Contamination Risk from Groundwater

Contaminated groundwater is not considered to exist beneath the site.

10.3.6 Risk from Ground Gas

The preliminary ground gas risk assessment recorded the absence of significant risk and lack of sources of ground bio-gas.

However, three rounds of gas monitoring including a worst-case visit recorded elevated carbon dioxide and depleted oxygen during all three monitoring occasions, which effected all three monitoring wells.

In light of the technical requirements to prolong the gas risk assessment to gather additional data in the pursuit of reducing the situation to CS1, professional opinion suggests it more prudent to ***install gas protection to CS2 in accordance with BS8485.***

11.0 GEOTECHNICAL ASSESSMENT

This section provides a geotechnical assessment in connection with the proposed development as described above and considers the GEO Limit State: failure or excessive deformation of the ground, in accordance with EN 1997 Eurocode 7: Geotechnical Design (and the UK National Annex to Eurocode 7) where applicable.

It is assumed for the purposes of this assessment that the finished ground floor levels of the proposed development buildings are the same as the ground level at each of the exploratory hole locations.

The assessment of the stability of any slopes or retaining structures across or adjacent the site, the requirement for additional retaining structures and the requirements for cut and fill that may be required to facilitate construction is outside the scope of this report.

Where applicable the following assessment includes bearing resistance assuming conventional construction only and no allowances have been made for interaction between existing adjacent foundations and proposed foundations or loads.

Eurocode 7 Section 2.1 Basis for Geotechnical Design indicates that for each geotechnical design situation it shall be verified that no limit state is exceeded. Geotechnical design requirements have been established by three Geotechnical Categories, 1, 2 and 3. For the purpose of this assessment the development is Geotechnical Category 2: which include conventional types of structure and foundation with no exceptional risk or difficult or loading conditions. Designs for structures in Geotechnical Category 2 should normally include quantitative geotechnical data and analysis to ensure that the fundamental requirements are satisfied. Routine procedures for field and laboratory testing and for design and execution may be used for Geotechnical Category 2 designs.

11.1 GROUND MODEL

The following table 11.1 provides the ground model for the site as determined from ground conditions encountered during the site investigation works.

Table 11.1: Ground Model

Stratum	Description	Top of Stratum (m bgl)	Bottom of Stratum (m bgl)	Average Thickness (m)
MADE GROUND	Various	0.0	0.45 – 0.9	0.66
CLAY	Soft, firm and stiff, sandy and gravelly CLAY	0.55 – 0.8	1.4 – 1.6	0.83

Table 11.1: Ground Model				
Stratum	**Description**	**Top of Stratum (m bgl)**	**Bottom of Stratum (m bgl)**	**Average Thickness (m)**
SAND	Medium dense and dense, becoming very dense, slightly clayey gravelly SAND	0.4 – 1.4	1.9 – 2.1	1.45
CLAY	Firm, becoming stiff and very stiff, silty CLAY	1.9 – 2.1	25.0	-
Notes				
Overlying hardstanding 0.1-0.25m.				
Groundwater				
Perched water at depths as shallow as 0.85m bgl during return monitoring on 3 October 2023.				

11.2 FOUNDATION DESIGN CONCEPT

The ground model and the following considerations will need to be taken in account in determining the foundation solution for the proposed development buildings:

- Temporary works in the overlying coarse (SAND) soils and elevated perched water.
- Underlying high volume change potential CLAY soils and the influence of trees; a number of mature trees are located around the site.
- Requirements of bridging across a surface water sewer beneath the proposed development buildings in the north of the site.
- Adequate bearing resistance to support the proposed development buildings.

The SAND soils present at relatively shallow depth across the site are of negligible volume change potential, above CLAY of high becoming very high plasticity showing high-volume change potential.

Assumed maximum 'characteristic action' (or line load) of 100kN/m run on conventional shallow foundations 1.0m wide on medium dense SAND at depths of between 1.0m and 1.4m bgl may be acceptable for the proposed development buildings subject to the above considerations.

It is assumed that the 'characteristic action' comprises a vertical permanent action. Further information regarding the permanent actions and variable actions (making up the 'characteristic actions') applied to the foundations may be required along with confirmation of the foundation type and foundation dimensions.

11.2 EXCAVATION CONDITIONS

Excavation of the materials encountered during the ground investigation should be achieved using conventional hydraulic excavation techniques.

11.2.1 Temporary Works

From the ground investigation undertaken, excavations in the natural coarse (SAND) soils are not expected to remain stable in the short term. Also, due to the MADE GROUND encountered, locally elevated perched water, and the requirement for excavations to facilitate the construction, care should be taken to ensure that instability of excavations does not affect existing structures and services (e.g. foundations, roads, boundary walls or buildings) both on and off-site, and temporary support is expected to be required in order to achieve this.

Further advice should therefore be sought from the appointed structural engineer and specialist contractor regarding temporary works. General guidance can be found within CIRIA Report 97: Trenching Practice, dated 2001.

Care should be taken to ensure that falls from excavation faces do not adversely affect the integrity of foundation concrete.

All excavations on site should be in accordance with HSE guidelines and stability should be practically maintained at all times.

11.2.2 Dewatering

Groundwater was encountered during the return monitoring in WS3 and WS5 at depths as shallow as 0.85m bgl (as of October 2023). The water is likely to be perched within the overlying SAND horizon (secondary (A) aquifer) or fissure flow locally held within the London Clay Formation.

On the basis of the data obtained; dewatering of perched water is expected to be required in shallow excavations beneath the site (as of October 2023).

Perched water is expected to rise in wetter winter months, and ongoing groundwater monitoring is recommended to determine the seasonal groundwater level below the site.

Consideration should be given to a summer build programme when groundwater is expected to be lower.

11.3 EXISTING SERVICES/SUBSTRUCTURES

Due to the historical development of the site and site environs, existing services or sub-structures should be anticipated.

Where foundations or obstructions are encountered during excavations for the proposed foundations, all new foundations should be extended downwards to fully penetrate or avoid all live and/or redundant former construction.

11.4 BEARING STRATA

To maintain the integrity of the storm water sewer in the north of the site, it is anticipated that the proposed development buildings (Plots 1-4) at this location will need to bridge the sewer on piled foundations.

Bearing resistance for the medium dense SAND soils at depths of between 1.0m and 1.4m bgl in the area of Plots 5 and 6 in the south of the site are provided below pending confirmation of the required foundation actions, foundations widths, foundation depths, tolerable settlement and the influence of trees.

11.4.1 Atterberg Limits and Material Properties

Atterberg limits tests conducted on the fine soils overlying the site locally in WS1 and WS6 at depths of 1.0m and 2.0m bgl respectively indicate that the soils comprise inorganic CLAY of low and high plasticity (CL/CH). The modified plasticity index was determined to be <10% indicating soils of negligible volume change potential.

The results of particle size distribution analysis indicate that the coarse soils tested comprise clayey gravelly medium to coarse SAND of negligible volume change potential.

Atterberg limits tests conducted on the fine soils underlying the SAND at depths of between 3.0m and 12.0m bgl comprise inorganic CLAY of high becoming very high plasticity (CH/CV). The modified plasticity index was determined to be >40% indicating soils of high volume change potential.

For the purposes of this assessment and in accordance with NHBC Standards Chapter 4.2, Building Near Trees, the overlying SAND soils at the anticipated foundation formation level beneath Plots 5 and 6 are classified as being of negligible volume change potential above CLAY of high-volume change potential.

The results of undrained triaxial testing using undisturbed samples from BH1 at 6.45m, 9.45m and 12.45m bgl, indicate shear strength of 115kPa, 11kPa and 122kPa respectively, indicating soils of high strength.

11.4.2 Desiccation

The overlying CLAY soils locally (WS1 and WS6 at 1.0m and 2.0m bgl respectively) are shown to be non-plastic with a modified plasticity index of <10%, above SAND of negligible volume change potential.

Using the ratio of the moisture content (MC) to the liquid limit (LL) (an empirical indicator of desiccation, after Driscoll, 1983), although the test results indicate that the underlying CLAY soils (3m+ bgl) are potentially desiccated (MC:LL ratio 0.35-0.4), the London Clay Formation is known to be overconsolidated and a MC:LL ratio of <0.5 is considered typical. An assessment in accordance with BRE Digest 412 Desiccation in Clay Soils 1996, also indicates that the shear strength, moisture content and liquidity index profiles at depth are shown to be relatively consistent between the sampling points indicating that desiccation is unlikely to have occurred in the samples tested.

Notwithstanding the above, consideration should be given to the influence of trees around the boundaries of the site and the CLAY soils underlying the SAND at shallow depths of 1.9-2.1m bgl, as noted in WS4, WS5 and WS6.

Mitigation measures to prevent heave in the plastic fine soils encountered across the site should be incorporated into the below ground construction within the influence of trees.

The soil sampling and testing undertaken provides for a preliminary assessment only based on limited sampling and testing locations. To enable a comprehensive desiccation assessment, consideration should be given to additional soil sampling, in-situ testing and profiling and laboratory analysis including soil suction tests.

11.4.3 Design Parameters

Characteristic values for design parameters for the strata encountered beneath the site are included in Table 11.4.3 below.

Table 11.4.3: Design Parameters

Stratum	Volume Change Potential	Unit Weight - $\gamma_{,k}$ (kN/m^3)	Undrained Shear Strength - C_{uk} (kPa) range	Critical State Angle of Friction - $\phi'_{cv,k}$ (degrees)
SAND	Negligible	19	-	30
CLAY	High	17-19	115 - 122	23

For assessment purposes a characteristic value of the angle of shearing resistance (ϕ) of 30^o has been determined for the SAND strata at the anticipated foundation formation level of 1.0-1.4m bgl beneath Plots 5 and 6. The characteristic value of the angle of shearing resistance was derived using the relationship between ϕ and the SPT N-value (N=10+) after Peck, Hanson and Thornburn (Foundation Engineering, 1967). Bearing capacity factors determined by Vesic (Analysis of Ultimate Loads of Shallow Foundations, 1973) have been applied.

Please note that when using this data for design purposes, the effects of eccentric loading are taken into account, and that the bearing pressure is limited to account for maximum tolerable settlement beneath the structures and adjacent properties.

Geotechnical laboratory material property test results are presented within **Appendix V.**

11.5 TREE INFLUENCE ON FOUNDATIONS

When considering the influence of trees on foundations, the material properties of the strata beneath the site and the distance and species of the trees to the foundations are the determining factors.

For the purposes of this assessment the SAND soils overlying the site to depths of between 1.9m and 2.1m bgl (as noted in WS4, WS5 and WS6) are classified as being of negligible volume change potential above CLAY soils of high-volume change potential.

An adjustment to foundation depths may therefore be required in accordance with NHBC Standards Chapter 4.2, Building Near Trees, 2021.

Where foundations are extended into perched water bearing SANDS, the requirements of temporary works may render a shallow foundation solution uneconomical, and a piled foundation solution may be required.

Mitigation measures to prevent heave in any overlying plastic fine soils encountered across the site should be incorporated into the below ground construction with the influence of trees.

Should roots or desiccated soils be encountered during the groundworks, and/or previously unidentified trees or tree stumps encountered during the site preparation works, foundations should be extended beneath the roots/desiccated soils and/or the depth adjusted to accommodate the species of tree/tree stump encountered. A record of the findings associated with roots, desiccated soils and trees/tree stumps should be kept during the groundworks phase.

Mitigation measures to protect existing tree species during the construction process will also need to be considered.

11.6 FOUNDATION TYPE, DEPTH AND ALLOWABLE BEARING PRESSURE

11.6.1 Trench Fill/Strip Foundations

To maintain the integrity of the storm water sewer in the north of the site, it is anticipated that the proposed development buildings in Plots 1 to 4 at this location will need to bridge the sewer on piled foundations.

Should the influence of trees and the requirements of temporary works be overcome, a conventional shallow foundation solution in the medium dense SAND at depths of between 1.0m and 1.4m bgl may be viable for the proposed development buildings in Plots 5 and 6.

Using an assumed maximum vertical characteristic action of 100kN/m run, and Design Approach 1 of Eurocode 7 (checking for a limit state of rupture or excessive deformation), Combination 1 and Combination 2 are both satisfied where the vertical design action (V_d) is less than the design value of the vertical bearing resistance (Rd) in each case. The GEO limit state requirement is therefore satisfied.

It is assumed that the action is vertical, and it is also assumed that the base of the foundations and the ground surface are horizontal. The vertical design actions include the trench fill foundations, assumed to be a maximum thickness of 1.4m, and also accounts for overburden.

The vertical characteristic action of **100kN/m run** corresponds to the bearing resistance in Table 11.6.1 of **100kN/m²** when applied to trench fill foundations 1.0m wide constructed medium dense **SAND** at depths of 1.0m to 1.4m bgl, in the area of the proposed development building in Plots 5 and 6 The serviceability state is satisfied with the total settlement being restricted to **25mm**.

Table 11.6.1: Bearing Resistance

Bearing Strata Exploratory Hole Location Plots	Depth BGL (m)	Footing Width (m)	Bearing Resistance (kN/m²)	Comment
Medium dense SAND WS1-WS3 / Plots 5-6	1.0-1.4	1.0	100	Adjustment to foundation depths may also be required in accordance with NHBC 4.2 Building Near Trees.
WS4-WS6 / Plots 1-4	To maintain the integrity of the storm water sewer in the north of the site, it is anticipated that Plots 1 to 4 will need to bridge the sewer on piled foundations.			
Temporary Works	Consideration should be given to the requirement of temporary works in coarse SAND soils and perched water noted at depths as shallow as 0.85m bgl (October 2023)			

The total settlement beneath trench fill foundations 1.0m wide is anticipated to be 25mm for the SAND soils encountered. Please note that increasing foundation widths will result in an increase in the total settlement anticipated.

Notwithstanding the above it is recommended that the formation beneath each section of the proposed re-development works is inspected to assess the competency of the bearing strata prior to pouring of foundation concrete. The formation should not be allowed to soften or loosen due to surface water, rainwater or groundwater ingress prior to pouring of foundation concrete.

It should be noted that the design actions and design layout/dimensions of the proposed works have not been supplied and the above bearing resistance accounts for conventional construction only. The moments resulting in eccentricity of loadings, and the settlement, sliding and overturning and the requirements for propping would need to be considered in the design of any retaining structures.

It should also be noted that the above recommendations have been made using data in cable and percussion borehole BH1 and window sample boreholes WS1-WS6 completed.

11.6.2 Piled Foundations

Should the influence of trees, the location of the storm water sewer or the issues of temporary works in elevated seasonal perched water be deemed uneconomical for conventional construction, a piled foundation solution may be required.

The advice of a piling specialist should be sought to determine the working loads of their proprietary piling technique when considering the ground and groundwater conditions encountered beneath the site, and the health and safety implications of working within the confines of the site and adjacent neighbouring properties.

11.6.3 Floor Slab

It is assumed at this stage that the ground floor slabs beneath the proposed development buildings will be suspended on ground beams.

Mitigation measures to prevent heave in any overlying plastic fine soils should also be incorporated into the below ground construction within the influence of trees.

11.7 CONCRETE CLASSIFICATION

In accordance with Building Research Establishment (BRE) Special Digest 1: 2005 - Concrete in Aggressive Ground, the following laboratory test data has been used to derive classifications for buried concrete (Table C1, natural ground locations) beneath the site:

- Soluble Sulphate (2:1 extract) – 0.0153 to 0.502g/l
- pH – 7.3 to 8.2
- Total Sulphate SO_4 – 0.0094 – 0.11%
- Total Sulphur – 0.005 – 0.48%
- Total Potential Sulphate – 0.015 – 1.44%
- Oxidisable Sulphide < 0.3% to 1.33%

"*BRE guidance suggests that 'if significant number of determination of oxidisable sulphides is above 0.3%, then use the results of total potential sulphate to determine the concrete class*".

Oxidisable sulphide has been calculated above 0.3% SO_4 in the natural clay soils sampled in BH1 at 10.45m and 18.45 bgl and exceeds the threshold where the concrete classification is based on oxidisable sulphide and total potential sulphate. However, assuming piled foundations at this depth, the action of piling is unlikely to result in disturbed ground and the results of soluble sulphate apply.

Based on the results obtained for soluble sulphate the Design Sulphate (DS) Class for shallow buried concrete in SAND soils beneath the site is DS-1. Assuming mobile water (secondary (A) aquifer), the Aggressive Chemical Environment for Concrete (ACEC) Class is AC-1. For piled foundations in the underlying London Clay Formation, the Design Sulphate (DS) Class for buried concrete is DS-2 and the ACEC-AC-2.

Should natural CLAY pile arisings from the London Clay Formation be used as backfill against foundations, the DS Class would be DS-2 and the ACEC AC-2.

It should be noted that additional considerations for the determination of concrete class and appropriate aggregate use are set out in BRE Special Digest 1. These are considerations specific to the soil type, the proposed development and the type of concrete foundations to be used at the site.

Laboratory results for the pH, sulphate and sulphur testing are included within **Appendix IV**.

11.8 PAVEMENT DESIGN

The results of DCP/TRL testing indicate CBR values typically reducing (bottoming out) to ~ 3.7% (DCP1), as the DCP probe penetrated the overlying surface. Locally however in the area of DCP2, a CBR result of 1.2% was obtained.

The soils in the area of DCP2 therefore require further investigation, or the soils should be replaced with suitably compacted material to grade.

Elsewhere and in the interim a preliminary CBR value of 3-4% is assumed. It is recommended that in-situ CBR tests are undertaken at road pavement formation level (once known) to confirm the preliminary CBR value determined.

The results of DCP testing are enclosed in **Appendix V**.

11.9 SOAKAWAY DRAINAGE

Soil infiltration testing in trial pits has been reported under separate cover, however, soakage drainage in not considered suitable

12.0 CONCLUSIONS AND RECOMMENDATIONS

This tier 1 PRA desk study and Site Investigation including tier 2 GQRA has provided an assessment of the site's history, geo-environmental setting and an evaluation of ground conditions.

12.1 ENVIRONMENTAL

Table 12.1 summarises the pertinent environmental risks providing advice on further works and assessment.

Table 12.1: Environment Risk Summary

Medium	Item	Risk Description	Comments/Recommendations
Soils	1	Local PAH soil contamination at WS1 which may present a risk to human health.	Complete hotspot removal and prepare Discovery Strategy, Remediation Action Plan and Verification Plan.
	2	Potential for undiscovered soil contamination around interceptor in the event of removal	Prepare a Discovery Strategy and enact watching brief during site clearance.
	3	Ensure material encountered is suitable for desired water main.	Consult local water authority prior to water main installation.
	4	Any imported Topsoil should be chemically suitable for use in private gardens.	Import suitable Topsoil (BS3882) to sustain planting.
	5	Asbestos in undiscovered locations.	Prepare a Discovery Strategy and enact watching brief during site clearance.
Ground Gas	6	Elevated carbon dioxide and depleted oxygen.	Gas protection should be designed and installed in accordance with BS8485 to CS2. Suitable verification of the installation shall be necessary.
Groundwater	7	Ground conditions are not considered to present a notable risk to groundwater or controlled waters.	Prepare a Discovery Strategy and enact watching brief during groundworks

Once the above risks have been evaluated/implemented the environmental risk assessment can be considered complete and the development suitable for occupancy.

12.2 GROUND HAZARDS SUMMARY

This report and the Clients preferred foundation solution should be presented to the Local Authority or appropriate build warranty provider for approval prior to construction.

Table 13.2 summarises the pertinent Ground Hazards Summary.

Table 12.2: Ground Hazards Summary

Construction Issue	Ground Hazard	Recommendation
Below Ground Obstructions	Foundations and filled ground should be anticipated at shallow depth beneath the site from the historical development. Storm water sewer and three-chambered interceptor in the north of the site.	Shallow obstructions likely to be removed with conventional excavation plant and hydraulic breaking equipment. It is anticipated that the proposed development buildings in Plots 1-4 at the location of the storm water sewer will need to bridge the sewer on piled foundations.
Foundations	Conventional shallow foundation solution subject to the requirements of temporary works and foundations depths of up to 1.4m bgl. Shallow excavations in MADE GROUND and coarse soils unlikely to be stable in the short term. Perched water at depths as shallow as 0.85m bgl (October 2023). Perched water expected to rise and fall seasonally.	Bearing resistance of 100kN/m^2 may be acceptable for trench fill foundations at 1.0-1.4m bgl in medium dense SAND in Plots 5-6. Foundations may however be required to greater depths locally due to the influence of trees. Piled foundations expected to be required beneath Plots 1-4. Dewatering expected to be required locally in shallow excavations depending on seasonal perched water fluctuations. Consider ongoing seasonal perched water monitoring and a summer build programme. Shoring of excavations expected to be required locally. SAND soils encountered at anticipated foundations formation level in Plots 5-6 are of negligible volume change potential (NHBC Chapter 4.2, Building Near Trees), above CLAY of high-volume change potential.
Floor Slabs	Suspended	Heave protection may be required in any shallow plastic fine soils within the influence of trees.
Buried Concrete	Low to moderately aggressive ground conditions encountered.	Concrete classification determined as DS-1, AC-1 for shallow foundations in SAND, and DS-2 AC-2 for piles in CLAY.
Drainage	Soil infiltration testing in trial pits has been reported under separate cover	Soakaway drainage is not considered suitable.

Table 12.2: Ground Hazards Summary		
Construction Issue	**Ground Hazard**	**Recommendation**
Pavements	Preliminary design CBR value of 3-4% assumed.	Consider in-situ CBR tests at road pavement formation level once known, and replacement of soils in the area of DCP2.

13.0 PROJECT INSTRUCTION AND LIMITATIONS

13.1 SCOPE OF WORKS

The following scope of work was undertaken to an agreed brief set out in Aviron's proposal and involves the following:

- One cable and percussion borehole to a depth of 25.0m bgl.
- Undertake one day of window sample boreholes to depths of up to 5.0m bgl, including SPTs at 1m intervals.
- Install three of the boreholes with monitoring pipe to enable return gas and groundwater readings.
- DCP/TRL testing to determine road pavement design parameters.
- Log the strata within each exploratory hole noting any water strikes.
- Collect disturbed soil samples from exploratory holes and submit for geochemical laboratory tests to determine the presence or absence of soil contaminants, and geotechnical material property tests to enable foundation recommendations and allow roadway and drainage design.
- All soil samples shall be collected in accordance with the instruction and ground conditions and submitted to UKAS/MCERTS accredited laboratories for testing.
- Prepare an interpretative GERA report to interpret ground conditions with respect to potential environmental risks and provide recommendations for foundation design and engineering parameters.

Aviron has relied upon information received from the Client and their agents as accurate, unless contradicted by written documentation or site observations.

13.2 PUBLISHED GUIDANCE

This report follows the technical approach presented on Land contamination risk management (LCRM), accessed on gov.uk website. The guidance replaced the Contaminated Land Report 11 (CLR11) "Model Procedures for the Management of Land Contamination" prepared by the Environment Agency in 2004. CLR11, which was withdrawn in 2020, provided guidance on the application of management processes when assessing potentially contaminated land.

This project and report have been designed to fulfil the information requirements set out in LCRM.

This report is additionally prepared in accordance with current guidance notes, standards and practices as set out by the Environment Agency and statutory organisations in order to establish potential and significant contaminant linkages as defined in Part IIA of the Environmental Protection Act 1990.

13.3 LIMITATIONS

Aviron's scope of work has been designed to meet the timeframe and as such it may follow that further work would be prudent upon evaluation of the ground conditions. The scope of work provided shall provide a view of site conditions and understanding of potential geo-environmental risks and possible mitigation procedures.

The information used in this report has been derived from the site investigation, which in turn were based on known current and historical land uses identified at the site and surrounding area, available to Aviron at the time of the investigation.

Intrusive points chosen relate to the data collected and the risk assessment and recommendations will rely on these points only. It therefore follows that some areas of the site will not be examined. It is always possible that some areas not investigated may contain conditions which would be impossible to determine due to lack of evidence or time and budget restrictions.

This report provides recommendations for foundation design based upon the ground conditions encountered and where possible makes predictions for possible variations in ground conditions. However, it is always possible that not all variations in ground conditions can be accounted for and shall also be dependent upon design loadings and foundation construction techniques used. It should be acknowledged that ground conditions may vary from intrusive point to intrusive point and without undertaking continuous investigation it is impossible to entirely understand variations in ground conditions. Our recommendations should therefore not supersede the project's Consulting Structural and Civil Engineers design.

This report comprises a Ground Investigation Report in accordance with BS EN 1997-2, unless otherwise stated. This report does not constitute a Geotechnical Design Report (BS EN 1997-2) and geotechnical recommendations in this report are for guidance only.

Should changes in legislation, statutory requirements or industry practices occurred following issue of this report, this report should be viewed in light of these changes.

Should a notable time period elapse between the date issue of this report and the date of application of this report changes to site dynamics may occur and in particular the site inspection notes may no longer be applicable should any change of use occur to the site in the interim.

In accordance with the BS EN 1998-1:2004+A1:2013 'Eurocode 8: Design of Structures for Earthquake Resistance – Part 1', the UK is located in an area of very low seismicity, and seismic loading need not be considered.

Unless otherwise stated, a preliminary or detailed risk assessment of unexploded ordnance (UXO) is outside the scope of this report.

Also, unless otherwise stated, an assessment of invasive species such as Japanese Knotweed and Himalayan Balsam is outside the scope of this report.

14.0 REFERENCES AND OTHER SOURCES OF INFORMATION

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BS EN 1997-1.2004+A1:2013 Eurocode 7 Geotechnical Design Part 1 General Rules

BS EN 1997-2.2007 Eurocode 7 Geotechnical Design Part 2 Ground Investigation and Testing

NA to BS NA+A1:2014 to EN 1997-1.2004+A1:2013 UK National Annex to Eurocode 7 Geotechnical Design Part 1 General Rules

NA to BS EN 1997-2.2007 UK National Annex to Eurocode 7 Geotechnical Design Part 2 Ground Investigation and Testing

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Figures

1	Site Location Plan
2	Pre-Clearance Site Layout Plan
3	Existing Site Layout Plan
4	Site Photographs
5	Proposed Development Plan
6	Exploratory Hole Location Plan - Existing Site Layout
7	Exploratory Hole Location Plan - Proposed Development
8	Made Ground Contamination Identification Plan

Legend

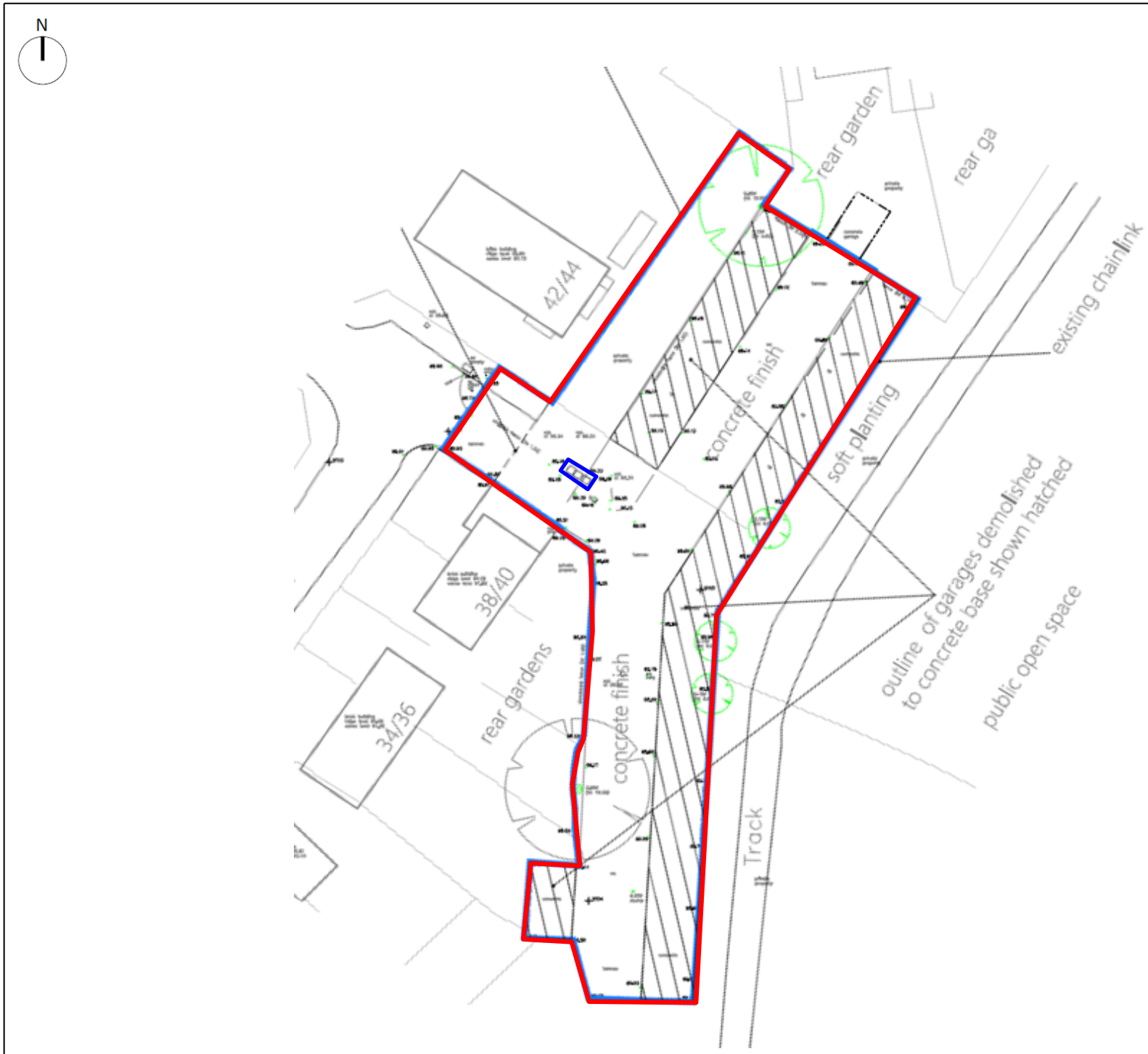
Approximate Site Boundary

Notes

Figure 1

Drawing Title	Site Location Plan
Project Number	23-248.01
Project Title	Land at Sullivan Crescent, Harefield, UB9 6NL
Drawn by	DN
Checked by	JB
Scale	NTS

Aviron Associates Limited - Badgemore House - Gravel Hill - Henley on Thames - RG9 4NR - T: 01491 413 722 - M: 07787 771 686 - E: james@aviron.co.uk



Legend

Approximate Site Boundary

Interceptor Chambers

Notes

Figure 2

Drawing Title

Pre-Clearance Site Layout Plan

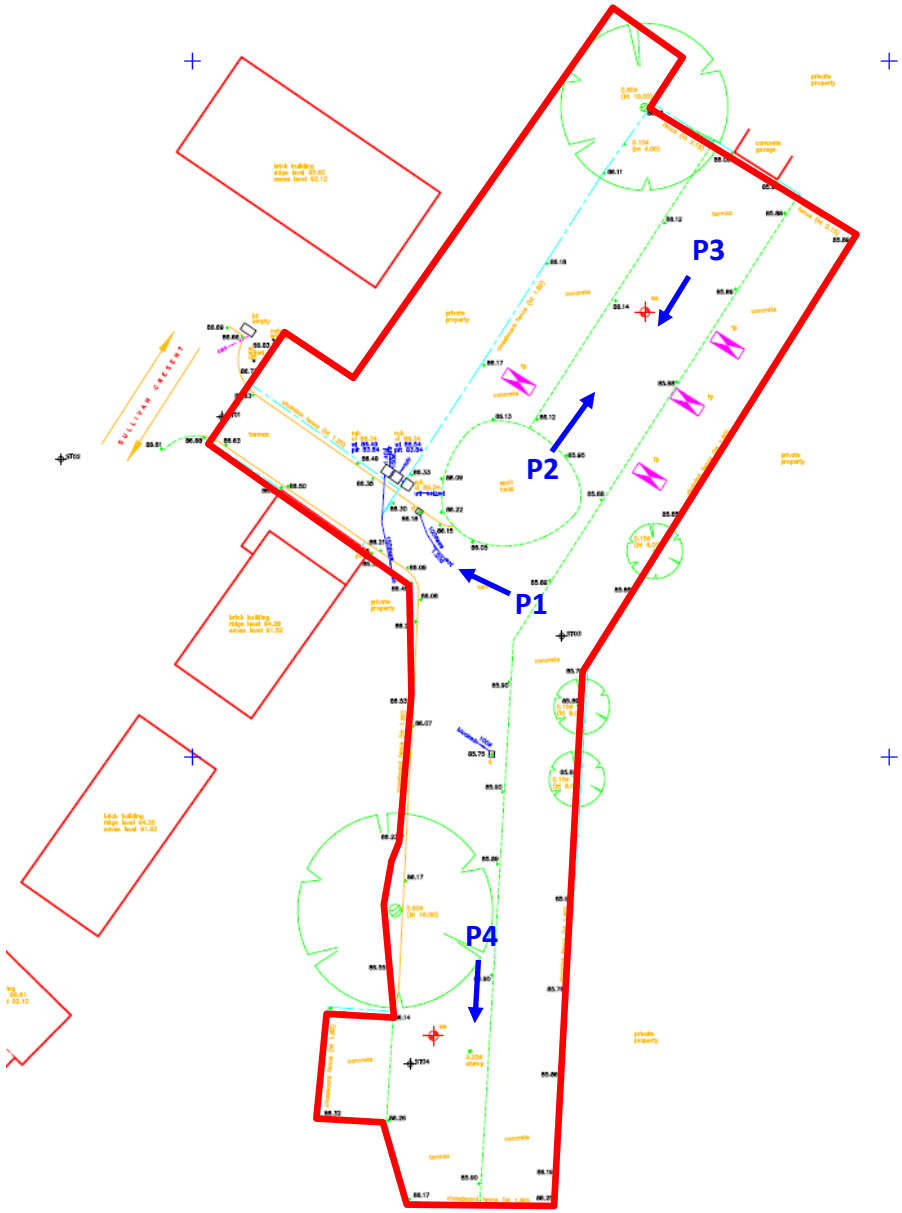
Project Number	23-248.01

Project Title

Land at Sullivan Crescent, Harefield, UB9 6NL

Drawn by	DN
Checked by	JB
Scale	NTS

Aviron Associates Limited - Badgemore House - Gravel Hill - Henley on Thames - RG9 4NR - T: 01491 413 722 - M: 07787 771 686 - E: james@aviron.co.uk



Legend

Approximate Site Boundary

Photo Direction

Notes

Figure 3

Drawing Title

Existing Site Layout Plan

Project Number	23-248.01
Project Title	Land at Sullivan Crescent, Harefield, UB9 6NL
Drawn by	DN
Checked by	JB
Scale	NTS

Aviron Associates Limited - Badgemore House - Gravel Hill - Henley on Thames - RG9 4NR - T: 01491 413 722 - M: 07787 771 686 - E: james@aviron.co.uk

N

Photo 1

Photo 2

Photo 3

Photo 4

Legend

Notes

Figure 4

Drawing Title

Site Photographs

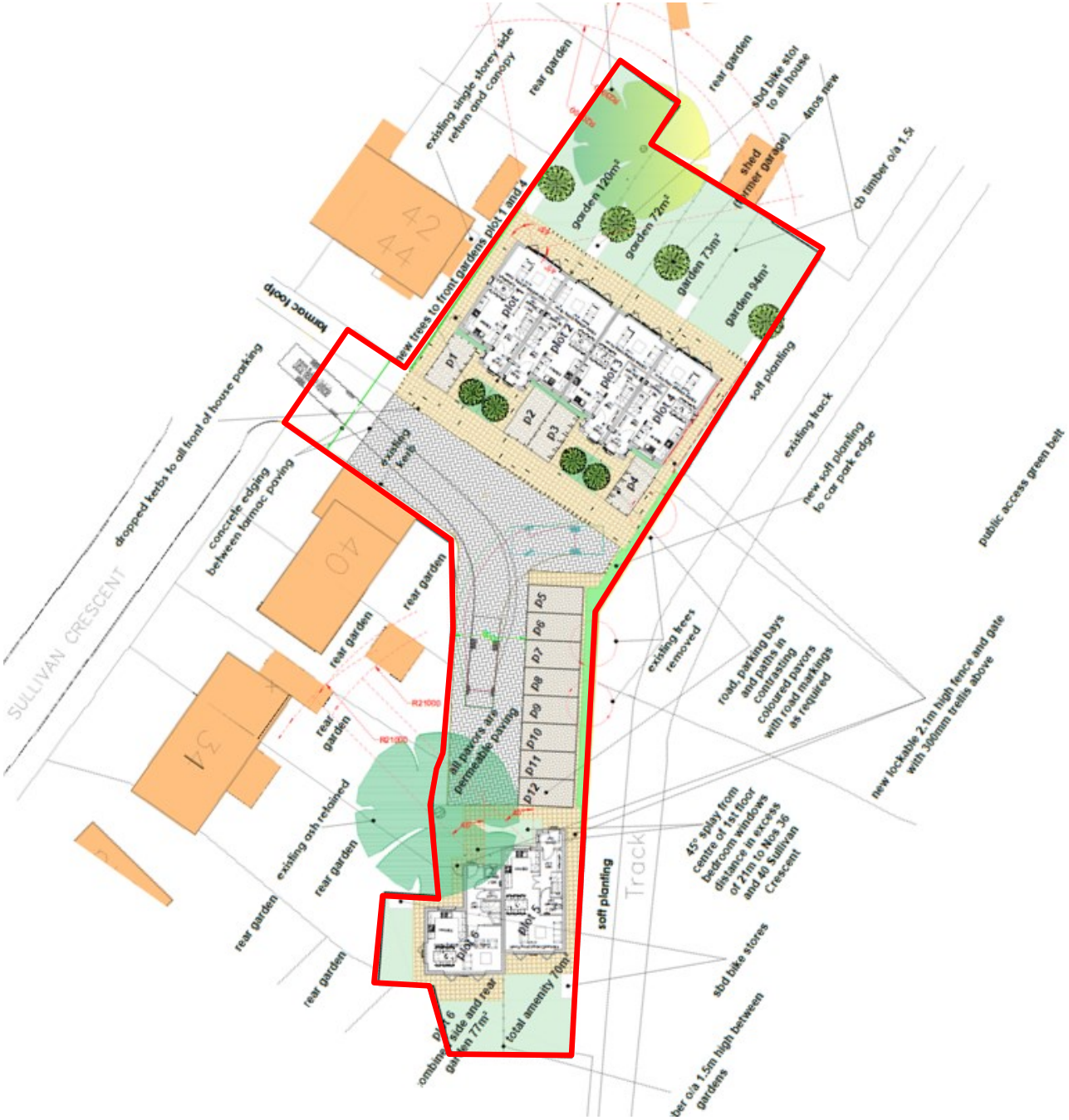
Project Number	23-248.01

Project Title

Land at Sullivan Crescent, Harefield, UB9 6NL

Drawn by	DN
Checked by	JB
Scale	NTS

Aviron Associates Limited - Badgemore House - Gravel Hill - Henley on Thames - RG9 4NR - T: 01491 413 722 - M: 07787 771 686 - E: james@aviron.co.uk



Legend

Approximate Site Boundary

Notes

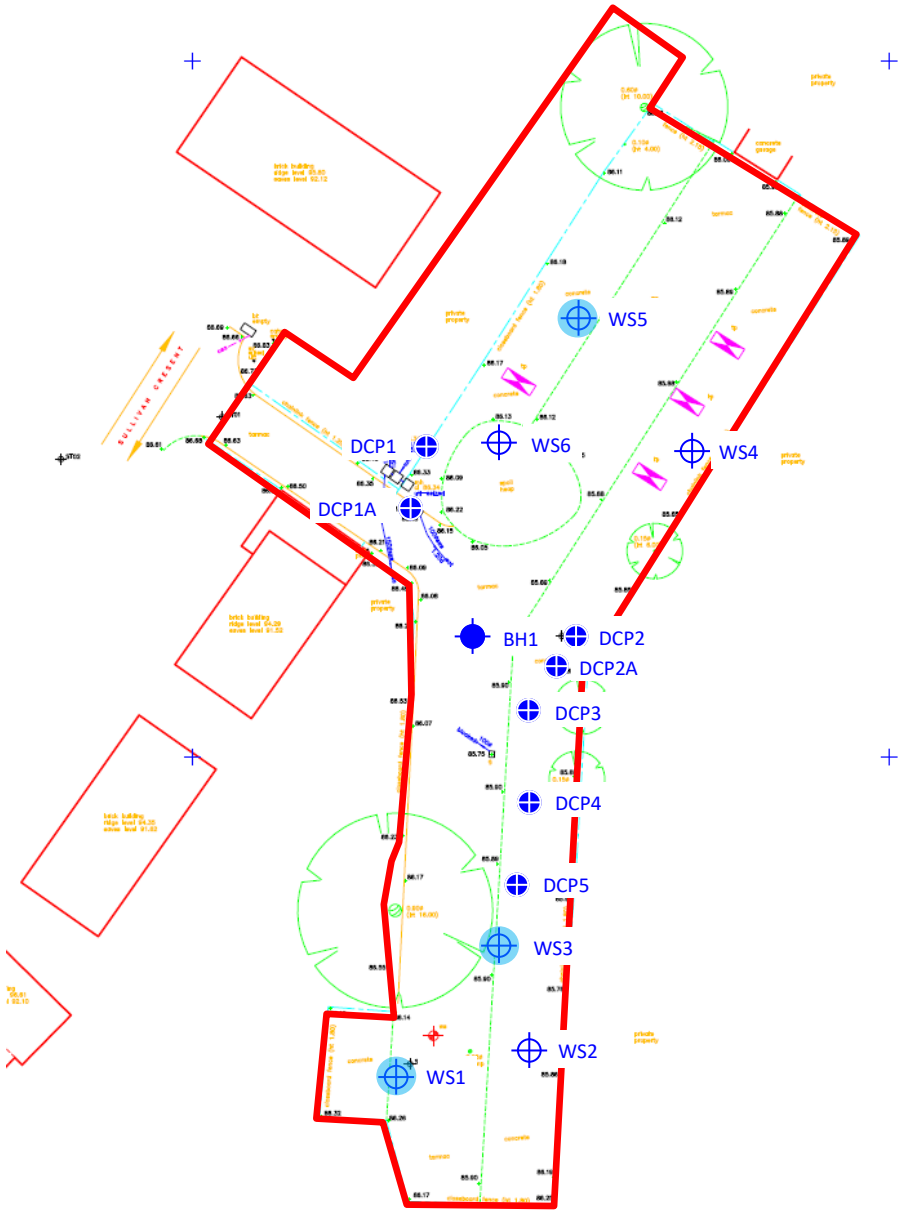
Figure 5

Drawing Title

Proposed Development Plan

Project Number	23-248.01
Project Title	Land at Sullivan Crescent, Harefield, UB9 6NL
Drawn by	DN
Checked by	JB
Scale	NTS

Aviron Associates Limited - Badgemore House - Gravel Hill - Henley on Thames - RG9 4NR - T: 01491 413 722 - M: 07787 771 686 - E: james@aviron.co.uk



Legend

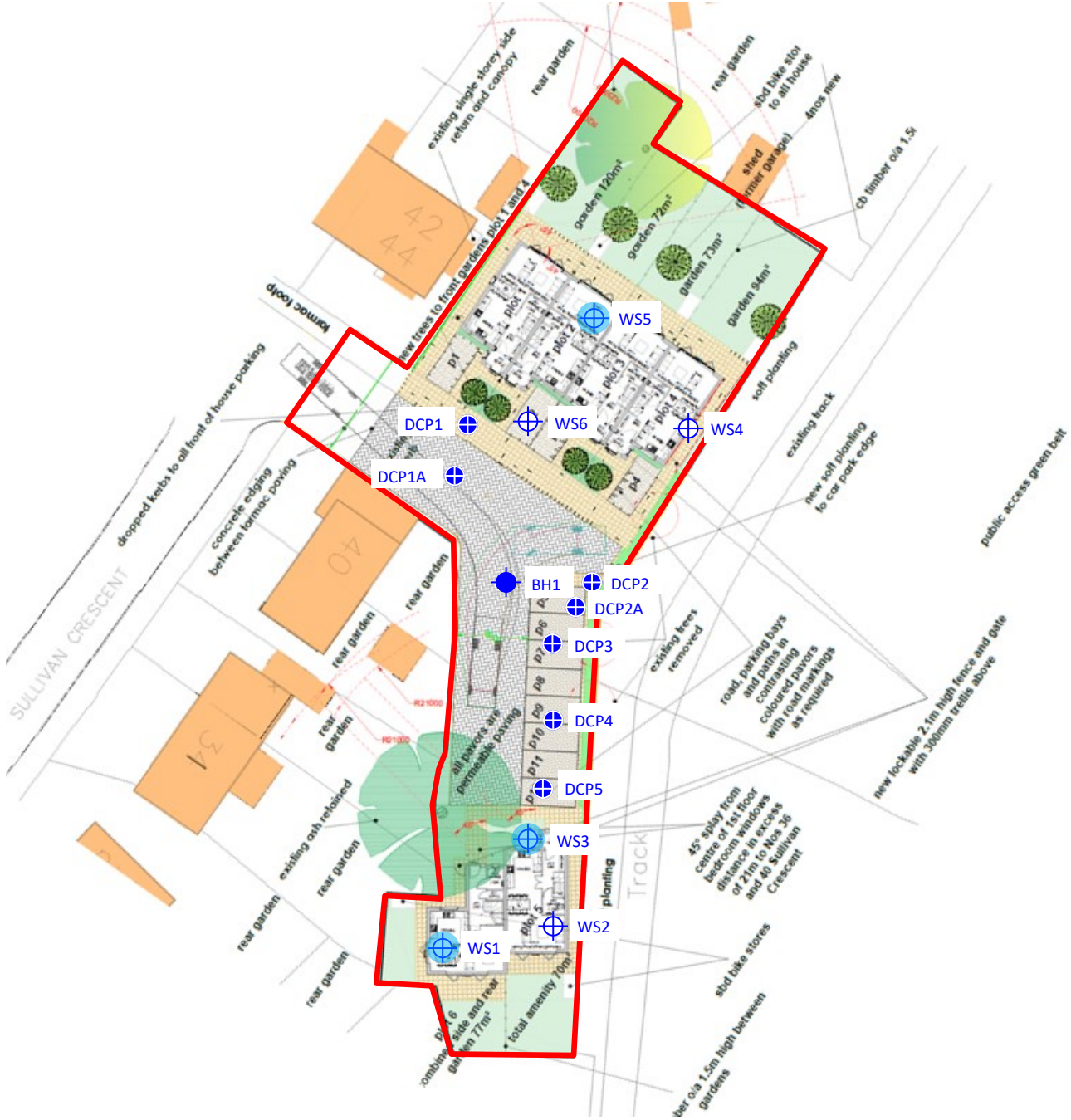
- Cable Percussion Borehole
- Window Sample Borehole
- Monitoring Well
- DCP / TRL Probing

Notes

Figure 6

Drawing Title	Exploratory Hole Location Plan
Project Number	23-248.01
Project Title	Land at Sullivan Crescent, Harefield, UB9 6NL
Drawn by	DN
Checked by	JB
Scale	NTS

Aviron Associates Limited - Badgemore House - Gravel Hill - Henley on Thames - RG9 4NR - T: 01491 413 722 - M: 07787 771 686 - E: james@aviron.co.uk



Legend

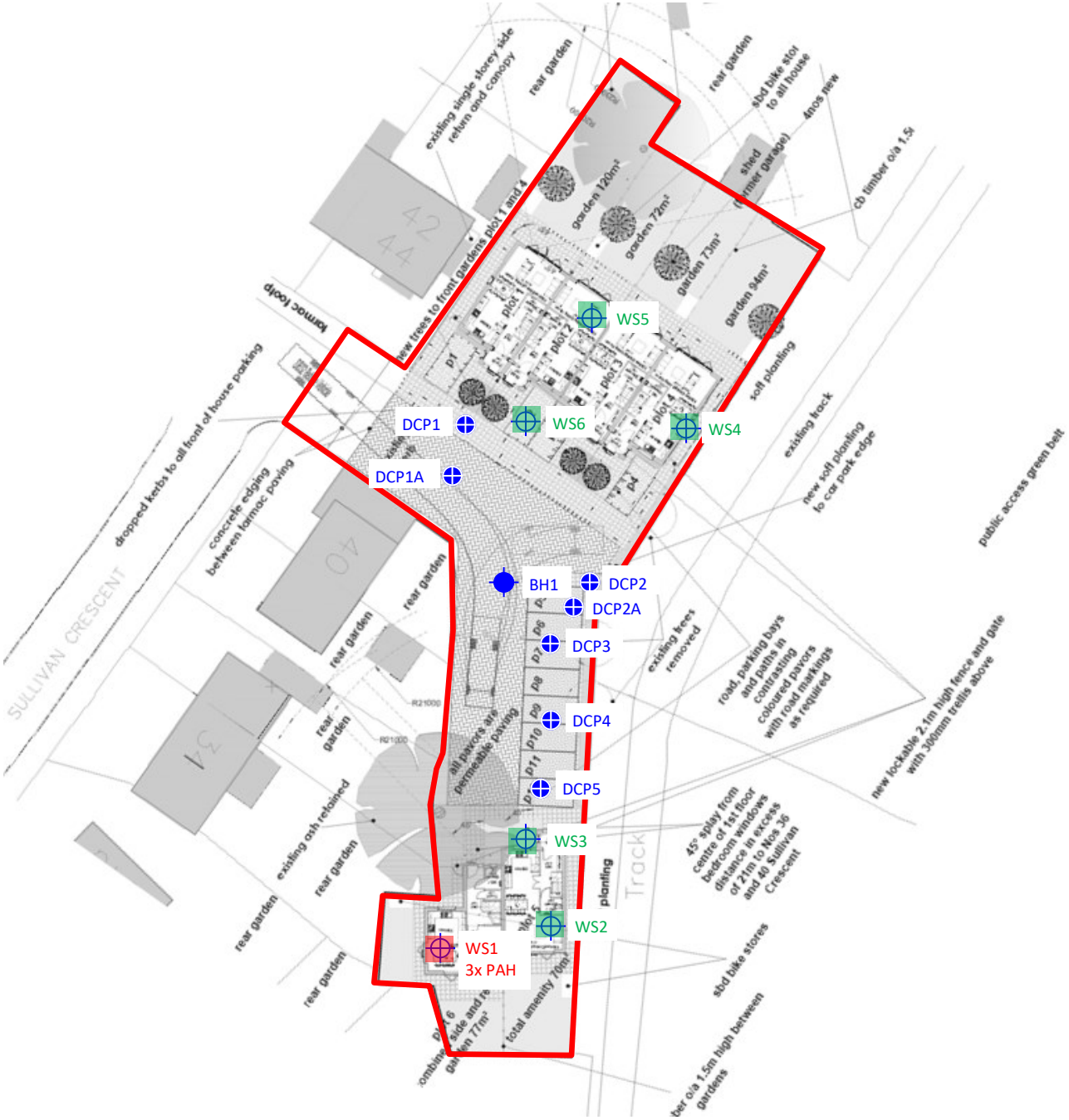
- Cable Percussion Borehole
- Window Sample Borehole
- Monitoring Well
- DCP / TRL Probing

Notes

Figure 7

Drawing Title	Exploratory Hole Location Plan
Project Number	23-248.01
Project Title	Land at Sullivan Crescent, Harefield, UB9 6NL
Drawn by	DN
Checked by	JB
Scale	NTS

Aviron Associates Limited - Badgemore House - Gravel Hill - Henley on Thames - RG9 4NR - T: 01491 413 722 - M: 07787 771 686 - E: james@aviron.co.uk



Legend

- ‘Contaminated’ Location
- ‘Uncontaminated’ Location

Notes

Where exploratory holes are not high-lighted red or green; no testing has been completed.

Figure 8

Drawing Title

Soil Contamination Identification Plan

Project Number	23-248.01
Project Title	Land at Sullivan Crescent, Harefield, UB9 6NL
Drawn by	DN
Checked by	JB
Scale	NTS

Aviron Associates Limited - Badgemore House - Gravel Hill - Henley on Thames - RG9 4NR - T: 01491 413 722 - M: 07787 771 686 - E: james@aviron.co.uk

Appendices

I Envirocheck Database Reports

II Exploratory Hole Logs and Photographs

III Field Monitoring Results

IV Soil Contamination Results and Assessment Criteria

V Soil Geotechnical Results

Appendix

I Envirocheck Database Reports

Appendix

II Exploratory Hole Logs and Photographs

Window Sampling Log

Project Name: Land at Sullivan Crescent	Client: Bugler Developments Limited	Date: 27/09/2023
Location: Harefield, UB9 6NL	Contractor:	
Project No. : 23-248.01	Crew Name: KDS	Drilling Equipment: Premier 110

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS1	WS		dn	1:50	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.15			Concrete
		0.40	ES		0.55			Firm dark grey brown silty sandy gravelly clay with fine brick, concrete and coarse clinker fragments. Gravel is fine to coarse sub-angular to rounded of flint. MADE GROUND
		1.00	D					Firm becoming stiff orange brown and grey mottled sandy gravelly CLAY. Gravel is fine to medium sub-angular of flint.
		1.00	SPT	N=22 (4,6/6,6,5,5)				
		1.50	ES		1.40			Dense becoming very dense orange brown slightly clayey gravelly medium to coarse SAND. Gravel content increasing with depth fine to coarse sub-angular of flint.
		2.00	D		2.00			End of Borehole at 2.00m
		2.00	SPT	N=61 (10,10/10,19,15,17)				

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

Seepage of groundwater encountered at 1.5m. Borehole wet at base. 50mm diameter standpipe installed to 2.0m . Response zone from 1.0m to 2.0m

Window Sampling Log

Project Name: Land at Sullivan Crescent	Client: Bugler Developments Limited	Date: 27/09/2023
Location: Harefield, UB9 6NL	Contractor:	
Project No. : 23-248.01	Crew Name: KDS	Drilling Equipment: Premier 110

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS2	WS		dn	1:50	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.30	ES		0.25 0.40			Concrete
					0.70			Dark grey brown silty sandy gravelly clay with fine brick, concrete and coarse clinker fragments. Gravel is fine to coarse sub-angular to rounded of flint. MADE GROUND
		1.00	SPT	N=24 (4,4/5,6,6,7)				Light brown sandy fine medium and coarse sub-angular to rounded gravel of flint. Reworked.
								Medium dense orange brown slightly clayey gravelly coarse SAND. Gravel is fine to coarse sub-angular of flint.
		2.00	SPT	N=45 (8,10/11,10,12,12)	2.00			Very dense orange brown very gravelly coarse SAND. Gravel content increasing with depth fine to coarse sub-angular of flint.
					2.50			End of Borehole at 2.50m
		3.00	SPT	N=17 (8,6/4,5,4,4)				

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

Seepage of groundwater encountered at 1.0m.

Window Sampling Log

Project Name: Land at Sullivan Crescent	Client: Bugler Developments Limited	Date: 27/09/2023
Location: Harefield, UB9 6NL	Contractor:	
Project No. : 23-248.01	Crew Name: KDS	Drilling Equipment: Premier 110

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS3	WS		dn	1:50	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.10			Concrete
					0.20			Dark grey brown silty sandy gravelly clay with fine brick, concrete and coarse clinker fragments. Gravel is fine to coarse sub-angular to rounded of flint. MADE GROUND
		0.50	ES					
					0.70			Light brown sandy fine medium and coarse sub-angular to rounded gravel of flint. Reworked.
					0.90			
		1.00	D					Light brown sandy gravelly clay. Gravel is medium and coarse sub-angular to rounded gravel of flint. Reworked.
		1.00	SPT	N=30 (4,6/6,10,6,8)				
								Medium dense orange brown slightly clayey gravelly coarse SAND with lenses of light grey sandy gravelly clay. Gravel is fine to coarse sub-angular of flint.
		2.00	D		2.00			Very dense orange brown very gravelly coarse SAND. Gravel content increasing with depth fine to coarse sub-angular of flint.
		2.00	SPT	N=62 (8,10/14,14,17,17)	2.30			End of Borehole at 2.30m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

50mm diameter standpipe installed to 2.3m. Groundwater not encountered.

AGS

Window Sampling Log

Project Name: Land at Sullivan Crescent	Client: Bugler Developments Limited	Date: 27/09/2023
Location: Harefield, UB9 6NL	Contractor:	
Project No. : 23-248.01	Crew Name: KDS	Drilling Equipment: Premier 110

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS4	WS		dn	1:50	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.15			Concrete
					0.20			Dark grey brown silty sandy gravelly clay with fine brick, concrete and coarse clinker fragments. Gravel is fine to coarse sub-angular to rounded of flint. MADE GROUND
					0.80			Firm brown sandy gravelly clay with fine to medium brick fragments and roots. MADE GROUND
		1.00	ES					
		1.00	SPT	N=16 (3,3/4,4,4,4)				Medium dense lght brown slightly clayey silty fine SAND.
					1.90			
		2.00	SPT	N=19 (4,5/5,4,5,5)				Stiff orange brown and grey mottled sandy CLAY with partings of coarse orange brown sand.
		3.00	SPT	N=16 (4,5/4,4,4,4)	3.00			End of Borehole at 3.00m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

Groundwater not encountered.

Window Sampling Log

Project Name: Land at Sullivan Crescent	Client: Bugler Developments Limited	Date: 27/09/2023
Location: Harefield, UB9 6NL	Contractor:	
Project No. : 23-248.01	Crew Name: KDS	Drilling Equipment: Premier 110

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS5	WS		dn	1:50	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.10			Concrete
		0.30	ES		0.15			Brown coarse rounded gravel. MADE GROUND
					0.40			Firm brown sandy gravelly clay with fine to medium brick fragments. MADE GROUND
								Light brown silty fine SAND.
		1.00	SPT	N=19 (3,4/5,5,4,5)	0.90			Medium dense orange brown silty fine SAND
		2.00	SPT	N=26 (6,6/8,8,6,4)	2.10			Stiff orange brown and grey mottled sandy CLAY.
		3.00	SPT	N=16 (4,4/4,4,4,4)	3.00			End of Borehole at 3.00m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

50mm diameter standpipe installed to 2.0m Groundwater not encountered.

Window Sampling Log

Project Name: Land at Sullivan Crescent	Client: Bugler Developments Limited	Date: 27/09/2023
Location: Harefield, UB9 6NL	Contractor:	
Project No. : 23-248.01	Crew Name: KDS	Drilling Equipment: Premier 110

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS6	WS		dn	1:50	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.15			Concrete
		0.30	ES		0.20 0.45			Dark grey brown silty sandy gravelly clay with fine brick, concrete and coarse clinker fragments. Gravel is fine to coarse sub-angular to rounded of flint. MADE GROUND
		1.00	SPT	N=19 (3,4/6,1,6,6)				Grey brown silty sandy gravelly clay with fine brick fragments. MADE GROUND
								Medium dense orange brown clayey gravelly coarse SAND with lenses of very sandy gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of flint.
		2.00	D		2.00			Stiff orange brown and grey mottled sandy CLAY with partings of coarse orange brown sand.
		2.00	ES					
		2.00	SPT	N=26 (10,8/10,8,4,4)				
		3.00	D					
		3.00	SPT	N=17 (4,4/4,4,4,5)				
					3.90			Stiff grey slightly fissured silty CLAY
		4.00	D					
		4.00	SPT	N=21 (4,5/7,5,4,5)				
		5.00	D		5.00			End of Borehole at 5.00m
		5.00	SPT	N=17 (4,5/4,5,4,4)				

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

Seepage of groundwater encountered at 2.1m.

Exploratory Hole Photographs

Project Number 23-248.01 **Project Title** Land at Sullivan Crescent, Harefield, UB9 6NL **Taken by** DN **Date** 27/09/2023

WS1 arisings

WS2 arisings

WS3 arisings

WS4 arisings

WS5 arisings

WS6 arisings

Percussion Drilling Log

Project Name: Land at Sullivan Crescent	Client: Bugler Developments Limited	Date: 02/10/2023 - 03/10/2023
Location: Harefield, UB9 6NL	Contractor:	
Project No. : 23-248.01	Crew Name: Star Drilling	Drilling Equipment: Pilcon

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
BH1	CP		dn	1:50	Sheet 1 of 3

Well	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								Brown and dark brown sandy gravelly reworked clay with brick cobbles. MADE GROUND
					0.50			
		0.70	D					Firm brown sandy gravelly clay with fine to medium brick fragments. MADE GROUND
					0.80			
								Firm, locally soft orange brown and grey sandy CLAY
		1.20	SPT	N=11 (1,2/2,2,3,4)				
		1.65	SPTLS		1.60			
								Firm orange brown sandy CLAY
		2.00	SPT	N=12 (2,2/2,3,3,4)				
		2.45	SPTLS					
					2.60			
		2.70	D					Firm becoming stiff grey silty CLAY
		3.00	SPT	N=17 (1,2/3,4,5,5)				
		3.45	SPTLS					
		4.00	SPT	N=16 (1,2/4,4,4,4)				
		4.45	SPTLS					
		5.00	SPT	N=18 (2,2/3,4,5,6)				
					5.30			
		5.45	SPTLS					Stiff high strength slightly fissured grey slightly silty CLAY
		6.00 - 6.45	U	Ublow=75				
		6.50	D					
		7.00	SPT	N=21 (2,3/4,5,5,7)				
		7.45	SPTLS					
		8.00	SPT	N=23 (3,3/5,5,6,7)				
		8.45	SPTLS					
					8.50			Stiff high strength fissured grey silty CLAY
		9.00 - 9.45	U	Ublow=95				
		9.50	D					
					9.70			Stiff high strength becoming very stiff fissured grey silty CLAY ... claystone encountered from 9.7m to 9.9m
		10.00	SPT	N=24 (3,4/5,6,6,7)				

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
25.00	150	3.00	150	8.50 9.70	8.60 9.90	01:00 01:00					

Remarks

Groundwater not encountered.

Percussion Drilling Log

Project Name: Land at Sullivan Crescent	Client: Bugler Developments Limited	Date: 02/10/2023 - 03/10/2023
Location: Harefield, UB9 6NL	Contractor:	
Project No. : 23-248.01	Crew Name: Star Drilling	Drilling Equipment: Pilcon

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
BH1	CP		dn	1:50	Sheet 2 of 3

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		10.45	SPTL S					Stiff high strength becoming very stiff fissured grey silty CLAY
		11.60	D					
		12.00 - 12.45	U	Ublow=100				
		12.50	D					
		13.20	D					
		14.00	SPT	N=26 (3,3/5,6,7,8)				
		14.45	SPTL S					
		15.10	D					
		16.00	SPT	N=28 (4,4/6,7,7,8)				
		16.45	SPTL S					
		17.20	D					
		18.00	SPT	N=30 (4,5/7,7,8,8)				
		18.45	SPTL S					
		19.30	D					
		20.00	SPT	N=34 (5,5/9,8,8,9)				

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
25.00	150	3.00	150	8.50 9.70	8.60 9.90	01:00 01:00					

Remarks

Groundwater not encountered.

Percussion Drilling Log

Project Name: Land at Sullivan Crescent	Client: Bugler Developments Limited	Date: 02/10/2023 - 03/10/2023
Location: Harefield, UB9 6NL	Contractor:	
Project No. : 23-248.01	Crew Name: Star Drilling	Drilling Equipment: Pilcon

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
BH1	CP		dn	1:50	Sheet 3 of 3

Well	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		20.45	SPTLS					Stiff high strength becoming very stiff fissured grey silty CLAY
		21.20	D					
		22.00	SPT	N=40 (6,6/9,10,11,10)				
		22.45	SPTLS					
		23.10	D					
		24.00	SPT	N=44 (6,6/10,11,12,11)				
		24.45	SPTLS					
		25.00	D		25.00			End of Borehole at 25.000m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
25.00	150	3.00	150	8.50 9.70	8.60 9.90	01:00 01:00					

Remarks

Groundwater not encountered.

Appendix

III Field Monitoring Results

MONITORING DATA SHEET

SITE Land at Sullivan Crescent, Harefield, UB9 6NL
PROJECT 23-248.01

VISIT NUMBER 1
DATE 03/10/2023

EQUIPMENT GFM436 + MiniRAE
TAKEN BY DN

Record of Stable Concentrations										Interpretation		
Location	Time	Flow (l/h)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	Baro. Prs. (mB)	PID (ppm)	Water (m bgl)	Base Well (m bgl)	CH4 GSV (l/h)	CO2 GSV (l/h)	CS
Site	11:30	n/a	0.0	0.0	20.6	1012	0.0	n/a	n/a	n/a	n/a	n/a
WS1	11:50	0.0	0.0	13.1	5.6	1012	0.0	*	*	0	0	CS-2
WS3	11:40	0.0	0.0	0.1	18.6	1012	0.0	1.34	2.14	0	0	CS-1
WS5	12:00	0.0	0.0	8.5	11.1	1012	0.0	0.85	2.40	0	0	CS-2

Weather Observations					
State of Ground	Cloud Cover	Wind	Rain	Air Temperature °C	
Dry	Clear	Calm	None	Before	12
Moist	Sunny	Light	Slight		
Wet	Slight	Moderate	Moderate	After	12
Snow	Cloudy	Strong	Heavy		
Frozen	Overcast				
	Fog/Mist				

Pressure Observations			
Source	Pressure Records		Trend
Metoffice	Location	**Ascot**	Falling
GFM436	Time	**07:00**	Steady
	Pressure	**1017**	Rising

Notes	
*Gas bung lodged in well	
Worst case conditions? (<1000mB and Falling)	No

Aviron Associates Limited
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MONITORING DATA SHEET

SITE Land at Sullivan Crescent, Harefield, UB9 6NL
PROJECT 23-248.01

VISIT NUMBER 1
DATE 03/10/2023

EQUIPMENT GFM436 + MiniRAE
TAKEN BY DN

Record of Stable Concentrations										Interpretation		
Location	Time	Flow (l/h)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	Baro. Prs. (mB)	PID (ppm)	Water (m bgl)	Base Well (m bgl)	CH4 GSV (l/h)	CO2 GSV (l/h)	CS
Site	11:20	n/a	0.0	0.0	20.5	1010	0.0	n/a	n/a	n/a	n/a	n/a
WS1	11:39	0.0	0.0	13.1	5.4	1010	0.0	*	*	0	0	CS-2
WS3	11:51	0.0	0.0	0.1	18.4	1010	0.0	1.24	2.07	0	0	CS-2
WS5	11:27	0.0	0.0	9.2	10.6	1010	0.0	1.82	2.31	0	0	CS-2

Weather Observations					
State of Ground	Cloud Cover	Wind	Rain	Air Temperature °C	
Dry	Clear	Calm	None	Before	18
Moist	Sunny	Light	Slight		
Wet	Slight	Moderate	Moderate	After	18
Snow	Cloudy	Strong	Heavy		
Frozen	Overcast				
	Fog/Mist				

Pressure Observations			
Source	Pressure Records		Trend
Metoffice	Location	**Hillingdon**	Falling
GFM436	Time	**08:00**	Steady
	Pressure	**1017**	Rising

Notes	
*Gas bung lodged in well	
Worst case conditions? (<1000mB and Falling)	No

Aviron Associates Limited
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MONITORING DATA SHEET

SITE Land at Sullivan Crescent, Harefield, UB9 6NL
PROJECT 23-248.01

VISIT NUMBER 3
DATE 19/10/2023

EQUIPMENT GFM436 + MiniRAE
TAKEN BY AC

Record of Stable Concentrations										Interpretation		
Location	Time	Flow (l/h)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	Baro. Prs. (mB)	PID (ppm)	Water (m bgl)	Base Well (m bgl)	CH4 GSV (l/h)	CO2 GSV (l/h)	CS
Site	12:20		0.0	0.0	20.5	978	0.0			n/a	n/a	n/a
WS1	12:28	0.0	0.0	7.1	4.4	978	1.7	*	*	0	0	CS-1
WS3	12:43	0.0	0.0	0.8	17.6	978	2.5	1.02	2.07	0	0	CS-2
WS5	12:56	0.0	0.0	9.5	9.2	978	0.0	1.63	2.31	0	0	CS-2

Weather Observations					
State of Ground	Cloud Cover	Wind	Rain	Air Temperature °C	
Dry	Clear	Calm	None	Before	17
Moist	Sunny	Light	Slight		
Wet	Slight	Moderate	Moderate	After	17
Snow	Cloudy	Strong	Heavy		
Frozen	Overcast				
	Fog/Mist				

Pressure Observations			
Source	Pressure Records		Trend
Metoffice	Location	**Hillingdon**	Falling
GFM436	Time	**07:00**	Steady
	Pressure	**984**	Rising

Notes	
*Gas bung lodged in well	
Worst case conditions? (<1000mB and Falling)	Yes

Aviron Associates Limited
Badgemore House - Badgemore Park - Gravel Hill - Henley on Thames - RG9 4NR
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Appendix

IV Soil Contamination Results and Assessment Criteria

James Burkitt
Aviron Associates Ltd
Badgemore House
Henley
Oxfordshire
RG9 4NR

e: Aviron -

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

t: 01923 225404
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e: reception@i2analytical.com

Analytical Report Number : 23-59208

Project / Site name:	Land at Sullivan Crescent Harefield UB9 6NL	**Samples received on:**	28/09/2023
Your job number:	23-248-01	**Samples instructed on/ Analysis started on:**	28/09/2023
Your order number:	23-248-01	**Analysis completed by:**	10/10/2023
Report Issue Number:	1	**Report issued on:**	10/10/2023
Samples Analysed:	8 soil samples		

Signed:

Dominika Liana
Junior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

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

Analytical Report Number: 23-59208
Project / Site name: Land at Sullivan Crescent Harefield UB9 6NL
Your Order No: 23-248-01

Lab Sample Number				2827588	2827589	2827590	2827591	2827592
Sample Reference				WS1	WS1	WS2	WS3	WS4
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.40	1.50	0.30	0.50	1.00
Date Sampled				27/09/2023	27/09/2023	27/09/2023	27/09/2023	27/09/2023
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	%	0.01	NONE	9.3	6.9	14	9.9	12
Total mass of sample received	kg	0.001	NONE	0.4	0.5	0.4	0.4	0.4
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	-	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	DSA	N/A	DSA	EWS	EWS
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.5	8.1	7.8	8.2	8.2
Total Cyanide	mg/kg	1	MCERTS	1.6	-	< 1.0	< 1.0	< 1.0
Total Sulphate as SO4	mg/kg	50	MCERTS	150	170	230	170	94
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.0249	0.0328	0.022	0.0164	0.0153
Total Sulphur	mg/kg	50	MCERTS	230	50	200	110	58
Organic Matter (automated)	%	0.1	MCERTS	1.7	-	2.3	1	0.5
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	< 1.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	1.7	-	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	0.47	-	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	0.57	-	< 0.05	< 0.05	0.11
Fluorene	mg/kg	0.05	MCERTS	0.5	-	< 0.05	< 0.05	0.07
Phenanthrene	mg/kg	0.05	MCERTS	2.5	-	0.15	< 0.05	1
Anthracene	mg/kg	0.05	MCERTS	0.57	-	< 0.05	< 0.05	0.35
Fluoranthene	mg/kg	0.05	MCERTS	5.1	-	0.42	< 0.05	2.3
Pyrene	mg/kg	0.05	MCERTS	6	-	0.32	< 0.05	1.9
Benzo(a)anthracene	mg/kg	0.05	MCERTS	2.3	-	0.17	< 0.05	0.98
Chrysene	mg/kg	0.05	MCERTS	2.5	-	0.27	< 0.05	1.1
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	4	-	0.34	< 0.05	1.4
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	1.2	-	0.16	< 0.05	0.5
Benzo(a)pyrene	mg/kg	0.05	MCERTS	3.1	-	0.23	< 0.05	1
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	2	-	0.14	< 0.05	0.69
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.36	-	< 0.05	< 0.05	0.19
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	2.2	-	0.17	< 0.05	0.83
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	35	-	2.37	< 0.80	12.4
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	11	-	12	11	2
Boron (water soluble)	mg/kg	0.2	MCERTS	6.1	-	0.3	0.3	0.2
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	-	< 0.2	< 0.2	< 0.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	19	-	20	20	9.4
Copper (aqua regia extractable)	mg/kg	1	MCERTS	74	-	26	14	15
Lead (aqua regia extractable)	mg/kg	1	MCERTS	56	-	110	28	9.7
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	-	0.4	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	49	-	14	9.6	5.5
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	34	-	53	25	18

Analytical Report Number: 23-59208
Project / Site name: Land at Sullivan Crescent Harefield UB9 6NL
Your Order No: 23-248-01

Lab Sample Number				2827588	2827589	2827590	2827591	2827592
Sample Reference				WS1	WS1	WS2	WS3	WS4
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.40	1.50	0.30	0.50	1.00
Date Sampled				27/09/2023	27/09/2023	27/09/2023	27/09/2023	27/09/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Monoaromatics & Oxygenates								
Benzene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	< 5.0	< 5.0
Toluene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	< 5.0	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	< 5.0	< 5.0
p & m-xylene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	< 5.0	< 5.0
o-xylene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	< 5.0	< 5.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	-	< 5.0	< 5.0	< 5.0
Petroleum Hydrocarbons								
TPH-CWG - Aliphatic >EC5 - EC6 $_{HS\_1D\_AL}$	mg/kg	0.1	NONE	< 0.10	-	< 0.10	< 0.10	< 0.10
TPH-CWG - Aliphatic >EC6 - EC8 $_{HS\_1D\_AL}$	mg/kg	0.1	NONE	< 0.10	-	< 0.10	< 0.10	< 0.10
TPH-CWG - Aliphatic >EC8 - EC10 $_{HS\_1D\_AL}$	mg/kg	0.1	NONE	< 0.10	-	< 0.10	< 0.10	< 0.10
TPH-CWG - Aliphatic >EC10 - EC12 $_{EH\_CU\_1D\_AL}$	mg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16 $_{EH\_CU\_1D\_AL}$	mg/kg	2	MCERTS	< 2.0	-	< 2.0	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21 $_{EH\_CU\_1D\_AL}$	mg/kg	8	MCERTS	< 8.0	-	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35 $_{EH\_CU\_1D\_AL}$	mg/kg	8	MCERTS	< 8.0	-	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic (EC5 - EC35) $_{EH\_CU+HS\_1D\_AL}$	mg/kg	10	NONE	< 10	-	< 10	< 10	< 10
TPH-CWG - Aromatic >EC5 - EC7 $_{HS\_1D\_AR}$	mg/kg	0.1	NONE	< 0.10	-	< 0.10	< 0.10	< 0.10
TPH-CWG - Aromatic >EC7 - EC8 $_{HS\_1D\_AR}$	mg/kg	0.1	NONE	< 0.10	-	< 0.10	< 0.10	< 0.10
TPH-CWG - Aromatic >EC8 - EC10 $_{HS\_1D\_AR}$	mg/kg	0.1	NONE	< 0.10	-	< 0.10	< 0.10	< 0.10
TPH-CWG - Aromatic >EC10 - EC12 $_{EH\_CU\_1D\_AR}$	mg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16 $_{EH\_CU\_1D\_AR}$	mg/kg	2	MCERTS	2.9	-	< 2.0	< 2.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21 $_{EH\_CU\_1D\_AR}$	mg/kg	10	MCERTS	< 10	-	< 10	< 10	< 10
TPH-CWG - Aromatic >EC21 - EC35 $_{EH\_CU\_1D\_AR}$	mg/kg	10	MCERTS	12	-	< 10	< 10	< 10
TPH-CWG - Aromatic (EC5 - EC35) $_{EH\_CU+HS\_1D\_AR}$	mg/kg	10	NONE	22	-	16	< 10	10

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number: 23-59208
Project / Site name: Land at Sullivan Crescent Harefield UB9 6NL
Your Order No: 23-248-01

Lab Sample Number				2827593	2827594	2827595
Sample Reference				WS5	WS6	WS6
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.30	0.30	2.00
Date Sampled				27/09/2023	27/09/2023	27/09/2023
Time Taken				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
Moisture Content	%	0.01	NONE	11	13	8.4
Total mass of sample received	kg	0.001	NONE	0.4	0.4	0.5
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	-
Asbestos Analyst ID	N/A	N/A	N/A	EWS	EWS	N/A
General Inorganics						
pH - Automated	pH Units	N/A	MCERTS	7.3	7.4	8.2
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	-
Total Sulphate as SO4	mg/kg	50	MCERTS	290	260	240
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.0986	0.16	0.0771
Total Sulphur	mg/kg	50	MCERTS	210	330	110
Organic Matter (automated)	%	0.1	MCERTS	1.4	1.8	-
Total Phenols						
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	-
Speciated PAHs						
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-
Phenanthrene	mg/kg	0.05	MCERTS	0.07	0.09	-
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-
Fluoranthene	mg/kg	0.05	MCERTS	0.22	0.16	-
Pyrene	mg/kg	0.05	MCERTS	0.23	0.17	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.13	0.07	-
Chrysene	mg/kg	0.05	MCERTS	0.14	0.12	-
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	0.14	0.13	-
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	0.06	< 0.05	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.12	0.08	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.11	0.07	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.1	0.09	-
Total PAH						
Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	1.32	0.98	-
Heavy Metals / Metalloids						
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	9.7	9.6	-
Boron (water soluble)	mg/kg	0.2	MCERTS	0.6	0.7	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	-
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	16	19	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	18	22	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	51	61	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	9.5	12	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	34	39	-

Analytical Report Number: 23-59208
Project / Site name: Land at Sullivan Crescent Harefield UB9 6NL
Your Order No: 23-248-01

Lab Sample Number				2827593	2827594	2827595
Sample Reference				WS5	WS6	WS6
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.30	0.30	2.00
Date Sampled				27/09/2023	27/09/2023	27/09/2023
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Monoaromatics & Oxygenates						
Benzene	µg/kg	5	MCERTS	< 5.0	< 5.0	-
Toluene	µg/kg	5	MCERTS	< 5.0	< 5.0	-
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0	-
p & m-xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	-
o-xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	< 5.0	-
Petroleum Hydrocarbons						
TPH-CWG - Aliphatic >EC5 - EC6 $_{HS\_1D\_AL}$	mg/kg	0.1	NONE	< 0.10	< 0.10	-
TPH-CWG - Aliphatic >EC6 - EC8 $_{HS\_1D\_AL}$	mg/kg	0.1	NONE	< 0.10	< 0.10	-
TPH-CWG - Aliphatic >EC8 - EC10 $_{HS\_1D\_AL}$	mg/kg	0.1	NONE	< 0.10	< 0.10	-
TPH-CWG - Aliphatic >EC10 - EC12 $_{EH\_CU\_1D\_AL}$	mg/kg	1	MCERTS	< 1.0	< 1.0	-
TPH-CWG - Aliphatic >EC12 - EC16 $_{EH\_CU\_1D\_AL}$	mg/kg	2	MCERTS	< 2.0	< 2.0	-
TPH-CWG - Aliphatic >EC16 - EC21 $_{EH\_CU\_1D\_AL}$	mg/kg	8	MCERTS	< 8.0	< 8.0	-
TPH-CWG - Aliphatic >EC21 - EC35 $_{EH\_CU\_1D\_AL}$	mg/kg	8	MCERTS	< 8.0	< 8.0	-
TPH-CWG - Aliphatic (EC5 - EC35) $_{EH\_CU+HS\_1D\_AL}$	mg/kg	10	NONE	< 10	< 10	-
TPH-CWG - Aromatic >EC5 - EC7 $_{HS\_1D\_AR}$	mg/kg	0.1	NONE	< 0.10	< 0.10	-
TPH-CWG - Aromatic >EC7 - EC8 $_{HS\_1D\_AR}$	mg/kg	0.1	NONE	< 0.10	< 0.10	-
TPH-CWG - Aromatic >EC8 - EC10 $_{HS\_1D\_AR}$	mg/kg	0.1	NONE	< 0.10	< 0.10	-
TPH-CWG - Aromatic >EC10 - EC12 $_{EH\_CU\_1D\_AR}$	mg/kg	1	MCERTS	< 1.0	< 1.0	-
TPH-CWG - Aromatic >EC12 - EC16 $_{EH\_CU\_1D\_AR}$	mg/kg	2	MCERTS	< 2.0	< 2.0	-
TPH-CWG - Aromatic >EC16 - EC21 $_{EH\_CU\_1D\_AR}$	mg/kg	10	MCERTS	< 10	< 10	-
TPH-CWG - Aromatic >EC21 - EC35 $_{EH\_CU\_1D\_AR}$	mg/kg	10	MCERTS	< 10	< 10	-
TPH-CWG - Aromatic (EC5 - EC35) $_{EH\_CU+HS\_1D\_AR}$	mg/kg	10	NONE	< 10	< 10	-

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number : 23-59208
Project / Site name: Land at Sullivan Crescent Harefield UB9 6NL

* 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 *
2827588	WS1	None Supplied	0.4	Brown clay with clinker.
2827589	WS1	None Supplied	1.5	Brown clay and sand with gravel.
2827590	WS2	None Supplied	0.3	Brown loam and sand with gravel.
2827591	WS3	None Supplied	0.5	Brown loam and clay with gravel.
2827592	WS4	None Supplied	1	Brown sandy clay with gravel.
2827593	WS5	None Supplied	0.3	Brown clay and sand with gravel.
2827594	WS6	None Supplied	0.3	Brown clay and sand with gravel.
2827595	WS6	None Supplied	2	Brown sand with gravel.

Analytical Report Number : 23-59208
Project / Site name: Land at Sullivan Crescent Harefield UB9 6NL

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
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
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-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
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
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. Refer to CoA for analyte specific accreditation.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
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
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS. Individual components MCERTS accredited	In-house method based on USEPA8260. Refer to CoA for analyte specific accreditation	L073B-PL	W	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID. Refer to CoA for band specific accreditation.	In-house method with silica gel split/clean up.	L088/76-PL	D	MCERTS
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS

Analytical Report Number : 23-59208
Project / Site name: Land at Sullivan Crescent Harefield UB9 6NL

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
D.O. for Gravimetric Quant if Screen/ID positive	Dependent option for Gravimetric Quant if Screen/ID positive scheduled.	In house asbestos methods A001 & A006.	A006-PL	D	NONE

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL or B' 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.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

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Analytical Report Number : 23-60184

Project / Site name:	Land at Sullivan Crescent Harefield UB9 6NL	**Samples received on:**	03/10/2023
Your job number:	23-248-01	**Samples instructed on/ Analysis started on:**	03/10/2023
Your order number:	23-248-01	**Analysis completed by:**	11/10/2023
Report Issue Number:	1	**Report issued on:**	11/10/2023
Samples Analysed:	2 soil samples		

Signed:

Joanna Szwagrzak
Junior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

Analytical Report Number: 23-60184
Project / Site name: Land at Sullivan Crescent Harefield UB9 6NL
Your Order No: 23-248-01

Lab Sample Number				2832814	2832815
Sample Reference				BH1	BH1
Sample Number				None Supplied	None Supplied
Depth (m)				10.45	18.45
Date Sampled				03/10/2023	03/10/2023
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**		
Stone Content	%	0.1	NONE	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	19	19
Total mass of sample received	kg	0.001	NONE	0.4	0.4

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.8	7.9
Total Sulphate as SO4	mg/kg	50	MCERTS	990	1100
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.486	0.502
Total Sulphur	mg/kg	50	MCERTS	4300	4800

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number : 23-60184
Project / Site name: Land at Sullivan Crescent Harefield UB9 6NL

* 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 *
2832814	BH1	None Supplied	10.45	Grey clay.
2832815	BH1	None Supplied	18.45	Grey clay.

Analytical Report Number : 23-60184
Project / Site name: Land at Sullivan Crescent Harefield UB9 6NL

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
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
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL or B' 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.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Residential with Homegrown Produce
Soil Screening Values
Private Gardens

Determinant	1% SOM (mg/kg)	2.5% SOM (mg/kg)	6% SOM (mg/kg)	Criteria
METALS, SEMI-METALS, INROGANICS + PAH (SUITE 1)				
Arsenic	37	37	37	C4SL/LQM S4UL
Boron	290	290	290	LQM S4UL
Cadmium	11	11	11	LQM S4UL
Chromium III	910	910	910	LQM S4UL
Chromium IV	6	6	6	LQM S4UL
Copper	2,400	2,400	2,400	LQM S4UL
Mercury	1.2	1.2	1.2	LQM S4UL
Nickel	180	180	180	LQM S4UL
Lead	200	200	200	LQM S4UL
Selenium	250	250	250	LQM S4UL
Zinc	3,700	3,700	3,700	LQM S4UL
Free Cyanide	34	34	34	ATRISK
Acenaphthene	210	510	1100	LQM S4UL
Acenaphthylene	170	420	920	LQM S4UL
Anthracene	2,400	5400	11000	LQM S4UL
Benzo(a)anthracene	7.2	11	13	LQM S4UL
Benzo(a)pyrene	2.2	2.7	3	LQM S4UL
Benzo(b)fluoranthene	2.6	3.3	3.7	LQM S4UL
Benzo(ghi)perylene	320	340	350	LQM S4UL
Benzo(k)fluoranthene	77	93	100	LQM S4UL
Chrysene	15	22	27	LQM S4UL
Dibenz(ah)anthracene	0.24	0.28	0.3	LQM S4UL
Fluoranthene	280	560	890	LQM S4UL
Fluorene	170	400	860	LQM S4UL
Indeno(123-cd)pyrene	27	36	41	LQM S4UL
Naphthalene	2.3	5.6	13	LQM S4UL
Phenanthrene	95	220	440	LQM S4UL

Determinant	1% SOM (mg/kg)	2.5% SOM (mg/kg)	6% SOM (mg/kg)	Criteria
Pyrene	620	1200	2000	LQM S4UL
Phenols	78	0.98	1.1	LQM S4UL
TOTAL PETROLEUM HYDOCARBONS				
Benzene	0.087	0.17	0.37	LQM S4UL
Toluene	130	290	660	LQM S4UL
Ethlybenzene	47	110	260	LQM S4UL
o-xylene	60	140	330	LQM S4UL
m-xylene	59	140	320	LQM S4UL
p-xylene	56	130	310	LQM S4UL
Aliphatic EC 5-6	42	78	160	LQM S4UL
Aliphatic EC >6-8	100	230	530	LQM S4UL
Aliphatic EC >8-10	27	65	150	LQM S4UL
Aliphatic EC >10-12	130	330	760	LQM S4UL
Aliphatic EC >12-16	1,100	2400	4300	LQM S4UL
Aliphatic EC >16-35	65,000	92000	110000	LQM S4UL
Aliphatic EC >35-44	65,000	92000	110000	LQM S4UL
Aromatic EC 5-7 (benzene)	70	140	300	LQM S4UL
Aromatic EC >7-8 (toluene)	130	290	660	LQM S4UL
Aromatic EC >8-10	34	83	190	LQM S4UL
Aromatic EC >10-12	74	180	380	LQM S4UL
Aromatic EC >12-16	140	330	660	LQM S4UL
Aromatic EC >16-21	260	540	930	LQM S4UL
Aromatic EC >21-35	1,100	1500	1700	LQM S4UL
Aromatic EC >35-44	1,100	1500	1700	LQM S4UL
Aromatic EC >44-70	1,600	1800	1900	LQM S4UL
ASBESTOS				
None Detectable			Aviron Adopted Value	

Appendix

V Soil Geotechnical Results

Summary of Natural Moisture Content, Liquid Limit and Plastic Limit Results

Job No.	Project Name	Programme	
34133	Sullivan Crescent, Harefield, UB9 6NL	Samples received	29/09/2023
		Schedule received	29/09/2023
Project No.	Client	Project started	02/10/2023
23-248.01	Aviron	Testing Started	10/10/2023

Hole No.	Sample				Soil Description	NMC	Passing 425µm	LL	PL	PI	Remarks
	Ref	Top m	Base m	Type		%	%	%	%	%	
WS1	-	1.00	-	D	Brown sandy gravelly silty CLAY (gravel is fmc and angular to sub-rounded flint)	10	43	30	16	14	Sample washed to obtain test fraction
WS6	-	2.00	-	D	Brown slightly sandy very gravelly silty CLAY (gravel is fmc and angular to sub-angular flint)	5.9	16	55	17	38	Sample washed to obtain test fraction
WS6	-	3.00	-	D	Dark brown silty CLAY	27	100	67	24	43	

Test Methods: BS1377: Part 2: 1990:
Natural Moisture Content : clause 3.2
Atterberg Limits: clause 4.3 and 5.0
These results only apply to the items tested

NOTE: The report shall not be reproduced except in full without authority of the laboratory

Test Report by K4 SOILS LABORATORY
Unit 8 Olds Close Olds Approach
Watford Herts WD18 9RU

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Email: James@k4soils.com

Checked and Approved

Initials J.P

Date: 12/10/2023

2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

Summary of Natural Moisture Content, Liquid Limit and Plastic Limit Results

Job No.	Project Name	Programme	
34141	Sullivan Crescent, Harefield, UB9 6NL	Samples received	03/10/2023
		Schedule received	03/10/2023
Project No.	Client	Project started	04/10/2023
23-248.01	Aviron	Testing Started	16/10/2023

Hole No.	Sample				Soil Description	NMC	Passing 425µm	LL	PL	PI	Remarks
	Ref	Top m	Base m	Type		%	%	%	%	%	
BH1	-	6.00	6.45	U	High strength dark grey silty CLAY	27	100	71	27	44	
BH1	-	9.00	9.45	U	High strength dark grey silty CLAY with rare pockets of fmc mudstone fragments	28	100	74	29	45	
BH1	-	12.00	12.45	U	High strength dark grey silty CLAY with rare pockets of silt	26	99	75	28	47	

Test Methods: BS1377: Part 2: 1990:
Natural Moisture Content : clause 3.2
Atterberg Limits: clause 4.3 and 5.0
These results only apply to the items tested

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Checked and Approved

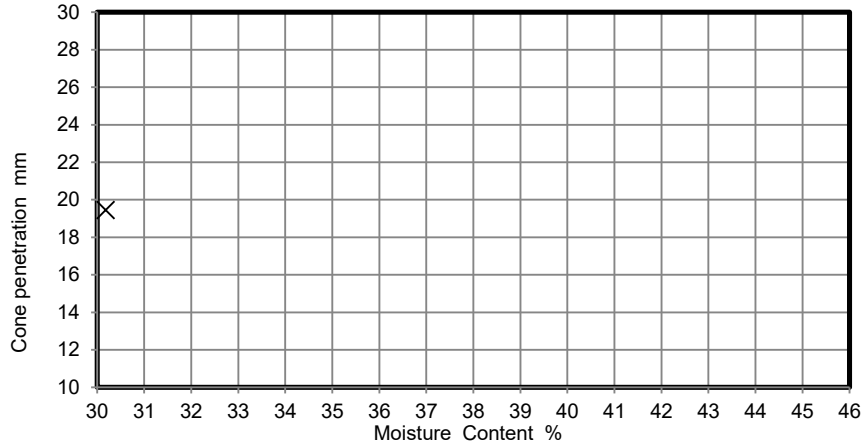
Initials J.P

Date: 17/10/2023

2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

	LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX			Job No.	34133
				Borehole/Pit No.	WS1
Site Name	Sullivan Crescent, Harefield, UB9 6NL			Sample No.	-
Project No.	23-248.01	Client	Aviron	Depth Top m	1.00
Soil Description	Brown sandy gravelly silty CLAY (gravel is fmc and angular to sub-rounded flint)			Depth Base m	-
				Sample Type	D
				Samples received	29/09/2023
				Schedules received	29/09/2023
				Project Started	02/10/2023
				Date Tested	10/10/2023



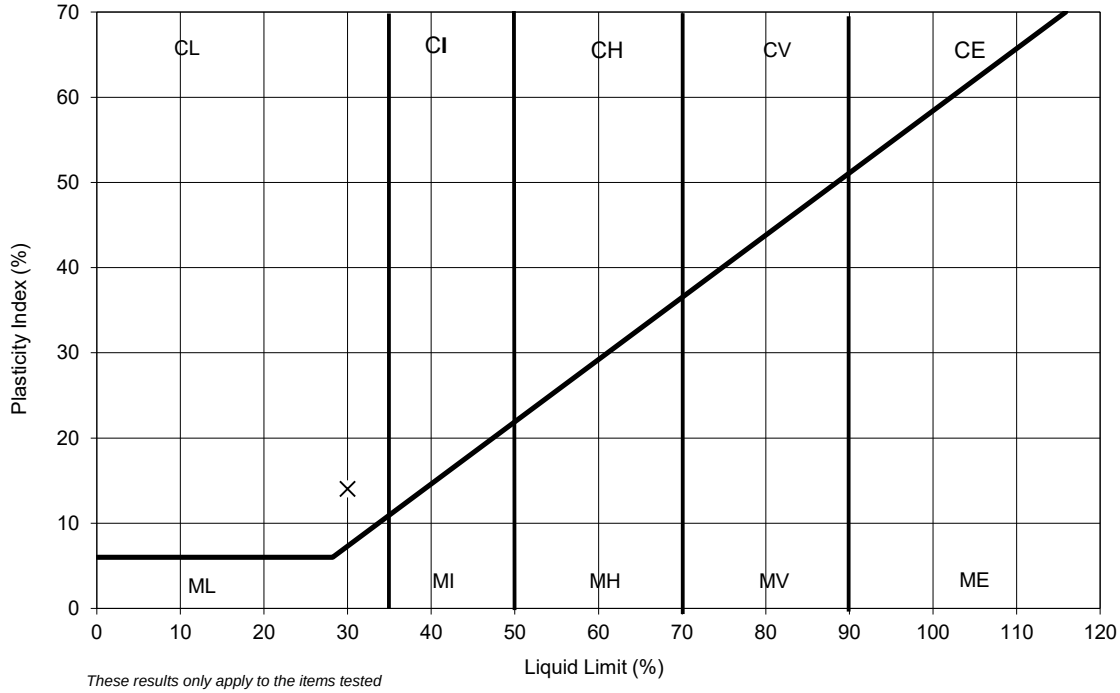
Factors corresponding to the cone penetration and moisture content range in Table 1 (BS1377:1990 ; Part 2)

NATURAL MOISTURE CONTENT	**10**	**%**
% PASSING 425µm SIEVE	**43**	**%**
LIQUID LIMIT	**30**	**%**
PLASTIC LIMIT	**16**	**%**
PLASTICITY INDEX	**14**	**%**

Remarks

Sample washed to obtain test fraction

PLASTICITY INDEX



These results only apply to the items tested

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TEST METHOD

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method
BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index
BS1377: Part 2 :Clause 3.2 : 1990:Determination of the moisture content by the oven drying

Checked and Approved

Initials: J.P
Date: 12/10/2023

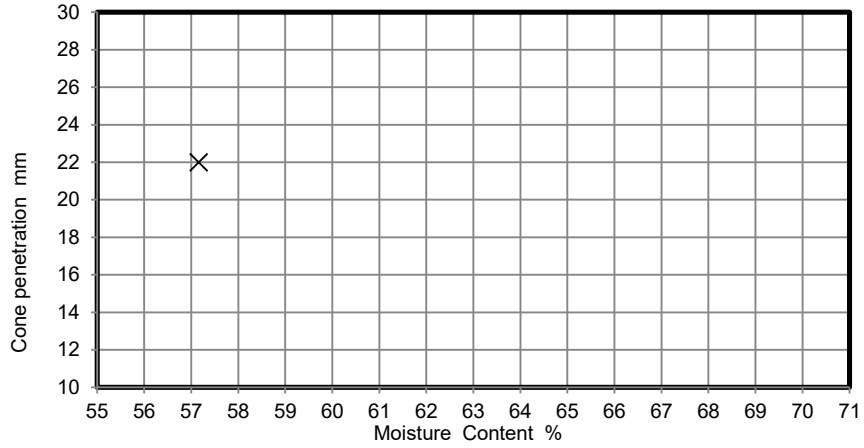
Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU
Tel: 01923 711 288 Email: James@k4soils.com

UKAS TESTING

2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

	LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX			Job No.	34133
				Borehole/Pit No.	WS6
Site Name	Sullivan Crescent, Harefield, UB9 6NL			Sample No.	-
Project No.	23-248.01	Client	Aviron	Depth Top m	2.00
Soil Description	Brown slightly sandy very gravelly silty CLAY (gravel is fmc and angular to sub-angular flint)			Depth Base m	-
				Sample Type	D
				Samples received	29/09/2023
				Schedules received	29/09/2023
				Project Started	02/10/2023
				Date Tested	10/10/2023



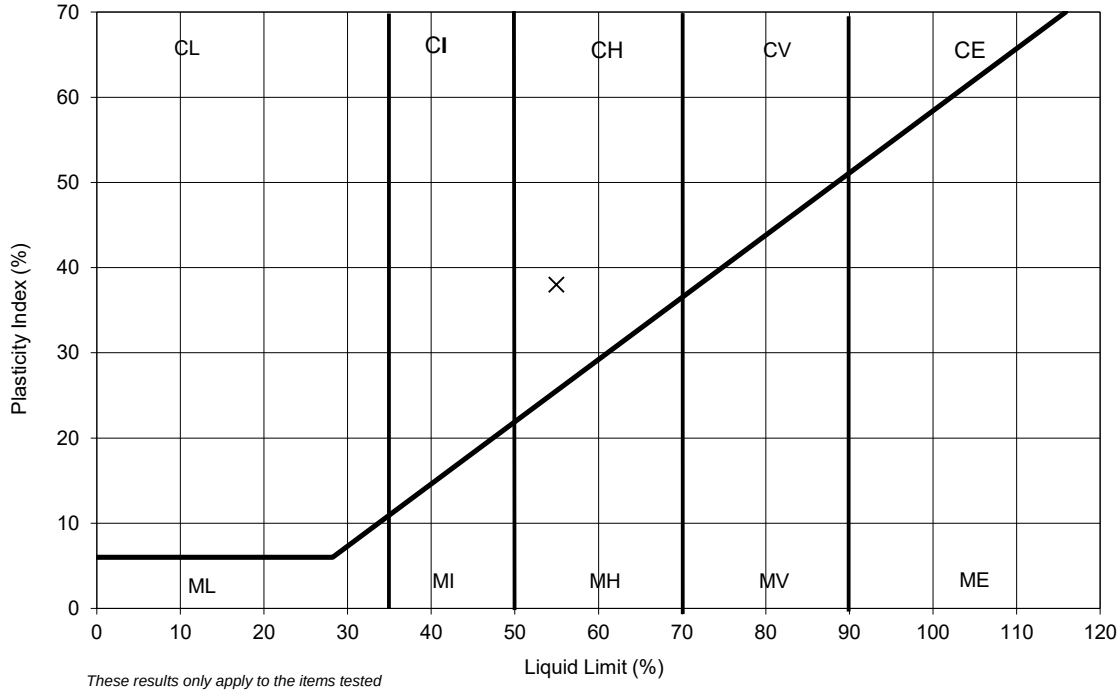
NATURAL MOISTURE CONTENT	**5.9**	**%**
% PASSING 425µm SIEVE	**16**	**%**
LIQUID LIMIT	**55**	**%**
PLASTIC LIMIT	**17**	**%**
PLASTICITY INDEX	**38**	**%**

Factors corresponding to the cone penetration and moisture content range in Table 1 (BS1377:1990 ; Part 2)

Remarks

Sample washed to obtain test fraction

PLASTICITY INDEX



These results only apply to the items tested

TEST METHOD

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method
BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index
BS1377: Part 2 :Clause 3.2 : 1990:Determination of the moisture content by the oven drying

Checked and Approved

Initials: J.P
Date: 12/10/2023

Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU
Tel: 01923 711 288 Email: James@k4soils.com

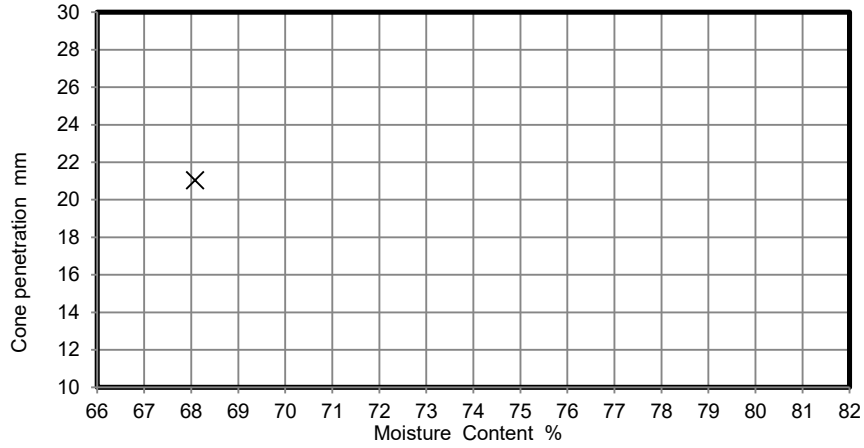
UKAS TESTING

2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

				Job No.	34133
				Borehole/Pit No.	WS6
Site Name	Sullivan Crescent, Harefield, UB9 6NL			Sample No.	-
Project No.	23-248.01	Client	Aviron	Depth Top m	3.00
Soil Description	Dark brown silty CLAY			Depth Base m	-
				Sample Type	D
				Samples received	29/09/2023
				Schedules received	29/09/2023
				Project Started	02/10/2023
				Date Tested	10/10/2023

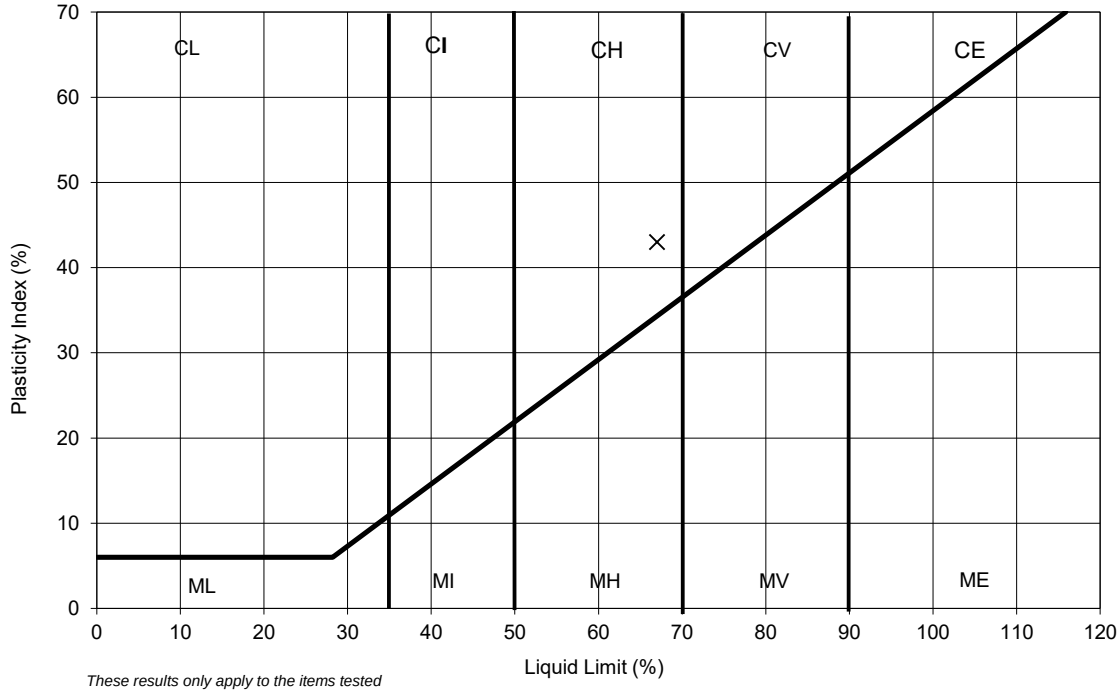


NATURAL MOISTURE CONTENT	**27**	**%**
% PASSING 425µm SIEVE	**100**	**%**
LIQUID LIMIT	**67**	**%**
PLASTIC LIMIT	**24**	**%**
PLASTICITY INDEX	**43**	**%**

Remarks

Factors corresponding to the cone penetration and moisture content range in Table 1 (BS1377:1990 ; Part 2)

PLASTICITY INDEX



These results only apply to the items tested

TEST METHOD

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method
BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index
BS1377: Part 2 :Clause 3.2 : 1990:Determination of the moisture content by the oven drying

Checked and Approved

Initials: J.P
Date: 12/10/2023

Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU
Tel: 01923 711 288 Email: James@k4soils.com

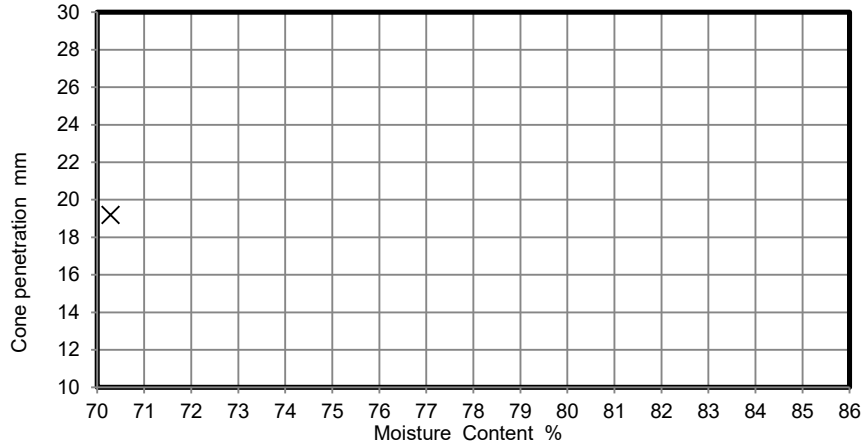
UKAS TESTING

2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

				Job No.	34141
				Borehole/Pit No.	BH1
Site Name	Sullivan Crescent, Harefield, UB9 6NL			Sample No.	-
Project No.	23-248.01	Client	Aviron	Depth Top m	6.00
Soil Description	High strength dark grey silty CLAY			Depth Base m	6.45
				Sample Type	U
				Samples received	03/10/2023
				Schedules received	03/10/2023
				Project Started	04/10/2023
				Date Tested	16/10/2023

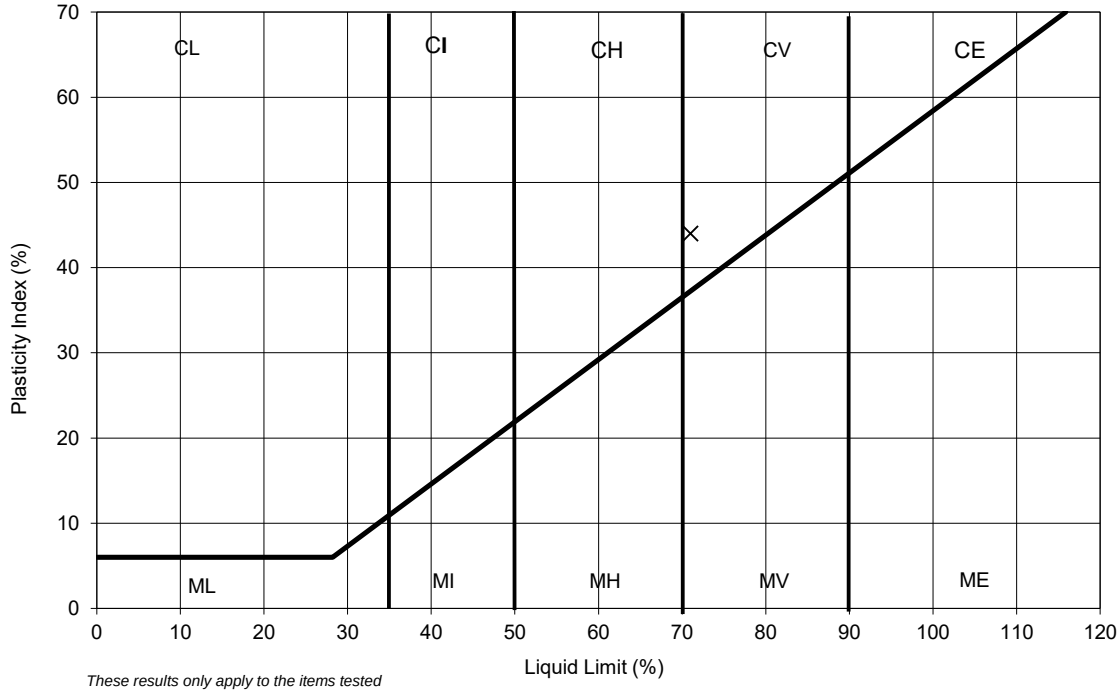


NATURAL MOISTURE CONTENT	**27**	**%**
% PASSING 425µm SIEVE	**100**	**%**
LIQUID LIMIT	**71**	**%**
PLASTIC LIMIT	**27**	**%**
PLASTICITY INDEX	**44**	**%**

Remarks

Factors corresponding to the cone penetration and moisture content range in Table 1 (BS1377:1990 ; Part 2)

PLASTICITY INDEX



These results only apply to the items tested

TEST METHOD

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method
BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index
BS1377: Part 2 :Clause 3.2 : 1990:Determination of the moisture content by the oven drying

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Date: 17/10/2023

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UKAS TESTING 2519

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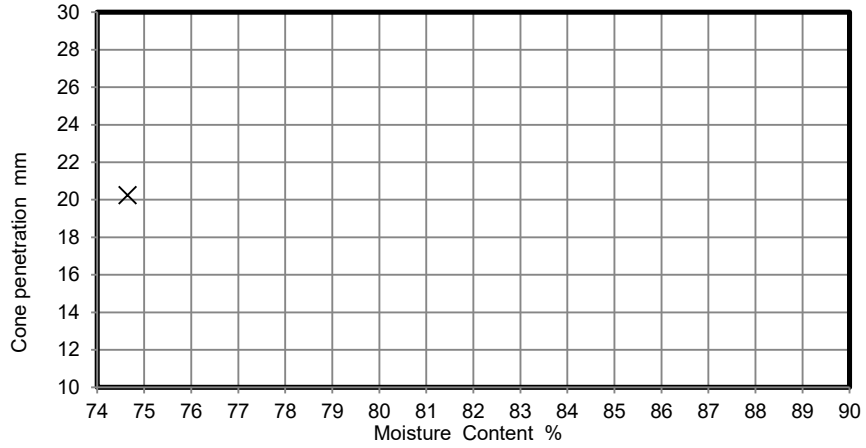
LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

				Job No.	34141
				Borehole/Pit No.	BH1
Site Name	Sullivan Crescent, Harefield, UB9 6NL			Sample No.	-
Project No.	23-248.01	Client	Aviron	Depth Top m	9.00
Soil Description	High strength dark grey silty CLAY with rare pockets of fmc mudstone fragments			Depth Base m	9.45
				Sample Type	U
				Samples received	03/10/2023
				Schedules received	03/10/2023
				Project Started	04/10/2023
				Date Tested	16/10/2023

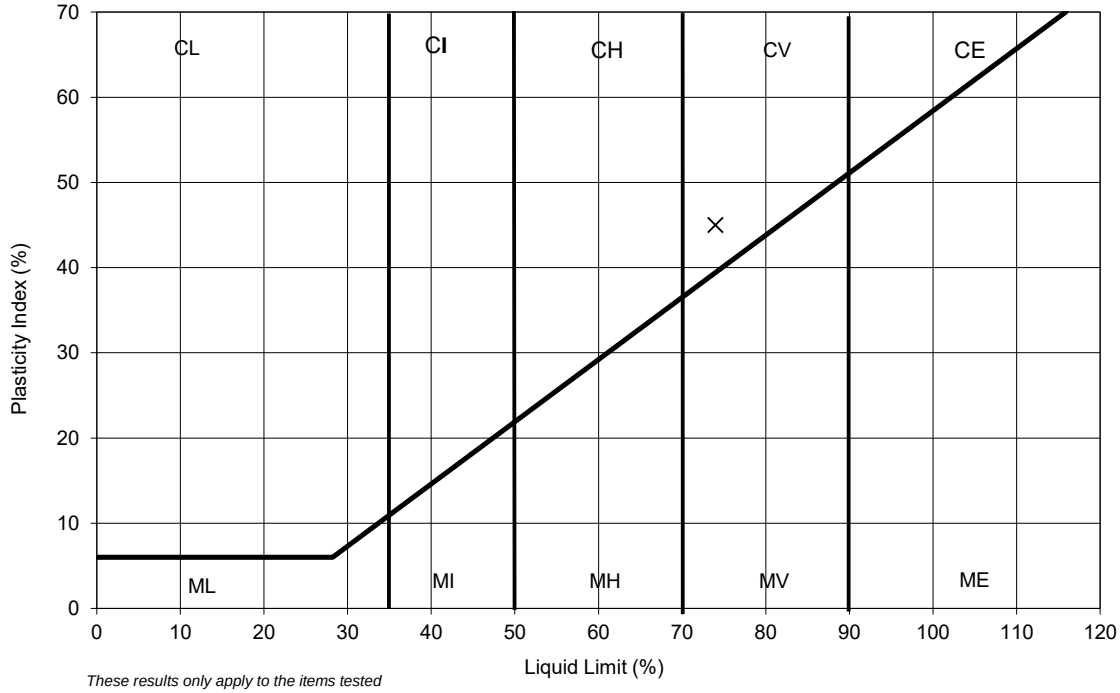


NATURAL MOISTURE CONTENT	**28**	**%**
% PASSING 425µm SIEVE	**100**	**%**
LIQUID LIMIT	**74**	**%**
PLASTIC LIMIT	**29**	**%**
PLASTICITY INDEX	**45**	**%**

Remarks

Factors corresponding to the cone penetration and moisture content range in Table 1 (BS1377:1990 ; Part 2)

PLASTICITY INDEX



These results only apply to the items tested

TEST METHOD

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method
BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index
BS1377: Part 2 :Clause 3.2 : 1990:Determination of the moisture content by the oven drying

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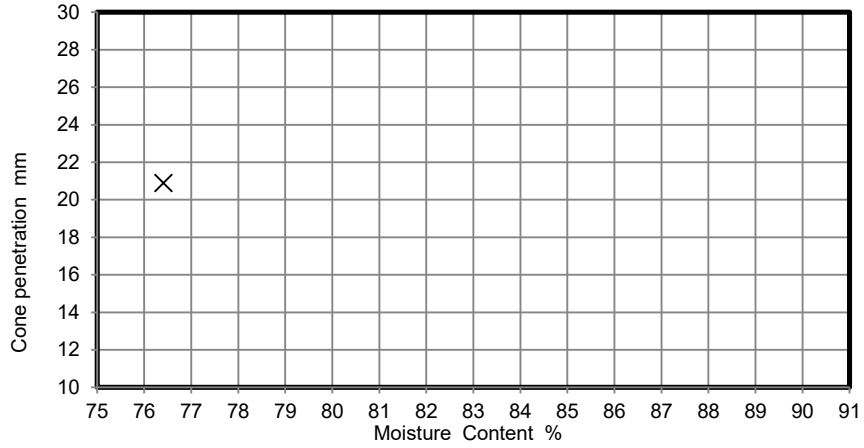
LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

				Job No.	34141
				Borehole/Pit No.	BH1
Site Name	Sullivan Crescent, Harefield, UB9 6NL			Sample No.	-
Project No.	23-248.01	Client	Aviron	Depth Top m	12.00
Soil Description	High strength dark grey silty CLAY with rare pockets of silt			Depth Base m	12.45
				Sample Type	U
				Samples received	03/10/2023
				Schedules received	03/10/2023
				Project Started	04/10/2023
				Date Tested	16/10/2023

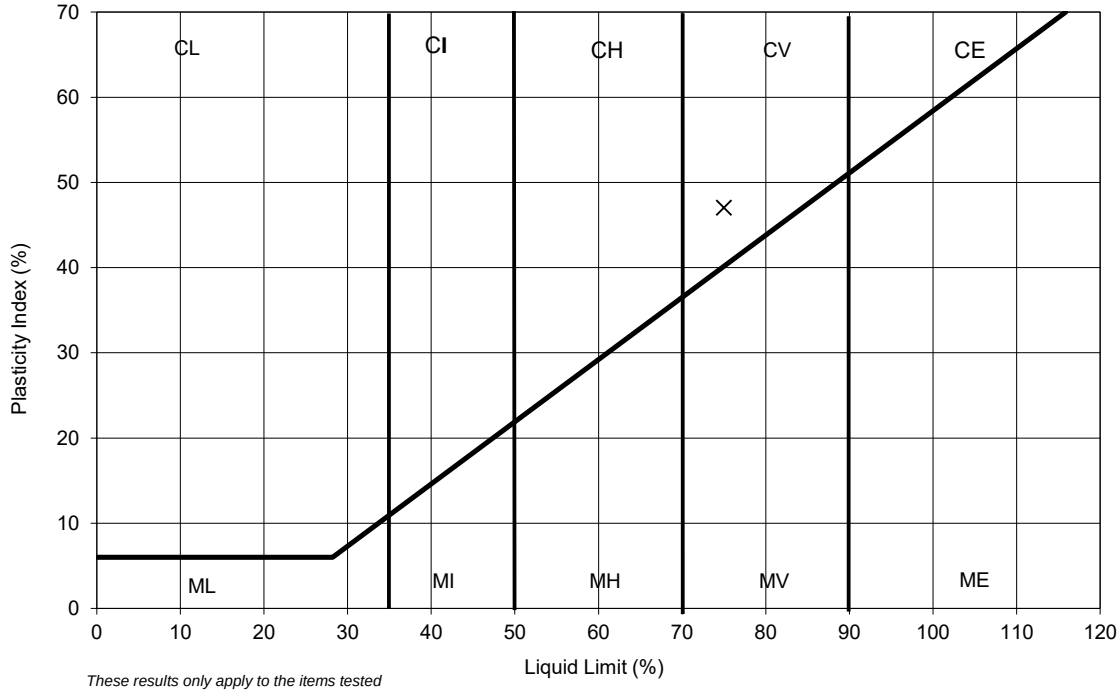


NATURAL MOISTURE CONTENT	**26**	**%**
% PASSING 425µm SIEVE	**99**	**%**
LIQUID LIMIT	**75**	**%**
PLASTIC LIMIT	**28**	**%**
PLASTICITY INDEX	**47**	**%**

Remarks

Factors corresponding to the cone penetration and moisture content range in Table 1 (BS1377:1990 ; Part 2)

PLASTICITY INDEX



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TEST METHOD

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method
BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index
BS1377: Part 2 :Clause 3.2 : 1990:Determination of the moisture content by the oven drying

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UKAS TESTING

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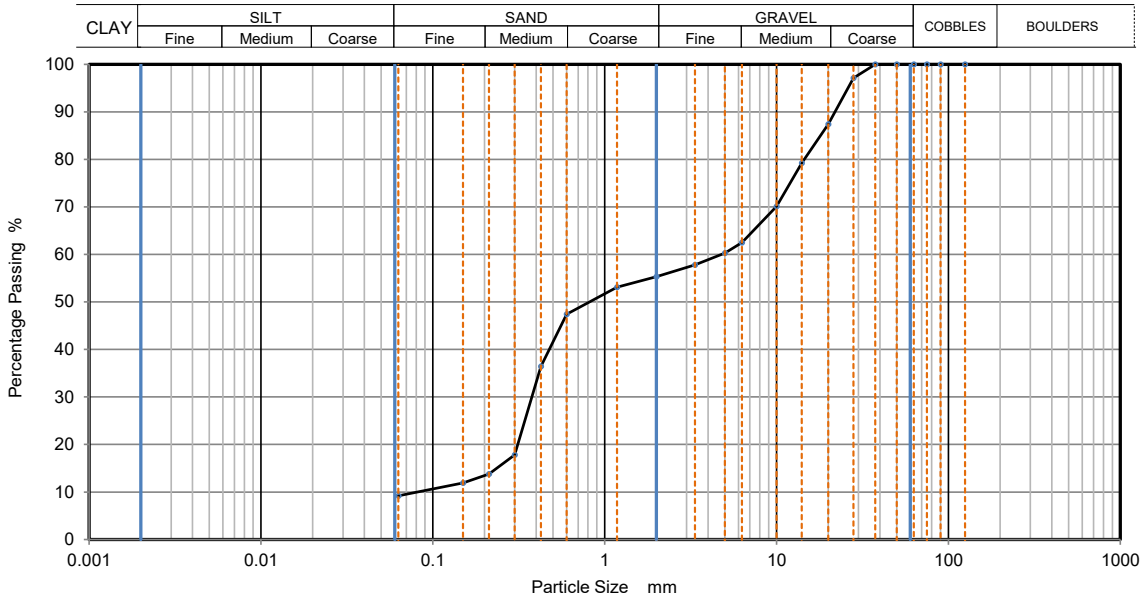
PARTICLE SIZE DISTRIBUTION

Site Name	Sullivan Crescent, Harefield, UB9 6NL			Sample No.	-
Project No.	23-248.01	Client	Aviron	Depth Top	2.00 m
Soil Description	Orangish brown clayey very gravelly SAND (gravel is fmc and sub-angular to sub-rounded)			Depth Base	- m
				Sample Type	D
				Samples received	29/09/2023
				Schedules received	29/09/2023
Test Method	BS1377:Part 2: 1990, clause 9.0			Project started	02/10/2023
				Date tested	09/10/2023

Job Ref: 34133

Borehole/Pit No.: WS1

These results only apply to the items tested



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	97		
20	87		
14	79		
10	70		
6.3	63		
5	60		
3.35	58		
2	55		
1.18	53		
0.6	47		
0.425	36		
0.3	18		
0.212	14		
0.15	12		
0.063	9		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	44.71
Sand	46.11
Fines <0.063mm	9.18

Grading Analysis		
D100	mm	
D60	mm	4.79
D30	mm	0.377
D10	mm	0.0822
Uniformity Coefficient		58
Curvature Coefficient		0.36

Remarks

Preparation and testing in accordance with BS1377 unless noted below

K4 Soils Laboratory

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Tel: 01923 711288

Checked and Approved

Initials: J.P

Date: 12/10/2023

UKAS TESTING

2519

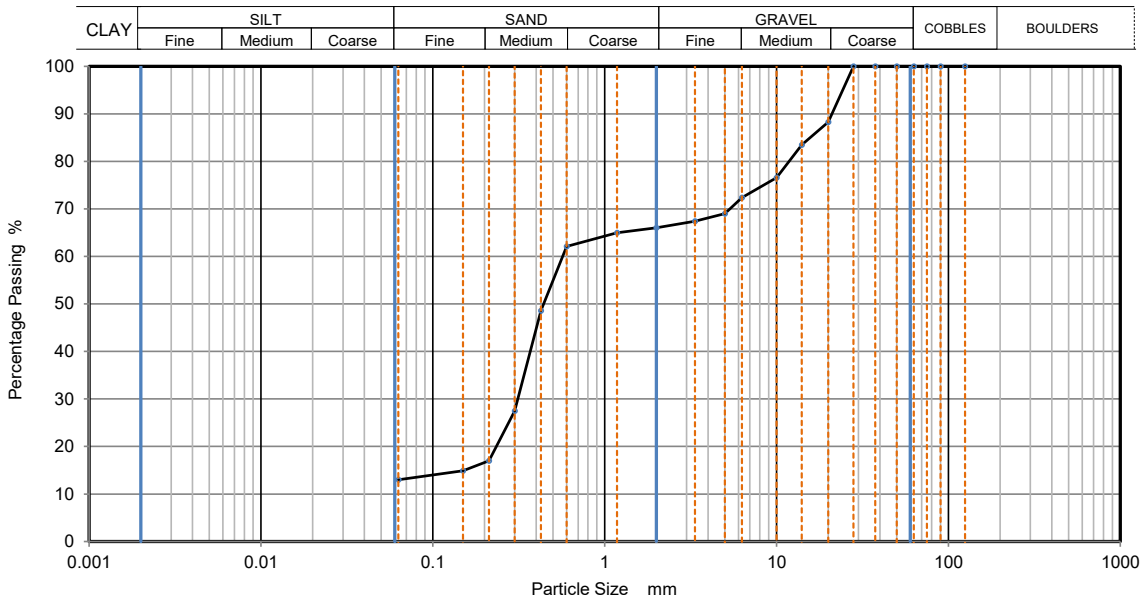
Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

MSF-5-R3

PARTICLE SIZE DISTRIBUTION

				Job Ref	34133
				Borehole/Pit No.	WS3
Site Name	Sullivan Crescent, Harefield, UB9 6NL			Sample No.	-
Project No.	23-248.01	Client	Aviron	Depth Top	1.00 m
Soil Description	Orangish brown silty clayey very gravelly SAND with occasional calcareous deposits (gravel is fmc and sub-angular to sub-rounded)			Depth Base	- m
				Sample Type	D
				Samples received	29/09/2023
				Schedules received	29/09/2023
Test Method	BS1377:Part 2: 1990, clause 9.0			Project started	02/10/2023
				Date tested	09/10/2023

These results only apply to the items tested



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	88		
14	84		
10	77		
6.3	72		
5	69		
3.35	67		
2	66		
1.18	65		
0.6	62		
0.425	49		
0.3	28		
0.212	17		
0.15	15		
0.063	13		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	34.00
Sand	53.05
Fines <0.063mm	12.95

Grading Analysis		
D100	mm	
D60	mm	0.569
D30	mm	0.312
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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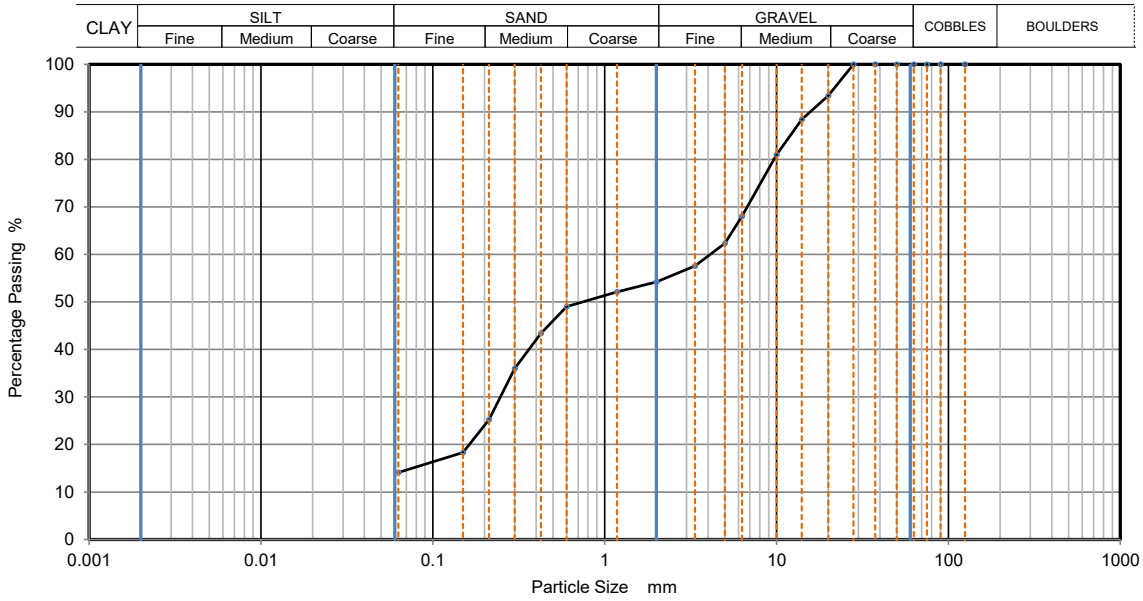
Date: 12/10/2023

PARTICLE SIZE DISTRIBUTION

				Job Ref	34133
				Borehole/Pit No.	WS3
Site Name	Sullivan Crescent, Harefield, UB9 6NL			Sample No.	-
Project No.	23-248.01	Client	Aviron	Depth Top	2.00 m
Soil Description	Orangish brown and bluish grey silty clayey very sandy GRAVEL (gravel is fmc and angular to sub-rounded)			Depth Base	- m
				Sample Type	D
				Samples received	29/09/2023
				Schedules received	29/09/2023
Test Method	BS1377:Part 2: 1990, clause 9.0			Project started	02/10/2023
				Date tested	09/10/2023

These results only apply to the items tested



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	93		
14	88		
10	81		
6.3	68		
5	62		
3.35	58		
2	54		
1.18	52		
0.6	49		
0.425	43		
0.3	36		
0.212	25		
0.15	18		
0.063	14		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	45.83
Sand	40.03
Fines <0.063mm	14.14

Grading Analysis		
D100	mm	
D60	mm	4.11
D30	mm	0.247
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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Initials: J.P

Date: 12/10/2023

Unconsolidated Undrained Triaxial Compression tests without measurement of pore pressure
Summary of Results

Tests carried out in accordance with BS1377:Part 7 : 1990 clause 8 or 9 as appropriate to test

Job No.	Project Name	Programme	
34141	Sullivan Crescent, Harefield, UB9 6NL	Samples received	03/10/2023
		Schedule received	03/10/2023
Project No.	Client	Project started	04/10/2023
23-248.01	Aviron	Testing Started	09/10/2023

Hole No.	Sample Ref	Top m	Base m	Type	Soil Description	Test Type	Density bulk Mg/m3	Density dry Mg/m3	w %	Length mm	Diameter mm	σ3 kPa	At failure: Axial strain %	σ1 - σ3 kPa	cu kPa	Mode	Remarks
BH1	-	6.00	6.45	U	High strength dark grey silty CLAY	UU	2.00	1.58	27	198	102	120	12	231	115	C	
BH1	-	9.00	9.45	U	High strength dark grey silty CLAY with rare pockets of fmc mudstone fragments	UU	2.05	1.60	28	198	102	180	12	223	111	C	
BH1	-	12.00	12.45	U	High strength dark grey silty CLAY with rare pockets of silt	UU	2.05	1.61	27	198	102	240	11	244	122	C	

Legend
UU - single stage test (single and multiple specimens) | σ3 Cell pressure | Mode of failure ; B - Brittle
UUM - Multistage test on a single specimen | σ1 - σ3 Maximum corrected deviator stress | P - Plastic
suffix R - remoulded or recompacted | cu Undrained shear strength, ½ (σ1 - σ3) | C - Compound

Test Report by K4 SOILS LABORATORY
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Email: james@k4soils.com

Checked and Approved

Initials: J.P

Date: 17/10/2023

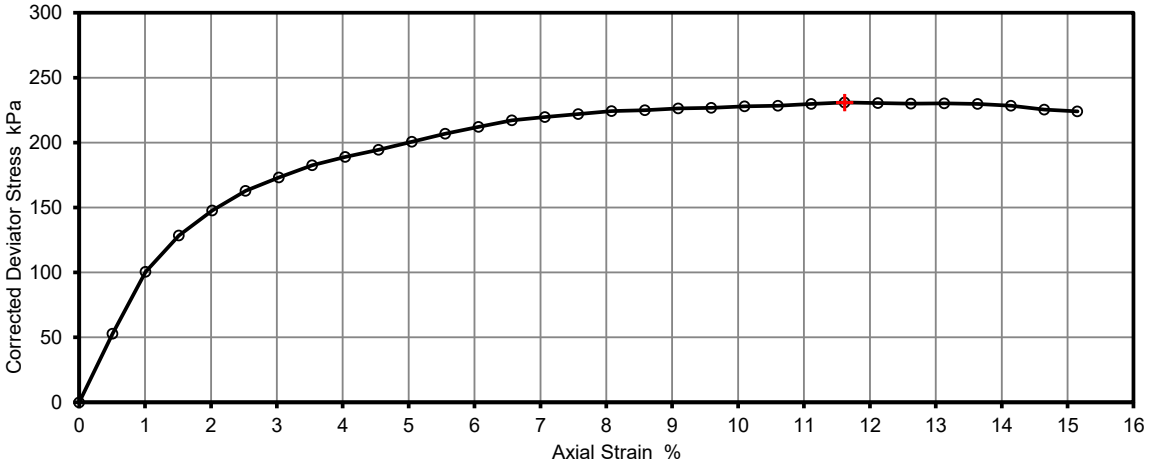
	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen			Job Ref	34141
				Borehole/Pit No.	BH1
Site Name	Sullivan Crescent, Harefield, UB9 6NL			Sample No.	-
Project No.	23-248.01	Client	Aviron	Depth Top	6.00 m
Soil Description	High strength dark grey silty CLAY			Depth Base	6.45 m
				Sample Type	U
				Samples received	03/10/2023
				Schedules received	03/10/2023
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	09/10/2023

Remarks

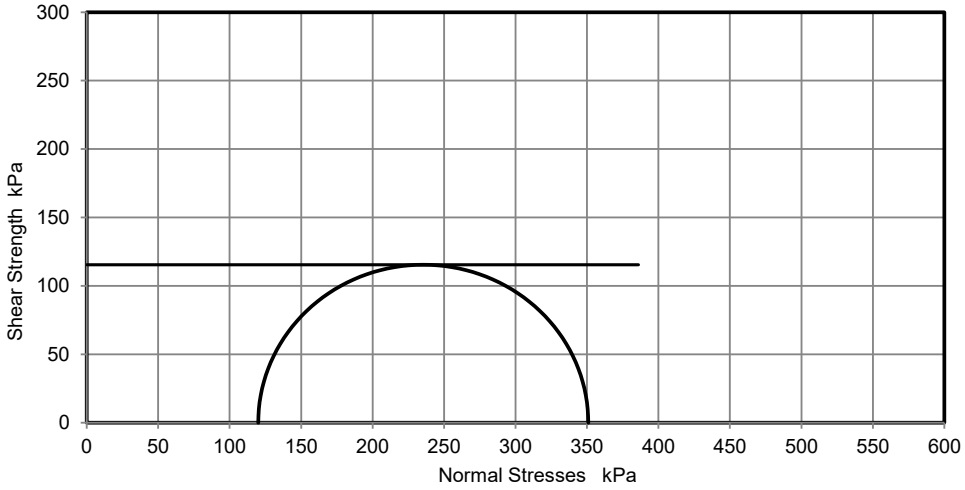
Position within sample

Test Number	1	
Length	198.0	mm
Diameter	102.0	mm
Bulk Density	2.00	Mg/m3
Moisture Content	27	%
Dry Density	1.58	Mg/m3
Rate of Strain	1.5	%/min
Cell Pressure	120	kPa
Axial Strain	12	%
Deviator Stress, (σ1 - σ3)f	231	kPa
Undrained Shear Strength, cu	115	kPa ½(σ1 - σ3)f
Mode of Failure	Compound	

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

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Checked and Approved
Initials: J.P
Date 17/10/2023

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

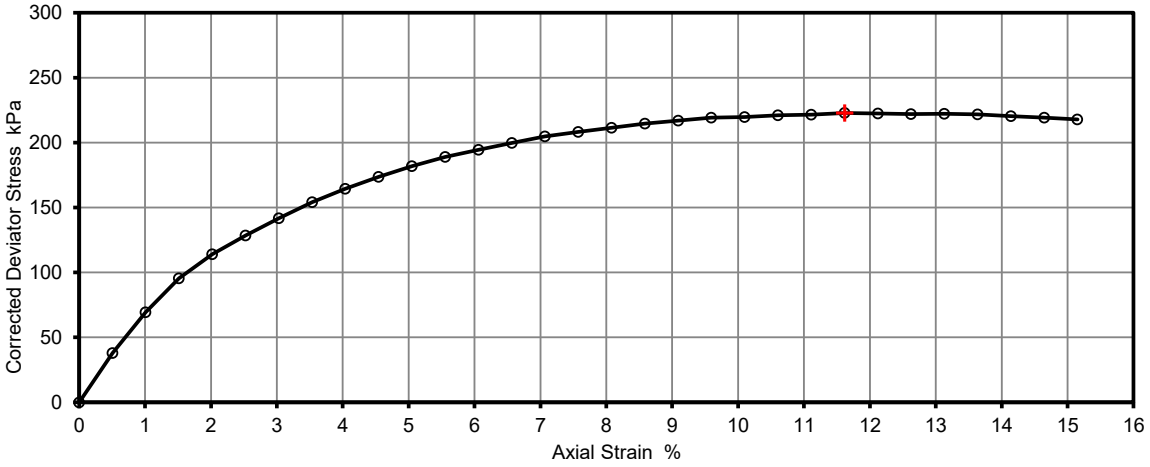
	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen			Job Ref	34141
				Borehole/Pit No.	BH1
Site Name	Sullivan Crescent, Harefield, UB9 6NL			Sample No.	-
Project No.	23-248.01	Client	Aviron	Depth Top	9.00 m
Soil Description	High strength dark grey silty CLAY with rare pockets of fmc mudstone fragments			Depth Base	9.45 m
				Sample Type	U
				Samples received	03/10/2023
				Schedules received	03/10/2023
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	09/10/2023

Remarks

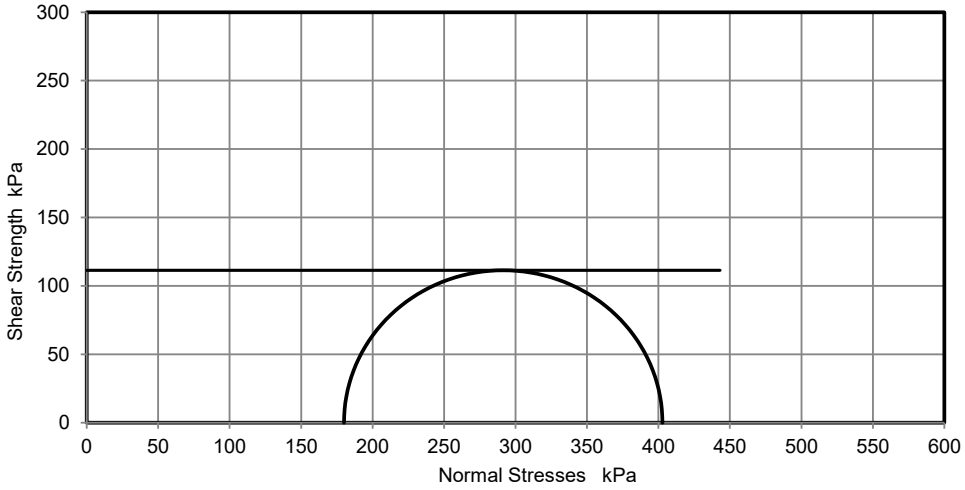
Position within sample

Test Number	1	
Length	198.0	mm
Diameter	102.0	mm
Bulk Density	2.05	Mg/m3
Moisture Content	28	%
Dry Density	1.60	Mg/m3
Rate of Strain	1.5	%/min
Cell Pressure	180	kPa
Axial Strain	12	%
Deviator Stress, (σ1 - σ3)f	223	kPa
Undrained Shear Strength, cu	111	kPa ½(σ1 - σ3)f
Mode of Failure	Compound	

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

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Initials: J.P
Date 17/10/2023

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

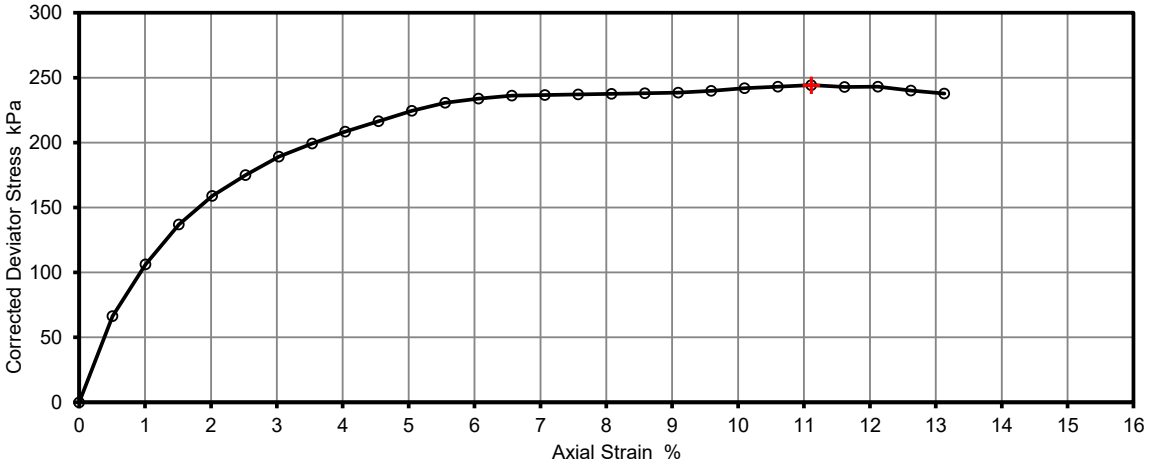
	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen			Job Ref	34141
				Borehole/Pit No.	BH1
Site Name	Sullivan Crescent, Harefield, UB9 6NL			Sample No.	-
Project No.	23-248.01	Client	Aviron	Depth Top	12.00 m
Soil Description	High strength dark grey silty CLAY with rare pockets of silt			Depth Base	12.45 m
				Sample Type	U
				Samples received	03/10/2023
				Schedules received	03/10/2023
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	09/10/2023

Remarks

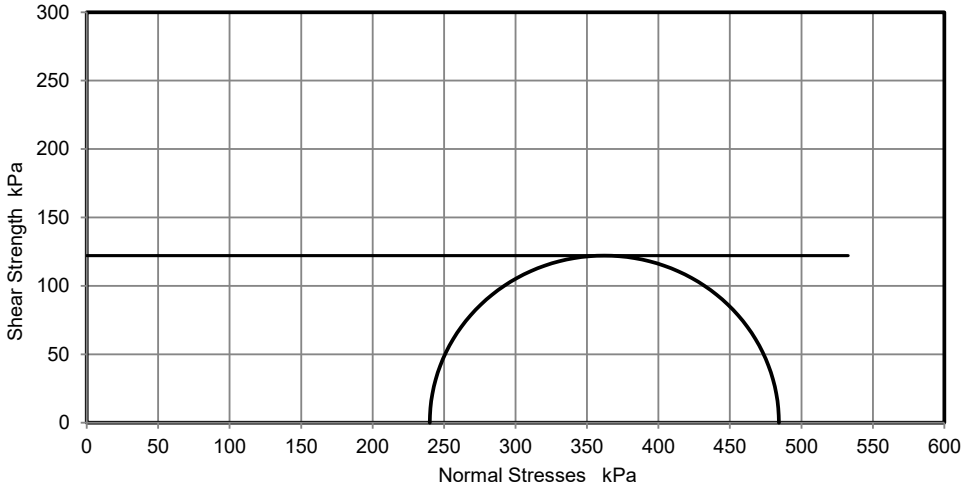
Position within sample

Test Number	1	
Length	198.0	mm
Diameter	102.0	mm
Bulk Density	2.05	Mg/m3
Moisture Content	27	%
Dry Density	1.61	Mg/m3
Rate of Strain	1.5	%/min
Cell Pressure	240	kPa
Axial Strain	11	%
Deviator Stress, (σ1 - σ3)f	244	kPa
Undrained Shear Strength, cu	122	kPa ½(σ1 - σ3)f
Mode of Failure	Compound	

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

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Checked and Approved
Initials: J.P
Date 17/10/2023

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

Dynamic Cone Penetrometer

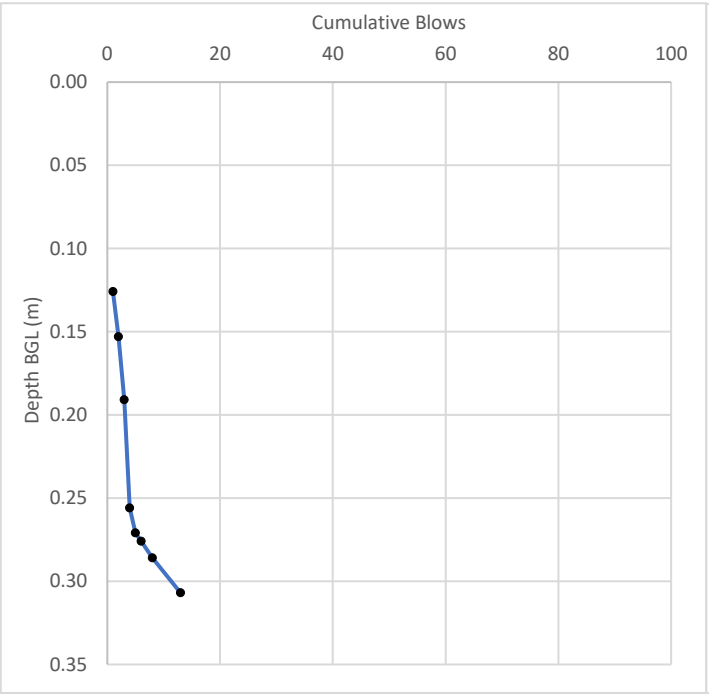
Project:	**Land at Sullivan Crescent, Harefield, UB9 6NL**	Project No: **23-248.01**	DCP Location: **DCP1**
Client:	**Bugler Developments Limited**	Operator: **DN**	Date: **20/09/2023**
Surface Conditions & Observations: **Concrete hardstanding removed**		Zero Error (mm): **39**	Approx AOD (m):

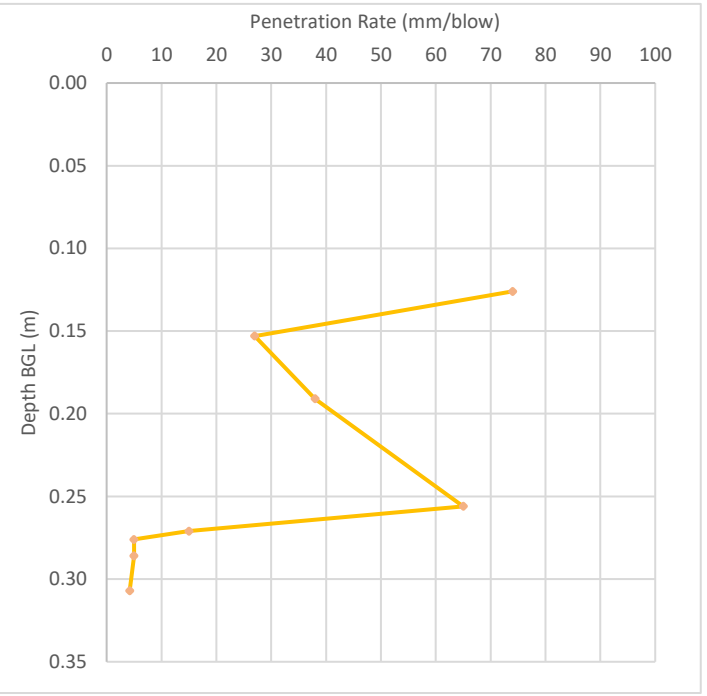
Blows	Cumulative Blows	Cumulative Penetration Depth (mm)	Depth Bgl (m)	AOD (m)	Penetration Rate (mm/blow)	CBR Value (%)
0		91	0.052	-0.052		
1	1	165	0.126	-0.126	74.0	3.2
1	2	192	0.153	-0.153	27.0	9.3
1	3	230	0.191	-0.191	38.0	6.5
1	4	295	0.256	-0.256	65.0	3.7
1	5	310	0.271	-0.271	15.0	17.3
1	6	315	0.276	-0.276	5.0	55.1
2	8	325	0.286	-0.286	5.0	55.1
5	13	346	0.307	-0.307	4.2	66.3

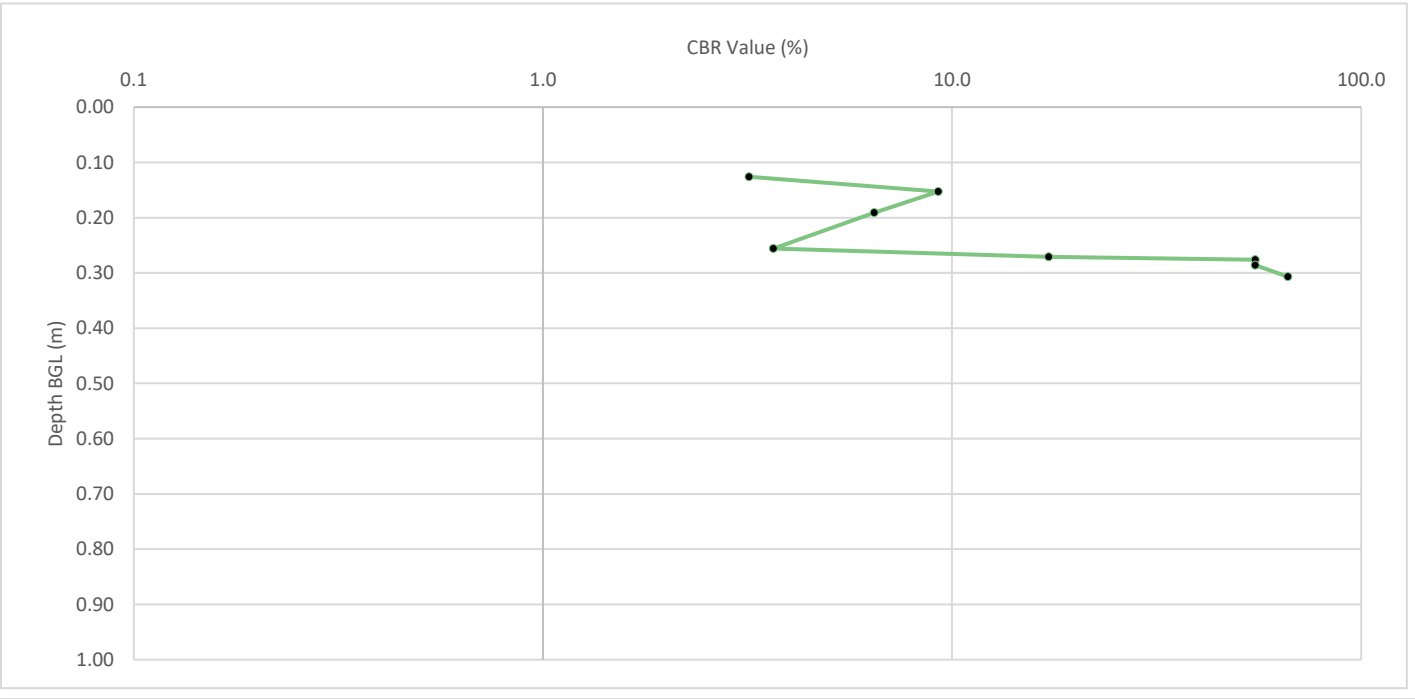
TRRL Road Note 8 Equation: Log_{10} (CBR) = 2.48 - 1.057 Log_{10} (mm/blow)		Cone Angle 60°

Dynamic Cone Penetrometer

Project: **Land at Sullivan Crescent, Harefield, UB9 6NL**	Project No: **23-248.01**	DCP Location: **DCP1**
Client: **Bugler Developments Limited**	Operator: **DN**	Date: **20/09/2023**
Surface Conditions & Observations: **Concrete hardstanding removed**	Zero Error (mm): **39**	Approx AOD (m):







Dynamic Cone Penetrometer

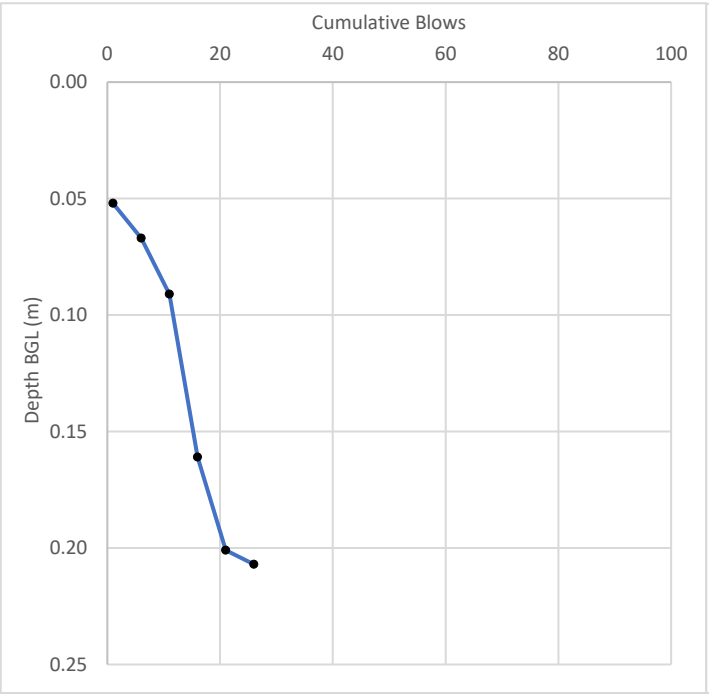
Project:	**Land at Sullivan Crescent, Harefield, UB9 6NL**	Project No: **23-248.01**	DCP Location: **DCP1A**
Client:	**Bugler Developments Limited**	Operator: **DN**	Date: **20/09/2023**
Surface Conditions & Observations: **Concrete hardstanding removed**		Zero Error (mm): **39**	Approx AOD (m):

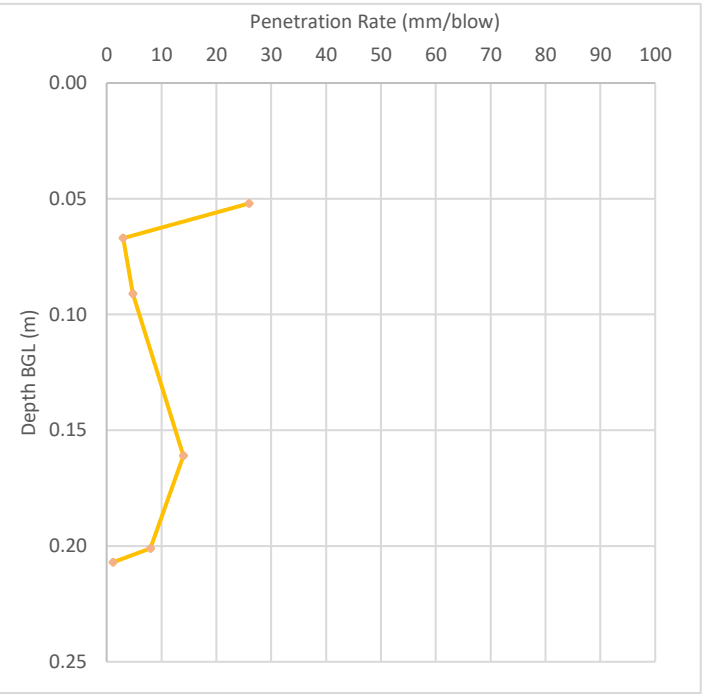
Blows	Cumulative Blows	Cumulative Penetration Depth (mm)	Depth Bgl (m)	AOD (m)	Penetration Rate (mm/blow)	CBR Value (%)
0		65	0.026	-0.026		
1	1	91	0.052	-0.052	26.0	9.6
5	6	106	0.067	-0.067	3.0	94.6
5	11	130	0.091	-0.091	4.8	57.5
5	16	200	0.161	-0.161	14.0	18.6
5	21	240	0.201	-0.201	8.0	33.5
5	26	246	0.207	-0.207	1.2	249.1

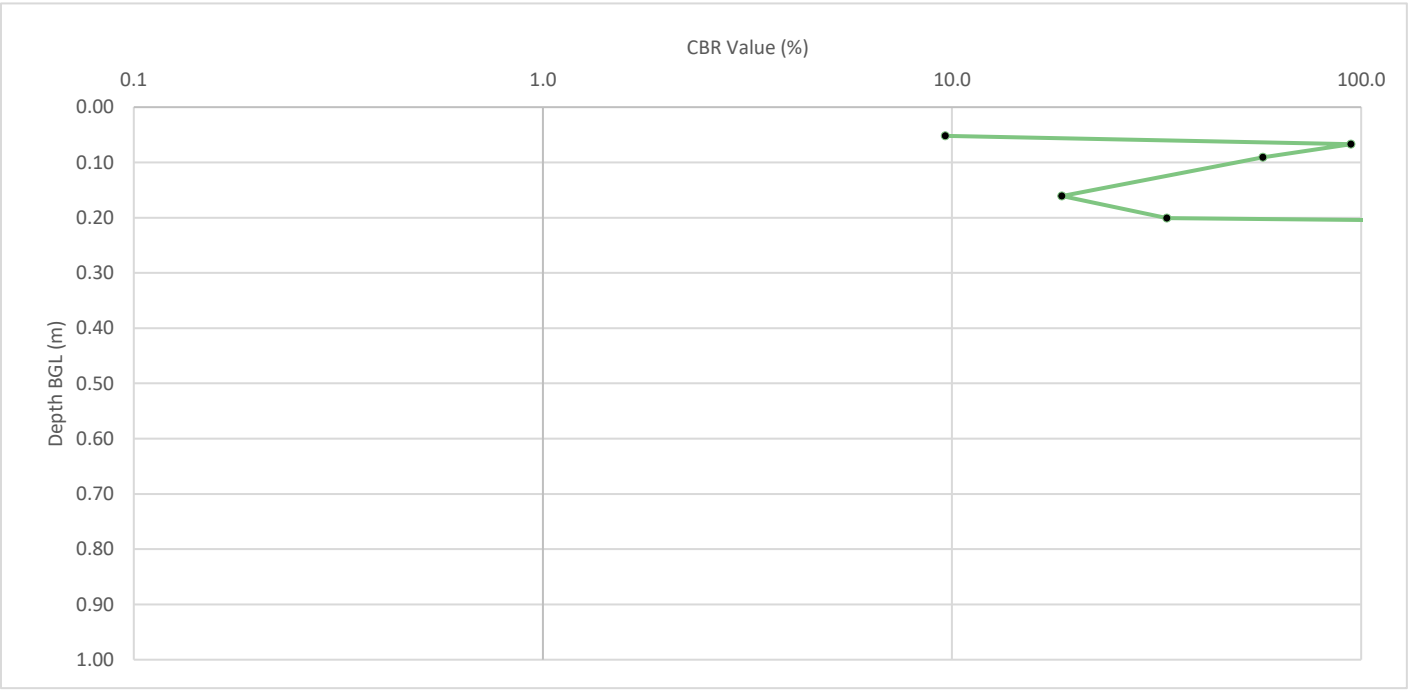
TRRL Road Note 8 Equation: Log_{10} (CBR) = 2.48 - 1.057 Log_{10} (mm/blow)		Cone Angle 60°

Dynamic Cone Penetrometer

Project: **Land at Sullivan Crescent, Harefield, UB9 6NL**	Project No: **23-248.01**	DCP Location: **DCP1A**
Client: **Bugler Developments Limited**	Operator: **DN**	Date: **20/09/2023**
Surface Conditions & Observations: **Concrete hardstanding removed**	Zero Error (mm): **39**	Approx AOD (m):







Dynamic Cone Penetrometer

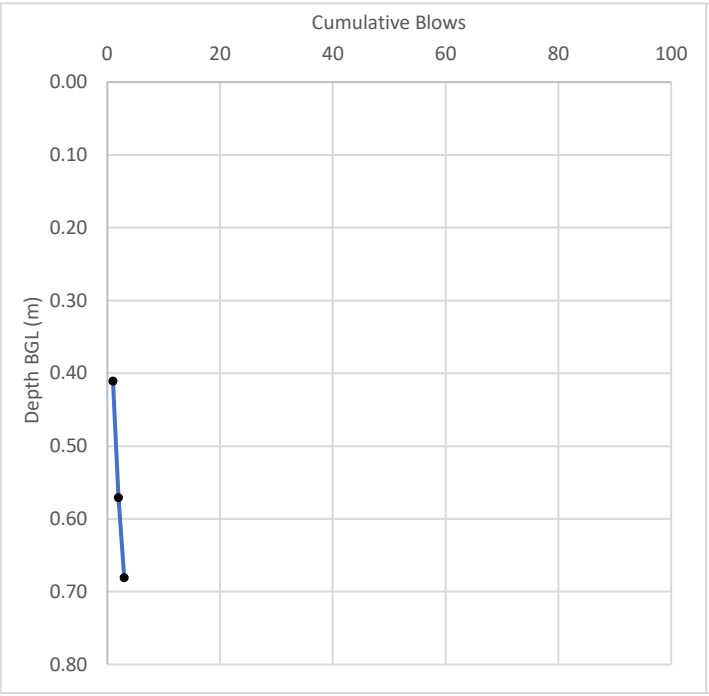
Project:	**Land at Sullivan Crescent, Harefield, UB9 6NL**	Project No: **23-248.01**	DCP Location: **DCP2**
Client:	**Bugler Developments Limited**	Operator: **DN**	Date: **20/09/2023**
Surface Conditions & Observations: **Rough ground - disturbed by installation of drainage**		Zero Error (mm): **39**	Approx AOD (m):

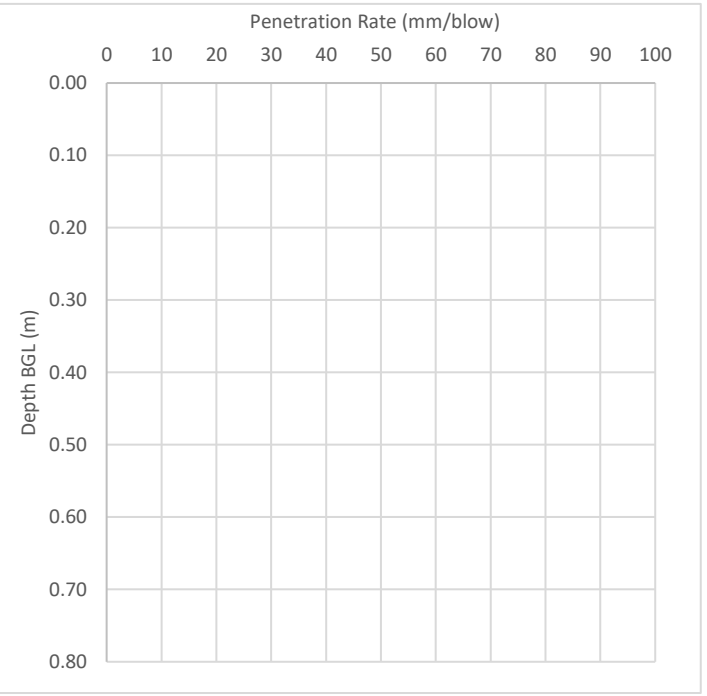
Blows	Cumulative Blows	Cumulative Penetration Depth (mm)	Depth Bgl (m)	AOD (m)	Penetration Rate (mm/blow)	CBR Value (%)
0		260	0.221	-0.221		
1	1	450	0.411	-0.411	190.0	1.2
1	2	610	0.571	-0.571	160.0	1.4
1	3	720	0.681	-0.681	110.0	2.1

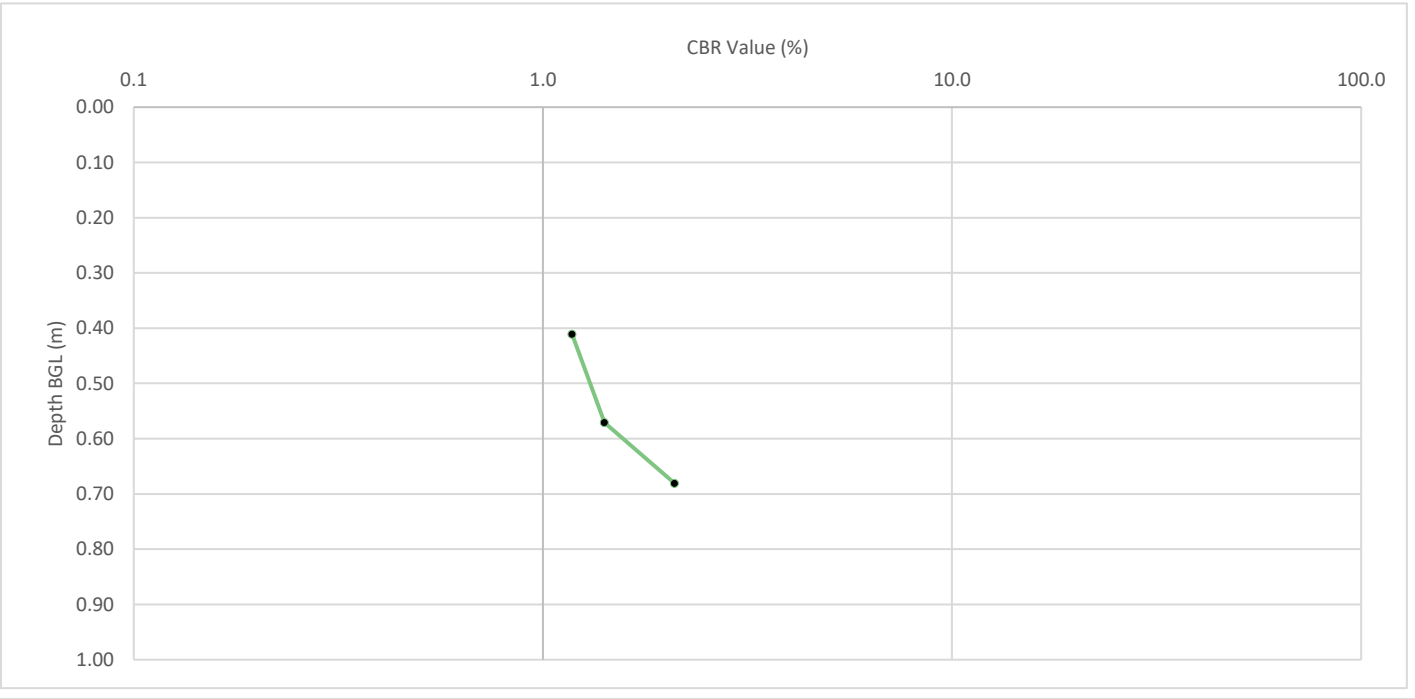
TRRL Road Note 8 Equation: Log_{10} (CBR) = 2.48 - 1.057 Log_{10} (mm/blow)		Cone Angle 60°

Dynamic Cone Penetrometer

Project: **Land at Sullivan Crescent, Harefield, UB9 6NL**	Project No: **23-248.01**	DCP Location: **DCP2**
Client: **Bugler Developments Limited**	Operator: **DN**	Date: **20/09/2023**
Surface Conditions & Observations: **Rough ground - disturbed by installation of drainage**	Zero Error (mm): **39**	Approx AOD (m):







Dynamic Cone Penetrometer

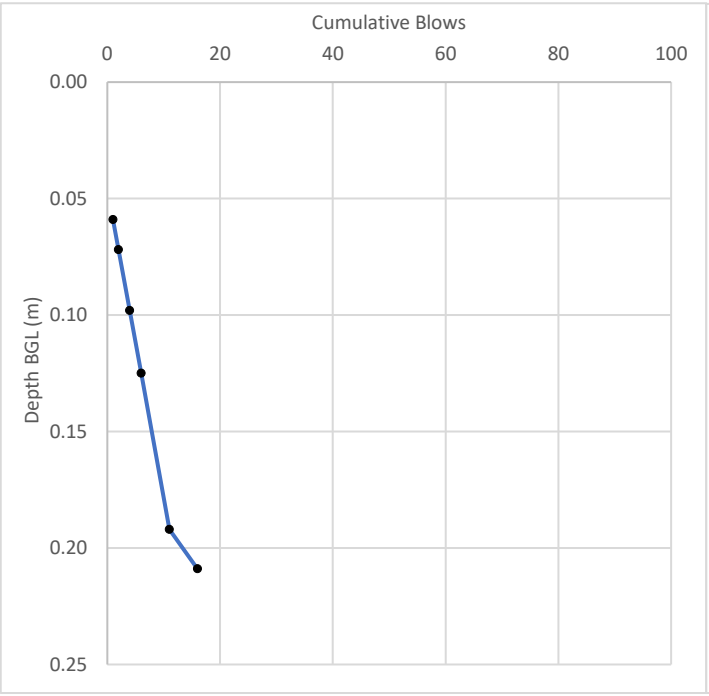
Project: **Land at Sullivan Crescent, Harefield, UB9 6NL**	Project No: **23-248.01**	DCP Location: **DCP2A**
Client: **Bugler Developments Limited**	Operator: **DN**	Date: **20/09/2023**
Surface Conditions & Observations: **Rough ground - disturbed by installation of drainage**	Zero Error (mm): **39**	Approx AOD (m):

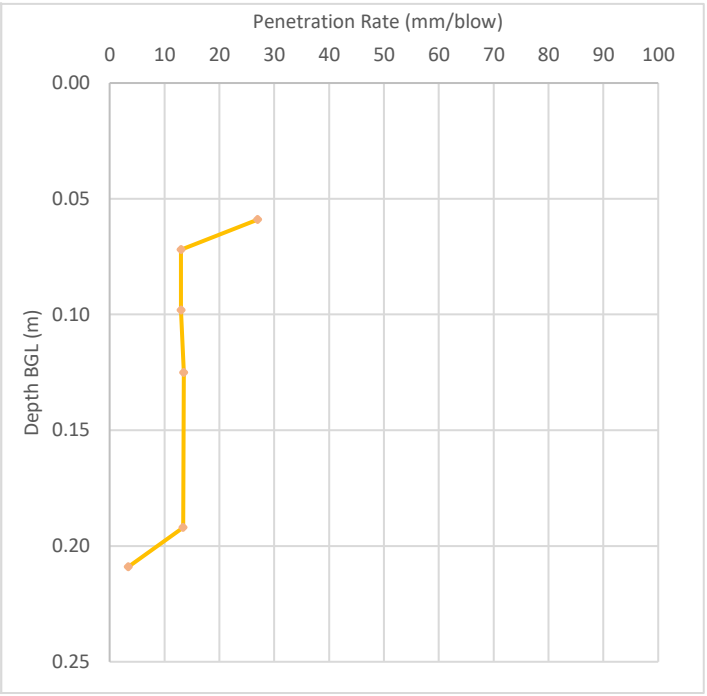
Blows	Cumulative Blows	Cumulative Penetration Depth (mm)	Depth Bgl (m)	AOD (m)	Penetration Rate (mm/blow)	CBR Value (%)
0		71	0.032	-0.032		
1	1	98	0.059	-0.059	27.0	9.3
1	2	111	0.072	-0.072	13.0	20.1
2	4	137	0.098	-0.098	13.0	20.1
2	6	164	0.125	-0.125	13.5	19.3
5	11	231	0.192	-0.192	13.4	19.4
5	16	248	0.209	-0.209	3.4	82.8

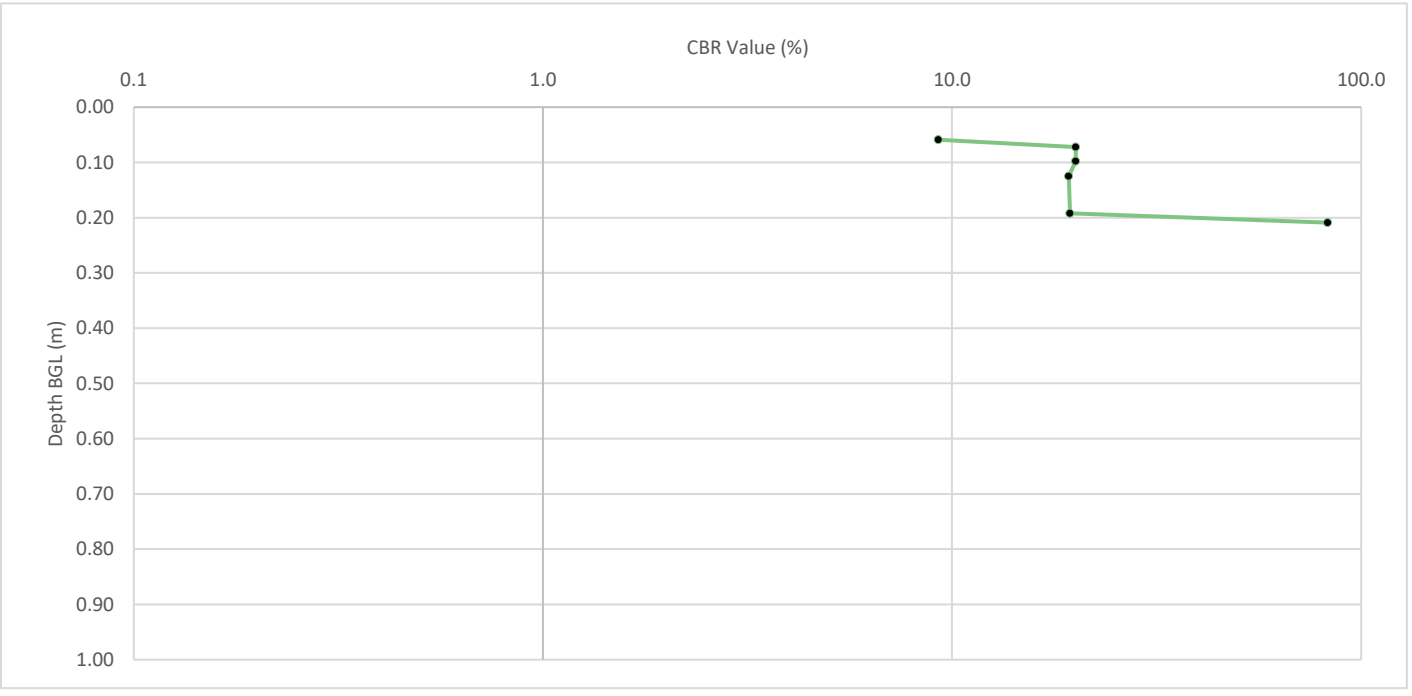
TRRL Road Note 8 Equation: Log_{10} (CBR) = 2.48 - 1.057 Log_{10} (mm/blow)		Cone Angle 60°

Dynamic Cone Penetrometer

Project: **Land at Sullivan Crescent, Harefield, UB9 6NL**	Project No: **23-248.01**	DCP Location: **DCP2A**
Client: **Bugler Developments Limited**	Operator: **DN**	Date: **20/09/2023**
Surface Conditions & Observations: **Rough ground - disturbed by installation of drainage**	Zero Error (mm): **39**	Approx AOD (m):







Dynamic Cone Penetrometer

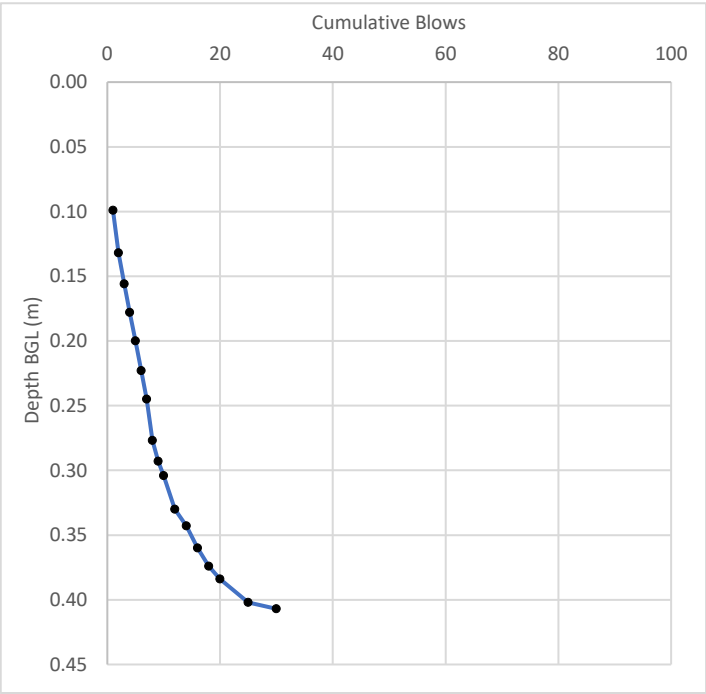
Project:	**Land at Sullivan Crescent, Harefield, UB9 6NL**	Project No: **23-248.01**	DCP Location: **DCP3**
Client:	**Bugler Developments Limited**	Operator: **DN**	Date: **20/09/2023**
Surface Conditions & Observations: **Concrete hardstanding removed**		Zero Error (mm): **39**	Approx AOD (m):

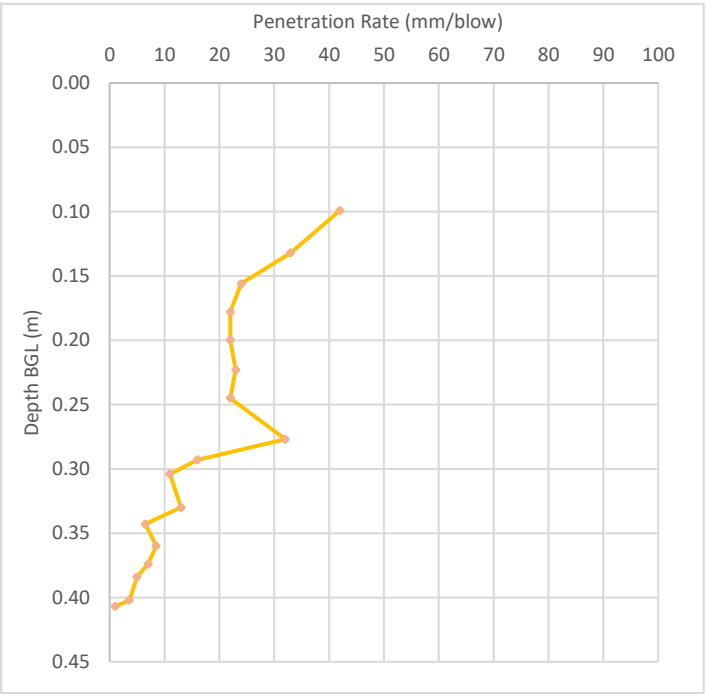
Blows	Cumulative Blows	Cumulative Penetration Depth (mm)	Depth Bgl (m)	AOD (m)	Penetration Rate (mm/blow)	CBR Value (%)
0		96	0.057	-0.057		
1	1	138	0.099	-0.099	42.0	5.8
1	2	171	0.132	-0.132	33.0	7.5
1	3	195	0.156	-0.156	24.0	10.5
1	4	217	0.178	-0.178	22.0	11.5
1	5	239	0.200	-0.200	22.0	11.5
1	6	262	0.223	-0.223	23.0	11.0
1	7	284	0.245	-0.245	22.0	11.5
1	8	316	0.277	-0.277	32.0	7.7
1	9	332	0.293	-0.293	16.0	16.1
1	10	343	0.304	-0.304	11.0	23.9
2	12	369	0.330	-0.330	13.0	20.1
2	14	382	0.343	-0.343	6.5	41.8
2	16	399	0.360	-0.360	8.5	31.4
2	18	413	0.374	-0.374	7.0	38.6
2	20	423	0.384	-0.384	5.0	55.1
5	25	441	0.402	-0.402	3.6	78.0
5	30	446	0.407	-0.407	1.0	302.0

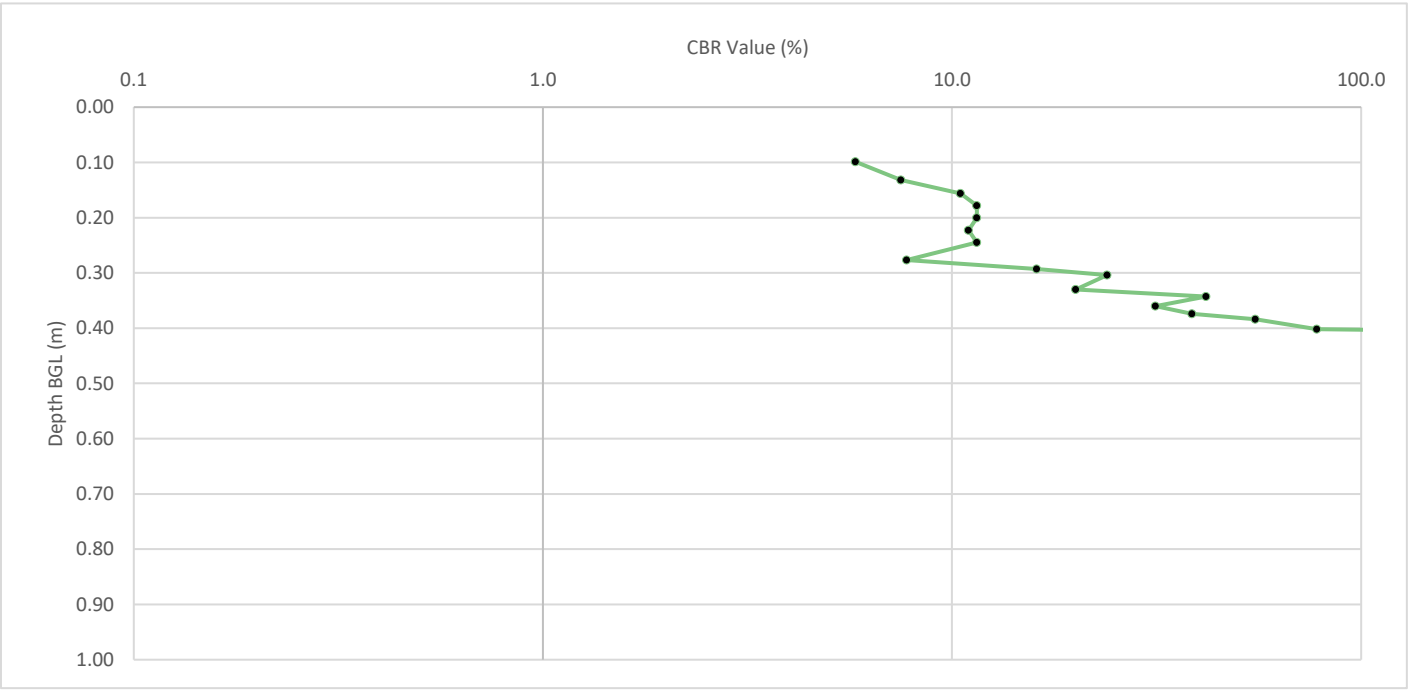
TRRL Road Note 8 Equation: Log_{10} (CBR) = 2.48 - 1.057 Log_{10} (mm/blow)		Cone Angle 60°

Dynamic Cone Penetrometer

Project: **Land at Sullivan Crescent, Harefield, UB9 6NL**	Project No: **23-248.01**	DCP Location: **DCP3**
Client: **Bugler Developments Limited**	Operator: **DN**	Date: **20/09/2023**
Surface Conditions & Observations: **Concrete hardstanding removed**	Zero Error (mm): **39**	Approx AOD (m):







Dynamic Cone Penetrometer

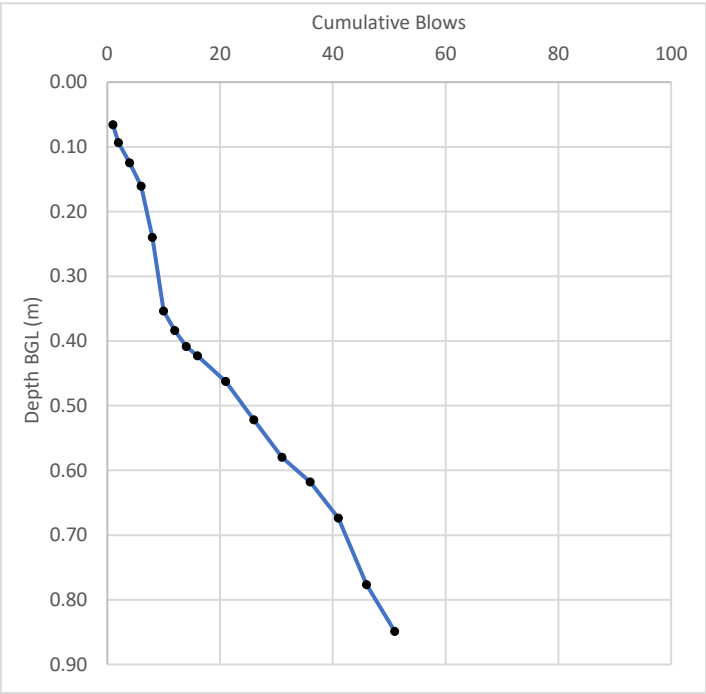
Project:	**Land at Sullivan Crescent, Harefield, UB9 6NL**	Project No: **23-248.01**	DCP Location: **DCP4**
Client:	**Bugler Developments Limited**	Operator: **DN**	Date: **20/09/2023**
Surface Conditions & Observations: **Concrete hardstanding removed**		Zero Error (mm): **39**	Approx AOD (m):

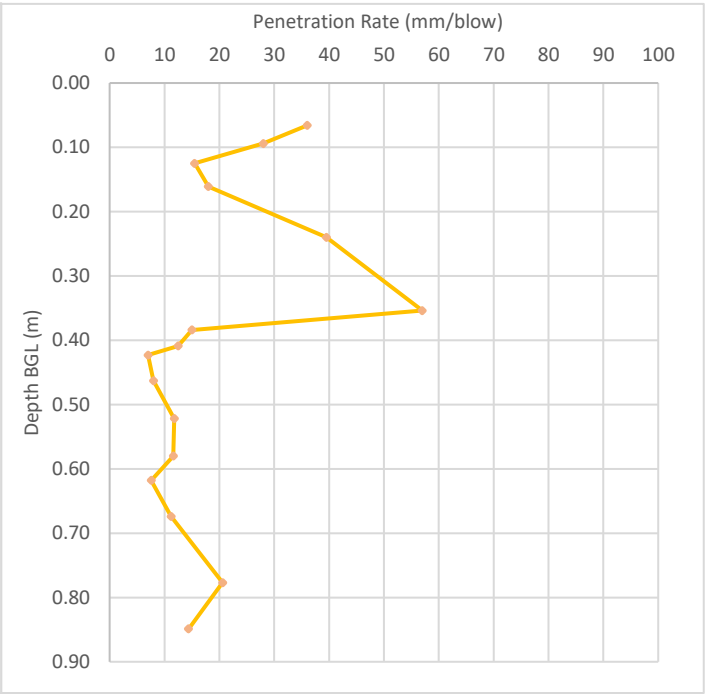
Blows	Cumulative Blows	Cumulative Penetration Depth (mm)	Depth Bgl (m)	AOD (m)	Penetration Rate (mm/blow)	CBR Value (%)
0		69	0.030	-0.030		
1	1	105	0.066	-0.066	36.0	6.8
1	2	133	0.094	-0.094	28.0	8.9
2	4	164	0.125	-0.125	15.5	16.7
2	6	200	0.161	-0.161	18.0	14.2
2	8	279	0.240	-0.240	39.5	6.2
2	10	393	0.354	-0.354	57.0	4.2
2	12	423	0.384	-0.384	15.0	17.3
2	14	448	0.409	-0.409	12.5	20.9
2	16	462	0.423	-0.423	7.0	38.6
5	21	502	0.463	-0.463	8.0	33.5
5	26	561	0.522	-0.522	11.8	22.2
5	31	619	0.580	-0.580	11.6	22.6
5	36	657	0.618	-0.618	7.6	35.4
5	41	713	0.674	-0.674	11.2	23.5
5	46	816	0.777	-0.777	20.6	12.3
5	51	888	0.849	-0.849	14.4	18.0

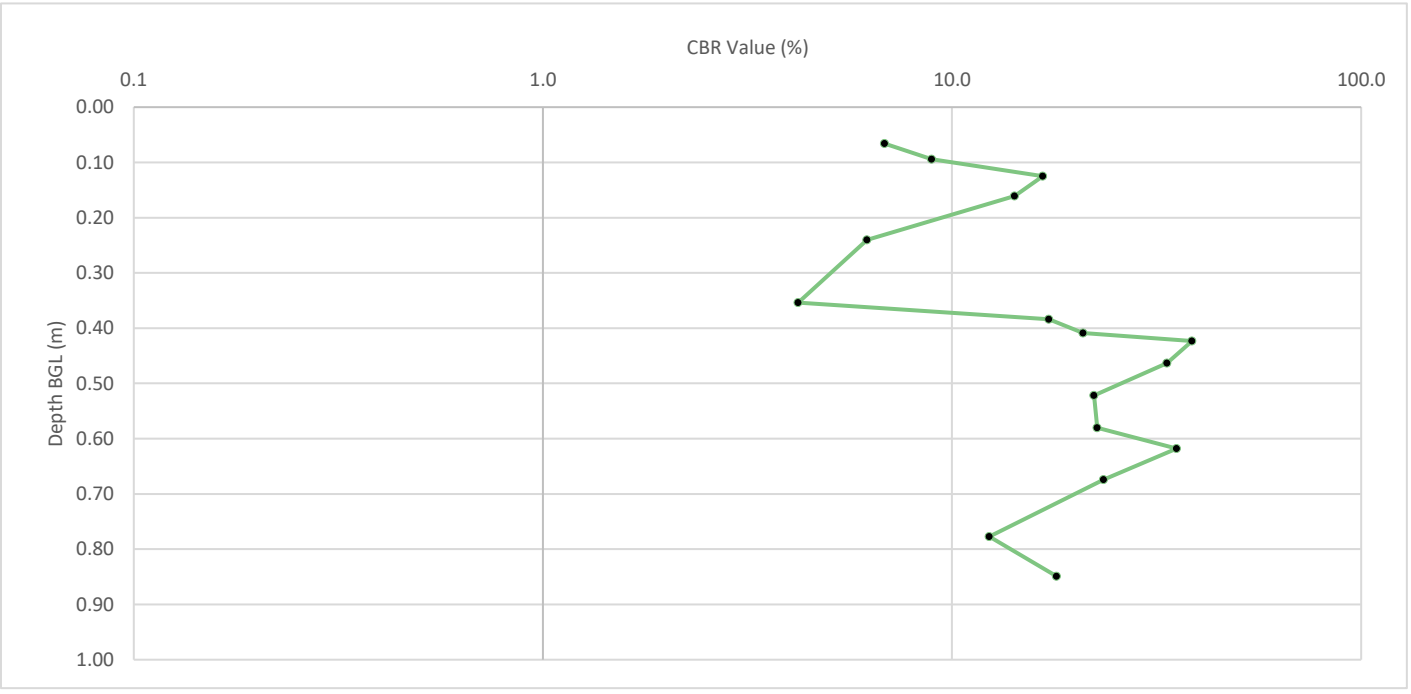
TRRL Road Note 8 Equation: Log_{10} (CBR) = 2.48 - 1.057 Log_{10} (mm/blow)		Cone Angle 60°

Dynamic Cone Penetrometer

Project: **Land at Sullivan Crescent, Harefield, UB9 6NL**	Project No: **23-248.01**	DCP Location: **DCP4**
Client: **Bugler Developments Limited**	Operator: **DN**	Date: **20/09/2023**
Surface Conditions & Observations: **Concrete hardstanding removed**	Zero Error (mm): **39**	Approx AOD (m):







Dynamic Cone Penetrometer

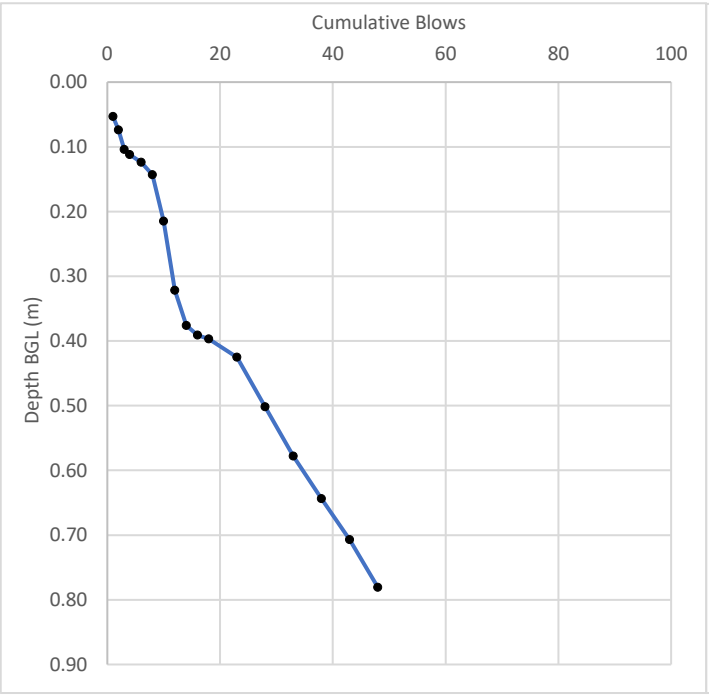
Project:	**Land at Sullivan Crescent, Harefield, UB9 6NL**	Project No: **23-248.01**	DCP Location: **DCP5**
Client:	**Bugler Developments Limited**	Operator: **DN**	Date: **20/09/2023**
Surface Conditions & Observations: **Concrete hardstanding removed**		Zero Error (mm): **39**	Approx AOD (m):

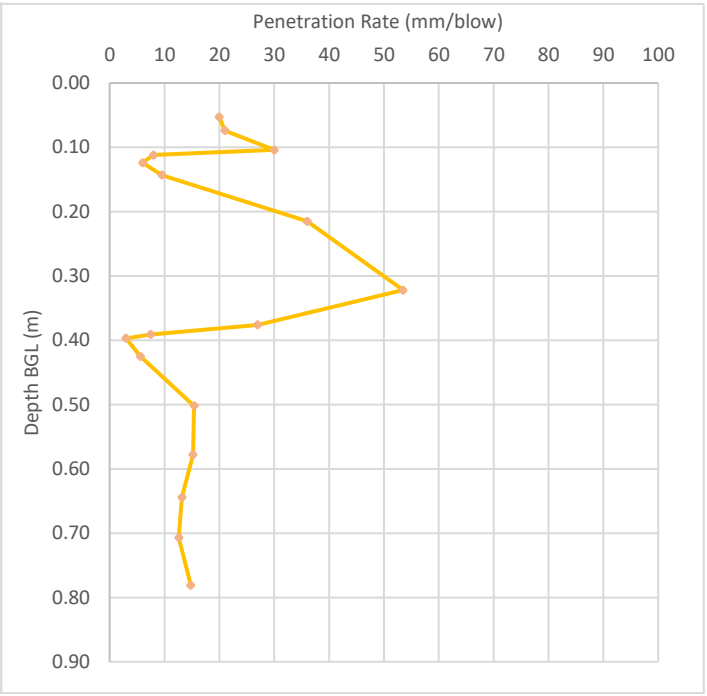
Blows	Cumulative Blows	Cumulative Penetration Depth (mm)	Depth Bgl (m)	AOD (m)	Penetration Rate (mm/blow)	CBR Value (%)
0		72	0.033	-0.033		
1	1	92	0.053	-0.053	20.0	12.7
1	2	113	0.074	-0.074	21.0	12.1
1	3	143	0.104	-0.104	30.0	8.3
1	4	151	0.112	-0.112	8.0	33.5
2	6	163	0.124	-0.124	6.0	45.4
2	8	182	0.143	-0.143	9.5	28.0
2	10	254	0.215	-0.215	36.0	6.8
2	12	361	0.322	-0.322	53.5	4.5
2	14	415	0.376	-0.376	27.0	9.3
2	16	430	0.391	-0.391	7.5	35.9
2	18	436	0.397	-0.397	3.0	94.6
5	23	464	0.425	-0.425	5.6	48.9
5	28	541	0.502	-0.502	15.4	16.8
5	33	617	0.578	-0.578	15.2	17.0
5	38	683	0.644	-0.644	13.2	19.7
5	43	746	0.707	-0.707	12.6	20.7
5	48	820	0.781	-0.781	14.8	17.5

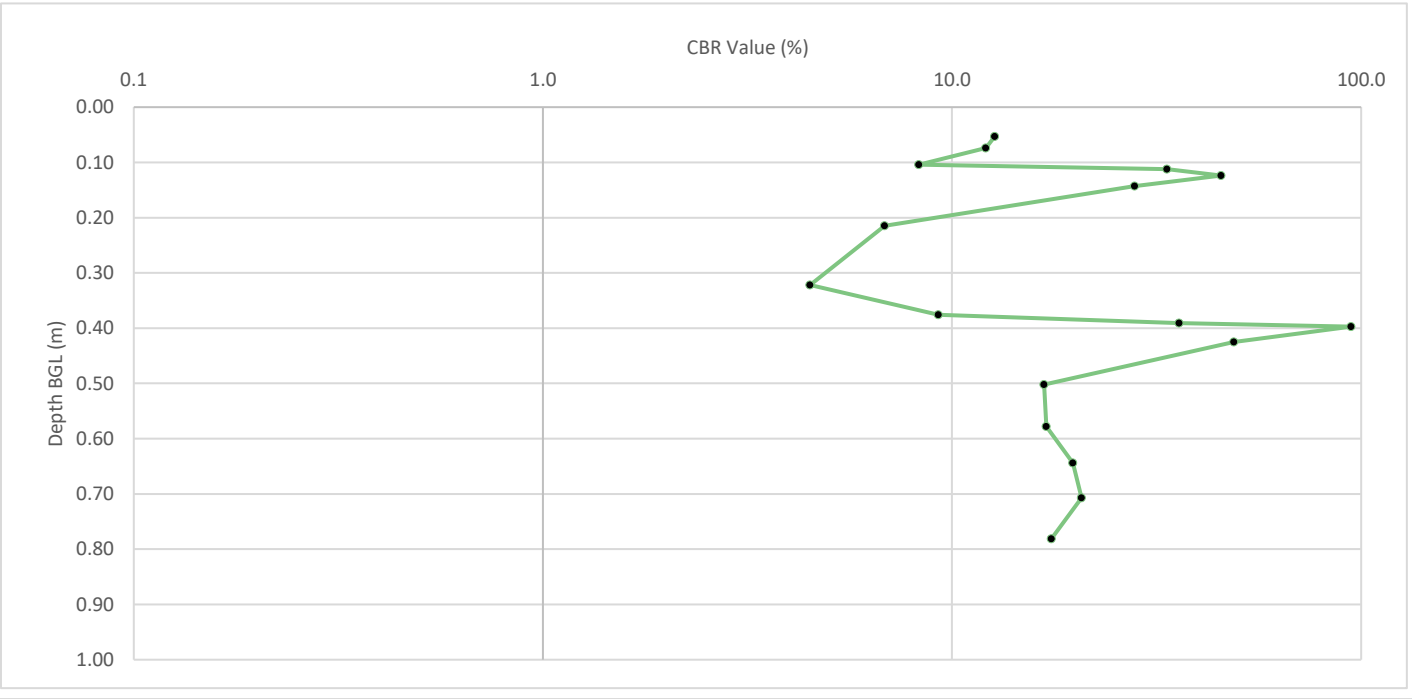
TRRL Road Note 8 Equation: Log_{10} (CBR) = 2.48 - 1.057 Log_{10} (mm/blow)		Cone Angle 60°

Dynamic Cone Penetrometer

Project: **Land at Sullivan Crescent, Harefield, UB9 6NL**	Project No: **23-248.01**	DCP Location: **DCP5**
Client: **Bugler Developments Limited**	Operator: **DN**	Date: **20/09/2023**
Surface Conditions & Observations: **Concrete hardstanding removed**	Zero Error (mm): **39**	Approx AOD (m):







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We continuously work hard to ensure our services are the most technically competent, efficient and viable in our market place. Our years of experience of vastly varied sites and projects compliment our ability to deliver assured and effective Ground Investigations and Risk Assessments of both Brownfield, Greenfield and Currently Developed Land.

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