

**REPORT ON
GROUND INVESTIGATION
AT
UNIT B, BIRCH BUSINESS PARK
HEYWOOD**



REPORT STATUS SHEET

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1.0 INTRODUCTION

1.1 Objectives and Scope of Investigation

An area of land at Birch Business Park, Heywood (the site) is being considered for redevelopment by Yeargate Ltd (the Client). The proposals for the site comprise demolition of an existing warehouse (Unit B) and construction of a steel portal framed warehouse for B2/B8 usage, with ancillary B1 office space and associated areas of parking/loading bays, servicing areas, associated works/infrastructure and some areas of soft peripheral landscaping.

A Phase 1 Geoenvironmental Risk Assessment was undertaken by Applied Geology on behalf of the Client in September 2016 (Report reference: AG2536-16-AA10), including the current site and the south-eastern portion of Birch Business Park. A summary of the desk study information, including a revised conceptual site model for the current site, is presented within Section 3 and 4 of this report. A Phase II ground investigation (report ref: AG2904-18-AF68, dated November 2018) was undertaken by Applied Geology for the area of land currently occupied by Units L1 and L2 adjacent to the northeast of the site and. Immediately to the west and a Phase II ground investigation (report ref: 2012/80-001-CON-Rev0, dated October 2012) was undertaken by Sub Soil Surveys Ltd. A Phase II ground investigation (report ref: AG3155-20-AK91, dated September 2020) was also undertaken by Applied Geology for the area of land currently occupied by Unit D adjacent to the northeast of the site.

Applied Geology was appointed by Ridge and Partners LLP (the Client's Engineer) to undertake a Phase II ground investigation at Unit B in order to:

- assess the potential for hazardous substances or conditions to exist at the site that might warrant mitigation or remediation appropriate to the intended end use proposed by the Client.
- establish geological conditions and geotechnical parameters to assist in the safe and economic engineering design of the proposed development.
- support Planning Application ref: 21-01489/FUL.

The terms of reference/brief for the works were mutually developed between Ridge and Partners LLP and Applied Geology and are outlined in our proposal (ref. AG21-7897let001) and estimate (ref. AG21-7897-01) dated 18th November 2021.

The scope of works undertaken by Applied Geology comprised:

- Ground investigation together with sampling, monitoring and a programme of laboratory testing.
- Assessment and reporting of the results of the works.

Underground service plans for the site were obtained by Applied Geology on 17th December 2021. A combined topographical and utility survey drawing (dwg ref: 3640-SHD-00-ZZ-DR-C-0112-RevP2, dated July 2020) was provided by the Engineer and is presented in Appendix A. Service clearance at each exploratory hole location was undertaken by Midland Survey Ltd.

1.2 Report Layout

This report presents a brief description of the site, the desk study data and the factual results of the intrusive investigations carried out. An interpretation of the ground conditions and a discussion/assessment of the findings is presented in the later report text sections. The main text of the report has been produced in a concise format, including the use of data tables to summarise key information where possible. The report should be read in conjunction with the general procedures detailed in Appendix E and General Notes given at the end of the main text, which provide details of investigation techniques, assessment methodology and standards, health & safety and limitations and exceptions of the report. Drawings and factual data including exploratory hole records, and laboratory testing results are presented in the other Appendices.

2.0 SITE DESCRIPTION AND PROPOSALS

2.1 Site Description

The site is located at Birch Business Park, Heywood, approximately 2.6km southwest of Heywood town centre. The Ordnance Survey grid reference for the centre of the site is 384098 408201 as shown on the Site Location Plan, Drawing No AG3353-21-01, in Appendix A.

The site is approximately rectangular in plan shape, with dimensions of approximately 150m by 120m and is relatively flat topographically at 131m AOD, as shown on Drawing No AG3353-21-02 in Appendix A.

A site inspection/walkover was undertaken by Applied Geology on 6th January 2022. Access to the site was gained off Moss Hall Road. At the time of the inspection, the site comprised the partially active Unit B warehouse, with loading bays to the west and the disused Unit G in the eastern portion. Several HGV trailers were parked adjacent to the western side of Unit B. Externally, the ground surface comprised loose gravel to the north, soft landscaping to the south, and asphalt associated with an access road immediately to the south. Internally, the ground surface comprised concrete throughout Unit B, and was being used for storage by a data management company. No significant changes had been observed between the time of the September 2016 Phase 1 desk study and January 2022.

The site was bound to the east by the newly developed Unit D, to the north by an open yard with a commercial unit beyond, and to the south and west by approximately 2m high palisade fencing, beyond which was Whittle Lane.

2.2 Site Proposals

The proposals for the site comprise the demolition of the existing Unit B and Unit G warehouse units and construction of a B2/B8 steel portal framed warehouse unit with ancillary B1 office space and associated areas of parking/loading bays, servicing areas, associated works/infrastructure and peripheral soft landscaping. The proposals are shown on the Proposed Site Plan by Fletcher Rae Architects (Dwg ref: 21033_PL03 Rev P03, dated August 2021), a copy of which is presented in Appendix A.

3.0 SUMMARY OF DESK STUDY INFORMATION

3.1 Previous Applied Geology Desk Study

The pertinent findings from the Phase 1 desk study undertaken by Applied Geology (Report ref: AG2536-16-AA10, dated September 2016) are summarised below and amended where relevant for the subject site.

Site History	• 1848 – Site and surrounding area shown to comprise open fields. Several ponds are shown across the wider area, the closest being approximately 175m north of the site (no longer shown by 1939). • 1980 – Site occupied by a building concurrent with the existing/most recent warehouse building on site, with a substation shown adjacent to the western site boundary. Surrounding area to the west has been developed comprising industrial units associated with the Birch Industrial Estate and labelled 'depot'. • 2016 – At the time of the 2016 Phase 1 desk study walkover, Unit B comprised a warehouse, with areas of soft landscaping to the southern and western boundaries. An area of storage for scaffolding poles was noted to the northern side of the building. At the time of the walkover, Unit B was being used for document storage by a data management company. Prior to this, it is understood that the building was used for storage by a carpet company. • 2021 – No significant changes.
Anticipated Geology and Ground Conditions	• Published BGS Map 'Sheet 85' indicates site underlain by solid geology of the Pennine Lower Coal Measures Formation with overlying drift deposits comprising Glacial Till and Glaciofluvial Ice Contact Deposits. Lacustrine, Head and Glaciofluvial Deposits are shown to be present across the wider area.
Radon	• Site is not in a radon affected area, with <1% of homes above the Action Level. No radon protection measures are therefore considered necessary for new properties.
Mining/Quarrying	• Coal Authority indicates the site to lie within a former Coal Mining Area. • The site is not within a development high risk area. • A Coal Authority Report (Report ref: 51001247491001) for site states that the site is not within a surface area that could be affected by past or present underground mining. • The nearest mine entries are shown to be approximately 700m to the northwest. • Site not in area associated with natural cavity formation.
Hydrology	• Nearest surface watercourse is a tertiary river 250m east of site. • Nearest water feature is an attenuation pond 150m northeast of site. • There are no surface water abstractions within 1.5km. • There is an active licensed discharge approx. 150m northeast of site relating to sewage discharges. • The site is situated outside of any floodplain.
Hydrogeology	• Superficial Glaciofluvial Ice Contact Deposits beneath the site are classified as a Secondary 'A' Aquifer. The Glacial Till is a Secondary 'Undifferentiated' Aquifer. The Solid strata of the Pennine Lower Coal Measures Formation is a Secondary 'A' Aquifer. • There are no groundwater abstractions within 500m of site. • Site is not located within a groundwater Source Protection Zone. • Likely groundwater flow direction is to the northeast, following the topography.
Other Environmental data	• No landfills or licensed waste sites within 750m of site. • 20 current industrial land usages within 250m. Of relevance to the site is a construction and tool hire yard adjacent to the northern boundary. • No recorded active petrol/fuel sites within 500m of site. • Two recorded pollution incidents within 250m. A Category 3 (minor impact to water) occurred on/near site in 2002 and a Category 3 (minor impact to land and water) 130m to the northwest occurred in 2003.

	The site is located within the Liverpool, Manchester and West Yorkshire Greenbelt (Rochdale District [B]).
Geohazards	The risk pertaining to shrink-swell clays, landslides, ground dissolution of soluble rocks, compressible deposits, and running sands are all considered to be very low – negligible.
Railways and Tunnels	No existing railways or tunnels are shown to be present on site or within 250m of the site.

3.2 UXO Risk

Applied Geology commissioned 1st Line Defence Ltd to undertake an Express Preliminary UXO Risk Assessment as part of the AG2904-18-AF68 report in 2018. The 1st Line Defence report (ref. EP7217-00) indicates that they deem the site to have no significant risk of items of unexploded ordnance (UXO) within the site boundaries and thus no further action was recommended.

3.3 Historical Ground Investigation Reports

Sub Soil Surveys Ltd Phase 2 (Ground Investigation) Report No 2012/80-001-CON-Rev0 (October 2012)

The investigation was undertaken for Applied Geology's Client, Yeagate Ltd and the data was provided to Applied Geology to assist with the Phase 2 investigation for Unit D.

This report describes an intrusive geo-environmental investigation carried out on the adjacent site, immediately to the north, where it was proposed to construct an industrial unit with service yard and parking. The ground investigation comprised 2 No Cable Percussive boreholes (Ref: BH1 & BH2), 4 No Driven Continuous Sampling boreholes (Ref: WS1 – WS4), and 1 No Trial Pit (Ref: TP1).

Made Ground was recorded to depths of between 0.2m and 3.0m below ground level (bgl), overlying soft cohesive strata to depths of between 0.7m and 2.3m bgl, which were in turn underlain by firm to stiff Glacial Till. Glaciofluvial Deposits were encountered within WS3 only, between 0.2m and 2.8m bgl (depth not proven). Solid Bedrock of the Pennine Lower Coal Measures Formation was encountered within BH1 and BH2 at depths of 13.1m and 13.3m bgl. Standard Penetration Tests (SPTs) were generally only carried out in the Made Ground and shallow cohesive strata, recording 'N' values of between N=2 and N=12.

Groundwater was encountered at depths of 9.5m and 12.9m bgl during drilling, however, two monitoring visits recorded groundwater levels at between 1.04m and 1.64m bgl in standpipes installed in the Made Ground and shallow natural strata.

Chemical testing was carried out on samples taken within the shallow soils and screened against the relevant human health screening criteria (valid at the time) for a commercial/industrial end-use. No contaminants of concern were detected. Limited leachate testing identified the presence of some PAHs, TPH fractions and high (alkaline) pH values. Groundwater testing was not undertaken.

The results of two ground gas monitoring visits on standpipes installed within the Made Ground and soft cohesive Glacial Till recorded methane concentrations of

between less than detection limit (<0.1%) and 8.2%, a maximum carbon dioxide concentration of 6.8%, and a maximum flow rate of 0.3l/hr.

Sub Soil Surveys Ltd concluded that end bearing piles, placed with the Glacial Till or Pennine Lower Coal Measures Strata would be the most suitable foundation solution. The site was deemed to not pose a risk to end users or Controlled Waters based on a 'Commercial' end use.

Applied Geology Report on Ground Investigation Ref: AG2904-18-AF68 (November 2018)

A combined geotechnical geo-environmental investigation was undertaken for Yeargate Ltd on the adjacent site, immediately to the north, where it was proposed to construct an industrial unit with service yard and parking (existing Unit L1 and L2).

The ground investigation comprised 3No Cable Percussive boreholes (Ref: CP1A to CP3) to depths of between 3m and 15m bgl and 6No machine excavated trial pits to depths of between 1.5m and 3.2m bgl.

Made Ground (up to 3m thickness) was encountered over predominantly granular and generally loose Glaciofluvial Ice Contact Deposits and in places underlain by stiff cohesive Glacial Till. SPTs undertaken in the Glaciofluvial Ice Contact Deposits recorded N values generally between N=3 and N=10 above 10m depth. Below 10m depth, N values ranged between N=14 and N=26.

Groundwater was not encountered during drilling. Subsequent monitoring of standpipe installations on four occasions recorded groundwater between 0.66m and 2.7m bgl.

Although the majority of source-pathway-receptor linkages to potential end users were considered to be effectively broken by the proposed 100% hard cover, a comparison of the results for chemical testing on samples of the Made Ground and natural strata against generic screening criteria for a commercial/industrial end use showed that there were no exceedances. Also, the results of leachate testing on samples of the Made Ground (including Metals, Phenol & PAHs) recorded determinand concentrations below the relevant screening values/less than detection. Based on the test results and proposed development, a low to negligible risk to human health and controlled water receptors was established.

Gas monitoring of installations recorded elevated methane (up to 12% by volume) and carbon dioxide (up to 17.2% by volume). However, flow readings were generally reported at or below the instrument limit of detection (0.1l/h). Characteristic Situation 2 conditions were recommended.

Neither the Made Ground nor the shallow Glaciofluvial Ice Contact Deposits were considered suitable to support conventional strip/trench fill or pad foundations due to the soft and loose nature. As such, a vibro-replacement stone column foundation solution was considered appropriate and it is understood that this was utilised during construction.

Applied Geology Report on Ground Investigation Ref: AG3155-20-AK91 (September 2020)

A combined geotechnical geo-environmental investigation was undertaken for Yeargate Ltd on the adjacent site, immediately to the south, where it was proposed to construct an industrial unit with service yard and parking (existing Unit D2).

The ground investigation comprised 5 No Cable Percussive boreholes (Ref: CP1 to CP5) to depths of 15.45m bgl and 4 No Driven Continuous Sampling boreholes (ref. DCS1 to DCS4) to 5.45m bgl.

Made Ground (up to 1.3m thickness) was encountered over interbedded granular Glaciofluvial Ice Contact Deposits and cohesive Glacial Till to the base of the boreholes. SPTs undertaken in the cohesive Glaciofluvial Ice Contact Deposits recorded N values generally between N=5 and N=22. SPTs undertaken in the granular Glaciofluvial Ice Contact Deposits recorded N values generally between N=10 and N=29. SPTs undertaken in the cohesive Glacial Till recorded N values generally between N=18 and N=42.

Groundwater was encountered during drilling at all exploratory hole locations, generally in the Glaciofluvial Ice Contact Deposits between depths of 1.1m and 7.5m bgl and locally in the Glacial Till at 5.3m and 5.7m bgl. Subsequent monitoring of standpipe installations on four occasions recorded groundwater between 0.81m and 3.47m bgl.

Although the majority of source-pathway-receptor linkages to potential end users were considered to be effectively broken by the proposed 90% hard cover, a comparison of the results for chemical testing on samples of the Made Ground and natural strata against generic screening criteria for a commercial/industrial end use showed that there were no exceedances. The results of leachate testing on samples of the Made Ground (including Metals, Phenol & PAHs) recorded phenol that marginally exceeded the screening value, in CP3 at 9.2µg/l and CP5 at 9.4µg/l, when compared against the screening value of 7.7µg/l. Based on the test results and proposed development, a low to negligible risk to human health and controlled water receptors was established.

Gas monitoring of installations recorded negligible methane (up to 0.3% by volume), locally slightly elevated carbon dioxide (up to 6.3% by volume) and negligible flow rates. As such, Characteristic Situation 1 conditions were deemed appropriate.

Neither the Made Ground nor the shallow Glaciofluvial Ice Contact Deposits were considered suitable to support conventional strip/trench fill or pad foundations due to the soft and loose nature. As such, a vibro-replacement stone column foundation solution or piled foundation solution was considered appropriate and it is understood that this was utilised during construction.

4.0 CONCEPTUAL SITE MODEL

In developing a Conceptual Site Model for the site, pollutant linkages are determined by identifying likely sources of contamination from previous and current site uses, possible targets such as site users, neighbouring site users and Controlled Waters and linkages between them. The potential sources, receptors and pathways are defined in the following sections:

4.1 Sources

- Made Ground soils on site associated with existing site development.
- On-site or off-site ground gases associated with decomposition of organic material in Made Ground, including historical backfilled pond 175m north of the site.
- Elevated sulphate concentrations in Made Ground or underlying natural strata.
- Possible minor hydrocarbon spillages relating to recent HGV/trailer storage.

4.2 Receptors

Standard receptors to be considered are as follows:

- End users (Human Health);
- Underlying Aquifers (Controlled Waters), including the Superficial Glaciofluvial Ice Contact Deposits and the Solid strata of the Pennine Lower Coal Measures Formation (both Secondary 'A' Aquifers);
- Buried foundation/substructure concrete (Building Materials); and
- Water supply services (Building Materials).

4.3 Pathways

Generic pathways, potentially linking the above sources and receptors, to be considered are as follows:

- Gas migration;
- Human dermal contact;
- Human ingestion via soil directly;
- Human inhalation of dust or vapours;
- Leaching and/or migration through permeable soils (granular Made Ground or Glaciofluvial Ice Contact Deposits); and
- Direct contact with buried concrete/water supply services.

4.4 Source/Pathway/Receptor Linkage and Assessed Risk

Source-pathway-receptor (SPR) linkages are tabulated below together with the qualitatively assessed risk. The risk to ground workers and construction workers is not included here due to the short-term exposure times that they will be subject to and the assumption that good hygiene practices will be adopted on site, together with the appropriate use of relevant PPE/RPE. Comments regarding contamination issues with respect to ground workers and construction workers are included in the health and safety section of the Standard Procedures included as Appendix E.

Source	Pathway	Receptor	Risk*
Potential contaminants within Made Ground, including possible minor hydrocarbon spillages associated with HGV parking.	Inhalation, ingestion, dermal contact.	End users	Low
	Migration and Leaching	Secondary Aquifers	Low
	Direct contact	Water supply pipes	Low
Ground gas from Made Ground or backfilled pond 175m north of the site	Migration into buildings, service ducts etc.	End users	Low-Negligible

Source	Pathway	Receptor	Risk*
(methane, carbon dioxide, poss. VOCs)			
Elevated sulphates in Made Ground or natural soils	Direct contact, leaching and contact with groundwater	Buried concrete	Medium

*** Definition of Risk Categories**

Negligible - Contaminants that might have unacceptable impact on key receptors, are unlikely to be present, or, no pathway is envisaged.

Low Risk: Contaminants may be present but are unlikely to be at levels to have unacceptable impact on key receptors, or pathways are likely to be minimal.

Medium Risk: Contaminants are probably present and might have an unacceptable impact on key receptors. Pathways may also be present therefore remedial measures may be necessary to reduce the risks.

High Risk – Contaminants probably or certainly present and pathways are probably also present. Therefore, contaminants are likely to have an unacceptable impact on key receptors and remedial measures are likely to be necessary to reduce the risks to acceptable levels.

5.0 GROUND INVESTIGATION WORKS

5.1 Fieldwork

The following scope of fieldwork was undertaken:

- 5 No 150mm diameter Cable Percussive boreholes (ref CP1 to CP5) to depths of between 14.65m and 15.45m bgl.
- 5 No Driven Continuous Sampling boreholes (ref. DCS1 to DCS5) to 5.45m bgl.

The borehole records are included in Appendix B along with the SPT calibration certificates.

The locations of the exploratory holes were selected by Ridge and Partners LLP and set out on site by Applied Geology Limited, by trained personnel using a calibrated CAT and Genny in conjunction with the consultation of statutory services drawings. The locations were significantly constrained by the available access on site and the presence of underground supply services. The sampling strategy for the exploratory hole locations was to provide best overall coverage given the access constraints and scope of the investigation, with the DCS boreholes positioned to permit collection of environmental samples. The cable percussion boreholes were positioned to determine the thickness of Made Ground within the footprint of the proposed development, to collect geotechnical samples and to undertake in situ tests and to allow installation of gas/groundwater monitoring standpipes. CP4 was commenced at the surface by concrete coring at 300mm diameter.

The positions of the exploratory holes were defined by taping from identifiable features on the Proposed Site Plan (dwg ref: 21033_PL03 Rev P03), provided by Ridge and Partners LLP. Surveying and service clearance of each location was undertaken by Midland Survey Ltd. The locations are presented on Drawing No. AG3353-21-02 in Appendix A.

5.2 Instrumentation and Monitoring

On completion of boring, 50mm diameter standpipes were installed in selected boreholes as follows, with further details included in the relevant borehole logs in Appendix B:

- CP1, 1.0m to 8.0m below ground level (bgl), in Glaciofluvial Ice Contact Deposits and Glacial Till;
- CP3, 1.0m to 8.0m bgl, in Glaciofluvial Ice Contact Deposits;
- CP4, 2.0m to 8.0m bgl, in Glaciofluvial Ice Contact Deposits and Glacial Till;
- CP5, 1.0m to 8.0m bgl, in Glaciofluvial Ice Contact Deposits.

Washed silica gravel (6-10mm) was used as the filter medium and a 300-micron filter sock was wrapped around the slotted section of the standpipe. Each standpipe was fitted with a push-in bung and single gas tap and was finished with a flush metal cover concreted in place.

Groundwater monitoring visits were undertaken on 4 occasions from 21st January to 2nd March 2022 including during two periods of low and/or falling atmospheric pressure. Although only a thin layer of Made Ground was encountered across the site and no obvious/significant sources of ground gas have been identified, confirmatory gas monitoring visits were undertaken alongside groundwater level monitoring. Each monitoring well was monitored for concentrations of carbon dioxide, methane, oxygen, VOCs, flow rates and differential pressures and water level. The monitoring results are included in Appendix C.

Falling head permeability tests were undertaken within the standpipes of CP1 and CP5 to provide a preliminary indication of infiltration potential, the results of which are discussed further in Section 8.6.

5.3 Laboratory Testing

Geotechnical laboratory testing was scheduled by Applied Geology on selected samples recovered. Testing was carried out at UKAS accredited laboratory Professional Soils Laboratory (PSL) and comprised the following:

- 6 No natural moisture content tests;
- 6 No Atterberg limit tests;
- 4 No particle size distribution tests;
- 4 No quick undrained triaxial tests; and
- 9 No BRE SD1 suite tests.

Chemical testing was scheduled by Applied Geology based upon the desk study, walkover and site observations during the fieldwork. Testing was carried out at UKAS accredited laboratory i2 Analytical and seven samples of the Made Ground were analysed for the following suite of contaminants:

- Selected metals suite [arsenic, boron, beryllium, cadmium, chromium (total, trivalent and hexavalent), copper, lead, mercury, nickel, selenium, vanadium and zinc];
- Speciated (16 US EPA) Polycyclic Aromatic Hydrocarbons (PAH);
- Phenols;

- pH;
- Soluble sulphate;
- Organic matter;
- Total Petroleum Hydrocarbons Criteria Working Group (TPH CWG);
- Benzene, Toulene, Ethylbenzene, and Xylene (BTEX);
- Methyl-tertiary-butyl-ether (MTBE); and
- Asbestos screening.

Three samples of the Made Ground were submitted for leachate analysis, comprising the following suite of contaminants:

- Selected metals suite [arsenic, beryllium, boron, cadmium, total chromium, copper, mercury, nickel, lead, selenium, vanadium, zinc];
- Speciated (16 US EPA) Polycyclic Aromatic Hydrocarbons (PAHs);
- Phenols (total);
- pH;
- Hardness; and
- Total Organic Carbon.

Laboratory test results are included in Appendix D.

6.0 GROUND CONDITIONS

6.1 Strata Encountered

The ground investigation has identified Made Ground (including hardstanding) to depths of up to 1.4m bgl, overlying granular Glaciofluvial Ice Contact Deposits and cohesive Glacial Till to the base of the boreholes. A concrete slab was present within/adjacent to the existing buildings and Topsoil in the areas of soft landscaping. Bedrock of the Pennine Lower Coal Measures Formation was not encountered. Full details of the strata encountered are given on the borehole records presented in Appendix B. SPT N value results are plotted against depth in Appendix A. A generalised ground profile is presented below to summarise the information.

The findings of this ground investigation are generally in line with the ground conditions previously encountered beneath Units L1 and L2 (by Applied Geology in 2018) and Unit D (by Applied Geology in 2020), both to the northeast of the site.

Stratum	Depth to Top of Strata (m bgl)	Thickness (range) (m)	Comments
Hardstanding	GL	0.2 – 0.4	Encountered at locations CP3 and CP4 as asphalt and concrete.
Topsoil & Made Ground/Topsoil	GL	0.2 – 0.4	Encountered at the perimeter of the site.
Made Ground	GL – 0.4	0.3 – 3.45	Generally, to depths of between 0.35m and 1.1m bgl. Deepest in CP4 at 3.6m bgl.
Glaciofluvial Ice Contact Deposits	0.2 – 1.4	0.3 – 15.25	Encountered at all exploratory hole locations. Thickest in CP2, CP3, and CP5.

Stratum	Depth to Top of Strata (m bgl)	Thickness (range) (m)	Comments
Glacial Till	1.4 - 3.6	0.6 - 8.6	Encountered only at exploratory hole locations CP1, CP4, CP5, DCS1 and DCS5. Significantly thicker in CP1 and CP4.

6.2 Hardstanding, Made Ground/Topsoil and Topsoil

Hardstanding was encountered adjacent to the existing Unit D building as asphalt (CP3) and Unit G (CP4) as concrete. The hardstanding was encountered from ground level to depth of between 0.3m and 0.4m bgl. At CP3, 0.2m thick concrete was encountered beneath the asphalt.

Made Ground/Topsoil was encountered at two locations, DCS2 and DCS5, from ground level to depths of 0.2m and 0.4m bgl, respectively. The Topsoil/Made Ground generally comprised dark brown silty clayey sand with rare rootlets. The stratum has been described as Made Ground/Topsoil as the presence of Made Ground beneath suggests this soil was placed rather than being naturally derived material.

Natural Topsoil was generally encountered in the soft landscaping to the perimeter of the site from ground level to depths of between 0.2m and 0.3m bgl. The Topsoil generally comprised dark brown clayey sand with frequent rootlets.

6.3 Made Ground

Made Ground soils were encountered in CP4 and all DCS locations except DCS4, from depths of between ground level and 0.4m bgl and generally to depths of between 0.35m and 1.1m, achieving thicknesses of between 0.35m and 0.7m. In CP4 however, Made Ground was encountered to 3.6m bgl.

The Made Ground generally comprised dark brown slightly gravelly clayey sand and slightly gravelly sandy clay. The gravel was fine to coarse subangular clinker, brick, and sandstone, with a high cobble content in DCS3. The gravel was fine to coarse subangular to subrounded clinker, brick, and sandstone. Cobbles were angular brick and sandstone.

Three SPTs carried out at depths of 1.2m, 2.0m and 3.0m bgl in the cohesive Made Ground in CP4 recorded 'N' values of 11, 6 and 4 respectively.

6.4 Glaciofluvial Ice Contact Deposits

Strata interpreted as Glaciofluvial Ice Contact Deposits were encountered in all exploratory holes as a predominantly granular soil, interbedded with cohesive layers, proven to depths of up to 15.45m bgl, giving proven thicknesses of between 0.2m and 9.9m and penetrations of between 3.25m and 15.25m (i.e. base not proven).

The granular Glaciofluvial Ice Contact Deposits generally comprised medium dense (locally loose) orange brown slightly gravelly clayey silty sand, with gravel of fine to coarse, subangular to rounded mudstone, quartzite and coal.

Four particle size distribution tests undertaken on samples of the granular Glaciofluvial Ice Contact Deposits recorded fines contents of between 9% and 28%, sand contents of between 72% and 91% and gravel contents of <1%, indicating the soil to generally be a slightly gravelly clayey/silty sand, which is in general accordance with the field descriptions.

Fifty SPTs carried out in the granular Glaciofluvial Ice Contact Deposits generally recorded 'N' values of between N=10 and N=39 (medium dense), with nine of the SPTs recording N' values of between N=6 and N=8 (loose). The SPTs generally show an increase in 'N' value with depth, as shown on the SPT versus depth plot in Appendix A. Although N values generally show an increase with depth, three SPTs, undertaken in CP2 at 7.5m and CP5 at 6.0m and 7.5m bgl recorded 'N' values of 6 and 8.

Cohesive layers/lenses of Glaciofluvial Ice Contact Deposits were encountered in DCS2 from 1.6m to 1.8m bgl and from 2.2m to 3.3m bgl, comprising firm to stiff orange-brown clayey silt and silty clay.

The results of a single Atterberg limit test carried out on a sample of the cohesive Glaciofluvial Ice Contact Deposits recorded a plastic limit of 18%, liquid limit of 35%, plasticity indices of 17% (no correction required) and a moisture content of 20%. The results indicate the soil to be clay of intermediate plasticity, with a low volume change potential.

Two SPTs undertaken in the cohesive Glaciofluvial Ice Contact Deposits recorded 'N' values of N=9 and N=10. By applying the empirical relationship between SPT 'N' value, mass shear strength and using a plasticity index of 17% and a corresponding f_1 of 6, this correlates to mass shear strengths of between c.50kN/m² and 60kN/m² (medium strength).

6.5 Glacial Till

Glacial Till was encountered in some exploratory holes underlying the Made Ground or Glaciofluvial Ice Contact Deposits with boreholes achieving a maximum penetration of 8.6m at CP4. The base of the stratum was not proven. The depth to the top of the Glacial Till was variable across the site, however, it was significantly deeper at CP5 at 12.8m bgl.

The Glacial Till generally comprised firm to stiff, in places becoming very stiff, brown slightly gravelly sandy clay. The gravel comprised fine to coarse, subangular to rounded mudstone, siltstone, and sandstone.

The results of five Atterberg limit tests undertaken on samples of the Glacial Till recorded plastic limits of between 14% and 18%, liquid limits of between 25% and 36%, plasticity indices of between 11% and 18% (corrected to 5% and 18%) and moisture contents of between 13% and 20%. The results indicate the soil to be clay of low to intermediate plasticity, with a low volume change potential.

The results of three quick undrained triaxial tests carried out on samples of the Glacial Till at depths of between 5.0m and 10.5m bgl recorded undrained shear strengths of 56kN/m² and 82kN/m² (high strength). A single quick undrained triaxial test at 4.0m bgl recorded an undrained shear strength of 12kN/m² (very low strength), generally correlating to the soft (SPT value N=4) Glacial Till at 3.0m bgl, however, it is possible

that some sample disturbance or softening due to the water strike at 3.5m may have taken place.

Seventeen SPTs carried out in the Glacial Till recorded 'N' values of generally between N=9 and N=36 generally showing an increase in 'N' value with depth, as shown on the SPT versus depth plot in Appendix A. By applying the empirical relationship of SPT 'N' value, mass shear strength and assuming a plasticity index of 14% and corresponding f_1 of 6, this correlates to mass shear strengths generally between 54kN/m² and 210kN/m² (medium to very high strength).

6.6 Groundwater and Falling Head Tests

Groundwater was encountered during drilling at all exploratory hole locations, generally in the Glaciofluvial Ice Contact Deposits between depths of 2.5m and 8.7m bgl and locally in the Glacial Till at 3.5m. Water was also encountered as a seepage in the Made Ground at 0.8m bgl in DCS3.

Subsequent monitoring of the standpipes between 21st January and 2nd March 2022 generally recorded resting groundwater levels of between 0.73m and 2.50m bgl (129.38m and 130.99m AOD), showing a general rise over the monitoring period. All of the standpipes were installed within the Glaciofluvial Ice Contact Deposits and Glacial Till, with response zones placed over the range of groundwater strikes encountered during drilling. The monitoring undertaken indicates groundwater flow towards the east.

It should be noted that groundwater levels may vary beyond that observed during the fieldwork period due to seasonal effects throughout the year.

Two variable head permeability tests were undertaken in the standpipe installations of CP1 and CP5, installed in the natural strata of the Glaciofluvial Ice Contact Deposits and Glacial Till. Further discussion is given in Section 8.6.

6.7 Ground Gas

Only a relatively thin Made Ground was encountered across the site and no significant on-site sources of ground gas were observed during the site investigation.

Monitoring of the standpipes on four occasions has recorded methane concentrations less than detection limit (0.1% by volume). Carbon dioxide concentrations were recorded between 0.1% and 1.9% by volume. Oxygen concentrations between 18.6% (slightly depleted) and 21.3% (atmospheric) by volume. VOC concentrations were recorded between 1.7ppm and less than the limit of detection (<0.1ppm). Flow readings taken over a three-minute average period recorded flow rates of between 0.2l/hr and less than the limit of detection (<0.1l/hr).

Gas screening values have been calculated for each installation using the highest concentrations and highest flow rates in accordance with CIRIA C665. The GSVs are as follows:

Stratum	BH	Response Zone (m bgl)	Ground water level (m bgl)	Max. Methane (%)	Max. Carbon Dioxide (%)	Max. Steady Flow (l/hr)	GSV Methane (l/hr)	GSV Carbon Dioxide (l/hr)
Glacial Deposits	CP1	1.0 – 8.0	0.73	<0.1	1.6	0.1	0.0001	0.0016
	CP3	1.0 – 8.0	1.97	<0.1	1.8	0.2	0.0002	0.0036
	CP4	2.0 – 8.0	1.04	<0.1	1.4	0.1	0.0001	0.0014
	CP5	1.0 – 8.0	2.21	<0.1	1.9	<0.1	0.0001	0.0019

Green highlighted cells indicate CS-1 conditions.

Blue highlighted cells indicate a fully saturated response zone

6.8 Contamination

The Made Ground in places contained gravel of clinker, brick, and concrete. However, the soils inspected during the site investigation did not show any visual or olfactory indicators of gross contamination.

7.0 GEOENVIRONMENTAL ASSESSMENT

7.1 Human Health Risk Assessment

Although some minor areas of soft landscaping are proposed to the perimeter of the new warehouse, the majority of the source-pathway-receptor linkages to potential end users are effectively broken by the large percentage of proposed hard cover. Considering this and the context of the proposed development, there is considered to be a negligible risk to Human Health from potential contaminants in the ground.

A comparison of the chemical test results against generic screening criteria for a commercial/industrial end usage has however been undertaken as the site is to include occupied buildings. The results of the chemical testing on the soils have been assessed as described in Appendix E, based on a proposed commercial/ industrial end usage and assuming 2.5% SOM in the soil. The spreadsheets summarising the laboratory results relative screening values each dataset are presented in Appendix D. In respect of benzo(a)pyrene and other genotoxic PAHs, various PAH ratios have been plotted and compared against data from the Culp et al study and found to be within the same range, therefore the use of the surrogate marker approach is justified.

None of the chemical test results exceeded their corresponding screening criteria.

Measurable concentrations of heavier end hydrocarbon fractions ($C_{10} - C_{44}$) were detected across the site at total TPH concentrations of between 10mg/kg and 990mg/kg, which are probably related to the presence of PAHs, with the maximum TPH corresponding to the maximum PAH concentrations in the sample from DCS5 at 0.6m bgl. It is noted that the Made Ground in this location contains clinker, which probably accounts for the presence of TPH/PAH. All individual fractions were however below their corresponding screening criteria.

Total phenols, BTEX compounds, and MTBE were all recorded below the detection limits.

The asbestos screening tests recorded the presence of chrysotile asbestos in the shallow Made Ground in one of the seven samples. Quantification was conducted on the sample, reporting 0.001% (i.e., the limit of detection). This is considered to be

representative of background concentrations in an urban area and is therefore not considered to be a significant risk to Human Health.

7.2 Controlled Waters Risk Assessment

Leachate testing was carried out on three samples of Made Ground, from DCS1 at 0.2m, DCS3 at 0.5m, and CP4 at 1.0m bgl, recorded concentrations below their relevant screening values and/or less than detection limit. All PAHs recorded values less than the laboratory detection limit (i.e., <0.01µg/l). The spreadsheet summarising the laboratory results and relevant screening criteria of the dataset is presented in Appendix D.

Considering the fact that the proposed redevelopment will mostly comprise hardstanding (which will inhibit the downward leaching of contaminants) and the absence of a Principal Aquifer, there is generally considered to be a negligible risk to Controlled Waters.

7.3 Disposal of Soil Arisings

The results of chemical testing should be used to assist with the classification of the soils for disposal.

The natural soils at the site are likely to be classified as inert, provided they are appropriately segregated from the Made Ground, however, this should be confirmed by the landfill operator. WAC testing would likely be required in any excavated soil if sent to landfill as inert or hazardous waste. The results on the Made Ground encountered across the site generally indicates that the material would likely be classified as non-hazardous if sent for disposal at landfill.

General comments regarding the procedures for the assessment of waste soil for off-site disposal purposes is included in Appendix E.

8.0 GEOTECHNICAL ASSESSMENT

8.1 General

The proposals comprise the demolition of the existing Unit B and Unit G warehouse units and construction of a B2/B8 steel portal framed warehouse unit with ancillary B1 office space and associated areas of parking/loading bays, servicing areas, associated works/infrastructure and peripheral soft landscaping. Proposed column and floor slab loadings have not been provided at the time of writing. The following Sections should therefore be re-assessed once the loading information and performance criteria of the floor slab and external areas are known.

The ground investigation has identified Made Ground to depths of between 0.2m and 1.4m bgl, overlying interbedded granular and cohesive Glaciofluvial Ice Contact Deposits and cohesive Glacial Till. Resting groundwater levels of between 0.73m and 2.50m bgl were recorded within the investigated strata during subsequent monitoring visits.

8.2 Foundation Design

It is considered that neither the Made Ground nor the majority of the shallow Glaciofluvial Ice Contact Deposits at the site are suitable to support conventional strip/trench fill or pad foundations due to the soft and loose nature of the strata. As such, a deeper foundation solution is considered warranted.

A vibro replacement stone column foundation solution could be utilised across this area. Allowable bearing pressures of between 100kN/m² and 125kN/m² are typically achieved for strata improved by stone columns, however, it is recommended that a specialist contractor is consulted to assess the suitability of the soils to be treated and the achievable allowable bearing pressures. It should be noted that the shallow groundwater may affect the design and construction of vibro stone columns. The presence of soft clay (Made Ground) as identified in CP4 (although not under the building footprint) will need to be considered when designing vibro concrete columns due to the low lateral resistance provided by these soils.

Alternatively, a piled foundation solution may be considered, founding within the deeper stiff/medium dense Glacial Till/Glaciofluvial Ice Contact Deposits. An SPT 'N' value versus depth plot is included in Appendix A and should be referred to along with the borehole logs when designing piles. However, attention is drawn to the ground conditions encountered in CP2 and CP5, where lower N values were recorded in the Glaciofluvial Ice Contact Deposits at c.7.5m bgl.

The advice of specialist and experienced piling contractors should be sought in relation to suitable piling techniques and designs for ground conditions at the site. An appropriate number of pile tests should be carried out in order to confirm the load capacities and help economical and detailed pile design.

It should be noted that unless driven piles were used, casing of the Made Ground and Glaciofluvial Ice Contact Deposits would likely be required.

8.3 Floor Slab and Gas Protection

It may be feasible to remove the upper layers of the Made Ground and re-engineer the soils to accommodate a lightly loaded floor slab. If the Made Ground soils are to be re-engineered, the sub-formation should be proof rolled and any soft spots removed and replaced with suitable granular fill.

Where a more heavily loaded floor slab is proposed or lower settlements are permissible, it is recommended that vibro ground improvement is extended to also cover the area of the floor slab.

The absence of deep Made Ground on the site and the gas concentrations measured indicate the lack of an identified source of ground gas. Therefore, there is considered to be a negligible risk from ground gas and, subject to approval by the Local Authority, it is considered that the site can be characterised as Situation 1 (CIRIA C665) for which no gas protection measures are considered necessary.

8.4 Excavations

Excavations up to c.1.5m deep are envisaged for the foundation excavations (on vibro-improved strata or for pile caps, if utilised) and service trenches. At this depth

excavations are expected to be in a combination of cohesive and granular Made Ground and granular Glaciofluvial Ice Contact Deposits. These materials may be prone to short-term instability and spalling and may need to be graded back to a stable angle or trench support should be provided. Trench support or the angle of batter should be designed by an appropriately qualified engineer or competent person to suit the required depth and the ground and groundwater conditions.

Groundwater ingress can be expected potentially from c.0.8m bgl. It is therefore recommended that some provision for obtaining sump pumping equipment is made in order to control any groundwater ingress and possible run off in wet weather conditions.

8.5 Pavement Design

Based on a review laboratory testing carried out, soil type and estimated construction conditions, a long-term (equilibrium) CBR value of 5% is recommended for the granular glacial strata. Due to the inherent variability of the Made Ground, an equilibrium CBR value of <2% is recommended for this stratum.

The Made Ground and Glaciofluvial Ice Contact Deposits are considered frost susceptible due to their high content of fines and should not be present within 450mm of the pavement construction surface.

8.6 Soakaways

Based on the field descriptions and PSD results (i.e., the low content of fines in some areas) and groundwater levels in some parts of the site, the near surface natural strata at the site could be considered as suitable for the use of conventional soakaway drainage. The results of the variable head permeability tests undertaken in CP1 and CP5 indicate a permeability between 1.0^{-6} and 7.0^{-7} m/s. It should however be noted that the permeability testing was undertaken over a range of soil types and depths, including granular strata of the Glaciofluvial Ice Contact Deposits and cohesive Glacial Till. Should infiltration rates be required for design purposes, it is recommended that soakaway testing in full accordance with BRE DG365 is undertaken at specific positions and depths related to proposed soakaway locations. Soakaway design should take account of groundwater levels, which are indicated to be shallow in places.

8.7 Buried Concrete and Services

The results of the testing in the Made Ground soils on site indicate characteristic values as following:

- water soluble sulphate: 0.083g/l;
- total potential sulphate: 0.23%; and
- pH: 6.5.

The results of the testing in the natural glacial soils on site indicate characteristic values as following:

- water soluble sulphate: 0.016g/l;
- total potential sulphate: 0.03%; and
- pH: 5.6.

The results of the sulphate tests carried out have identified the Design Sulphate Class to be DS-1 with the Aggressive Chemical Environment for Concrete (ACEC) being AC-1 as defined by the BRE Special Digest 1, Concrete Aggressive Ground, 2005 for a brownfield site and mobile groundwater regime. Further reference should be made to BRE Special Digest 1 for requirements in respect of types of cement and aggregate to be used and variations in type of concrete construction.

Petroleum hydrocarbon fractions (C₁₀ to C₄₄) were detected in the samples of the Made Ground between concentrations of between 10mg/kg and 990mg/kg total TPH, although as discussed in Section 7.1 is likely attributed to the presence of PAHs and clinker in the Made Ground. No BTEX, MTBEs, phenols, or 'light end' (less than C₁₀) petroleum hydrocarbons were detected. This suggests that restrictions on buried water supply pipe materials are unlikely. However, the chosen pipeline materials should be discussed and agreed with the local Water Authority once water supply pipe routes are known.

9.0 CONCLUSIONS AND RECOMMENDATIONS

9.1 Geo-environmental

The risk assessments in Section 7 have established a low risk to Human Health and negligible risk to Controlled Water receptors. The majority of the source-pathway-receptor linkages to potential end users are effectively broken by the hardstanding cover and lack of landscaping across the site. The highest concentrations of PAHs and TPH in the shallow Made Ground are likely due to the presence of clinker in the Made Ground.

It is therefore considered that further assessment or remedial actions are not warranted for this redevelopment.

This report should be submitted to the Local Authority to support Planning Application Ref: 21-01489/FUL and assist with the discharge of relevant Planning Conditions, if imposed.

The chemical test results should be provided to the local water authority via a pipeline risk assessment for the selection of suitable water pipe materials.

9.2 Geotechnical

Based upon the ground conditions encountered at the site, ground improvement or a deeper foundation solution is likely to be required. Possible foundation solutions include ground improvement using vibro replacement columns and piles founded in the underlying competent glacial soils.

If ground bearing floor slabs are required, the Made Ground could either be removed and re-engineered or ground improvement, utilising such as vibro stone columns, could be undertaken. No gas protection measures are considered necessary.

DS-1 and AC-1 conditions are considered appropriate for buried concrete at the site.

Soakaways in shallow granular soils are potentially feasible subject to further assessment and confirmation of groundwater levels. Soakaway tests in accordance

with BRE 365 should be undertaken at specific locations if soakaways drainage is required.

Once column and floor slab loadings and performance criteria of the floor slab/external areas are known, re-assessment of the foundation and floor slab options should be undertaken.

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GENERAL NOTES

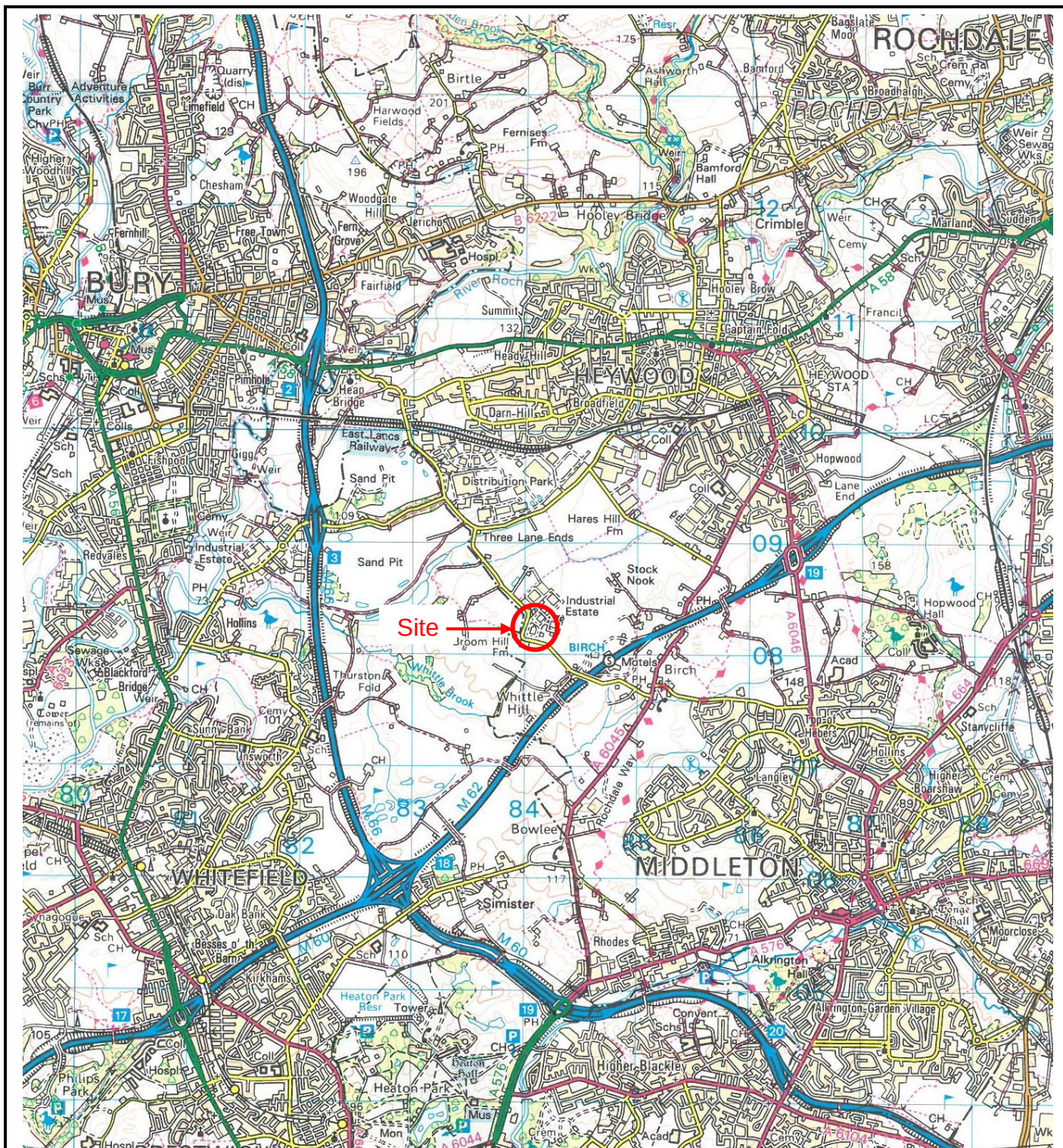
- A) The assessment made in this report is based on the site terrain and ground conditions revealed by the various field investigations undertaken and also any other relevant data for the site including previous site investigation reports (if available) and desk study data. There may be special conditions appertaining to the site, however, which have not been revealed by the investigation and which have not, therefore, been taken into account in the report. The assessment may be subject to amendment in the light of additional information becoming available. It must be recognised that many of the Environmental Searches obtained during the course of the desk study are often lengthy. Applied Geology have, where appropriate and in the interests of simplicity, only reproduced the summary of the searches within the report. A full copy of all the search data is held at the Applied Geology office and is available for inspection if required.
- B) The services provided are defined within our proposal and are carried out in line with the terms of appointment between Applied Geology and the Client.
- C) Where any data supplied by the Client or other external source, including that from previous site investigations, has been used it has been assumed that the information is correct. No responsibility can be accepted by Applied Geology for inaccuracies within this data.
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- E) Comments on groundwater (and landfill gas) conditions are based on observations made during the course of the present and past investigations or with reference to published data unless otherwise stated. It should be noted, however, that groundwater (and landfill gas) levels vary due to seasonal (or atmospheric conditions) or other effects.
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- I) Ground conditions should be monitored during the construction of the works and the recommendations of the report re-evaluated in the light of this data by the supervising geotechnical or geo-environmental engineers.
- J) Unless specifically stated, the investigation has not taken into account the possible effects of mineral extraction.
- K) The works performed are not a comprehensive site characterisation and should not be construed as being such.
- L) The findings of the geo-environmental risk assessment are based on information obtained from a variety of sources which Applied Geology believe to be correct. Applied Geology cannot and does not guarantee the authenticity or reliability of the information it has relied upon.
- M) The report represents the findings and opinions of experienced geo-environmental consultants. Applied Geology does not provide legal advice and the advice of lawyers may be required.
- N) Conditions at the site are subject to change from the time of the site inspection.
- O) It is possible that researches carried out by Applied Geology, whilst fully appropriate for a phase 1 desk study, failed to indicate the existence of important information sources. Assuming such indicators actually exist, their information could not have been considered in the formulation of Applied Geology findings and opinions.
- P) The economic viability of the proposals referred to in the report, or of the solutions put forward to any problems encountered, depends on very many factors in addition to geotechnical considerations and hence its evaluation is outside the scope of this report.
- Q) Applied Geology operates as a Consultancy and does not operate its own laboratory for soil testing, this work being sub contracted to known and respected, generally UKAS accredited, laboratories. Applied Geology can therefore not be held responsible for the testing carried out.

LIST OF REFERENCES COMMONLY USED BY APPLIED GEOLOGY IN REPORTS

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DCLG:2012 National Planning Policy Framework and Practice Guidance	Department for Communities and Local Government
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Construction (Design & Management) Regulations 2015 (CDM)	Health & Safety Executive
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APPENDIX A



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Project:

UNIT B, BIRCH BUSINESS PARK,
HEYWOOD

Drawn By:

JS

Checked By:

HH

Paper Size:

A4

Scale:

1:50,000

Date:

27.01.2022

NGR:

384098 408201

Title:

SITE LOCATION PLAN

Drawing No:

AG3353-21-01

Revision:

0



KEY: CP1 Cable Percussion Borehole DCS1 Driven Continuous Sampling Borehole		
Drawing based on Fletcher Rae Architects, drawing No:21033-SK01 Revision A, dated 07/08/2021.		
APPLIED GEOLOGY First Floor, Lowton Business Park Newton Road Lowton St. Mary's Warrington WA3 2AN Tel: 01925 738599 email:admin@appliedgeology.co.uk		
Client: YEARGATE LIMITED		
Project: UNIT B, BIRCH BUSINESS PARK, HEYWOOD		
Title: EXPLORATORY HOLE LOCATION PLAN		
Drawn By: JS	Checked By: HH	Paper Size: A3
Scale: 1:1000	Date: 27.01.2022	
Drawing No: AG3353-21-02	Revision: 0	



General Notes

All site dimensions shall be verified by the Contractor on site prior to commencing any works.

Do not scale from this drawing.

Only work to written dimensions.

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Planning Boundary
Site Area 6.11 Acres (24,726 sqm)

Business Park Boundary

Revision	P03	Proposed FFL raised from 131.40m to 132.40m	29.09.21	JB
	P02	Landscape proposal underlaid	13.09.21	JB
	P01	Issued for Planning	01.09.21	JB

Scale 1:500@A2
Status PLANNING
Drawn by JB
Date 27.08.21
Client
Yeargate Ltd

Project
Birch Business Park - Unit B

Drawing Description
Proposed Site Plan

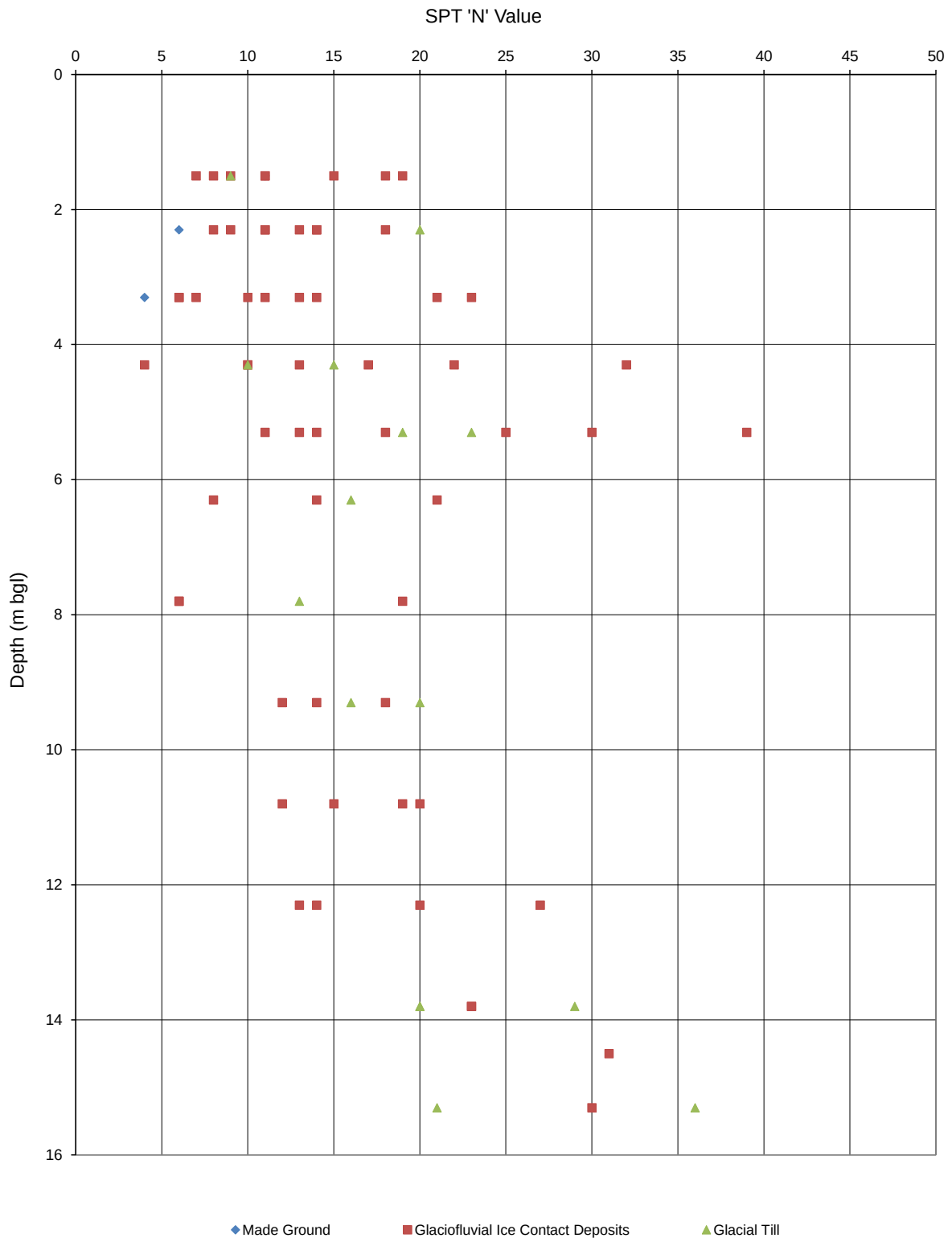
Drawing No. 21033_PL03 Rev. P03

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Uncorrected SPT 'N' Value versus depth



Notes: 1. Uncorrected N values plotted

Client:	Yeargate Ltd	APPLIED GEOLOGY
Project:	Unit B, Birch Business Park, Heywood	
Project No.	AG3353-21	

APPENDIX B

BOREHOLE LOG - CABLE PERCUSSION

CP1

Project Unit B, Birch Business Park, Heywood

Project No.

AG3353-21

Client Yeargate Limited

Sheet

1 of 2

Start 14/01/2022

Coordinates E 384038.58 N 408233.90

Scale

1:50

End 14/01/2022

Ground Level 131.72m AOD

Total Depth

15.45m

Sample / Test Type	Depth (m)	Result	Casing Depth (m)	Level (mAoD)	Strata Depth (thickness) (m)	Description of Strata	Legend	GW	Install
B	0.20			131.52	(0.20)	Dark brown clayey SAND with frequent rootlets.			
ES	0.50				0.20	(TOPSOIL)			
					(0.80)	Dark grey SAND. (GLACIOFLUVIAL ICE CONTACT DEPOSITS)			
				130.72	1.00				
B	1.20					Medium dense orange-brown SAND. (GLACIOFLUVIAL ICE CONTACT DEPOSITS)			
D	1.20								
S	1.20	N = 15	1.20						
ES	1.50								
B	2.00								
D	2.00								
S	2.00	N = 14	1.50		(2.60)				
B	3.00								
D	3.00								
S	3.00	N = 14	3.00						
				128.12	3.60				
						Stiff brown slightly gravelly sandy CLAY. Gravel is fine to coarse subangular to subrounded sandstone, mudstone and siltstone. (GLACIAL TILL)			
B	4.00								
D	4.00								
S	4.00	N = 15	4.00						
B	5.00								
D	5.00								
UT	5.00	(73)							
D	5.50								
B	6.00								
D	6.00								
S	6.00	N = 16	6.00						
B	7.00								
UT	7.50	(71)							
D	8.00				(8.50)				
D	8.50								
B	9.00								
D	9.00								
S	9.00	N = 20	9.00						
D	10.00								

Continued next sheet

Chiselling			Groundwater Strikes					Drilled: Lundy Site Investigation Logged: HH Checked: PG
From	To	Duration (hh:mm)	Depth Strike	Rose to	Remarks	Cased	Sealed	
			3.60	3.00		3.00	3.80	

Remarks: Hand dug service inspection pit excavated to 1.20m bgl.

Installation: 50mm diameter standpipe installed to 8.00m bgl.

Diameter: 150mm to 15.45m

Exploratory hole logs should be read in conjunction with key sheets

APPLIED GEOLOGY

BOREHOLE LOG - CABLE PERCUSSION

CP1

Project Unit B, Birch Business Park, Heywood

Project No.

AG3353-21

Client Yeargate Limited

Sheet

2 of 2

Start 14/01/2022

Coordinates E 384038.58 N 408233.90

Scale

1:50

End 14/01/2022

Ground Level 131.72m AOD

Total Depth

15.45m

Sample / Test Type	Depth (m)	Result	Casing Depth (m)	Level (mAoD)	Strata Depth (thickness) (m)	Description of Strata	Legend	GW	Install
UT	10.50	(81)				Stiff brown slightly gravelly sandy CLAY. Gravel is fine to coarse subangular to subrounded sandstone, mudstone and siltstone. (GLACIAL TILL)			
D	11.00								
D	11.50								
D	12.00								
S	12.00	N = 13	12.00	119.62	12.10 (0.30)	Medium dense brown fine to coarse subangular to subrounded GRAVEL of sandstone and quartzite. (GLACIOFLUVIAL ICE CONTACT DEPOSITS)			
				119.32	12.40	Very stiff brown slightly gravelly sandy CLAY. Gravel is fine to coarse subangular to subrounded sandstone and mudstone. (GLACIAL TILL)			
D	13.00								
B	13.50								
D	13.50								
S	13.50	N = 29	13.50		(3.05)				
B	14.50								
D	15.00								
S	15.00	N = 36	13.50						
				116.27	15.45	End of Borehole at 15.45m			

Chiselling			Groundwater Strikes					Drilled: Lundy Site Investigation Logged: HH Checked: PG
From	To	Duration (hh:mm)	Depth Strike	Rose to	Remarks	Cased	Sealed	
			3.60	3.00		3.00	3.80	

Remarks: Hand dug service inspection pit excavated to 1.20m bgl.

Installation: 50mm diameter standpipe installed to 8.00m bgl.

Diameter: 150mm to 15.45m

Exploratory hole logs should be read in conjunction with key sheets

APPLIED GEOLOGY

BOREHOLE LOG - CABLE PERCUSSION

CP2

Project Unit B, Birch Business Park, Heywood

Project No.

AG3353-21

Client Yeagate Limited

Sheet

1 of 2

Start 17/01/2022

Coordinates E 384026.76 N 408180.14

Scale

1:50

End 17/01/2022

Ground Level 132.27m AOD

Total Depth

15.45m

Sample / Test Type	Depth (m)	Result	Casing Depth (m)	Level (mAoD)	Strata Depth (thickness) (m)	Description of Strata	Legend	GW	Install
D	0.00			132.07	(0.20)	Dark brown clayey SAND with frequent rootlets.			
ES	0.50				0.20	(TOPSOIL)			
ES	1.00			131.17	(0.90)	Dark brown slightly clayey SAND. (GLACIOFLUVIAL ICE CONTACT DEPOSITS)			
B	1.20				1.10				
D	1.20								
S	1.20	N = 9	1.20			Loose to medium dense orange-brown slightly gravelly silty SAND. Gravel is fine to coarse subangular to subrounded sandstone and siltstone. (GLACIOFLUVIAL ICE CONTACT DEPOSITS)			
B	2.00								
D	2.00								
S	2.00	N = 11	1.50						
B	3.00								
D	3.00								
S	3.00	N = 7	3.00						
B	4.00								
D	4.00								
S	4.00	N = 10	4.00						
B	5.00								
D	5.00								
S	5.00	N = 14	4.50						
D	6.00								
S	6.00	N = 14	5.20			Below 6.00m bgl: frequent coal flecks.			
D	7.00								
B	7.50								
D	7.50								
S	7.50	N = 6	7.50						
D	8.50				(14.35)				
D	9.00								
S	9.00	N = 14	9.00			Below 9.00m bgl: medium dense.			
D	10.00								

Continued next sheet

Chiselling			Groundwater Strikes					Drilled: Lundy Site Investigation Logged: HH Checked: PG
From	To	Duration (hh:mm)	Depth Strike	Rose to	Remarks	Cased	Sealed	
			7.30	6.00		7.00		

Remarks: Hand dug service inspection pit excavated to 1.20m bgl. Borehole backfilled with arisings on completion.

Installation:

Diameter: 150mm to 15.45m

Exploratory hole logs should be read in conjunction with key sheets

APPLIED GEOLOGY

BOREHOLE LOG - CABLE PERCUSSION

CP2

Project Unit B, Birch Business Park, Heywood

Project No.

AG3353-21

Client Yeagate Limited

Sheet

2 of 2

Start 17/01/2022

Coordinates E 384026.76 N 408180.14

Scale

1:50

End 17/01/2022

Ground Level 132.27m AOD

Total Depth

15.45m

Sample / Test Type	Depth (m)	Result	Casing Depth (m)	Level (mAoD)	Strata Depth (thickness) (m)	Description of Strata	Legend	GW	Install
B D S	10.50 10.50 10.50	N = 15	10.50			Loose to medium dense orange-brown slightly gravelly silty SAND. Gravel is fine to coarse subangular to subrounded sandstone and siltstone. (GLACIOFLUVIAL ICE CONTACT DEPOSITS)			
D	11.50								
B D S	12.00 12.00 12.00	N = 14	12.00						
D	13.00								
B D S	13.50 13.50 13.50	N = 23	13.50						
D	14.50								
D S	15.00 15.00	N = 30	13.50			Below 15.00m bgl: dense			
				116.82	15.45	End of Borehole at 15.45m			

Chiselling			Groundwater Strikes					Drilled: Lundy Site Investigation Logged: HH Checked: PG
From	To	Duration (hh:mm)	Depth Strike	Rose to	Remarks	Cased	Sealed	
			7.30	6.00		7.00		

Remarks: Hand dug service inspection pit excavated to 1.20m bgl. Borehole backfilled with arisings on completion.

Installation:

Diameter: 150mm to 15.45m

Exploratory hole logs should be read in conjunction with key sheets

APPLIED GEOLOGY

BOREHOLE LOG - CABLE PERCUSSION

CP3

Project Unit B, Birch Business Park, Heywood

Project No.

AG3353-21

Client Yeargate Limited

Sheet

1 of 2

Start 11/01/2022

Coordinates E 384101.04 N 408173.16

Scale

1:50

End 11/01/2022

Ground Level 132.09m AOD

Total Depth

14.65m

Sample / Test Type	Depth (m)	Result	Casing Depth (m)	Level (mAoD)	Strata Depth (thickness) (m)	Description of Strata	Legend	GW	Install
ES	0.50			131.99	(0.10)	Asphalt.			
				131.79	0.10	(MADE GROUND)			
					(0.20)	CONCRETE.			
					0.30	(MADE GROUND)			
ES	1.00					Loose orange brown slightly gravelly clayey SAND with rare clay bands. Gravel is fine to medium subangular to subrounded sandstone and quartzite.			
D	1.20					(GLACIOFLUVIAL ICE CONTACT DEPOSITS)			
S	1.20	N = 8	1.00						
D	2.00								
S	2.00	N = 8	1.50		(3.70)				
D	3.00					From 3.00m bgl: medium dense.			
S	3.00	N = 13	3.00						
D	4.00			128.09	4.00	Medium dense brown silty SAND.			
S	4.00	N = 22	4.00			(GLACIOFLUVIAL ICE CONTACT DEPOSITS)			
D	5.00								
S	5.00	N = 25	4.50						
D	6.00								
S	6.00	N = 21	6.00						
B	7.00								
D	7.00								
S	7.50	N = 19	7.50						
B	8.50								
D	8.50								
S	9.00	N = 18	9.00						
					(10.65)				
B	10.00					Continued next sheet			

Chiselling			Groundwater Strikes					Drilled: Lundy Site Investigation Logged: HH Checked: PG
From	To	Duration (hh:mm)	Depth Strike	Rose to	Remarks	Cased	Sealed	
			7.20	4.20		7.00		

Remarks: Hand dug service inspection pit excavated to 1.20m bgl.

Installation: 50mm diameter standpipe installed to 8.00m bgl.

Diameter: 150mm to 14.20m

Exploratory hole logs should be read in conjunction with key sheets

APPLIED GEOLOGY

CP3

AG3353-21

2 of 2

1:50

14.65m

Chiselling			Groundwater Strikes					Drilled: Lundy Site Investigation Logged: HH Checked: PG
From	To	Duration (hh:mm)	Depth Strike	Rose to	Remarks	Cased	Sealed	
			7.20	4.20		7.00		

Diameter: 150mm to 14.20m

APPLIED GEOLOGY

BOREHOLE LOG - CABLE PERCUSSION

CP4

Project Unit B, Birch Business Park, Heywood

Project No.

AG3353-21

Client Yeagate Limited

Sheet

1 of 2

Start 11/01/2022

Coordinates E 384139.66 N 408146.60

Scale

1:50

End 11/01/2022

Ground Level 131.22m AOD

Total Depth

15.45m

Sample / Test Type	Depth (m)	Result	Casing Depth (m)	Level (mAoD)	Strata Depth (thickness) (m)	Description of Strata	Legend	GW	Install
D	0.25			131.06	(0.15)	CONCRETE with rebar.			
ES	0.40				0.15	(MADE GROUND)			
					(0.75)	Soft brown slightly gravelly sandy CLAY. Gravel is fine to coarse subangular to subrounded brick, sandstone and limestone.			
						(MADE GROUND)			
D	0.90			130.32	0.90	Dark grey slightly clayey sandy fine to coarse angular to subangular			
ES	1.00				(0.50)	GRAVEL. Gravel is brick, sandstone and limestone.			
S	1.20	N = 11				(MADE GROUND)			
B	1.40			129.82	1.40	Firm becoming soft brown slightly gravelly sandy CLAY. Gravel is fine to coarse subangular to subrounded sandstone and rare brick.			
ES	1.50					(MADE GROUND)			
B	2.00								
D	2.00								
S	2.00	N = 6	1.70		(2.20)				
B	3.00								
D	3.00								
S	3.00	N = 4	3.00						
				127.62	3.60	Firm brown slightly gravelly sandy CLAY. Gravel is fine to coarse subangular to subrounded sandstone, mudstone and siltstone.			
						(GLACIAL TILL)			
UT	4.00	(27)							
D	4.50								
B	5.00								
D	5.00								
S	5.00	N = 19	4.50			From 5.00m bgl: stiff.			
B	6.00								
UT	6.00	(29)							
					(6.40)				
D	7.00								
B	7.50								
D	7.50								
S	7.50	N = 13	7.50						
D	8.50								
B	9.00								
S	9.00	N = 16	9.00						
				121.22	10.00	Continued next sheet			

Chiselling			Groundwater Strikes					Drilled: Lundy Site Investigation Logged: HH Checked: PG
From	To	Duration (hh:mm)	Depth Strike	Rose to	Remarks	Cased	Sealed	
			3.50 8.70	1.00 6.30		3.00 8.50	6.00	

Remarks: Hand dug service inspection pit excavated to 1.20m bgl. Borehole backfilled with arisings on completion.

Installation: 50mm diameter standpipe installed to 8.00m bgl.

Diameter: 150mm to 9.45m

Exploratory hole logs should be read in conjunction with key sheets

APPLIED GEOLOGY

BOREHOLE LOG - CABLE PERCUSSION

CP4

Project Unit B, Birch Business Park, Heywood

Project No.

AG3353-21

Client Yeargate Limited

Sheet

2 of 2

Start 11/01/2022

Coordinates E 384139.66 N 408146.60

Scale

1:50

End 11/01/2022

Ground Level 131.22m AOD

Total Depth

15.45m

Sample / Test Type	Depth (m)	Result	Casing Depth (m)	Level (mAoD)	Strata Depth (thickness) (m)	Description of Strata	Legend	GW	Install
D C	10.50	N = 12	10.40	120.72	(0.50)	Sandy CLAY. (Driller's Description). (GLACIOFLUVIAL ICE CONTACT DEPOSITS)			
	10.50			120.42	10.50 (0.30) 10.80	Medium dense brown sandy fine to coarse subangular to subrounded GRAVEL of mudstone, siltstone and sandstone. (GLACIOFLUVIAL ICE CONTACT DEPOSITS) Stiff brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse subangular to subrounded sandstone, mudstone and siltstone. (GLACIAL TILL)			
UT	12.00	(14)							
D	12.45								
					(4.65)				
B S	13.50 13.50	N = 20	13.30						
S	15.00	N = 21	14.90						
				115.76	15.45	End of Borehole at 15.45m			

Chiselling			Groundwater Strikes					Drilled: Lundy Site Investigation Logged: HH Checked: PG
From	To	Duration (hh:mm)	Depth Strike	Rose to	Remarks	Cased	Sealed	
			3.50 8.70	1.00 6.30		3.00 8.50	6.00	

Remarks: Hand dug service inspection pit excavated to 1.20m bgl. Borehole backfilled with arisings on completion.

Installation: 50mm diameter standpipe installed to 8.00m bgl.

Diameter: 150mm to 9.45m

Exploratory hole logs should be read in conjunction with key sheets

APPLIED GEOLOGY

BOREHOLE LOG - CABLE PERCUSSION

CP5

Project Unit B, Birch Business Park, Heywood

Project No.

AG3353-21

Client Yeagate Limited

Sheet

1 of 2

Start 14/01/2022

Coordinates E 384140.83 N 408198.32

Scale

1:50

End 14/01/2022

Ground Level 131.88m AOD

Total Depth

15.00m

Sample / Test Type	Depth (m)	Result	Casing Depth (m)	Level (mAoD)	Strata Depth (thickness) (m)	Description of Strata	Legend	GW	Install
B	0.00					Dark brown clayey SAND with frequent rootlets.			
ES	0.25			131.48	(0.40)	(TOPSOIL)			
B	0.50				0.40				
ES	0.70					Medium dense orange-brown slightly gravelly very clayey SAND. Gravel is fine to coarse subangular to subrounded sandstone and quartzite. (GLACIOFLUVIAL ICE CONTACT DEPOSITS)			
B	1.20				(1.90)				
D	1.20								
S	1.20	N = 18	1.20						
B	2.00								
D	2.00								
S	2.00	N = 20	1.50	129.58	2.30	Stiff brown slightly gravelly sandy CLAY. Gravel is subangular to subrounded, fine to coarse sandstone and mudstone.			
					(0.60)				
B	2.80					(GLACIAL TILL)			
B	3.00			128.98	2.90	Medium dense orange-brown slightly gravelly very clayey SAND. Gravel is fine to coarse subangular to subrounded sandstone and quartzite. (GLACIOFLUVIAL ICE CONTACT DEPOSITS)			
D	3.00								
S	3.00	N = 21	3.00						
B	4.00								
D	4.00								
S	4.00	N = 17	4.00						
B	5.00								
D	5.00								
S	5.00	N = 18	4.50						
B	6.00					From 6.00m bgl: loose.			
D	6.00								
S	6.00	N = 8	6.00						
D	7.00								
B	7.50								
D	7.50								
S	7.50	N = 6	7.50		(9.90)				
D	8.50								
B	9.00					From 9.00m bgl: medium dense.			
D	9.00								
S	9.00	N = 12	9.00						
D	10.00					Continued next sheet			

Chiselling			Groundwater Strikes					Drilled: Lundy Site Investigation Logged: HH Checked: PG
From	To	Duration (hh:mm)	Depth Strike	Rose to	Remarks	Cased	Sealed	
			5.50	3.00		4.50		

Remarks: Hand dug service inspection pit excavated to 1.20m bgl.

Installation: 50mm diameter standpipe installed to 8.00m bgl.

Diameter: 150mm to 15.00m

Exploratory hole logs should be read in conjunction with key sheets

APPLIED GEOLOGY

BOREHOLE LOG - CABLE PERCUSSION

CP5

Project Unit B, Birch Business Park, Heywood

Project No.

AG3353-21

Client Yeagate Limited

Sheet

2 of 2

Start 14/01/2022

Coordinates E 384140.83 N 408198.32

Scale

1:50

End 14/01/2022

Ground Level 131.88m AOD

Total Depth

15.00m

Sample / Test Type	Depth (m)	Result	Casing Depth (m)	Level (mAoD)	Strata Depth (thickness) (m)	Description of Strata	Legend	GW	Install
B D S D	10.50 10.50 10.50 11.00	N = 20	10.50			Medium dense orange-brown slightly gravelly very clayey SAND. Gravel is fine to coarse subangular to subrounded sandstone and quartzite. (GLACIOFLUVIAL ICE CONTACT DEPOSITS)			
B D S	12.00 12.00 12.00	N = 20	12.00						
D	13.00			119.08	12.80	Stiff brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse subangular to subrounded sandstone, siltstone and mudstone. (GLACIAL TILL)			
B D S	13.50 13.50 13.50	N = 20			(2.20)				
UT	14.50	(100)							
D	15.00			116.88	15.00	End of Borehole at 15.00m			

Chiselling			Groundwater Strikes					Drilled: Lundy Site Investigation Logged: HH Checked: PG
From	To	Duration (hh:mm)	Depth Strike	Rose to	Remarks	Cased	Sealed	
			5.50	3.00		4.50		

Remarks: Hand dug service inspection pit excavated to 1.20m bgl.

Installation: 50mm diameter standpipe installed to 8.00m bgl.

Diameter: 150mm to 15.00m

Exploratory hole logs should be read in conjunction with key sheets

APPLIED GEOLOGY

SPT SUMMARY SHEET

Project: Unit B, Birch Business Park, Heywood
Client: Yeagate Limited
Project No: AG3353-21

Borehole No.	Borehole depth (m)	Bottom depth (m)	Casing depth (m)	Water Level (m)	Equipment ref.	Seating Drive		Test Drive					Test Type	N Value
						Blows	Pen (mm)	Blows			Pen (mm)			
CP1	1.20	1.65	1.20	Dry	AR3822	2 2	75 75	3 3 4 5	75 75 75 75	300	S	15		
CP1	2.00	2.45	1.50	Dry	AR3822	2 1	75 75	2 3 4 5	75 75 75 75	300	S	14		
CP1	3.00	3.45	3.00	Dry	AR3822	1 1	75 75	2 2 4 6	75 75 75 75	300	S	14		
CP1	4.00	4.45	4.00	Dry	AR3822	2 2	75 75	3 3 4 5	75 75 75 75	300	S	15		
CP1	6.00	6.45	6.00	Dry	AR3822	2 2	75 75	3 3 4 6	75 75 75 75	300	S	16		
CP1	9.00	9.45	9.00	Dry	AR3822	2 2	75 75	3 4 6 7	75 75 75 75	300	S	20		
CP1	12.00	12.45	12.00	Dry	AR3822	2 1	75 75	1 2 4 6	75 75 75 75	300	S	13		
CP1	13.50	13.95	13.50	Dry	AR3822	3 4	75 75	6 6 8 9	75 75 75 75	300	S	29		
CP1	15.00	15.45	13.50	Dry	AR3822	3 5	75 75	9 9 9 9	75 75 75 75	300	S	36		
CP2	1.20	1.65	1.20	1.00	AR3822	1 2	75 75	1 2 3 3	75 75 75 75	300	S	9		
CP2	2.00	2.45	1.50	1.50	AR3822	1 1	75 75	2 2 3 4	75 75 75 75	300	S	11		
CP2	3.00	3.45	3.00	2.70	AR3822	1 1	75 75	1 2 2 2	75 75 75 75	300	S	7		
CP2	4.00	4.45	4.00	3.50	AR3822	1 2	75 75	1 2 2 5	75 75 75 75	300	S	10		
CP2	5.00	5.45	4.50	4.50	AR3822	2 2	75 75	2 3 4 5	75 75 75 75	300	S	14		
CP2	6.00	6.45	5.20	6.00	AR3822	2 1	75 75	2 3 4 5	75 75 75 75	300	S	14		
CP2	7.50	7.95	7.50	6.00	AR3822	2 1	75 75	1 1 1 3	75 75 75 75	300	S	6		
CP2	9.00	9.45	9.00	6.10	AR3822	2 2	75 75	2 3 4 5	75 75 75 75	300	S	14		
CP2	10.50	10.95	10.50	6.40	AR3822	2 1	75 75	2 2 5 6	75 75 75 75	300	S	15		
CP2	12.00	12.45	12.00	6.90	AR3822	1 1	75 75	2 3 4 5	75 75 75 75	300	S	14		
CP2	13.50	13.95	13.50	7.00	AR3822	2 4	75 75	5 5 6 7	75 75 75 75	300	S	23		
CP2	15.00	15.45	13.50		AR3822	3 4	75 75	6 6 8 10	75 75 75 75	300	S	30		
CP3	1.20	1.65	1.00	Dry	AR3822	1 2	75 75	2 2 2 2	75 75 75 75	300	S	8		
CP3	2.00	2.45	1.50	Dry	AR3822	0 1	75 75	1 2 2 3	75 75 75 75	300	S	8		
CP3	3.00	3.45	3.00	Dry	AR3822	2 2	75 75	3 3 3 4	75 75 75 75	300	S	13		
CP3	4.00	4.45	4.00	Dry	AR3822	22 2	75 75	5 5 6 6	75 75 75 75	300	S	22		
CP3	5.00	5.45	4.50	Dry	AR3822	1 2	75 75	6 6 6 7	75 75 75 75	300	S	25		
CP3	6.00	6.45	6.00	Dry	AR3822	2 2	75 75	4 5 6 6	75 75 75 75	300	S	21		
CP3	7.50	7.95	7.50	4.20	AR3822	1 2	75 75	3 4 6 6	75 75 75 75	300	S	19		
CP3	9.00	9.45	9.00	4.60	AR3822	2 2	75 75	3 3 4 8	75 75 75 75	300	S	18		
CP3	10.50	10.95	10.50	5.90	AR3822	1 2	75 75	4 4 4 7	75 75 75 75	300	S	19		
CP3	12.00	12.45	12.00	5.10	AR3822	1 2	75 75	4 5 8 10	75 75 75 75	300	S	27		
CP3	13.50	13.95	13.50	6.20	AR3822	2 3	75 75	4 4 7 8	75 75 75 75	300	S	23		
CP3	14.20	14.65	13.50	7.90	AR3822	2 4	75 75	7 7 8 9	75 75 75 75	300	S	31		
CP4	1.20	1.65			AR3822	4 16	75 75	2 2 3 4	75 75 75 75	300	S	11		

- Notes:
- 1. Test carried out in general accordance with BS EN ISO 22476-3:2005
 - 2. N values have not been subjected to any correction.
 - 3. Test carried out using split spoon S, or solid cone C.

SPT SUMMARY SHEET

Project: Unit B, Birch Business Park, Heywood
Client: Yeagate Limited
Project No: AG3353-21

Borehole No.	Borehole depth (m)	Bottom depth (m)	Casing depth (m)	Water Level (m)	Equipment ref.	Seating Drive		Test Drive					Test Type	N Value
						Blows	Pen (mm)	Blows		Pen (mm)		Total Pen (mm)		
CP4	2.00	2.45	1.70	Dry	AR3822	1 1	75 75	1 2 1 2	75 75 75 75	300	S	6		
CP4	3.00	3.45	3.00	Dry	AR3822	1 1	75 75	1 1 1 1	75 75 75 75	300	S	4		
CP4	5.00	5.45	4.50	3.90	AR3822	2 3	75 75	4 4 5 6	75 75 75 75	300	S	19		
CP4	7.50	7.95	7.50	Dry	AR3822	2 2	75 75	2 4 3 4	75 75 75 75	300	S	13		
CP4	9.00	9.45	9.00	6.30	AR3822	2 4	75 75	3 3 4 6	75 75 75 75	300	S	16		
CP4	10.50	10.95	10.40	5.00	AR3822	3 3	75 75	4 3 3 2	75 75 75 75	300	C	12		
CP4	13.50	13.95	13.30	Dry	AR3822	3 3	75 75	4 5 5 6	75 75 75 75	300	S	20		
CP4	15.00	15.45	14.90	Dry	AR3822	2 4	75 75	4 5 6 6	75 75 75 75	300	S	21		
CP5	1.20	1.65	1.20		AR3822	1 2	75 75	3 3 6 6	75 75 75 75	300	S	18		
CP5	2.00	2.45	1.50	1.60	AR3822	2 3	75 75	4 5 5 6	75 75 75 75	300	S	20		
CP5	3.00	3.45	3.00	2.10	AR3822	2 2	75 75	3 3 6 9	75 75 75 75	300	S	21		
CP5	4.00	4.45	4.00	2.60	AR3822	1 1	75 75	2 4 5 6	75 75 75 75	300	S	17		
CP5	5.00	5.45	4.50	4.10	AR3822	2 3	75 75	4 4 4 6	75 75 75 75	300	S	18		
CP5	6.00	6.45	6.00	3.20	AR3822	2 2	75 75	2 2 2 2	75 75 75 75	300	S	8		
CP5	7.50	7.95	7.50	3.20	AR3822	1 2	75 75	1 2 1 2	75 75 75 75	300	S	6		
CP5	9.00	9.45	9.00	3.90	AR3822	2 3	75 75	3 2 3 4	75 75 75 75	300	S	12		
CP5	10.50	10.95	10.50	4.60	AR3822	2 1	75 75	4 5 5 6	75 75 75 75	300	S	20		
CP5	12.00	12.45	12.00	6.20	AR3822	2 3	75 75	4 5 5 6	75 75 75 75	300	S	20		
CP5	13.50	13.95		Dry	AR3822	2 3	75 75	3 5 5 7	75 75 75 75	300	S	20		
DCS1	1.20	1.65			DART400	1 1	75 75	1 2 2 2	75 75 75 75	300	S	7		
DCS1	2.00	2.45			DART400	3 2	75 75	3 4 3 3	75 75 75 75	300	S	13		
DCS1	3.00	3.45			DART400	1 3	75 75	4 3 2 2	75 75 75 75	300	S	11		
DCS1	4.00	4.45			DART400	1 1	75 75	2 2 2 4	75 75 75 75	300	S	10		
DCS1	5.00	5.45			DART400	2 2	75 75	2 3 2 4	75 75 75 75	300	S	11		
DCS2	1.20	1.65			DART400	3 3	75 75	3 2 2 2	75 75 75 75	300	S	9		
DCS2	2.00	2.45			DART400	2 2	75 75	2 2 3 2	75 75 75 75	300	S	9		
DCS2	3.00	3.45			DART400	3 2	75 75	3 3 2 2	75 75 75 75	300	S	10		
DCS2	4.00	4.45			DART400	3 3	75 75	3 4 3 3	75 75 75 75	300	S	13		
DCS2	5.00	5.45			DART400	5 5	75 75	7 8 7 8	75 75 75 75	300	S	30		
DCS3	1.20	1.65			DART400	3 3	75 75	3 3 2 3	75 75 75 75	300	S	11		
DCS3	2.00	2.45			DART400	3 3	75 75	4 3 4 3	75 75 75 75	300	S	14		
DCS3	3.00	3.45			DART400	3 3	75 75	2 2 1 1	75 75 75 75	300	S	6		
DCS3	4.00	4.45			DART400	1 1	75 75	1 1 1 1	75 75 75 75	300	S	4		
DCS3	5.00	5.45			DART400	2 2	75 75	3 3 3 4	75 75 75 75	300	S	13		

- Notes:
- 1. Test carried out in general accordance with BS EN ISO 22476-3:2005
 - 2. N values have not been subjected to any correction.
 - 3. Test carried out using split spoon S, or solid cone C.

SPT SUMMARY SHEET

Project: Unit B, Birch Business Park, Heywood
Client: Yeagate Limited
Project No: AG3353-21

Borehole No.	Borehole depth (m)	Bottom depth (m)	Casing depth (m)	Water Level (m)	Equipment ref.	Seating Drive		Test Drive					Test Type	N Value
						Blows	Pen (mm)	Blows		Pen (mm)		Total Pen (mm)		
DCS4	1.20	1.65			DART400	4 4	75 75	5 5 4 5	75 75 75 75	300	S	19		
DCS4	2.00	2.45			DART400	4 4	75 75	4 4 5 5	75 75 75 75	300	S	18		
DCS4	3.00	3.45			DART400	4 4	75 75	6 5 5 7	75 75 75 75	300	S	23		
DCS4	4.00	4.45			DART400	4 6	75 75	7 7 9 9	75 75 75 75	300	S	32		
DCS4	5.00	5.45			DART400	8 9	75 75	10 9 10 10	75 75 75 75	300	S	39		
DCS5	1.20	1.65			DART400	2 2	75 75	3 2 3 3	75 75 75 75	300	S	11		
DCS5	2.00	2.45			DART400	3 2	75 75	3 2 3 3	75 75 75 75	300	S	11		
DCS5	3.00	3.45			DART400	1 1	75 75	1 1 2 2	75 75 75 75	300	S	6		
DCS5	4.00	4.45			DART400	2 2	75 75	2 2 3 3	75 75 75 75	300	S	10		
DCS5	5.00	5.45			DART400	3 3	75 75	4 6 6 7	75 75 75 75	300	S	23		

- Notes:
- 1. Test carried out in general accordance with BS EN ISO 22476-3:2005
 - 2. N values have not been subjected to any correction.
 - 3. Test carried out using split spoon S, or solid cone C.

SPT Hammer Energy Test Report

In accordance with BS EN ISO 22476-3:2005

ARCHWAY ENGINEERING (UK) LTD
AINLEYS INDUSTRIAL ESTATE
ELLAND
WEST YORKSHIRE
HX5 9JP

SPT Hammer Ref: AR3822
Test Date: 12/11/2021
Report Date: 12/11/2021
File Name: AR3822.spt
Test Operator: CM

Instrumented Rod Data

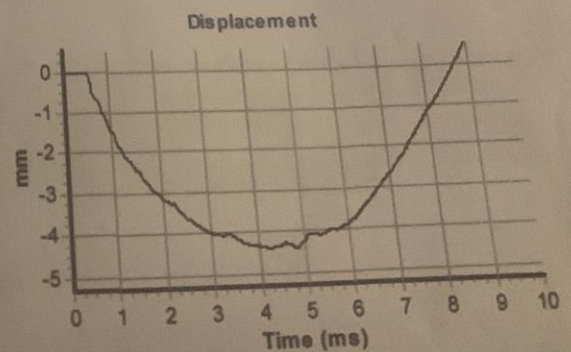
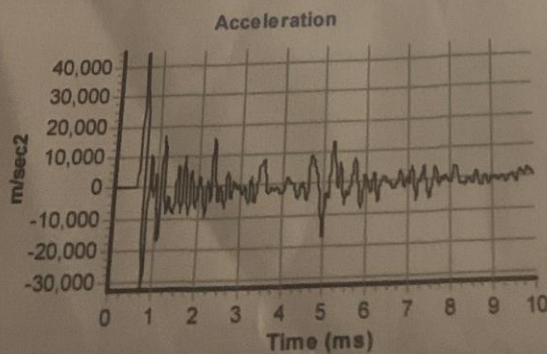
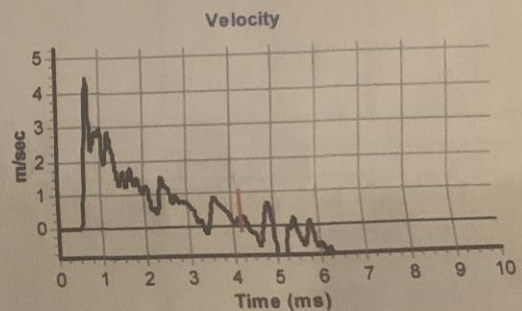
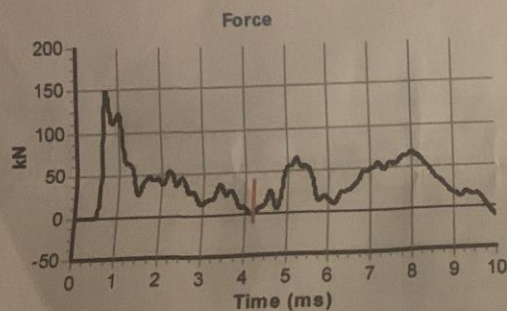
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.0
Assumed Modulus E_a (GPa): 200
Accelerometer No.1: 7080
Accelerometer No.2: 11609

SPT Hammer Information

Hammer Mass m (kg): 63.5
Falling Height h (mm): 760
SPT String Length L (m): 10.0

Comments / Location

KARTER DRILLING - 78070

**Calculations**

Area of Rod A (mm^2): 905
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 319

Energy Ratio E_r (%): 67

Signed: C. McCUSKEY
Title: FITTER

The recommended calibration interval is 12 months

BOREHOLE LOG - DRIVEN CONTINUOUS SAMPLING

DCS1

Project	Unit B, Birch Business Park, Heywood			Project No.	AG3353-21	
Client	Yeargate Limited			Sheet	1 of 2	
Start	10/01/2022	Coordinates	E 384089.56 N 408247.57		Scale	1:25
End	11/01/2022	Ground Level	132.08m AOD		Total Depth	5.45m

Sample / Test Type	Depth (m)	Result	Dia./ Rec.	Level (mAoD)	Strata Depth (thickness) (m)	Description of Strata	Legend	GW	Install
ES	0.20	N = 7		131.73	(0.35)	Grey fine to coarse angular to subangular sandy GRAVEL with high cobble content. Gravel is sandstone, concrete, brick and wood fragments. Cobbles are subangular to subrounded sandstone. (MADE GROUND)			
D	0.30				0.35				
ES	0.50					Loose orange-brown slightly gravelly silty SAND with high cobble content. Gravel is fine to coarse subangular to subrounded sandstone and siltstone. Cobbles are subangular sandstone. (GLACIOFLUVIAL ICE CONTACT DEPOSITS)			
D	1.00								
D	1.20								
S	1.20								
		N = 13	101mm /90%						
D	1.80								
D	2.00								
S	2.00					From 2.00m bgl: medium dense.			
B	2.30								
		N = 11	92mm /80%		(5.10)				
D	3.00								
S	3.00								
D	3.70					From 3.60m to 3.80m bgl: rare peaty pockets.			
		N = 10	79mm /80%						
D	4.00								
S	4.00								
			79mm /60%						
D	5.00								
						Continued next sheet			

Installation:
Remarks: Hand dug service inspection pit excavated to 1.20m bgl. Borehole backfilled with arisings on completion.

Groundwater Strikes					Drilled: Exploration Ltd Logged: HH Checked: PG
Depth Strike	Rose to	Remarks	Cased	Sealed	
3.00	3.00				

DCS1

Project No. AG3353-21

Sheet 2 of 2

Scale 1:25

Total Depth 5.45m

Installation:
Remarks: Hand dug service inspection pit excavated to 1.20m bgl. Borehole backfilled with arisings on completion.

Exploratory hole logs to be read in conjunction with key sheet

BOREHOLE LOG - DRIVEN CONTINUOUS SAMPLING

DCS2

Project

Unit B, Birch Business Park, Heywood

Project No.

AG3353-21

Client

Yeagate Limited

Sheet

1 of 2

Start

10/01/2022

Coordinates

E 384025.74 N 408255.22

Scale

1:25

End

10/01/2022

Ground Level

132.16m AOD

Total Depth

5.45m

Sample / Test Type	Depth (m)	Result	Dia./ Rec.	Level (mAoD)	Strata Depth (thickness) (m)	Description of Strata	Legend	GW	Install
ES	0.40			131.96	(0.20)	Dark brown SAND with frequent rootlets. (MADE GROUND/TOPSOIL)			
					0.20	Dark brown clayey slightly gravelly SAND. Gravel is fine to coarse subangular clinker, brick and sandstone. (MADE GROUND)			
ES	0.90			131.46	(0.50)				
					0.70	Firm orange-brown slightly gravelly sandy CLAY. Gravel is fine to coarse subangular to subrounded sandstone and mudstone. (GLACIAL TILL)			
D	1.20	N = 9			(0.90)				
S	1.20								
D	1.80		101mm /100%	130.56	1.60	Firm orange-brown silty CLAY. (GLACIOFLUVIAL ICE CONTACT DEPOSITS)			
					(0.20)				
D	2.00	N = 9		130.36	1.80	Firm dark brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse subangular to subrounded sandstone, mudstone and siltstone. (GLACIAL TILL)			
S	2.00				(0.40)				
D	2.80		92mm /80%	129.96	2.20	Stiff to firm orange-brown silty CLAY. (GLACIOFLUVIAL ICE CONTACT DEPOSITS)			
					(1.10)				
D	3.00	N = 10							
S	3.00								
D	4.00	N = 13	79mm /70%	128.86	3.30	Medium dense orange-brown slightly gravelly SAND with rare clay bands. Gravel is fine to medium subangular to subrounded sandstone. (GLACIOFLUVIAL ICE CONTACT DEPOSITS)			
D	5.00				(2.15)				
D	5.00					Continued next sheet			

Installation:
Remarks: Hand dug service inspection pit excavated to 1.20m bgl. Borehole backfilled with arisings on completion.

Groundwater Strikes					Drilled: Exploration Ltd
Depth Strike	Rose to	Remarks	Cased	Sealed	
4.00	4.00				Logged: HH
					Checked: PG

BOREHOLE LOG - DRIVEN CONTINUOUS SAMPLING

DCS2

Project

Unit B, Birch Business Park, Heywood

Client

Yeagate Limited

Start

10/01/2022

End

10/01/2022

Coordinates

E 384025.74 N 408255.22

Ground Level

132.16m AOD

Project No.

AG3353-21

Sheet

2 of 2

Scale

1:25

Total Depth

5.45m

Sample / Test Type	Depth (m)	Result	Dia./ Rec.	Level (mAoD)	Strata Depth (thickness) (m)	Description of Strata	Legend	GW	Install
S	5.00	N = 30				Medium dense orange-brown slightly gravelly SAND with rare clay bands. Gravel is fine to medium subangular to subrounded sandstone. (GLACIOFLUVIAL ICE CONTACT DEPOSITS)			
				126.71	5.45	End of Borehole at 5.45m			

Installation:
Remarks: Hand dug service inspection pit excavated to 1.20m bgl. Borehole backfilled with arisings on completion.

Groundwater Strikes					Drilled: Exploration Ltd
Depth Strike	Rose to	Remarks	Cased	Sealed	
4.00	4.00				Logged: HH
					Checked: PG

BOREHOLE LOG - DRIVEN CONTINUOUS SAMPLING

DCS3

Project

Unit B, Birch Business Park, Heywood

Project No.

AG3353-21

Client

Yeargate Limited

Sheet

1 of 2

Start

10/01/2022

Coordinates

E 384010.17 N 408207.61

Scale

1:25

End

10/01/2022

Ground Level

131.88m AOD

Total Depth

5.45m

Sample / Test Type	Depth (m)	Result	Dia./ Rec.	Level (mAoD)	Strata Depth (thickness) (m)	Description of Strata	Legend	GW	Install
ES	0.50			131.58	(0.30)	Dark brown clayey SAND with frequent rootlets. (TOPSOIL/MADE GROUND)			
	0.60				0.30	Firm dark grey slightly gravelly sandy CLAY with high cobble content. Gravel is fine to coarse subangular to subrounded clinker, brick and sandstone. Cobbles are angular brick and sandstone. (MADE GROUND)			
D	1.20	N = 11		130.98	0.90	Medium dense brown silty SAND. (GLACIOFLUVIAL ICE CONTACT DEPOSITS) <i>Between 0.90m to 1.10m bgl: rare rootlets.</i>			
	1.40				(0.90)				
D	1.90	N = 14	101mm /100%	130.08	1.80	Medium dense grey slightly gravelly silty SAND. Gravel is fine to coarse subangular to subrounded mudstone, quartzite and sandstone. (GLACIOFLUVIAL ICE CONTACT DEPOSITS)			
	2.00								
D	3.00	N = 6	92mm /80%			From 3.00m bgl: loose.			
	3.00								
D	3.80	N = 4	79mm /70%		(3.65)				
	4.00								
D	5.00								
Continued next sheet									

Installation:
Remarks: Hand dug service inspection pit excavated to 1.20m bgl. Borehole backfilled with arisings on completion.

Groundwater Strikes					Drilled: Exploration Ltd
Depth Strike	Rose to	Remarks	Cased	Sealed	
0.80 3.00	0.80 3.00				
					Logged: HH
					Checked: PG

DCS3

Project No. AG3353-21

Sheet 2 of 2

Scale 1:25

Total Depth 5.45m

Installation:
Remarks: Hand dug service inspection pit excavated to 1.20m bgl. Borehole backfilled with arisings on completion.

Exploratory hole logs to be read in conjunction with key sheet

BOREHOLE LOG - DRIVEN CONTINUOUS SAMPLING

DCS4

Project

Unit B, Birch Business Park, Heywood

Client

Yeagate Limited

Start

10/01/2022

End

10/01/2022

Coordinates

E 384065.89 N 408163.40

Ground Level

133.05m AOD

Project No.

AG3353-21

Sheet

1 of 2

Scale

1:25

Total Depth

5.45m

Sample / Test Type	Depth (m)	Result	Dia./ Rec.	Level (mAoD)	Strata Depth (thickness) (m)	Description of Strata	Legend	GW	Install
ES	0.40	N = 19		132.85	(0.20)	Dark brown clayey SAND with frequent rootlets. (TOPSOIL)			
					0.20	Brown clayey SAND.			
					(0.40)	(GLACIOFLUVIAL ICE CONTACT DEPOSITS)			
D ES	0.80			132.45	0.60	Medium dense red-orange slightly gravelly silty SAND. Gravel is fine to coarse subangular to subrounded sandstone and mudstone. (GLACIOFLUVIAL ICE CONTACT DEPOSITS)			
B D S	1.20			101mm /100%	(1.60)				
B S	2.00			N = 18		130.85	2.20		
D	2.60	N = 23	92mm /80%						
D S	3.00	79mm /80%							
D	3.70	N = 32			(3.25)				
D S	4.00	79mm /70%				Below 4m bgl: dense.			
D	5.00								
Continued next sheet									

Installation:
Remarks: Hand dug service inspection pit excavated to 1.20m bgl. Borehole backfilled with arisings on completion.

Groundwater Strikes					Drilled: Exploration Ltd
Depth Strike	Rose to	Remarks	Cased	Sealed	
4.00	4.00				
					Logged: HH
					Checked: PG

DCS4

Project No. AG3353-21

Sheet 2 of 2

Scale 1:25

Total Depth 5.45m

Installation:
Remarks: Hand dug service inspection pit excavated to 1.20m bgl. Borehole backfilled with arisings on completion.

Exploratory hole logs to be read in conjunction with key sheet

BOREHOLE LOG - DRIVEN CONTINUOUS SAMPLING

DCS5

Project

Unit B, Birch Business Park, Heywood

Project No.

AG3353-21

Client

Yeagate Limited

Sheet

1 of 2

Start

10/01/2022

Coordinates

E 384146.92 N 408229.86

Scale

1:25

End

11/01/2022

Ground Level

131.51m AOD

Total Depth

5.45m

Sample / Test Type	Depth (m)	Result	Dia./ Rec.	Level (mAoD)	Strata Depth (thickness) (m)	Description of Strata	Legend	GW	Install		
D ES	0.60 0.60	N = 11		131.11	(0.40)	Dark brown silty clayey SAND with rare rootlets. (TOPSOIL/MADE GROUND)					
					0.40	Dark brown-grey slightly clayey slightly gravelly SAND. Gravel is fine to coarse subangular to subrounded sandstone, brick, clinker and wood fragments. (MADE GROUND)					
ES	1.00			130.41	1.10	Dark brown very clayey SAND with rare rootlets. (GLACIOFLUVIAL ICE CONTACT DEPOSITS)					
D S	1.20 1.20				(0.30)						
ES	1.60			130.11	1.40	Medium dense orange-brown slightly gravelly SAND. Gravel is fine to coarse subangular to subrounded sandstone and quartzite. (GLACIOFLUVIAL ICE CONTACT DEPOSITS)					
D S	2.00 2.00										
D	2.50			92mm /70%	(2.10)						
D S	3.00 3.00			N = 6		Below 3m bgl: loose.					
D	3.60			N = 10		128.01	3.50			Firm dark brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse subangular to subrounded sandstone and mudstone. (GLACIAL TILL)	
S	4.00										
					(1.95)						
S	5.00	N = 23				Continued next sheet					

Installation:
Remarks: Hand dug service inspection pit excavated to 1.20m bgl. Borehole backfilled with arisings on completion.

Groundwater Strikes					Drilled: Exploration Ltd Logged: HH Checked: PG
Depth Strike	Rose to	Remarks	Cased	Sealed	
2.50	2.50				

BOREHOLE LOG - DRIVEN CONTINUOUS SAMPLING

DCS5

Project

Unit B, Birch Business Park, Heywood

Client

Yeagate Limited

Start

10/01/2022

End

11/01/2022

Coordinates

E 384146.92 N 408229.86

Ground Level

131.51m AOD

Project No.

AG3353-21

Sheet

2 of 2

Scale

1:25

Total Depth

5.45m

Sample / Test Type	Depth (m)	Result	Dia./ Rec.	Level (mAoD)	Strata Depth (thickness) (m)	Description of Strata	Legend	GW	Install
				126.06	5.45	Firm dark brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse subangular to subrounded sandstone and mudstone. (GLACIAL TILL)			
						End of Borehole at 5.45m			

Installation:
Remarks: Hand dug service inspection pit excavated to 1.20m bgl. Borehole backfilled with arisings on completion.

Groundwater Strikes					Drilled: Exploration Ltd
Depth Strike	Rose to	Remarks	Cased	Sealed	
2.50	2.50				Logged: HH
					Checked: PG

SPT Hammer Energy Test Report

In accordance with BSEN ISO 22476-3:2005

ARCHWAY ENGINEERING (UK) LTD
AINLEYS INDUSTRIAL ESTATE
ELLAND
WEST YORKSHIRE
HX5 9JP

SPT Hammer Ref: DART400
Test Date: 21/01/2022
Report Date: 21/01/2022
File Name: DART400.spt
Test Operator: MT

Instrumented Rod Data

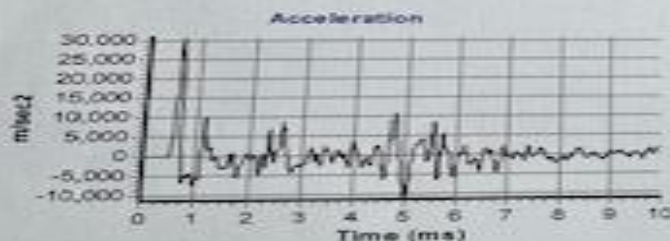
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.0
Assumed Modulus E_a (GPa): 200
Accelerometer No.1: 7080
Accelerometer No.2: 11609

SPT Hammer Information

Hammer Mass m (kg): 63.5
Falling Height h (mm): 760
SPT String Length L (m): 10.0

Comments / Location

EXPLORATION LTD - 78845



Calculations

Area of Rod A (mm^2): 905
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 288

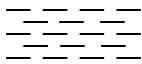
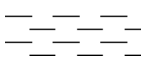
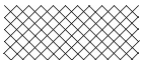
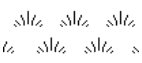
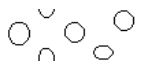
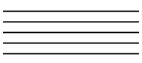
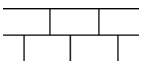
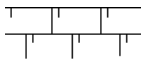
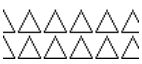
Energy Ratio E_r (%):

61

Signed: M.TONER
Title: TRAINEE FITTER

The recommended calibration interval is 12 months

Exploratory Hole Log Key Sheet

Sample Notation			Backfill Symbols		Legend Symbols	
D	Small Disturbed sample			Sand		Topsoil
B	Bulk Disturbed sample			Gravel		Made Ground
ES	Environmental sample			Concrete		Concrete
U	Undisturbed U100 sample			Bentonite		Clay
UT	Undisturbed UT100 sample			Arisings		Silt
C	Core sample			Grout		Sand
W	Water sample					Gravel
In Situ Test Notation			Installation Symbols			Peat
S	Standard Penetration Test			Plain Standpipe		Cobbles
S (C)	Standard Penetration Test (cone)			Slotted Standpipe		Boulders
HV	Hand Shear Vane Test			Piezometer		Mudstone
PID	Photoionization Detector Test			Vibrating Wire Piezometer		Siltstone
MEXE	Mexecone Cone Penetrometer Test			Inclinometer		Sandstone
PP	Pocket Penetrometer Test			Extensometer (with magnet locations)		Limestone
K	Permeability Test					Chalk
Results Notation			Groundwater (GW)			Coal
Cu	Shear Strength	kN/m ²				Breccia
N	SPT N Value	-				Conglomerate
PID	VOC Concentration	ppm				Shale
()	U/UT Blow Count	-				Igenous Rock
Rotary Core Notation						Metamorphic Rock
TCR	Total Core Recovery			Rise	NR NR	No Recovery
SCR	Solid Core Recovery			Groundwater Strike - with Recorded Rise	NR NR	No Recovery
RQD	Rock Quality Designation			Strike		
FI	Fracture Index			Groundwater Strike - No Recorded Rise		
If	Fracture Spacing					
NI	Non Intact					
NR	No Recovery					
NA	Not Applicable					
Ease of Dig			General Notes			
VE	Very Easy		1. Details of the standpipe/piezometer are given on the log. The 'Install' column shows a graphical representation of the installed including depth of instruments including slotted section or piezometer depth, and backfill details. 2. Standard Penetration Test is defined in BS EN ISO 17892. Total N value is shown on the logs, full details of the test increments, equipment references, water and casing levels shown on the SPT Summary Sheet.			
E	Easy					
M	Moderate					
H	Hard					
VH	Very Hard					
					Note: Most soils comprise a mixture of particle sizes. The soil type is graphically represented on the log and may be a combination of these symbols.	

APPENDIX C

Ground Gas Monitoring and Flow Results

Project Number: AG3353-21

Project Name: Unit B, Birch Business Park, Heywood

Date and Time of Monitoring: Friday 21st January 2022 - 10:00

Phase of Monitoring: 1 of 4

BH No.	Flow Range (litres/hr over 3 mins)			Differential Pressure (mb)	Methane % v/v		Carbon dioxide % v/v		Oxygen % v/v		Diameter of installation (mm)	Water level (m bgl)
	Max	Min	Avg		Peak	Steady	Peak	Steady	Min	Steady		
CP1	0.1	<0.1	<0.1	0.00	<0.1	<0.1	1.6	0.6	20.9	21.2	50	0.90
CP3	<0.1	<0.1	<0.1	0.00	<0.1	<0.1	1.8	1.6	20.0	20.1	50	2.40
CP4	<0.1	<0.1	<0.1	0.00	<0.1	<0.1	1.4	1.0	20.5	20.5	50	1.40
CP5	<0.1	<0.1	<0.1	0.00	<0.1	<0.1	1.5	1.5	19.7	19.7	50	2.50

Additional gases (if required)

BH No.	VOCs (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	Diameter of installation (mm)
CP1	<0.1	12	<1	50
CP3	<0.1	<1	<1	50
CP4	<0.1	<1	<1	50
CP5	<0.1	<1	<1	50

Borehole specific comments/observations

Meteorological Data

Atmospheric Pressure (mb)	Start: 1022
Atmospheric Pressure (mb)	Finish: 1022
Pressure Rising or Falling	Rising
Weather Conditions	Drizzle
Atmospheric Oxygen (% vol)	21.2
Wind Speed & Direction	4 kmph W
Ambient Air Temperature (°C)	3.0

Site Data

Monitoring Personnel	Hannah Hadwin
GPS Instrument	
Gasmeter Serial Number	G503948
PID Serial Number	110423
Ground Conditions (vegetation stress, visual contamination):	

General Notes:

1. Instrument specification data and calibration information provided on a separate sheet

APPLIED GEOLOGY

Ground Gas Monitoring and Flow Results

Project Number: AG3353-21

Project Name: Unit B, Birch Business Park, Heywood

Date and Time of Monitoring: Wednesday 26th January 2022 - 10:30

Phase of Monitoring: 2 of 4

BH No.	Flow Range (litres/hr over 3 mins)			Differential Pressure (mb)	Methane % v/v		Carbon dioxide % v/v		Oxygen % v/v		Diameter of installation (mm)	Water level (m bgl)
	Max	Min	Avg		Peak	Steady	Peak	Steady	Min	Steady		
CP1	<0.1	<0.1	<0.1	0.00	<0.1	<0.1	0.3	0.3	21.3	21.4	50	0.85
CP3	0.2	0.1	0.1	0.00	<0.1	<0.1	1.7	1.7	19.7	19.7	50	2.40
CP4	<0.1	<0.1	<0.1	0.00	<0.1	<0.1	1.2	0.7	20.9	21.0	50	1.45
CP5	<0.1	<0.1	<0.1	0.00	<0.1	<0.1	1.2	1.1	19.5	19.5	50	2.50

Additional gases (if required)

BH No.	VOCs (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	Diameter of installation (mm)
CP1	<0.1	<1	<1	50
CP3	<0.1	<1	<1	50
CP4	<0.1	<1	<1	50
CP5	<0.1	4	<1	50

Borehole specific comments/observations

Meteorological Data

Atmospheric Pressure (mb)	Start: 1022
Atmospheric Pressure (mb)	Finish: 1022
Pressure Rising or Falling	Rising
Weather Conditions	Overcast
Atmospheric Oxygen (% vol)	21.2
Wind Speed & Direction	WSW 19 km/h
Ambient Air Temperature (°C)	7.0

Site Data

Monitoring Personnel	Hannah Hadwin
GPS Instrument	
Gasmeter Serial Number	G503948
PID Serial Number	110423
Ground Conditions (vegetation stress, visual contamination):	

General Notes:

1. Instrument specification data and calibration information provided on a separate sheet

APPLIED GEOLOGY

Ground Gas Monitoring and Flow Results

Project Number: AG3353-21

Project Name: Unit B, Birch Business Park, Heywood

Date and Time of Monitoring: Friday 4th February 2022 - 11.30

Phase of Monitoring: 3 of 4

BH No.	Flow Range (litres/hr over 3 mins)			Differential Pressure (mb)	Methane % v/v		Carbon dioxide % v/v		Oxygen % v/v		Diameter of installation (mm)	Water level (m bgl)
	Max	Min	Avg		Peak	Steady	Peak	Steady	Min	Steady		
CP1	<0.1	<0.1	<0.1	-0.02	<0.1	<0.1	0.2	0.2	20.6	20.6	50	0.73
CP3	<0.1	<0.1	<0.1	-0.02	<0.1	<0.1	0.1	0.1	20.6	20.6	50	2.30
CP4	0.1	<0.1	<0.1	-0.10	<0.1	<0.1	0.1	0.1	19.8	19.8	50	1.21
CP5	<0.1	<0.1	<0.1	0.00	<0.1	<0.1	1.9	1.9	18.6	18.6	50	2.36

Additional gases (if required)

BH No.	VOCs (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	Diameter of installation (mm)
CP1	0.4	<1	<1	50
CP3	0.3	<1	<1	50
CP4	0.9	<1	<1	50
CP5	0.3	<1	<1	50

Borehole specific comments/observations

Meteorological Data

Atmospheric Pressure (mb)	Start: 993
Atmospheric Pressure (mb)	Finish: 995
Pressure Rising or Falling	Steady
Weather Conditions	Sunshine/heavy showers
Atmospheric Oxygen (% vol)	20.2
Wind Speed & Direction	moderate breeze NW
Ambient Air Temperature (°C)	6.0

Site Data

Monitoring Personnel	Malcolm McGlone
GPS Instrument	
Gasmeter Serial Number	G506760
PID Serial Number	108606
Ground Conditions (vegetation stress, visual contamination):	

General Notes:

1. Instrument specification data and calibration information provided on a separate sheet

APPLIED GEOLOGY

Ground Gas Monitoring and Flow Results

Project Number: AG3353-21

Project Name: Unit B, Birch Business Park, Heywood

Date and Time of Monitoring: Wednesday 2nd March 2022 - 10:00

Phase of Monitoring: 4 of 4

BH No.	Flow Range (litres/hr over 3 mins)			Differential Pressure (mb)	Methane % v/v		Carbon dioxide % v/v		Oxygen % v/v		Diameter of installation (mm)	Water level (m bgl)
	Max	Min	Avg		Peak	Steady	Peak	Steady	Min	Steady		
CP1	<0.1	<0.1	<0.1	0.00	<0.1	<0.1	0.2	0.2	21.0	21.0	50	0.75
CP3	<0.1	<0.1	<0.1	-0.03	<0.1	<0.1	1.5	1.5	19.9	19.9	50	1.97
CP4	0.1	<0.1	<0.1	-0.07	<0.1	<0.1	1.0	1.0	21.0	21.0	50	1.04
CP5	<0.1	<0.1	<0.1	0.00	<0.1	<0.1	0.9	0.9	20.1	20.1	50	2.21

Additional gases (if required)

BH No.	VOCs (ppm)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	Diameter of installation (mm)
CP1	0.6	<1	<1	50
CP3	0.1	<1	<1	50
CP4	1.7	<1	<1	50
CP5	0.9	<1	<1	50

Borehole specific comments/observations

Meteorological Data

Atmospheric Pressure (mb)	Start: 1019
Atmospheric Pressure (mb)	Finish: 1020
Pressure Rising or Falling	Rising
Weather Conditions	Heavy rain
Atmospheric Oxygen (% vol)	20.9
Wind Speed & Direction	Light breeze
Ambient Air Temperature (°C)	7.0

Site Data

Monitoring Personnel	Malcolm McGlone
GPS Instrument	
Gasmeter Serial Number	G506760
PID Serial Number	115558
Ground Conditions (vegetation stress, visual contamination):	

General Notes:

1. Instrument specification data and calibration information provided on a separate sheet

APPLIED GEOLOGY

Gas Monitoring Equipment Specification and Accuracy Details

Instrument Specifications

Instrument	Atmospheric Pressure Range	Temperature Range	Flow Range	Flow Resolution	Borehole Pressure Range
GA5000	500-1500 mb +/- 5 mb	-10°C to + 50°C	0-20 lt/hr +/- 0.3 l/hr	0.1l/hr	+.500/-500 mbar +/- 4 mbar
Phocheck Tiger	-	-20 to + 60°C (Certified to -15 to + 45°C)	-	-	-

Instrument Accuracy

Instrument		Methane	Lower Explosive Limit	Carbon Dioxide	Oxygen	Volatile Organic Compounds	Hydrogen Sulphide	Carbon Monoxide
GA5000	Detection Range	0-100%	-	0 -100%	0-25%	NA	0 -50ppm response <30 secs	0 - 1000ppm response <30 Secs
	Detection Accuracy	./- 0.5% @ 0 to 70%, ./-1.5% @ 70 to 100% Response < 10 secs	N/A	./- 0.5% @ 0 to 60%, ./-1.5% @ 60 to 100% Response < 10 secs	./- 1.0% @ 0 to 25%, Response < 20 secs	NA	./- 1.5% FS	./- 2% of FS
Phocheck Tiger	Detection Range	N/A	N/A	N/A	N/A	1 ppb - 10,000 ppm	N/A	N/A
	Detection Accuracy	N/A	N/A	N/A	N/A	+/- 1ppb +/- 5% of actual displayed accuracy +/- One digit Response < 2sec	N/A	N/A

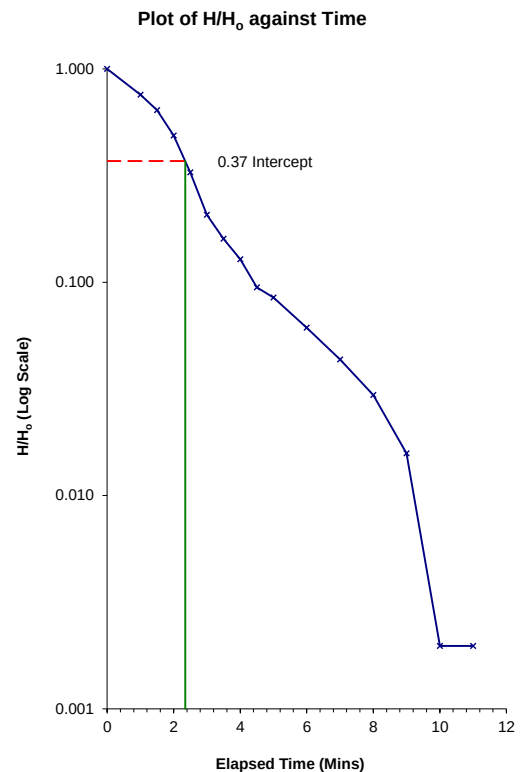
Calibration Frequency

Equipment Serial Numbers

Instruments are calibrated annually. Details of the instrument calibration certificates and service records are available if required.		
	GA5000 (G503948, G505383, G506760)	
	Phocheck Tiger - (T-108308, T-109597, T-109598, T-110423)	

Variable Head Permeability Test - Hvorslev Method

Borehole No.	CP1	Test No.	1
Date	04/02/2022	Type of Test	RH
Operator	MM	Ground level (mOD)	131.72
Diameter of response zone, D (mm)	150	Diameter of standpipe,d (mm)	50.00
Top of response zone (mbgl)	1.00	Height of standpipe above GL (m)	0.00
Base of response zone (mbgl)	8.00	Water level before test, below top of pipe (m)	0.73

[illegible]

Permeability Results

Using BS EN ISO 2282-2 Equation B.7

For when Plot of Time vs Head Ratio go below $H/H_o = 0.37$

$$k = \frac{r^2 \cdot \ln(L/R)}{2 \cdot L \cdot t_0}$$

Assessed to = 2.35 mins

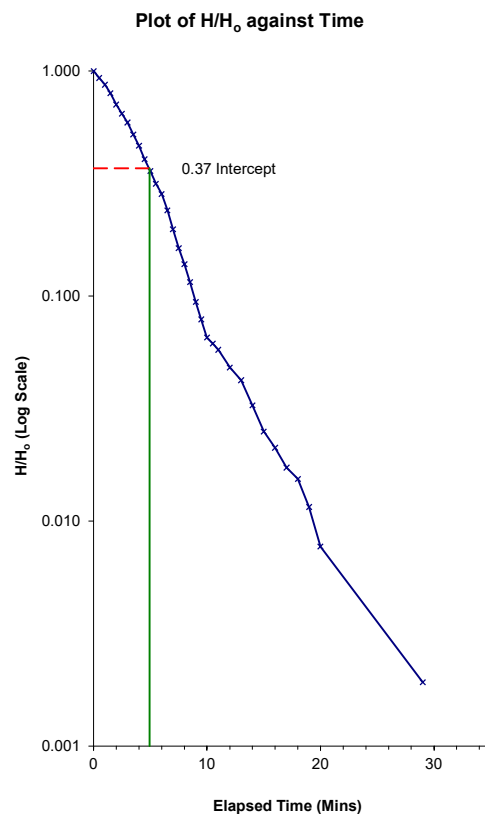
Permeability $k = 1.4E-06$ m/sec

Client:	Yeargate Ltd	
Project:	Unit B, Birch Business Park, Heywood	
Project No.	AG3353-21	

Variable Head Permeability Test - Hvorslev Method

Borehole No.	CP5	Test No.	1
Date	04/02/2022	Type of Test	RH
Operator	MM	Ground level (mOD)	131.88
Diameter of response zone, D (mm)	150	Diameter of standpipe, d (mm)	50.00
Top of response zone (mbgl)	1.00	Height of standpipe above GL (m)	0.00
Base of response zone (mbgl)	8.00	Water level before test, below top of pipe (m)	2.36

Field Data			
Elapsed Time (t) (mins)	Depth to water from top of casing or standpipe (m)	Head (H) (m)	Head Ratio H/H ₀
0.00	7.56	-5.20	1.000
0.50	7.20	-4.84	0.931
1.00	6.88	-4.52	0.869
1.50	6.50	-4.14	0.796
2.00	6.05	-3.69	0.710
2.50	5.72	-3.36	0.646
3.00	5.43	-3.07	0.590
3.50	5.08	-2.72	0.523
4.00	4.78	-2.42	0.465
4.50	4.47	-2.11	0.406
5.00	4.23	-1.87	0.360
5.50	4.00	-1.64	0.315
6.00	3.84	-1.48	0.285
6.50	3.61	-1.25	0.240
7.00	3.39	-1.03	0.198
7.50	3.21	-0.85	0.163
8.00	3.08	-0.72	0.138
8.50	2.96	-0.60	0.115
9.00	2.85	-0.49	0.094
9.50	2.77	-0.41	0.079
10.00	2.70	-0.34	0.065
10.50	2.68	-0.32	0.062
11.00	2.66	-0.30	0.058
12.00	2.61	-0.25	0.048
13.00	2.58	-0.22	0.042
14.00	2.53	-0.17	0.033
15.00	2.49	-0.13	0.025
16.00	2.47	-0.11	0.021
17.00	2.45	-0.09	0.017
18.00	2.44	-0.08	0.015
19.00	2.42	-0.06	0.012
20.00	2.40	-0.04	0.008
29.00	2.37	-0.01	0.002



Permeability Results

Using BS EN ISO
22282-2 Equation B.7

For when Plot of Time vs Head Ratio go below H/H₀ = 0.37

$$k = \frac{r^2 \cdot \ln(L/R)}{2 \cdot L \cdot t_0}$$

Assessed to = 4.95 mins

Permeability k = 6.8E-07 m/sec

Client:	Yeagate Ltd	APPLIED GEOLOGY
Project:	Unit B, Birch Business Park, Heywood	
Project No.	AG3353-21	

APPENDIX D

SUMMARY OF LEACHATE TEST RESULTS

Site Unit B, Birch Business Park, Heywood
Job Number AG3353-21
Type of Water Leachate

Determinand	Limit of Detection	Hazardous or Non-Hazardous^	Sample Identity Depth Sampled Date	DCS1 0.2 10/01/2022 MG	DCS3 0.5 10/01/2022 MG	CP4 1.0 13/01/2022 MG	No. of samples (n)	Waters Screening Value	Source & Justification
pH		-	-	8	7.2	7.8	3	-	-
TOC		-	mg l ⁻¹	18.8	10.4	11.9	3	-	-
Arsenic	1	Haz	µg l ⁻¹	13	11	15	3	50	WFD Environmental Standard, 2010
Cadmium	0.08	Non Haz	µg l ⁻¹	0.16	0.26	0.23	3	5	UK Drinking Water Standards (2010)
Chromium (Total)	0.4	Non Haz	µg l ⁻¹	0.6	2.3	0.9	3	50	UK Drinking Water Standards (2010)
Chromium (III)	1	Non Haz	µg l ⁻¹	1.0	2.3	1.0	3	50	UK Drinking Water Standards (2010)
Chromium (VI)	5	Haz	µg l ⁻¹	5.0	5.0	5.0	3	5	Detection Limit
Copper	0.7	Non Haz	µg l ⁻¹	14	7.6	9.2	3	2000	UK Drinking Water Standards (2010)
Lead	1	Haz	µg l ⁻¹	7.6	7.5	7.9	3	10	UK Drinking Water Standards (2010)
Mercury	0.5	Haz	µg l ⁻¹	1.8	0.5	0.5	3	6	WHO Guidelines for Drinking Water Quality, 4th Edition (2011)
Nickel	0.3	Non Haz	µg l ⁻¹	5.4	4.5	5	3	20	UK Drinking Water Standards (2010)
Selenium	4	Non Haz	µg l ⁻¹	4.0	4.0	4.0	3	10	UK Drinking Water Standards (2010)
Zinc	0.4	Non Haz	µg l ⁻¹	13	20	10	3	5000	UK Drinking Water Standards (2010)
Boron	10	Non Haz	µg l ⁻¹	24	16	23	3	1000	UK Drinking Water Standards (2010)
Beryllium	0.2	Non Haz	µg l ⁻¹	0.3	0.3	0.2	3	12	UK Drinking Water Standards (2010)
Vanadium	1.7	Non Haz	µg l ⁻¹	5.8	6.8	12	3	20	EQS
Sulphate	0.1	Non Haz	mg l ⁻¹	22.2	7.4	7.4	3	250	UK Drinking Water Standards (2010)
Phenol	1	Non Haz	µg l ⁻¹	3.2	5.3	3.9	3	7.7	WFD Environmental Standard, 2010
Naphthalene	0.01	Non Haz	µg l ⁻¹	0.01	0.01	0.01	3	0.01	Detection Limit
Acenaphthylene	0.01	Haz	µg l ⁻¹	0.01	0.01	0.01	3	0.01	Detection limit
Acenaphthene	0.01	Haz	µg l ⁻¹	0.01	0.01	0.01	3	0.01	Detection limit
Fluorene	0.01	Haz	µg l ⁻¹	0.01	0.01	0.01	3	0.01	Detection limit
Phenanthrene	0.01	Haz	µg l ⁻¹	0.01	0.01	0.01	3	0.01	Detection limit
Anthracene	0.01	Haz	µg l ⁻¹	0.01	0.01	0.01	3	0.01	Detection limit
Fluoranthene	0.01	Haz	µg l ⁻¹	0.01	0.01	0.01	3	0.01	Detection limit
Pyrene	0.01	Haz	µg l ⁻¹	0.01	0.01	0.01	3	0.01	Detection limit
Benzo[a]anthracene	0.01	Haz	µg l ⁻¹	0.01	0.01	0.01	3	0.01	Detection limit
Chrysene	0.01	Haz	µg l ⁻¹	0.01	0.01	0.01	3	0.01	Detection limit
Benzo[b]fluoranthene	0.01	Haz	µg l ⁻¹	0.01	0.01	0.01	3	0.01	Detection limit
Benzo[k]fluoranthene	0.01	Haz	µg l ⁻¹	0.01	0.01	0.01	3	0.01	Detection limit
Benzo[a]pyrene	0.01	Haz	µg l ⁻¹	0.01	0.01	0.01	3	0.01	Detection Limit
Dibenz(a,h)Anthracene	0.01	Haz	µg l ⁻¹	0.01	0.01	0.01	3	0.01	Detection limit
Indeno(1,2,3-c,d)Pyrene	0.01	Haz	µg l ⁻¹	0.01	0.01	0.01	3	0.01	Detection limit
Benzo[g,h,i]perylene	0.01	Haz	µg l ⁻¹	0.01	0.01	0.01	3	0.01	Detection limit

Key-
Result exceeds test screening criteria
Values in bold at the limit of detection

^ Note: Hazardous and non-hazardous substances determined by JAGDAG (Jan 2017) and published at <http://www.wfduk.org/sites/default/files/Media/170116%20Substance%20Determinationsfinal.pdf>. These are marked in bold.
For substances not assessed by JAGDAG, Applied Geology has assumed a determination based on our understanding of the behaviour of the chemical. These determinations are highlighted in yellow.

SOIL CHEMICAL RESULTS COMPARED AGAINST SCREENING VALUES FOR HUMAN HEALTH

Site: Unit B, Birch Business Park, Heywood
Job No: AG3353-21

Land Use: Commercial / Industrial
Dataset: Made Ground
Soil Organic Matter (%): 2.5 %

Exploratory Hole Reference		DCS1	DCS2	DCS3	DCS4	DCS5	DCS5	CP1	No. of samples (n)	Commercial / Industrial	Source/Justification
Depth (m)		0.20	0.40	0.50	0.40	0.60	1.00	1.00			
Strata		MG	MG	MG	MG	MG	MG	MG			
	Units										
Organic Matter (%)	%	2.5	5.9	8.1	3.7	4.9	2.9	2.8	7		
pH	pH Units	8.4	7.4	6.6	6.5	8.1	7.8	7.7	7		
Arsenic	mg/kg	8.6	16	27	10	10	11	12	7	640	LQM/CIEH S4UL (2015)
Beryllium	mg/kg	0.55	0.9	1.3	0.77	1.1	1.1	0.68	7	12	LQM/CIEH S4UL (2015)
Boron - Total	mg/kg	2.8	2.8	3.7	3.4	4.8	4.3	3.9	7	240000	LQM/CIEH S4UL (2015)
Cadmium	mg/kg	0.4	0.2	0.2	0.2	0.5	0.2	0.2	7	190	LQM/CIEH S4UL (2015)
Chromium (total)	mg/kg	19	45	66	16	14	17	27	7	8600	LQM/CIEH S4UL (2015)
Chromium - III	mg/kg	17	45	65	16	13	16	26	7	8600	LQM/CIEH S4UL (2015)
Chromium (VI) Screen	mg/kg	4	4	4	4	4	4	4	7	33	LQM/CIEH S4UL (2015)
Copper	mg/kg	26	46	74	25	62	56	30	7	68000	LQM/CIEH S4UL (2015)
Lead	mg/kg	57	70	110	44	83	87	50	7	2330	C4SL (2014)
Mercury (Total)	mg/kg	0.3	0.3	0.3	0.3	0.3	0.3	0.3	7	1100	LQM/CIEH S4UL (2015)
Nickel	mg/kg	13	16	26	16	11	22	18	7	980	LQM/CIEH S4UL (2015)
Selenium	mg/kg	1	1	1	1	1	1	1	7	12000	LQM/CIEH S4UL (2015)
Vanadium	mg/kg	20	27	38	26	21	28	26	7	9000	LQM/CIEH S4UL (2015)
Zinc	mg/kg	110	110	120	52	110	65	65	7	730000	LQM/CIEH S4UL (2015)
Naphthalene	mg/kg	0.05	0.05	0.28	0.05	0.41	0.05	0.05	7	460	LQM/CIEH S4UL (2015)
Acenaphthylene	mg/kg	0.05	0.05	0.05	0.05	1.5	0.05	0.05	7	97000	LQM/CIEH S4UL (2015)
Acenaphthene	mg/kg	0.05	0.05	0.37	0.05	4.9	0.42	0.48	7	97000	LQM/CIEH S4UL (2015)
Fluorene	mg/kg	0.05	0.05	0.19	0.05	4.8	0.3	0.41	7	68000	LQM/CIEH S4UL (2015)
Phenanthrene	mg/kg	1	0.23	1.9	0.05	68	3.5	4.5	7	22000	LQM/CIEH S4UL (2015)
Anthracene	mg/kg	0.26	0.05	0.39	0.05	25	1.2	1.1	7	540000	LQM/CIEH S4UL (2015)
Fluoranthene	mg/kg	3.1	0.45	3.2	0.05	160	7.8	13	7	23000	LQM/CIEH S4UL (2015)
Pyrene	mg/kg	3	0.46	2.8	0.05	130	7	12	7	54000	LQM/CIEH S4UL (2015)
Benzo[a]anthracene	mg/kg	1.6	0.26	1.6	0.05	81	4.3	5.8	7	*	Genotoxic PAH see Benzo(a)pyrene
Chrysene	mg/kg	1.4	0.34	1.7	0.05	59	3.2	5.2	7	*	Genotoxic PAH see Benzo(a)pyrene
Benzo[b]fluoranthene	mg/kg	1.5	0.29	1.7	0.05	59	3.9	6.2	7	*	Genotoxic PAH see Benzo(a)pyrene
Benzo[k]fluoranthene	mg/kg	1	0.2	0.78	0.05	33	1.8	3.1	7	*	Genotoxic PAH see Benzo(a)pyrene
Benzo[a]pyrene	mg/kg	1.7	0.32	1.5	0.05	53	3.8	6.6	7	76	C4SL (2014)
Dibenzo[a,h]anthracene	mg/kg	0.85	0.05	0.74	0.05	24	1.9	3	7	*	Genotoxic PAH see Benzo(a)pyrene
Indeno[1,2,3-cd]pyrene	mg/kg	0.21	0.05	0.22	0.05	6.4	0.52	0.77	7	*	Genotoxic PAH see Benzo(a)pyrene
Benzo[g,h,i]perylene	mg/kg	0.98	0.05	0.83	0.05	22	2	3.5	7	*	Genotoxic PAH see Benzo(a)pyrene
Total of 16 PAHs	mg/kg	16.6	2.55	18.2	0.8	731	41.6	65.3	7		
Phenols (Total)	mg/kg	1	1	1	1	1	1	1	7	690	LQM/CIEH S4UL (2015)
Benzene	mg/kg	1	1	1	1	1	1	1	7	47	LQM/CIEH S4UL (2015)
Toluene	mg/kg	1	1	1	1	1	1	1	7	110000	LQM/CIEH S4UL (2015)
Ethylbenzene	mg/kg	1	1	1	1	1	1	1	7	13000	LQM/CIEH S4UL (2015)
m&p Xylene	mg/kg	1	1	1	1	1	1	1	7	14000	LQM/CIEH S4UL (2015)
o-Xylene	mg/kg	1	1	1	1	1	1	1	7	15000	LQM/CIEH S4UL (2015)
Aliphatic TPH >C5-C6	mg/kg	0.001	0.001	0.001	0.001	0.001	0.001	0.001	7	5900	LQM/CIEH S4UL (2015)
Aliphatic TPH >C6-C8	mg/kg	0.001	0.001	0.001	0.001	0.001	0.001	0.001	7	17000	LQM/CIEH S4UL (2015)
Aliphatic TPH >C8-C10	mg/kg	0.001	0.001	0.001	0.001	0.001	0.001	0.001	7	4800	LQM/CIEH S4UL (2015)
Aliphatic TPH >C10-C12	mg/kg	1	1	1	1	1	1	1	7	23000	LQM/CIEH S4UL (2015)
Aliphatic TPH >C12-C16	mg/kg	3.3	2	2	2	2	2	2	7	82000	LQM/CIEH S4UL (2015)
Aliphatic TPH >C16-C21	mg/kg	8.7	8	8	8	10	8	8	7	-	-
Aliphatic TPH >C21-C35	mg/kg	50	8	8	8	57	8	8	7	No Risk	LQM/CIEH S4UL (2015)
Aliphatic TPH >C35-C44	mg/kg	59	8.4	8.4	8.4	42	8.4	8.4	7	No Risk	LQM/CIEH S4UL (2015)
Total Aliphatic Hydrocarbons	mg/kg	120	10	10	10	110	10	10	7		
Aromatic TPH >C5-C7	mg/kg	0.001	0.001	0.001	0.001	0.001	0.001	0.001	7	46000	LQM/CIEH S4UL (2015)
Aromatic TPH >C7-C8	mg/kg	0.001	0.001	0.001	0.001	0.001	0.001	0.001	7	100000	LQM/CIEH S4UL (2015)
Aromatic TPH >C8-C10	mg/kg	0.001	0.001	0.001	0.001	0.001	0.001	0.001	7	8100	LQM/CIEH S4UL (2015)
Aromatic TPH >C10-C12	mg/kg	1	1	1	1	3	1	1	7	28000	LQM/CIEH S4UL (2015)
Aromatic TPH >C12-C16	mg/kg	2	2	2	2	33	4.5	8.7	7	37000	LQM/CIEH S4UL (2015)
Aromatic TPH >C16-C21	mg/kg	11	10	13	10	290	22	40	7	28000	LQM/CIEH S4UL (2015)
Aromatic TPH >C21-C35	mg/kg	47	18	31	10	470	37	63	7	28000	LQM/CIEH S4UL (2015)
Aromatic TPH >C35-C44	mg/kg	8.4	8.4	8.4	8.4	88	8.4	8.4	7	28000	LQM/CIEH S4UL (2015)
Total Aromatic Hydrocarbons	mg/kg	58	22	44	10	880	63	110	7		
Total Petroleum Hydrocarbons	mg/kg	180	22	44	10	990	63	110	7		
Asbestos ID	Detection	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	Asbestos Detected	No Asbestos Detected	0		Detection Limit
Asbestos ID	Description	-	-	-	-	-	Chrysotile	-	0		Detection Limit
Asbestos Quantity	%	-	-	-	-	-	0.001	-	0		Detection Limit

Key -
Value within sample set exceeds screening value
Statistical value exceeds screening value

LQM/CIEH S4UL Reference No. S4UL3159 (2015)
Values in **bold** are reported at the laboratory limit of detection
Benzo(a)pyrene has been used as a 'surrogate marker for genotoxic PAH' as discussed in Appendix E of CL-AIRE SP1010 'Development of C4SL for Assessment of Land Affected by Contamination', December 2013.
This allows assessment of the combined carcinogenic risk associated with genotoxic PAH using only b(a)p. Genotoxic PAHs include Benz(a)pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(ah)anthracene, Indeno(123cd)pyrene, Benzo(ghi)perylene and have been marked with a * on the table.



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Analytical Report Number : 22-33705

Project / Site name:	Birch Ind Park - Unit B	Samples received on:	18/01/2022
Your job number:	AG3353-21	Samples instructed on/ Analysis started on:	18/01/2022
Your order number:	17750	Analysis completed by:	27/01/2022
Report Issue Number:	1	Report issued on:	01/02/2022
Samples Analysed:	3 leachate samples - 7 soil samples		

Signed:

Izabela Wójcik

Izabela Wójcik
Technical Reviewer (Reporting Team)
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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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: 22-33705
Project / Site name: Birch Ind Park - Unit B
Your Order No: 17750

Lab Sample Number				2140561	2140562	2140563	2140564	2140565
Sample Reference				DCS1	DCS2	DCS3	DCS5	DCS5
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	0.40	0.50	0.60	1.00
Date Sampled				10/01/2022	10/01/2022	10/01/2022	10/01/2022	10/01/2022
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	41	< 0.1
Moisture Content	%	0.01	NONE	12	22	22	14	16
Total mass of sample received	kg	0.001	NONE	0.80	0.80	0.80	0.80	0.80

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

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.4	7.4	6.6	8.1	7.8
Total Sulphate as SO4	%	0.005	MCERTS	-	0.047	-	0.118	0.041
Water Soluble Sulphate as SO4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	250	14	130	600	76
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.12	0.0071	0.066	0.30	0.038
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	125	7.1	65.6	299	38.0
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	-	2.4	-	52	5.8
Total Sulphur	%	0.005	MCERTS	-	0.028	-	0.078	0.029
Organic Matter (automated)	%	0.1	MCERTS	2.5	5.9	8.1	4.9	2.9
Water Soluble Nitrate (2:1) as NO3	mg/kg	2	NONE	-	9.1	-	19	2.7
Water Soluble Nitrate (2:1) as NO3 (leachate equivalent)	mg/l	5	NONE	-	< 5.0	-	9.3	< 5.0

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.28	0.41	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	1.5	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.37	4.9	0.42
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.19	4.8	0.30
Phenanthrene	mg/kg	0.05	MCERTS	1.0	0.23	1.9	68	3.5
Anthracene	mg/kg	0.05	MCERTS	0.26	< 0.05	0.39	25	1.2
Fluoranthene	mg/kg	0.05	MCERTS	3.1	0.45	3.2	160	7.8
Pyrene	mg/kg	0.05	MCERTS	3.0	0.46	2.8	130	7.0
Benzo(a)anthracene	mg/kg	0.05	MCERTS	1.6	0.26	1.6	81	4.3
Chrysene	mg/kg	0.05	MCERTS	1.4	0.34	1.7	59	3.2
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	1.5	0.29	1.7	59	3.9
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	1.0	0.20	0.78	33	1.8
Benzo(a)pyrene	mg/kg	0.05	MCERTS	1.7	0.32	1.5	53	3.8
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.85	< 0.05	0.74	24	1.9
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.21	< 0.05	0.22	6.4	0.52
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.98	< 0.05	0.83	22	2.0

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	16.6	2.55	18.2	731	41.6
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Analytical Report Number: 22-33705
Project / Site name: Birch Ind Park - Unit B
Your Order No: 17750

Lab Sample Number				2140561	2140562	2140563	2140564	2140565
Sample Reference				DCS1	DCS2	DCS3	DCS5	DCS5
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	0.40	0.50	0.60	1.00
Date Sampled				10/01/2022	10/01/2022	10/01/2022	10/01/2022	10/01/2022
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	8.6	16	27	10	11
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.55	0.90	1.3	1.1	1.1
Boron (total)	mg/kg	1	MCERTS	2.8	2.8	3.7	4.8	4.3
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.4	< 0.2	< 0.2	0.5	< 0.2
Chromium (hexavalent)	mg/kg	4	NONE	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (III)	mg/kg	1	NONE	17	45	65	13	16
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	19	45	66	14	17
Copper (aqua regia extractable)	mg/kg	1	MCERTS	26	46	74	62	56
Lead (aqua regia extractable)	mg/kg	1	MCERTS	57	70	110	83	87
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	13	16	26	11	22
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	20	27	38	21	28
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	110	110	120	110	65

Magnesium (water soluble)	mg/kg	5	NONE	7.1	< 5.0	7.0	8.1	5.6
Magnesium (leachate equivalent)	mg/l	2.5	NONE	-	< 2.5	-	4.1	2.8

Monoaromatics & Oxygenates

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

Analytical Report Number: 22-33705
Project / Site name: Birch Ind Park - Unit B
Your Order No: 17750

Lab Sample Number				2140561	2140562	2140563	2140564	2140565
Sample Reference				DCS1	DCS2	DCS3	DCS5	DCS5
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	0.40	0.50	0.60	1.00
Date Sampled				10/01/2022	10/01/2022	10/01/2022	10/01/2022	10/01/2022
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6 _{HS_1D_AL}	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8 _{HS_1D_AL}	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10 _{HS_1D_AL}	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12 _{EH_CU_1D_AL}	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16 _{EH_CU_1D_AL}	mg/kg	2	MCERTS	3.3	< 2.0	< 2.0	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21 _{EH_CU_1D_AL}	mg/kg	8	MCERTS	8.7	< 8.0	< 8.0	10	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35 _{EH_CU_1D_AL}	mg/kg	8	MCERTS	50	< 8.0	< 8.0	57	< 8.0
TPH-CWG - Aliphatic > EC35 - EC44 _{EH_CU_1D_AL}	mg/kg	8.4	NONE	59	< 8.4	< 8.4	42	< 8.4
TPH-CWG - Aliphatic (EC5 - EC35) _{EH_CU+HS_1D_AL}	mg/kg	10	MCERTS	62	< 10	< 10	69	< 10
TPH-CWG - Aliphatic (EC5 - EC44) _{EH_CU+HS_1D_AL}	mg/kg	10	NONE	120	< 10	< 10	110	< 10

TPH-CWG - Aromatic >EC5 - EC7 _{HS_1D_AR}	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8 _{HS_1D_AR}	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10 _{HS_1D_AR}	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12 _{EH_CU_1D_AR}	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	3.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16 _{EH_CU_1D_AR}	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	33	4.5
TPH-CWG - Aromatic >EC16 - EC21 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	11	< 10	13	290	22
TPH-CWG - Aromatic >EC21 - EC35 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	47	18	31	470	37
TPH-CWG - Aromatic > EC35 - EC44 _{EH_CU_1D_AR}	mg/kg	8.4	NONE	< 8.4	< 8.4	< 8.4	88	< 8.4
TPH-CWG - Aromatic (EC5 - EC35) _{EH_CU+HS_1D_AR}	mg/kg	10	MCERTS	58	22	44	800	63
TPH-CWG - Aromatic (EC5 - EC44) _{EH_CU+HS_1D_AR}	mg/kg	10	NONE	58	22	44	880	63

TPHCWG - Total C5 - C44 Aliphatic & Aromatic _{EH_CU+HS_1D}	mg/kg	10	NONE	180	22	44	990	63
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U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number: 22-33705
Project / Site name: Birch Ind Park - Unit B
Your Order No: 17750

Lab Sample Number				2140566	2140567
Sample Reference				DCS4	CP4
Sample Number				None Supplied	None Supplied
Depth (m)				0.40	1.00
Date Sampled				10/01/2022	13/01/2022
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Stone Content	%	0.1	NONE	< 0.1	100
Moisture Content	%	0.01	NONE	17	18
Total mass of sample received	kg	0.001	NONE	0.80	0.80

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	-
Asbestos Quantification Total	%	0.001	ISO 17025	-	-
Asbestos Analyst ID	N/A	N/A	N/A	MWI	MWI

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	6.5	7.7
Total Sulphate as SO ₄	%	0.005	MCERTS	0.028	-
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	9.3	160
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.0047	0.083
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	4.7	82.5
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	1.6	-
Total Sulphur	%	0.005	MCERTS	0.021	-
Organic Matter (automated)	%	0.1	MCERTS	3.7	2.8
Water Soluble Nitrate (2:1) as NO ₃	mg/kg	2	NONE	4.5	-
Water Soluble Nitrate (2:1) as NO ₃ (leachate equivalent)	mg/l	5	NONE	< 5.0	-

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	0.48
Fluorene	mg/kg	0.05	MCERTS	< 0.05	0.41
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	4.5
Anthracene	mg/kg	0.05	MCERTS	< 0.05	1.1
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	13
Pyrene	mg/kg	0.05	MCERTS	< 0.05	12
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	5.8
Chrysene	mg/kg	0.05	MCERTS	< 0.05	5.2
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	6.2
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	3.1
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	6.6
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	3.0
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	0.77
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	3.5

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	65.3
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Analytical Report Number: 22-33705
 Project / Site name: Birch Ind Park - Unit B
 Your Order No: 17750

Lab Sample Number				2140566	2140567
Sample Reference				DCS4	CP4
Sample Number				None Supplied	None Supplied
Depth (m)				0.40	1.00
Date Sampled				10/01/2022	13/01/2022
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Heavy Metals / Metalloids					
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	10	12
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.77	0.68
Boron (total)	mg/kg	1	MCERTS	3.4	3.9
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	NONE	< 4.0	< 4.0
Chromium (III)	mg/kg	1	NONE	16	26
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	16	27
Copper (aqua regia extractable)	mg/kg	1	MCERTS	25	30
Lead (aqua regia extractable)	mg/kg	1	MCERTS	44	50
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	16	18
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	26	26
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	52	65

Magnesium (water soluble)	mg/kg	5	NONE	< 5.0	< 5.0
Magnesium (leachate equivalent)	mg/l	2.5	NONE	< 2.5	-

Monoaromatics & Oxygenates

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

Analytical Report Number: 22-33705
Project / Site name: Birch Ind Park - Unit B
Your Order No: 17750

Lab Sample Number				2140566	2140567
Sample Reference				DCS4	CP4
Sample Number				None Supplied	None Supplied
Depth (m)				0.40	1.00
Date Sampled				10/01/2022	13/01/2022
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Petroleum Hydrocarbons					
TPH-CWG - Aliphatic >EC5 - EC6 _{HS_1D_AL}	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8 _{HS_1D_AL}	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10 _{HS_1D_AL}	mg/kg	0.001	MCERTS	< 0.001	< 0.001
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 > EC35 - EC44 _{EH_CU_1D_AL}	mg/kg	8.4	NONE	< 8.4	< 8.4
TPH-CWG - Aliphatic (EC5 - EC35) _{EH_CU+HS_1D_AL}	mg/kg	10	MCERTS	< 10	< 10
TPH-CWG - Aliphatic (EC5 - EC44) _{EH_CU+HS_1D_AL}	mg/kg	10	NONE	< 10	< 10

TPH-CWG - Aromatic >EC5 - EC7 _{HS_1D_AR}	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8 _{HS_1D_AR}	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10 _{HS_1D_AR}	mg/kg	0.001	MCERTS	< 0.001	< 0.001
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	8.7
TPH-CWG - Aromatic >EC16 - EC21 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	< 10	40
TPH-CWG - Aromatic >EC21 - EC35 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	< 10	63
TPH-CWG - Aromatic > EC35 - EC44 _{EH_CU_1D_AR}	mg/kg	8.4	NONE	< 8.4	< 8.4
TPH-CWG - Aromatic (EC5 - EC35) _{EH_CU+HS_1D_AR}	mg/kg	10	MCERTS	< 10	110
TPH-CWG - Aromatic (EC5 - EC44) _{EH_CU+HS_1D_AR}	mg/kg	10	NONE	< 10	110

TPHCWG - Total C5 - C44 Aliphatic & Aromatic _{EH_CU+HS_1D}	mg/kg	10	NONE	< 10	110
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U/S = Unsuitable Sample I/S = Insufficient Sample



Analytical Report Number: 22-33705
Project / Site name: Birch Ind Park - Unit B
Your Order No: 17750

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

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

Quantitative Analysis

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

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

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

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
2140565	DCS5	1.00	151	Loose Fibres	Chrysotile	< 0.001	< 0.001

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



Analytical Report Number: 22-33705
Project / Site name: Birch Ind Park - Unit B

Your Order No: 17750

Lab Sample Number				2140568	2140569	2140570
Sample Reference				DCS1	DCS3	CP4
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.20	0.50	1.00
Date Sampled				10/01/2022	10/01/2022	13/01/2022
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	Units	Limit of detection	Accreditation Status			

General Inorganics

pH (automated)	pH Units	N/A	ISO 17025	8.0	7.2	7.8
Sulphate as SO ₄	mg/l	0.1	ISO 17025	22.2	7.4	7.4
Total Organic Carbon (TOC)	mg/l	0.1	NONE	18.8	10.4	11.9

Total Phenols

Total Phenols (monohydric)	µg/l	1	ISO 17025	3.2	5.3	3.9
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Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	NONE	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	NONE	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	NONE	< 0.01	< 0.01	< 0.01

Total PAH

Total EPA-16 PAHs	µg/l	0.2	NONE	< 0.2	< 0.2	< 0.2
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Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	1	ISO 17025	13	11	15
Beryllium (dissolved)	µg/l	0.2	ISO 17025	0.3	0.3	0.2
Boron (dissolved)	µg/l	10	ISO 17025	24	16	23
Cadmium (dissolved)	µg/l	0.08	ISO 17025	0.16	0.26	0.23
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0
Chromium (III)	µg/l	5	NONE	< 5.0	< 5.0	< 5.0
Chromium (dissolved)	µg/l	0.4	ISO 17025	3.9	4.1	2.1
Copper (dissolved)	µg/l	0.7	ISO 17025	14	7.6	9.2
Lead (dissolved)	µg/l	1	ISO 17025	7.6	7.5	7.9
Mercury (dissolved)	µg/l	0.5	ISO 17025	1.8	< 0.5	< 0.5
Nickel (dissolved)	µg/l	0.3	ISO 17025	5.4	4.5	5.0
Selenium (dissolved)	µg/l	4	ISO 17025	< 4.0	< 4.0	< 4.0
Vanadium (dissolved)	µg/l	1.7	ISO 17025	5.8	6.8	12
Zinc (dissolved)	µg/l	0.4	ISO 17025	13	20	10

Magnesium (dissolved)	mg/l	0.005	ISO 17025	1.6	0.85	1.3
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U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number : 22-33705

Project / Site name: Birch Ind Park - Unit B

* 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 *
2140561	DCS1	None Supplied	0.2	Brown clay and sand with gravel and vegetation.
2140562	DCS2	None Supplied	0.4	Grey clay with vegetation.
2140563	DCS3	None Supplied	0.5	Grey clay with gravel.
2140564	DCS5	None Supplied	0.6	Grey clay with stones.
2140565	DCS5	None Supplied	1	Grey clay and sand with gravel.
2140566	DCS4	None Supplied	0.4	Grey clay with vegetation.
2140567	CP4	None Supplied	1	Grey clay with stones.

Analytical Report Number : 22-33705

Project / Site name: Birch Ind Park - Unit B

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
NRA Leachate Prep	10:1 extract with de-ionised water shaken for 24 hours then filtered.	In-house method based on National Rivers Authority	L020-PL	W	NONE
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Metals by ICP-OES in leachate	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Boron in leachate	Determination of boron in leachate. Sample acidified and followed by ICP-OES.	In-house method based on MEWAM	L039-PL	W	ISO 17025
Hexavalent chromium in leachate	Determination of hexavalent chromium in leachate by acidification, addition of 1,5 diphenylcarbazine followed by colorimetry.	In-house method	L080-PL	W	ISO 17025
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazine followed by colorimetry.	In-house method	L080-PL	W	NONE
Magnesium, water soluble, in soil	Determination of water soluble magnesium by extraction with water followed by ICP-OES.	In-house method based on TRL 447	L038-PL	D	NONE
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols in leachate - LOW LEVEL 1 ug/l	Determination of phenols in leachate by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
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
Nitrate, water soluble, in soil	Determination of nitrate by reaction with sodium salicylate and colorimetry.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08, 2:1 extraction.	L078-PL	D	NONE
Speciated EPA-16 PAHs in leachate	Determination of PAH compounds in leachate by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L102B-PL	W	NONE
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
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
pH at 20oC in leachate (automated)	Determination of pH in leachate by electrometric measurement.	In house method.	L099B	W	ISO 17025

Analytical Report Number : 22-33705

Project / Site name: Birch Ind Park - Unit B

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
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 organic carbon in leachate	Determination of dissolved organic carbon in leachate by TOC/DOC NDIR analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Cr (III) in soil	In-house method by calculation from total Cr and Cr VI.	In-house method by calculation	L080-PL	W	NONE
Cr (III) in leachate	In-house method by calculation from total Cr and Cr VI.	In-house method by calculation	L080-PL	W	NONE
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	NONE
TPHCWG Ali Aro Sum	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	NONE
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in house method based on references.	HSE Report No: 83/1996, HSG 248, HSG 264 & SCA Blue Book (draft).	A006-PL	D	ISO 17025
Sulphate in leachates	Determination of sulphate in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil"	L039-PL	W	ISO 17025
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
Total Sulphate in soil as %	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Total Sulphur in soil as %	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
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
Chloride, water soluble, in soil	Determination of Chloride colorimetrically by discrete analyser.	In house method.	L082-PL	D	MCERTS
Water Soluble Nitrate (leachate equivalent)	Determination of nitrate by reaction with sodium salicylate and colorimetry.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08, 2:1 extraction.	L078-PL	D	NONE
Sulphate, water soluble, in soil	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

Analytical Report Number : 22-33705

Project / Site name: Birch Ind Park - Unit B

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
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For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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



LABORATORY REPORT



4043

Contract Number: PSL22/0551

Report Date: 02 March 2022
Client's Reference: AG3353-21
Client Name: Applied Geology Limited
Unit 23, Abbey Park
Stareton
Kenilworth
Warwickshire
CV8 2LY

For the attention of: Hannah Hadwin/Peter Gabrielle

Contract Title: Birch Ind Park, Unit B
Date Received: 21/1/2022
Date Commenced: 21/1/2022
Date Completed: 2/3/2022

Notes: Opinions and Interpretations are outside the UKAS Accreditation

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

Checked and Approved Signatories:

A Watkins
(Director)

R Berriman
(Quality Manager)

S Royle
(Laboratory Manager)

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SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
CP3		B	2.00		Brown very silty SAND.
CP4		U	4.00		Very soft brown very gravelly very sandy CLAY.
CP4		D	2.00		Brown slightly gravelly very sandy CLAY.
CP4		D	5.00		Brown slightly gravelly very sandy CLAY.
CP5		B	3.00		Brown very silty SAND.
DCS2		D	2.80		Brown slightly gravelly very sandy CLAY.
DCS4		B	1.20		Brown very silty SAND.
CP1		U	5.00		Firm brown slightly gravelly very sandy CLAY.
CP1		U	7.50		Firm brown very sandy CLAY.
CP1		U	10.50		Stiff brown slightly gravelly very sandy CLAY.
CP2		B	2.00		Brown silty SAND.



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PSL

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AG3353-21 Birch Ind Park, Unit B

Contract No:

PSL22/0551

Client Ref:

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SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

[illegible]

SYMBOLS : NP : Non Plastic

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



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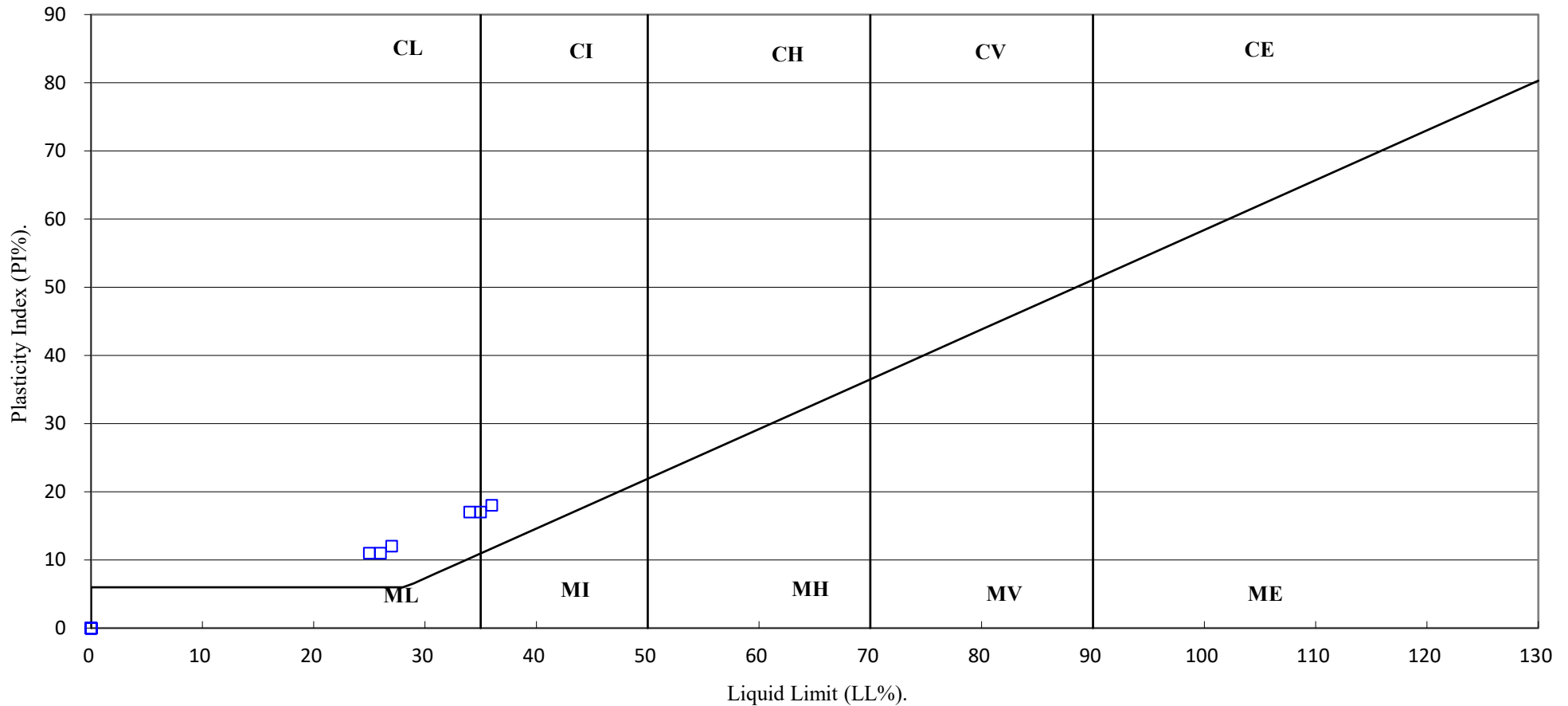
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PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



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PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:

CP5

Top Depth (m):

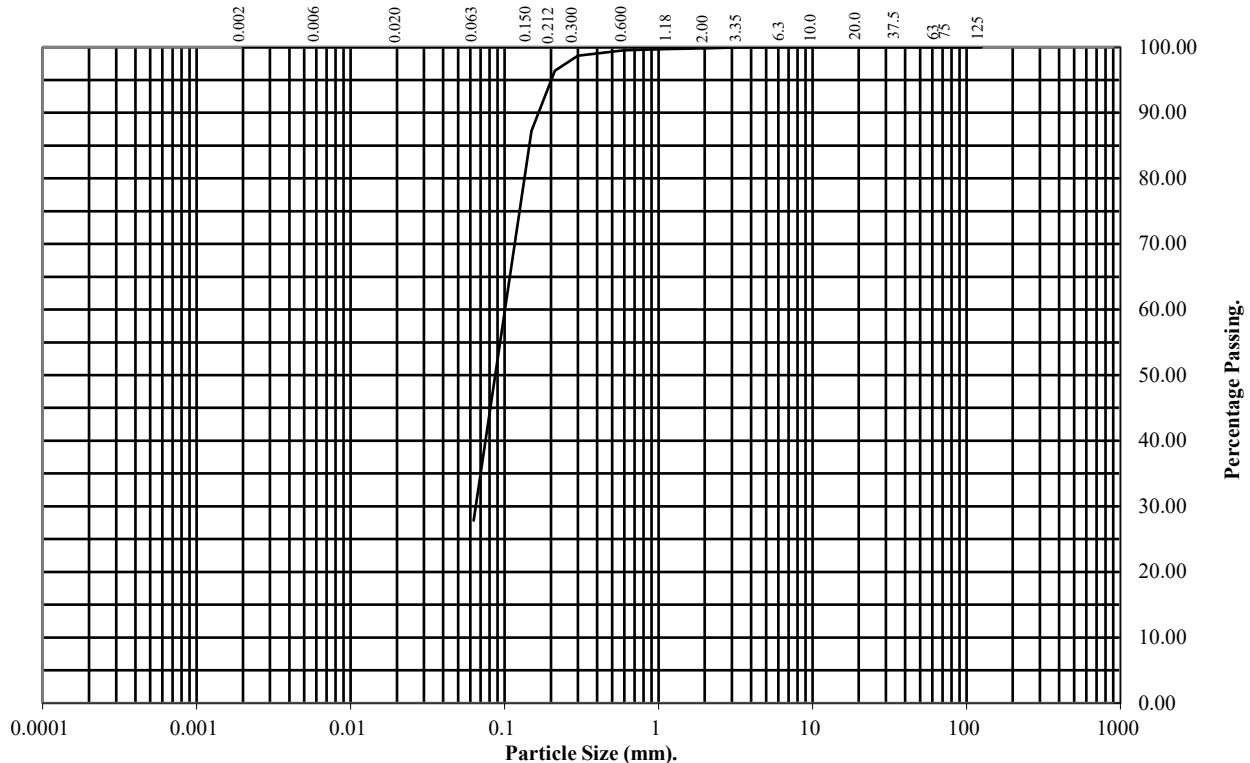
3.00

Sample Number:

Base Depth(m):

Sample Type:

B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	100
2	100
1.18	100
0.6	100
0.3	99
0.212	96
0.15	87
0.063	28

Soil Fraction	Total Percentage
Cobbles	0
Gravel	0
Sand	72
Silt/Clay	28

Remarks:

See Summary of Soil Descriptions



PSL
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Contract No:

PSL22/0551

Client Ref:

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PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:

CP2

Top Depth (m):

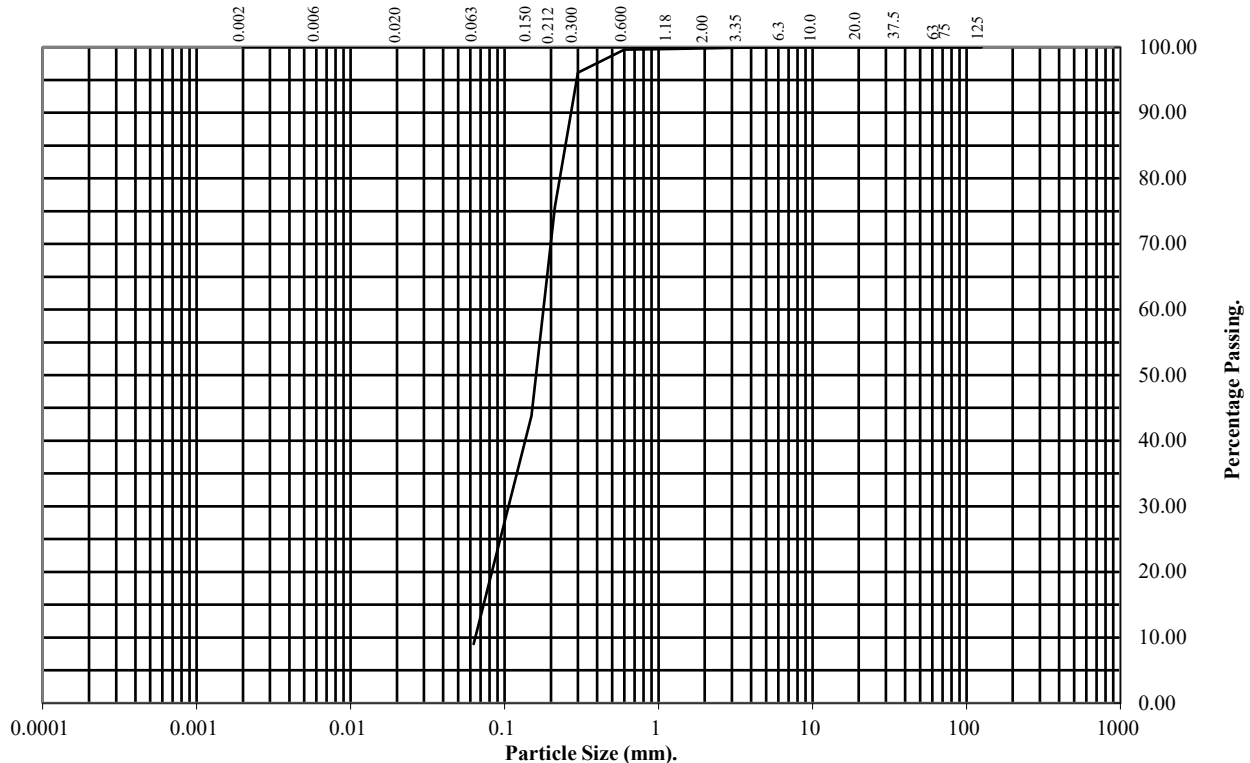
2.00

Sample Number:

Base Depth(m):

Sample Type:

B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	100
2	100
1.18	100
0.6	100
0.3	96
0.212	76
0.15	44
0.063	9

Soil Fraction	Total Percentage
Cobbles	0
Gravel	0
Sand	91
Silt/Clay	9

Remarks:

See Summary of Soil Descriptions



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AG3353-21 Birch Ind Park, Unit B

Contract No:

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Client Ref:

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PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

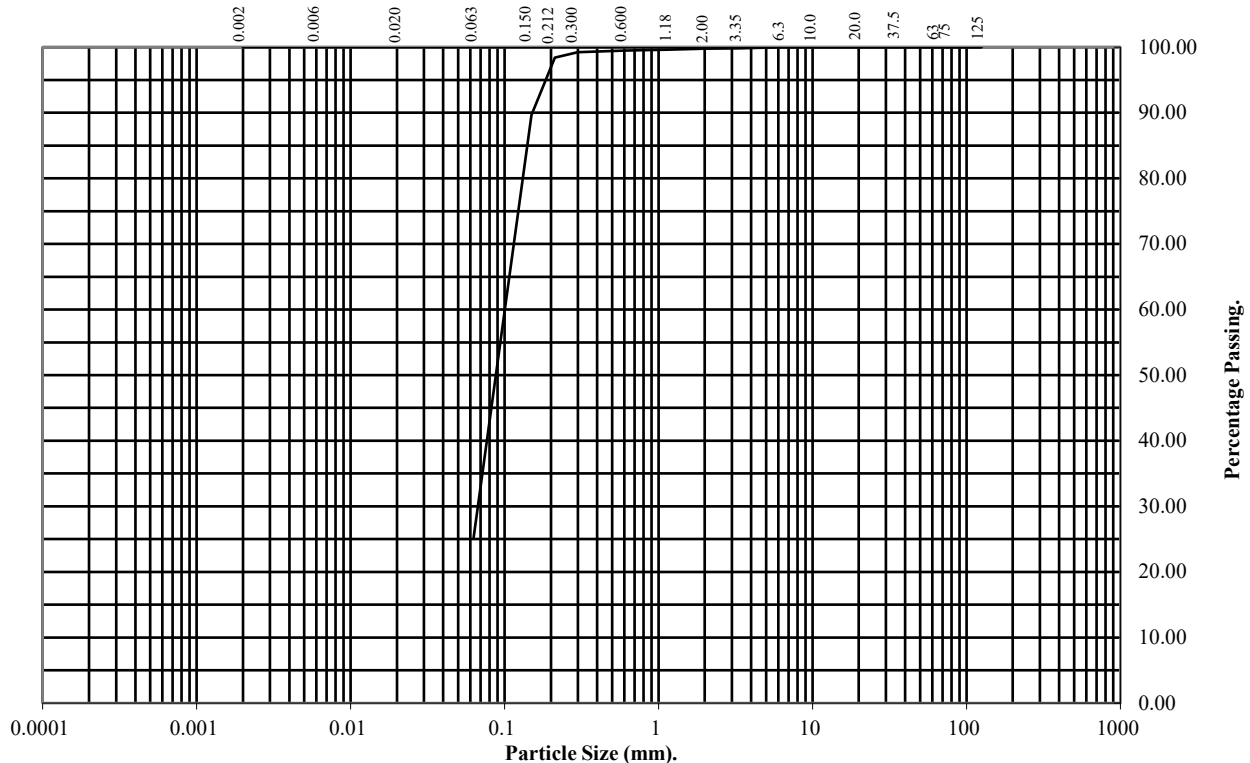
Hole Number: CP3

Top Depth (m): 2.00

Sample Number:

Base Depth(m):

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	100
2	100
1.18	100
0.6	99
0.3	99
0.212	98
0.15	90
0.063	25

Soil Fraction	Total Percentage
Cobbles	0
Gravel	0
Sand	75
Silt/Clay	25

Remarks:

See Summary of Soil Descriptions



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PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:

DCS5

Top Depth (m):

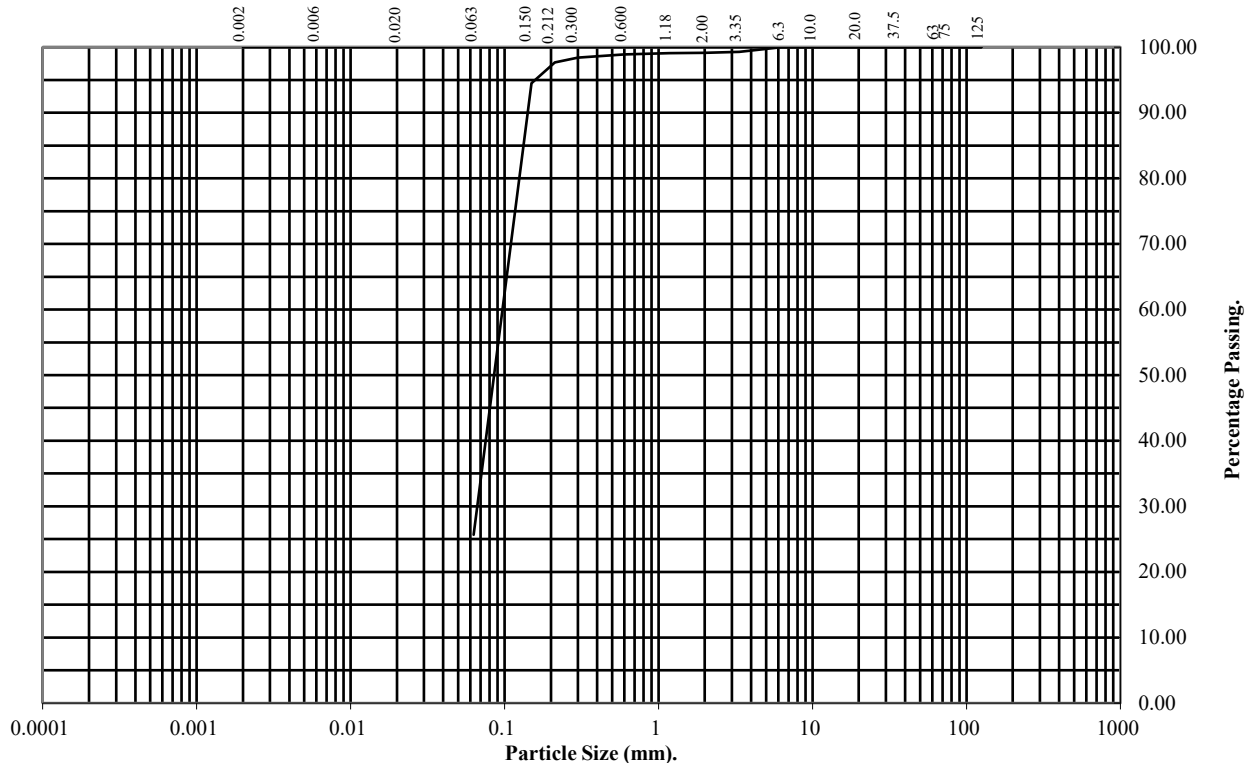
1.20

Sample Number:

Base Depth(m):

Sample Type:

B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	99
2	99
1.18	99
0.6	99
0.3	98
0.212	98
0.15	95
0.063	26

Soil Fraction	Total Percentage
Cobbles	0
Gravel	1
Sand	73
Silt/Clay	26

Remarks:

See Summary of Soil Descriptions



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AG3353-21 Birch Ind Park, Unit B

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PSL22/0551

Client Ref:

17785

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

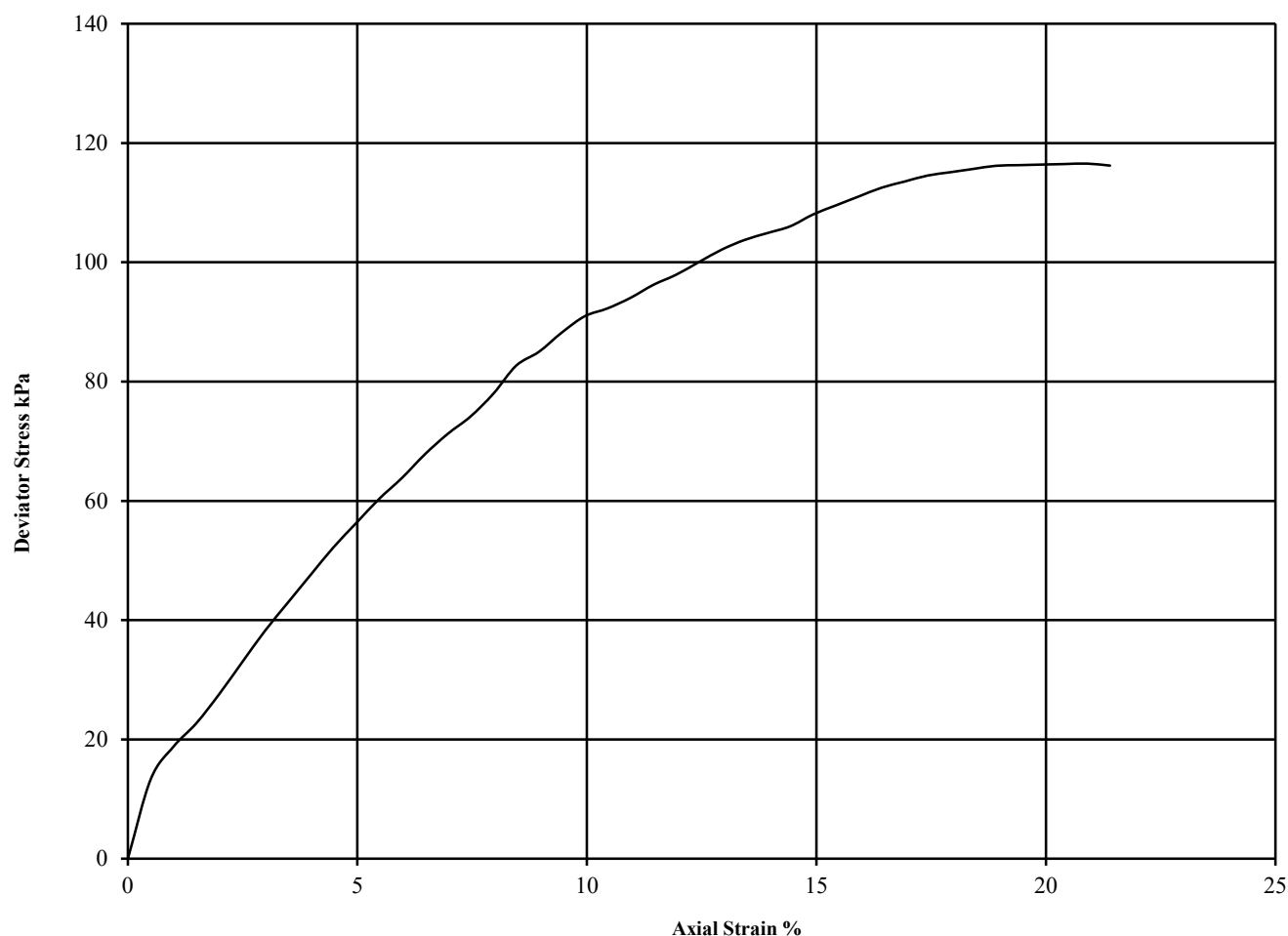
Hole Number: CP 1

Top Depth (m): 5.00

Sample Number:

Base Depth (m):

Sample Type U



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.33 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	18	2.15	1.82	100	117	58	20.9	Plastic	



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PSL22/0551

Client Ref:

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UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

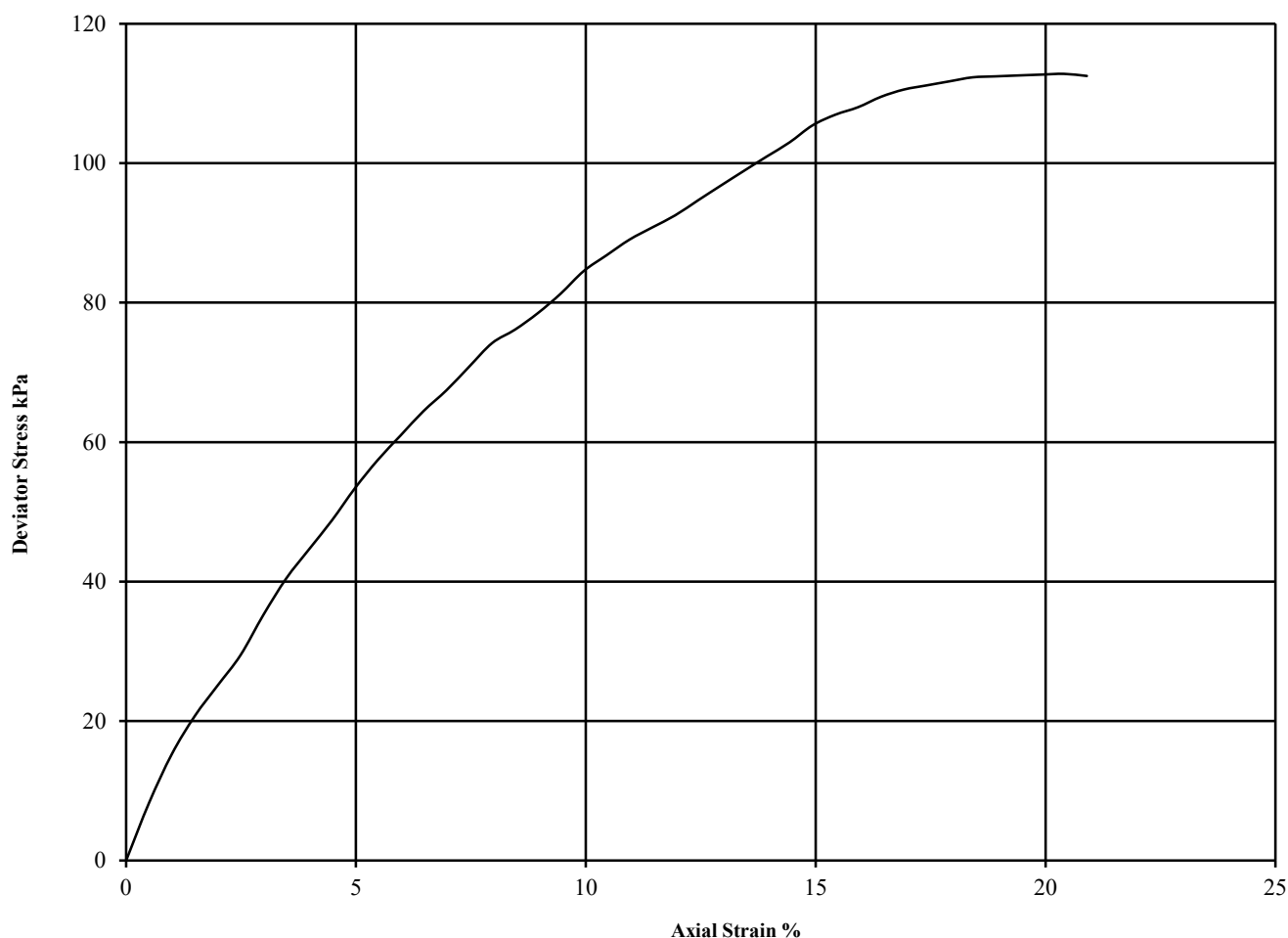
Hole Number: CP 1

Top Depth (m): 7.50

Sample Number:

Base Depth (m):

Sample Type U



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.33 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	17	2.15	1.84	150	113	56	20.4	Plastic	



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UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

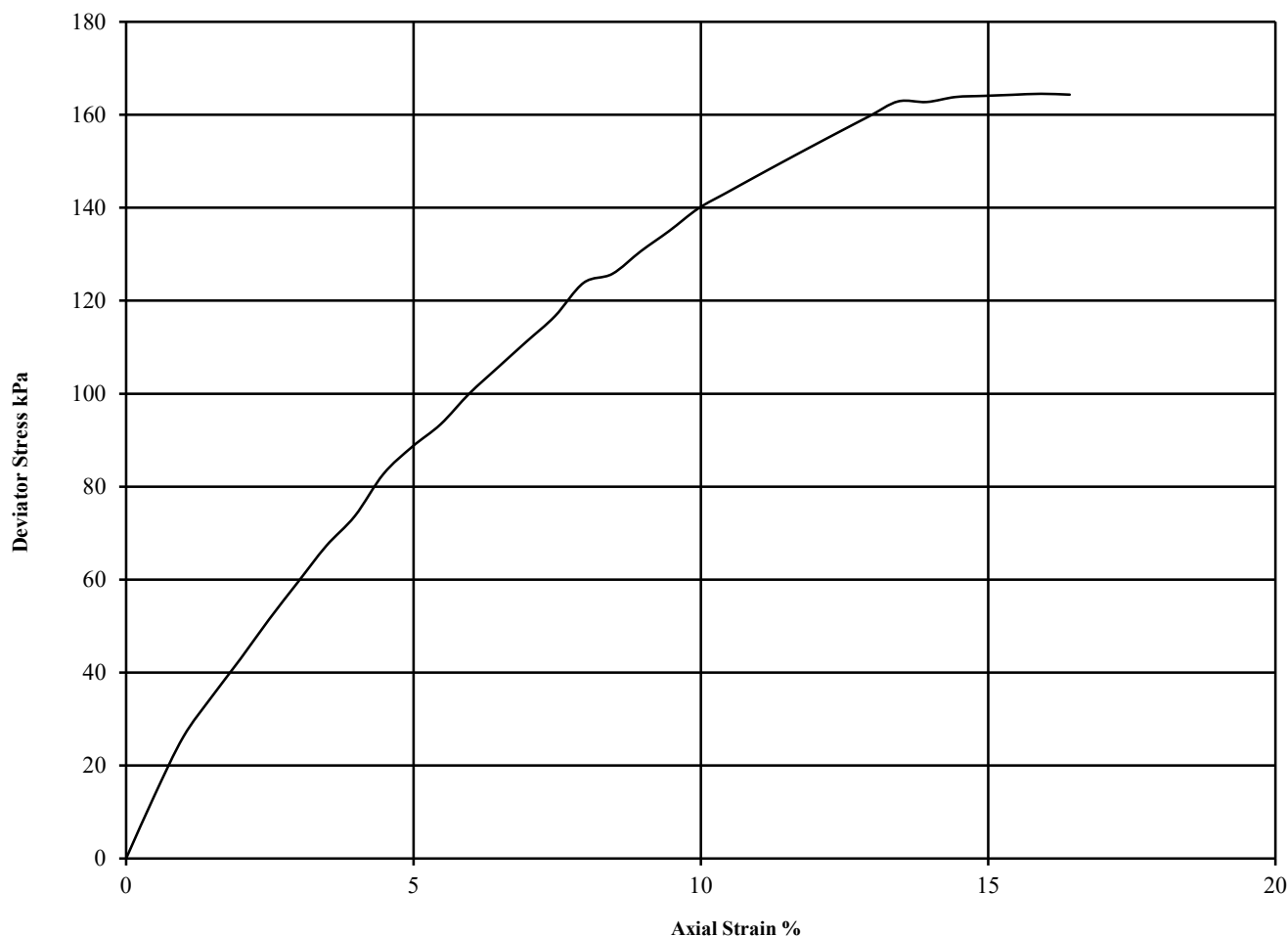
Hole Number: CP 1

Top Depth (m): 10.50

Sample Number:

Base Depth (m):

Sample Type U



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.34 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	18	2.12	1.80	210	165	82	15.9	Plastic	



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UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

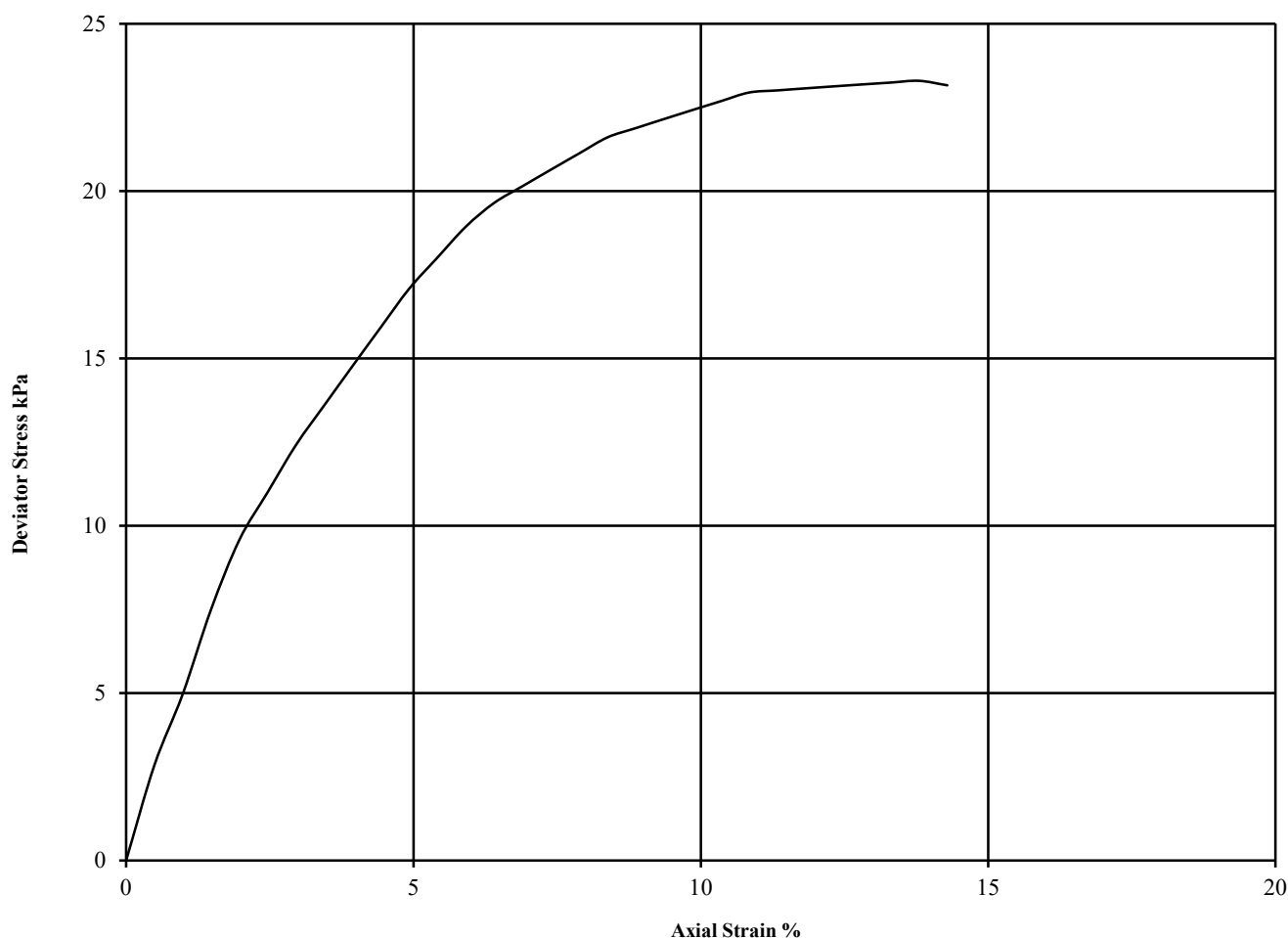
Hole Number: CP 4

Top Depth (m): 4.00

Sample Number:

Base Depth (m): 4.45

Sample Type U



Diameter (mm):		102	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.35 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	17	2.25	1.92	80	23	12	13.8	Plastic	



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Professional Soils Laboratory

'AG3353-21 Birch Ind Park, Unit B

Contract No:

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Client Ref:

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ANALYTICAL TEST REPORT

Contract no: 105613

Contract name: AG3353-21, Birch Industrial Park, Unit B

Client reference: PSL22/0551

Clients name: Professional Soils Laboratory

Clients address: 5/7 Hexthorpe Road
Doncaster
DN4 0AR

Samples received: 08 February 2022

Analysis started: 08 February 2022

Analysis completed: 14 February 2022

Report issued: 14 February 2022

Key

U	UKAS accredited test
M	MCERTS & UKAS accredited test
\$	Test carried out by an approved subcontractor
I/S	Insufficient sample to carry out test
N/S	Sample not suitable for testing

Approved by:

Rachael Burton

Reporting Team Lead

Chemtech Environmental Limited

SOILS

Lab number			105613-1	105613-2	105613-3	105613-4	105613-5
Sample id			CP2	CP3	DCS1	DCS3	DCS5
Depth (m)			1.20	3.00	1.80	1.20	1.20
Sample Type			D	D	D	D	D
Date sampled			-	-	-	-	-
Test	Method	Units					
pH	CE004 ^U	units	5.6	6.9	7.1	6.3	6.9
Magnesium (2:1 water soluble)	CE061	mg/l Mg	13	3.1	2.1	1.7	2.2
Chloride (2:1 water soluble)	CE049 ^U	mg/l Cl	4.7	5.5	6.6	3.4	7.0
Nitrate (2:1 water soluble)	CE049 ^U	mg/l NO ₃	1.1	<1	2.8	<1	6.0
Sulphate (2:1 water soluble)	CE061 ^U	mg/l SO ₄	16	<10	23	<10	14
Sulphate (total)	CE062 ^U	mg/kg SO ₄	116	<100	<100	135	205
Sulphur (total)	CE119	mg/kg S	100	<100	<100	168	259
Sulphur (total)	CE119	% w/w S	0.01	<0.01	<0.01	0.02	0.03

Chemtech Environmental Limited

METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE004	pH	Based on BS 1377, pH Meter	As received	U	-	units
CE061	Magnesium (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry		1	mg/l Mg
CE049	Chloride (2:1 water soluble)	Aqueous extraction, IC-COND	Dry	U	1	mg/l Cl
CE049	Nitrate (2:1 water soluble)	Aqueous extraction, IC-COND	Dry	U	1	mg/l NO ₃
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	U	10	mg/l SO ₄
CE062	Sulphate (total)	Acid extraction, ICP-OES	Dry	U	100	mg/kg SO ₄
CE119	Sulphur (total)	Acid extraction, ICP-OES	Dry		100	mg/kg S
CE119	Sulphur (total)	Acid extraction, ICP-OES	Dry		0.01	% w/w S

Chemtech Environmental Limited

DEVIATING SAMPLE INFORMATION

Comments

Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.

For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.

Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N	No (not deviating sample)
Y	Yes (deviating sample)
NSD	Sampling date not provided
NST	Sampling time not provided (waters only)
EHT	Sample exceeded holding time(s)
IC	Sample not received in appropriate containers
HP	Headspace present in sample container
NCF	Sample not chemically fixed (where appropriate)
OR	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
105613-1	CP2	1.20	Y	All (NSD)
105613-2	CP3	3.00	Y	All (NSD)
105613-3	DCS1	1.80	Y	All (NSD)
105613-4	DCS3	1.20	Y	All (NSD)
105613-5	DCS5	1.20	Y	All (NSD)

Chemtech Environmental Limited

ADDITIONAL INFORMATION

Notes

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

Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.

All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.

Methods, procedures and performance data are available on request.

Results reported herein relate only to the material supplied to the laboratory.

This report shall not be reproduced except in full, without prior written approval.

Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

For soils and solids, all results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.

Analytical results are inclusive of stones, where applicable.

APPENDIX E

APPENDIX E

STANDARD FIELDWORK AND ASSESSMENT PROCEDURES

Scope of Work

The scope of work undertaken is defined in Section 1 of the Report. It should be noted that Applied Geology Limited does not provide arboricultural surveys, specialist surveys for the detection of invasive plant species (such as Japanese Knotweed) or protected species of wildlife. Information from environmental and ecological datasets is included from a review of the MAGIC (Multi-Agency Geographic Information for the Countryside) website, however, if a full assessment of Environmental or Ecological aspects is required, it is recommended that other specialists are consulted. Similarly, information on flood risk is included; obtained from the Environment Agency Web site and the GroundSure report; but this is not intended to be a full hydrological study and, if a flood risk assessment is needed, additional analysis by others is recommended to confirm this aspect of the development. Also, whilst our field staff have undergone asbestos awareness training, Applied Geology does not undertake asbestos surveys or provide specific advice relating to asbestos-containing materials. Any suspected asbestos-containing materials observed by our field staff will be mentioned in the report but further assessment by others may be required.

Fieldwork

Fieldwork is generally carried out in accordance with BS5930 (2015) "Code of Practice for Site Investigations" and BS10175 (2011) Investigation of Potentially Contaminated Sites, unless otherwise stated.

Prior to commencement on site, statutory services plans are generally obtained and verbal enquiries are also made regarding the positions of private or statutory services on site. Prior to excavation or drilling, locations are scanned with a cable avoidance tool (CAT) and service pits are generally excavated at borehole positions, where possible.

Descriptions and depths of the various strata recovered are presented on the exploratory hole records, reproduced in the report appendices, together with sample depths, the results of in-situ testing, comments on groundwater inflows, and any other pertinent information. The strata descriptions are in general accordance with BS5930:2015. Disturbed plastic pot and glass amber jar samples are recovered from the various strata and stored and transported in cool boxes, where relevant, for possible future laboratory testing.

Light cable percussion boreholes are generally drilled using a Pilcon Wayfarer or Dando rig and are advanced using equipment to bore 200/150mm diameter boreholes. Disturbed plastic pot samples are recovered from all deposits encountered to allow examination and laboratory testing. Certain strata are cased off due to their tendency to collapse, particularly in the presence of groundwater inflows and/or to reduce the risk of cross contamination. In situ Standard Penetration Tests, using Split Spoon (SPT) and Cone (CPT) are undertaken in the boreholes to provide a measure of the relative density of the granular (coarse grained) deposits or shear strength of the clay/chalk/ weathered rock deposits using industry recognised correlation guidelines of shear strength against SPT "N" value results. Within the fine grained (cohesive) deposits, "undisturbed" 100mm driven open tube samples were recovered from the various deposits to provide samples for examination and laboratory testing. On encountering groundwater, boring is usually suspended for 20 minutes while any rise in water level is recorded. Full details of the groundwater observations and monitoring results during boring operations are included on the borehole records. All boreholes without monitoring wells installed are usually backfilled with arisings upon completion, unless otherwise stated on the individual logs.

Unless otherwise stated on the relevant logs, trial pits are excavated using a wheeled backhoe excavator, usually with a 0.6m wide bucket. The excavations are logged from the ground surface by an Engineering Geologist / Geo-environmental Engineer and relevant field testing, appropriate to the soils encountered, is carried out on samples brought to the surface. Representative disturbed soil samples are collected from selected horizons for subsequent laboratory testing. The trial pits are

usually unshored and where reasonable, left open for a period of time to allow observations of pit stability and depth and inflow rate of any groundwater ingress. The excavations are backfilled with arisings prior to moving on to the next position. Any trial pits carried out as part of this or previous investigations may represent soft spots and conduits/sumps for groundwater or surface water. In excavations, such materials may also be loose and unstable.

Driven Continuous Sampling (DCS) boreholes are drilled using a track mounted Global mini-rig or similar using sampling tubes of varying diameter (decreasing with depth). Samples of the deposits encountered are recovered in 1m long clear plastic liners, which are logged and sub-sampled on site by an Engineering Geologist. Generally for geotechnical investigations, during the drilling process in-situ Standard Penetration Tests (SPTs) are undertaken at selected depths to provide a measure of the relative density of the granular (coarse grained) deposits or shear strength of the clay/chalk/ weathered rock deposits using industry recognised correlation guidelines of shear strength against SPT "N" value results. Groundwater seepages are noted during drilling if encountered. All boreholes without monitoring wells installed are usually backfilled with arisings upon completion.

Unless specifically stated in the report, exploratory hole locations should be regarded as approximate. Consideration should be given to accurate location of the exploratory holes where it is considered they may impact on proposed development.

It should be noted that groundwater levels at any particular site may fluctuate due to rainfall, seasonal variations etc and, therefore, levels may be different to those measured during the course of the fieldwork and monitoring period.

Laboratory Testing

The geotechnical testing was carried out in accordance with BS 1377:1990 Method of Tests for Soils for Civil Engineering Purposes and was undertaken by a UKAS accredited specialist laboratory. Chemical testing was undertaken by a UKAS accredited specialist chemical testing laboratory and MCERTS accredited methods, in accordance with Environment Agency recommendations, were specified where available.

Contamination Assessment – Human Health

Applied Geology Limited has followed the guidance given in the CLR 11 publication and other available guidance to assess the contaminant concentrations. Details of the methodology followed are briefly outlined below.

The available chemical data is sorted into appropriate datasets depending on sampling regime and ground conditions. An initial generic quantitative risk assessment is undertaken on this data using statistical tests, where appropriate, and relevant screening values. Risk to human health has been initially assessed by comparing soil results against various published screening criteria. These have been sourced from the following, in order of preference:

- DEFRA. Category 4 Screening Levels (C4SL), March 2014;
- LQM/CIEH S4UL for Human Health Risk Assessment (S4UL), 2015*;
- Environment Agency/DEFRA, Soil Guideline Values (SGV) published in 2009;
- EIC/AGS/CL:AIRE Soil Generic Assessment Criteria (GAC), 2010.

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Except for lead and benzo(a)pyrene, the assessments will be carried out by comparing results against the LQM/CIEH S4UL in the first instance, where these values are exceeded, then reference will be made to the C4SLs where such exist. Lead will only be compared to the C4SL because no S4UL exists for lead. For Benzo(a)pyrene, Applied Geology has chosen to adopt the approach presented by the C4SL committee rather than the approach proposed by LQM/CIEH. Further discussion on this is presented below.

It is our view, and the view of others in the industry, that the C4SL were derived for use in both the Part IIA system and through the planning system, as they allow identification of those sites that fall within Category 4 (not contaminated) and are therefore able to be developed with no further remedial action. The C4SLs are considered to represent a contamination level that is 'low' from a toxicological view point, which we therefore consider to be 'acceptable' under planning.

Historically, the level of contamination has been assessed with reference to SGV values which were derived to represent a 'minimal' level of contamination. The SGVs are still valid and can be used alongside C4SL, however both screening values are only intended to provide guidance as to the level of contamination and, where concentrations fall below these screening values, the site is not contaminated (and is within Category 4). Exceedance of a SGV/S4UL/C4SL does not automatically indicate that an 'unacceptable' risk exists at a site; simply that further consideration of that particular contaminant is required.

At this time, there are two toxicological methodologies that can be used in the derivation of screening criteria for PAHs; Relative Potency Factor (RPFs) or the Surrogate Marker approach. Applied Geology has chosen (based on the latest guidance from the Health Protection Agency (HPA) to use the surrogate marker approach proposed in the C4SL methodology, whereby benzo(a)pyrene can be used as a surrogate marker for all 'genotoxic' (gene damaging) PAHs. The surrogate marker approach estimates the toxicity of a mixture of PAHs in an environmental matrix by using data from toxicity studies in which a PAH mixture of known composition was tested. Exposure to the surrogate marker benzo(a)pyrene is assumed to represent exposure to all the PAHs in the environmental matrix. Thus, the level of toxicity ascribed to the surrogate represents the toxicity of the PAH mixture. This allows an assessment of the combined carcinogenic risk associated with genotoxic PAHs using only benzo(a)pyrene. In order to confirm that the mixture of genotoxic PAH in the soil is similar to the coal tar mixture used in the toxicological study, various PAH ratios are plotted and checked to see that they fall within the limits set in HPA, 2010.

Contamination Assessment – Water Quality

Risks to water quality has been assessed by following the Environment Agency guidance on groundwater protection (previously known as GP3), updated on their website in March 2017, see <https://www.gov.uk/government/policies/water-quality> and 'The Environment Agency's approach to groundwater protection' (March 2017 Version 1.0).

For hazardous substances, which should be prevented from entering groundwater, the screening criteria are initially set as the limit of detection, however, if groundwater has already been impacted, an appropriate environmental standard will then be used. For hazardous substances, background quality may also be taken into account.

For non-hazardous compounds, their release should not result in any pollution or significant risk of pollution in the future, as such comparison with UK DWS or EQS standards will allow determination of whether pollution could occur. Typically screening criteria will be sourced from the following:

- Environmental Standards (ES), which are defined in European legislation such as the Water Framework Directive (WFD) (2000/60/EC) and the Priority Substances Directive (PSD) (2008/105/EC) a daughter directive of the WFD.
- The River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Direction, 2010.
- UK Water Supply (Water Quality) Regulations, 2010.
- UK quality standards for water to be used for direct abstraction to potable supply e.g. Surface Water (Abstraction for Drinking Water) (Classification) Regulations, 1996.
- World Health Organisation (WHO) Guidelines for Drinking Water Quality.

Re-use of Soils and Waste Soil Disposal

It is noted that if any excavated material is to be reused on site, a Waste Management Plan (WMP) and / or a Materials Management Plan (MMP) will probably be required. Any such materials must be suitable for re-use without further treatment, and only the quantity necessary for the specified works should be used. Any materials not within these definitions may need to be considered as waste whereby a Waste Management Licence Exemption may also be required.

A specific categorisation and assessment of potential waste soils arising from the proposed development has not been undertaken as part of the investigation, unless otherwise detailed in the report text. However, generic comments and advice are made below for the reader.

All waste soils should be sorted to prevent mixtures of waste types. Where possible, any waste soil should be recycled and the volume of soil to be disposed of should be minimised. Any excavated soil material and excess spoil disposed of off-site should be treated as Waste and classified as Inert, Non-hazardous or Hazardous, prior to removal from site, as required by the "Duty of Care" (Environmental Protection Act, 1990) legislation together with Annex II of Directive 1999/31/EC ("Landfill Directive"). Initially, Basic Characterisation of the waste is required whereby the material should be described and its source of origin recorded (a site plan, exploratory hole records and the certificates of chemical analysis in this report should be included). This should also include data on its composition and leaching behaviour, its European Waste Catalogue (EWC) code, and where relevant any hazardous properties according to Annex III of Directive 91/689/EEC. This information should be provided to the licensed waste contractor.

Soils excavated on many sites would generally fall under the EWC description "Soil and Stones", EWC code 17 05 04. Waste Acceptance Criteria (WAC) testing is required for many Inert wastes and generally for all Hazardous Waste but not for non-hazardous waste. There are certain restrictions for inert wastes regarding topsoil and peat. Any asbestos must be disposed of by suitably licensed contractors to a suitably licensed facility.

Health & Safety Aspects

As outlined within the HSE publication 'Successful Health and Safety Management - HSG65', this report should inform your development of safe systems of work and information as an input into the safety management system.

When developing risk control systems we suggest making reference to the CIRIA report 132 "A guide for safe working on contaminated sites" and the HSE document "Protection of workers and the general public during the development of contaminated land – HSG66". All risk control measures should be in accordance with the guidelines laid down within the Management of Health and Safety at Work Regulations 1999.

The contents of this report may be used to supplement the contents of the Health and Safety File as required under the Construction Design and Management (CDM) Regulations.

Where excavations are undertaken on site, trench support or the angle of batter should be designed by an appropriately qualified engineer or competent person to suit the required depth and the ground and groundwater conditions. Care should be taken when digging excavations to prevent undermining or causing loss of support to the foundations of the nearby adjoining structures. Surcharging such as from spoil or vehicle movements close to excavation sides should be avoided. Practical guidance on trench excavation is given in CIRIA Report 97 Trenching Practice. Guidance on groundwater control is given in CIRIA Report 113 Control of groundwater for temporary works. Temporary works should be designed by a suitably qualified engineer or a competent person particularly where personnel access is necessary, in accordance with the requirements of the Construction (Design and Management) (CDM) Regulations.