



University of Manchester: The Relocation of The Limes, Fallowfield Campus

Ground Investigation Report For University of Manchester

Date 5 August 2024

Doc ref LIMES-HYD-XX-XX-RP-G-2001

Document control sheet

Issued by	Hydrock Consultants Limited Northern Assurance Buildings 9-21 Princess Street Albert Square Manchester M2 4DN United Kingdom T +44 (0)161 804 5550 E manchestercentral@hydrock.com W hydrock.com	Client	University of Manchester
		Project name	University of Manchester: The Relocation of The Limes, Fallowfield Campus
		Title	Ground Investigation Report
		Doc ref	LIMES-HYD-XX-XX-RP-G-2001
		Project number	33445
		Status	S2
		Date	05/08/2024

Document production record

Issue number	S2	Name
Prepared by	Russell Sumner BSc (Hons) CSci FGS	
Checked by	Lauren Mollart BSc (Hons) CGeol FGS RoGEP	
Approved by	Adam Cheers BSc (Hons) CSci MEnvSc FGS	

Document revision record

Issue number	Status	Date	Revision details
S2	P01	23/05/2024	First Issue
S2	P02	05/08/2024	Second Issue
S2	P03	24/10/2024	Updated to project title and description

Hydrock Consultants Limited (Hydrock) has prepared this report in accordance with the instructions of the above-named Client, under the terms of appointment for Hydrock, for the sole and specific use of the Client and parties commissioned by them to undertake work where reliance is placed on this report. Any third parties who use the information contained herein do so at their own risk. Hydrock shall not be responsible for any use of the report or its contents for any purpose other than that for which it was prepared or for use of the report by any parties not defined in Hydrock’s appointment.

Contents

Executive summary	3
1. Introduction	5
1.1 Terms of Reference	5
1.2 Objectives	5
1.3 Scope	5
1.4 Available Information	5
1.5 Regulatory Information	6
2. Desk study review	7
2.1 Introduction	7
2.2 Site Location	7
2.3 Site Description	7
2.4 Site History	7
2.5 Geology	7
2.6 Hydrogeology	8
2.7 Hydrology	8
2.8 Flood Risk	8
2.9 Mining and Mineral Extraction	8
2.10 Natural Ground Instability	8
2.11 Waste Management	8
2.12 Regulatory Information	8
2.13 Natural Soil Chemistry	8
2.14 Radon	8
2.15 Unexploded Ordnance (UXO)	8
3. Initial Conceptual Site Model	9
3.1 Introduction	9
3.2 Ground Model	9
3.3 Geotechnical Hazard Identification	9
3.4 Geo-environmental Exposure Model	9
4. Ground Investigation	10
4.1 Site Works	10
4.2 Geo-environmental Testing	11
4.3 Geotechnical Testing	11
5. Ground Investigation records and data	12
5.1 Physical Ground Conditions	12
5.2 Groundwater	13

5.3 Ground Gases	13
5.4 Geotechnical Data	14
6. Geotechnical Assessment	17
6.1 Geotechnical Categorization of the Proposed Development	17
6.2 Groundworks	17
6.3 Foundation Recommendations	18
6.4 Ground Floor Slab	18
6.5 Roads and pavements	19
6.6 Drainage	19
6.7 Buried Concrete	19
7. Geo-environmental Assessment	19
7.1 Updated Conceptual Model	19
7.2 Risk Assessment Approach	19
7.3 Human Health Risk Assessment	19
7.4 Phytotoxicity Risk Assessment	20
7.5 Pollution of Controlled Waters Risk Assessment	21
7.6 Ground Gas Risk Assessment	22
7.7 Construction Material Risk Assessment	23
7.8 Contamination Risk to Ground Workers	23
7.9 Findings of the generic contamination risk assessments	23
7.10 Climate Change	24
7.11 Mitigation Measures	24
8. Waste and material management	26
8.1 Introduction	26
8.2 Waste Disposal	26
8.3 Materials Management	27
9. Uncertainties and limitation	29
9.1 General Comments	29
10. Recommendations for further work	29
11. References	30

Tables

Table 4.1: Summary of site works	10
Table 4.2: Summary of monitoring installations	10
Table 4.3: Geo-environmental analyses of soils or other solids	11
Table 4.4: Geo-environmental analyses of waters	11
Table 4.5: Summary of sample numbers for geotechnical tests	11
Table 5.1: Strata encountered	12
Table 5.2: Visual and olfactory evidence of contamination - soils	13

Table 5.3: Groundwater occurrence 13

Table 5.4: Groundwater level data summary 13

Table 5.5: Range of ground gas data 14

Table 5.6: Volume change potential.....14

Table 5.7: PSD results summary 15

Table 5.8: Soil strength results and derived values.....15

Table 5.9: Relative density results and derived values.....16

Table 5.10: Summary of compressibility 16

Table 5.11: CBR results and derived values 16

Table 5.12: Aggressive chemical environment concrete classification 16

Table 6.1: Characteristic geotechnical values.....17

Table 7.1: CoPC in soils which require further assessment (human health) 20

Table 7.2: Asbestos in soil samples (laboratory testing) 20

Table 7.3: CoPC which require further assessment (phytotoxic) 21

Table 7.4: Summary of water quality risk assessment protocol.....21

Table 7.5: CoPC which require further assessment (controlled waters) 21

Table 7.6: Ground gas risk assessment 22

Table 7.7: Residual risks following risk evaluation.....24

Table 7.8: Gas protection score by CS and type of building (after BS 8485:2015 +A1:2019).....25

Figures

Figure 1.1: Proposed Development Layout 5

Figure 2.1: 1934 Historical OS Mapping.....7

Figure 5.1: Typical Cross Section below the proposed building 13

Figure 5.2: Soil Water Content- Moisture Content/Liquid Limit against depth (m bgl).....14

Figure 5.3: Liquidity Index against depth (m bgl).....14

Figure 5.4: Undrained Shear Strength over depth (m bgl).....15

Figure 5.5: Undrained Shear Strength against level (m AOD) 15

Figure 7.1: Rooting depth requirements from Manchester City Council Planning Guidance (2021) 24

Appendices

Appendix A Drawings

Appendix B Exploratory Hole Location Plan, Exploratory Hole Logs and Photographs

Appendix C Geotechnical Test Results and Geotechnical Plots

Appendix D Site Monitoring Data and Ground Gas Risk Assessment

Appendix E Contamination Test Results and GQRA

Appendix F Waste Assessment

Appendix G Geotechnical Risk Register

Appendix H Plausible Source-Pathway-Receptor Contaminant Linkages

Appendix I Climate Change Considerations for CSM

Appendix J Preliminary UXO Risk Assessment

Executive summary

Site information and setting

Objectives	Ground Investigation Report.
Client	University of Manchester.
Site name and location	University of Manchester: The Relocation of The Limes, Fallowfield Campus. Owen Park Fallowfield, Manchester, M14 6YZ.
Proposed development	The proposed development is to comprise a two storey building utilised for food preparation including kitchen, ancillary area, food stores, changing rooms, workshops, plant rooms and meeting rooms and external areas including access, service yard and landscaping.
Site description	The site comprises a flat asphalt car park including a bike shed in the centre and various scars associated with underground services. Mature and semi-mature trees are present on the north and west boundary. There are also mature trees present close to the southern boundary.

Desk study summary

Topography	The site is flat and lies at between 44.35 to 44.41m AOD.
Hydrology	An unnamed brook is present 250m west.
Site History	Between 1849 and 1907 the site remained undeveloped. Between 1907 up to 1995 the site included two stands in the south/south east and an earthworks/embankment in the south west associated with the offsite sports stadia. During this time period small unnamed buildings were present in the north east, west and north west. From 1995 the site became a car park.
Geology	Artificial and Made Ground: Made Ground Superficial: Glacial Till Solid: Chester Formation
Hydrogeology	The Glacial Till is classified as a Secondary Undifferentiated Aquifer. The Chester Formation is classified as a Principal Aquifer. The site is within a groundwater Source Protection Zone (SPZ) Zone 3 (Total Catchment). There are no active groundwater abstractions within 1km of the site.
UXO risk	According to the preliminary report, the risk from UXO on site is not considered to be significantly elevated above the 'background level' for the region.

Ground Model proven by Investigation

Ground and groundwater conditions encountered by investigation	The ground conditions as proven by the investigation(s) undertaken at the site comprise: - Surface covering- Asphalt hardstanding between ground level and 0.15m below ground level (bgl). 'Non-General' Made Ground- between 0.07m and 0.55m bgl, comprising a Type 1 sandy GRAVEL; 'General Made Ground' – between 0.17m and 1.40m bgl comprising a silty CLAY or clayey/silty ashy SAND or GRAVEL. Gravel content of brick, mudstone, coal and sandstone.
--	---

- Glacial Till – between 0.35m and 4.70m bgl, comprising soft to firm silty CLAY extending to 2.00m, underlain by a stiff to very stiff slightly sandy slightly gravelly CLAY.
- Weathered Chester Formation – top encountered at 3.65m and 4.70m bgl, comprising a dense SAND.

Groundwater was encountered at depths between 0.70m bgl and 1.20m bgl during the investigation with locally deeper groundwater encountered at 3.00m in WS08 within a band of sand in the Glacial Till.

It is likely that the 40cm to 50cm of water within BH01 and BH02 present between 4.30m and 4.63m bgl (40.06m to 39.81 m AOD) is representative of seepage of perched groundwater on top of the Glacial Till, migrating into the well below the bentonite seal.

Within WS08 the groundwater appears to be associated with a band of sand at 3.00m bgl which is under sub artesian pressure rising to 0.96 to 1.10m bgl (43.59 – 43.45m AOD).

There is olfactory evidence of petroleum hydrocarbon contamination in WS09 with very weak odours between 1.00m and 1.10m bgl (within the Made Ground). Laboratory testing completed on the Made Ground found no elevations of GACs for petroleum hydrocarbons, therefore they are considered to pose a low risk to human health.

Summary of Geotechnical conclusions

Groundwork	Excavation to proposed founding depth generally should be readily achievable with standard excavation plant following breaking out of the existing hardstanding. Water seepages into excavations are likely to be adequately controlled by sump pumping.
Foundations and Floor Slab	Foundations are recommended to comprise: - Pad foundations targeting 2.50m bgl in the high strength Glacial Till (subject to additional desiccation assessment). or - Driven piled foundation. Allowable net bearing pressure of 150 kN/m² for pad foundations should be achievable. Deepening of foundations/heave protection is likely to be required to allow for the effects of trees. Suspended floor slabs are recommended due to the depth of Made Ground (up to 1.65m) and presence of medium shrinkage potential clay soils. Floor slabs should be suspended over a void where within the influencing distance of trees. If pad foundations are the preferred foundation option, then additional ground investigation and desiccation assessment will be required in accordance with BRE Digest 298. The designer will also need to account for desiccation if designing piles for the structure.
Roads and pavements	For road / pavement design, a design CBR of 2.5 % for the Made Ground and <2.5% for the soft to firm Glacial Till.
Sustainable drainage	Soakaway drainage is considered unsuitable for this site due to the underlying low permeability Glacial Till and potential for perched groundwater on top of the Made Ground which would reduce the potential unsaturated zone for a soakaway test.
Buried concrete	Design Sulphate Class - DS-1 and ACEC Class AC-1. Equivalent to Design Chemical Class DC-1 for a 50 year design life.

Summary of geo-environmental assessment	
Human Health	Pervasive PAH and asbestos loose fibres have been encountered within the Made Ground across the site.
Phytotoxicity	A localised hotspots for elevated Zinc within the Glacial Till was recorded. However, this is not considered to be representative of the Glacial Till and does not pose a risk.
Controlled waters	Based on the concentrations of the inorganic contaminants being within the reported ranges of the baseline concentrations in the sandstone bedrock and low likelihood of the Made Ground onsite being source of the inorganic contaminants due to the absence of elevated PAHs in the groundwater the site is considered to pose a low risk to controlled waters.
Radon	The site is not in a radon affected area.
Potable water supply pipes	The site is brownfield and organic contamination PAHs-particularly Naphthalene is resulting in exceedance for PE pipe threshold values within the Made Ground and Hydrock believes barrier pipe is required. However, confirmation should be sought from the water supply company at the earliest opportunity.
Ground gases or vapours:	Moderate risk from ground gases and CS2 conditions apply if the building is piled. If the building is not piled the 1.50m of stiff low permeability Glacial Till remaining below the pad foundation will sever any ground gas pathways between the building and the Chester Formation.

Enabling Works	
Proposed mitigation measures	The installation of a simple cover system in soft landscaping to align with Manchester City Council Planning Guidance documentation and should include 450mm in Zone 1 areas (grass seeding) and in Zone 2 (shrub planting) 600mm, comprising a visible geomembrane marker layer, subsoil beneath a topsoil thickness of between 150mm and 300mm. Installation of Barrier pipework for potable water pipes installed within Made Ground; Suitable quantities of testing of any topsoil and subsoil placed in landscaped areas; Gas monitoring is complete; and ground gas mitigation measures to comply with CS2 conditions if the building is piled,
Waste Management	The excavated Made Ground and Glacial Till will likely be classed as non-hazardous. Made Ground classified as Hazardous for off-site disposal purposes was identified in WS09 between 1.00m and 1.10m bgl, due to Made Ground in WS09 underneath the proposed landscaping area between 1.00m and 1.10m bgl is locally classified as hazardous (under HP7 carcinogenic and HP11 mutagenic) due to the concentrations of petroleum hydrocarbon bandings. However, excavation for the formation level for soft landscaping in this area of the site is unlikely to encroach on the impacted Made Ground.

Further Considerations	
Further Works	Following the ground investigation works undertaken to date, the following further works will be required: • should pad foundations from a cost perspective be the preferred foundation option then additional ground investigation and desiccation assessment would be required; • discussion and agreement with utility providers regarding the materials suitable for pipework; • discussions with regulatory bodies and the warranty provider regarding the conclusions of this report; • discussions with piling Contractors regarding conclusions of this report and design of the piles if required; • provision of geotechnical design for the Category 2 structure (if piles are the preferred foundation option); • production of a Remediation Strategy and Verification Plan (and agreement with the regulatory bodies and the warranty provider); • production of a Materials Management Plan relating to reuse of site-won and imported soils. • remediation and mitigation work; and • verification of the remediation.

This Executive Summary forms part of Hydrock Consultants Limited report number LIMES-HYD-XX-XX-RP-G-2001 and should not be used as a separate document

1. Introduction

1.1 Terms of Reference

In February 2024, Hydrock Consultants Limited (Hydrock) was commissioned by University of Manchester (the Client) to undertake a ground Investigation at University of Manchester - The Limes Relocation. The site is located off Whitworth Lane, Fallowfield, Manchester.

The proposed Development will combine the University's Catering Central Processing Unit (CPU), Maintenance Services Unit (MSU), Environmental Services Unit (ESU) and Residences Team to form a facility consisting of facility management stores and workshops, catering facilities, staff workspaces and storage facilities.

The site is divided into two main sections: the western part is designated for parking, while the eastern section houses the building, which is split into the main building and the external stores.

The western side of the Site will provide 45 car parking spaces, inclusive of 4 accessible car parking space. It is noted that Richmond Park Halls will be allocated 2 dedicated accessible car parking spaces. The eastern side of the Site will provide 14 car parking spaces for staff car parking inclusive of 2 accessible car parking bays, 2 accessible car parking space will be dedicated to Richmond Park Halls for student parking; 5 electric vehicle (EV) car parking space will be provided inclusive of 1 accessible EV parking bay; and 1 parking space will be provided for Tail Lift/Sprinter parking. The total number of car parking spaces will be 66 and 1 Tail Lift/Sprinter parking. The overall car parking provision represents a reduction of 64 spaces. Additionally, a bike store with 20 cycle spaces and 7 cycle racks will be provided for staff and students outside the entrance to the main building.

The proposed development layout (Butress Drawings, LIMES-BUT-M3-R3-DR-A-04101); is shown below as Figure 1.1.



Figure 1.1: Proposed Development Layout

The study has been undertaken in accordance with Hydrock's proposal referenced (Ref 33445-GNST-FP-GE-0001 dated February 2024) and the Client's instructions to proceed (email dated 13th February 2024).

1.2 Objectives

The works have been commissioned to support the planning application and to assist with the design of the development.

The objectives of the Phase 2 Ground Investigation are:

- » to resolve any geotechnical and geoenvironmental uncertainties identified in the Phase 1 Desk Study by refining and updating the preliminary Ground Model, based on the conditions met in accordance with the principles of Environment Agency (EA) 'Land Contamination: Risk Management' (LCRM) (2023);
- » to identify any geo-environmental mitigation requirements to enable development to progress; and
- » to provide preliminary geotechnical recommendations for design.

1.3 Scope

The scope of the Phase 2 Ground Investigation comprises:

- » a ground investigation including dynamic windowless sampling and cable percussive boring to:
 - » obtain data on the ground and groundwater conditions of the site;
 - » allow collection of samples for geotechnical and chemical laboratory analysis;
 - » allow geotechnical field tests to be undertaken;
 - » install gas and groundwater wells;
- » ground gas concentration and groundwater level monitoring;
- » groundwater sampling;
- » geotechnical and chemical laboratory analysis;
- » updating of the preliminary Ground Model;
- » preparation of a geotechnical risk register;
- » presentation of an initial geotechnical design recommendations;
- » formulation of an updated Conceptual Site Model (CSM), including identification of any plausible contaminant linkages;
- » completion of a generic quantitative risk assessment of any identified chemical contaminants to establish 'suitability for use' under the current planning regime;
- » discussion of any potential environmental liabilities associated with land contamination (soil, water and gas); and
- » identification of outline mitigation requirements to ensure the site is 'suitable for use'.

1.4 Available Information

Hydrock produced the Ground Conditions Desk Study report for the site, referenced as:

- » Hydrock, May 2024. 'Ground Conditions Desk Study Report, UoM The Limes Relocation', Ref: LIMES-HYD-XX-XX-RP-G-1001.

The following document has been provided to Hydrock by Client for use in the preparation of this report:

- » Butress, March 2024. 'Owen Park Fallowfield, Manchester, M14 6YZ, Sketch Scheme- Site Arrangement Option 3', Ref: LIMES-BUT-MS-00-DR-A-10002-P01.

It is understood that the Client defined in Section 1.1 has obtained assignment of the above document and Hydrock has assumed full reliance can be placed upon its contents. Should this not be the case, Hydrock should be informed at the earliest opportunity.

The following documents have been reviewed by Hydrock from publicly available sources for use in the preparation of this report:

- » Geotechnics. August, 2015. 'Project Oak SI Scope Stage 2B', Factual Report, Ref: PN153349 undertaken for Coffey Geotechnics.

Hydrock acknowledge that these documents are not assigned to the University of Manchester, and have been used for information purposes only. No formal reliance has been placed upon their contents.

1.5 Regulatory Information

The investigation work has been carried out in general compliance with recognised best practice, including (but not limited to) BS 5930:2015+A1:2020, BS 10175:2011+A2:2017 and the AGS (2006) 'Good Practice Guidelines for Site Investigations'.

The geo-environmental section of this report is written in broad accordance with BS 10175:2011+ A2:2017 and EA LCRM (2023).

Phase 2 comprises intrusive ground investigation work and testing. The factual information from the desk study and the ground investigation are used to develop the Conceptual Site Model (CSM). This CSM is based on a ground model of the site physical conditions and an exposure model of the possible contaminant linkages. The CSM forms the basis for Generic Quantitative Risk Assessment (GQRA) in accordance with current guidelines. This GQRA might lead to more Detailed Quantitative Risk Assessment (DQRA).

Professional judgement is then used to evaluate the findings of the risk assessments and to provide recommendations for the development.

The geotechnical section of this report is prepared in general accordance with BS EN 1997-1+A1: 2013, BS EN 1997-2:2007 and BS 8004:2015+A1:2020. This report constitutes a Ground Investigation Report (GIR) as described in Part 2 of Eurocode 7 (BS EN 1997-2) (EC7). However, it is not intended to fulfil the requirements of a Geotechnical Design Report (GDR) as specified in EC7.

Where relevant the relevant requirements of the current edition of NHBC Standards have also been applied.

The geo-environmental and geotechnical aspects are discussed in separate sections. Throughout the report the term 'geotechnical' is used to describe aspects relating to the physical nature of the site (such as foundation requirements). The term 'geo-environmental' is used to describe aspects relating to ground-related environmental issues (such as potential contamination). However, it should be appreciated that this is an integrated investigation and these two main aspects are inter-related. Designers should take all aspects of the investigation into account.

Remaining uncertainties and recommendations for further work are listed in Section 9 and Section 10.

2. Desk study review

2.1 Introduction

Hydrock have completed a Ground Conditions Desk Study for the site (as detailed in Section 1.4) and the following section is a summary of the pertinent information presented in the Desk Study.

2.2 Site Location

The site is located on Owen Park, Fallowfield, Manchester, M14 6YZ. The site is situated between Whitworth Lane (west) and Chancellors Way (East), approximately 230m east of Platt Field Park and 4km south east of Manchester City Centre.

A site location plan (Hydrock Drawing LIMES-HYD-XX-XX-D-G-00001) is presented in Appendix A.

2.3 Site Description

The site is rectangular in shape and has an area of approximately 0.56ha. The site is flat and lies at 44.35 to 44.41m AOD.

The site is currently an asphalt car park utilised by student living within the adjacent halls of residence. The site is bordered by mature and semi mature trees to the north/south and adjacent to the access from Whitworth Lane. .

Visual scarring is present across the car park and various manholes and inspection chambers relating to existing services crossing the site including BT, Gas, Sewers and Electricity.

A site features plan (Hydrock Drawing LIMES-HYD-XX-XX-D-G-00002) is presented in Appendix A.

2.4 Site History

Between 1849 and 1907 the site remained undeveloped. Between 1907 up to 1995 the site included two stands in the south/south east and an earthworks in the south west associated with the offsite sports stadium. Other uses also include a Tennis Court in the north and pavilion associated with the bowling club in the north east. During this time period small unnamed buildings were present in the north east, west and north west.

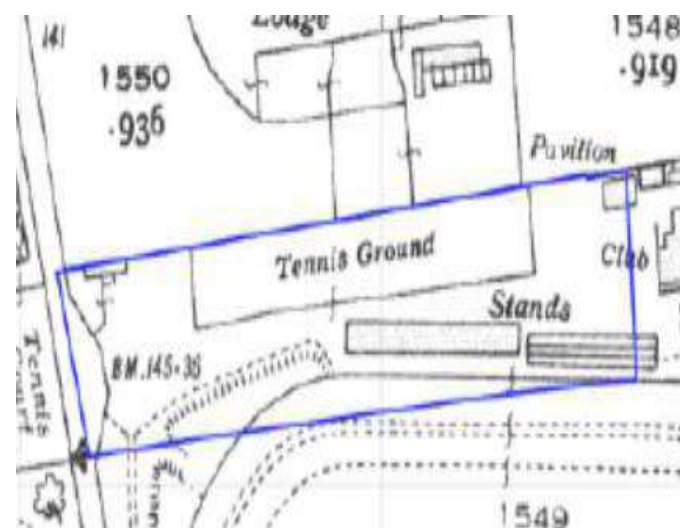


Figure 2.1: 1934 Historical OS Mapping

As shown in Figure 2.1 in 1934 two stands in the south and south east of the site. A Tennis Ground present in the north. Pavilion associated with the Bowling Green in the north east and a small unnamed building in the north west. Earthworks associated with the adjacent Athletics Stadium is present in the south west.

From 1995 the site became a car park. The historical mapping does not show any pertinent off-site sources of contamination in close proximity. The age of the car park post-dates the use of coal tar within tarmac binders and therefore, the existing asphalt hardstanding is not considered to pose a risk to site end users, due to the unlikely probability of it containing coal tar.

2.5 Geology

The Groundsure Report and BGS geological mapping record no artificial/worked or infilled ground onsite or in close proximity, however it is anticipated that Made Ground will be present on-site especially associated with the former stands, buildings (north east, northwest and west) and possibly from the previous earthworks in the south west.

The superficial geology comprises Glacial Till, likely including either sandy gravelly CLAY or gravelly silty CLAY.

The solid geology comprises Chester Formation, comprising reddish brown, cross-bedded, pebbly sandstones with subordinate beds of red-brown mudstone. The Chester Formation is indicated to be up to 400m thick, but is unlikely to be so thick below the site.

A fault is present 370m east, the site lies on the downthrow side of the fault.

A review of the BGS archive found the closest freely available borehole completed to a suitable depth is situated 240m to the north west.

- » SJ89SE9, located on the corner of Old Hall Lane and Wilmslow Road (NGR 385604E, 394457N), drilled to a depth of 13.11m and recorded:
 - » Made Ground between ground level and 0.90m below ground level (bgl);
 - » Plastic CLAY (assumed firm) from 0.90m to 3.96m bgl (probable Glacial Till);
 - » Hard CLAY between 3.96m and 4.88m bgl (probable Glacial Till); and
 - » Light red SAND from 4.88m to 13.11m bgl (probable weathered Chester Formation).

Groundwater was encountered at 3.66m bgl on top of the Hard CLAY mentioned above.

2.5.1 Previous Investigations

Hydrock 2016 Ground Investigation

In November 2016 Hydrock undertook a ground investigation on Unsworth Park 20m to the east of the site. As part of the investigation Hydrock were provided a factual ground investigation which included boreholes on the site and the wider Owen Park, the ground investigation was undertaken for Coffey Geotechnics by Geotechnics in 2015.

As part of the site investigation BH18/1A was completed below the energy centre to the east of the Limes site. BH16 to BH17/1A were completed on the subject site.

BH16/1A (E385888.9, 394338N) confirmed Made Ground to 0.70m bgl and a very weak hydrocarbon odour was present at 0.70m bgl. The Glacial Till was firm becoming stiff slightly sandy slightly gravelly CLAY encountered to 4.30m bgl, underlain by the weathered Chester Formation. The borehole was dry.

BH17/1A (E385921.5, N394340.9) recorded a very weak hydrocarbon odour at the base of the Made Ground (a dark greyish brown sandy gravelly CLAY) at 0.80m bgl in a perched groundwater. Beneath the Made Ground firm reddish brown mottled grey slightly sandy slightly gravelly CLAY above the weathered Chester Formation was encountered to 4.10m bgl.

BH18/1A (E385959.9, N394344.0) found deep Made Ground between ground level and 3.10m bgl (41.35m AOD). The Made Ground comprised a light greyish brown/black gravelly SAND and a soft reddish brown mottled grey sandy gravelly CLAY (reworked natural). The gravel content including sandstone, ceramic, slag, clinker, coal, brick, clayware and siltstone. Groundwater was recorded towards the base of the Made Ground at 2.60m rising to 2.10m bgl after 20 minutes.

2.6 Hydrogeology

The Glacial Till is classed by the Environment Agency as a Secondary Undifferentiated Aquifer. The Chester Formation is classified as a Principal Aquifer.

The Groundsure report states that the vulnerability of the aquifer within the Glacial Till is considered to be low. The vulnerability of the aquifer within the Chester Formation is also considered to be low due to the intervening low permeability cohesive Glacial Till overlying the sandstone.

The site is within a groundwater Source Protection Zone (SPZ) Zone 3 (Total Catchment). There are no active groundwater abstractions within 1km of the site boundary.

The environmental data report indicates a moderate risk of groundwater flooding, potentially due to shallow perched groundwater on top of the (cohesive) Glacial Till subjected to seasonal variations.

2.6.1 Groundwater levels, recharge and flow

The BGS boreholes within the surrounding area suggest circa 4.00m of low permeability Glacial Till overlying the Principal Aquifer (sandstone bedrock). The groundwater within the sandstone, is likely to be protected by the overlying Glacial Till should there be sufficient thickness (and the Till is proven to be sufficiently impermeable).

Any shallow groundwater underlying the site will likely be perched/local and discontinuous either at the interface of the Made Ground and Glacial Till or between any granular horizons within the Glacial Till.

Because the site is underlain by hardstanding, recharge to the shallow groundwater is more likely to take place via the undeveloped field to the north/north east, and because the sport fields to the east are likely to include controlled drainage systems capturing infiltrating waters.

The presence of up to 4m of low permeability clay will restrict/limit the potential migration of leachable contaminants into the sensitive Principal Aquifer.

2.7 Hydrology

An unnamed brook is present 250m west. Given the likely discontinuous nature of the perched groundwater within the Glacial Till it is unlikely to be in direct hydraulic continuity with unnamed brook 250m west which feeds into Platt Lake further west.

Reference to the Environment Agency web site shows the site is located within the catchment known as the Bollin Dean Mersey Upper, the specific river water body being the Platt Brook (Source to Fallowfield Brook). The current (2019 cycle 3) overall status under the Water Framework Directive is described as 'moderate'.

There are no surface water abstractions within 1km of the site.

There are no active licensed surface water discharges within 1km of the site.

2.8 Flood Risk

The desk study information indicates the proposed development is in Flood Zone 1 with a low probability of flooding from rivers or the sea.

The desk study information indicates the proposed development is not at risk from surface water flooding (pluvial flooding).

No further consideration of flood risk is undertaken in this report. Specialist flood risk advice should be sought with regard to drainage and flooding.

2.9 Mining and Mineral Extraction

The site is not within an area of recorded mining and mining risk is not considered further in this report.

2.10 Natural Ground Instability

Semi mature trees are present sporadically across tree pits in the centre and mature/semi-mature trees are present on northern and western boundary, close to the southern site boundary. Cohesive deposits of the Glacial Till may be affected by potential for shrink-swell ground movements in clays as a result of changes in moisture content from removal or growth of trees.

Across the south east there were former stands associated with adjacent Athletics Stadium and in the south west earthworks were present onsite also associated with the Athletics Stadium. The extent to which foundations associated with stands were grubbed out before the development of the car park is unknown. This represents a geotechnical risk due to the presence of heterogeneous Made Ground. Foundations will need to be deepened to below the Made Ground.

The Made Ground may contain elevated sulphates.

There is potentially for shallow perched groundwater on top the Glacial Till. The shallow perched groundwater although discontinuous could vary in depth seasonally and during heavier rainfall events could rise to a shallower depth.

2.11 Waste Management

There are no current or historical waste management sites recorded within 500m of the site.

2.12 Regulatory Information

Information provided in the desk study indicates no records significant regulatory controls in the general area of the site which would be considered to pose a risk to the subject site.

2.13 Natural Soil Chemistry

The desk study did not identify any significantly elevated naturally occurring elements that may present a risk to future site users.

2.14 Radon

The guidance indicates that the site is not in a Radon Affected Area and no radon protection measures are required.

2.15 Unexploded Ordnance (UXO)

As per CIRIA Report C681, a preliminary UXO risk assessment has been commissioned (See Appendix J). This indicates:

- » During WWII the site was situated within the County Borough of Manchester, which sustained an overall low density of bombing, with an average of 27.1 items recorded per 1,000 acres according to official Home Office bombing statistics.
- » Local bomb plot and damage mapping does not record any bomb strikes or damage on or directly bordering the site area.
- » Given the low density of bombing across the district, with no positive evidence found to suggest any bombing/damage occurred within the site, the risk of encountering UXO is not considered significantly elevated above the 'background' level of risk for the region.

Given the findings of this preliminary report, the risk from UXO on site is not considered to be significantly elevated above the 'background level' for the region and low, no further risk assessment is required.

3. Initial Conceptual Site Model

3.1 Introduction

The initial Conceptual Site Model (CSM) incorporates evidence from the site walkover, the Desk Study and previous investigations carried out at the site. The formulation of an initial CSM is a key component of the LCRM methodology, and incorporates: a ground model of the site physical conditions; and an exposure model of the possible contaminant linkages. It forms the basis for Generic Quantitative Risk Assessment (GQRA) in accordance with current guidelines.

3.2 Ground Model

The preliminary ground model presented in Section 2 provides an understanding of the ground conditions and is the basis for preparing the preliminary geotechnical hazard assessment (Section 3.3) and the preliminary geo-environmental exposure model (Section 3.4).

3.3 Geotechnical Hazard Identification

3.3.1 Context

The preliminary geotechnical hazard identification has been undertaken in accordance with the general requirements of ICE/DETR Document 'Managing Geotechnical Risk' and the HE documents CS 641 and CD 622.

The following section sets out the identified geotechnical hazards and the development elements potentially affected (see Table G.1 in Appendix G for further information).

3.3.2 Plausible Geotechnical Hazards

Plausible geotechnical hazards identified at the site are:

- » Uncontrolled Made Ground (variable strength and compressibility).
- » Soft / loose compressible ground (low strength and high settlement potential).
- » Shrinkage / swelling of the clay fraction of soils under the influence of vegetation.
- » Variable lateral and vertical changes in ground conditions.
- » Attack of buried concrete by aggressive ground conditions.
- » Obstructions.
- » Shallow perched groundwater.
- » Changing groundwater conditions.
- » Loose Made Ground, leading to difficulty with excavation and collapse of side walls.

3.3.3 Potential Development Element Affected

Development elements potentially affected by geotechnical hazards are:

- » Buildings – foundations.
- » Buildings – floor Slabs.
- » Service yard and pavements.
- » Services.
- » Landscaped Area.
- » Construction staff, vehicles and plant operators.
- » Concrete below ground.

3.4 Geo-environmental Exposure Model

3.4.1 Context

The preliminary exposure model is used to identify geo-environmental hazards and to establish potential contaminant linkages, based on the source-pathway-receptor (SPR) approach.

A viable contaminant linkage requires all the components of an SPR to be present. If only one or two are present, there is no linkage and no further assessment is required.

3.4.2 Potential Contaminants

For the purpose of this assessment the potential contaminants have been separated according to whether they are likely to have originated from an on-site or off-site source.

3.4.2.1 Potential on-site sources of contamination

- » Made Ground, associated with historical construction activities and imported fill (associated with former buildings, the stands and earthworks), possibly including elevated concentrations of metals, metalloids, asbestos fibres, Asbestos Containing Materials, PAH and petroleum hydrocarbons (S01).
- » Ground gases (carbon dioxide and methane) from organic materials in the Made Ground associated with historical construction and the previous earthworks (S02).

3.4.2.2 Potential receptors

The following potential receptors in relation to the proposed land use have been identified.

- » People (neighbours, site end users) (R01).
- » Development end use (buildings, utilities and landscaping) (R02).
- » Groundwater: Principal Aquifer status of the Chester Formation (R03).

3.4.2.3 Potential Pathways

The following potential pathways have been identified.

- » Ingestion, skin contact, inhalation of dust and outdoor air by people (P01).
- » Methane/Carbon Dioxide ingress via permeable soils and/or construction gaps (P02).
- » Root uptake by plant (P03).
- » Migration of contaminant via leachate migration through the unsaturated zone in the Made Ground or Glacial Till (P04).
- » Migration of contaminant from the groundwater within the Glacial Till to the groundwater within the Chester Formation (P05).

Health and safety risks to site development contractors and maintenance workers have not been assessed as part of this study and will need to be considered separately.

The above sources, pathways and receptors have been considered as part of the Preliminary Risk Assessment in accordance with LCRM (2023), are considered to be plausible in the context of this site and have been carried forward for investigation and assessment. An assessment of the Source – Pathway – Receptor linkages is presented in Appendix H (Table H.1).

3.4.2.4 Potential Implications of climate change

Climate change has the potential to change the risk profile for conceptual site models and associated contaminant linkages. The impact of climate change on the CSM is site-specific, and a qualitative assessment of the potential impact of climate change on the CSM for this site is summarised below. The

assessment has primarily utilised the guidance in Environment Agency (2010)¹ and SoBRA (2022)² which set out the UK context to climate change and land contamination. Both guidance documents advocate a “what if” scenario approach in the context of changes in ambient temperatures, an increase in the frequency of extreme rainfall/storm events and heatwaves/droughts, and long-term changes in groundwater and sea levels.

Those “what if” scenarios that are relevant to this CSM are:

- » Increased long-term rainfall leading to increased infiltration and seasonally higher groundwater and water levels in surface waters.- *Given that the proposed site will largely be hardstanding or buildings with limited landscaping area, infiltration increase is likely to be minimal. Shallow groundwater is not anticipated across the site, therefore variations in groundwater are not anticipated.*
- » Increased frequency and/or magnitude of extreme rainfall events leading to short-term surface flooding, surface water run-off and groundwater flooding.- *Although perched groundwater may be present on top of the Glacial Till, the installed surface water draining and hardstanding will restrict infiltrating water therefore reducing the risk of groundwater flooding. The site is 250m from the nearest surface water course and increase rainfall is not considered to alter the existing flood risk classification which is of low probability Flood Zone 1.*
- » Increased frequency and/or magnitude of storm events leading to short-term drops in barometric pressure and/or high winds.- *Extensive Made Ground containing organic deposits is not anticipated across the site. Given the anticipated low risk from ground gas changes in barometric pressure are considered unlikely to alter the gas regime, due to the lack of notable ground gas source.*
- » Occurrence of extreme cold and hot weather events leading to changes in ground conditions such as soil temperature, evapo(trans)piration, and soil moisture (for example freeze-thaw effects and desiccation), decreased infiltration and fall in groundwater and surface water levels. – *Foundations for the proposed building will be designed to account for potential shrink and swell in clays due to soil moisture changes. Furthermore, hardstanding will protect the underlying soils from the impacts of freeze thaw and also potential extreme changes in soil temperature.*
- » Long-term decrease in rainfall leading to lower infiltration and fall in groundwater and surface water levels.- *Although the site lies above a principal aquifer, there are no groundwater abstractions within close proximity to the site and drops in groundwater level in the aquifer are not considered to impact the CSM.*

The above “what if” scenarios that are considered to be plausible in the context of this site are discussed further in Section 7.10. and Appendix I.

4. Ground Investigation

4.1 Site Works

The ground investigation works, including the rationale which was based on the findings of the preliminary risk assessment is summarised in Table 4.1.

The fieldwork took place between 2 April and 4 April 2024. The ground investigation locations were surveyed in using a topographic survey quality GPS and are shown on the Exploratory Hole Location Plan (Hydrock Drawing LIMES- HYD-XX-XX-D-G-00003) in Appendix B.

The logs, including details of ground conditions, soil sampling, in situ testing and any installations, are also presented in Appendix B.

Table 4.1: Summary of site works

Activity	Method	No	Name	Depth Range (m bgl)	In situ tests	Rationale
Drilling, Pitting and Probing						
Boreholes	Cable percussive	2	BH01 to BH02	5.00- 5.16	SPT	To investigate the composition/thickness of Made Ground.
	Dynamic Windowless sampler	10	WS01 to WS10	4.02- 5.45	SPTs and HSVs	To investigate strength profile of the Glacial Till and confirm the top of the Chester Formation. To monitor the gas and groundwater regimes.

Wells for monitoring groundwater levels and ground gas concentrations, and to facilitate the sampling of groundwater, were installed in number of the windowless sampler and cable percussion boreholes. A summary of the monitoring well installations is presented in Table 4.2.

Table 4.2: Summary of monitoring installations

Location	Ground level (m OD)	Standpipe / piezometer diameter	Screen top and base depth (m bgl)	Screen top and base elevation (m OD)	Strata targeted
BH01	44.36	50	1.00 to 5.00	43.36 to 39.36	Chester Formation
BH02	44.44	50	1.00 to 5.00	43.44 to 39.36	Chester Formation
WS04	44.25	50	1.00 to 4.50	43.25 to 39.75	Chester Formation
WS05	44.17	50	1.00 to 3.70	43.25 to 40.47	Glacial Till
WS08	44.55	50	1.00 to 4.00	43.55 to 40.55	Glacial Till

¹ Environment Agency, 2010. Guiding Principles for Land Contamination. Part 2. FAQs, technical information, detailed advice and references, March 2010.

² SoBRA, 2022. Guidance on Assessing Risk to Controlled Waters from UK Land Contamination Under Conditions of Future Climate Change, Society of Brownfield Risk Assessment, August 2022.

4.2 Geo-environmental Testing

4.2.1 Sampling Strategy and Protocols

Exploratory hole positions were determined by reference to the site conditions and uncertainties identified in the Initial Conceptual Model.

Certain specific features such as the former stands were targeted with WS01 and WS02, the earthworks by WS08 and WS09, unnamed building by WS07 and Tennis Courts by WS04 and WS06. BH01, BH02, WS04 to WS06 and WS10 targeted the location of the proposed building to allow for foundation and floor slab design.

Samples were taken, stored and transported in general accordance with BS 10175:2011+A2:2017.

4.2.2 Geo-environmental Monitoring

Gas monitoring boreholes have been monitored on four occasions as part of this commission. The results are presented in Appendix D.

4.2.3 Geo-environmental Laboratory Analyses

The chemical test certificates for testing undertaken as part of Hydrock's investigation are provided in Appendix E and summarised in the table below. Wherever possible, UKAS and MCERTS accredited procedures have been used. The geo-environmental analyses undertaken on soils are summarised in Table 4.3.

Table 4.3: Geo-environmental analyses of soils or other solids

Determinand Suite	Made Ground	Glacial Till
Hydrock minimum suite of determinands for solids ³	5	3
Speciated aliphatic and aromatic banding Total petroleum hydrocarbons by HS-GC/MS and GC/FID (Hydrock Tier 2 TPH Suite)	1	1
Benzene, toluene, ethylbenzene and xylene (BTEX) by HS-GC/MS	1	1
MTBE (Methyl Tertiary Butyl Ether) by HS-GC/MS	1	1
³ Hydrock minimum soil suite comprises: As, B (water soluble), Be, Cd, Cr (total), Cr (VI), Cu, Hg, Ni, Pb, S (elemental), Se, V, Zn, cyanide (total), sulphide, pH, asbestos fibres, speciated polynuclear aromatic hydrocarbons (PAH, by GC-FID), total phenols and fraction of organic carbon.		

The soils chemical test data are interpreted and assessed in Sections 7.3 and 7.4.

The geo-environmental analyses undertaken as part of Hydrock's investigation on waters are summarised in Table 4.4.

Table 4.4: Geo-environmental analyses of waters,

Determinand Suite	Groundwater
Hydrock minimum suite of determinands for waters ⁴	1
Speciated aliphatic and aromatic banding Total petroleum hydrocarbons by HS-GC/MS and GC/FID (Hydrock Tier 2 TPH Suite)	1
Benzene, toluene, ethylbenzene and xylene (BTEX) by HS-GC/MS	1
MTBE (Methyl Tertiary Butyl Ether) by HS-GC/MS	1

The groundwater chemical test data are interpreted and assessed in Section 7.5.

4.3 Geotechnical Testing

4.3.1 Geotechnical Laboratory Testing

The geotechnical tests undertaken by Hydrock are summarised in Table 4.5 and the test certificates are provided in Appendix C. Wherever possible, UKAS accredited procedures have been used.

Table 4.5: Summary of sample numbers for geotechnical tests

Test	Made Ground	Glacial Till	Chester Formation
Soil Water content	-	12	-
Atterberg limits	-	12	-
Particle size distribution (sieve/sedimentation)	-	1	1
Sulphate and aggressive chemical environment classification for buried concrete classification (full BRE SD1 suite)	3	2	1
Single stage undrained triaxial compressive strength	-	4	-
One dimensional oedometer consolidation	-	2	-
Remoulded California Bearing Ratio at natural moisture content (soaked)	1	1	-

³ The Hydrock minimum suite of determinands for waters comprises As, B (water soluble), Be, Cd, Cr (total), Cr(VI), Cu, Hg, Ni, Pb, S (elemental), Se, V, Zn, cyanide (total), sulphide, pH, asbestos fibres, speciated polynuclear aromatic hydrocarbons (PAH, by GC-FID), total phenols, fraction of organic carbon and free and "complex" cyanide species, if high total cyanide is detected

⁴ Hydrock minimum waters/soil leachate analysis suite comprising — Ag, Al, As, B, Ba, Cd, Co, Cr (III), Cr(VI), Cu, Fe, Hg, Mn, Mo, Na, Ni, Pb, Sb, Se, Sn, Zn, V, cyanide (total), phenols (total), ammonium, bromate, chloride, fluoride, nitrate, nitrite, sulphate, PAH (speciated), pH, EC and hardness

5. Ground Investigation records and data

5.1 Physical Ground Conditions

5.1.1 Summary of Strata Encountered

The following presents a summary of the properties of the ground and groundwater conditions encountered, based on field observations, interpretation of the field data and laboratory test results, taking into account drilling, excavation and sampling methods, transport, handling and specimen preparation.

All relevant data from the Hydrock investigation discussed in Section 4 are used from this point forward.

Details of the Hydrock ground investigation works are provided in the logs in Appendix B, a summary of the ground model is presented in Table 5.1

Table 5.1: Strata encountered

Stratum	Depth to top (m bgl)	Depth to base (m bgl)	Thickness (m) (range)	Thickness (m) (average)
Surface Cover – Asphalt Hardstanding	0.00 – 0.15	0.07 – 0.15	0.07 – 0.15	0.15
Non-General Made Ground	0.07 – 0.15	0.17 – 0.55	0.10 – 0.45	0.19
'General' Made Ground	0.17 – 0.55	0.40 – 1.65	0.23 – 1.40	0.71
Glacial Till	0.35 – 1.65	3.65 -4.70	2.65 – 3.80	3.20
Chester Formation	3.65 – 4.70	>5.45	Unproven	Unproven

5.1.2 Surface Covering

The following surface cover was identified during the field reconnaissance and the fieldworks:

- » Asphalt hardstanding, covering approximately 85% of the site and noted to be in generally good condition with some significant scars associated with services).
- » Landscaped areas (grass, shrubs and trees), covering approximately 15% of the site.

5.1.3 'Non-General' Made Ground

The 'Non General' Made Ground was present directly below the asphalt hardstanding between 0.07 and 0.55m bgl and comprised of a layer of Type 1 sub base material of grey sandy GRAVEL of limestone.

5.1.4 'General' Made Ground

'General' Made Ground was present in each exploratory hole location, with an average thickness of 0.71m bgl. Made Ground under the proposed building was generally 1.00m; however, it was indicated to be thinner to between 0.40-0.80m below the south east of the building footprint. Made Ground was locally deep in WS01 (below the south eastern section), potentially associated with the former stands and was present to 1.65m bgl.

The base of Made Ground is shown on Hydrock's drawing "LIMES-HYD-XX-XX-D-G-00003", presented in Appendix A..

The 'General' Made Ground encountered in the majority of locations beneath the Type 1 comprised a soft to firm low strength, blackish grey, locally gravelly silty CLAY, containing a gravel content of brick, coal, mudstone and sandstone. Within WS06 and WS07 the 'General' Made Ground contained a very weak organic (humic) odour.

Beneath the location of the former stands (WS01 and WS02 in the south east) was a granular Made Ground of loose dark grey/BLACK gravelly clayey/silty ashy SAND with a gravel content of brick, shale, clinker and coal.

Beneath the location of the former earthworks features the granular Made Ground comprised pale red SAND and GRAVEL and a black ashy GRAVEL.

5.1.5 Glacial Till

The top of the Glacial Till ranged from 0.35m to 1.65m bgl, the deepest being in the south east within WS01. The thickness of the Glacial Till was proven as between 2.65m and 3.80m.

Directly below the Made Ground the shallow Glacial Till extending to 2.00m to 2.20m bgl comprised a soft to firm, light grey mottled yellow/blackish brown silty CLAY. At depth the Glacial Till is a firm becoming very stiff high to very high strength, reddish brown mottled grey, slightly sandy slightly gravelly CLAY, with a gravel content of mudstone, sandstone and coal.

In the centre and west (beyond the proposed building footprint) the deeper Glacial Till was encountered as a firm to stiff medium becoming high strength, reddish brown silty CLAY.

At 3.20m to 3.80m bgl the Glacial Till becomes sandy and friable with frequent fragments of coal.

5.1.6 Weathered Chester Formation

The top of the weathered Chester Formation was encountered in the majority of locations across the site ranging between 3.65m and 4.70m bgl and was recovered as a dense, reddish brown SAND, or a dense reddish brown gravelly SAND, with a gravel content of quartzite. The top of bedrock is shown on drawing LIMES-HYD-XX-XX-D-G-00004, which is presented in Appendix A..

The base of the Chester Formation was not proven.

5.1.7 Cross Section

Figure 5.1 is a typical cross section from west to east below the proposed building footprint with Made Ground extending to 1.00m bgl. The soft to firm low strength silty CLAY present to 1.50m/2.00m depth in the west, and 2.00m bgl in the centre. The deeper very stiff to stiff high to very high strength slightly sandy slightly gravelly CLAY present to 3.1.0m and 4.20m bgl. The weathered Chester Formation base was unproven and groundwater in the bedrock is present from 4.30m to 4.45m bgl (blue line).

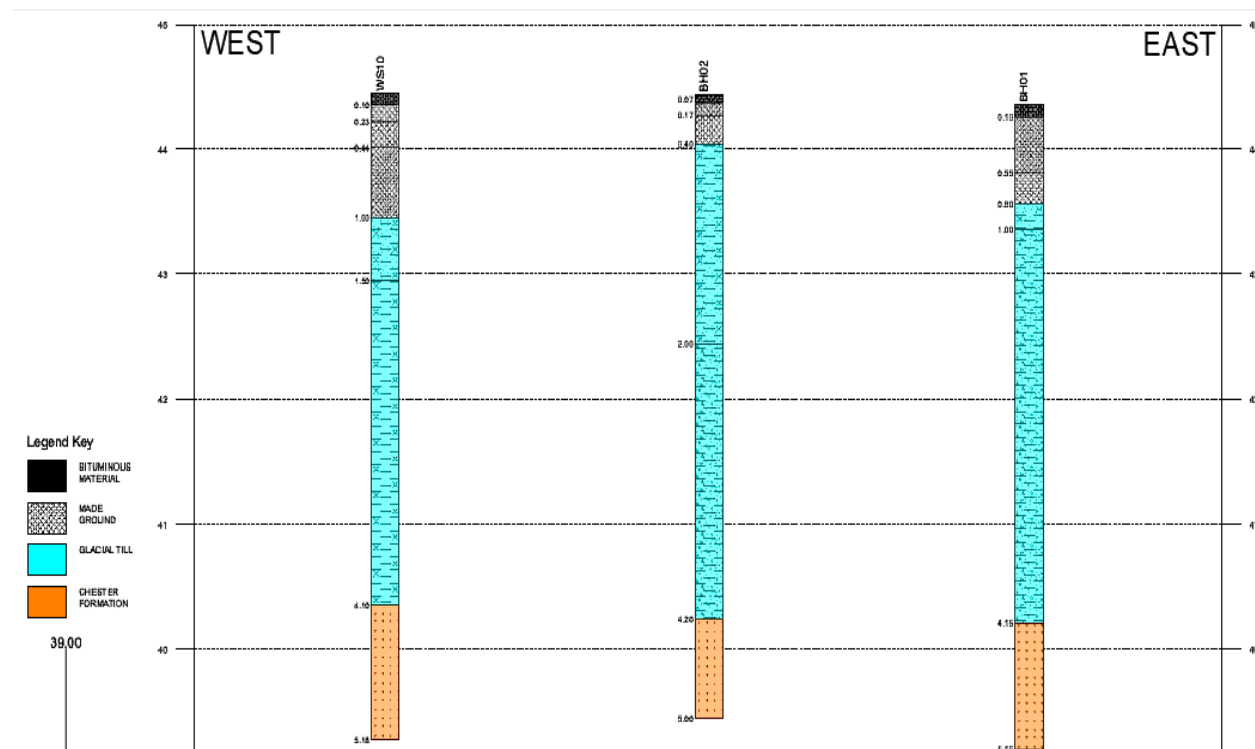


Figure 5.1: Typical Cross Section below the proposed building

5.1.8 Visual and Olfactory Evidence of Contamination (Soil)

In addition to the more common man-made constituents (ash, clinker, plastic, etc), described above in Section 5.1.4, visual and olfactory evidence of contamination was noted in one location, detailed in Table 5.2.

Table 5.2: Visual and olfactory evidence of contamination - soils

Stratum	Location	Depth (m bgl)	Description
Made Ground	WS09	1.00 to 1.10	Very weak hydrocarbon odour

WS09 is located below proposed landscaping in the south west of the site and are not considered to pose a risk to controlled waters as they are outside of an area which will potentially be piled.

5.1.9 Soil Organic Carbon Content

Using a conversion between fraction of organic carbon content and total organic carbon content (e.g. 1.0% TOC = 0.010 FOC), the total organic carbon content has been calculated.

For the Made Ground the total organic content ranged from 1.5 to 2.6% and the Glacial Till ranged from 1.3 to 1.5%.

5.2 Groundwater

5.2.1 Groundwater Observations and Levels.

Groundwater encountered during the investigation is listed in Table 5.3. A groundwater observation represents the depth at which groundwater was first observed and is likely to be deeper than the actual water table level at that location.

Table 5.3: Groundwater occurrence

Stratum	Date	Location	Fieldwork	Comment
			Groundwater observation (m bgl)	
Made Ground	02/03/24	BH01	0.70	Slow Inflow
Glacial Till	03/03/24 to 04/03/24	WS05	1.20	Slow Inflow
		WS06	1.20	Slow Inflow
		WS08	3.00	Moderate Inflow

Groundwater levels recorded during post-fieldwork monitoring are summarised in Table 5.4.

Table 5.4: Groundwater level data summary

Stratum	Date range	Location	Response Zone Level (m AOD)	Post-fieldwork monitoring	
				Depth to groundwater (range) (m bgl)	Groundwater elevation (range) (m OD)
Glacial Till	09/04/24-29/04/24	WS05	43.25 to 40.47	0.60 - 0.77	43.57 - 43.40*
	WS08	43.25 to 40.47	43.25 to 40.47	0.96 - 1.10	43.59 - 43.45*

*Response Zones are flooded.

5.2.2 Soakaway Suitability

The site is underlain by low permeability Glacial Till, comprising sandy gravelly CLAY/silty CLAY. The ground investigation and post investigation monitoring confirmed a localised/discontinuous perched groundwater at the interface of the Made Ground and Glacial Till.

Therefore, given the underlying low permeability clays and possibility for shallow perched groundwater, there is unlikely to be a suitable unsaturated zone at the proposed depth of a soakaway.

5.2.3 Groundwater Summary

The post fieldworks monitoring has proven that there is a perched groundwater table at the interface of the Made Ground and Glacial Till between 0.60m and 0.77m bgl (43.57 to 43.40m AOD).

It is likely that the 40cm to 50cm of water within BH01 and BH02 present between 4.30m and 4.63m bgl (40.06m to 39.81 m AOD) is representative of seepage of perched groundwater on top of the Glacial Till, migrating into the well below the bentonite seal.

Within WS08 the groundwater appears to be associated with a band of sand at 3.00m bgl which is under sub artesian pressure rising to 0.96 to 1.10m bgl (43.59 - 43.45m AOD).

5.3 Ground Gases

Records from the gas monitoring boreholes are presented in Appendix D and summarised in Table 5.5.

Four ground gas monitoring visits have been completed as part of this commission, aligning with BS8576:2013 monitoring regime for a low risk commercial building and a very low gas generation potential (i.e. Made Ground up to or <1.00m). The data are assessed in Section 7.6.

Within Table 5.5, the consistently elevated methane and carbon dioxide readings are from BH01 and BH02, likely associated with ground gas migrating through the Chester Formation from an anthropogenic source within the wider area.

Although carbon monoxide is elevated within WS05 and WS08 during the 1st visit at 168ppm and 235ppm the oxygen level within the wells do not suggest anoxic conditions. There is no likely source of carbon monoxide on the site and therefore these elevated concentrations are likely due to the flooded response zone trapping gases and are not considered to be representative of the actual conditions within the soils.

Table 5.5: Range of ground gas data

Stratum	Methane (%)	Carbon dioxide (%)	Oxygen (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	Steady flow rate (L/hr)
Chester Formation	<0.1 – 2.0	<0.1 – 9.1	10.8 – 21.3	<1	<1	<0.1 – 2.4

*WS05 and WS08 included flooded response zones therefore the data has not been included within Table 5.5 as its considered misrepresentative of the ground gas regime.

5.4 Geotechnical Data

5.4.1 Introduction

Laboratory test results are contained in Appendix C with in situ test results shown on the relevant exploratory hole log or datasheet in Appendix B. The following sections summarise the main findings and provide interpretation where appropriate.

5.4.2 Plasticity

The volume change potentials in terms of BRE Digest 298 with respect to building near trees have been determined from the results of plasticity index tests on samples of soil. These are summarised in Table 5.6.

Table 5.6: Volume change potential

Stratum	No. of tests	Plasticity Index			Modified Plasticity Index			Plasticity designation	Volume Change Potential
		Min.	Max	Av.	Min.	Max	Av.		
Glacial Till	12	13	25	22	16	25	21	Low to medium	Low to medium

*Out of 12 tests, nine Atterberg Limits test indicated medium volume change potential with modified plasticity index >20%.

5.4.3 Soil Water Content with soil index properties

Presented in Figure 5.2 is a soil water content profile showing a comparison between soil moisture content and the Liquid Limit. A value less than 0.4 times the Liquid Limit is normally considered as significantly desiccated and this is shown by the vertical line.

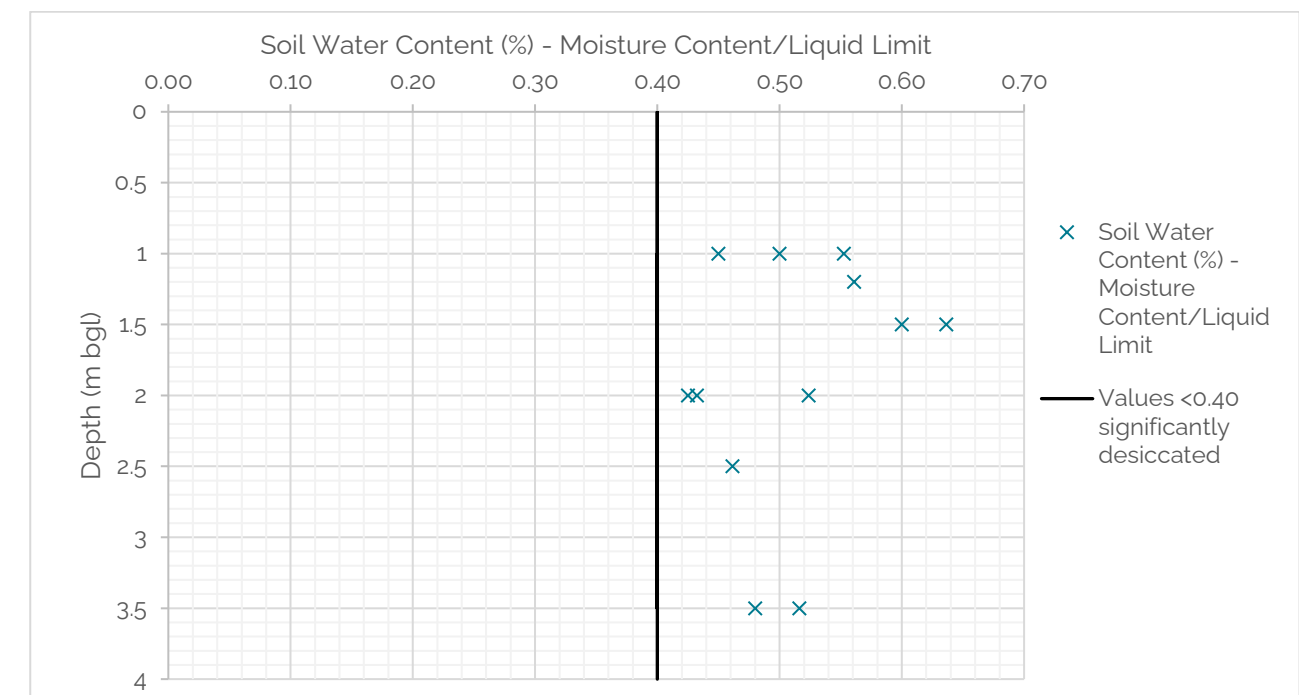


Figure 5.2: Soil Water Content- Moisture Content/Liquid Limit against depth (m bgl)

Shown on Figure 5.3, is a profile of liquidity Index calculated from soil moisture content (w) – Plastic Limit (PL) divided by Plasticity Index (PI). Where a liquidity index of 0 represents a soil moisture content at the Plastic Limit. Negative values represent soils that are potentially desiccated with soil moisture content drier than the plastic limit.

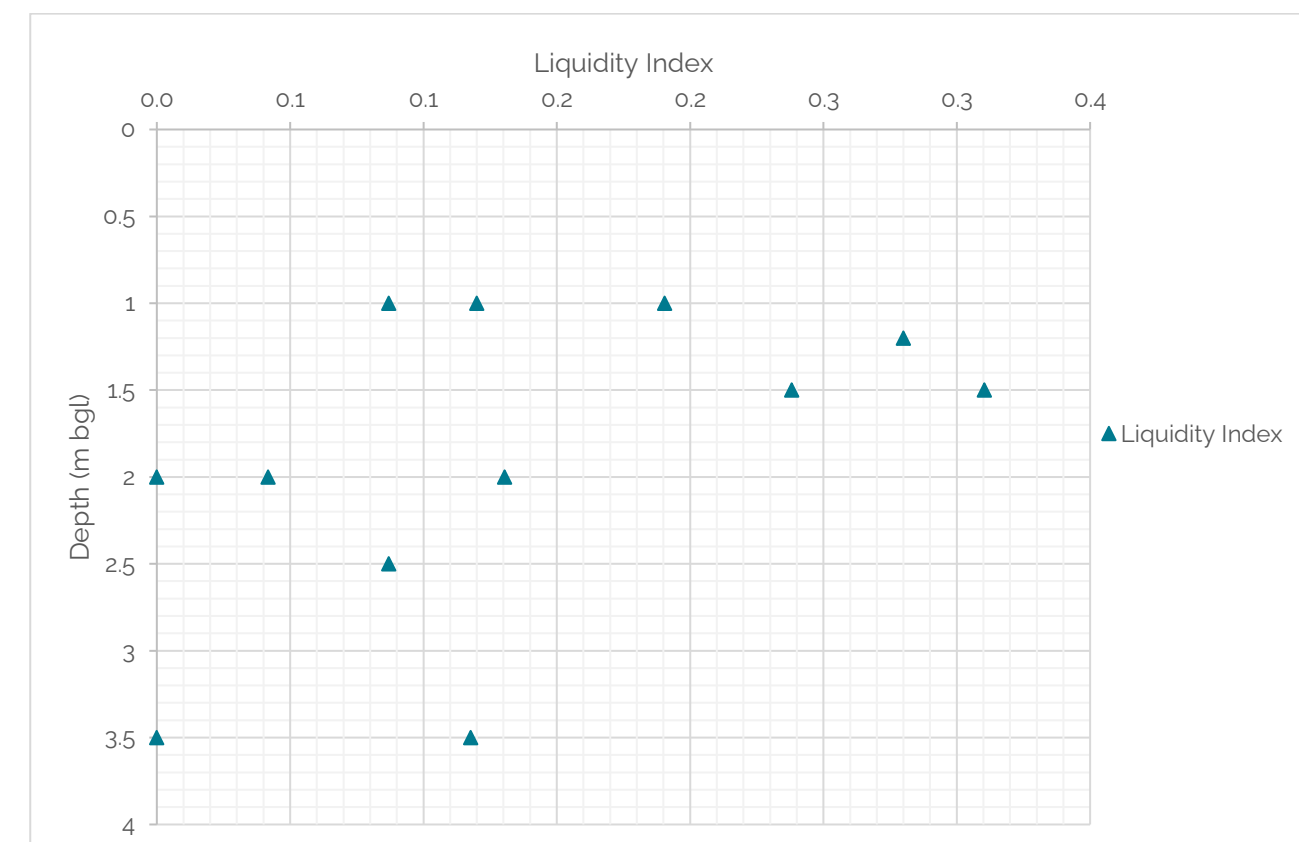


Figure 5.3: Liquidity Index against depth (m bgl)

Figure 5.2 and Figure 5.3 do not constitute a full desiccation assessment in accordance with BRE Digest 298 which requires a more comprehensive sample set over depth. However, Figure 5.2 shows the Soil Water Content (%) over depth does not indicate considerable desiccation. Figure 5.3 although does not show negative value, the liquidity index within WS04 at 2.00m, WS06 at 2.00m and 3.50m bgl are in the order of 0.0 to 0.4, therefore close to becoming negative and with a more coarser sample set, negative values may be present indicating potential desiccated soils.

5.4.4 Particle Size Distribution

Particle Size Distribution test (PSDs) results are summarised in Table 5.7 and summary descriptions and PSD plots of the material analysed are presented in Appendix C.

Table 5.7: PSD results summary

Stratum	No. of tests	Silt/Clay %	Sand %	Gravel %	General description
Glacial Till	1	67	31	2	Reddish brown slightly sandy slightly gravelly CLAY
Chester Formation	1	27	73	0	Reddish brown/ dark red very silty SAND

5.4.5 Soil Strength

Table 5.8 summarises information pertaining to the shear strength of the soils according to geological stratum. Factual results are summarised for laboratory tests, field tests (e.g. hand shear vane) and uncorrected Standard Penetration Tests (SPT). Where the SPT is used to infer shear strength by published correlation, this is also tabulated. A shear strength versus depth profile is summarised in Figure 5.4, and plots are presented in Appendix C.

Table 5.8: Soil strength results and derived values

Stratum	No. of tests	SPT (N60-value) (range)	cu (kPa)	c' (kPa)	phi' (°)	Method
Glacial Till	34	6 - 46	31 - 230	2	26	SPT – windowless sampler boreholes.
	2	15 - 18	76 - 92			SPT – cable percussion.
	4	-	74 - 300			Laboratory triaxial test
	8	-	25 - 148			Hand shear vane
*Correlation with Stroud (1975) based on 'average' plasticity						

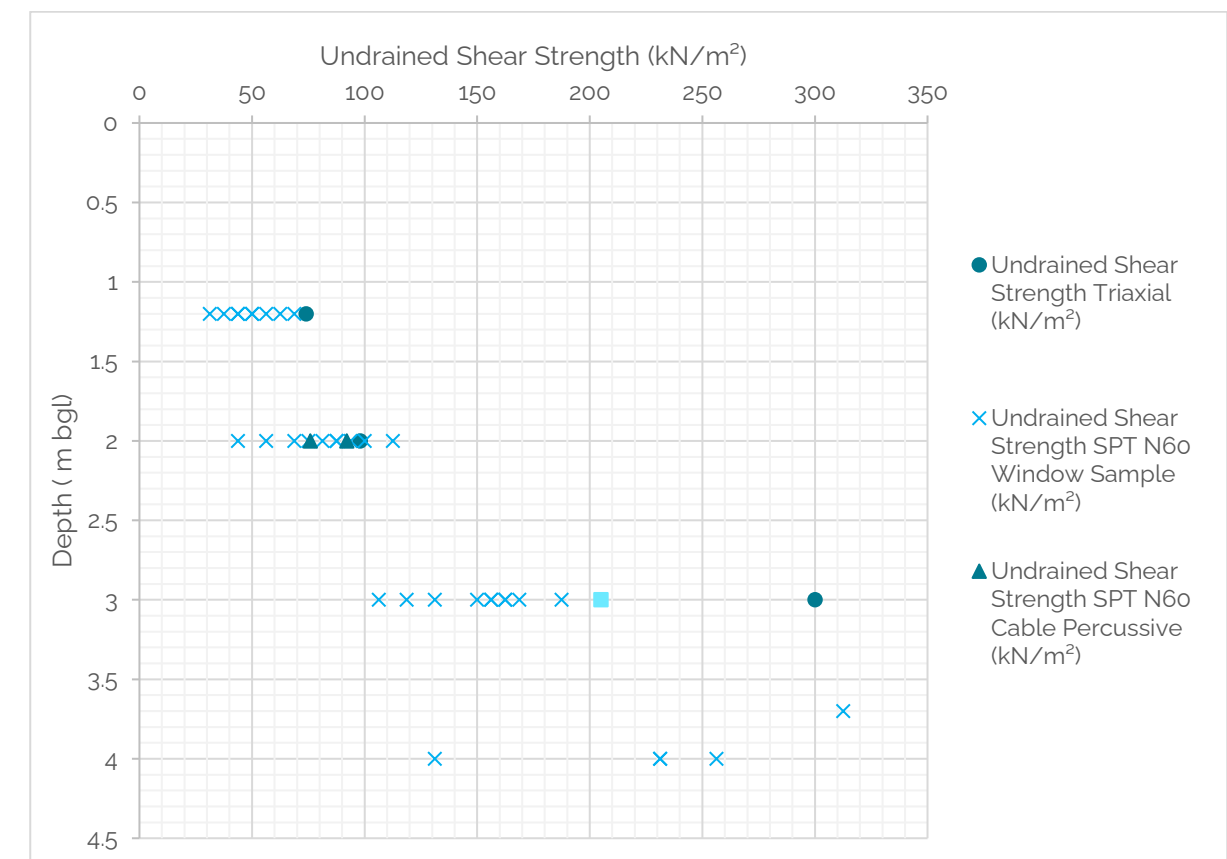


Figure 5.4: Undrained Shear Strength over depth (m bgl)

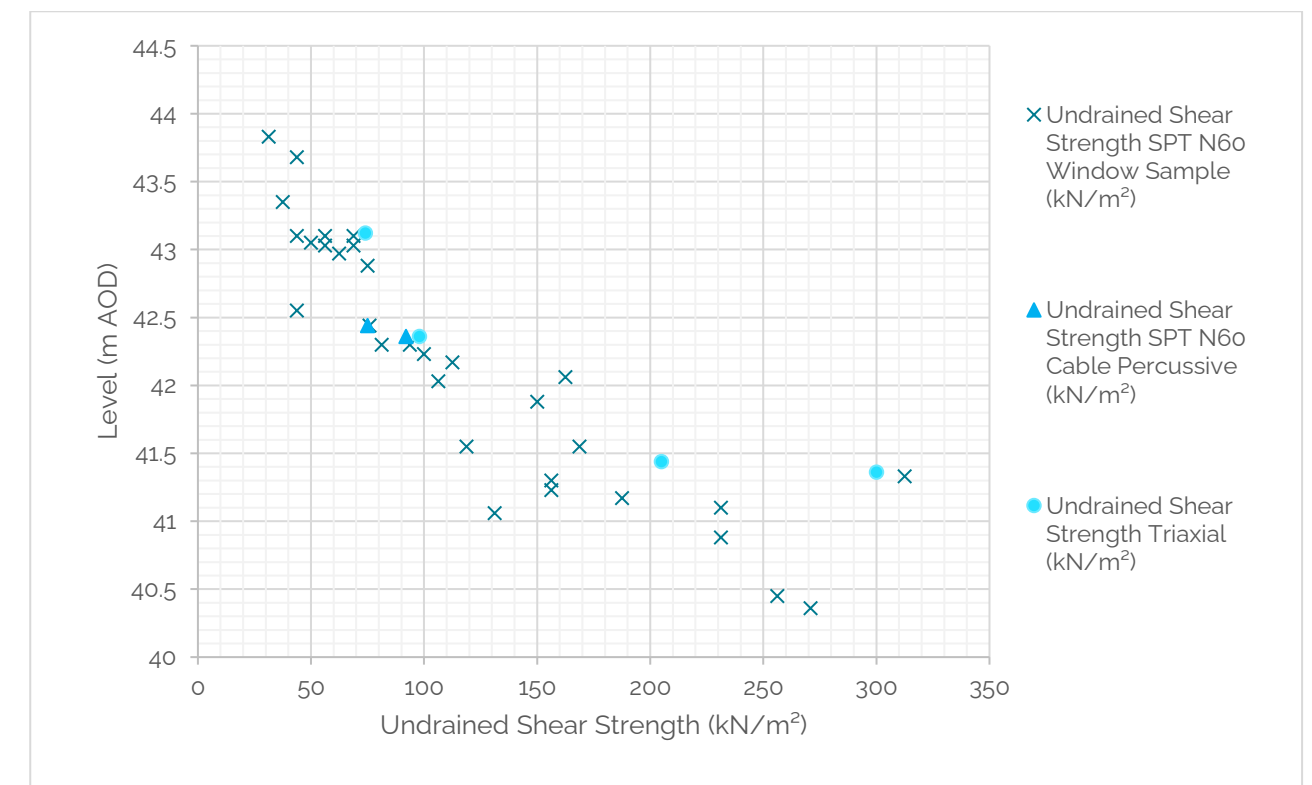


Figure 5.5: Undrained Shear Strength against level (m AOD)

Shown in Figure 5.4 the undrained shear strength at 1.20m bgl is in the range of low to medium strength with values in the order of 38 to 75kN/m². At 2.00m bgl the data clustering suggests that the Glacial Till is of high strength with values in the order of 75 to 100kN/m². Below 3.00m bgl the clay becomes high to very high strength with values >100 kN/m²

As shown in Figure 5.5 the undrained shear strength plot shows a strong relationship between undrained shear strength, generally between 43.1m AOD and 42.44m AOD the Glacial Till is of medium strength in the order of 44 to 77kN/m². Between 42.44m AOD and 41.3m AOD the Glacial Till is high strength with undrained shear strengths in the order of 75 to 150kN/m². Below 41.3m AOD the undrained shear strength indicates a very high strength clay.

5.4.6 Relative Density

Table 5.9 summarises information pertaining to the relative density of the granular soils according to geological stratum. Factual results are summarised for field tests (e.g. SPT correlation).

Table 5.9: Relative density results and derived values

Stratum	No. of tests	Method	SPT (N60-value)	phi' (°)
Chester Formation	9	SPT – windowless sampler boreholes (Peck et. al. (1967).	36 62	32-36
	2	SPT – cable percussion (Peck et. al. (1967).	54	35

5.4.7 Compressibility

Table 5.10 presents a summary of the derived parameters for coefficient of consolidation and compressibility. The data indicates that the Glacial Till is generally of medium to high compressibility over the pressure ranges tested.

Table 5.10: Summary of compressibility

Stratum	No. of tests / results	Method	Pressure range (kN/m ²)	Coefficient of volume compressibility (mv) (m ² /MN)	Coefficient of consolidation (Cv) (m ² /yr)
Glacial Till	36	Correlation with SPT*	-	0.33 - 0.04	-
	2	One Dimensional Oedometer Testing	10-20	0.12 – 0.02	1.7
			40-80	0.45 – 0.36	1.8 – 0.7
			160	0.23 – 0.22	2 – 1.4
			Unload	0.08 – 0.05	-

* An f2 value of 0.50 has been used based on a plasticity index of 22. (Tomlinson (2001), after Stroud)).

** Derived mv of <0.01 recorded for the less weathered/intact bedrock layers

5.4.8 Subgrade Stiffness

The subgrade stiffness (CBR and Subgrade Surface Modulus) results are summarised in Table 5.11.

Table 5.11: CBR results and derived values

Stratum	No. tests	Method	Subgrade Surface Modulus r (MPa) (Range)	CBR (%)
Made Ground	1	Laboratory remoulded sample at Natural Moisture Content (NMC)	130	11.6
Glacial Till	1		11.6	0.93

Where using the IAN method, 'k' has been back calculated from the Equivalent CBR.

5.4.9 Sulphate Content

In accordance with BRE (Special Digest 1), the Design Sulphate (DS) classification and the Aggressive Chemical Environment for Concrete (ACEC) classification are presented in Table 5.12. The assessment summary sheets are presented in Appendix C.

Table 5.12: Aggressive chemical environment concrete classification

Stratum	No. tests	DS	ACEC
Made Ground	3	DS-1	AC-1
Glacial Till	2	DS-1	AC-1
Chester Formation	1	DS-1	AC-1

6. Geotechnical Assessment

6.1 Geotechnical Categorization of the Proposed Development

Eurocode 7, Section 2 advocates the use of geotechnical categorization of the proposed structures to establish the design requirements.

The proposed development is to comprise a two storey building utilised for food preparation. The proposed development will be in proximity to moderate to high water demand trees as shown on the Tree Constraints Plan (Drawing Referenced 16638_P02) presented in Appendix A. Therefore, it is possible that the foundations will require piling due to the possibility of excessive stepping in the order of 2.50m or >2.50m bgl.

Based on the above, for the purposes of this investigation, the proposed structures have been classed as Geotechnical Category 2. For Category 2 structures, the Geotechnical Category should be re-assessed at the design stage and specific geotechnical design (in addition to this investigation), is required.

Following ground investigation and as part of the assessment provided in the following section, the preliminary geotechnical hazard identification undertaken in Section 3.3 has been updated.

Assessment has been undertaken in accordance with the general requirements of ICE/DETR Document 'Managing Geotechnical Risk' and the HE documents HE-DMRB-G CS 641 and CD 622. The preliminary Geotechnical Risk Register following investigation is provided in Appendix G (Table G.3) and will need to be updated during future design works.

In accordance with BS EN ISO 1997-1 (EC 7), Hydrock consider the proposed structures would be classified as Category 2 structures. As part of the separate geotechnical design, the designer should determine the geotechnical design values.

Table 6.1 provides characteristic geotechnical values to assist the designer. These are based on laboratory testing, in situ testing and by professional judgement using published data together with knowledge and experience of the ground conditions. Care should be exercised in using these assumed soil strength parameters for any purpose beyond the scope of this report because it may be that additional sampling and testing are required for certain purposes. The reader should refer to the original test results summarised in Section 5.4 and provided in Appendix C.

Table 6.1: Characteristic geotechnical values

Parameter	Bulk unit weight kN/m³	Effective angle of internal friction	Effective cohesion kN/m²	Undrained shear strength kN/m²	Coefficient of compressibility m²/MN	Modulus of subgrade reaction (IAN73/O6) MN/m²/m
Stratum	γ^a	$\phi'^{b,c}$	c'^d	c_u^e	m_v^f	k^g
Made Ground	18.2	28	0	-	-	30
Glacial Till	20.3	26	2	75	0.33	11.6
Weathered Chester Formation	23.0	32	0	-	0.01	-

- a. Measured as part of the triaxial strength test and estimated based on the recommendations of BS 8004-2015.
- b. Internal friction (ϕ') values for the granular in situ material derived from SPT data following the recommendations of Peck et al., (1967).
- c. Internal friction (ϕ') values for the cohesive in-situ material derived from BS 8004-2015, where ϕ_{cv}' is derived from plasticity index. The use of ϕ_{cv}' in the analysis is considered to provide a conservative estimate of ϕ' .
- d. BS 8002:1994 Code of practice for Earth retaining structures, British Standards institution.
- e. Site measurements and laboratory data.

Parameter	Bulk unit weight kN/m³	Effective angle of internal friction	Effective cohesion kN/m²	Undrained shear strength kN/m²	Coefficient of compressibility m²/MN	Modulus of subgrade reaction (IAN73/O6) MN/m²/m
Stratum	γ^a	$\phi'^{b,c}$	c'^d	c_u^e	m_v^f	k^g

- f. Laboratory data.
- g. Based upon the equilibrium long term CBR from DMRB IAN 73/O6 Rev 1 Table 5.1.

6.2 Groundworks

6.2.1 Site Preparation

Whilst no buried obstructions were encountered by this investigation, the possibility of buried obstructions being encountered remains. Therefore, it is recommended that an allowance be made for breaking out obstructions, for example provision of pneumatic breakers for site plant. If underground structures cannot be removed, they will need to be surveyed in three dimensions and the new structures will need to be designed to accommodate them.

Topsoil should be removed from beneath all building and hardstanding areas, the faces of shallow, near vertically sided excavations put down at the site are likely to remain stable for short periods of time.

6.2.2 Groundworks

Following breaking out of hardstanding, excavation of shallow soils should be readily undertaken by conventional plant and equipment. However, excavation through any buried construction may require heavy-duty excavation plant and the use of specialist breaking equipment

Due to the fairly shallow depth of Made Ground, generally <1.00m bgl and underlying firm to stiff clays, the faces of shallow, near vertically sided excavations put down at the site are likely to remain stable for short periods of time.

Temporary trench support, or battering of excavation sides, is recommended for all excavations that are to be left open for any length of time and will definitely be required where man entry is required. Particular attention should be paid to excavation at, or close to, adjoining existing roads/buildings, where collapse of excavation faces could have a disproportionate effect.

A risk assessment of the stability of any open excavation should be undertaken by a competent person and appropriate measures adopted to ensure safe working practise in and around open excavations. Further guidance on responsibilities and requirements for working near, and in, excavations can be obtained from the Construction Design and Management Regulations (2015); Construction Information Sheet 47: Inspections and Reports (2005) and HSG47: Avoiding Danger from Underground Services.

To ensure no loads are imposed on the sides of the excavation, spoil should not be placed immediately adjacent to the excavation. Spoil should be placed a suitable distance from the side of the excavation (as assessed by a competent person).

Based on site observations, the rate of water ingress to the proposed excavations is likely to be slow. In these circumstances, groundwater control by sump pumping is likely to be sufficient.

Any water pumped from excavations may need to be passed via settlement tanks (to reduce suspended solids) before being discharged to the sewer. Discharge consents may also be required.

6.2.3 Earthworks

At this stage, Hydrock is not aware of proposals for earthworks at the site.

Should earthworks be required, supplementary earthworks testing and an earthworks Specification will be necessary to ensure the appropriate management and reuse of the existing soils.

If significant earthworks are required, the works may be Category 2 in accordance with BS EN ISO 1997-1 (EC 7) and further geotechnical design may be necessary. Once site proposals have been further defined more specific consideration will need to be given to the reuse of materials and reference should be made back to this office.

6.3 Foundation Recommendations

In accordance with EC7, BS EN 1997-1+A1 (2013), the proposed building is considered to be Geotechnical Category 2 should a piled solution be required. However, if pad foundations of <2.50m are considered appropriate the classification could be lowered to Category 1. As such, foundation recommendations are presented to aid development proposals only and separate geotechnical design will be required if piling is necessary.

6.3.1 Spread foundations

Following an assessment of foundation depth due to tree influence, pad foundations may be considered suitable with dwarf wall structures and trench foundations. The pad foundations should be founded at least 300mm into the stiff or better clays of the Glacial Till below the tree zone of influence.

As a guide, a permissible bearing capacity of 150kN/m² is considered appropriate for a pad foundation of 1.5m by 1.5m bearing in the stiff clays of the Glacial Till, subject to confirmation of settlement being within acceptable and serviceable amount.

If enlarging the foundations is considered (for example because loads are such that the quoted permissible bearing pressure is inadequate) this could lead to increased settlements and the above recommendations should be reviewed.

Based on the medium volume change potential of the clay soils, the minimum founding depth for pad foundations is below the base of the Made Ground, and to below the depth of influence of trees from desiccation effects and roots at 2.50m bgl, as outlined within (tree influence and ring exercise undertaken in accordance NHBC chapter 4.2 presented in the Stage 2 Civils and Structural Report referenced LIMS-HYD-XX-XX-RP-S-0001.

If trees are to be removed, the roots should be grubbed out and foundations extended to below the zone of disturbance created by this activity and to below any remaining root hairs.

Deepening of foundations in accordance with BRE 240 and BRE 298 will be required where pad foundations are within the zone of influence of existing, removed or proposed trees and proposed shrub planting. NHBC Standards (Chapter 4.2) should also be taken into account.

Where it is not practical to deepen individual pads beyond the influencing distance of the desiccated soils, it is recommended that bulk excavation of the affected area be undertaken and, following moisture conditioning, the soils are replaced to an Engineered Specification.

Where foundations are within the zone of potential desiccation from trees and are deeper than 1.5m bgl, a suitable compressible material or void former will be required on the inside faces of foundations to external walls, and beneath piled ring beams and ground bearing floor slabs.

Foundation formations should be inspected by a geotechnical engineer or other suitably competent person to ensure the founding conditions are suitable and as indicated in this report. Any formation materials deemed as unsuitable should be excavated and replaced with lean mix concrete or deepened to suitable strata.

Foundation excavations should be protected from rain and snow and inflow of surface water, frost and freezing conditions. They should also be protected from drying out in hot dry weather.

Any water that collects at the base of the foundation excavations should be removed by pumping from a sump in the base.

To ensure underlying soils are not desiccated as discussed in Section 5.4.3, it would be prudent to complete a desiccation assessment involving additional window sample boreholes, including assessment boreholes close to trees and control boreholes outside of tree influence zones, with a coarser sampling regime to assess the soil moisture content and soil index properties over 0.50m intervals down to the base of the Glacial Till at approximately 4.30m bgl. Should the chosen foundation option be piled then a desiccation assessment will not be required but the designer will still need to consider desiccation.

6.3.2 Piled Foundation

Piled foundations may be required, to deepen foundations to below the influence of trees.

Depending on column loads and layouts, piles should extend through the Made Ground and below the influence of trees in the Glacial Till and to a suitable depth into the underlying dense weathered Chester Formation.

Driven piles should be suitable to support the foundations for the structure. However, the choice of piling system should be undertaken by a specialist piling Contractor and the design of piles is beyond the scope of this report. The decision on pile type and design should take into account the following factors relevant to the site:

- » Piles should extend a minimum of five pile diameters into the dense Chester Formation to mobilise sufficient shaft friction and end-bearing resistance to carry the required loads without unacceptable settlement.
- » Where foundations are constructed on clay soils within the influencing distance of trees design should include for the upper section of the pile to be sleeved or additional length allowed for to resist stresses from clay swelling or shrinkage. In addition, heave protection may be required on the inside faces and underside of the ground beams.

The pile design should be undertaken by a specialist based on loading criteria and the serviceability limit states provided by the structural engineer.

6.3.3 Foundation works risk assessment

As there is a low risk to Controlled Waters, Hydrock believes that a foundation works risk assessment is not required as the proposed piling, will not result in a significant increase in risk of pollution to Controlled Waters.

6.3.4 Working platform

For piling, a working platform will be required prior to the arrival on site of tracked plant. This should be designed and installed in accordance with BR470 (BRE 2004) based on data on the piling plant in accordance with an FPS certificate for the rig loadings.

6.4 Ground Floor Slab

As Made Ground greater than 600mm thick and clay soils of medium volume change potential are present at the site, it is recommended that suspended floor slabs with a void be adopted, supported by either ground beam or subwall over pad foundations.

Ground floor slabs should be designed to incorporate any gas mitigation measures that may be required, as discussed later within this report.

6.5 Roads and pavements

Based on the test results and subject to *in situ* testing during construction, it is considered likely an equilibrium CBR of 2.5% will be achievable for the shallow Type 1 materials or granular Made Ground. For the shallow soft to firm Glacial Till an equilibrium CBR of less than 2.5% is likely present.

Proof rolling of the formation level will be required and any loose or soft spots should be removed and replaced with an engineered fill, in accordance with a suitable Specification. The formation level will also need to be protected during inclement weather from deterioration; all slopes should be trimmed to falls to shed rain water and the surface sealed to limit infiltration.

Prior to the placement of the founding materials and the construction of the road pavement, the sub-formation and formation will need to be inspected and checked in accordance with a suitable specification to ensure the ground conditions are as expected. All testing should be carried out in accordance with DMRB IAN 73/06 to confirm that the ground conditions at time of construction are consistent with the previous design parameters.

Where the CBR is found to be less than 2.5% for formations on the soft to firm Glacial Till, the sub-grade may be unsuitable for both the trafficking of site plant and as support for a permanent foundation, without improvement works being undertaken. Improvement works should be carried out in accordance with DMRB IAN 73/06 Rev 1 Chapter 5. In summary, consideration may be given to the following potential remedial techniques:

- » excavation and re-engineering or replacement of weaker soils; and
- » the inclusion of geosynthetic reinforcement within the unbound layers of the capping and sub-grade.

6.6 Drainage

The underlying ground is cohesive, so discharge to soakaway is not a workable solution. There are no watercourses in the immediate vicinity. Therefore, discharge to the existing private surface water drainage network is the most appropriate option.

6.7 Buried Concrete

Based on guidelines provided in BRE Special Digest 1 (BRE 2005) and the information presented in Section 5.4.9 (Table 5.12):

- » The shallow soils (Made Ground, Glacial Till and Chester Formation) can be classified as Design Sulphate Class DS-1 and ACEC Class AC-1.

This equates to a Design Chemical Class⁵ of:

- » DC-1 for the shallow soils (Made Ground, Glacial Till and Chester Formation);

The designer should check and confirm the classification of concrete using the information presented in Appendix C.

7. Geo-environmental Assessment

7.1 Updated Conceptual Model

7.1.1 Updated ground model

The initial CSM developed from the review of the desk study 2 has been updated using the findings of the ground investigation and is presented in 5. The updated CSM is the basis for the geo-environmental assessment presented in this section.

7.1.2 Updated exposure model

7.1.2.1 Sources

No potential sources have been removed from, or added to, the exposure model.

7.1.2.2 Receptors

No potential receptors have been removed from, or added to, the exposure model.

7.1.2.3 Pathways

No pathways have been removed from, or added to, the exposure model.

Using the updated ground model and updated exposure model, generic risk assessment is undertaken as presented below.

7.2 Risk Assessment Approach

Using the updated CSM, a Stage 1 Tier 2 generic quantitative risk assessment (GQRA) for identified receptors based on all media sampled has been undertaken in accordance with the principles of LCRM.

Firstly, the risks associated with the identified potential contaminant linkages have been estimated using standardised methods (typically involving comparison of site data with published 'screening values'). Secondly, where screening values are exceeded, the result has been evaluated in an authoritative review of the findings with other pertinent information to determine whether or not the exceedance is or is not acceptable in the site-specific circumstances.

The data sets used in the assessment comprise the analytical results obtained by Hydrock as listed in Section 4.2.3.

In cases where potentially unacceptable risks are indicated and/or the land is potentially unsuitable for its intended use, actions such as more advanced stages of risk assessment (Tier 3, detailed quantitative risk assessment (DQRA)) or remediation are proposed in Section 7.11.

7.3 Human Health Risk Assessment

7.3.1 Soils Assessment

7.3.1.1 Generic Assessment Criteria

The soil screening values used are Generic Assessment Criteria (GAC) (i.e. derived in accordance with EA CLEA guidance (2009) using the updated exposure model detailed in Defra SP1010 (2014), with the exception of published C4SLs. The term 'GAC' used in this report is inclusive of all generic soil screening values.

⁵ The calculated ACEC class can be used in accordance with BS 8500-1+A2 (2019), Table A.10 to select the Designated Concrete (DC) class for an intended working life of 50 years. However, the designer is referred to BS 8500-1+A2 (2019), for full details and notes to Table A.11, including any Additional Protective Measures (APMs).

The proposed development is bound by sensitive land uses including a residential development directly north and University Halls of Residence to the east, west and south. Therefore, the generic assessment criteria (GAC) is based on a conservative residential public open space CLEA land use scenario, to align with the bordering sensitive land uses adjacent to the site.

GAC are selected based on the following hierarchy:

- » Category 4 Screening Levels (C4SL), where available.
- » SoBRA Acute GAC for free cyanide, as acute dose toxicity is the primary risk driver.
- » Hydrock GAC, derived by Hydrock as detailed in Appendix E.

The potential risks to human health arising from the presence of volatile contaminants in groundwater have been assessed in accordance with the SoBRA GW GAC guidance (2017). This is a preliminary approach whereby GAC have been developed using the CLEA v1.071 model for indoor air and outdoor inhalation pathways only, assuming a residential or commercial end-use. Exclusion screening distances for assessing vapour intrusion risk are also considered as an additional line of evidence where appropriate. Human health risk from the consumption of potable water (if relevant) is addressed by the Controlled Waters Risk Assessment with the adoption of drinking water guidelines and standards as the assessment criteria (see Section 7.5).

7.3.1.2 Data sets

The data set used in this report is based on the conceptual site model and the proposed development, and is taken to be based on the following site zones, with the data separated into Made Ground and natural Glacial Till.

GAC based on a conservative soil organic matter (SOM) of 1% have been adopted for all soils. Assessment sheets are presented in Appendix E.

7.3.1.3 Assessment Results

Based on individual test results that exceed the GAC, the chemicals of potential concern (CoPC) which require further assessment are summarised in Table 7.1.

Table 7.1: CoPC in soils which require further assessment (human health)

CoPC	GAC (mg/kg)	GAC Source	No. samples	Min. (mg/kg)	Max. (mg/kg)	No. samples >GAC
Made Ground						
Beryllium	2.2	Hydrock GAC	5	0.97	2.6	2
Benzo(a)anthracene	29	Hydrock GAC	5	1.1	83	4
Benzo(a)pyrene	10	C4SL	5	1.2	73	4
Benzo(b)fluoranthene	7.2	Hydrock GAC	5	1.3	93	4
Chrysene	57	Hydrock GAC	5	1.3	79	1
Dibenz(a,h)anthracene	0.57	Hydrock GAC	5	0.14	9.2	4
Glacial Till						
No exceedances						

The individual analytical results have been compared with the relevant GAC in the summary table Appendix E. From this, the CoPC in Made Ground there are elevations for beryllium and pervasive PAHs. The presence of beryllium and pervasive PAHs in Made Ground requires further consideration.

7.3.2 Asbestos

There was no visual evidence of Asbestos Containing Materials (ACM) encountered during the ground investigation. Asbestos has been identified by laboratory testing of soil samples as provided in Table 7.2.

Table 7.2: Asbestos in soil samples (laboratory testing)

Location	Depth (m bgl)	Stratum	% Asbestos (w/w)	Comment
WS08	0.30	Made Ground	<0.001	Loose Fibres (amosite).

The presence of asbestos fibres in soil requires further consideration.

7.3.3 Risk Evaluation

The screening exercise has identified asbestos loose fibres, PAHs and beryllium in Made Ground at concentrations above the GAC. These are considered further here to assess if the exceedance may be acceptable with respect to the proposed development. The phrase 'further assessment' does not necessarily mean that the soil is 'contaminated' or not fit for use.

7.3.3.1 Beryllium in the Made Ground

Concentrations of beryllium were identified in the Made Ground with a GAC of 2.6mg/kg compared to a GAC of 2.2mg/kg. This is a very slight exceedance and is considered not to represent a risk to end users. Hydrock believes mitigation measures with regards to beryllium are unnecessary.

7.3.3.2 PAHs in the Made Ground

The Made Ground contains significant exceedances for PAHs in 4 out of 5 samples, the Made Ground is considered to contain pervasive concentrations of PAHs. These significant exceedances are considered to be an unacceptable risk, which requires mitigation for the proposed end use.

7.3.3.3 Petroleum Hydrocarbons in the Made Ground

Within WS09 between 1.00m and 1.10m the Made Ground contained a very weak hydrocarbon odour. The laboratory testing found no elevations for GACs associated with the weak hydrocarbon odours in WS09, therefore no further assessment is required.

7.4 Phytotoxicity Risk Assessment

7.4.1 Risk Estimation

Soil contaminants, if present at sufficient concentrations, can have an adverse effect on the plant population. Phytotoxic effects can be manifested by a variety of responses, such as growth inhibition, interference with plant processes, contaminant-induced nutrient deficiencies and chlorosis (yellowing of leaves). Phytotoxicity is a difficult parameter to quantify given that experimental techniques vary widely and variations exist in plant tolerances, soil effects and synergistic/antagonistic reactions between chemicals. Guidelines for phytotoxicity and general plant health have been published for a limited number of substances for topsoil (BS BS3882:2015) , for soils used for grazing/landscaping (ICRCL 70/90), and for agricultural uses (MAFF Code of Good Agricultural Practice). Some of these guidelines focus on reduced yield for agricultural crops, and in general do not define concentrations in soil at which plant health is necessarily significantly compromised. The guidelines are not based on plant uptake and human consumption considerations, this is considered as an exposure route in the derivation of human health GAC.

Priority phytotoxic chemical concentrations have been screened against published values to determine the likely risk to plant growth (phytotoxic GAC). Phytotoxic GAC based on a pH of >7% have been adopted for all soils based on laboratory results.

As with human health, individual sample test results are compared directly with the phytotoxic GAC.

Based on individual test results that exceed the phytotoxic GAC, CoPC which require further assessment are summarised in Table 7.3.

Table 7.3: CoPC which require further assessment (phytotoxic)

CoPC	GAC (mg/kg)	Basis for GAC	No. samples	Min. (mg/kg)	Max. (mg/kg)	No. samples >GAC
Made Ground						
No exceedances						
Glacial Till						
Zinc	300	BS3882:2015	3	43	700	1
Weathered Chester Formation						
No Exceedances						

Detriment to plant life is difficult to quantify and many of the GAC are based on agricultural crop yields rather than harm to particular plant species.

Within the Glacial Till, concentrations of zinc are elevated when compared to the GAC in one location in WSO2 at 0.90m bgl. This exceedance for zinc within the Glacial Till is considered to be local and not representative of the Glacial Till where two remaining sample contained zinc concentrations of 43 to 46mg/kg.

Notwithstanding the concentrations of contamination identified, there is no topsoil growing medium on the site and this will require import.

Prior to installing the cover system in soft landscaping area to align with the remediation strategy and verification plan suitable quantity of testing will be required within the Glacial Till if the Glacial Till if utilised in cover system does not pose a risk to plant life.

The requirement for mitigation of risk to human health (as discussed in Section 7.3.3) will also serve to mitigate risks to plant life.

7.5 Pollution of Controlled Waters Risk Assessment

7.5.1 Risk Estimation

The risks to groundwater and surface water from contaminants on site have been assessed in accordance with the Environment Agency (2006) Remedial Targets Methodology (RTM) Levels 1-2. In doing so the compliance point for the assessment is set as the groundwater directly beneath the site on a precautionary basis.

Site contaminant loadings are compared with relevant screening values (Water Quality Targets (WQTs), which are linked to the CSM.

Acceptable WQT are defined for protection of human health (based on Drinking Water Standards (DWS)) and for protection of aquatic ecosystems (Environmental Quality Standards (EQS)).

As related specifically to this site, the data are compared with criteria selected in accordance with the methodology presented in Appendix E. This methodology involves selecting which of several alternative risk scenarios apply in this case. The assessment is presented in Table 7.4 below, with the justification for the scenarios selected explained in the following text:

- » The Glacial Till is classified as a Secondary Undifferentiated Aquifer and the Chester Formation is classified as a Principal Aquifer.
- » The site is within a groundwater Source Protection Zone (SPZ) Zone 3 (Total Catchment). There are no active groundwater abstractions within a 1km of the site boundary.
- » An unnamed brook is present 250m west. Given the likely discontinuous nature of the perched groundwater within the Glacial Till and depth to groundwater within the Chester Formation it is unlikely to be in direct hydraulic continuity with unnamed brook.

Table 7.4: Summary of water quality risk assessment protocol

Hydro ck	Water body receptors	Secondary receptors	Example contaminant linkages	RTM level and data used	Water quality targets
A	Groundwater	Human health (abstraction)	Contaminants from site leach or seep into a groundwater body that is a (potential/actual) source of water for human consumption.	RTM Level 2 - Groundwater. Direct comparison of surface water samples	DWS

Notes: This table and the results of the assessment are considered as a first screening for potential risks of pollution of Controlled Waters. More specific requirements may be stipulated by the relevant Agency.

The results of the screening assessment are presented in Appendix E and are summarised in Table 7.5.

In some instances, the reporting limit (or detection limit) quoted by the laboratory may be greater than the WQT that it is being assessed against. As the current exercise is an initial screening assessment, further assessment of these elements has not been undertaken.

Table 7.5: CoPC which require further assessment (controlled waters)

CoPC	WQT (µg/l)	Basis for WQT	No. samples	No. samples above LoD	Concentration (µg/l)	No. samples exceeding WQT and above LoD
Groundwater in the Glacial Till						
Aluminium	200	DWS	1	1	220	1
Mercury	1	DWS	1	1	5.6	1
Manganese	50	DWS	1	1	1700	1
Ammonium	50	DWS	1	1	2600	1

Note: the maximum recorded value is compared with the water quality target.

7.5.2 Risk Evaluation

The groundwater within the Glacial Till is characterised by exceedances for Aluminium, Mercury, Manganese and Aluminium.

A review of the BGS baseline report series for the Permo Triassic Sandstones of Manchester and East Cheshire, provides evidence that the contaminants in the groundwater within the Glacial Till are naturally occurring background concentrations and within the range of reported baseline concentrations.

The 97.7th percentile for Aluminium in the sandstone bedrock is 357µg/l compared to concentrations in the groundwater within Glacial Till of 220µg/l.

The maximum for Ammonium is 5400µg/l. compared to concentrations on site of 2600µg/l. and the 97.7th percentile is 1700µg/l. The Ammonium concentrations in the Glacial Till are below the maximum baseline concentrations and close to the 97.7th percentile concentrations.

There is an exceedance within the groundwater for manganese, which is considered to be naturally occurring and explained by locally reducing conditions causing reduction of the manganese (IV) to manganese (II), which is more soluble and hence dissolve into solution. The manganese within the groundwater within the Glacial Till is less than the maximum baseline concentrations within the bedrock.

Mercury (inorganic) concentrations within soil samples of Made Ground were low in the order of 0.3 to 0.5mg/kg, therefore the onsite Made Ground is unlikely to be a source of the Mercury given that it is underlain by up to 2.00m of low permeability Glacial Till above the groundwater at 3.00m bgl.

Also given that the groundwater exceedances are inorganic in nature, if the source of the exceedances was from the anthropogenic Made Ground onsite, the significantly elevated PAHs present in the Made Ground would also be present in the groundwater.

Very weak hydrocarbon odours were present towards the base of the Made Ground in WS09 at 1.00m to 1.10m bgl and during the historical ground in BH16/1A at 0.70m and BH17/1A at 0.80m bgl. Hydrock have drilled close the locations previously investigated and did not encounter similar hydrocarbon odours.

Given the absence of hydrocarbons previously encountered, hardstanding being present across the majority of the site and low permeability Glacial Till underlies the Made Ground, infiltration will be restricted, therefore its considered unlikely that hydrocarbons will become mobile as they leach out of the Made Ground and for this reason are not considered to pose a risk to the principal aquifer in the Chester Formation.

Therefore, based on the concentrations of the inorganic contaminants being within the reported ranges of the baseline concentrations in the sandstone bedrock and low likelihood of the Made Ground onsite being source of the inorganic contaminants due to the absence of elevated PAHs in the groundwater the site is considered to pose a low risk to controlled waters.

7.6 Ground Gas Risk Assessment

7.6.1 Data

As per BS8576:2013 Decision Matrix for Initial Monitoring, it is judged from the available evidence that the gas generation potential at the site is very low (due to the shallow depth of Made Ground and low organic content) and as per Tables 5.5a and 5.5b CIRIA C665, the sensitivity of the development is low (due to food preparation, commercial end use). Consequently, and in accordance with CIRIA C665 (Table 5.5a and 5.5b) and Figure 6 BS8576:2013, an appropriate minimum monitoring regime is four readings over one month, provided other monitoring requirements are also met, such as prevailing atmospheric

pressure conditions (for example, BS 8485:2015 +A1:2019 and CL:AIRE TB17 advocate that monitoring should include a period of rapidly falling atmospheric pressure).

Hydrock has undertaken four readings required, including a period of falling atmospheric pressure. As such, the conclusions presented below are considered final.

7.6.2 Assessment

The risks associated with the ground gases methane (CH₄) and carbon dioxide (CO₂) have been assessed using BS 8485:2015 +A1:2019.

The assessment guidelines set out in Table 2 of BS 8485 are based on interpretation of the gas concentrations and the gas flow rates. The quantitative assessment has been carried out by comparing the individual gas concentrations and gas screening values (GSV⁶) in Appendix D with the published CS thresholds (BS 8485 Table 2), in addition to a worst-case GSV assessment in accordance with section 6.3.7 of BS 8485. The assessment is summarised in Table 7.6 and the full assessment is presented in Appendix D. As the response zones within WS05 and WS08 are flooded they have not been included within the ground gas risk assessment.

Table 7.6: Ground gas risk assessment

Flow / gas	Min	Max	Typical ^①	Comment
Steady Flow Rate (L/hr)	<0.1	2.4	<0.1 – 1.0	-
Methane (%)	<0.1	2.0	>1	The typical methane concentration is greater than 1% and the typical carbon dioxide concentration is greater than 5%. Given that there is a potential source (via the Chester Formation) Hydrock considers that as a precautionary measure the Characteristic Situation indicated by the GSV requires raising by one level if the foundations proposals are to pile the building.
Carbon Dioxide (%)	<0.1	9.1	>5	
Carbon Monoxide (ppm)	<1	<1	<1	-
Hydrogen Sulphide (ppm)	<1	<1	<1	-
Oxygen (%)	10.8	21.3	<16	The oxygen concentrations suggest anoxic conditions are present within the monitoring wells.
Carbon Dioxide GSV (L/hr)	0.005	0.168	<0.7	CS2
Methane GSV (L/hr)	0.000	0.043	<0.07	CS1

^① Hydrock assumes that values are considered to be atypical if 95% or more of the remaining data are less than the value under consideration.

As indicated in Table 7.6, the computed GSV for carbon dioxide indicates CS2 conditions. Also, methane and carbon dioxide concentrations have been measured at concentrations 'typically' above 1% and 5%.

The worst case gas screening value for carbon dioxide is 0.2184 L/hr, indicating CS2 conditions. The worst case gas screening value calculates from highest flow at 2.4L/hr and highest carbon dioxide at 9.1%.

⁶ Note: GSV is synonymous with 'site characteristic hazardous gas flow rate' (Q_{HGS}) of BS 8485:2015 +A1:2019 Table.

The source of the ground gas is likely from degradation of organics from an anthropogenic Made Ground source in the wider area which is utilising the Chester Formation as a preferential pathway.

Should the building be piled there is potential that a preferential pathway would be formed whereby ground gas could travel up the pile length and through gaps in construction. If the foundation solution is pad foundations, the of 1.50m of low permeability clays under the foundation and above the Chester Formation would remove the pathway for ground gas to enter the building.

As such if the building is piled, the classification requires additional consideration and the site is classified as Characteristic Situation 2.

Based on the data to date, mitigation measures are required if a piled solution is adopted for the building. These are described in Section 7.11.

7.6.3 Off-site risks from carbon dioxide and methane

The National Planning Policy Framework in England requires that a developed site should be incapable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990. This position includes a consideration of the potential for off-site migration of ground gases that may impact on adjacent properties.

Consequently, it may be necessary to consider the imposition of measures to protect adjacent, off-site receptors. In this case as the methane and carbon dioxide are considered to be from an offsite source using the Chester Formation as a preferential pathway, the Made Ground and natural soils on the subject site are not considered to pose a ground gas source.

7.7 Construction Material Risk Assessment

7.7.1 Water Pipelines

A formal water pipe investigation and risk assessment is beyond the scope of this report. However, the findings of this investigation have been compared to the threshold values in Water UK HBF (2014), Table 1 as far as is practicable.

The site is brownfield and organic contamination PAHs-particularly Naphthalene is resulting in exceedance for PE pipe threshold values within the Made Ground and Hydrock believes barrier pipe is required. However, confirmation should be sought from the water supply company at the earliest opportunity. Locally in WSO9 the Made Ground and Glacial Till contains exceedances of PE thresholds for Aliphatic and Aromatic bands EC10-16 and EC16-40.

7.7.2 Other construction materials

Plastic pipes for drains and sewers are manufactured from unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) or polyethylene (PE). These materials may be affected by the presence of organic compounds in the soil.

For the Made Ground in accordance with the British Plastics Federation Guidance (August, 2018), as the concentrations of total PAH are above 100mg/kg, the pipework manufacturer should be consulted with regard the suitability of the pipework. Within the Glacial Till total PAHs are less than 100mg/kg and for pipes within the Glacial Till PVC-U, PP or PE pipework are considered suitable.

The implications for buried concrete are discussed in Section 6.7.

7.8 Contamination Risk to Ground Workers

7.8.1 Introduction

Whilst risks to construction workers are not discussed in detail, the following section discusses potential risks that should be considered.

Information presented in this document is provided to assist in managing the risk associated with contamination in soil and groundwater at the site but is not definitive. The Contractors are responsible for undertaking their own assessments and assessing what risks are present and what control measures are required.

Task specific risk assessments and method statements should be in place, and risks and required mitigation measures communicated to all relevant personnel prior to the works commencing. Appropriate PPE and, if required, RPE should be provided and utilised.

7.8.2 Beryllium and PAHs in the Made Ground

The Made Ground contains elevated concentrations of beryllium and pervasive PAHs. Therefore, construction workers should wear gloves when handling soils and maintain a good oral hygiene and wash their hands before eating and drinking.

7.8.3 Ground Gas

It is noted that concentrations of carbon dioxide (an asphyxiant) in the soil exceed HSE Workplace Exposure Limits for personnel in the working environment of 1.5% for short term (15 minutes) exposure 0.5% for long term exposure. Furthermore, soil concentrations of oxygen are below the HSE recommendations of 18%.

Soil gas concentrations are not necessarily reflected by those in the breathing zone, as such, all Contractors and maintenance workers should be made aware of the possible presence of carbon dioxide and should take all necessary health and safety precautions when working in trenches or confined spaces.

7.8.4 Asbestos

No clearly identifiable ACM has been seen during the site walkover or during the ground investigation and the laboratory testing has identified trace concentrations of asbestos fibres (<0.001%) in the soils.

All site staff should be made aware of the possibility to encounter asbestos within the Made Ground soils anywhere on the site at any stage of the development. It is advised that the Contractor should consider supplying suitable and sufficient 'Asbestos Awareness' training (specific to asbestos in soils) to all site staff who could foreseeably encounter asbestos containing materials during the course of their work.

The Contractor for each stage of works must assess the risks in accordance with Regulation 6 of the Control of Asbestos Regulations 2012 (CAR2012) and if considered necessary compile a methodology in accordance with Regulation 7 of CAR2012.

It is the responsibility of the Contractor to ensure that mitigation measures are suitable and sufficient to prevent exposure to airborne asbestos so far as is reasonably practicable in accordance with Regulation 11 of CAR2012. However, the asbestos fibres detected at the site are at a very low concentration and within a soil matrix. As such, if the soils are kept damp and appropriate site hygiene measures are in place, this should assist in minimising the risk of the release of airborne fibres.

7.9 Findings of the generic contamination risk assessments

The potential sources, pathways and receptors identified in the desk study (Section 2) have been investigated (Sections 5 and 7) and assessed (Sections 7.2 to 7.6). A Source-Pathway-Receptor linkage assessment has been undertaken and is presented in Appendix H (Table H.2).

A summary of the Source-Pathway-Receptor (SPR) contaminant linkages for which the risks may be unacceptable and require mitigation (those that are moderate or higher) are discussed in Table 7.7.

Table 7.7 assumes the following SPR linkages which have been discounted (subject to agreement) at the risk evaluation stage are confirmed by the regulators and the warranty provider as not requiring further

consideration (mitigation). If these assumptions are not agreed during regulatory discussions, the conclusions as noted in Table 7.7 will need to be updated:

- » Aluminium present within the groundwater in the Chester Formation is considered to of marginal exceedance and does not pose a risk to controlled waters; and
- » Ammonium and mercury within the groundwater in the Chester Formation are considered to be pre-existing concentrations from wider anthropogenic sources.

Table 7.7: Residual risks following risk evaluation

Contaminant Linkage				Comments	
Pollutant Linkage	Sources	Pathways	Receptors	General	Mitigation
PL 1.	Pervasive PAHs and asbestos loose fibres in the Made Ground.	Ingestion, inhalation or direct contact.	Human health.	Significant exceedance of the GAC for PAHs.	Mitigation required in the form of a simple cover system.
PL 2.	Elevated Naphthalene within the Made Ground.	Direct contact	Water supply pipes.	The Made Ground contains Naphthalene above the PE threshold.	Installation of "Protectaline" (or similar) pipework if placed in Made Ground.
PL 3.	Locally elevated Zinc within the Glacial Till.	Root uptake	Plant Life	Elevated concentration of zinc within the Glacial Till.	Additional testing of the Glacial Till which will be used within soft landscaping areas.
PL 4.	Methane and carbon dioxide via migration through the Chester Formation	Migration via pile length and through gaps in constructions	Human health via asphyxiation and buildings via explosion.	Characteristic Situation 2 conditions required if the proposed building will be piled.	Mitigation required by the construction of a subfloor void and installation of suitable gas resistant membrane. To be installed by trained installer. To be validated and verified.

7.10 Climate Change

In considering the potential impact of climate change, the following factors have been considered:

- » The design life of the proposed development is 50 years.
- » The location and elevation of the site in relation to the sea is 44m AOD.
- » The site is predicted to remain above the projected flood level increase for sea level rise and coastal flood threats during the life time of the project.

- » The current depth to groundwater is 0.60m for the perched groundwater and 4.30m for the deeper groundwater within the Chester Formation.
- » The superficial deposits and underlying geology at the site are likely to be physically adversely affected by desiccation and subsidence.
- » The UK Climate Predictions published by the Met Office indicate that over the lifetime of the proposed development average:
 - » Precipitation is forecast to increase by 10%;
 - » Temperature is forecast to increase by 3 to 4°C.; and
 - » Groundwater recharge is forecast to increase in winter months by 1.63mm/day.

For further details on the considerations made, refer to Table I.1 in Appendix I.

7.11 Mitigation Measures

The outline remediation strategy presented below is provided for guidance only, and does not represent a 'Remediation Options Appraisal', or a 'Remediation Strategy', prepared in accordance with LCRM (2023).

As shown in Table 7.7, Hydrock consider the following mitigation is required to ensure the site is suitable for use for the proposed end use. The mitigation measures include:

- » The installation of a simple cover system in soft landscaping to align with Manchester City Council Planning Guidance documentation (extract in Figure 7.1 and should include 450mm in Zone 1 areas (grass seeding) and in Zone 2 (shrub planting) 600mm, comprising a visible geomembrane marker layer, subsoil beneath a topsoil thickness of between 150mm and 300mm (PL1).

Table 1 Growth medium rooting depths for various vegetation types

Vegetation Type	Rooting Depth (mm)
Grass	450
Plants	450
Shrubs	600
Trees	900

Figure 7.1: Rooting depth requirements from Manchester City Council Planning Guidance (2021)

- » Installation of Barrier pipework for pipes installed within Made Ground (PL2).
- » Suitable quantities testing of topsoil and subsoil for soils placed in landscaped areas (PL3);
- » Installation of ground gas mitigation measures to comply with CS2 conditions if the building is piled (as described in Section 7.11.1) (PL4).

The methodology for the remediation should be set out in a Remediation Strategy (which will include the 'Implementation Plan', the 'Verification Plan' and the 'Long Term Monitoring and Maintenance Plan'), which will need to be submitted to the warranty provider and the regulatory authorities for approval.

In addition, the production of a Materials Management Plan and its approval by a Qualified Person will be required to allow reuse of suitable material at the site in accordance with waste regulations.

Verification reports by a competent independent geo-environmental specialist will be required following completion of any remedial works (including cover system installation and ground gas membrane installation).

7.11.1 Gas Protection Measures

Mitigation of the risk from ground gases needs to be undertaken in accordance with BRE 414, CIRIA 665, BS 8485:2015 +A1:2019, and CIRIA C735. In accordance with BS 8485:2015 +A1:2019, the design of gas

protection measures needs to be undertaken in accordance with the Characteristic Situation and the building type:

- » The site is provisionally classified as Characteristic Situation 2 should a piled solution be adopted.
- » The proposed food preparation building is classified as Type C buildings.

As such, the food preparation requires 3 points of protection. This is illustrated in Table 7.8.

Table 7.8: Gas protection score by CS and type of building (after BS 8485:2015 +A1:2019)

Characteristic Situation	Minimum gas protection score (points)			
	High risk		Medium risk	Low risk
	Type A building	Type B building	Type C building	Type D building
2	3.5	3.5	2.5	1.5

A) Residential buildings should not be built on CS4 or higher sites unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g. high-performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system, e.g. in institutional and/or fully serviced contractual situations.

B) The gas hazard is too high for this empirical method to be used to define the gas protection measures.

The final design of ground gas protection measures is subject to a detailed design in accordance with section 7.4 and 8.3 of BS 8485:2015 + A1:2019 and is to be specified by the designer (in accordance with CIRIA 665 and BS 8485:2015 +A1:2019). The protection will need to be achieved by a combination of two or more of the following three types of protection measures:

- » the structural barrier of the floor slab,
- » ventilation measures; and
- » gas resistant membrane.

Where design elements are required to meet certain standards to qualify for the protection points (e.g. cast in situ monolithic reinforced floor slab), it is up to the designer to ensure the minimum requirements of the standards are met.

Where used, gas resistant membranes should be:

- » sufficiently impervious to methane and carbon dioxide;
- » capable, after installation, of providing a complete barrier to the entry of the relevant gas;
- » sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions;
- » sufficiently strong to withstand in service stresses (e.g. due to ground settlement if placed below a floor slab);
- » sufficiently strong to withstand the installation process and following construction activities until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, and dropping tools); and
- » chemically resistant to degradation by other contaminants that might be present.

As preliminary guidance, Hydrock would suggest the following:

For CS2 - Type C1 - 2.5 points:

- » Beam and block or pre-cast concrete floor slab (0 points);
- » passive sub floor ventilation e.g. void (good performance 1.5 points); and

- » 2000g gas resistant membrane (2.0 points).

Other variations are possible. It is up to the designer to design and specify ground gas protection measures.

Where a gas resistant membrane is required as part of the design, all joints and penetrations are to be sealed and the installation is to be verified in accordance with CIRIA C735 (Mallet et al 2014) or it will score zero points and will not be deemed to afford any protection. This verification will involve verification by the Contractor and independent verification on a selected number of plots by Hydrock or alternative qualified independent third-party.

Whilst tape can be utilised to seal the seams Hydrock would recommend the membranes are sealed using welded seams and the use of specialist seals around penetrations (top hats etc.). The installer is to present an installation methodology and a QA/QC plan for installation to Hydrock for comment, with particular attention given to sealing the membrane.

In order to achieve the points specified for ventilation, the architect is to design passive ventilation to meet at least 'good performance', as described in Annex B of BS 8485:2015 +A1:2019.

8. Waste and material management

8.1 Introduction

The Waste Framework Directive (WFD) (2009/98/EC) defines waste as '*any substance which the holder discards or intends to discard.*' In a geo-environmental context, the waste is most often 'soil' and the two main scenarios are offsite disposal of the material as a waste and/or reuse of the material on site. For cost and sustainability reasons, reuse is preferred to off-site disposal.

Section 8.2 below describes the key issues relating to off-site disposal to landfill and Section 9 considers requirements relating to reuse of soils and materials management.

8.2 Waste Disposal

8.2.1 Principals

Based on the WFD, any material excavated on site may be classified as waste and it is the responsibility of the producer of a material to determine whether or not it is waste. Where off-site disposal is undertaken, the following guidance applies.

Classification is a staged process:

- » A hazardous waste is defined under the WFD as one which possesses one or more of fifteen defined hazardous properties. If a waste is not defined as hazardous, then it is non-hazardous.
- » Where the materials are soil, it is then be assigned using the 'List of Waste Codes', which classifies the material as either:
 - » hazardous (17-05-03), which is defined as "*soil and stones containing hazardous substances*"; or
 - » non-hazardous (17-05-04), which is defined as "*soil and stones other than those mentioned in 17-05-03*".
 - » Hydrock utilise the proprietary assessment tool, HazWasteOnline™ to undertake this assessment.
- » Waste Acceptance Criteria (WAC) testing is then undertaken (if required), and are only applicable following classification of the waste, and only where the waste is destined for disposal to landfill. The WAC are both qualitative and quantitative. The WAC and the associated laboratory analyses (leaching tests) are not suitable for use in the determination of whether a waste is hazardous or non-hazardous.

It should be noted that some non-hazardous wastes may be suitable for disposal at an inert landfill as non-hazardous waste, subject to meeting the appropriate waste acceptance criteria.

It should be noted that classification must be undertaken on the waste produced, by the waste producer. Necessary sampling frequency to adequately characterise a soil population is defined within WM3.

Topsoil and Peat

Topsoil and peat are biodegradable, therefore if they are surplus to requirements and cannot be re-used in accordance with a Materials Management Plan, they cannot be classified as inert. As such, topsoil and peat need to be classified by a staged assessment and sampling process and would either be classified as hazardous or non-hazardous, depending upon the results of the assessment.

Greenfield sites

Waste from completely greenfield sites may be accepted at a landfill as inert waste if it meets the requirements of paragraph 10 (wastes acceptable without testing at landfills for inert waste) of the Landfill (England and Wales) (Amendment) Regulations (2005) ('the Regulations') can be met. Paragraph 10 of the Regulations states, "*soils may be able to be classified as inert waste without testing, if:*

- » *they are single stream waste of a single waste type;*
- » *there is no suspicion of contamination and they do not contain other material or substances such as metals, asbestos, plastics, chemicals, etc...."*

As such, where the site is greenfield and the waste producer is confident about the quality of a soil (i.e. naturally occurring and uncontaminated), further sampling and laboratory testing is not necessary for the Basic Characterisation and this can be undertaken on qualitative Waste Acceptance Criteria testing.

In this instance the waste producer can characterise the waste based on visual assessment and written description of the waste in addition to supporting evidence such as a desk study assessment of the greenfield status. However, it should be noted this characterisation is subject to agreement by the landfill operator who may require testing to be undertaken to confirm classification.

Contaminated or potentially contaminated sites

If the site is brownfield, contaminated or potentially contaminated, the waste must undergo an initial waste classification exercise using background information on the source and origin of the waste and assessment of chemical test data in accordance with Environment Agency Technical Guidance WM3.

If following the initial waste classification exercise, the soils are acceptable for disposal to a non-hazardous landfill, further qualitative Waste Acceptance Criteria (WAC) testing is not required.

However, if soils are potentially able to be disposed to an inert landfill as non-hazardous waste, or require testing to determine if they can be disposed of to a stable non-reactive hazardous or hazardous class of landfill, the next stage of assessment is to undertake qualitative WAC testing. This will determine the Basic Characterisation and the landfill category at which the soils can be accepted.

Hazardous material must be subjected to WAC testing to determine whether it requires treatment before it can be accepted at the hazardous landfill, while non-hazardous material can be tested to determine whether it may be suitable for placement in an inert landfill. .

8.2.2 HazWasteOnline™ assessment

As the site is brownfield, in order to inform the preliminary waste characterisation process, Hydrock has undertaken an exercise using the proprietary web-based tool HazWasteOnline™. The output of the HazWasteOnline™ assessment is provided in Appendix F and a summary of the preliminary waste classification is provided below in Section 8.2.4.

8.2.3 WAC testing

The site is brownfield. However, WAC testing has not been undertaken to date but may be requested by the landfill for excavated soils that are to be disposed of, to assist with waste disposal options prior to disposal. A summary of the preliminary waste disposal options is provided below in Section 8.2.4.

8.2.4 Preliminary waste disposal options

The site is brownfield and based on the site history, and the HazWasteOnline™ assessment, if suitable segregation of different types of waste is put in place, for soils to be disposed of, it is considered that:

- » The 'General' Made Ground is likely to be classified as non-hazardous waste.
- » The Glacial Till is likely to be classified as non-hazardous waste.
- » Made Ground in WS09 underneath the proposed landscaping area between 1.00m and 1.10m bgl is locally classified as hazardous (under HP7 carcinogenic and HP11 mutagenic) due to the concentrations of petroleum hydrocarbon bandings.
- » Any soils containing > 0.1% asbestos or visible asbestos containing materials would be considered as hazardous.

8.2.5 General Waste Comments

It should be noted that:

- » Any soils containing > 0.1% asbestos or visible asbestos containing materials would be considered as hazardous.
- » It is the waste producer's responsibility to segregate the waste at source and waste producers must not mix waste materials/streams or dilute hazardous components, for example by mixing with less or non-hazardous waste on site to meet WAC limit values.
- » The above preliminary assessment has been made on the basis of the soils tested as part of the ground investigation, using the HazWasteOnline™ assessment. However, the formal classification of waste can only be undertaken on the material to be disposed of, and by the waste producer and the receiving landfill as license conditions vary from landfill to landfill.
- » Basic Characterisation should be undertaken in accordance with Environment Agency guidance by the waste producer. Hydrock can assist if required and this report will assist the characterisation. However, Basic Characterisation does not form part of the current commission and would require further assessment and testing on the wastes actually to be disposed.
- » Once the waste producer has undertaken an initial Basic Characterisation on each waste stream, they can manage the soils as part of the on-site processing programme (for example, stockpiling, treatment, screening and separation). The waste producer and landfill operator will then need to agree the suite of compliance testing for regularly generated waste to demonstrate compliance with the initial Basic Characterisation prior to disposal.
- » At the time of disposal, additional testing on the excavated soils to be disposed of, will likely be necessary.
- » Non-hazardous and hazardous soils require pre-treatment (separation, sorting and screening) prior to disposal.
- » The costs for disposal of non-hazardous and hazardous soils are significant compared to disposal of inert material.
- » In addition to disposal costs, landfill tax will be applicable. Non-hazardous and hazardous waste will generally be subject to the Standard Rate Landfill Tax. Inert or inactive waste will generally be subject to the Lower Rate Landfill Tax. The landfill tax value changes each April and can be found at <https://www.gov.uk/government/publications/rates-and-allowances-landfill-tax/landfill-tax-rates-from-1-april-2013>.
- » Before a waste producer can move waste to a landfill site for disposal, they need to check the landfill site has the appropriate permit and must have completed the following⁷:
 - » Duty of care transfer note / Hazardous Waste consignment note, including comment as to if pre-treatment has been undertaken; and
 - » Basic Characterisation of the waste, to include: description of the waste; waste code (using list of wastes); composition of the waste (by testing, if necessary) and; WAC testing (if required).

8.3 Materials Management

8.3.1 Introduction

Soils that are to remain on site, should be managed and reused in accordance with a Materials Management Plan (MMP), prepared in accordance with 'The Definition of Waste: Development Industry

Code of Practice', Version 2 (CL:AIRE), known as the DoWCoP. Where all aspects of the DoWCoP are followed the soils are considered not to be waste, because they were never discarded in the first place.

Version 2 of the DoWCoP clearly sets out the principles and an outline of the requirements of a MMP. The following compliance criteria must be seen to apply to the MMP for the site:

- Factor 1: Protection of human health and protection of the environment.
- Factor 2: Suitability for use, without further treatment.
- Factor 3: Certainty of Use.
- Factor 4: Fixed Quantity of Material.

The reuse of soils at sites should be considered during the planning and development design process so that compliance with issues such as fixed quantity and certainty of use clearly relate to agreed site levels. Suitability of Use is normally evident from the remediation strategy or the design statement, which form an integral part of a MMP. However, some soils may need to be tested post-excavation to prove they are suitable for use.

Once the MMP is finalised, it must be declared by a Qualified Person (QP). The Declaration is an on-line submission as part of which the QP is required to confirm that the declaration is being made before the relevant works have commenced (i.e. it is not a retrospective application).

Once all material movements have been completed in accordance with the MMP a verification report must be produced, kept for 2 years and provided to the EA on request.

It should be noted that failure to comply with the requirements of the DoWCoP when re-using materials has potentially significant consequences for the waste holder. The risk is that the reused materials are still regarded as a waste that has been illegally deposited. From 1 April 2018, the scope of Landfill Tax has been extended to sites operating without the appropriate environmental disposal permit, and operators of illegal waste sites will now be liable for Landfill Tax. Further information is available at: <https://www.gov.uk/government/publications/landfill-tax-disposals-not-made-at-landfill-sites/landfill-tax-disposals-not-made-at-landfill-sites>.

If soils are excavated and reused on sites (or moved to another site) without a MMP, exemption, or appropriate Permit in place, anyone who knowingly facilitates the disposal may be *'jointly and severally liable'* to any assessment of tax, fines or prosecution.

8.3.2 Materials management scenarios

The materials management scenarios present on site are discussed below.

It should be noted that more than one scenario may apply, dependent upon where the soils are proposed for reuse.

8.3.2.1 Clean, naturally occurring materials – reused on the site of origin

Where soils are naturally occurring, uncontaminated and are reused on the site they are excavated (i.e. greenfield site with documented site history, with no Made Ground), they will fall outside the Waste Framework Directive (WFD) (i.e. they will not be a waste when reused on the site of origin).

⁷ ENVIRONMENT AGENCY. November 2010. Guidance on waste acceptance procedures and criteria. Waste acceptance at landfills. The Environment Agency.

However, there needs to be certainty of that reuse, and evidence is necessary to support this strategy, for example through information provided during the planning process. The onus is on the developer to demonstrate that the materials are not a waste and will never become a waste. As such, a Materials Re-use Strategy is recommended to show certainty. Alternatively, if the volume of material is under 1,000 tonnes, then a U1 waste exemption may be applied for from the Environment Agency.

It may be noted that some 'clean naturally occurring materials' may still fail the 'suitable for use' test, for example, soils with a naturally high organic content may not be suitable for use because of their propensity to produce ground gases such as methane. Rules regarding other more unusual circumstances such as where natural soils contain an unacceptably high mineral content are described in the DoWCoP.

8.3.2.2 *Clean, naturally occurring materials – transferred to other sites*

Where soils are naturally occurring, uncontaminated and are transferred to other sites (i.e. direct transfer), they will not become waste as long as the transfer is undertaken in accordance with the DoWCoP. A MMP must be prepared for the receiving site and the materials movement must be noted in the MMP of the Donor site. This movement must have been declared to CL:AIRE prior to the works commencing.

8.3.2.3 *Made Ground and other contaminated soils*

On sites where Made Ground or contaminated soils are present, any soils excavated will be a waste as soon as they are excavated (even if they are clean, naturally occurring materials), unless they are subject to reuse in accordance with the DoWCoP. As such, for any brownfield site or a site where Made Ground is present and soils are being moved and reused, the materials could be deemed a waste, subject to either: a Materials Management Plan (MMP), to prevent the material being classified as a waste following reuse; or an exemption (for limited volumes); or an environmental permit, dependant on its status.

Other commonly occurring circumstances are:

If Made Ground is being moved between sites, it must be ensured that appropriate permits are in place to ensure the soils are not classified as a waste. Made Ground cannot be moved between sites under DoWCoP alone and would require relevant permits as part of the MMP documentation for the Hub site the material is being treated at.

8.3.2.4 *Made Ground and other contaminated soils*

All recycled materials (6F2 etc.) must be produced under the 2013 WRAP 'Quality Protocol: Aggregates from inert waste', whether on site or off-site. If they are not, they will be deemed a waste and can only be used on site under a permit. More information can be found at <https://www.gov.uk/government/publications/quality-protocol-production-of-aggregates-from-inert-waste>.

8.3.2.5 *Geotechnical improvement requirements*

Construction activities carried out on uncontaminated soils solely for the purpose of improving geotechnical properties e.g. lime / cement modification, are not generally regarded as waste treatment operations and do not require a permit.

However, should processing be needed (such as screening, treatment or improvement), that would constitute a waste activity and require a mobile treatment permit. This may be as simple as removing oversize material with an excavator bucket, to using a riddle bucket to remove hardcore to full mechanical screening.

9. Uncertainties and limitation

9.1 General Comments

Hydrock Consultants Limited (Hydrock) has prepared this report in accordance with the instructions of University of Manchester (the Client), by e-mail dated 13th February 2024 under the terms of appointment for Hydrock, for the sole and specific use of the Client and parties commissioned by them to undertake work where reliance is placed on this report. Any third parties who use the information contained herein do so at their own risk. Hydrock shall not be responsible for any use of the report or its contents for any purpose other than that for which it was prepared or for use of the report by any parties not defined in Hydrock's appointment.

This report details the findings of work carried out in April 2024. The report has been prepared by Hydrock on the basis of available information obtained during the study period. Although every reasonable effort has been made to gather all relevant information, not all potential environmental constraints or liabilities associated with the site may have been revealed.

Hydrock has used reasonable skill, care and diligence in the design of the investigation of the site and in its interpretation of the information obtained. The inherent variation of ground conditions allows only definition of the actual conditions at the locations and depths of trial pits and boreholes at the time of the investigation. At intermediate locations, conditions can only be inferred.

Groundwater data are only representative of the dates on which they were obtained and both levels and quality may vary. Unless otherwise stated, the recommendations in this report assume that ground levels will remain as existing. If there is to be any re-profiling (e.g. to create development platforms or for flood alleviation) then the recommendations may not apply.

The work has been carried out in general accordance with recognised best practice. Unless otherwise stated, no assessment has been made for the presence of radioactive substances or unexploded ordnance. Where the phrase 'suitable for use' is used in this report, it is in keeping with the terminology used in planning control and does not imply any specific warranty or guarantee offered by Hydrock.

The chemical analyses reported were scheduled for the purposes of risk assessment with respect to human health, plant life and controlled waters as discussed in the report. Whilst the results may be useful in applying the Hazardous Waste Assessment Methodology given in Environment Agency Technical Guidance WM3, they are not primarily intended for that purpose and additional analysis will be required at the time of disposal to fully classify waste. Discussion and comment with regards to waste classification are preliminary and do not form the requirements of 'Basic Characterisation' as required.

Unless otherwise stated, at the time of this investigation the future routes of water supply pipes had not been established. This investigation and sampling strategy may not be fully compliant with UKWIR recommendations. Consequently, a targeted investigation and specific sampling and chemical testing may be required at a later date once the routes of the supply pipes are known. In addition, it is recommended that the relevant water supply company be contacted at an early stage to confirm its requirements for assessment, which may not necessarily be the same as those recommended by UKWIR.

Whilst the preliminary risk assessment process has identified potential risks to construction workers, consideration of occupational health and safety issues is beyond the scope of this report.

Please note that notwithstanding any site observations concerning the presence or otherwise of archaeological sites, asbestos-containing materials or invasive weeds, this report does not constitute a formal survey of these potential constraints and specialist advice should be sought.

Any site boundary line depicted on plans does not imply legal ownership of land.

10. Recommendations for further work

Following the ground investigation works undertaken to date, the following further works will be required:

- » should pad foundations from a cost perspective be the preferred foundation option then additional ground investigation to complete a desiccation assessment would be required;
- » discussion and agreement with utility providers regarding the materials suitable for pipework;
- » discussions with regulatory bodies and the warranty provider regarding the conclusions of this report;
- » discussions with piling Contractors regarding conclusions of this report and design of the piles;
- » provision of geotechnical design for the Category 2 (if piles are the preferred foundation option.);
- » production of a Remediation Strategy and Verification Plan (and agreement with the regulatory bodies and the warranty provider);
- » production of a Materials Management Plan relating to reuse of Glacial Till in cover systems if applicable, import of Topsoil (if manufactured and less than 1000t the EAs regulatory position statement is that the soils will not class as waste and enforcement would not be undertaken) ;
- » remediation and mitigation work; and
- » verification of the remediation works.

11. References

- ASSOCIATION OF GROUND INVESTIGATION SPECIALISTS. 2006. Guidelines for Good Practice in Site Investigation. Issue 2. AGS, Beckenham.
- ASSOCIATION OF GROUND INVESTIGATION SPECIALISTS. 2019. Waste Classification for Soils – A Practitioners' Guide. AGS, Beckenham.
- BRE. 1980. Low-rise buildings on shrinkable clay soils: Part 1. BRE Digest 240. Building Research Establishment, Garston.
- BRE. 2016. Soakaway design. BRE DG 365. BRE, Garston.
- BRE. 2004. Working platforms for tracked plant: good practice guide to the design, installation, maintenance and repair of ground-supported working platforms. BR470. BRE, Garston.
- BRE. 2005. Concrete in aggressive ground. BRE Special Digest 1, 3rd Edition. BRE, Garston.
- BRITISH GEOLOGICAL SOCIETY. 2003. Baseline Report Series: 8. The Permo-Triassic Sandstones of Manchester and East Cheshire. Technical Report NC/99/74/8.
- BRITISH PLASTIC FEDERATION. August 2018. 'Designing Drains and Sewers for Brownfield Sites. Guidance Notes'. BPF Pipes Group (<https://www.bfppipesgroup.com/media/29155/Designing-drains-and-sewers-for-brownfield-sites.pdf>)
- BRITISH STANDARDS INSTITUTION. 2003. Geotechnical investigation and testing - Identification and classification of rock - Part 1: Identification and description. BS EN ISO 14689-1 Incorporating Corrigendum No.1. BSI, London
- BRITISH STANDARDS INSTITUTION. 2004+A1 2013. Eurocode 7 – Geotechnical design - Part 1: General rules. BS EN 1997-1+A1. Incorporating Corrigendum February 2009. BSI, London.
- BRITISH STANDARDS INSTITUTION. 2007. Eurocode 7 – Geotechnical design - Part 2: Geotechnical investigation and testing. BS EN 1997-2. BSI, London.
- BRITISH STANDARDS INSTITUTION. 2010. Code of practice for earthworks. BS 6031 Incorporating Corrigendum No.1:2010. BSI, London.
- BRITISH STANDARDS INSTITUTION. 2017. Code of Practice for Investigation of Potentially Contaminated sites. BS 10175 Incorporating Amendment No. 2:2017. BSI, London.
- BRITISH STANDARDS INSTITUTION. 2012. Trees in relation to design, demolition and construction – Recommendations. BS 5837. BSI, London.
- BRITISH STANDARDS INSTITUTION. 2015+A1:2020. Code of Practice for Foundations. BS 8004. BSI, London.
- BRITISH STANDARDS INSTITUTION. 2015. Specification for topsoil. BS 3882. BSI, London.
- BRITISH STANDARDS INSTITUTION. 2020. Code of practice for ground investigations. BS 5930+A1 2020. BSI, London.
- BRITISH STANDARDS INSTITUTION. 2015+A2 2019. Concrete – complementary British Standard to BS EN 206-1 – Part 1: Method of specifying and guidance to the specifier. BS 8500-1+A2 2019. BSI, London.
- BRITISH STANDARDS INSTITUTION. 2015+A1 2019. Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings. BS 8485:2015 +A1:2019. BSI, London.
- CARD, G., WILSON, S. and MORTIMER, S. 2012. A pragmatic approach to ground gas risk assessment. CL:AIRE Research Bulletin RB17. CL:AIRE, London.
- CARD, G., LUCAS, J., WILSON, S., 2019. Risk and reliability in gas protection design - 20 years on. Ground Engineering, August/September 2019.
- CL:AIRE. 2011. The Definition of Waste: Development Industry Code of Practice, Version 2. Contaminated Land: Applications in the Real Environment (CL:AIRE), London.
- CL:AIRE, 2017. A Pragmatic Approach to Ground Gas Risk Assessment. Research Bulletin 17, CL:AIRE, Buckinghamshire. ISSN 2047-6450.
- CL:AIRE. 2016. CAR-SOIL™ Control of Asbestos Regulations 2012 - Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials: Industry guidance. Contaminated Land: Applications in the Real Environment (CL:AIRE), London.
- CL:AIRE, 2018. Ground gas monitoring and 'worst-case' conditions. Technical Bulletin 17, CL:AIRE, Buckinghamshire, August 2018.
- CL:AIRE, 2020. Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration. CL:AIRE, Buckinghamshire. ISBN 978-1-905046-35-5.
- CL:AIRE, 2021. Good practice for risk assessment for coal mine gas emissions. CL:AIRE, Buckinghamshire. ISBN 978-1-905046-39-3
- CL:AIRE, 2022. Resilience and Adaptation for Sustainable Remediation, SuRF-UK bulletin SuRF 5, August 2022.
- CLAYTON, C. R. I. 2001. Managing Geotechnical Risk. Improving productivity in UK building and construction. Thomas Telford, London.
- CONCRETE SOCIETY, THE. 2013. Concrete industrial ground floors. A guide to design and construction. Technical Report 34 (4th Ed.). The Concrete Society, Camberley.
- DLUHC. July 2021. National Planning Policy Framework. DLUHC, London.
- DEPARTMENT FOR ENVIRONMENT FOOD AND RURAL AFFAIRS (DEFRA). 2005. 'Landfill (England and Wales) (Amendment) Regulations', (with reference to previous iterations of the regulations).
- DEFRA. 2014. SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document. Defra, London.
- ENVIRONMENT AGENCY. June 2001. National Groundwater and Contaminated Land Centre Report NC/99/73: Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention. The Environment Agency, Bristol.
- ENVIRONMENT AGENCY. 2006. Remedial Targets Methodology. Hydrogeological Risk Assessment for Land Contamination. The Environment Agency, Bristol.
- ENVIRONMENT AGENCY, 2010. Guiding Principles for Land Contamination. Part 2. FAQs, technical information, detailed advice and references, March 2010.
- ENVIRONMENT AGENCY. August 2023. Environment Agency Regulator Position Statement RPS 190 The Environment Agency.
- Environment Agency, 2010. Guiding Principles for Land Contamination. Part 2. FAQs, technical information, detailed advice and references, March 2010.
- ENVIRONMENT AGENCY. November 2011. Treatment of waste for landfill. Report – GEHO111BVDF-E-E 913_11, Version 2 The Environment Agency. <http://publications.environment-agency.gov.uk/pdf/GEHO111BVDF-E-E.pdf>
- ENVIRONMENT AGENCY. 2021. Waste classification. Guidance on the classification and assessment of waste (1st Edition v1.2.GB) Technical Guidance WM3. The Environment Agency.

ENVIRONMENT AGENCY. 2023. Land Contamination: Risk Management (LCRM). The Environment Agency.

HATANAKA, M, UCHIDA, A, KAKURAI, M, and AOKI, M. 1980. A consideration on the relationship between SPT N-value and internal friction angle of sandy soils. Journal of Structural and Construction Engineering (Transactions of AIJ). 63. 125-129. 10.3130/aijs.63.125_2.

HEALTH and SAFETY EXECUTIVE. December 2005. Construction Information Sheet 47: Inspections and Reports (CIS 47 (Rev 1)). HSE.

HEALTH and SAFETY EXECUTIVE. 2014. HSG47 - Avoiding danger from underground services (Third edition). HSE.

HEALTH and SAFETY EXECUTIVE. January 2020. EH40/2005 Workplace Exposure Limits (4th edition 2020.). HSE.

HIGHWAYS AGENCY. 2009. Design Guidance for Road Pavement Foundations (Draft HD25). Interim Advice Note 73/06. Rev 1. Highway Agency, London.

HIGHWAYS AGENCY. 2014. Manual of Contract Documents for Highway Works, Specification for Highway Works: Volume 1, Amendment August 2014. Highway Agency, London.

THE HIGHWAYS AGENCY. 2000. Design Manual, Road and Bridges: CS 641 - Managing the maintenance of highway geotechnical assets. CS 641 Rev O. Highway Agency, London.

THE HIGHWAYS AGENCY. 2019. Design Manual for Roads and Bridges. Managing Geotechnical Risk. CD 622 Rev O. Highway Agency, London.

JOHNSON, R. 2001. Protective measures for housing on gas contaminated land. Building Research Establishment Report BR 414. BRE, Garston.

MALLETT, H., COX, L., WILSON, S., and CORBAN, M. 2014. Good practice on the testing and verification of protection systems for buildings against hazardous ground gases. CIRIA Report C735. Contaminated Land: Applications in Real Environments, London.

UK HEALTH SECURITY AGENCY (UKHSA) and BRITISH GEOLOGICAL SURVEY. December 2022. Indicative Atlas of Radon Potential for Great Britain (Version 3) (<https://www.ukradon.org/information/ukmaps>)

NHBC. 2023. NHBC Standards. NHBC, Milton Keynes. <https://nhbc-standards.co.uk/>

NHBC FOUNDATION. 2023. Hazardous ground gas - an essential guide for housebuilders. NF94. NHBC, Milton Keynes

PECK, R.B., HANSON, W.E., AND THORNBURN, T.H., Foundation Engineering, 2nd Edn, John Wiley, New York, 1967, p.310.

RAWLINS, B. G., McGRATH, S. P., SCHEIB, A. J., CAVE, N., LISTER, T. R., INGHAM, M., GOWING, C. and CARTER, S. 2012. The advanced geochemical atlas of England and Wales. British Geological Survey, Keyworth.

SCIVYER, C. and JAGGS M. 2023. Radon: Guidance on protective measures for new buildings. Building Research Establishment Report BR 211 6th Edition. BRE, Garston.

SoBRA, 2022. Guidance on Assessing Risk to Controlled Waters from UK Land Contamination Under Conditions of Future Climate Change, Society of Brownfield Risk Assessment, August 2022.

STONE, K., MURRAY, A., COOKE, S., FORAN, J. and GOODERHAM, L. 2009. Unexploded ordnance (UXO), a guide to the construction industry. CIRIA Report C681. Contaminated Land: Applications in Real Environments, London.

STROUD, M. A. 1975. The standard penetration test in insensitive clays and soft rocks. Proceedings of the European Symposium on penetration testing, 2, 367-375.

TOMLINSON. M.J. 2001. Foundation Design and Construction (6th Edition and 7th Edition). Prentice Hall Press

WASTE AND RESOURCES ACTION PROGRAMME (WRAP). October 2013. Quality Protocol. Aggregates from inert waste. End of waste criteria for the production of aggregates from inert waste.

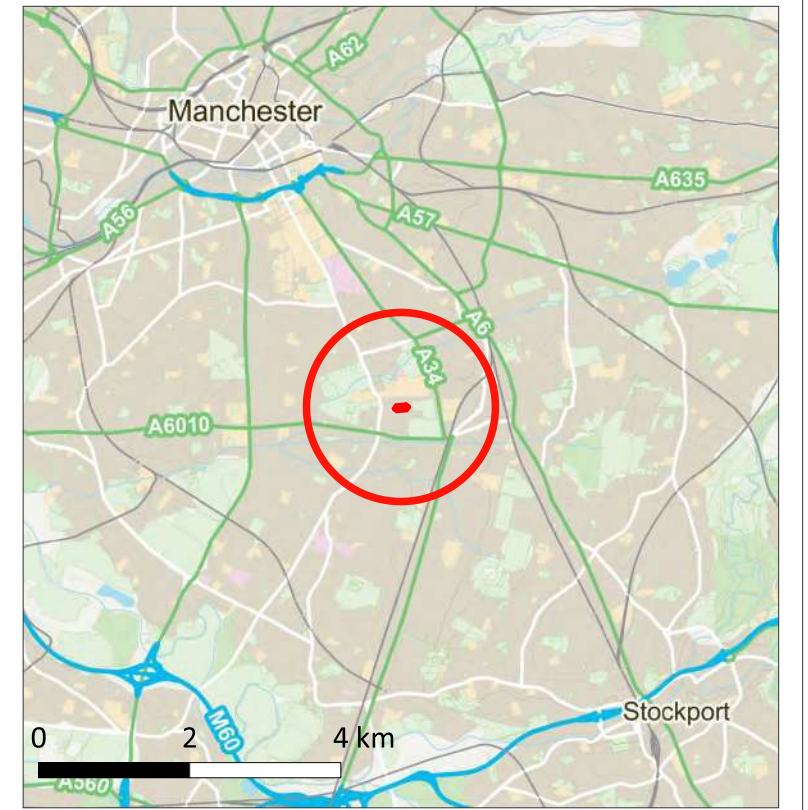
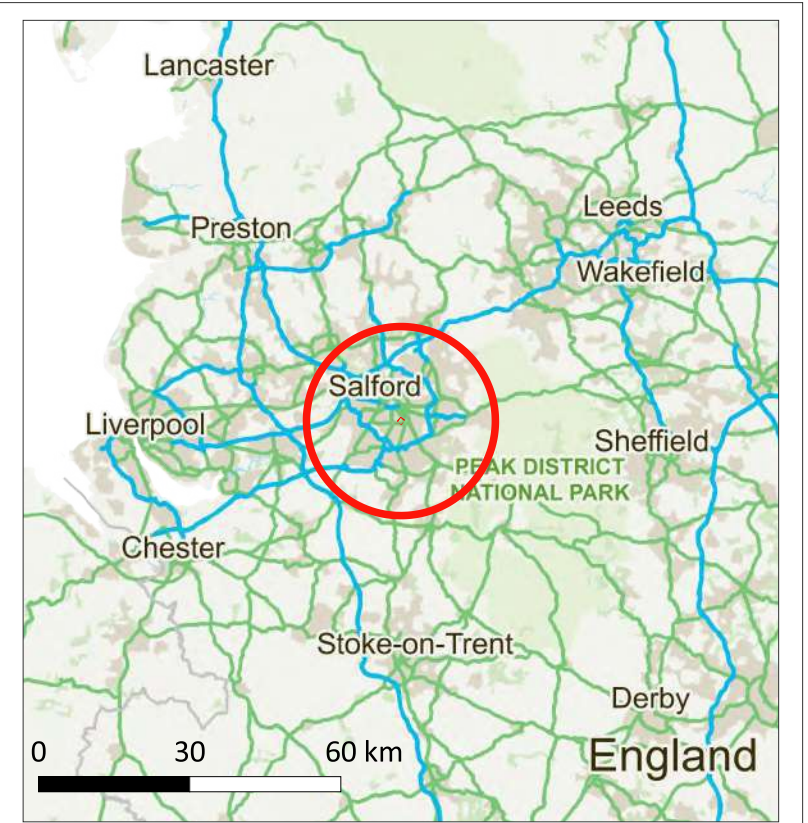
WATER UK HBF. January 2014. Contaminated Land Assessment Guidance. Water UK and the Home Builders Federation.

WILSON, S., OLIVER, S., MALLETT, H., HUTCHINGS, H. and CARD, G. 2007. Assessing risks posed by hazardous ground gases to buildings. CIRIA Report C665. Contaminated Land: Applications in Real Environments, London.

WILSON, S., COLLINS, F. and LAVERY, R., G. 30th July 2018. Using ternary plots for interpretation of ground gas monitoring results. Ground Gas Information Sheet No 1 Paper 1.0. Ambisense Limited and EPG Limited.

WILSON, S. and MORTIMER, S., 2017. Piled foundations and pathways for ground gas migration, Environmental Geotechnics, ICE Publishing.

Appendix A Drawings



Contains Ordnance Survey data © Crown copyright and database right (2020)

KEY PLAN Site Boundary	NOTES 1. Contains OS data © Crown copyright and database right (2022)	REVISIONS					TITLE SITE LOCATION PLAN			
		REV.	DRAWN BY INITIALS	CHECKED BY INITIALS	DATE		REVISION NOTES/COMMENTS	HYDROCK PROJECT NO. 33445	SCALE @ A3 1:850	
		P01	RS	LM	18.03.24		First issue			
							CLIENT University of Manchester	PURPOSE OF ISSUE SUITABLE FOR INFORMATION		STATUS S2
							PROJECT The Limes Relocation	DRAWING NO. LIMES-HYD-XX-XX-D-G-00001		REVISION P01



NOTE:

All information is based on external survey information (2D and 3D). Heights have been provided through external 3D survey models and plans have been based on 2D external survey information. Further information required in terms of existing and extent of retained car parking spaces, bike shelter trees, planters, gas/grover/meter enclosure T&C. Extent of red line boundary may need to be adjusted to suit proposed road access, turning heads and radius. Refer to Turley's for landscape details.

Key:

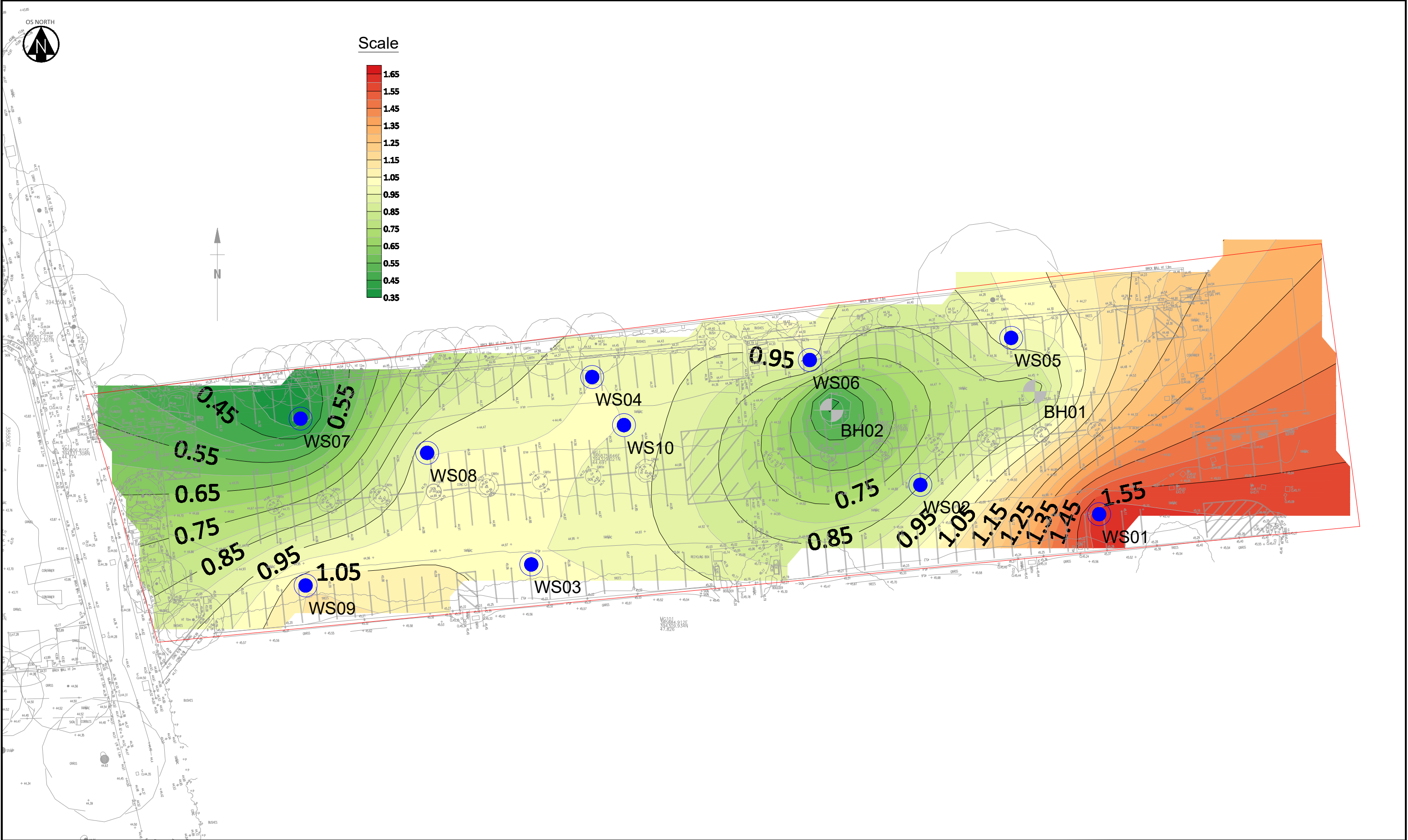
- Area for new soft landscaping. Refer to Turley's details for existing retained and proposed landscaping.
- Area for new hard landscaping. Refer to Turley's details for existing retained and proposed landscaping.
- Secure rated Steel PPC perimeter fence compound. With integral lockable sliding gate and Swing Gates. (Vehicle & Pedestrian). 2.5m high
- Acoustic Wall Barrier. Height varies refer to drawings. (Refer to Acoustician details)
- Existing boundary mesh fencing to north site boundary. Height varies refer to drawings.
- Existing boundary brick wall to north site boundary. Height varies refer to drawings.

Legend:

- CPU
- ESU
- Residences
- Ancillary Spaces/Plant



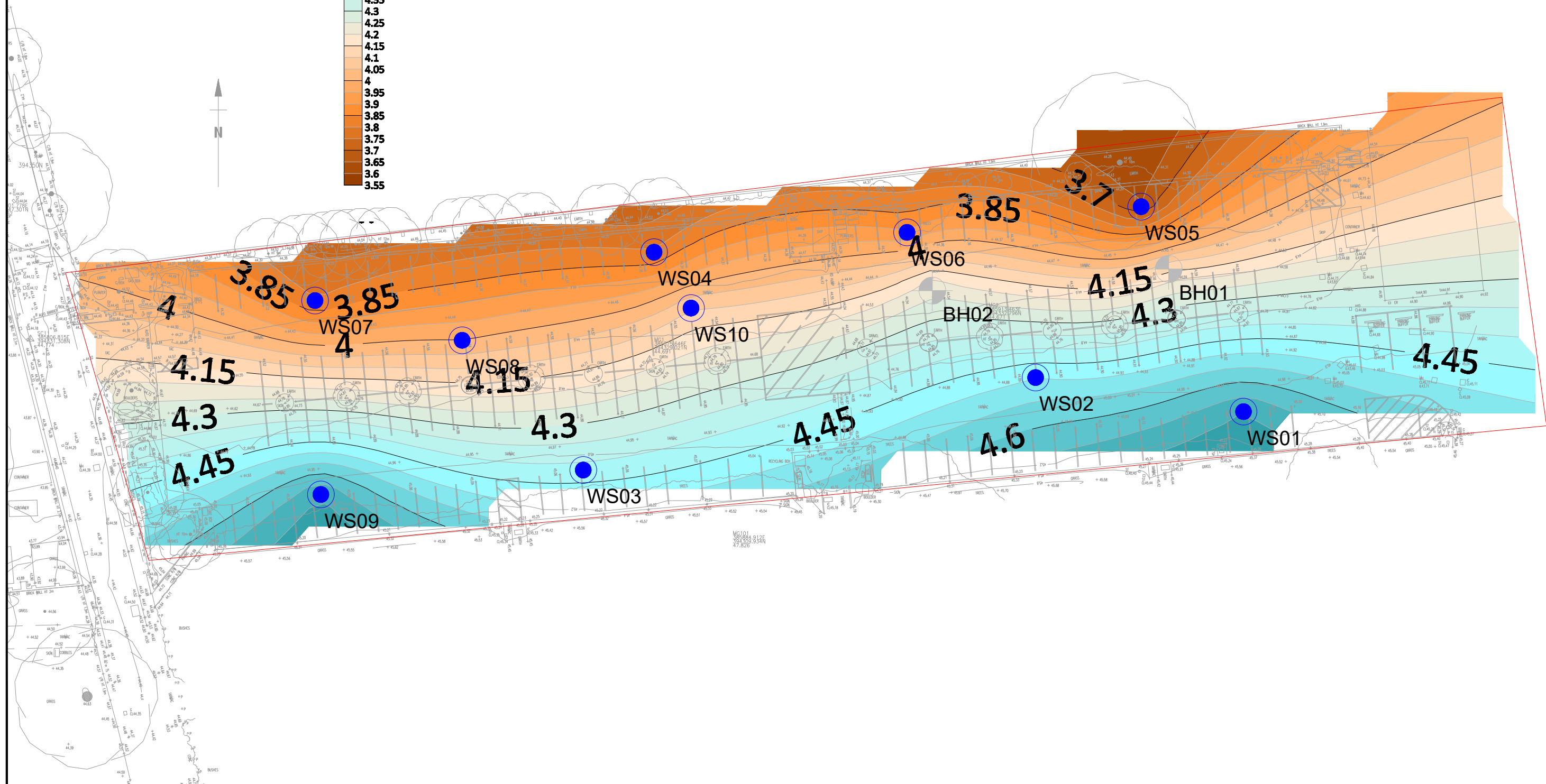
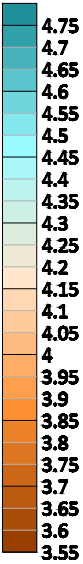
KEY PLAN Site Boundary [1] Current Site Features (Polygons) Mature/Semi Mature Trees/Inclu Crown Scarring Suspected Service Existing Site Compound Landscaping Gas Meter and United Utilities Bike Sheds Street Lighting Existing Building Permeable Area



KEY	Site Boundary	NOTES 1. All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing. 2. This drawing is to be read in conjunction with all relevant Engineers' and Service Engineers' drawings and specifications. 3. This drawing has been based on the following drawings and information: From the Topographical Survey of thr subject site.			Hydrock 4 Lakeside Festival Way Stoke-on-Trent ST1 5RY t: +44(0) 1782 261919 e: stoke@hydrock.com or visit www.hydrock.com CLIENT UNIVERSITY OF MANCHESTER PROJECT UoM THE LIMES RELOCATION	TITLE BASE OF MADE GROUND PLAN (m bgl)	
	BHOX Cable Percussive Borehole					HYDROCK PROJECT NO. 33445	SCALE @ A3 1:2250
	WS0X Window Sample Borehole					PURPOSE OF ISSUE SUITABLE FOR INFORMATION	STATUS S2
						DRAWING NO. (PROJECT CODE-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER) LIMES-HYD-XX-XX-D-G-00004	REVISION P01
	PO1 FIRST ISSUE RS 16/05/24 LM 17/05/24 LM 17/05/24	REV. REVISION NOTES/COMMENTS DRAWN BY DATE CHECKED BY DATE APPROVED BY DATE					



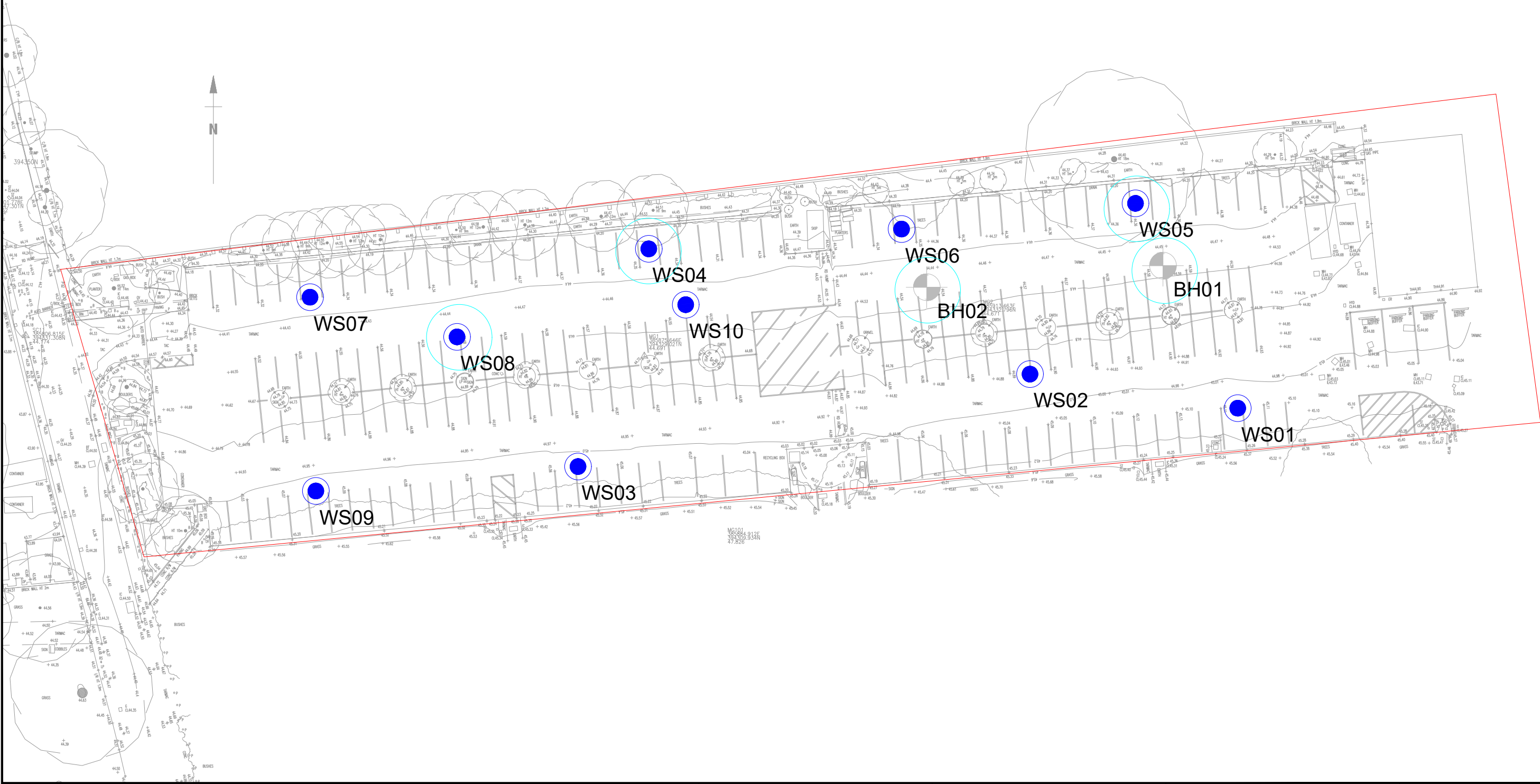
Scale



KEY Site Boundary Cable Percussive Borehole BH0X Window Sample Borehole WS0X	NOTES 1. All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing. 2. This drawing is to be read in conjunction with all relevant Engineers' and Service Engineers' drawings and specifications. 3. This drawing has been based on the following drawings and information: From the Topographical Survey of thr subject site.											Hydrock 4 Lakeside Festival Way Stoke-on-Trent ST1 5RY t: +44(0) 1782 261919 e: stoke@hydrock.com or visit www.hydrock.com CLIENT UNIVERSITY OF MANCHESTER PROJECT UoM THE LIMES RELOCATION										TITLE TOP OF BEDROCK PLAN (m bgl) HYDROCK PROJECT NO. 33445 SCALE @ A3 1:2250 PURPOSE OF ISSUE SUITABLE FOR INFORMATION STATUS S2 DRAWING NO. (PROJECT CODE-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER) LIMES-HYD-XX-XX-D-G-00005 REVISION P01									
		P01 FIRST ISSUE RS 16/05/24 LM 17/05/24 LM 17/05/24																													
		REV. REVISION NOTES/COMMENTS																													
		DRAWN BY DATE CHECKED BY DATE APPROVED BY DATE																													

Appendix B Exploratory Hole Location Plan, Exploratory Hole Logs and Photographs

Exploratory hole location plan



KEY Site Boundary Cable Percussive Borehole Window Sample Borehole Gas and Groundwater Monitoring Well	NOTES 1. All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing. 2. This drawing is to be read in conjunction with all relevant Engineers' and Service Engineers' drawings and specifications. 3. This drawing has been based on the following drawings and information: From the Topographical Survey of thr subject site.			Hydrock 4 Lakeside Festival Way Stoke-on-Trent ST1 5RY t: +44(0) 1782 261919 e: stoke@hydrock.com or visit www.hydrock.com CLIENT UNIVERSITY OF MANCHESTER	TITLE EXPLORATORY HOLE LOCATION PLAN		
				HYDROCK PROJECT NO. 33445 SCALE @ A3 1:2250			
				P01 FIRST ISSUE RS 15/05/24 LM 16/05/24 LM 16/05/24		PURPOSE OF ISSUE SUITABLE FOR INFORMATION STATUS S2	
				REV. REVISION NOTES/COMMENTS DRAWN BY DATE CHECKED BY DATE APPROVED BY DATE	PROJECT UoM THE LIMES RELOCATION DRAWING NO. (PROJECT CODE-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER) LIMES-HYD-XX-XX-D-G-00003 REVISION P01		

Exploratory hole logs

 Hydrock	Project: UoM The Limes Relocation	Borehole No WS01
		Page No. 1 of 1

Method: Dynamic (Windowless) Sampler	Date(s) : 04/04/2024	Logged By: DS	Drilled By: RP Drilling
Client: University of Manchester	Co-ords: 385541.68, 394323.23	Checked By: RS	Rigg: Archway dart
Hydrock Project No: 33445	Ground Level: 45.10m OD		Scale: 1:30

Sample Run Info			Testing		Water-Strikes	Stratum Description	Depth				Legend	Instrumentation / Backfill
Sample Run	Run Ø	Recovery	Depth (m)	Type			Results	Depth mbgl	Thickness (m)	Level m OD		
1.20 - 2.00	102mm	100%	0.40	ES		ASPHALT HARDSTANDING (BITUMINOUS MATERIAL) Grey sandy angular to subangular fine to coarse GRAVEL of limestone. (MADE GROUND) Loose dark grey gravelly clayey fine to coarse sandy SAND. Gravel is angular to subangular fine to coarse of brick, shale and coal. (MADE GROUND)	0.10	(0.10)	45.00			
							0.25	(0.15)	44.85			
						... below 1.00m bgl becomes slightly sandy slightly gravelly.	1	(1.40)				
2.00 - 3.00	87mm	100%	2.00 - 3.00	SPT B	N=9 (2,2,2,2,3)	Soft light grey mottled yellow silty CLAY with traces and small fragments of coal. (GLACIAL TILL)	1.65		43.45			
								(0.45)				
3.00 - 4.00	77mm	100%	3.00	SPT	N=21 (3,3,4,4,6,7)	Firm becoming very stiff medium becoming very high strength reddish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone and coal. (GLACIAL TILL)	2		43.00			
								(2.60)				
4.00 - 5.00	67mm	100%	4.00	SPT	N=37 (7,7,7,10,9,11)	... below 3.80m bgl becomes sandy and friable.	3					
						Weathered SANDSTONE bedrock, recovered as dense reddish brown fine to coarse SAND (CHESTER FORMATION)	4		40.40			
								(0.75)				
						End of Borehole at 5.45m	5		38.65			
							6					

General Remarks:
1. Concrete coring from ground level to 0,10m bgl. 2. Hand dug inspection from 0,10m bgl to 1,20m bgl. 3. Dynamic windowless sampling between 1,20m bgl to 3,45m bgl. 4. Refusal on weathered sandstone bedrock at 3,49m bgl. 5. Backfilled with arisings.

	Project: UoM The Limes Relocation	Borehole No WS02
		Page No. 1 of 1

Method: Dynamic (Windowless) Sampler	Date(s): 03/04/2024	Logged By: DS	Drilled By: RP Drilling
Client: University of Manchester	Co-ords: 38.5918.56, 39.4327.03	Checked By: RS	Rigg: Archway dart
Hydrock Project No: 33445	Ground Level: 44.88m OD		Scale: 1:30

Sample Run Info				Testing		Water-Strikes	Stratum Description	Depth					Legend	Instrumentation / Backfill
Sample Run	Run Ø	Recovery	Depth (m)	Type	Results			mbgl	Thickness (m)	Level m OD				
			0.31	ES		ASPHALT HARDSTANDING (BITUMINOUS MATERIAL)	0.12	(0.12)	44.76					
						0.30	(0.18)	44.58						
1.20 - 2.00	102mm	100%	0.90	ES		Grey sandy angular to subangular fine to coarse GRAVEL of limestone.								
			1.20	SPT	N=7 (1.1,2.1,2.2)	Black subangular to subrounded fine to coarse ashy SAND and GRAVEL of coal and brick. Low cobble content of subangular brick. (MADE GROUND)		(0.55)						
2.00 - 3.00	87mm	100%	2.00	SPT	N=12 (2.2,2.3,3.4)	Soft low strength dark grey becoming light grey mottled yellowish brown silty CLAY with occasional fragment of shale. (GLACIAL TILL)	1		44.03					
3.00 - 4.00	77mm	100%	2.00 - 3.00	B		Firm becoming very stiff medium becoming high strength reddish brown mottled grey slightly sandy silty CLAY with occasional fragment of coal and mudstone. (GLACIAL TILL)	2		42.66					
4.00 - 4.70	67mm	100%	3.50	D		... below 3.50m bgl becomes friable.		(2.30)						
			4.00	SPT	N=37 (7.6,8.9,9.11)		3							
			4.50	D		Weathered SANDSTONE bedrock, recovered as dense reddish brown fine to coarse SAND (CHESTER FORMATION)	4		40.38					
			4.70	SPT	50/105mm (25,30,20)			(0.39)						
			4.70	D		End of Borehole at 4.85m	5		39.99					

General Remarks:
1. Concrete coring from ground level to 0.12m bgl. 2. Hand dug inspection from 0.12m bgl to 1.20m bgl. 3. Dynamic windowless sampling between 1.20m bgl to 4.65m bgl. 4. Refusal on weathered sandstone bedrock at 4.69m bgl. 5. Backfilled with anslings.

 Hydrock	Project: UoM The Limes Relocation	Borehole No WS03
		Page No. 1 of 1

Method: Dynamic (Windowless) Sampler	Date(s): 03/04/2024	Logged By: DS	Drilled By: RP Drilling
Client: University of Manchester	Co-ords: 385568.27, 394316.74	Checked By: RS	Rigg: Archway dart
Hydrock Project No: 33445	Ground Level: 45.03m OD		Scale: 1:30

Sample Run Info			Testing		Water-Strikes	Stratum Description	Depth				Legend	Instrumentation / Backfill
Sample Run	Run Ø	Recovery	Depth (m)	Type			Results	Depth mbgl	Thickness (m)	Level m OD		
			0.40	ES		ASPHALT HARDSTANDING (BITUMINOUS MATERIAL) Grey sandy angular to subangular fine to coarse GRAVEL of limestone. (MADE GROUND) Firm blackest grey gravelly CLAY. Gravel is angular to subangular fine to coarse of brick. Low cobble content of subangular brick. (MADE GROUND)	0.10 0.25	(0.10) (0.15)	44.83 44.78			
1.20 - 2.00	102mm	100%	1.20 1.20 - 2.00 1.50	SPT B D D	N=5 (1.1,1.1,2.1)	Soft low strength light grey mottled yellow silty CLAY. (GLACIAL TILL)	1.00		44.03			
2.00 - 3.00	87mm	100%	2.00	SPT	N=11 (1.1,2.3,3.3)		2		42.83			
3.00 - 3.70	77mm	100%	3.00	SPT	N=17 (2.3,3.3,5.6)	Firm becoming stiff low becoming high strength reddish brown mottled grey silty CLAY. (GLACIAL TILL)	2.20					
			2.50	D								
			3.50	D								
			3.70	SPT	50/210mm (17.8,17.17,16)	... at 3.20m bgl becomes sandy silty friable with frequent fragments of coal.						
						End of Borehole at 4.02m	4		41.01			
							6					

General Remarks:
1. Concrete coring from ground level to 0,10m bgl. 2. Hand dug inspection from 0,10m bgl to 1,20m bgl. 3. Dynamic windowless sampling between 1,20m bgl to 4,02m bgl. 4. Refusal on weathered sandstone bedrock at 4,02m bgl. 5. Backfilled with arslings.

 Hydrock	Project: UoM The Limes Relocation	Borehole No WS04
		Page No. 1 of 1

Method: Dynamic (Windowless) Sampler	Date(s): 03/04/2024	Logged By: DS	Drilled By: RP Drilling
Client: University of Manchester	Co-ords: 385876.14, 394340.96	Checked By: RS	Rigg: Archway dart
Hydrock Project No: 33445	Ground Level: 44.25m OD	Scale: 1:30	

Sample Run Info				Testing		Water- Strikes	Stratum Description	Depth				Legend	Instrumentation / Backfill
Sample Run	Run Ø	Recovery	Depth (m)	Type	Results			mbgl	Thickness (m)	Level m OD			
			0.30	ES			ASPHALT HARDSTANDING (BITUMINOUS MATERIAL) Grey sandy angular to subangular fine to coarse GRAVEL of limestone. (MADE GROUND) Firm dark grey silty CLAY. (MADE GROUND)	0.10 0.22	10.00 (0.12)	44.15 44.03			
1.20 - 2.00	102mm	100%	1.00 - 2.00 1.00- 2.00 1.20 SPT 1.20 - 2.00 B HSV	B D SPT B HSV	N=8 (1,2,2,1,3,2) 25kPa	1.00	Soft low strength light brown mottled yellow silty CLAY with traces and small fragments of coal (GLACIAL TILL)	43.25	(0.78)				
2.00 - 3.00	87mm	100%	2.00 2.00- 3.00 2.00 SPT D HSV	SPT D HSV D	N=14 (2,3,2,3,4,5) 30kPa	2.00	Firm becoming stiff medium becoming high strength reddish brown sandy silty CLAY. (GLACIAL TILL)	42.25					
3.00 - 4.00	77mm	100%	3.00 SPT	SPT	N=26 (4,3,5,5,8,8)	3- (1.80)							
4.00 - 4.50	67mm	100%	4.00 4.20 SPT D SPT	SPT D SPT	N=29 (5,6,6,7,7,9) 50/105mm (25,29,21)	4- (0.85)	Weathered SANDSTONE bedrock, recovered as dense reddish brown fine to coarse SAND (CHESTER FORMATION)	40.45					
						4.65	End of Borehole at 4.65m	39.80					
						6							

General Remarks:
1. Concrete coring from ground level to 0,10m bgl to 1,20m bgl. 2. Hand dug inspection from 0,10m bgl to 1,20m bgl. 3. Dynamic windowless sampling between 1,20m bgl to 4,65m bgl. 4. Refusal on weathered sandstone bedrock at 4,50m bgl. 5. Installed with a response between 1,00m and 4,65m bgl.

 Hydrock	Project: UoM The Limes Relocation	Borehole No WS05
		Page No. 1 of 1

Method: Dynamic (Windowless) Sampler	Date(s) : 04/04/2024	Logged By: DS	Drilled By: RP Drilling
Client: University of Manchester	Co-ords: 385930.31, 394346.03	Checked By: RS	Rigg: Archway dart
Hydrock Project No: 33445	Ground Level: 44.17m OD		Scale: 1:30

Sample Run Info			Testing		Water-Strikes	Stratum Description	Depth mbgl	Thickness (m)	Level m OD	Legend	Instrumentation / Backfill
Sample Run	Run Ø	Recovery	Depth (m)	Type							
1.20 - 2.00	102mm	100%	0.40	ES		ASPHALT HARDSTANDING (BITUMINOUS MATERIAL) Grey sandy angular to subangular fine to coarse GRAVEL of limestone. (MADE GROUND) Firm dark grey sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, sandstone and brick. (MADE GROUND)	0.30	(0.22)	43.87		
								(0.70)			
2.00 - 3.00	87mm	100%	2.00	SPT	N=18 (2.3,3.4,7)	Soft low strength light grey mottled yellow silty CLAY with occasional fragments of mudstone. (GLACIAL TILL)	1.00		43.17		
								(0.50)			
3.00 - 3.70	77mm	100%	3.00	SPT	N=30 (4.5,6,8,10)	Firm becoming stiff medium becoming high strength reddish brown mottled grey silty CLAY with occasional fragments of coal and mudstone. (GLACIAL TILL)	1.50		42.67		
								(2.15)			
			3.50 3.50 3.70	D D SPT	50/265mm (9.9,11,14,15,10)	Weathered SANDSTONE bedrock, recovered as dense reddish brown fine to coarse SAND. (CHESTER FORMATION)	3.65	(0.47)	40.52		
						End of Borehole at 4.12m	4.12		40.05		

General Remarks:
1. Concrete coring from ground level to 0.08m bgl. 2. Hand dug inspection from 0.08m bgl to 1.20m bgl. 3. Dynamic windowless sampling between 1.20m bgl to 4.12m bgl. 4. Reliased on weathered sandstone bedrock at 4.12m bgl. 5. Installed with a response between 1.00m and 3.70m bgl.

 Hydrock	Project: UoM The Limes Relocation	Borehole No WS06
		Page No. 1 of 1

Method: Dynamic (Windowless) Sampler	Date(s): 04/04/2024	Logged By: DS	Drilled By: RP Drilling
Client: University of Manchester	Co-ords: 385904.27, 394343.17	Checked By: RS	Rigg: Archway dart
Hydrock Project No: 33445	Ground Level: 44.23m OD		Scale: 1:30

Sample Run Info			Testing		Water- Strikes	Stratum Description						
Sample Run	Run Ø	Recovery	Depth (m)	Type			Results	Depth mbgl	Thickness (m)	Level m OD	Legend	
1.00 - 2.00	102mm	100%	0.40	ES	D	N=9 (2,1,2,2,2,3)	ASPHALT HARDSTANDING (BITUMINOUS MATERIAL) Grey sandy angular to subangular fine to coarse GRAVEL of limestone. (MADE GROUND) Firm blackish grey slightly gravelly silty CLAY with a very weak organic (humic) odour. Gravel is subangular fine and medium of brick and coal. (MADE GROUND)	0.08	(0.08)	44.15		
							0.25	(0.17)	43.98			
							1.00		43.28			
1.20 - 2.00	102mm	100%	1.20	SPT	B	N=9 (2,1,2,2,2,3)	Soft to firm medium strength light grey mottled yellow silty CLAY. (GLACIAL TILL)					
							(0.50)		42.73			
2.00 - 3.00	87mm	100%	2.00	SPT	B	N=16 (3,3,3,4,4,5)	Silt high strength reddish brown mottled grey silty CLAY (GLACIAL TILL)	1.50		42.73		
3.00 - 4.00	77mm	100%	3.00	SPT	D	N=25 (3,3,5,5,7,8)		3				
4.00 - 5.00	77mm	100%	3.50	D	D	N=25 (3,3,5,5,7,8)	Weathere d SANDSTONE bedrock; recovered as dense reddish brown fine to coarse SAND. (CHESTER FORMATION)	4	(0.38)	40.33		
5.00 - 6.00	77mm	100%	4.00	SPT	D	N=25 (3,3,5,5,7,8)	End of Borehole at 4.28m	4.28		39.95		

General Remarks:
1. Concrete coving from ground level to 0,08m bgl. 2. Hand dug inspection from 0,08m bgl to 1,20m bgl. 3. Dynamic windowless sampling between 1,20m bgl to 4,20m bgl. 4. Retrieval on weathered sandstone bedrock at 4,20m bgl. 5. Backfilled with arisings.

Method: Dynamic (Windowless) Sampler	Date(s): 03/04/2024	Logged By: DS	Drilled By: RP Drilling
Client: University of Manchester	Co-ords: 385838.45, 394335.59	Checked By: RS	Rig: Archway dart
Hydrock Project No: 33445	Ground Level: 44.30m OD	Scale: 1:30	

Sample Run Info				Testing		Water- Strokes	Stratum Description	Depth	Thickness	Level	Legend	Instrumentation / Backfill
Sample Run	Run Ø	Recovery	Depth (m)	Type	Results			m bgl	(m)	m OD		
			0.40	ES			ASPHALT HARDSTANDING (BITUMINOUS MATERIAL) Grey sandy angular to subangular fine to coarse GRAVEL of limestone. (MADE GROUND) Firm dark grey becoming light grey mottled yellowish brown slightly gravelly CLAY with a very weak organic (humic) odour. Gravel is subangular to subrounded fine and medium of mudstone. (GLACIAL TILL)	0.08 (0.08)	0.27 (0.27)	44.22 43.95		
1.20 - 2.00	102mm	100%	1.20	SPT	N=11 (2,1,3,2,3,3)				(1.00)			
			1.50	D				1.35		42.95		
2.00 - 3.00	87mm	100%	2.00 2.00 - 3.00	SPT B	N=15 (2,2,2,4,3,6)							
								2				
3.00 - 3.80	77mm	100%	3.00	SPT	N=25 (3,4,4,6,6,9)							
								3				
			3.50	D								
			3.80	SPT	50/295mm (4,7,8,9,9,24)			4	(0.45)	40.56		
												
								4.25		40.05		
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												
												

General Remarks: 1. Concrete coring from ground level to 0.08m bgl. 2. Hand dug inspection from 0.08m bgl to 1.20m bgl. 3. Dynamic windowless sampling between 1.20m bgl to 4.25m bgl. 4. Refusal on weathered sandstone bedrock at 4.25m bgl. 5. Backfilled with arisings.

Method: Dynamic (Windowless) Sampler	Date(s): 03/04/2024	Logged By: DS	Drilled By: RP Drilling
Client: University of Manchester	Co-ords: 385854.81, 394331.17	Checked By: RS	Rig: Archway dart
Hydrock Project No: 33445	Ground Level: 44.55m OD	Scale: 1:30	

Sample Run Info				Testing		Water- Strokes	Stratum Description							
Sample Run	Run Ø	Recovery	Depth (m)	Type	Results			Depth mbgl	Thickness (m)	Level m OD	Legend	Instrumentation / Backfill		
			0.30	ES			ASPHALT HARDSTANDING (BITUMINOUS MATERIAL) Grey sandy angular to subangular fine to coarse GRAVEL of limestone. (MADE GROUND) Black fine to coarse ashy SAND. (MADE GROUND) Firm bluish grey silty CLAY. (MADE GROUND)	0.10 0.25 0.45	10.10 (0.15) (0.20)	44.45 44.30 44.10	     			
1 20 - 2.00	102mm	100%	1.00	HSV SPT	148kPa N=6 (0.0,1.2,1)		Soft low strength light grey mottled yellow silty CLAY. (GLACIAL TILL)	1.00		43.55				
2 00 - 3.00	87mm	100%	2.00 2.50	SPT HSV D	N=7 (1.2,1.1,2.3) 114kPa				(1.80)					
3 00 - 3.80	77mm	100%	3.00 3.80	SPT B	N=27 (3.4,4.6,7.10)		Stiff high strength reddish brown mottled grey silty CLAY (GLACIAL TILL) ... at 3.00m bgl becomes very sandy.	2.80		41.75				
			3.80	SPT	50/235mm (8.8,12.15,15.8)		Weathered SANDSTONE bedrock, recovered as dense reddish brown fine to coarse SAND. (CHESTER FORMATION) End of Borehole at 4.19m	4.10 4.19	(0.09)	40.45 40.36	 			
														

 Hydrock	Project: UoM The Limes Relocation	Borehole No WS09
		Page No. 1 of 1

Method: Dynamic (Windowless) Sampler	Date(s): 03/04/2024	Logged By: DS	Drilled By: RP Drilling
Client: University of Manchester	Co-ords: 38.5539, 10, 394314.02	Checked By: RS	Rigg: Archway dart
Hydrock Project No: 33445	Ground Level: 45.06m OD		Scale: 1:30

Sample Run Info			Testing		Water-Strikes	Stratum Description	Depth mbgl	Thickness (m)	Level m OD	Legend	Instrumentation / Backfill
Sample Run	Run Ø	Recovery	Depth (m)	Type							
1.20 - 2.00	102mm	100%	1.00	ES	N=7 (4.2,1.2,2.2)	ASPHALT HARDSTANDING (BITUMINOUS MATERIAL) Grey sandy angular to subangular fine to coarse GRAVEL of limestone. (MADE GROUND) Pale red angular to subangular medium to coarse SAND and GRAVEL of brick with high content of angular cobbles of brick (MADE GROUND)	0.15	(0.15)	44.91		
			1.20	SPT			0.35	(0.20)	44.71		
			1.50 - 2.00	B				(0.55)			
2.00 - 3.00	87mm	100%	2.00	SPT	N=13 (3.2,3.3,3.4)	Soft light grey gravelly silty CLAY. Gravel is angular to subangular medium to coarse of brick. (MADE GROUND) Black angular to subangular fine to coarse ashy GRAVEL of brick and clinker with a very weak hydrocarbon odour. (MADE GROUND) Soft becoming firm low becoming medium strength light grey mottled yellow silty CLAY. (GLACIAL TILL)	0.90		44.16		
							1.00	(0.10)	44.06		
							1.10	(0.10)	43.96		
3.00 - 4.00	77mm	100%	3.00	SPT	N=26 (4.3,5.6,6.9)	Stiff high strength reddish brown mottled grey slightly gravelly silty CLAY. Gravel is subangular fine of coal. (GLACIAL TILL)			42.46		
			3.00 - 4.00	B							
4.00 - 4.70	67mm	100%	4.00	SPT	N=21 (3.3,4.5,5.7)	Weathered SANDSTONE bedrock, recovered as dense reddish brown fine to coarse SAND. (CHESTER FORMATION) End of Borehole at 4.87m	4.70		40.36		
							4.87	(0.17)	40.19		

General Remarks:
1. Concrete coring from ground level to 0,15m bgl. 2. Hand dug inspection from 0,15m bgl to 1,20m bgl. 3. Dynamic windowless sampling between 1,20m bgl to 4,87m bgl. 4. Refusal on weathered sandstone bedrock at 4,87m bgl. 5. Backfilled with arslings.

 Hydrock	Project: UoM The Limes Relocation	Borehole No WS10
	Page No. 1 of 1	

Method: Dynamic (Windowless) Sampler	Date(s): 03/04/2024	Logged By: DS	Drilled By: RP Drilling
Client: University of Manchester	Co-ords: 38.580.25, 39.4334.73	Checked By: RS	Rigg: Archway dart
Hydrock Project No: 33445	Ground Level: 44.45m OD		Scale: 1:30

Sample Run Info			Testing		Water-Strikes	Stratum Description	Depth	Thickness	Level	Legend	Instrumentation / Backfill
Sample Run	Run Ø	Recovery	Depth (m)	Type			Results	mbl	(m)	m OD	
1.20 - 2.00	102mm	100%	0.30	ES	N=8 (0.1,2.1,2.3)	ASPHALT HARDSTANDING (BITUMINOUS MATERIAL) Grey sandy angular to subangular fine to coarse GRAVEL of limestone. (MADE GROUND) Black angular to subangular fine to coarse ashy GRAVEL of brick and concrete. Low to medium cobble content of brick and concrete. (MADE GROUND) Soft to firm dark grey silty CLAY. (MADE GROUND)	0.10	(0.10)	44.35		
			0.50	ES			0.23	(0.13)	44.22		
2.00 - 3.00	87mm	100%	1.50	D	N=14 (2.2,3.3,4.4)	Soft light grey mottled yellow silty CLAY. (GLACIAL TILL)	0.44	(0.21)	44.01		
			2.00	SPT			0.56		43.45		
3.00 - 4.00	77mm	100%	3.50	D	N=19 (3.3,5.5,6)	Firm becoming stiff medium becoming high strength reddish brown mottled grey slightly gravelly silty CLAY with rare rootlets. Gravel is subangular fine of Coal. (GLACIAL TILL)	1.50		42.95		
			2.00	SPT			0.50		42.95		
4.00 - 4.80	67mm	100%	4.50	D	N=41 (6.7,8.10,11,12)	... below 3.20m bgl becomes friable.	4		40.35		
			4.00	SPT			4.10		40.35		
4.00 - 4.80	67mm	100%	4.80	SPT	N=41 (6.7,8.10,11,12)	Weathered SANDSTONE bedrock, recovered as dense reddish brown gravely fine to coarse SAND. Gravel is subrounded medium of quartzite. (CHESTER FORMATION) ... at 4.50m bgl with subangular to subrounded coarse gravel of limestone.	5	(1.08)			
			4.80	SPT			5.18		39.27		
						End of Borehole at 5.16m					

General Remarks:
1. Concrete coring from ground level to 0,10m bgl. 2. Hand dug inspection from 0,10m bgl to 1,20m bgl. 3. Dynamic windowless sampling between 1,20m bgl to 5,18m bgl. 4. Refusal on weathered sandstone bedrock at 5,18m bgl. 5. Backfilled with arisings.

Exploratory hole photographs

**Site Investigation
Photograph 1****Date:** 04/04/24**Direction
Photograph
Taken:** N/A**Description:**

WS01 0.00m to
5.45m bgl
(inspection pit and
liners)

**Site Investigation
Photograph 2****Date:** 03/04/24**Direction
Photograph
Taken:** N/A**Description:**

WS02 1.20m to
4.89m bgl



**Site Investigation
Photograph 3****Date:** 03/04/24**Direction
Photograph
Taken:** N/A**Description:**
WS03 0.00m to
4.00m bgl
(inspection pit and
liners)**Site Investigation
Photograph 4****Date:** 03/04/24**Direction
Photograph
Taken:** N/A**Description:**
WS04 0.00m to
1.20m bgl

**Site Investigation
Photograph 5****Date:** 03/04/24**Direction
Photograph
Taken:** N/A**Description:**
WS04 1.20m to
4.65m bgl**Site Investigation
Photograph 6****Date:** 04/04/24**Direction
Photograph
Taken:** N/A**Description:**
WS05 0.00m to
5.00m bgl
(inspection pit and
liners)

**Site Investigation
Photograph 7****Date:** 04/04/24**Direction
Photograph
Taken:** N/A**Description:**
WS06 0.00m to
4.00m bgl
(inspection pit and
liners)**Site Investigation
Photograph 8****Date:** 03/04/24**Direction
Photograph
Taken:** N/A**Description:**
WS07 0.00m to
1.20m bgl

**Site Investigation
Photograph 9**

Date: 03/04/24

**Direction
Photograph
Taken:** N/A

Description:
WS07 1.20m to
4.00m bgl



**Site Investigation
Photograph 10**

Date: 03/04/24

**Direction
Photograph
Taken:** N/A

Description:
WS08 0.00m to
1.20m bgl



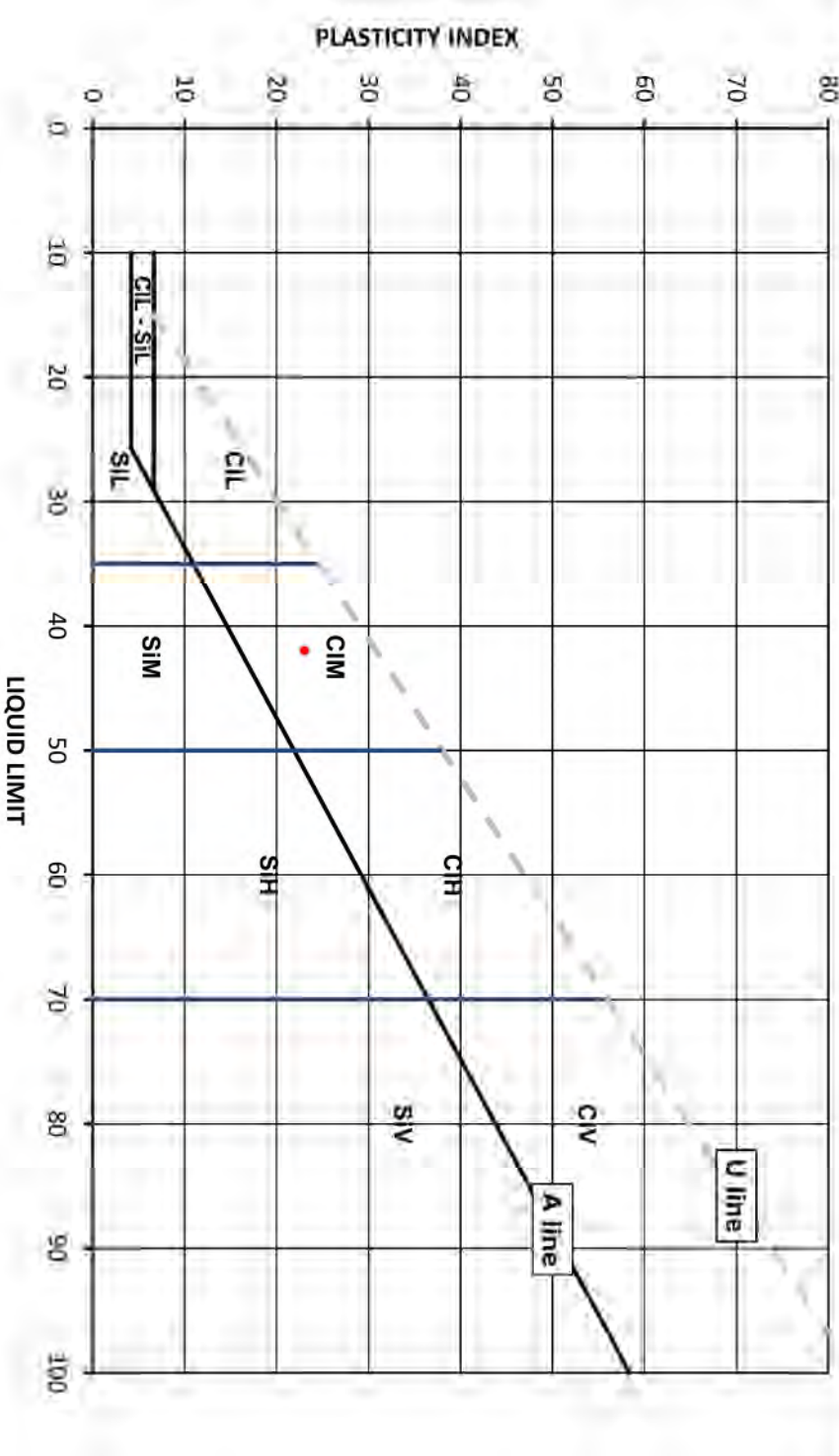
**Site Investigation
Photograph 11****Date:** 03/04/24**Direction
Photograph
Taken:** N/A**Description:**
WS08 1.20m to
4.00m bgl**Site Investigation
Photograph 12****Date:** 03/04/24**Direction
Photograph
Taken:** N/A**Description:**
WS09 0.00m to
4.87m bgl
(inspection pit and
liners)

**Site Investigation
Photograph 13****Date:** 03/04/24**Direction
Photograph
Taken:** N/A**Description:**
WS10 0.00m to
1.20m bgl**Site Investigation
Photograph 14****Date:** 18/03/24**Direction
Photograph
Taken:** Looking
east.**Description:**
WS10 1.20m to
5.00m bgl

Appendix C Geotechnical Test Results and Geotechnical Plots

Geotechnical laboratory test results

As Received Water Content [w] %	Liquid Limit [WL] %	Plastic Limit [WP] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
21.6	42	19	23	0.13	0.87	99



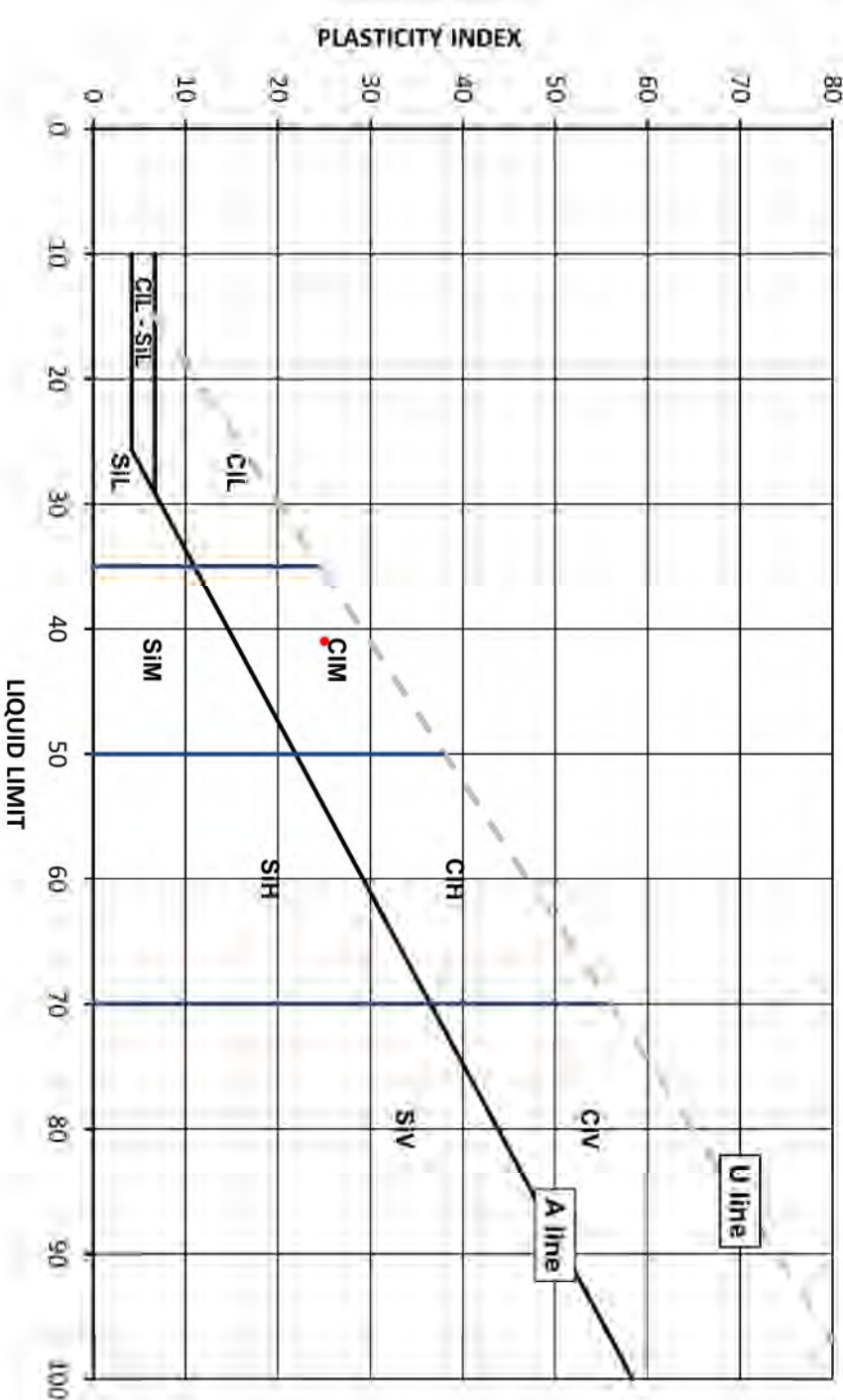
Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

Plasticity		Liquid Limit
CI	Clay	L Low below 35
SI	Silt	M Medium 35 to 50
		H High 50 to 70
		V Very high exceeding 70
O	Organic	append to classification for organic material (eg CH(O))

Note: Water Content by BS EN 17892-1: 2014; # Non accredited

Remarks:

As Received Water Content [w] %	Liquid Limit [WL] %	Plastic Limit [WP] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
23.4	41	16	25	0.28	0.72	98



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

Plasticity		Liquid Limit
CI	Clay	L Low below 35
SI	Silt	M Medium 35 to 50
		H High 50 to 70
		V Very high exceeding 70
O	Organic	append to classification for organic material (eg CH(O))

Note: Water Content by BS EN 17892-1: 2014; # Non accredited

Remarks:



Client: Hydrock Consultants Ltd
Client Address: 4 Lakeside, Festival Park,
Stoke on Trent, ST1 5RY

Contact: Russell Sumner
Site Address: UoM The Limes Relocation

Testing carried out at 12 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

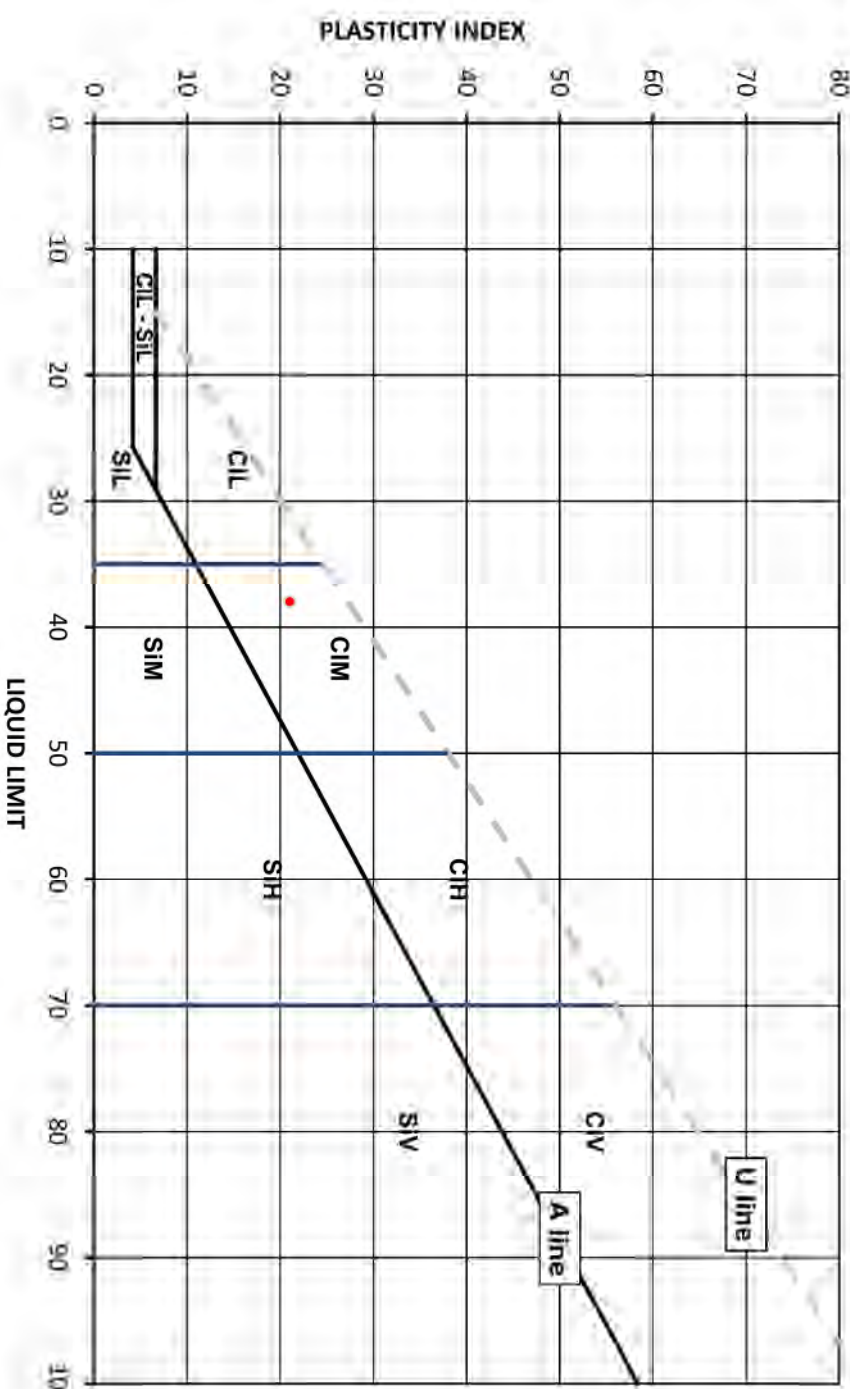
Client Reference: 33445

Job Number: 24-012824-1
Date Sampled: 02/04/2024
Date Received: 08/04/2024
Date Tested: 15/04/2024
Sampled By: Client - RS

Test Results:

Laboratory Reference: 164277
Hole No.: WS04
Sample Reference: 2
Sample Description: Brownish grey slightly gravelly sandy CLAY
Sample Preparation: Tested after >0.425mm removed by hand; The water content in the sample was increased
Cone Type: 80g/30deg

As Received Water Content [w] %	Liquid Limit [WL] %	Plastic Limit [WP] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
21.4	38	17	21	0.19	0.81	99



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

Plasticity

Liquid Limit

Cl Clay below 35

Si Silt 35 to 50

H High 50 to 70

V Very high exceeding 70

O Organic append to classification for organic material (eg CH(O))

Note: Water Content by BS EN 17892-1: 2014; # Non accredited

Remarks:

Signed:

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.

Katarzyna Koziel
Senior Reporting Specialist
for and on behalf of 12 Analytical Ltd

Client: Hydrock Consultants Ltd
Client Address: 4 Lakeside, Festival Park,
Stoke on Trent, ST1 5RY

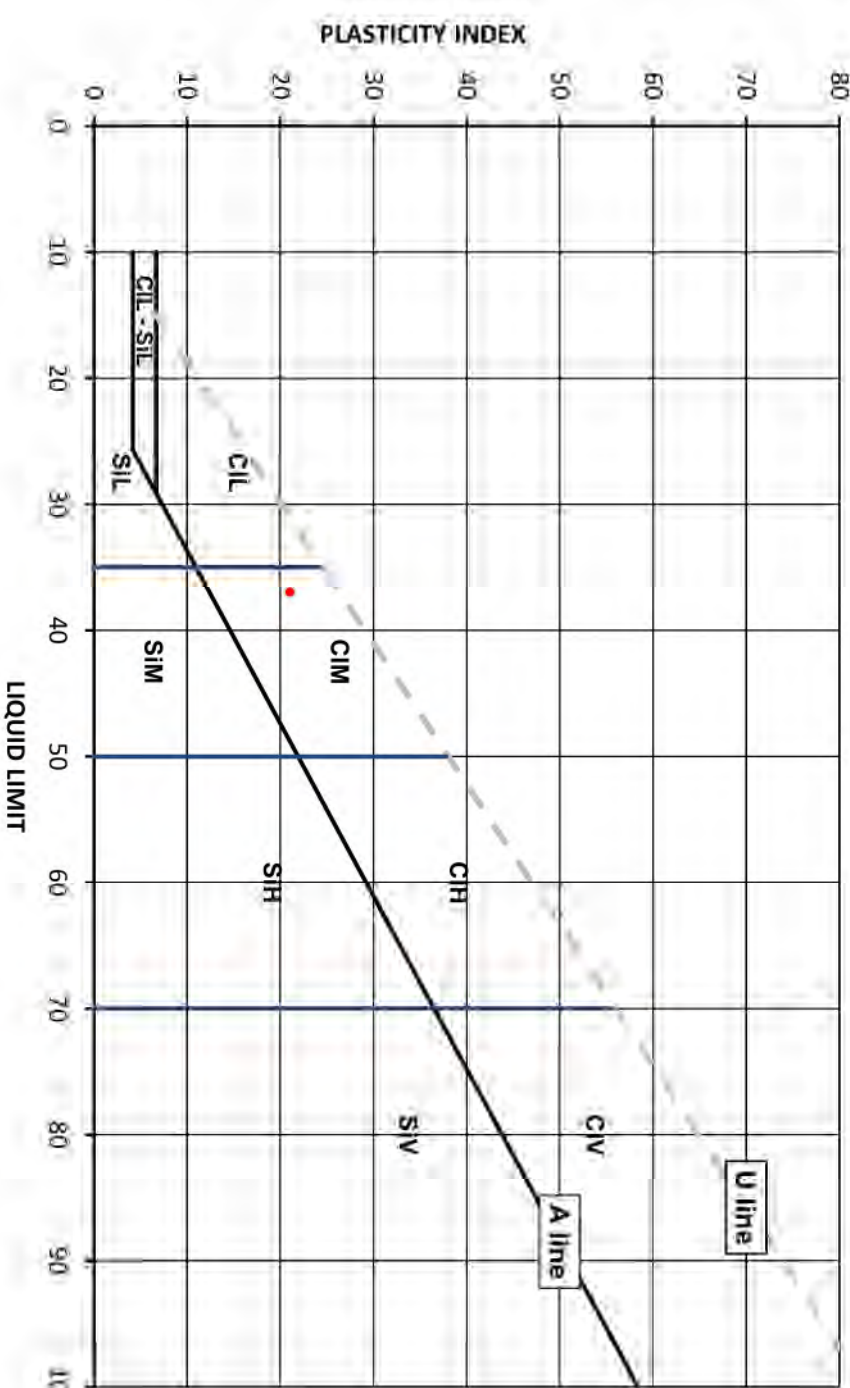
Contact: Russell Sumner
Site Address: UoM The Limes Relocation

Testing carried out at 12 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference: 164278
Hole No.: WS04
Sample Reference: 3
Sample Description: Brownish grey slightly gravelly sandy CLAY
Sample Preparation: Tested after >0.425mm removed by hand; The water content in the sample was increased
Cone Type: 80g/30deg

As Received Water Content [w] %	Liquid Limit [WL] %	Plastic Limit [WP] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
16.2	37	16	21	0.00	1.00	82



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

Plasticity

Liquid Limit

Cl Clay below 35

Si Silt 35 to 50

H High 50 to 70

V Very high exceeding 70

O Organic append to classification for organic material (eg CH(O))

Note: Water Content by BS EN 17892-1: 2014; # Non accredited

Remarks:

Signed:

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.

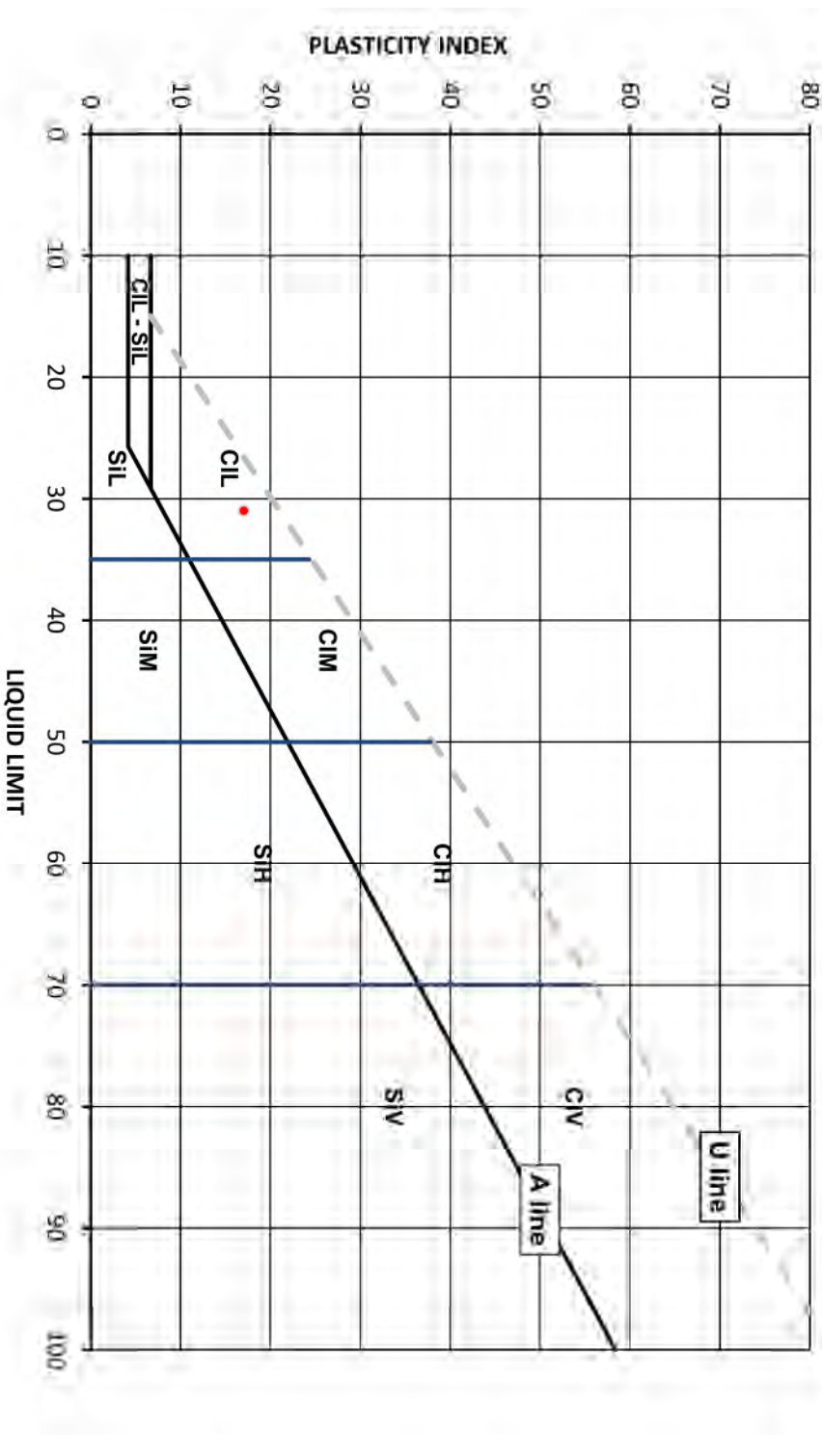
Katarzyna Koziel
Senior Reporting Specialist
for and on behalf of 12 Analytical Ltd

c| 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022,



0

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [WP] %	Plasticity Index [Ip] %	Liquidity Index [LI] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
16.0	31	14	17	0.12	0.88	95



ication for organic material (eg C_2H_6)

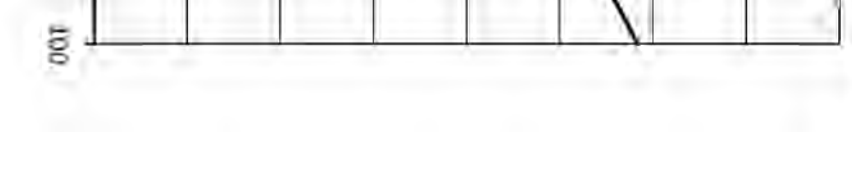
Remarks:

Senior Reporting Specialist
for and on behalf of i2 Analytical Ltd

laboratory. The results included within the report relate only to the sample(s) submitted for testing.

GF 337.13

95	Test Sieve	Passing 425µm
----	------------	---------------



ication for organic material (eg $\text{C}_2\text{H}_6\text{O}$)

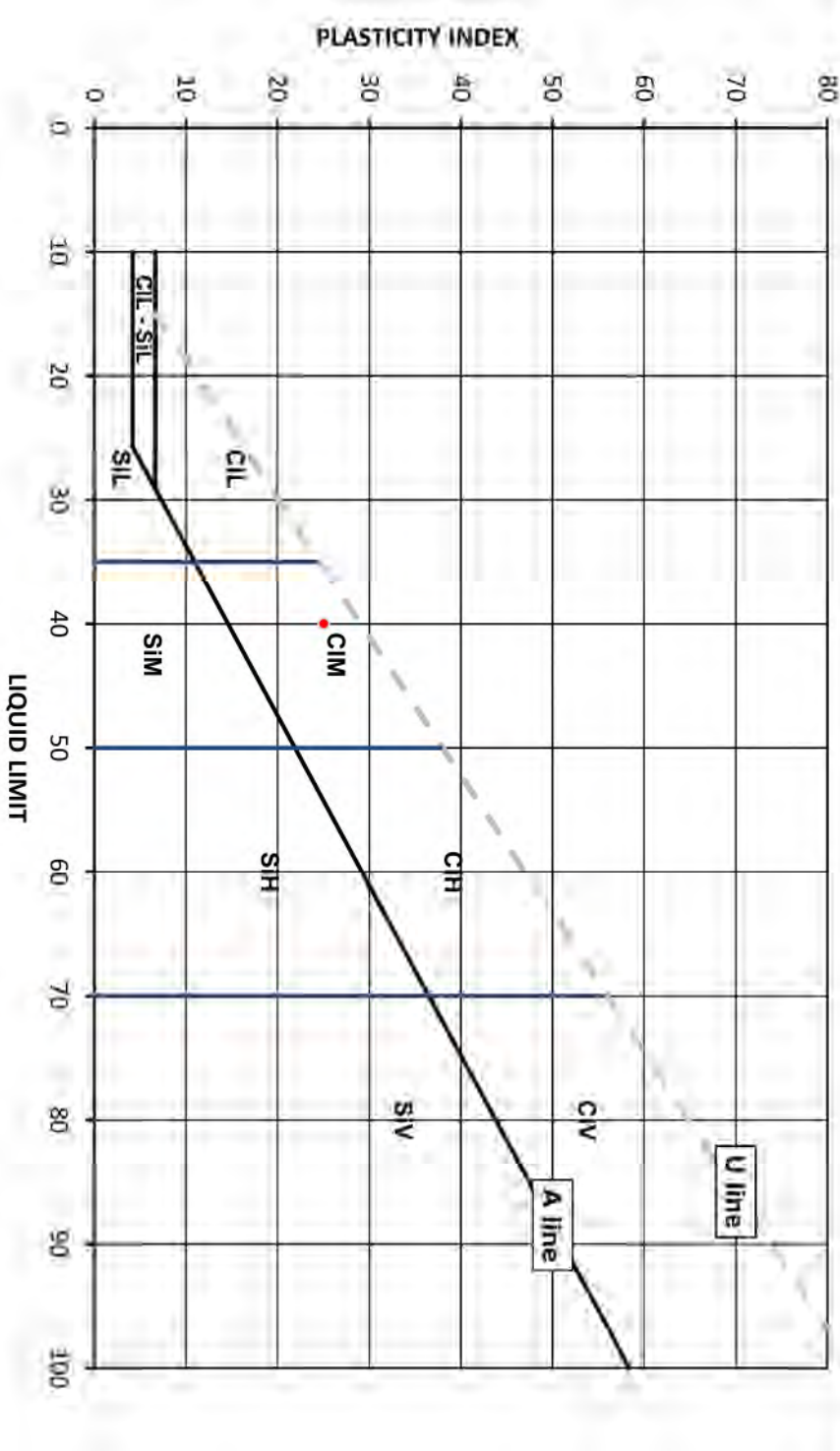
Remarks:

Senior Reporting Specialist
for and on behalf of i2 Analytical Ltd

laboratory. The results included within the report relate only to the sample(s) submitted for testing

GF 337.13

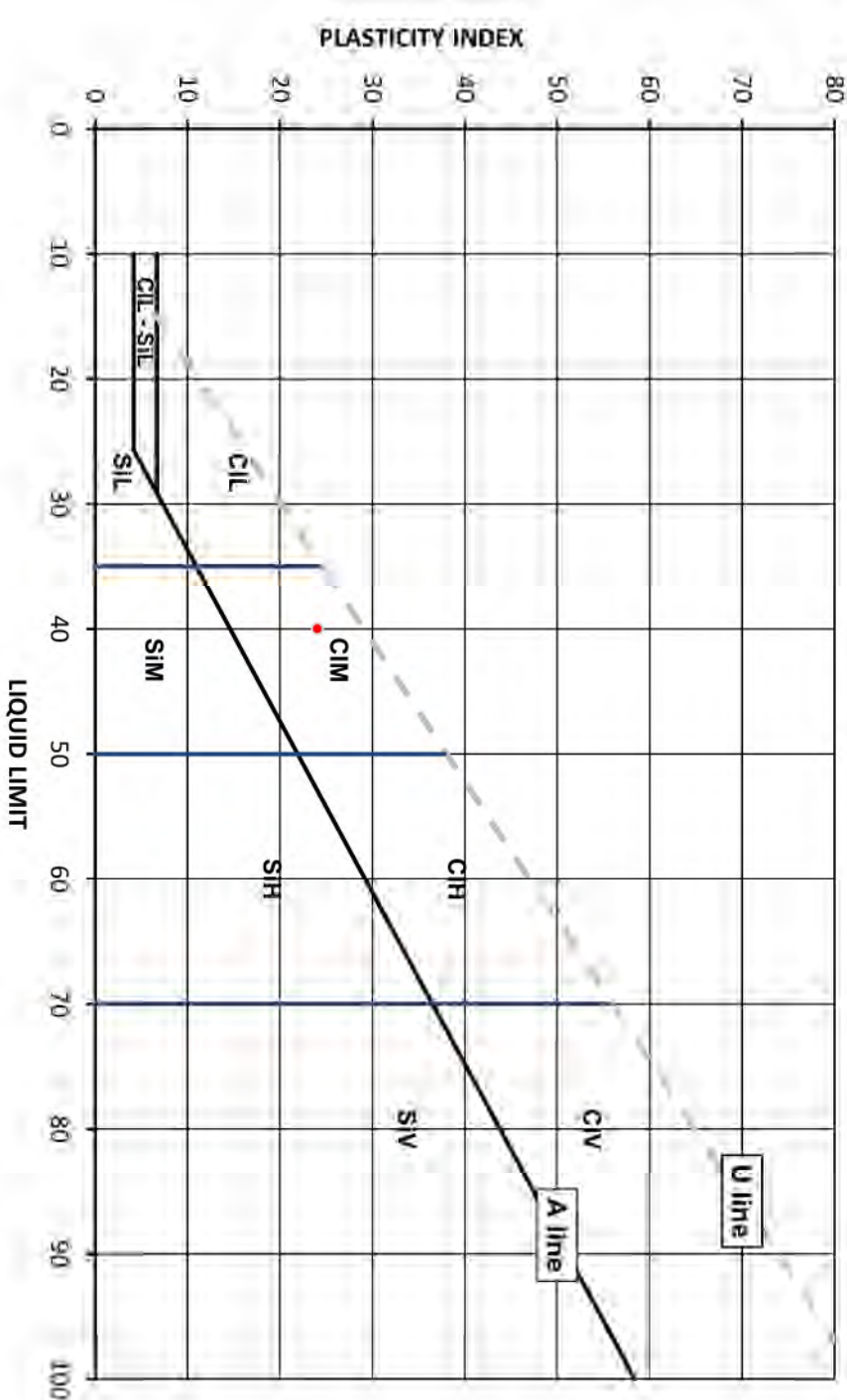
As Received Water Content [w] %	Liquid Limit [WL] %	Plastic Limit [WP] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
18.2	40	15	25	0.12	0.88	98



Note: Water Content by BS EN 17892-1: 2014; # Non accredited

Remarks:

As Received Water Content [w] %	Liquid Limit [WL] %	Plastic Limit [WP] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
17.2	40	16	24	0.04	0.96	98



Note: Water Content by BS EN 17892-1: 2014; # Non accredited

Remarks:

12 Analytical Ltd
Unit 8 Harrowden Road
Barnet, Herts AL5 2JF

12 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

© 2006 The Authors
Journal compilation © 2006 Blackwell Publishing Ltd

Client: Hydrack Consultants Ltd
Client Address: 41 Lakeside, Festival Park

Contact:	Russell Sumner
Site Address:	UoM The Limes Relocation

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	164275
Hole No.:	BH01
Sample Reference:	2
Sample Description:	Brown CLAY

Specimen Preparation:

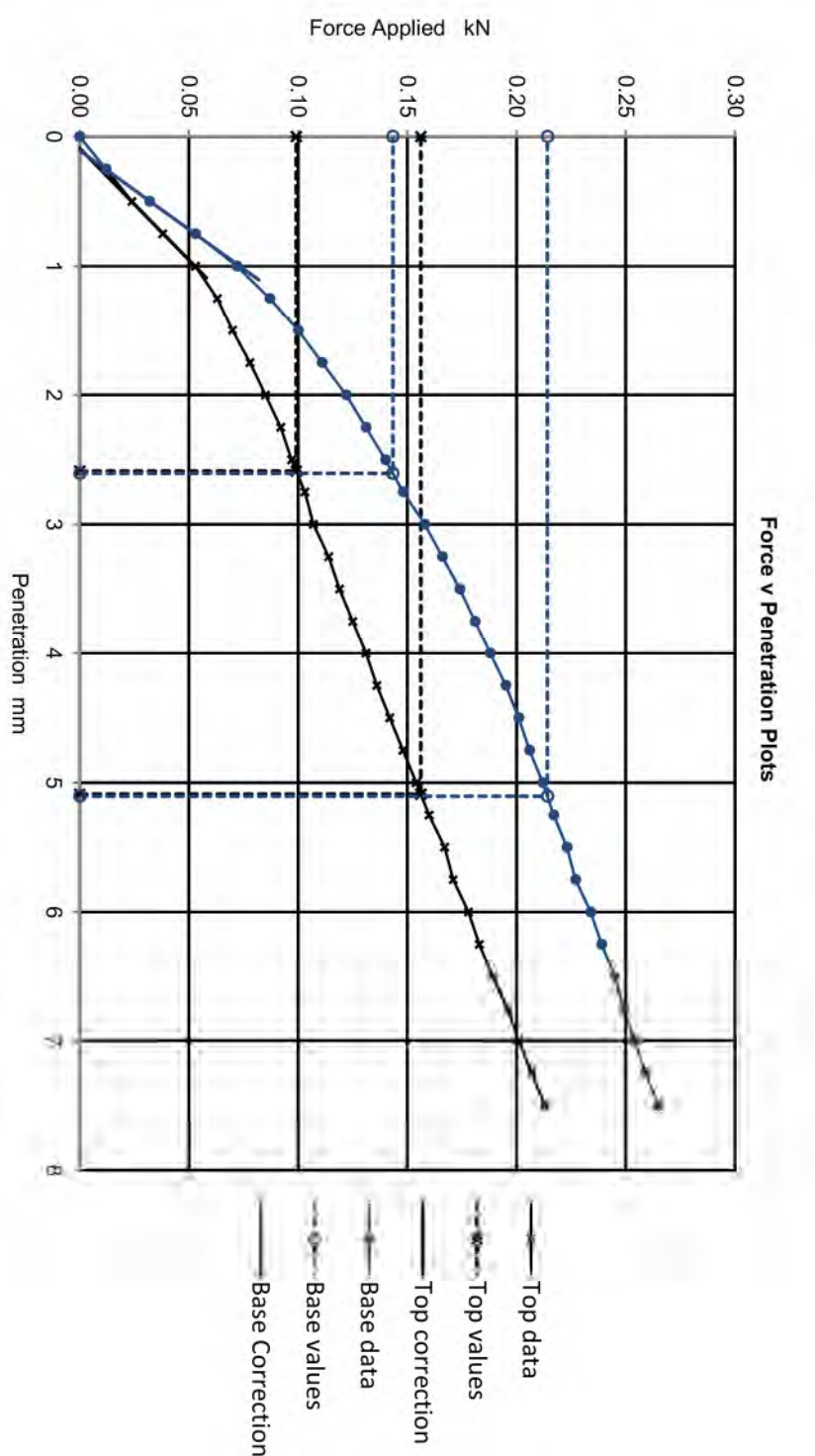
Condition Details	Remoulded
	Recompacted with specified standard effort using 2.5kg rammer

Material retained on 20mm sieve removed	0	%

Initial Specimen details	
Bulk density	1.92 Mg/m3
Dry density	1.51 Mg/m3
Water content	27 %

Soaking details	Not soaked
Period of soaking	days
Time to surface	days
Amount of swell recorded	mm
Dry density after soaking	Mg/m ³

Surcharge applied	8 kg	4.9 kPa
-------------------	------	---------



Results	Curve correction applied	CBR Values, %			Water Content %
		2.5mm	5mm	Highest	
TOP	Yes	0.75	0.78	0.78	29
	Yes	1.1	1.1	1.1	27
BASE					

Remarks:	Test/ Specimen specific remarks:
----------	----------------------------------

Signed:

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing

Katayunc
phair

Senior Reporting Specialist
for and on behalf of i2 Analytical Ltd

Client: Hydrock Consultants Ltd
Client Address: 41 Akasida, Festival Park

Contact: Russell Sumner
Site Address: UoM The Limes Relocation

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	164276
Hole No.:	BH02
Sample Reference:	3
Sample Description:	Dark gr

Specimen Preparation:

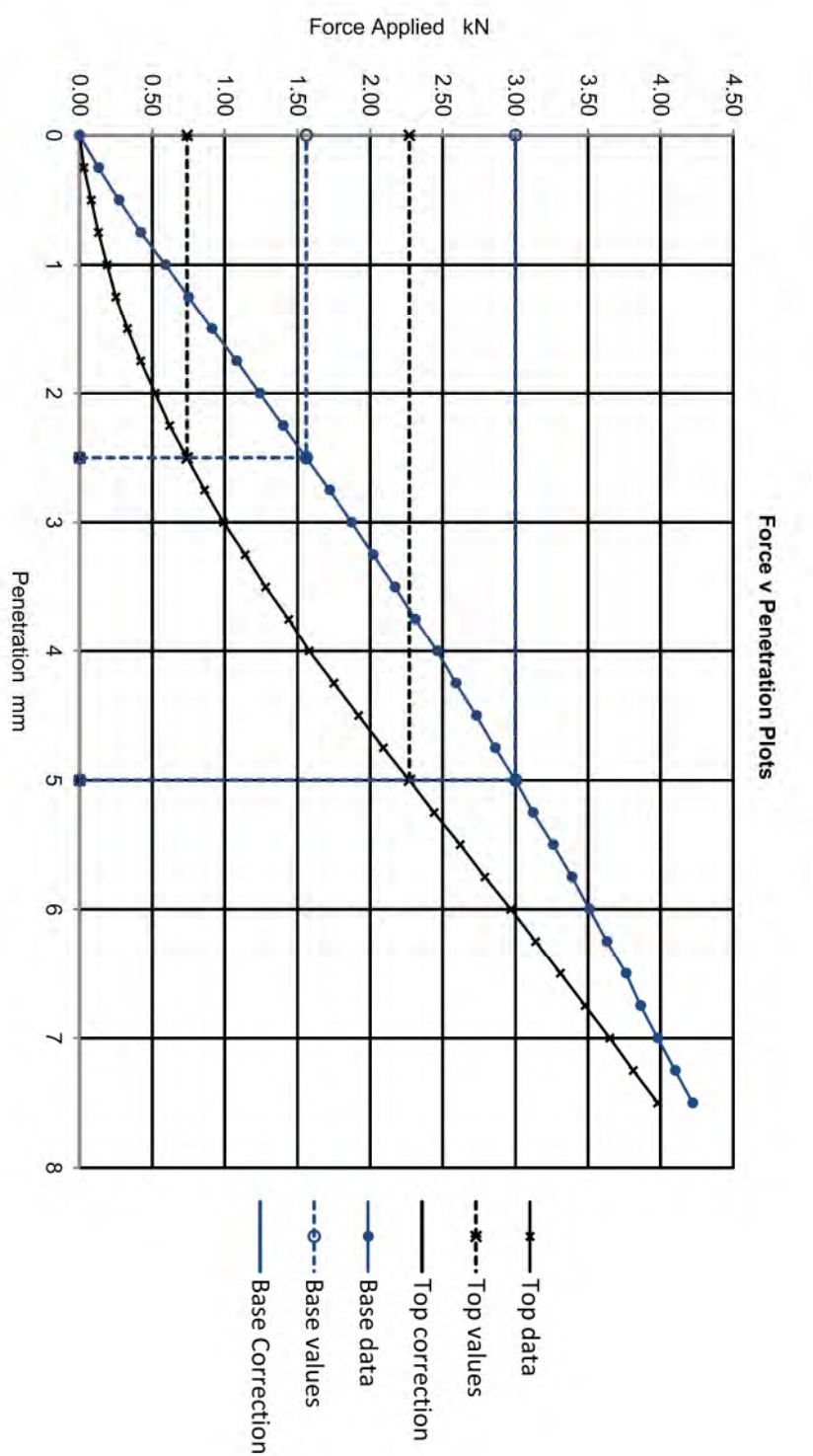
Condition Details	Remoulded
	Recompacted with specified standard effort using 2.5kg rammer

Material retained on 20mm sieve removed	10 %
Material retained on 20mm sieve removed	10 %

Initial Specimen details	
Bulk density	1.86 Mg/m ³
Dry density	1.56 Mg/m ³
Water content	19 %

Soaking details	Not soaked
Period of soaking	days
Time to surface	days
Amount of swell recorded	mm
Dry density after soaking	Mg/m ³

Surcharge applied	8 kg
	4.9 kPa



Results	Curve correction applied	CBR Values, %			Average	Water Content %
		2.5mm	5mm	Highest		
TOP	NO	5.6	11	11		19
BASE	NO	12	15	15		18

Test/ Specimen specific remarks:	
Remarks:	

Signed:

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing

Katayunc
Phelix

Senior Reporting Specialist
for and on behalf of I2 Analytical Ltd

Geotechnical Plots

Client		Location or material to which this assessment applies	
University of Manchester		Made Ground	
Project			
The Limes Relocation			
Job number			
33445			
Concrete in aggressive ground			
		After BRE Special Digest 1:2005 + 2017 3e	
Soil data			
(Adjusted) water soluble sulfate (mg/l)		Total potential sulfate (%)	
Number of tests		3	
No. tests in 20% data set		1	
No. tests with suspected pyrite		0	
Maximum value		208	
Mean of highest two values		186	
Mean of highest 20%		0	
Characteristic Value		208	
		0.3	
		11	
		Mg not required	
[no pyrite]		[pyrite suspected]	
DS Class		DS-1	
		DS-2	
If pyrite suspected, DS Class limited to		DS-2	
Is pyrite assumed to be present?		No	
		Adopted DS Class = DS-1	
Water data			
(Adjusted) soluble sulfate (mg/l)		Soluble magnesium (mg/l)	
Characteristic Value		0	
(Maximum Level)		Mg not required	
DS Class			
pH data			
Soil		Water	
Number of tests		3	
No. tests in 20% data set		1	
Lowest pH		7.2	
Mean of lowest 20%		7.2	
Characteristic value		7.2	
Design value		7.2	
Number of soil pH results less than 5.5		0	
DS Class design value			
Based on higher of soil and water data		DS-1	
		Mobile groundwater	
		AC-1	
ACEC Class design value			

Client		Location or material to which this assessment applies	
University of Manchester		Glacial Till	
Project		The Limes Relocation	
Job number		33445	

Concrete in aggressive ground		After BRE Special Digest 1:2005 + 2017 3e	
Soil data			
(Adjusted) water soluble sulfate (mg/l)	Total potential sulfate (%)	Water soluble magnesium (mg/l)	
Number of tests	2	2	
No. tests in 20% data set	0	0	
No. tests with suspected pyrite	0	0	
Maximum value	229	10	
Mean of highest two values	144	9	
Mean of highest 20%			
Characteristic Value	229	10	
[no pyrite]		[pyrite suspected]	
DS Class	DS-1	DS-2	
If pyrite suspected, DS Class limited to			
DS-2			
Is pyrite assumed to be present?			
No		Adopted DS Class = DS-1	

Water data	
(Adjusted) soluble sulfate (mg/l)	Soluble magnesium (mg/l)
Characteristic Value (Maximum Level)	0
DS Class	

pH data	
Soil	Water
Number of tests	2
No. tests in 20% data set	0
Lowest pH	7.4
Mean of lowest 20%	
Characteristic value	7.4
Design value	7.4

Number of soil pH results less than 5.5	
0	

DS Class design value		ACEC Class design value	
Based on higher of soil and water data		Natural ground	
		Mobile groundwater	
		AC-1*	

* increase to AC-2z in flowing water (pure or with >15mg/l carbon dioxide)

* Increase to AC-2z in flowing water (pure or with >15mg/l carbon dioxide)

Client	University of Manchester	
Project	The Limes Relocation	
Job number	33445	

Location or material to which this assessment applies

Chester Formation

Concrete in aggressive ground	After BRE Special Digest 1:2005 + 2017 3e
-------------------------------	---

Soil data

	(Adjusted) water soluble sulfate (mg/l)	Total potential sulfate (%)	Water soluble magnesium (mg/l)
Number of tests	1	1	
No. tests in 20% data set	0	0	
No. tests with suspected pyrite		0	
Maximum value	27.4	0	
Mean of highest two values	27	0	
Mean of highest 20%			
Characteristic Value	27.4	0	

	[no pyrite]	[pyrite suspected]
DS Class	DS-1	DS-1

If pyrite suspected, DS Class limited to

DS-1

Is pyrite assumed to be present? No Adopted DS Class = DS-1

Water data

	(Adjusted) soluble sulfate (mg/l)	Soluble magnesium (mg/l)
Characteristic Value (Maximum Level)	0	0
DS Class		

pH data

	Soil	Water
Number of tests	1	0
No. tests in 20% data set	0	
Lowest pH	8.3	
Mean of lowest 20%		
Characteristic value	8.3	
Design value	8.3	

Number of soil pH results less than 5.5 0

DS Class design value

ACEC Class design value

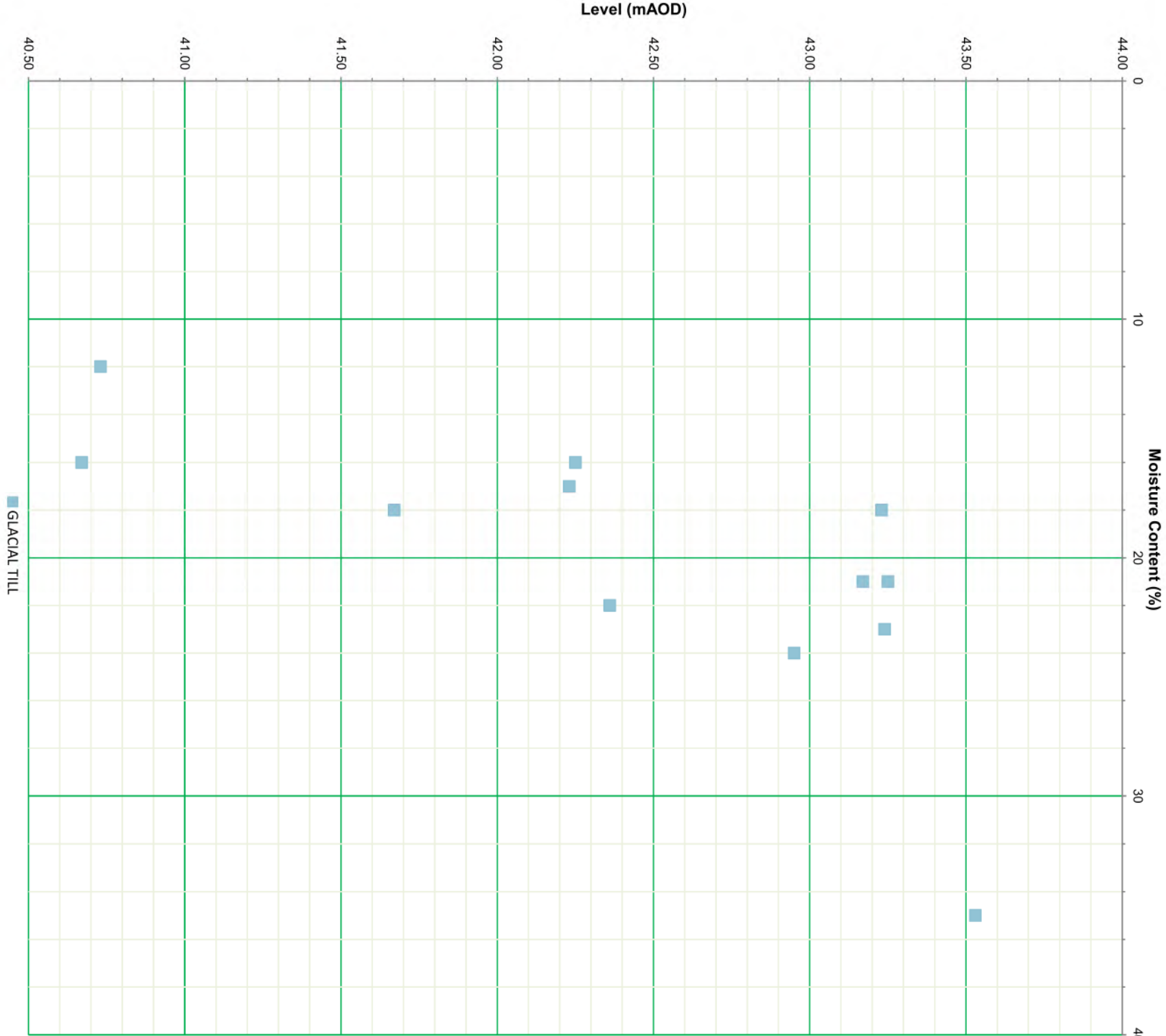
Based on higher of soil and water data

DS-1	Natural ground
AC-1 *	Mobile groundwater

* Increase to AC-2z in flowing water (pure or with >15mg/l carbon dioxide)

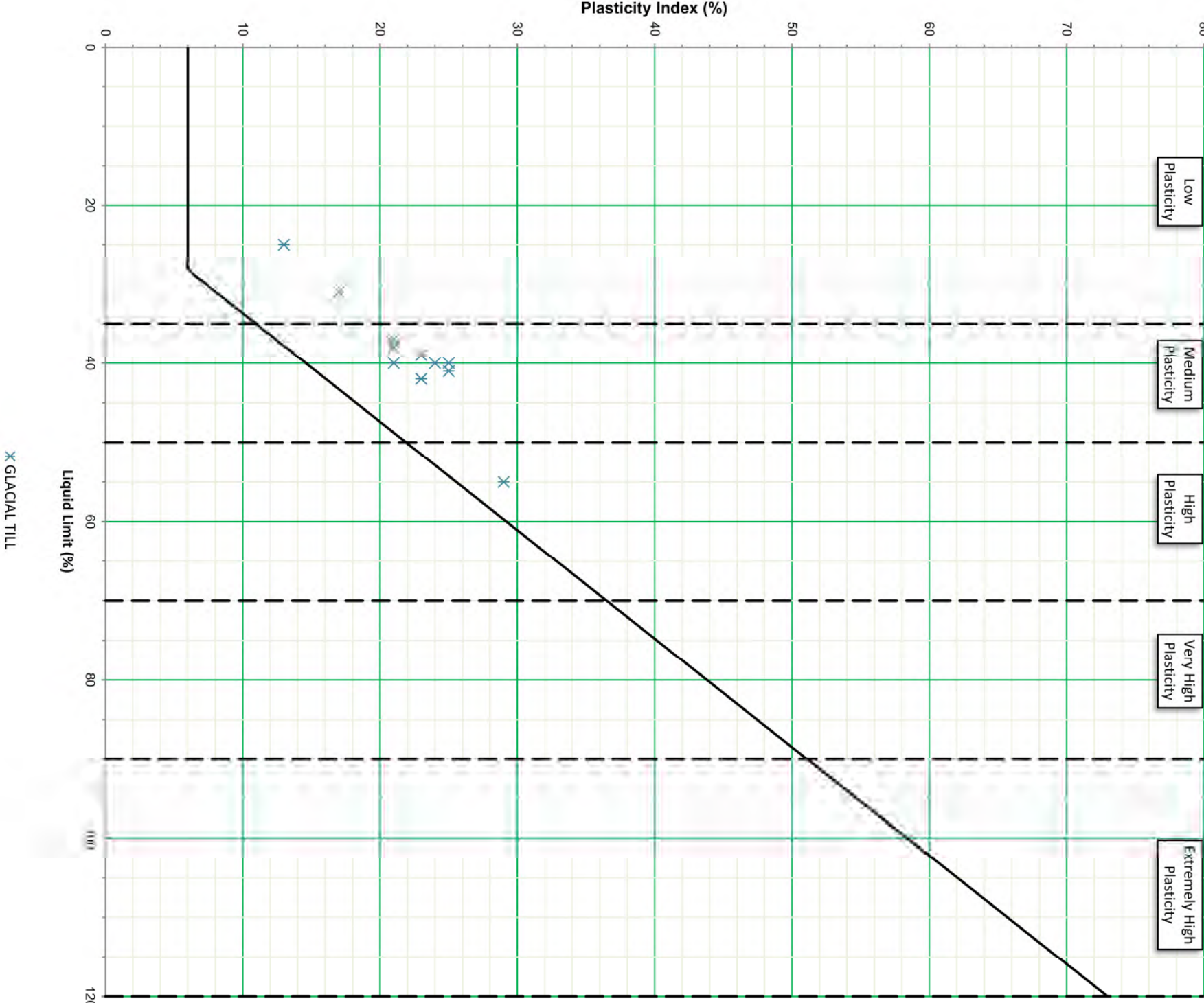
MOISTURE CONTENT VS LEVEL

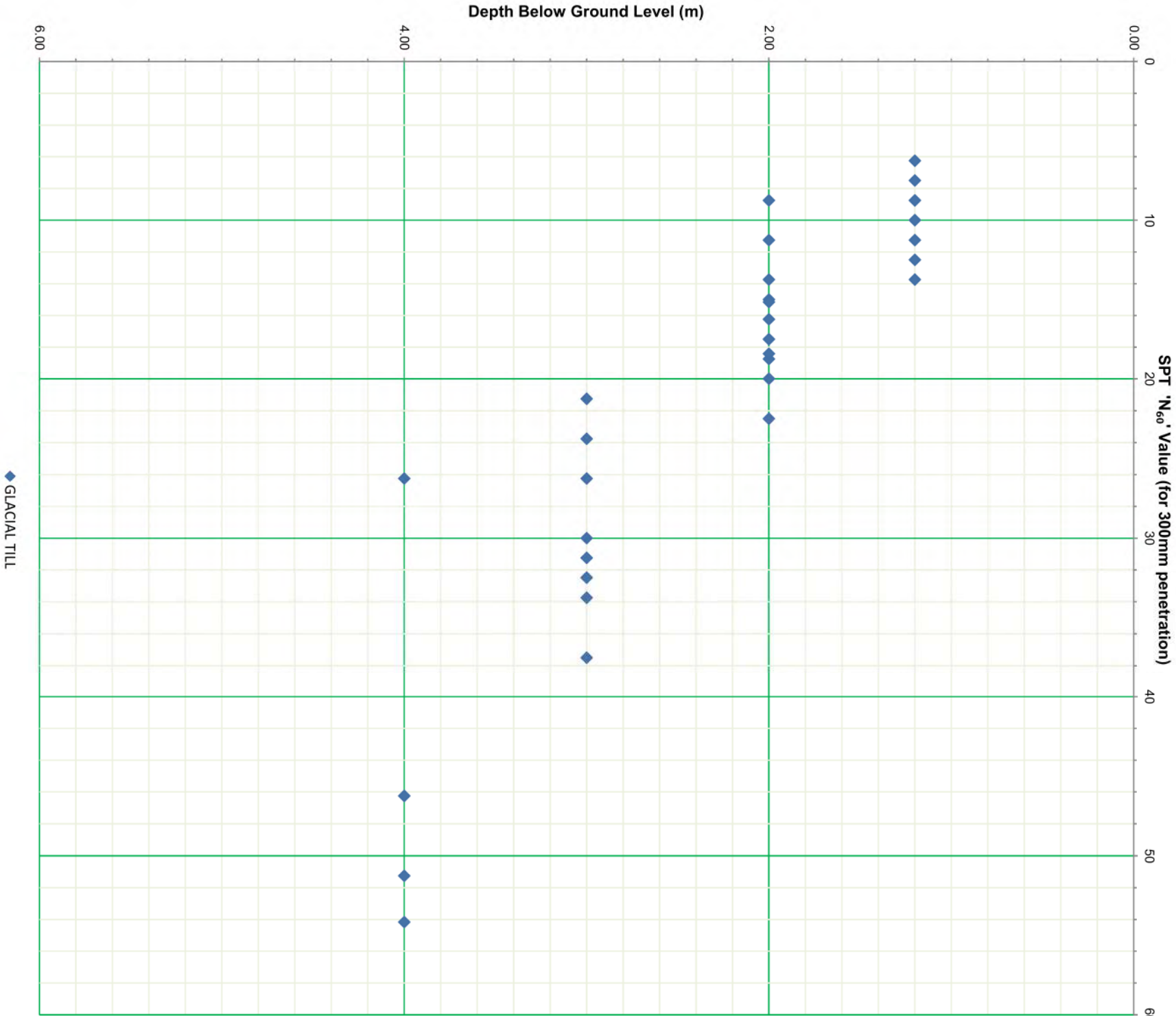
Site:	Client:	Contract No.	33445
UoM T1e Lines Relocation	University of Manchester	All Data	



PLASTICITY CLASSIFICATION CHART

Site:	Client:	Contract No.	33445
UoM T1e Lines Relocation	University of Manchester	All Data	

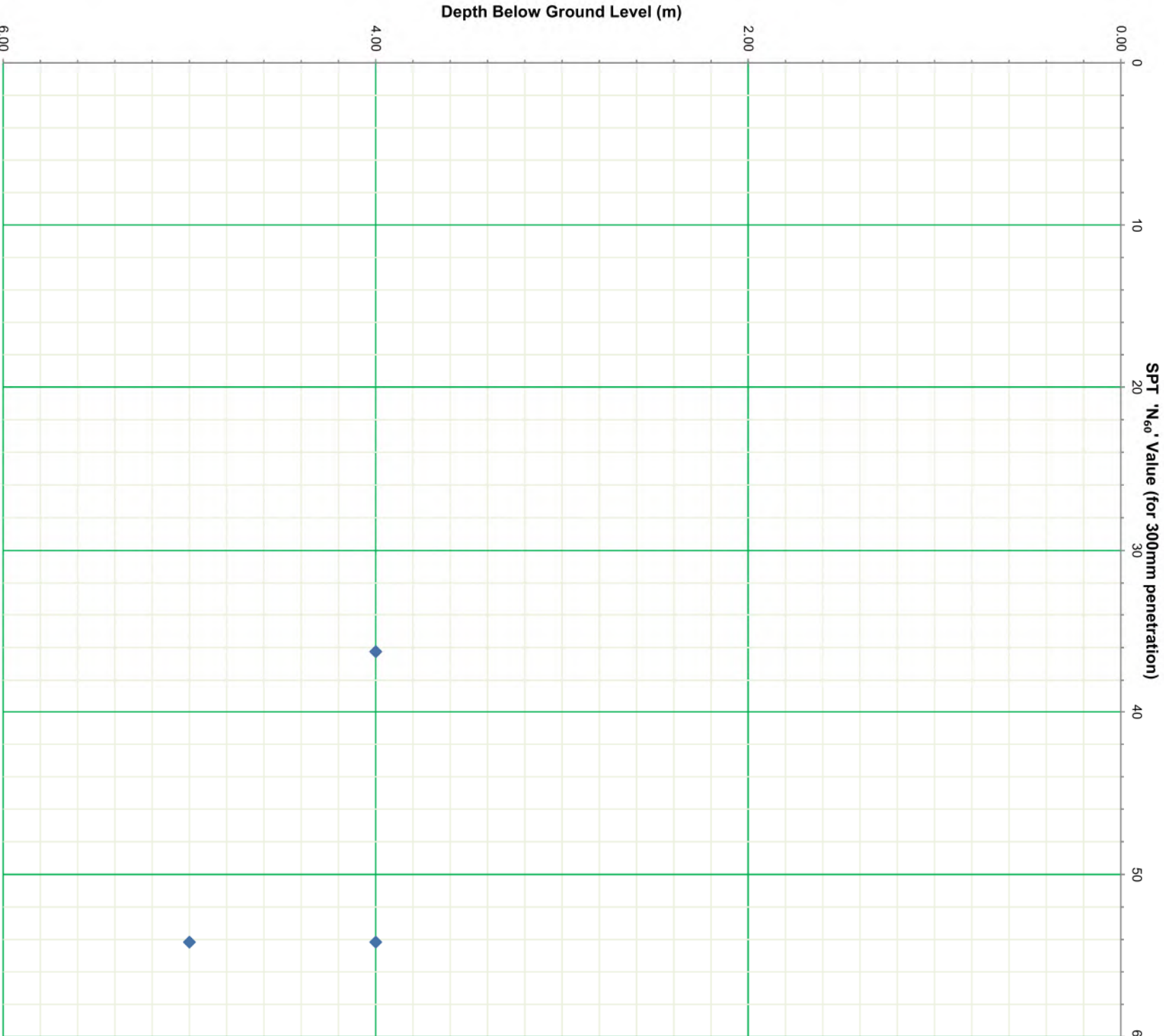






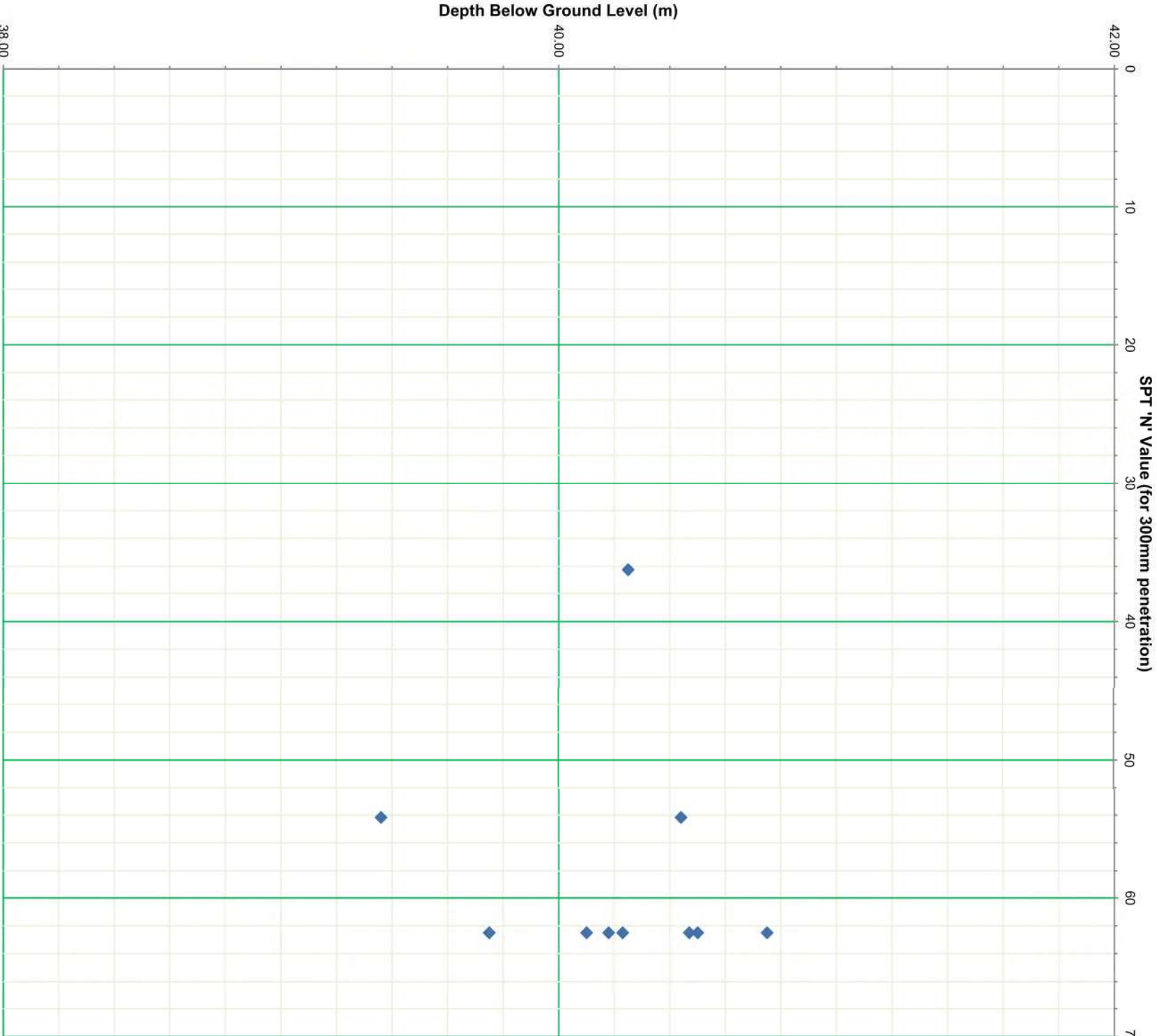
SPT 'N₆₀' VALUES GRANULAR
NATURAL STRATA vs DEPTH

Site:	Client:		Contract No.	33445
	University of Manchester		All Data	



SPT 'N₆₀' VALUES GRANULAR
STRATA vs LEVEL

Site:	Client:		Contract No.	33445
	University of Manchester		All Data	



Appendix D Site Monitoring Data and Ground Gas Risk Assessment

Site: The Limes Relocation Job number: 33445 Client: University of Manchester Gas analyser: GA5000 Equipment check OK: Y Service in date: Y Calibration check OK: Y Name of person monitoring: See Notes.							Notes on site conditions:																			
							Date			Operator			Weather Conditions													
							09/04/2024			DS			Broken clouds and rain, wind speed 16-20mph and air temperature 7-8°C.													
							18/04/2024			AE			Light rain and cloudy, wind soeed 13-14mph and air temperature 9°C.													
							29/04/2024			DS			Sunny with scattered showers, wind speed 9-12mph and air temperature 11-13°C.													
							Notes: LEL = lower explosive limit = 5%v/v. * where the flow is less than the limit of detection of the instrument, the detection limit is reported (Highlighted in blue). GSVs are rounded to 3 places.																			
Monitoring round		Borehole details					Pressure and flow					Gas concentrations										GSV		Local conditions		
Date	Time	Borehole	Single or dual gas tap	Response zone depth (m)	Depth to water or depth of hole if dry (m)	D denotes dry hole	Atmospheric pressure (hPa)	Atm pressure falling / rising / steady	Relative BH pressure (hPa)	Gas flow* (l/hr)	Gas flow* (absolute value) (l/hr)	VOC (as ppm using PID)	CH ₄ (%v/v)		CH ₄ (%LEL)		CO ₂ (%v/v)		O ₂ (%v/v)		Other Gases		Gas Screening Value (CH ₄) (l/hr)	Gas Screening Value (CO ₂) (l/hr)	Notes on condition of borehole and surrounding ground	
													Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	CO (PPM)	H ₂ S (PPM)				
							Max. individual values:					2.4	2.7		54.0		10.0		21.3		0.043		0.168	Summary statistics for this monitoring period.		
							Min. individual values:					0.1	0.1		2.0		0.1		10.8		0.000		0.000			
							Worst-case GSVs based on max. individual flow and max. individual conc. over the duration of this table:															0.0648				0.24
09/04/24	AM	BH01	S	1.00 - 5.00	4.30		1016	R	0.09	0.1	0.1	NR	0.2	0.1	4	2	5.7	4.8	13.2	13.8	<1	<1	0.000	0.005		
09/04/24	AM	BH02	S	1.00 - 5.00	4.54		1016	R	0.07	0.1	0.1	NR	0.5	0.4	10	8	4.8	4.8	15.3	15.3	<1	<1	0.000	0.005		
09/04/24	AM	WS04	S	1.00 - 4.50	4.50	D	1021	R	0.04	0.1	0.1	NR	0.1	0.1	2	2	1.5	0.1	18.5	21.3	<1	<1	0.000	0.000		
09/04/24	AM	WS05	S	1.00 - 3.70	0.60		1021	R	0.08	0.1	0.1	NR	0.1	0.1	2	2	0.5	0.4	20.1	20.2	235	<1	0.000	0.000	CO rising to 235ppm over 2 mins. Response Zone Flooded.	
09/04/24	AM	WS08	S	1.00 - 4.00	1.00		1021	R	0.09	0.1	0.1	NR	0.3	0.2	6	4	9.1	9.1	15.0	15.9	168	<1	0.000	0.009	CO rising to 168ppm over 3 mins. Response Zone Flooded.	
18/04/24	PM	BH01	S	1.00 - 5.00	4.48		1017	F	-0.05	2.4	2.4	NR	2.8	1.8	56	36	7.1	6.6	12.4	12.5	<1	<1	0.043	0.158		
18/04/24	PM	BH02	S	1.00 - 5.00	4.60		1017	F	-0.02	2.4	2.4	NR	1.2	1.2	24	24	7.0	7.0	12.3	12.4	<1	<1	0.029	0.168	Peak gas flow -2.8l/hr.	
18/04/24	PM	WS04	S	1.00 - 4.50	4.47	D	1017	F	-0.02	1.2	1.2	NR	0.6	0.6	12	12	1.8	1.8	17.3	17.3	<1	<1	0.007	0.022	Peak gas flow -2.9l/hr. Peak CO at 26ppm, falling to <1 over 2 mins.	
18/04/24	PM	WS05	S	1.00 - 3.70	0.77		1017	F	-0.05	0.1	0.1	NR	2.8	2.7	56	54	0.4	0.4	20.8	20.8	17	<1	0.003	0.000	Response Zone Flooded.	
18/04/24	PM	WS08	S	1.00 - 4.00	0.96		1017	F	0.00	0.1	0.1	NR	0.2	0.2	4	4	1.4	1.4	19.9	19.9	2	<1	0.000	0.001	Peak gas flow 4.0l/hr. Response Zone Flooded.	
29/04/24	AM	BH01	S	1.00 - 5.00	4.50		1004	S	-0.23	0.1	0.1	NR	0.9	0.9	18	18	7.4	6.7	21.0	13.6	<1	<1	0.001	0.007		
29/04/24	AM	BH02	S	1.00 - 5.00	4.63		1004	S	0.02	0.1	0.1	NR	2.0	2.0	40	40	9.0	9.0	13.8	10.8	<1	<1	0.002	0.009		
29/04/24	AM	WS04	S	1.00 - 4.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Unable to monitor due to parked car	
29/04/24	AM	WS05	S	1.00 - 3.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Unable to monitor due to parked car	
29/04/24	AM	WS08	S	1.00 - 4.00	1.10		1017	S	0.07	0.1	0.1	NR	1.8	1.6	36	32	10.0	10.0	16.8	15.2	19	<1	0.002	0.010	Response Zone Flooded.	

Appendix E Contamination Test Results and GQRA

Contamination Test Results



Hydrock Consultants Ltd
4 Lakeside
Festival Park
Stoke on Trent
ST1 5RY

t: 01782 261919
e: Russellsumner@hydrock.com



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

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

Analytical Report Number : 24-013057

Replaces Analytical Report Number: 24-013057, issue no. 1
Additional analysis undertaken.
Asbestos Quantification added on sample 165349 as per client's request

Project / Site name: UoM The Limes Relocation
Your job number: 33445
Your order number: PO33404
Report Issue Number: 2
Report issued on: 26/04/2024

Samples Analysed: 13 soil samples

Signed:

Joanna Wawrzeczko
Senior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

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

Analytical Report Number: 24-013057
Project / Site name: UoM The Limes Relocation
Your Order No: PO33404

Lab Sample Number	165347	165348	165349	165350	165351
Sample Reference	BH02	WS07	WS08	WS09	WS09
Sample Number	1	1	1	1	2
Depth (m)	0.40	0.40	0.30	1.00	1.20
Date Sampled	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024
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	23.6	< 0.1
Moisture Content	%	0.01	NONE	10	17	14	16	17
Total mass of sample received	kg	0.1	NONE	0.9	0.9	0.9	0.8	0.6

Asbestos								
Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	Not-detected	Not-detected	Detected	-	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	MBI	MBI	MBI	-	MBI
Actinolite detected	Type	N/A	ISO 17025	-	-	Not-detected	-	-
Amosite detected	Type	N/A	ISO 17025	-	-	Detected	-	-
Anthophyllite detected	Type	N/A	ISO 17025	-	-	Not-detected	-	-
Chrysotile detected	Type	N/A	ISO 17025	-	-	Not-detected	-	-
Crocidolite detected	Type	N/A	ISO 17025	-	-	Not-detected	-	-
Tremolite detected	Type	N/A	ISO 17025	-	-	Not-detected	-	-

Asbestos % by hand picking/weighing	%	0.001	ISO 17025	-	-	< 0.001	-	-
-------------------------------------	---	-------	-----------	---	---	---------	---	---

Asbestos Containing Material Types Detected (ACM)	Type	N/A	ISO 17025	-	-	Loose fibres	-	-
---	------	-----	-----------	---	---	--------------	---	---

General Inorganics								
pH (1099)	pH Units	N/A	MCERTS	8.1	7.3	8	-	7.2
Free Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-	-	-	-	-
Total Sulphate as SO ₄	%	0.005	MCERTS	-	-	-	-	-
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	780	160	360	-	210
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1) Leachate Equivalent)	g/l	0.00125	MCERTS	0.388	0.0781	0.178	-	0.106
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	388	78.1	178	-	106
Water Soluble Chloride (2:1)	mg/kg	1	MCERTS	-	-	-	-	-
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	-	-	-	-	-
Total Sulphur	mg/kg	50	MCERTS	-	-	-	-	-
Total Sulphur	%	0.005	MCERTS	-	-	-	-	-
Ammoniacal Nitrogen as NH ₄ ⁺	mg/kg	0.5	MCERTS	-	-	-	-	-
Ammonium as NH ₄ ⁺ (10:1 leachate equivalent)	mg/l	0.05	MCERTS	-	-	-	-	-
Fraction Organic Carbon (FOC) Automated	%	0.001	MCERTS	0.023	0.013	0.026	-	0.015
Water Soluble Nitrate (2:1) as NO ₃	mg/kg	2	NONE	-	-	-	-	-
Water Soluble Nitrate (2:1) as NO ₃ (leachate equivalent)	mg/l	5	NONE	-	-	-	-	-

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

Analytical Report Number: 24-013057

Project / Site name: UoM The Limes Relocation

Your Order No: P033404

Lab Sample Number	165347	165348	165349	165350	165351
Sample Reference	BH02	WS07	WS08	WS09	WS09
Sample Number	1	1	1	1	2
Depth (m)	0.40	0.40	0.30	1.00	1.20
Date Sampled	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)					
	Units	Limit of detection	Accreditation Status		

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	0.68	< 0.05	0.82	-	0.94
Acenaphthylene	mg/kg	0.05	MCERTS	0.23	< 0.05	0.51	-	0.23
Acenaphthene	mg/kg	0.05	MCERTS	2.3	0.06	2.7	-	1.5
Fluorene	mg/kg	0.05	MCERTS	1.9	0.08	2.9	-	2.2
Phenanthrene	mg/kg	0.05	MCERTS	16	0.41	21	-	9.3
Anthracene	mg/kg	0.05	MCERTS	4	0.1	4.8	-	2.3
Fluoranthene	mg/kg	0.05	MCERTS	31	0.59	33	-	9.1
Pyrene	mg/kg	0.05	MCERTS	30	0.61	32	-	9.3
Benz(a)anthracene	mg/kg	0.05	MCERTS	16	0.33	17	-	4.3
Chrysene	mg/kg	0.05	MCERTS	15	0.3	16	-	4.2
Benz(b)fluoranthene	mg/kg	0.05	ISO 17025	18	0.35	17	-	4.3
Benz(k)fluoranthene	mg/kg	0.05	ISO 17025	8	0.12	7.9	-	1.5
Benz(a)pyrene	mg/kg	0.05	MCERTS	17	0.29	17	-	4.1
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	7	0.13	7	-	1.5
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	1.8	< 0.05	1.8	-	0.4
Benz(ghi)perylene	mg/kg	0.05	MCERTS	7.7	0.16	8.2	-	1.8

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	ISO 17025	178	3.53	189	-	57
	0.8						

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	29	8.3	31	-	10
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	1.6	0.84	2.2	-	1.1
Boron (water soluble)	mg/kg	0.2	MCERTS	1.4	0.7	0.8	-	2
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	-	< 0.2
Chromium (flexivalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	-	< 1.8
Chromium (III)	mg/kg	1	NONE	19	19	21	-	24
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	19	19	21	-	24
Copper (aqua regia extractable)	mg/kg	1	MCERTS	64	15	85	-	21
Lead (aqua regia extractable)	mg/kg	1	MCERTS	< 0.3	19	98	-	40
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	0.4	-	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	28	19	40	-	22
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	5.1	-	< 1.0
Sodium (aqua regia extractable)	mg/kg	1	MCERTS	39	23	51	-	30
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	110	43	110	-	46

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

This certificate should not be reproduced, except in full, without the express permission of the laboratory

Iss No 24-013057-2-UoM The Limes Relocation 33445 FR.xlsm

Analytical Report Number: 24-013057

Project / Site name: UoM The Limes Relocation

Your Order No: P033404

Lab Sample Number	165347	165348	165349	165350	165351
Sample Reference	BH02	WS07	WS08	WS09	WS09
Sample Number	1	1	1	1	2
Depth (m)	0.40	0.40	0.30	1.00	1.20
Date Sampled	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024
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-CMG - Aliphatic > C5 - C6	HS, ID, AL	mg/kg	0.02	NONE	-	-	< 0.020	< 0.020
TPH-CMG - Aliphatic > C6 - C8	HS, ID, AL	mg/kg	0.02	NONE	-	-	< 0.020	< 0.020
TPH-CMG - Aliphatic > C8 - C10	HS, ID, AL	mg/kg	0.05	NONE	-	-	< 0.050	< 0.050
TPH-CMG - Aliphatic > C10 - C12	HS, CL, ID, AL	mg/kg	1	MCERTS	-	-	4.1	< 1.0
TPH-CMG - Aliphatic > C12 - C16	HS, CL, ID, AL	mg/kg	2	MCERTS	-	-	19	< 2.0
TPH-CMG - Aliphatic > C16 - C21	HS, CL, ID, AL	mg/kg	8	MCERTS	-	-	21	< 8.0
TPH-CMG - Aliphatic > C16 - C35	HS, CL, ID, AL	mg/kg	10	MCERTS	-	-	46	< 10
TPH-CMG - Aliphatic > C21 - C35	HS, CL, ID, AL	mg/kg	8	MCERTS	-	-	25	< 8.0
TPH-CMG - Aliphatic > C35 - C44	HS, CL, ID, AL	mg/kg	8.4	NONE	-	-	< 8.4	< 8.4
TPH-CMG - Aliphatic > C5 - C35	HS, CL, HS, ID, AL	mg/kg	10	NONE	-	-	69	< 10
TPH-CMG - Aliphatic > C5 - C44	HS, CL, HS, ID, AL	mg/kg	10	NONE	-	-	69	< 10

TPHCWG - Aromatic > EC5 - EC7 RH, IO, AR	mg/kg	0.01	NONE	-	-	< 0.010	< 0.010
TPHCWG - Aromatic > EC7 - EC8 RH, IO, AR	mg/kg	0.01	NONE	-	-	< 0.010	< 0.010
TPHCWG - Aromatic > EC8 - EC10 RH, IO, AR	mg/kg	0.05	NONE	-	-	< 0.050	< 0.050
TPHCWG - Aromatic > EC10 - EC12 RH, IO, AR	mg/kg	1	MCERTS	-	-	20	< 1.0
TPHCWG - Aromatic > EC12 - EC16 RH, IO, IO, AR	mg/kg	2	MCERTS	-	-	270	7.5
TPHCWG - Aromatic > EC16 - EC21 RH, IO, IO, AR	mg/kg	10	MCERTS	-	-	2100 \$	36
TPHCWG - Aromatic > EC21 - EC35 RH, IO, IO, AR	mg/kg	10	MCERTS	-	-	3400	44
TPHCWG - Aromatic > EC35 - EC44 RH, IO, IO, AR	mg/kg	8.4	NONE	-	-	200	30
TPHCWG - Aromatic > EC5 - EC35 RH, OH, IO, AR	mg/kg	10	NONE	-	-	5800 \$\$\$	88
TPHCWG - Aromatic > EC5 - EC44 RH, OH, IO, AR	mg/kg	10	NONE	-	-	6000 \$\$\$	120

TPH Total >C5 - C44 EH_CU+HS_ID_TOTAL	mg/kg	10	NONE	-	-	6000 \$\$\$	120

VOCs

MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	-	-	< 5.0	< 5.0
Benzene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0
Toluene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0
p & m-Xylene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0
o-Xylene	µg/kg	5	MCERTS	-	-	< 5.0	< 5.0

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

This certificate should not be reproduced, except in full, without the express permission of the laboratory

Iss No 24-013057-2-UOM The Limes Relocation 33445 FR.xlsm

Analytical Report Number: 24-013057

Project / Site name: UoM The Limes Relocation

Your Order No: P033404

Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Lab Sample Number	165352	165353	165354	165355	165356			
Sample Reference	WS01	WS03	WS02	WS05	BH02			
Sample Number	1	1	2	1	2			
Depth (m)	0.40	0.40	0.90	0.40	0.50			
Date Sampled	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024			
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied			

Stone Content	%	NONE	< 0.1	18.3	< 0.1	< 0.1
Moisture Content	%	NONE	14	14	25	16
Total mass of sample received	kg	NONE	0.9	0.7	0.7	0.8

Asbestos

Asbestos in Soil Detected/Not Detected	Type	N/A	150 17025	Not-detected	EWS	Not-detected	EWS	Not-detected	EWS	-
Asbestos Analyst ID	N/A	N/A	N/A	EWS	EWS					-
Actinolite detected	Type	N/A	150 17025	-	-	-	-	-	-	-
Amosite detected	Type	N/A	150 17025	-	-	-	-	-	-	-
Anthophyllite detected	Type	N/A	150 17025	-	-	-	-	-	-	-
Chrysotile detected	Type	N/A	150 17025	-	-	-	-	-	-	-
Crocidolite detected	Type	N/A	150 17025	-	-	-	-	-	-	-
Tremolite detected	Type	N/A	150 17025	-	-	-	-	-	-	-

Asbestos % by hand picking/weighting	%	ISO 17025	-	-	-	-
	0.001		-	-	-	-

Asbestos Containing Material Types Detected (ACM)	Type	N/A	ISO 17025	-	-	-	-

General Inorganics

pH (D099)	pH Units	N/A	MCERTS	9.8	10.1	7.8	7.4	7.4
Free Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-	-	1100	360	-
Total Sulphate as SO ₄	%	0.005	MCERTS	-	-	0.109	-	0.036
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	420	590	460	180	120
Water Soluble SO ₄ 16hr extraction (2:1) Leachate Equivalent	g/l	0.00125	MCERTS	0.21	0.293	0.229	0.0923	0.0582
Water Soluble SO ₄ 16hr extraction (2:1) Leachate Equivalent	mg/l	1.25	MCERTS	210	293	229	92.3	58.2
Water Soluble Chloride (2:1)	mg/kg	1	MCERTS	-	-	81	-	19
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	-	-	40	-	9.7
Total Sulphur	mg/kg	50	MCERTS	-	-	1200	-	270
Total Sulphur	%	0.005	MCERTS	-	-	0.027	-	0.027
Ammoniacal Nitrogen as NH ₄ ⁺	mg/kg	0.5	MCERTS	-	-	28	-	24
Ammonium as NH ₄ ⁺ (10:1 leachate equivalent)	mg/l	0.05	MCERTS	-	-	1.65	-	1.55
Fraction Organic Carbon (FOC) Automated	%	0.001	MCERTS	0.025	0.023	0.015	0.015	-
Water Soluble Nitrate (2:1) as NO ₃	mg/kg	2	NONE	-	-	< 2.0	-	< 2.0
Water Soluble Nitrate (2:1) as NO ₃	mg/l	5	NONE	-	-	< 5.0	-	< 5.0

Total Phenols

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

This certificate should not be reproduced, except in full, without the express permission of the laboratory

Analytical Report Number: 24-013057

Project / Site name: UoM The Limes Relocation

Your Order No: P033404

Lab Sample Number	165352	165353	165354	165355	165356
Sample Reference	WS01	WS03	WS02	WS05	BH02
Sample Number	1	1	2	1	2
Depth (m)	0.40	0.40	0.90	0.40	0.50
Date Sampled	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		

Naphthalene	mg/kg	0.05	MCERTS	1.8	19	0.12	0.11	-
Acenaphthylene	mg/kg	0.05	MCERTS	1.9	< 0.05	< 0.05	< 0.05	-
Acenaphthene	mg/kg	0.05	MCERTS	7.5	41	0.42	0.31	-
Fluorene	mg/kg	0.05	MCERTS	7.2	34	0.3	0.23	-
Phenanthrene	mg/kg	0.05	MCERTS	53	200	1.9	1.7	-
Anthracene	mg/kg	0.05	MCERTS	17	54	0.46	0.36	-
Fluoranthene	mg/kg	0.05	MCERTS	74	210	2.7	2.3	-
Pyrene	mg/kg	0.05	MCERTS	65	180	2.6	2.4	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	30	83	1.2	1.1	-
Chrysene	mg/kg	0.05	MCERTS	29	79	1.3	1.3	-
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	35	93	1.3	1.3	-
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	13	32	0.61	0.46	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	28	73	1.2	1.2	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	14	35	0.54	0.49	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	3.5	9.2	0.25	0.14	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	15	38	0.63	0.57	-

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	150	17025	394	1180	15.6	13.9	-
-----------------------------	-------	-----	-------	-----	------	------	------	---

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	39	20	46	13	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	2.6	1.1	0.84	0.97	-
Boron (water soluble)	mg/kg	0.2	MCERTS	0.9	1.2	0.3	0.7	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	-
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8	-
Chromium (III)	mg/kg	1	NONE	26	18	21	23	-
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	26	18	21	23	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	160	54	32	24	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	250	140	97	64	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	0.5	0.4	< 0.3	0.3	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	43	25	19	19	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	-
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	62	30	25	30	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	190	120	700	48	-

Magnesium (leachate equivalent)	mg/l	2.5	NONE	-	10	-	8.1
Magnesium (water soluble)	mg/kg	5	NONE	-	21	-	16

This certificate should not be reproduced, except in full, without the express permission of the laboratory

Analytical Report Number: 24-013057

Project / Site name: UoM The Limes Relocation

Your Order No: P033404

Analytical Parameter (Soil Analysis)	Lab Sample Number	165352	165353	165354	165355	165356
	Sample Reference	WS01	WS03	WS02	WS05	BH02
	Sample Number	1	1	2	1	2
	Depth (m)	0.40	0.40	0.90	0.40	0.50
	Date Sampled	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024
	Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
	Units	Limit of detection	Accreditation Status			

Petroleum Hydrocarbons

TPHCWG - Aliphatic > C5 - C6 HS, JD, AL	mg/kg	0.02	NONE	-	-	-	-	-	-
TPHCWG - Aliphatic > C5 - C8 HS, JD, AL	mg/kg	0.02	NONE	-	-	-	-	-	-
TPHCWG - Aliphatic > C8 - C10 HS, JD, AL	mg/kg	0.05	NONE	-	-	-	-	-	-
TPHCWG - Aliphatic > C10 - C12 HS, OL, JD, AL	mg/kg	1	MCERTS	-	-	-	-	-	-
TPHCWG - Aliphatic > C12 - C16 HS, OL, JD, AL	mg/kg	2	MCERTS	-	-	-	-	-	-
TPHCWG - Aliphatic > C16 - C21 HS, OL, JD, AL	mg/kg	8	MCERTS	-	-	-	-	-	-
TPHCWG - Aliphatic > C16 - C35 HS, OL, JD, AL	mg/kg	10	MCERTS	-	-	-	-	-	-
TPHCWG - Aliphatic > C21 - C35 HS, OL, JD, AL	mg/kg	8	MCERTS	-	-	-	-	-	-
TPHCWG - Aliphatic > C35 - C44 HS, OL, HS, JD, AL	mg/kg	10	NONE	-	-	-	-	-	-
TPHCWG - Aliphatic > C5 - C35 HS, OL, HS, JD, AL	mg/kg	10	NONE	-	-	-	-	-	-
TPHCWG - Aliphatic > C5 - C44 HS, OL, HS, JD, AL	mg/kg	10	NONE	-	-	-	-	-	-

TPHCWG - Aromatic > EC5 - EC7 HS,JD,AR	mg/kg	0.01	NONE	-	-	-	-	-	-
TPHCWG - Aromatic > EC7 - EC8 HS,JD,AR	mg/kg	0.01	NONE	-	-	-	-	-	-
TPHCWG - Aromatic > EC8 - EC10 HS,JD,AR	mg/kg	0.05	NONE	-	-	-	-	-	-
TPHCWG - Aromatic > EC10 - EC12 BR,CU,JD,AR	mg/kg	1	MCERTS	-	-	-	-	-	-
TPHCWG - Aromatic > EC12 - EC16 BR,CU,JD,AR	mg/kg	2	MCERTS	-	-	-	-	-	-
TPHCWG - Aromatic > EC16 - EC21 BR,CU,JD,AR	mg/kg	10	MCERTS	-	-	-	-	-	-
TPHCWG - Aromatic > EC21 - EC35 BR,CU,JD,AR	mg/kg	10	MCERTS	-	-	-	-	-	-
TPHCWG - Aromatic > EC35 - EC44 BR,CU,JD,AR	mg/kg	8.4	NONE	-	-	-	-	-	-
TPHCWG - Aromatic > EC5 - EC35 BR,CUHS,JD,AR	mg/kg	10	NONE	-	-	-	-	-	-
TPHCWG - Aromatic > EC5 - EC44 BR,CUHS,JD,AR	mg/kg	10	NONE	-	-	-	-	-	-

TPH Total > C5 - C44 EH_QUHS_ID_TOTAL	mg/kg	10	NONE	-	-	-	-

VOCs

MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	-	-	-	-
Benzene	µg/kg	5	MCERTS	-	-	-	-
Toluene	µg/kg	5	MCERTS	-	-	-	-
Ethylbenzene	µg/kg	5	MCERTS	-	-	-	-
p & m-Xylene	µg/kg	5	MCERTS	-	-	-	-
o-Xylene	µg/kg	5	MCERTS	-	-	-	-

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

This certificate should not be reproduced, except in full, without the express permission of the laboratory

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

Analytical Report Number: 24-013057

Project / Site name: UoM The Limes Relocation

Your Order No: P033404

Lab Sample Number	165357	165358	165359
Sample Reference	BH01	WS10	WS10
Sample Number	1	1	2
Depth (m)	0.60	0.30	0.50
Date Sampled	02/04/2024	02/04/2024	02/04/2024
Time Taken	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status

Analytical Parameter (Soil Analysis)

Stone Content	%	0.1	NONE	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	11	20
Total mass of sample received	Kg	0.1	NONE	0.8	0.8

Asbestos

Asbestos in Soil Detected/Not Detected	Type	N/A	150 17025	-	-	-
Asbestos Analyst ID	N/A	N/A	N/A	-	-	-
Actinolite detected	Type	N/A	150 17025	-	-	-
Amosite detected	Type	N/A	150 17025	-	-	-
Anthrophyllite detected	Type	N/A	150 17025	-	-	-
Chrysotile detected	Type	N/A	150 17025	-	-	-
Crocidolite detected	Type	N/A	150 17025	-	-	-
Tremolite detected	Type	N/A	150 17025	-	-	-

Asbestos % by hand picking/weighting	%	0.001	ISO 17025	-	-
--------------------------------------	---	-------	-----------	---	---

Asbestos Containing Material Types Detected (ACM)	Type	N/A	ISO 17025	-	-

General Inorganics

pH (U099)	pH Units	N/A	MCERTS	7.2	8.6	7.3
Free Cyanide	mg/kg	1	MCERTS	-	-	-
Total Sulphate as SO ₄	mg/kg	50	MCERTS	850	910	870

Wistar-Kyoto (WKY)

Water Soluble Sulphate as SO ₄ 2- (10:1 leachate equivalent)	mg/kg	2.0	MCERTS	0.163	0.129	0.208
Water Soluble SO ₄ 10hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.163	0.129	0.208
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	163	129	208
Water Soluble Chloride (2:1)	mg/kg	1	MCERTS	29	28	17
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	15	14	8.5
Total Sulphur	mg/kg	50	MCERTS	660	820	1100
Total Sulphur	%	0.005	MCERTS	0.066	0.082	0.108
Ammoniacal Nitrogen as NH ₄ ⁺	mg/kg	0.5	MCERTS	29	1.1	24
Ammonium as NH ₄ ⁺ (10:1 leachate equivalent)	mg/l	0.05	MCERTS	1.81	0.08	1.52
Fraction Organic Carbon (FOC) Automated	%	0.001	MCERTS	-	-	-
Water Soluble Nitrate (2:1) as NO ₃	mg/kg	2	NONE	< 2.0	< 2.0	5.5
Water Soluble Nitrate (2:1) as NO ₃ (leachate equivalent)	mg/l	5	NONE	< 5.0	< 5.0	< 5.0

Total Phenols

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

This certificate should not be reproduced, except in full, without the express permission of the laboratory

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

Iss No 24-013057-2-Uom The Limes Relocation 33445 FR.xlsm

Page 8 of 17

Lab Sample Number	165357	165358	165359
Sample Reference	BH01	WS10	WS10
Sample Number	1	1	2
Depth (m)	0.60	0.30	0.50
Date Sampled	02/04/2024	02/04/2024	02/04/2024
Time Taken	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status

Naphthalene	mg/kg	0.05	MCERTS	-	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	-
Acenaphthene	mg/kg	0.05	MCERTS	-	-	-
Fluorene	mg/kg	0.05	MCERTS	-	-	-
Phenanthrene	mg/kg	0.05	MCERTS	-	-	-
Anthracene	mg/kg	0.05	MCERTS	-	-	-
Fluoranthene	mg/kg	0.05	MCERTS	-	-	-
Pyrene	mg/kg	0.05	MCERTS	-	-	-
Benz(a)anthracene	mg/kg	0.05	MCERTS	-	-	-
Chrysene	mg/kg	0.05	MCERTS	-	-	-
Benz(b)fluoranthene	mg/kg	0.05	150 170/25	-	-	-
Benz(k)fluoranthene	mg/kg	0.05	150 170/25	-	-	-
Benz(a)pyrene	mg/kg	0.05	MCERTS	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	-
Benz(ghi)perylene	mg/kg	0.05	MCERTS	-	-	-

Total PAH			
Speciated Total EPA-16 PAHs	mg/kg	ISO 17025	-
	0.8	-	-

Heavy Metals / Metalloids									
Arsenic (agua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-	-
Beryllium (agua regia extractable)	mg/kg	0.06	MCERTS	-	-	-	-	-	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-	-	-	-	-	-
Cadmium (agua regia extractable)	mg/kg	0.2	MCERTS	-	-	-	-	-	-
Chromium (hexavalent)	mg/kg	1.8	MCERTS	-	-	-	-	-	-
Chromium (III)	mg/kg	1	NONE	-	-	-	-	-	-
Chromium (agua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-	-
Copper (agua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-	-
Lead (agua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-	-
Mercury (agua regia extractable)	mg/kg	0.3	MCERTS	-	-	-	-	-	-
Nickel (agua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-	-
Selenium (agua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-	-
Vanadium (agua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-	-
Zinc (agua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-	-
Magnesium (leachate equivalent)	mg/l	2.5	NONE	11	6.2	11			
Magnesium (water soluble)	mg/kg	5	NONE	21	13	21			

Lab Sample Number	165357	165358	165359
Sample Reference	BH01	WS10	WS10
Sample Number	1	1	2
Depth (m)	0.60	0.30	0.50
Date Sampled	02/04/2024	02/04/2024	02/04/2024
Time Taken	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)			
Units	Limit of detection	Accreditation Status	
Petroleum Hydrocarbons			
TPHOMG - Aliphatic > C5 - C6 HS, ID, AL	mg/kg	0.02	NONE
TPHOMG - Aliphatic > C6 - C8 HS, ID, AL	mg/kg	0.02	NONE
TPHOMG - Aliphatic > C8 - C10 HS, ID, AL	mg/kg	0.05	NONE
TPHOMG - Aliphatic > C10 - C12 HL, CL, ID, AL	mg/kg	1	MCERTS
TPHOMG - Aliphatic > C12 - C16 HL, CL, ID, AL	mg/kg	2	MCERTS
TPHOMG - Aliphatic > C16 - C21 HL, CL, ID, AL	mg/kg	8	MCERTS
TPHOMG - Aliphatic > C21 - C35 HL, CL, ID, AL	mg/kg	10	MCERTS
TPHOMG - Aliphatic > C35 - C44 HL, CL, ID, AL	mg/kg	8.4	NONE
TPHOMG - Aliphatic > C5 - C35 HL, CL+HS, ID, AL	mg/kg	10	NONE
TPHOMG - Aliphatic > C5 - C44 HL, CL+HS, ID, AL	mg/kg	10	NONE
VOCs			
TPHOMG - Aromatic > EC5 - EC7 HS, ID, AR	mg/kg	0.01	NONE
TPHOMG - Aromatic > EC7 - EC8 HS, ID, AR	mg/kg	0.01	NONE
TPHOMG - Aromatic > EC8 - EC10 HS, ID, AR	mg/kg	0.05	NONE
TPHOMG - Aromatic > EC10 - EC12 HL, CL, ID, AR	mg/kg	1	MCERTS
TPHOMG - Aromatic > EC12 - EC16 HL, CL, ID, AR	mg/kg	2	MCERTS
TPHOMG - Aromatic > EC16 - EC21 HL, CL, ID, AR	mg/kg	10	MCERTS
TPHOMG - Aromatic > EC21 - EC35 HL, CL, ID, AR	mg/kg	10	MCERTS
TPHOMG - Aromatic > EC35 - EC44 HL, CL, ID, AR	mg/kg	8.4	NONE
TPHOMG - Aromatic > EC5 - EC35 HL, CL+HS, ID, AR	mg/kg	10	NONE
TPHOMG - Aromatic > EC5 - EC44 HL, CL+HS, ID, AR	mg/kg	10	NONE
TPH Total > C5 - C44 HL, CL+HS, ID, TOTAL	mg/kg	10	NONE
VOCs			
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE
Benzene	µg/kg	5	MCERTS
Toluene	µg/kg	5	MCERTS
Ethylbenzene	µg/kg	5	MCERTS
p & m-Xylene	µg/kg	5	MCERTS
o-Xylene	µg/kg	5	MCERTS

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

Analytical Report Number: 24-013057

Project / Site name: UoM The Limes Relocation

Your Order No: P033404

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

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

Quantitative Analysis

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

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

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

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
165349	WS08	0.30	112	Loose Fibres	Amosite	< 0.001	< 0.001

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

Analytical Report Number : 24-013057

Project / Site name: UoM The Limes Relocation

* 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 *
165347	BH02	1	0.4	Brown loam with gravel
165348	WS07	1	0.4	Brown clay
165349	WS08	1	0.3	Brown loam with gravel
165350	WS09	1	1	Brown gravelly clay with stones
165351	WS09	2	1.2	Brown clay and sand
165352	WS01	1	0.4	Brown clay and sand with gravel
165353	WS03	1	0.4	Brown clay and sand with stones
165354	WS02	2	0.9	Brown clay and sand
165355	WS05	1	0.4	Brown clay and sand
165356	BH02	2	0.5	Brown clay and sand
165357	BH01	1	0.6	Brown clay and sand
165358	WS10	1	0.3	Brown loam with gravel
165359	WS10	2	0.5	Brown clay and sand

Analytical Report Number : 24-013057

Project / Site name: UoM The Limes Relocation

Water matrix abbreviations:

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos Identification in Soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques	In-house method based on HSG 248, 2021	A001B	D	ISO 17025
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in house method based on references	HSE Report No: 83/1996, HSG 248 (2021), HSG 264 (2012) & SCA Blue Book (draft)	A006B	D	ISO 17025
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	LO19B	W	NONE
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.	LO19B	D	NONE
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES	In-house method based on MEVAM 2006 Methods for the Determination of Metals in Soil	LO38B	D	MCERTS
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES	In-house method based on Second Site Properties version 3	LO38B	D	MCERTS
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	LO38B	D	NONE
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES	In-house method	LO38B	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Sulphate, water soluble, in soil (16hr extraction)	In-house method	LO38B	D	MCERTS
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES	In-house method	LO38B	D	MCERTS
Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds (including PAH) in soil by extraction in dichloromethane and hexane followed by GC-MS	In-house method based on USEPA 8270	LO64B	D	MCERTS
TPH Chromatogram in soil	TPH Chromatogram in soil	In-house method	LO64B	D	NONE
BTEX and/or Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS	In-house method based on USEPA 8260	LO73B	W	MCERTS
Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	LO76B/LO88	D/W	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, Z.1 extraction	LO78	W	NONE
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, Z.1 extraction	LO78	W	NONE
Chromium III in soil	In-house method by calculation from total Cr and Cr VI	In-house method by calculation	LO80	W	NONE

Analytical Report Number : 24-013057

Project / Site name: UoM The Limes Relocation

Water matrix abbreviations:

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5-diphenylcarbazide followed by colorimetry	In-house method	L080	W	MCERTS
Free cyanide in soil	Determination of free cyanide by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	MCERTS
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	L080	W	MCERTS
Chloride, water soluble, in soil	Determination of Chloride colorimetrically by discrete analyser	In-house method	L082B	D	MCERTS
Ammonium as NH4 in soil	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method, 10:1 water extraction.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082B	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement	In-house method	L099	D	MCERTS

This certificate should not be reproduced, except in full, without the express permission of the laboratory

This certificate should not be reproduced, except in full, without the express permission of the laboratory

Project / Site name: UoM The Limes Relocation

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

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).

the client. The instructed on date indicates the date on which this information was provided to the laboratory.

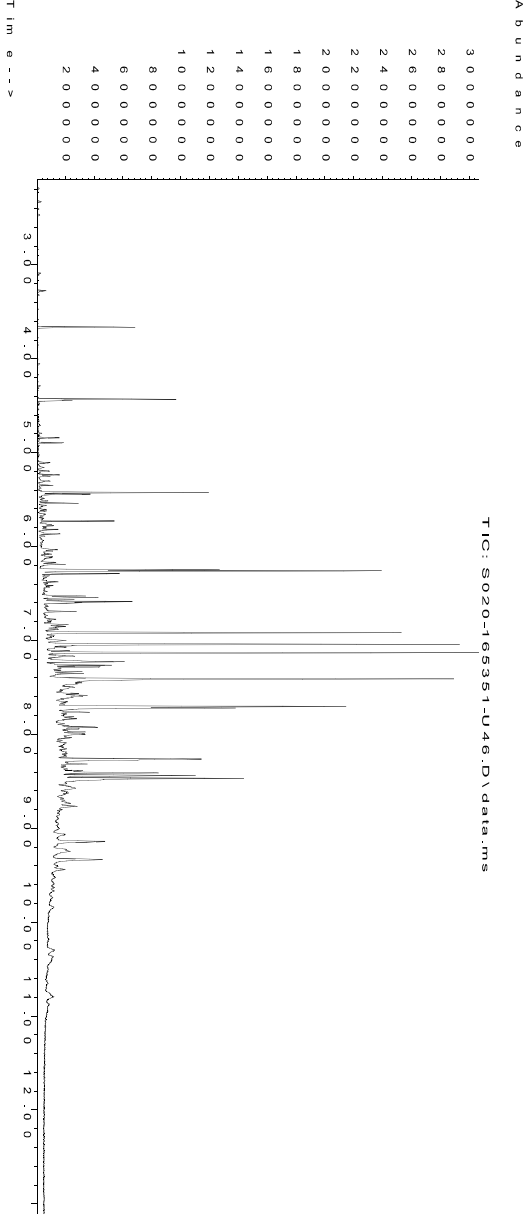
List of HWOL Acronyms and Operators

Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

with caution

calibration range despite high dilution, concentration determined by extrapolated calibration. The result should be interpreted with caution





Hydrock Consultants Ltd
4 Lakeside
Festival Park
Stoke on Trent
ST1 5RY

t: 01782 261919
e: Russellsummer@hydrock.com



i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS
t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 24-012825

Project / Site name:	UoM The Limes Relocation	Samples received on:	08/04/2024
Your job number:	33445	Samples instructed on/ Analysis started on:	08/04/2024
Your order number:	PO33404	Analysis completed by:	15/04/2024
Report Issue Number:	1	Report issued on:	15/04/2024
Samples Analysed:	1 soil sample		

Signed:

Izabela Wójcik
Senior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

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

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report are representative of the samples submitted for analysis.

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report are representative of the samples submitted for analysis.



Analytical Report Number: 24-012825
Project / Site name: UoM The Limes Relocation

Lab Sample Number	164287		
Sample Reference	BH02		
Sample Number	9		
Depth (m)	4.50-5.00		
Date Sampled	02/04/2024		
Time Taken	None Supplied		
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status

Stone Content	%	0.1	NONE	< 0.1
Moisture Content	%	0.01	NONE	6.9
Total mass of sample received	kg	0.1	NONE	0.5

General Inorganics

pH (1099)	pH Units	N/A	MCERTS	8.3
Total Sulphate as SO ₄	%	0.005	MCERTS	0.018
Water Soluble Sulphate as SO ₄ , 16hr extraction (2:1)	mg/kg	2.5	MCERTS	55
Water Soluble SO ₄ , 16hr extraction (2:1 Leadrate Equivalent)	mg/l	1.25	MCERTS	27.4
Total Sulphur	mg/kg	50	MCERTS	110
Total Sulphur	%	0.005	MCERTS	0.011

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



Analytical Report Number : 24-012825
Project / Site name: UoM The Limes Relocation

* 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 *
164287	BH02	9	4.50-5.00	Brown clay and sand with gravel





Analytical Report Number : 24-012825

Project / Site name: UoM The Limes Relocation

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L0198	W	NONE
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	L0198	D	NONE
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES	In-house method	L0388	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Sulphate, water soluble, in soil (16hr extraction)	In-house method	L0388	D	MCERTS
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES	In-house method	L0388	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electronic measurement	In-house method	L099	D	MCERTS

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL' or 'B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 300C.
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.



Hydrock Consultants Ltd
4 Lakeside
Festival Park
Stoke on Trent
ST1 5RY

t: 01782 261919
e: Russellsumner@hydrock.com

Analytical Report Number : 24-015315

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS
t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com



Project / Site name:	UoM The Limes Relocation	Samples received on:	22/04/2024
Your job number:	33445	Samples instructed on/ Analysis started on:	22/04/2024
Your order number:	PO33517	Analysis completed by:	25/04/2024
Report Issue Number:	1	Report issued on:	26/04/2024
Samples Analysed:	1 water sample		

Anna Goc
Signed: _____

Anna Goc
PL Head of 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
Excel copies of reports are only valid when accompanied by this PDF certificate.

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

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report are representative of the samples submitted for analysis.

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 24-015315
Project / Site name: UoM The Limes Relocation

Your Order No: PO33517

Lab Sample Number	176564		
Sample Reference	WS08		
Sample Number	EW1		
Depth (m)	1.14		
Date Sampled	18/04/2024		
Time Taken	None Supplied		
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status

General Inorganics

pH (LO99)	pH Units	N/A	ISO 17025	6.8
Electrical Conductivity at 20°C	µS/cm	10	ISO 17025	920
Total Cyanide (Low Level 1 µg/l)	µg/l	1	NONE	< 1.0
Free Cyanide (Low Level 1 µg/l)	µg/l	1	NONE	< 1.0
Sulphate as SO ₄	mg/l	0.045	ISO 17025	69.9
Chloride	mg/l	0.15	ISO 17025	45
Fluoride	µg/l	50	ISO 17025	100
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	2000
Ammoniacal Nitrogen as NH ₃	µg/l	15	ISO 17025	2400
Ammoniacal Nitrogen as NH ₄ ⁺	µg/l	15	ISO 17025	2600
Dissolved Organic Carbon (DOC)	mg/l	0.1	ISO 17025	22.4
Nitrate as N	mg/l	0.01	ISO 17025	0.02
Nitrate as NO ₃	mg/l	0.05	ISO 17025	0.1
Nitrite as NO ₂	µg/l	5	ISO 17025	28
Hardness - Total	mgCaCO ₃ /l	1	ISO 17025	528
Bromate by IC	mg/l	0.002	ISO 17025	< 0.002

Total Phenols

Total Phenols (Monohydric) Low Level	µg/l	1	NONE	< 1.0
--------------------------------------	------	---	------	-------

Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01

PAH Sums

Sum of Benzo(b)fluoranthene & Benzo(k)fluoranthene	µg/l	0.02	NONE	< 0.020
Sum of Benzo(ghi)perylene & Indeno(1,2,3-cd)pyrene	µg/l	0.02	NONE	< 0.020
Sum of Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(ghi)perylene & Indeno(1,2,3-cd)pyrene	µg/l	0.04	NONE	< 0.040

Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16
-------------------	------	------	-----------	--------

Analytical Report Number: 24-015315
Project / Site name: UoM The Limes Relocation

Your Order No: PO33517

Lab Sample Number	176564		
Sample Reference	WS08		
Sample Number	EW1		
Depth (m)	1.14		
Date Sampled	18/04/2024		
Time Taken	None Supplied		
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status

Heavy Metals / Metalloids

Aluminium (dissolved)	µg/l	1	ISO 17025	220
Antimony (dissolved)	µg/l	0.4	ISO 17025	1.9
Arsenic (dissolved)	µg/l	0.15	ISO 17025	1.3
Barium (dissolved)	µg/l	0.06	ISO 17025	71
Cadmium (dissolved)	µg/l	0.02	ISO 17025	< 0.02
Chromium (dissolved)	µg/l	0.2	ISO 17025	0.5
Cobalt (dissolved)	µg/l	0.2	ISO 17025	1.7
Copper (dissolved)	µg/l	0.5	ISO 17025	0.5
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2
Manganese (dissolved)	µg/l	0.05	ISO 17025	1700
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	5.6
Selenium (dissolved)	µg/l	0.6	ISO 17025	3.5
Silver (dissolved)	µg/l	0.05	NONE	< 0.05
Tin (dissolved)	µg/l	0.2	ISO 17025	< 0.20
Vanadium (dissolved)	µg/l	0.2	ISO 17025	0.4
Zinc (dissolved)	µg/l	0.5	ISO 17025	2.2

Boron (dissolved)	µg/l	10	ISO 17025	86
Calcium (dissolved)	mg/l	0.012	ISO 17025	150
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0
Chromium (III)	µg/l	5	NONE	< 5.0
Iron (dissolved)	mg/l	0.004	ISO 17025	0.079
Sodium (dissolved)	mg/l	0.01	ISO 17025	33

Analytical Report Number: 24-015315
Project / Site name: UoM The Limes Relocation

Your Order No: PO33517

Lab Sample Number	176564		
Sample Reference	WS08		
Sample Number	EW1		
Depth (m)	1.14		
Date Sampled	18/04/2024		
Time Taken	None Supplied		
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status

Heavy Metals / Metalloids

Aluminium (dissolved)	µg/l	1	ISO 17025	220
Antimony (dissolved)	µg/l	0.4	ISO 17025	1.9
Arsenic (dissolved)	µg/l	0.15	ISO 17025	1.3
Barium (dissolved)	µg/l	0.06	ISO 17025	71
Cadmium (dissolved)	µg/l	0.02	ISO 17025	< 0.02
Chromium (dissolved)	µg/l	0.2	ISO 17025	0.5
Cobalt (dissolved)	µg/l	0.2	ISO 17025	1.7
Copper (dissolved)	µg/l	0.5	ISO 17025	0.5
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2
Manganese (dissolved)	µg/l	0.05	ISO 17025	1700
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	5.6
Selenium (dissolved)	µg/l	0.6	ISO 17025	3.5
Silver (dissolved)	µg/l	0.05	NONE	< 0.05
Tin (dissolved)	µg/l	0.2	ISO 17025	< 0.20
Vanadium (dissolved)	µg/l	0.2	ISO 17025	0.4
Zinc (dissolved)	µg/l	0.5	ISO 17025	2.2

Boron (dissolved)	µg/l	10	ISO 17025	86
Calcium (dissolved)	mg/l	0.012	ISO 17025	150
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0
Chromium (III)	µg/l	5	NONE	< 5.0
Iron (dissolved)	mg/l	0.004	ISO 17025	0.079
Sodium (dissolved)	mg/l	0.01	ISO 17025	33

Analytical Report Number: 24-015315

Project / Site name: UoM The Limes Relocation

Your Order No: PO33517

Lab Sample Number	176564		
Sample Reference	WS08		
Sample Number	EW1		
Depth (m)	1.14		
Date Sampled	18/04/2024		
Time Taken	None Supplied		
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status

Petroleum Hydrocarbons			
TPH - Aliphatic >C5 - C6 _{HS} ID _{AL}	µg/l	1	ISO 17025
TPH - Aliphatic >C6 - C8 _{HS} ID _{AL}	µg/l	1	ISO 17025
TPH - Aliphatic >C8 - C10 _{HS} ID _{AL}	µg/l	1	ISO 17025
TPH - Aliphatic >C10 - C12 _{HS} ID _{AL}	µg/l	10	NONE
TPH - Aliphatic >C12 - C16 _{HS} ID _{AL}	µg/l	10	NONE
TPH - Aliphatic >C16 - C21 _{HS} ID _{AL}	µg/l	10	NONE
TPH - Aliphatic >C21 - C35 _{HS} ID _{AL}	µg/l	10	NONE
TPH - Aliphatic >C5 - C35 _{HS+HS} ID _{AL}	µg/l	10	NONE
TPH - Aliphatic >C16 - C35 _{HS} ID _{AL}	µg/l	10	NONE
TPH - Aliphatic >C21 - C44 _{HS} ID _{AL}	µg/l	20	NONE
TPH - Aliphatic >C35 - C44 _{HS} ID _{AL}	µg/l	10	NONE
TPH - Aliphatic >C40 - C44 _{HS} ID _{AL}	µg/l	10	NONE
TPH - Aliphatic >C5 - C44 _{HS+HS} ID _{AL}	µg/l	10	NONE

TPH - Aromatic >EC5 - EC7 _{HS} ID _{AR}	µg/l	1	ISO 17025
TPH - Aromatic >EC7 - EC8 _{HS} ID _{AR}	µg/l	1	ISO 17025
TPH - Aromatic >EC8 - EC10 _{HS} ID _{AR}	µg/l	1	ISO 17025
TPH - Aromatic >EC10 - EC12 _{HS} ID _{AR}	µg/l	10	NONE
TPH - Aromatic >EC12 - EC16 _{HS} ID _{AR}	µg/l	10	NONE
TPH - Aromatic >EC16 - EC21 _{HS} ID _{AR}	µg/l	10	NONE
TPH - Aromatic >EC21 - EC35 _{HS} ID _{AR}	µg/l	10	NONE
TPH - Aromatic >EC5 - EC35 _{HS+HS} ID _{AR}	µg/l	10	NONE
TPH - Aromatic >EC21 - EC44 _{HS} ID _{AR}	µg/l	20	NONE
TPH - Aromatic >EC35 - EC44 _{HS} ID _{AR}	µg/l	10	NONE
TPH - Aromatic >EC40 - EC44 _{HS} ID _{AR}	µg/l	10	NONE
TPH - Aromatic >EC40 - EC44 _{HS} ID _{AR}	µg/l	10	NONE
TPH - Aromatic >EC5 - EC44 _{HS+HS} ID _{AR}	µg/l	10	NONE

TPH Total >C5 - C44 _{HS+HS} ID _{TOTAL}	µg/l	10	NONE
			< 10

VOCs			
MTBE (Methyl Tertiary Butyl Ether)	µg/l	3	ISO 17025
Benzene	µg/l	3	ISO 17025
Toluene	µg/l	3	ISO 17025
Ethylbenzene	µg/l	3	ISO 17025
p & m-xylene	µg/l	3	ISO 17025
o-xylene	µg/l	3	ISO 17025

Sum of m, p & o-Xylene	µg/l	3	NONE
			< 3.0

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

Analytical Report Number : 24-015315

Project / Site name: UoM The Limes Relocation

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Bromate in water by IC	Determination of bromate in waters based on ion chromatography. Accredited matrices GW, PW, SW	In-house method based on Standard Methods for the Analysis of Water and Waste Water, method 4500	L008B	W	ISO 17025
Exotic metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW	In-house method based on USEPA Method 6020 & 200.8 for the determination of trace elements in water by ICP-MS	L012B	W	NONE
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW	In-house method based on USEPA Method 6020 & 200.8 for the determination of trace elements in water by ICP-MS	L012B	W	ISO 17025
Electrical conductivity at 20°C of water	Determination of electrical conductivity in water by electromagnetic measurement. Accredited Matrices SW, GW, PW	In-house method	L031B	W	ISO 17025
Fluoride in water	Determination of fluoride in water by 1:1 ratio with a buffer solution followed by Ion Selective Electrode. Accredited matrices: SW PW, GW	In-house method based on Use of Total Ionic Strength Adjustment Buffer for Electrode Determination	L033B	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved organic carbon in water by TOC/DOC NDIR Analyser	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037B	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices: SW, GW, PW, P+W (A), Cu, Fe,Zn)	In-house method based on MEVAM 2006 Methods for the Determination of Metals in Soil	L039B	W	ISO 17025
Total Hardness of water	Determination of hardness in waters by calculation from calcium and magnesium	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L045B	W	ISO 17025
Total petroleum hydrocarbons with carbon banding by GC-MS in water	Determination of total petroleum hydrocarbons in water by GC-MS/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	L070B	W	NONE
TPH Chromatogram in water	TPH Chromatogram in water	In-house method	L070B	W	NONE
BTEX and/or Volatile organic compounds in water	Determination of volatile organic compounds in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA 8260	L073B	W	ISO 17025
Nitrate as N in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L078	W	ISO 17025
Nitrate in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L078	W	ISO 17025
Chromium III in water	In-house method by calculation from total Cr and Cr VI	In-house method by calculation	L080	W	NONE
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW	L080	W	ISO 17025
Free cyanide (low level) in water	Determination of free cyanide by distillation followed by colorimetry.Accredited matrices SW, GW, PW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	NONE
Monohydric Phenols (low level) in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	NONE



4041

Analytical Report Number : 24-015315

Project / Site name: UoM The Limes Relocation

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Total cyanide (low level) in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	NONE
Chloride in water	Determination of Chloride colorimetrically by discrete analyser	In-house based on MEVAM Method ISBN 0117516260. Accredited matrices: SW,PW, GW,FSE,LL	L082B	W	ISO 17025
Ammonia as NH3 in water	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082B	W	ISO 17025
Ammonium as NH4 in water	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082B	W	ISO 17025
Nitrite in water	Determination of nitrite in water by addition of sulphanilamide and NED followed by discrete analyser (colorimetry). Accredited matrices SW, GW, PW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082B	W	ISO 17025
Total petroleum hydrocarbons by GC-MS HS in water	Determination of total petroleum hydrocarbons in water by GC-MS HS	In-house method	L088	W	ISO 17025
pH at 20°C in water (automated)	Determination of pH in water by electronic measurement. Accredited matrices: SW PW GW	In-house method	L099	W	ISO 17025
Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in water	Determination of semi-volatile organic compounds (including PAH) in leachate by extraction in dichloromethane followed by GC-MS	In-house method based on USEPA 8270	L102B	W	ISO 17025
Ammoniacal Nitrogen as N in water	Determination of Ammonium/Ammonia/Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method. Accredited matrices SW, GW, PW, FSE, LL	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082B	W	ISO 17025
Sulphate in water	Determination of sulphate in water after filtration by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PW, LL	In-house method based on MEVAM 2006 Methods for the Determination of Metals in Soil	L039B	W	ISO 17025

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL' or 'B' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 300C.
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



4041

Analytical Report Number : 24-015315

Project / Site name: UoM The Limes Relocation

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
#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				



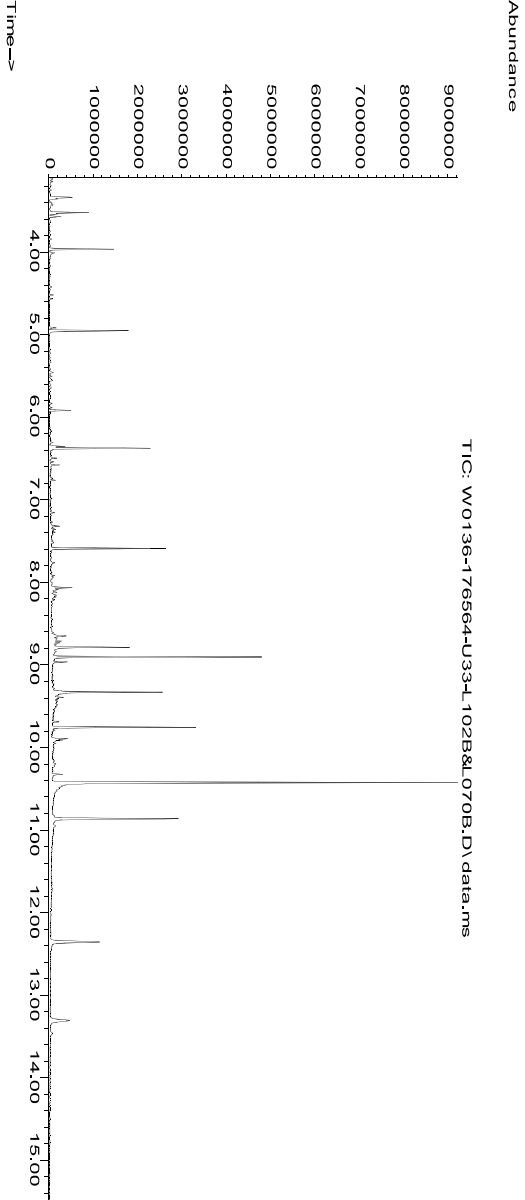
4041

Analytical Report Number : 24-015315

Project / Site name: UoM The Limes Relocation

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
#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				



Analytical Report Number : 24-015315

Project / Site name: UoM The Limes Relocation

This deviation report indicates the sample and test deviations that apply to the samples submitted for analysis. Please note that the associated result(s) may be unreliable and should be interpreted with care.

Key: a - No sampling date b - Incorrect container c - Holding time d - Headspace e - Temperature

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
WS08	EW1	W	176564	c	Ammonia as NH3 in water	L082B	c
WS08	EW1	W	176564	c	Ammoniacal Nitrogen as N in water	L082B	c
WS08	EW1	W	176564	c	Ammonium as NH4 in water	L082B	c
WS08	EW1	W	176564	c	Electrical conductivity at 20°C of water	L031B	c
WS08	EW1	W	176564	c	pH at 20°C in water (automated)	L099	c

GAC Derivation

Background

Initially, the Hydrock GAC were derived following the publishing of soil guideline values (SGV), toxicological (TOX) reports and associated publications by the Environment Agency (EA) in 2009 referenced under Science Report SC050021 (EA, 2009a, b, c, d). The Hydrock GAC have then been periodically updated following publication of new information on toxicological, physico-chemical, land use or receptor parameters, namely:

- » LQM/CIEH, 2009. LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment, second edition. Nathaniel, C. P., McCaffrey, C., Ashmore, M., Cheng, Y., Gillet, A. G., Ogden, R. C. and Scott, D.
- » CL:AIRE, 2010. 'The EIC/AGS/CL:AIRE Soil Generic Assessment Criteria for Human Health Risk Assessment'. Environmental Industries Commission, The Association of Geotechnical and Geoenvironmental Specialists and Contaminated Land: Applications in Real Environment.
- » CL:AIRE, 2014. 'Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination', Revision 2, DEFRA research project SP1010. Contaminated Land: Applications in Real Environment.
- » LQM/CIEH, 2015. 'The LQM/CIEH S4ULs for Human Health Risk Assessment'. Nathaniel, C. P., McCaffrey, C., Gillet, A. G., Ogden, R. C. and Nathaniel, J. F.
- » CL:AIRE, 2021-2024. 'C4SL Phase 2 Technical Reports'. Contaminated Land: Applications in Real Environment.
- » CL:AIRE, 2022. C4SL Phase 2 Technical Report for 1,2-dichloroethane. Contaminated Land: Applications in Real Environment.
- » CL:AIRE, 2024. C4SL Phase 2 Technical Reports for cis-1,2-dichloroethene, trans-1,2-dichloroethene and naphthalene. Contaminated Land: Applications in Real Environment.

Land use scenarios

Hydrock has derived generic assessment criteria (GAC) for human health based on the six exposure scenarios defined in CL:AIRE (2014) using generic default assumptions from published guidance. GAC for each exposure scenario have been derived for three soil organic matter (SOM) contents, 1%, 2.5% and 6%.

All GAC have been rounded to two significant figures.

Exposure parameters

The exposure parameters used for the Hydrock GAC are the default parameters stated in SR3, unless updated in CL:AIRE (2014) where the CL:AIRE (2014) values have been adopted.

Approach to consumption rates

Hydrock have adopted the 90th percentile consumption rates from Table 3.4 of CL:AIRE (2014) for all produce types. This is noted to be more conservative than the "top two" approach taken in the derivation of C4SLs.

Approach to plant uptake for GAC omitted in CL:AIRE (2010)

Plant uptake factors were not identified in CL:AIRE (2010) for antimony, barium and molybdenum. Hydrock has sourced the required parameter values from ORNL (1984) in order to derive GAC that are inclusive of the homegrown produce exposure pathway.

Chemical and toxicity parameters

The chemical and toxicity parameters have been adopted based on the following documents:

- » IRIS, 2016. 'Toxicological Review of Trimethylbenzenes'. Integrated Risk Information System, National Centre for Environmental Assessment, office of Research and Development, U.S. Environmental Protection Agency.
- » LQM/CIEH, 2015.

» ORNL, 1984. 'ORNL-5786. A Review and Analysis of Parameters for Assessing Transport of Environmentally released Radionuclides through Agriculture'. Oak Ridge National Laboratory.

» CL:AIRE, 2010.

» RIVM, 2001. RIVM Report 711701 025 'HCV Re-evaluation of human-toxicological maximum-permissible risk levels'. National Institute of Public Health and the Environment.

» LQM/CIEH, 2009.

» EA, 2009a.

Approach to Cyanide GAC

The Hydrock GAC for free cyanide have been derived based on ingestion of a bolus of contaminated soil. The GAC are derived for acute exposure of a child (0-6 years old) for all land uses except commercial, where the GAC are derived for acute exposure of an adult (16-65 years old). For the purpose of GQRA, the child value may be adopted for all land use scenarios.

For complex cyanide, the GAC have been derived based on chronic exposure, using the default exposure scenarios but excluding the consumption of homegrown produce, soil attached to homegrown produce, indoor vapour and outdoor vapour pathways. The chronic health criteria value (HCV) for complex cyanide is based on the EA (2009a) HCV for free cyanide and the ratio of toxicity between free and complex cyanide proposed by RIVM (2001).

Approach to Phenol GAC

In accordance with the EA Science Report SC050021 / Phenol SGV, a GAC_{ing/inh} has been derived for ingested and inhaled phenol using the CLEA model, with a GAC_{derm} derived for dermal contact using Equation 5.7 within SR3. The lower of the GAC_{ing/inh} and GAC_{derm} has been adopted as the final GAC.

Approach to PCB GAC

GAC for assessing the non-dioxin-like risk from PCBs have been based on the "Dutch 7". As the TDI used by the authors of the Dutch guidance is for the sum of the 7 individual congeners, the TDI has been divided by 7 to create a TDI for each congener. The non-dioxin-like risk from PCBs is therefore assessed using a Hazard Index approach as for total petroleum hydrocarbons (TPH).

Sub-surface soil to indoor air correction factors

Reflecting the approach taken by the Environment Agency in the development of revised SGV in 2009 for BTEX, a sub-surface soil to indoor air correction factor of 10 has been applied for petroleum hydrocarbons in order to account for over-prediction of vapour intrusion into building using the Johnson and Ettinger approach.

The correction factor of 10 has been applied to the following petroleum hydrocarbons (it makes negligible difference to less volatile TPH and PAH compounds):

- » TPHCWG fractions, namely aliphatic EC>5-44 and aromatic EC>6-44;
- » PAHs (acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene), benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h,)anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, pyrene);
- » BTEX;
- » Isopropylbenzene;
- » Propylbenzene;
- » 1,2,4- and 1,3,5-trimethylbenzene; and
- » Styrene.

Approach to saturation limits

The CLEA model includes a traffic light colour system to highlight when saturated soil conditions have potentially been exceeded for the vapour pathways during calculation of assessment criteria. The colours represent:

- » Green: the assessment criteria do not exceed the saturated soil concentration.
- » Amber: the assessment criteria exceed the saturated soil concentration but the contribution of the indoor and outdoor vapour pathway to total exposure is less than 10% and will not significantly affect the assessment criteria.
- » Red: the assessment criteria exceed the saturated soil concentration and the contribution of the indoor and outdoor vapour pathway to total exposure is greater than 10% and will significantly affect the assessment criteria.

Hydrock have not applied any further calculations or assessment in relation to saturation limits during GAC derivation, with the CLEA-modelled GAC being presented as the GAC. Consideration of saturation limits is undertaken during the data assessment stage.

References

CL:AIRE, 2010. 'The EIC/AGS/CL:AIRE Soil Generic Assessment Criteria for Human Health Risk Assessment'. Environmental Industries Commission, The Association of Geotechnical and Geoenvironmental Specialists and Contaminated Land: Applications in Real Environment.

CL:AIRE, 2014. 'Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination', Revision 2, DEFRA research project SP1010. Contaminated Land: Applications in Real Environment

CL:AIRE, 2021-2024. C4SL Phase 2 Technical Reports for tetrachloroethene, trichloroethene and vinyl chloride. Contaminated Land: Applications in Real Environment.

CL:AIRE, 2022. C4SL Phase 2 Technical Report for 1,2-dichloroethane. Contaminated Land: Applications in Real Environment.

CL:AIRE, 2024. C4SL Phase 2 Technical Reports for cis-1,2-dichloroethene, trans-1,2-dichloroethene and naphthalene. Contaminated Land: Applications in Real Environment.

EA, 2009a. 'Science Reports SC050021 – SGV and TOX reports for: benzene, toluene, ethylbenzene, xylene, arsenic, nickel, mercury, selenium, cadmium, inorganic cyanide, phenol, dioxins, furans and dioxin-like PCBs'; 'Supplementary information for the derivation of SGV for: benzene, toluene, ethylbenzene, xylene, arsenic, nickel, mercury, selenium, cadmium, inorganic cyanide, phenol, dioxins, furans and dioxin-like PCBs', and 'Contaminants in soil: updated collation of toxicological data and intake values for humans: benzene, toluene, ethylbenzene, xylene, arsenic, nickel, mercury, selenium, cadmium, inorganic cyanide, phenol, dioxins, furans and dioxin-like PCBs'. Environment Agency.

EA, 2009b. 'Science Report – SC050021/SR2. Human health toxicological assessment of contaminants in soil'. Environment Agency.

EA, 2009c. 'Science Report – SC050021/SR3. Updated technical background to the CLEA model'. Environment Agency.

EA, 2009d. 'Science Report – SC050021/SR4. CLEA Software (version 1.05) Handbook'. Environment Agency.

IRIS, 2016. 'Toxicological Review of Trimethylbenzenes'. Integrated Risk Information System, National Centre for Environmental Assessment, office of Research and Development, U.S. Environmental Protection Agency.

LQM/CIEH, 2009. LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment, second edition. Nathaniel, C. P., McCaffrey, C., Ashmore, M., Cheng, Y., Gillet, A. G., Ogden, R. C. and Scott, D.

LQM/CIEH, 2015. 'The LQM/CIEH S4ULs for Human Health Risk Assessment'. Nathaniel, C. P., McCaffrey, C., Gillet, A. G., Ogden, R. C. and Nathaniel, J. F.

ORNL, 1984. 'ORNL-5786. A Review and Analysis of Parameters for Assessing Transport of Environmentally released Radionuclides through Agriculture'. Oak Ridge National Laboratory.

RIVM, 2001. RIVM Report 711701 025 'HCV Re-evaluation of human-toxicological maximum-permissible risk levels'. National Institute of Public Health and the Environment.

Human Health GQRA

Assessment of Chemicals of Potential Concern to Human Health

Risk parameter: Client: Site: Job no.: Lab. report no(s):														Default - Human Health - POSresi (1%SOM)										Data Filters										Hydrock										W500-0.3										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1										W500-0.1																			
---	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--------------	--	--	--	--	--	--	--	--	--	---------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	----------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Assessment of Chemicals of Potential Concern to Human Health

[illegible]

Phytotoxic GQRA

Assessment of Chemicals of Potential Concern to Plant Life

Risk parameter:

Client:

Site:

Job no.:

Lab. report no(s).:

Phytotoxic pH >7

University of Manchester

The Limes, Manchester

33445

24-013057-2

Data Filters

Zone

Strata

Depth Min (m bgl)

Depth Max (m bgl)

All

All

0.3

1.2

Hydrock

BH02 @ 0.4 WSo8 @ 0.3 WSo9 @ 1 WSo1 @ 0.4 WSo1 @ 0.4 WSo5 @ 0.4 WSo7 @ 0.4 WSo9 @ 1.2 WSo2 @ 0.9

Dataset mean pH

Scenario pH

8.21

>7

All values in mg/kg unless otherwise stated

CAS No / P Code	Chemical of Potential Concern	Units	LoD	No. Samples	Min. Value	Max. Value	Mean	Median	Standard Deviation	No. Samples >= GAC & > LoD	GAC	GAC Source	Strata	MG	MG	MG	MG	MG	MG	GT	GT	GT	
-	Hydrock Default Suite - FOC / SOM / pH																						
P1334	pH (su)	pH Units	0.1	8	7.20	10.10	8.21	7.90	1.12		-	-		8.1	8		9.8	10.1	7.4	7.3	7.2	7.8	
-	Hydrock Default Suite - Metals & PAH																						
7440-38-2	Arsenic	mg/kg	1	8	8.30	46.00	24.54	24.50	13.94	0	250	MAFF 1998		29	31		39	20	13	8.3	10	46	
7440-42-8	Boron	mg/kg	0.2	8	0.30	2.00	1.00	0.85	0.52	0	5	Nable, et al. 1997		1.4	0.8		0.9	1.2	0.7	0.7	2	0.3	
16065-83-1	Chromium (III)	mg/kg	1	8	18.00	26.00	21.38	21.00	2.77	0	400	MAFF 1998 (Cr(T))		19	21		26	18	23	19	24	21	
18540-29-9	Chromium (VI)	mg/kg	1.8	8	1.80	1.80	1.80	1.80	0.00	0	25	ICRCL 70/90 1990		<1.8	<1.8		<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	
7440-50-8	Copper	mg/kg	1	8	15.00	160.00	56.88	43.00	48.14	0	200	BS3882 2015		64	85		160	54	24	15	21	32	
7440-02-0	Nickel	mg/kg	1	8	19.00	43.00	26.88	23.50	9.61	0	110	BS3882 2015		28	40		43	25	19	19	22	19	
7440-66-6	Zinc	mg/kg	1	8	43.00	700.00	170.88	110.00	219.54	1	300	BS3882 2015		110	110		190	120	48	43	46	700	

Legend:

MG

GT

Made Ground

Glacial Till

<0.02

0.02

64.00

<10

Y

-

+

Value below the laboratory reporting limit and are considered as being at the detection limit for the purposes of statistical analysis, as a conservative estimate.

Value greater than, or equal to, the generic assessment criterion (GAC).

Value exceed saturation limit and substance is liquid or solid at ambient temperature.

Value excluded from statistical analysis

Text result

Represents a determinand that was not tested.

represents a data point that is not included in the current filter settings

Template Version:

109: 11/03/24

Controlled waters GQRA

23/05/2024, 13:55

Hydrock Scenario: Scenario A - DWS											2013/39/EU Annex I					
RTM Level: RTM Level 2 - Groundwater Beneath Source Assessment - groundwater samples											P = priority substance					
Water body receptor(s): Groundwater and surface water											PH = priority hazardous substances.					
Secondary receptor(s): Human health (abstraction)											WFD Designation (2015 Directions)					
Data set: Groundwater											OP = Other substance identical to previous legislation					
Client: University of Manchester											SP = Specific Pollutant					
Site: The Limes Relocation											JAGDAG Hazardous Substances Determination (UK)					
Job no: 33445											H Hazardous substance					
Test Certificates(s): 24-015315											NP Non-hazardous pollutant					
Dataset ALL ZONES											(blank) Not included in assessment					

CAS / AGS Number	Chemicals of Potential Concern (concentrations in µg/l)	WFD Designation	Hazardous Substance Status	Summary of Sample Data						Value Being Compared to Target = Maximum Value	Water Quality Target (Exceeded if Red)		No. Samples Exceeding Water Quality Target		No. Samples above LoD Exceeding Water Quality		Notes
				No. of Samples	No. of Samples > LoD	Limit of Detection	Minimum Value	Maximum Value	95-%ile Value		DWS		DWS		DWS		
7440-22-4	Silver (Ag) (dissolved)			1	0	0.05	<0.05	<0.05	<0.05	<0.05	n/a						
7429-90-5	Aluminium (Al) (dissolved)			1	1	0.001	220	220	220	220	200		1		1		
7440-38-2	Arsenic (As) (dissolved)	SP	H	1	1	0.15	1.3	1.3	1.3	1.3	10		0		0		
7440-42-8	Boron (B) (dissolved)		NP	1	1	10	86	86	86	86	1000		0		0		
7440-39-3	Barium (Ba) (dissolved)			1	1	0.06	71	71	71	71	1300		0		0		
7440-43-9	Cadmium (Cd) (dissolved)	PH	NP	1	0	0.02	<0.02	<0.02	<0.02	<0.02	5		0		0		
7440-48-4	Cobalt (Co) (dissolved)		NP	1	1	0.2	1.7	1.7	1.7	1.7	n/a						
18540-29-9	Chromium (VI) (Cr) (dissolved)	SP	H	1	0	5	<5	<5	<5	<5	n/a						
16065-83-1	Chromium (III) (Cr) (dissolved)	SP		1	0	5	<5	<5	<5	<5	n/a						
7440-47-3	Chromium (Cr) (total) (dissolved)			1	1	0.2	5	5	5	5	50		0		0		
7440-50-8	Copper (Cu) (dissolved)	SP	NP	1	0	0.5	<0.5	<0.5	<0.5	<0.5	2000		0		0		
7439-89-6	Iron (Fe) (dissolved)	SP		1	1	4	79	79	79	79	200		0		0		
7439-97-6	Mercury (Hg) (dissolved)	PH	H	1	1	0.005	5.6	5.6	5.6	5.6	1		1		1		
P1286	Manganese (Mn) (dissolved)	SP		1	1	0.05	1700	1700	1700	1700	50		1		1		
7440-23-5	Sodium (Na) (dissolved)			1	1	10	33000	33000	33000	33000	200000		0		0		
7440-02-0	Nickel (Ni) (dissolved)	P	NP	1	1	0.5	5.6	5.6	5.6	5.6	20		0		0		
7439-92-1	Lead (Pb) (dissolved)	P	H	1	0	0.2	<0.2	<0.2	<0.2	<0.2	10		0		0		
7440-36-0	Antimony (Sb) (dissolved)		NP	1	1	0.4	1.9	1.9	1.9	1.9	5		0		0		
7782-49-2	Selenium (Se) (dissolved)		NP	1	1	0.6	3.5	3.5	3.5	3.5	10		0		0		
7440-31-5	Tin (Sn) (dissolved)			1	0	0.2	<0.2	<0.2	<0.2	<0.2	n/a						
7440-62-2	Vanadium (V) (dissolved)			1	1	0.2	0.4	0.4	0.4	0.4	n/a						
7440-66-6	Zinc (Zn) (dissolved)	SP	NP	1	1	0.5	2.2	2.2	2.2	2.2	n/a						
P1095	Cyanide (free) (hydrogen cyanide)	SP	NP														
				1	0	1	<1	<1	<1	<1	n/a						
57-12-5	Cyanide (total)			1	0	1	<1	<1	<1	<1	50		0		0		
P1140	Ammonium (NH ₄ ⁺)		NP	1	1	15	2600	2600	2600	2600	500		1		1		
P1238	Ammoniacal Nitrogen (as N)		NP	1	1	15	2000	2000	2000	2000	n/a						
P1720	Ammonia (unionised) (NH ₃ as N) {free ammonia}	SP	NP														
				1	1	15	2400	2400	2400	2400	n/a						
15541-45-4	Bromate (BrO ₃ ⁻)			1	0	2	<2	<2	<2	<2	10		0		0		
16887-00-6	Chloride (Cl ⁻)			1	1	150	45000	45000	45000	45000	250000		0		0		
16984-48-8	Fluoride (F ⁻)			1	1	50	100	100	100	100	1500		0		0		
P1348	Nitrate (NO ₃ ⁻)			1	1	50	100	100	100	100	50000		0		0		
P1349	Nitrite (NO ₂ ⁻)			1	1	5	28	28	28	28	500		0		0		
14808-79-8	Sulfate (SO ₄ ²⁻)			1	1	45	69900	69900	69900	69900	250000		0		0		
P1134	pH (min.) (su)			1	1	0	6.8	6.8	6.8	6.8	6.5		0		0		
P1134	pH (max.) (su)			1	1	0	6.8	6.8	6.8	6.8	9.5		0		0		
P1287	Electrical conductivity (µS/cm)			1	1	10	920	920	920	920	2500		0		0		
120-12-7	Anthracene	PH	H	1	0	0.01	<0.01	<0.01	<0.01	<0.01	n/a						
50-32-8	Benzo(a)pyrene	PH	H														
				1	0	0.01	<0.01	<0.01	<0.01	<0.01	0.01		0		0		
206-44-0	Fluoranthene	P	H	1	0	0.01	<0.01	<0.01	<0.01	<0.01	n/a						
91-20-3	Naphthalene	P	NP	1	0	0.01	<0.01	<0.01	<0.01	<0.01	n/a						
GRP01	PAHs = sum of benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(ghi)perylene, indeno(1,2,3-cd)pyrene	P	H														
				1	0	0.04	<0.04	<0.04	<0.04	<0.04	0.1		0		0		
P1877	Phenol	SP	NP	1	0	1	<1	<1	<1	<1	n/a						
P1407	Ali EC5-EC6			1	0	1	<1	<1	<1	<1	15000		0		0		
P1408	Ali >EC6-EC8			1	0	1	<1	<1	<1	<1	15000		0		0		
P1409	Ali >EC8-EC10			1	0	1	<1	<1	<1	<1	300		0		0		
P1410	Ali >EC10-EC12			1	0	10	<10	<10	<10	<10	300		0		0		
P1411	Ali >EC12-EC16			1	0	10	<10	<10	<10	<10	300		0		0		
P1938	Ali >EC16-EC35			1	0	10	<10	<10	<10	<10	n/a						
P1415	Ali >EC35-EC44			1	0	10	<10	<10	<10	<10	n/a						
P1441	Aro EC5-EC7			1	0	1	<1	<1	<1	<1	1		0		0		
P1355	Aro >EC7-EC8			1	0	1	<1	<1	<1	<1	700		0		0		
P1356	Aro >EC8-EC10			1	0	1	<1	<1	<1	<1	300		0		0		
P1357	Aro >EC10-EC12			1	0	10	<10	<10	<10	<10	90		0		0		
P1358	Aro > EC12-EC16			1	0	10	<10	<10	<10	<10	90		0		0		
P1359	Aro >EC16-EC21			1	0	10	<10	<10	<10	<10	90		0		0		
P1360	Aro >EC21-EC35																
				1	0	10	<10	<10	<10	<10	90		0		0		
P1362	Aro >EC35-EC44			1	0	10	<10	<10	<10	<10	n/a						
71-43-2	Benzene	P	H	1	0	3	<3	<3	<3	<3	1		1		0		
108-88-3	Toluene	SP	H	1	0	3	<3	<3	<3	<3	700		0		0		
100-41-4	Ethylbenzene		H	1	0	3	<3	<3	<3	<3	300		0		0		
95-47-6	o-Xylene		H	1	0	3	<3	<3	<3	<3	500		0		0		DWS for total xylene
P1374	m,p-Xylene		H	1	0	3	<3	<3	<3	<3	500		0		0		DWS for total xylene
1634-04-04	Methyl tertiary butyl ether (MTBE)		NP														
				1	0	3	<3	<3	<3	<3	15		0		0		Non health based value - WHO odour threshold

Appendix F Waste Assessment

HazWasteOnline™ assessment

Waste Classification Report

HazWasteOnline™ classifies waste as either **hazardous** or **non-hazardous** based on its chemical composition, related legislation and the rules and data defined in the current UK or EU technical guidance (Appendix C) (note that HP 9 Infectious is not assessed). It is the responsibility of the classifier named below to:

- a) understand the origin of the waste
- b) select the correct List of Waste code(s)
- c) confirm that the list of determinands, results and sampling plan are fit for purpose
- d) select and justify the chosen metal species (Appendix B)
- e) correctly apply moisture correction and other available corrections
- f) add the meta data for their user-defined substances (Appendix A)
- g) check that the classification engine is suitable with respect to the national destination of the waste (Appendix C)

To aid the reviewer, the laboratory results, assumptions and justifications managed by the classifier are highlighted in pale yellow.



OCS16-JAUM0-YPSDL

Job name

33445- UoM The Limes Relocation

Description/Comments

Project

The Limes Relocation, Owen Park, Fallowfield, Manchester

Site

The Limes Relocation, Owen Park, Fallowfield, Manchester

Classified by

Name: Kurt Gilmore
Company: Hydrock Consultants Ltd
Date: 16 May 2024 09:18 GMT
Telephone:

HazWasteOnline™ provides a two day, hazardous waste classification course that covers the use of the software and both basic and advanced waste classification techniques. Certification has to be renewed every 3 years.
HazWasteOnline™ Certification:
Course Hazardous Waste Classification
Date 08 Sep 2020
3 year Refresher overdue

Purpose of classification

2 - Material Characterisation

Address of the waste

The Limes Relocation, Owen Park, Fallowfield, Manchester

Post Code M14 6YZ

SIC for the process giving rise to the waste

41201 Construction of commercial buildings

Description of industry/producer giving rise to the waste

Proposed kitchen/food preparation building

Description of the specific process, sub-process and/or activity that created the waste

soils produced from foundations, roads and landscaping excavations

Description of the waste

*General Made Ground sandy locally ashy GRAVEL including brick, limestone, mudstone and coal. Glacial Till- gravelly silty CLAY.

Job summary

#	Sample name	Depth [m]	Classification Result	Hazard properties	Page
1	BH02[3]	0.4	Non Hazardous		3
2	WS08[3]	0.3	Non Hazardous		5
3	WS09[5]	1	Hazardous	HP 3(i), HP 7, HP 11	7
4	WS01[3]	0.4	Non Hazardous		9
5	WS03[3]	0.4	Non Hazardous		11
6	WS05[3]	0.4	Non Hazardous		13
7	WS07[3]	0.4	Non Hazardous		15
8	WS09[6]	1.2	Non Hazardous		17
9	WS02[3]	0.9	Non Hazardous		20

Related documents

#	Name	Description
1	Hydrock Standard plus Cresol (amended) Lead	waste stream template used to create this job

Report

Created by: Kurt Gilmore

Created date: 16 May 2024 09:18 GMT

Appendices

Appendix A: Classifier defined and non GB MCL determinands	Page 22
Appendix B: Rationale for selection of metal species	Page 23
Appendix C: Version	Page 24

Classification of sample: BH02[3]

**Non Hazardous Waste**
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:	BH02[3]	LoW Code:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:	0.4 m	Chapter:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
Moisture content:	10%	Entry:	
	(no correction)		

Hazard properties

None identified

Determinands

Moisture content: **10% No Moisture Correction applied (MC)**

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
1	 acenaphthene	201-469-6	83-32-9		2.3	mg/kg	2.3	0.00023 %		
2	 acenaphthylene	205-917-1	208-96-8		0.23	mg/kg	0.23	0.000023 %		
3	 anthracene	204-371-1	120-12-7		4	mg/kg	4	0.0004 %		
4	 arsenic {  arsenic trioxide }	033-003-00-0	215-481-4		29	mg/kg	1.32	38.289	mg/kg	0.00383 %
5	 benzo[<i>a</i>]anthracene	601-033-00-9	200-280-6		16	mg/kg		16	mg/kg	0.0016 %
6	 benzo[<i>a</i>]pyrene; benzo[<i>b</i>]fluoranthene	601-032-00-3	200-028-5		17	mg/kg		17	mg/kg	0.0017 %
7	 benzo[<i>b</i>]fluoranthene	601-034-00-4	205-911-9		18	mg/kg		18	mg/kg	0.0018 %
8	 benzo[<i>ghi</i>]perylene	205-883-8	191-24-2		7.7	mg/kg		7.7	mg/kg	0.00077 %
9	 benzo[<i>k</i>]fluoranthene	601-036-00-5	205-916-6		8	mg/kg		8	mg/kg	0.0008 %
10	 beryllium {  beryllium oxide }	004-003-00-8	215-133-1		1.6	mg/kg	2.775	4.441	mg/kg	0.000444 %
11	 boron {  boron tribromide/trichloride/trifluoride (combined) }				1.4	mg/kg	13.43	18.802	mg/kg	0.00188 %
12	 cadmium {  cadmium sulfide }	048-010-00-4	215-147-8		<0.2	mg/kg	1.285	<0.257	mg/kg	<0.00002 %
13	 chromium in chromium(III) compounds {  chromium(III) oxide (worst case) }				19	mg/kg	1.462	27.77	mg/kg	0.00278 %
14	 chromium in chromium(VI) compounds {  chromium(VI) oxide }	024-001-00-0	215-607-8		<1.8	mg/kg	1.923	<3.462	mg/kg	<0.000346 %

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
15	 chrysene	601-048-00-0	205-923-4	218-01-9	15	mg/kg		15	mg/kg	0.0015 %
16	 copper {  dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1	64	mg/kg	1.126	72.057	mg/kg	0.00721 %
17	 cyanides {  salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }	006-007-00-5			<1	mg/kg	1.884	<1.884	mg/kg	<0.000188 %
18	 dibenz[<i>a,h</i>]anthracene	601-041-00-2	200-181-8	53-70-3	1.8	mg/kg		1.8	mg/kg	0.00018 %
19	 fluoranthene		205-912-4	206-44-0	31	mg/kg		31	mg/kg	0.0031 %
20	 fluorene		201-695-5	86-73-7	1.9	mg/kg		1.9	mg/kg	0.00019 %
21	 indeno[1,2,3- <i>c</i>]pyrene		205-893-2	193-39-5	7	mg/kg		7	mg/kg	0.0007 %
22	 lead {  lead compounds with the exception of those specified elsewhere in this Annex }	082-001-00-6			91	mg/kg		91	mg/kg	0.0091 %
23	 mercury {  mercury dichloride }	080-010-00-X	231-299-8	7487-94-7	<0.3	mg/kg	1.353	<0.406	mg/kg	<0.0000406 %
24	 naphthalene	601-052-00-2	202-049-5	91-20-3	0.68	mg/kg		0.68	mg/kg	0.000068 %
25	 nickel {  nickel dihydroxide }	028-008-00-X	235-008-5 [1] 234-348-1 [2]	12054-48-7 [1] 11113-74-9 [2]	28	mg/kg	1.579	44.226	mg/kg	0.00442 %
26	 pH				8.1	pH		8.1	pH	8.1 pH
27	 phenanthrene		201-581-5	85-01-8	16	mg/kg		16	mg/kg	0.0016 %
28	 phenol	604-001-00-2	203-632-7	108-95-2	<1	mg/kg		<1	mg/kg	<0.0001 %
29	 pyrene		204-927-3	129-00-0	30	mg/kg		30	mg/kg	0.003 %
30	 zinc {  zinc oxide }	030-013-00-7	215-222-5	1314-13-2	110	mg/kg	1.245	136.919	mg/kg	0.0137 %
					Total:			0.0617 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
<LOD	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: WS08[3]



Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:	WS08[3]	LoW Code:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:	0.3 m	Chapter:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
Moisture content:	14% (no correction)	Entry:	

Hazard properties

None identified

Determinands

Moisture content: **14% No Moisture Correction applied (MC)**

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
1	acenaphthene	201-469-6	83-32-9		2.7 mg/kg		2.7 mg/kg	0.00027 %		
2	acenaphthylene	205-917-1	208-96-8		0.51 mg/kg		0.51 mg/kg	0.00051 %		
3	anthracene	204-371-1	120-12-7		4.8 mg/kg		4.8 mg/kg	0.00048 %		
4	arsenic { arsenic trioxide }	033-003-00-0	215-481-4		31 mg/kg	1.32	40.93 mg/kg	0.00409 %		
5	benzo[<i>a</i>]anthracene	601-033-00-9	200-280-6		17 mg/kg		17 mg/kg	0.0017 %		
6	benzo[<i>a</i>]pyrene; benzo[<i>b</i>]fluoranthene	601-032-00-3	200-028-5		17 mg/kg		17 mg/kg	0.0017 %		
7	benzo[<i>b</i>]fluoranthene	601-034-00-4	205-911-9		17 mg/kg		17 mg/kg	0.0017 %		
8	benzo[<i>ghi</i>]perylene	205-883-8	191-24-2		8.2 mg/kg		8.2 mg/kg	0.00082 %		
9	benzo[<i>k</i>]fluoranthene	601-036-00-5	205-916-6		7.9 mg/kg		7.9 mg/kg	0.00079 %		
10	beryllium { beryllium oxide }	004-003-00-8	215-133-1		2.2 mg/kg	2.775	6.106 mg/kg	0.000611 %		
11	boron { boron tribromide/trichloride/trifluoride (combined) }		10294-33-4, 10294-34-5, 7637-07-2		0.8 mg/kg	13.43	10.744 mg/kg	0.00107 %		
12	cadmium { cadmium sulfide }	048-010-00-4	215-147-8	1	<0.2 mg/kg	1.285	<0.257 mg/kg	<0.00002 %		<LOD
13	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }	215-160-9	1308-38-9		21 mg/kg	1.462	30.693 mg/kg	0.00307 %		
14	chromium in chromium(VI) compounds { chromium(VI) oxide }	024-001-00-0	215-607-8		<1.8 mg/kg	1.923	<3.462 mg/kg	<0.000346 %		<LOD

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
15	chrysene	601-048-00-0	205-923-4	218-01-9	16 mg/kg		16 mg/kg	0.0016 %		
16	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1	85 mg/kg	1.126	95.701 mg/kg	0.00957 %		
17	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }	006-007-00-5			<1 mg/kg	1.884	<1.884 mg/kg	<0.000188 %		<LOD
18	di(2,2,4,4-tetrafluoroethyl) ether	601-041-00-2	200-181-8	53-70-3	1.8 mg/kg		1.8 mg/kg	0.00018 %		
19	fluoranthene	205-912-4	206-44-0		33 mg/kg		33 mg/kg	0.0033 %		
20	fluorene	201-695-5	86-73-7		2.9 mg/kg		2.9 mg/kg	0.00029 %		
21	indene	205-893-2	193-39-5		7 mg/kg		7 mg/kg	0.0007 %		
22	lead { lead compounds with the exception of those specified elsewhere in this Annex }	082-001-00-6			98 mg/kg		98 mg/kg	0.00098 %		
23	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7	0.4 mg/kg	1.353	0.541 mg/kg	0.0000541 %		
24	naphthalene	601-052-00-2	202-049-5	91-20-3	0.82 mg/kg		0.82 mg/kg	0.000082 %		
25	nickel { nickel dihydroxide }	028-008-00-X	235-008-5 [1] 234-348-1 [2]	12054-48-7 [1] 11113-74-9 [2]	40 mg/kg	1.579	63.18 mg/kg	0.00632 %		
26	pH				8 pH		8 pH	8pH		
27	phenanthrene	201-581-5	85-01-8		21 mg/kg		21 mg/kg	0.0021 %		
28	phenol	604-001-00-2	203-632-7	108-95-2	<1 mg/kg		<1 mg/kg	<0.0001 %		<LOD
29	pyrene	204-927-3	129-00-0		32 mg/kg		32 mg/kg	0.0032 %		
30	zinc { zinc oxide }	030-013-00-7	215-222-5	1314-13-2	110 mg/kg	1.245	136.919 mg/kg	0.0137 %		
31	asbestos	650-013-00-6	12001-28-4 132207-32-0 12172-73-5 77536-66-4 77536-68-6 77536-67-5 12001-29-5		0.001 mg/kg		0.001 mg/kg	0.0000001 %		
Total:					0.0679 %					

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: WS0915]



Hazardous Waste
Classified as **17 05 03 ***
in the List of Waste

Sample details

Sample name:	WS0915]	LoW Code:	
		Chapter:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:	1 m	Entry:	17 05 03 * (Soil and stones containing hazardous substances)
Moisture content:	16%		
	(no correction)		

Hazard properties

HP 3(i): Flammable "flammable liquid waste: liquid waste having a flash point below 60°C or waste gas oil, diesel and light heating oils having a flash point > 55°C and <= 75°C"

Force this Hazardous property to hazardous because Sample is not liquid.

Hazard Statements hit:

Flam. Liq. 3; H226 "Flammable liquid and vapour."

Because of determinands:

diesel petroleum group: (conc.: 0.358%)
TPH (C6 to C40) petroleum group: (conc.: 0.972%)

HP 7: Carcinogenic "waste which induces cancer or increases its incidence"

Hazard Statements hit:

Carc. 1B; H350 "May cause cancer [state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard]."

Because of determinand:

TPH (C6 to C40) petroleum group: (conc.: 0.972%)

HP 11: Mutagenic "waste which may cause a mutation, that is a permanent change in the amount or structure of the genetic material in a cell"

Hazard Statements hit:

Muta. 1B; H340 "May cause genetic defects [state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard]."

Because of determinand:

TPH (C6 to C40) petroleum group: (conc.: 0.972%)

Determinands

Moisture content: **16% No Moisture Correction applied (MC)**

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
1	diesel petroleum group									
			68334-30-5, 68476-34-6, 9414-59-7, 1159170-26-9		3577.1		3577.1	0.358 %		
2	ethylbenzene				<0.005	mg/kg	<0.005	mg/kg	<0.0000005 %	<LOD
	601-023-00-4	202-849-4	100-41-4							

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
3	TPH (C6 to C40) petroleum group				9721.997	mg/kg	9721.997	mg/kg	0.972 %	
			TPH							
Total:					1.33 %					

Key

- User supplied data
- Determinand values ignored for classification, see column 'Conc. Not Used' for reason
- Hazardous result
- Determinand defined or amended by HazWasteOnline (see Appendix A)
- <LOD
- Below limit of detection

Classification of sample: WS01[3]

 **Non Hazardous Waste**
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:	WS01[3]	LoW Code:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:	0.4 m	Chapter:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
Moisture content:	14% (no correction)	Entry:	

Hazard properties

None identified

Determinands

Moisture content: **14% No Moisture Correction applied (MC)**

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
1	 acenaphthene	201-469-6	83-32-9		7.5 mg/kg		7.5 mg/kg	0.00075 %		
2	 acenaphthylene	205-917-1	208-96-8		1.9 mg/kg		1.9 mg/kg	0.00019 %		
3	 anthracene	204-371-1	120-12-7		17 mg/kg		17 mg/kg	0.0017 %		
4	 arsenic {  arsenic trioxide }	033-003-00-0	215-481-4		39 mg/kg	1.32	51.493 mg/kg	0.00515 %		
5	 benzo[<i>a</i>]anthracene	601-033-00-9	200-280-6		30 mg/kg		30 mg/kg	0.003 %		
6	 benzo[<i>a</i>]pyrene; benzo[<i>b</i>]fluoranthene	601-032-00-3	200-028-5		28 mg/kg		28 mg/kg	0.0028 %		
7	 benzo[<i>b</i>]fluoranthene	601-034-00-4	205-911-9		35 mg/kg		35 mg/kg	0.0035 %		
8	 benzo[<i>ghi</i>]perylene	205-883-8	191-24-2		15 mg/kg		15 mg/kg	0.0015 %		
9	 benzo[<i>k</i>]fluoranthene	601-036-00-5	205-916-6		13 mg/kg		13 mg/kg	0.0013 %		
10	 beryllium {  beryllium oxide }	004-003-00-8	215-133-1		2.6 mg/kg	2.775	7.216 mg/kg	0.000722 %		
11	 boron {  boron tribromide; trichloride; trifluoride (combined) }		10294-33-4, 10294-34-5, 7637-07-2		0.9 mg/kg	13.43	12.087 mg/kg	0.00121 %		
12	 cadmium {  cadmium sulfide }	048-010-00-4	215-147-8	1	<0.2 mg/kg	1.285	<0.257 mg/kg	<0.00002 %		<LOD
13	 chromium in chromium(III) compounds {  chromium(III) oxide (worst case) }		215-160-9		26 mg/kg	1.462	38 mg/kg	0.0038 %		
14	 chromium in chromium(VI) compounds {  chromium(VI) oxide }	024-001-00-0	215-607-8		<1.8 mg/kg	1.923	<3.462 mg/kg	<0.000346 %		<LOD

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
15	 chrysene	601-048-00-0	205-923-4	218-01-9	29 mg/kg		29 mg/kg	0.0029 %		
16	 copper {  dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1	160 mg/kg	1.126	180.142 mg/kg	0.018 %		
17	 cyanides {  salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }	006-007-00-5			<1 mg/kg	1.884	<1.884 mg/kg	<0.000188 %		<LOD
18	 dibenz[<i>a,h</i>]anthracene	601-041-00-2	200-181-8	53-70-3	3.5 mg/kg		3.5 mg/kg	0.00035 %		
19	 fluoranthene		205-912-4	206-44-0	74 mg/kg		74 mg/kg	0.0074 %		
20	 fluorene		201-695-5	86-73-7	7.2 mg/kg		7.2 mg/kg	0.00072 %		
21	 indeno[1,2,3- <i>c,d</i>]pyrene		205-893-2	193-39-5	14 mg/kg		14 mg/kg	0.0014 %		
22	 lead {  lead compounds with the exception of those specified elsewhere in this Annex }	082-001-00-6			250 mg/kg		250 mg/kg	0.025 %		
23	 mercury {  mercury dichloride }	080-010-00-X	231-299-8	7487-94-7	0.5 mg/kg	1.353	0.677 mg/kg	0.0000677 %		
24	 naphthalene	601-052-00-2	202-049-5	91-20-3	1.8 mg/kg		1.8 mg/kg	0.00018 %		
25	 nickel {  nickel dihydroxide }	028-008-00-X	235-008-5 [1] 234-348-1 [2]	12054-48-7 [1] 11113-74-9 [2]	43 mg/kg	1.579	67.918 mg/kg	0.00679 %		
26	 pH				9.8 pH		9.8 pH	9.8 pH		
27	 phenanthrene		201-581-5	85-01-8	53 mg/kg		53 mg/kg	0.0053 %		
28	 phenol	604-001-00-2	203-632-7	108-95-2	<1 mg/kg		<1 mg/kg	<0.0001 %		<LOD
29	 pyrene		204-927-3	129-00-0	65 mg/kg		65 mg/kg	0.0065 %		
30	 zinc {  zinc oxide }	030-013-00-7	215-222-5	1314-13-2	190 mg/kg	1.245	236.496 mg/kg	0.0236 %		
					Total:		0.125 %			

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
<LOD	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
CLP: Note 1	Below limit of detection
	Only the metal concentration has been used for classification

Classification of sample: WS03J3

 **Non Hazardous Waste**
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:	WS03J3	LoW Code:	Chapter:
Sample Depth:	0.4 m	Entry:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Moisture content:	14%		17 05 04 (Soil and stones other than those mentioned in 17 05 03)
	(no correction)		

Hazard properties

None identified

Determinands

Moisture content: **14% No Moisture Correction applied (MC)**

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
1	acenaphthene	201-469-6	83-32-9		41		41	0.0041 %		
2	acenaphthylene	205-917-1	208-96-8		<0.05	mg/kg	<0.05	mg/kg	<0.000005 %	<LOD
3	anthracene	204-371-1	120-12-7		54	mg/kg	54	mg/kg	0.0054 %	
4	arsenic { arsenic trioxide }	215-481-4	1327-53-3		20	mg/kg	1.32	26.407	mg/kg	0.00264 %
5	benzo[<i>a</i>]anthracene	200-280-6	56-55-3		83	mg/kg	83	mg/kg	0.0083 %	
6	benzo[<i>a</i>]pyrene; benzo[<i>b</i>]fluoranthene	200-028-5	50-32-8		73	mg/kg	73	mg/kg	0.0073 %	
7	benzo[<i>b</i>]fluoranthene	205-911-9	205-99-2		93	mg/kg	93	mg/kg	0.0093 %	
8	benzo[<i>ghi</i>]perylene	205-883-8	191-24-2		38	mg/kg	38	mg/kg	0.0038 %	
9	benzo[<i>k</i>]fluoranthene	205-916-6	207-08-9		32	mg/kg	32	mg/kg	0.0032 %	
10	beryllium { beryllium oxide }	215-133-1	1304-56-9		1.1	mg/kg	2.775	3.053	mg/kg	0.000305 %
11	boron { boron tribromide/trichloride/trifluoride (combined) }		10294-33-4, 10294-34-5, 7637-07-2		1.2	mg/kg	13.43	16.116	mg/kg	0.00161 %
12	cadmium { cadmium sulfide }	215-147-8	1306-23-6	1	<0.2	mg/kg	1.285	<0.257	mg/kg	<0.00002 %
13	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }	215-160-9	1308-38-9		18	mg/kg	1.462	26.308	mg/kg	0.00263 %
14	chromium in chromium(VI) compounds { chromium(VI) oxide }	215-607-8	1333-82-0		<1.8	mg/kg	1.923	<3.462	mg/kg	<0.000346 %

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
15	chrysene	205-923-4	218-01-9		79	mg/kg	79	mg/kg	0.0079 %	
16	copper { dicopper oxide; copper (I) oxide }	215-270-7	1317-39-1		54	mg/kg	1.126	60.798	mg/kg	0.00608 %
17	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }	006-007-00-5			<1	mg/kg	1.884	<1.884	mg/kg	<0.000188 %
18	di(2,2,4,4-tetrafluoroethyl) ether	200-181-8	53-70-3		9.2	mg/kg	9.2	mg/kg	0.00092 %	
19	fluoranthene	205-912-4	206-44-0		210	mg/kg	210	mg/kg	0.021 %	
20	fluorene	201-695-5	86-73-7		34	mg/kg	34	mg/kg	0.0034 %	
21	indeno[1,2,3- <i>cd</i>]pyrene	205-893-2	193-39-5		35	mg/kg	35	mg/kg	0.0035 %	
22	lead { lead compounds with the exception of those specified elsewhere in this Annex }	082-001-00-6		1	140	mg/kg	140	mg/kg	0.014 %	
23	mercury { mercury dichloride }	231-299-8	7487-94-7		0.4	mg/kg	1.353	0.541	mg/kg	0.0000541 %
24	naphthalene	202-049-5	91-20-3		19	mg/kg	19	mg/kg	0.0019 %	
25	nickel { nickel dihydroxide }	235-008-5 [1] 234-348-1 [2]	12054-48-7 [1] 11113-74-9 [2]		25	mg/kg	1.579	39.487	mg/kg	0.00395 %
26	pH		PH		10.1	pH	10.1	pH	10.1	pH
27	phenanthrene	201-581-5	85-01-8		200	mg/kg	200	mg/kg	0.02 %	
28	phenol	203-632-7	108-95-2		<1	mg/kg	<1	mg/kg	<0.0001 %	<LOD
29	pyrene	204-927-3	129-00-0		180	mg/kg	180	mg/kg	0.018 %	
30	zinc { zinc oxide }	215-222-5	1314-13-2		120	mg/kg	1.245	149.366	mg/kg	0.0149 %
					Total:			0.165 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: WS05[3]

Non Hazardous Waste
Classified as 17 05 04
in the List of Waste

Sample details

Sample name: WS05[3] LoW Code: Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth: 0.4 m Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)
Moisture content: 17% (no correction)

Hazard properties

None identified

Determinands

Moisture content: 17% No Moisture Correction applied (MC)

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
1	acenaphthene	201-469-6	83-32-9		0.31 mg/kg		0.31 mg/kg	0.000031 %		
2	acenaphthylene	205-917-1	208-96-8		<0.05 mg/kg		<0.05 mg/kg	<0.000005 %		<LOD
3	anthracene	204-371-1	120-12-7		0.36 mg/kg		0.36 mg/kg	0.000036 %		
4	arsenic { arsenic trioxide }	033-003-00-0	215-481-4		13 mg/kg	1.32	17.164 mg/kg	0.00172 %		
5	benzo[<i>a</i>]anthracene	601-033-00-9	200-280-6		1.1 mg/kg		1.1 mg/kg	0.00011 %		
6	benzo[<i>a</i>]pyrene; benzo[<i>b</i>]fluoranthene	601-032-00-3	200-028-5		1.2 mg/kg		1.2 mg/kg	0.00012 %		
7	benzo[<i>b</i>]fluoranthene	601-034-00-4	205-911-9		1.3 mg/kg		1.3 mg/kg	0.00013 %		
8	benzo[<i>ghi</i>]perylene	205-883-8	191-24-2		0.57 mg/kg		0.57 mg/kg	0.000057 %		
9	benzo[<i>k</i>]fluoranthene	601-036-00-5	205-916-6		0.46 mg/kg		0.46 mg/kg	0.000046 %		
10	beryllium { beryllium oxide }	004-003-00-8	215-133-1		0.97 mg/kg	2.775	2.692 mg/kg	0.000269 %		
11	boron { boron tribromide/trichloride/trifluoride (combined) }		10294-33-4, 10294-34-5, 7637-07-2		0.7 mg/kg	13.43	9.401 mg/kg	0.00094 %		
12	cadmium { cadmium sulfide }	048-010-00-4	215-147-8	1	<0.2 mg/kg	1.285	<0.257 mg/kg	<0.00002 %		<LOD
13	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }	215-160-9	1308-38-9		23 mg/kg	1.462	33.616 mg/kg	0.00336 %		
14	chromium in chromium(VI) compounds { chromium(VI) oxide }	024-001-00-0	215-607-8		<1.8 mg/kg	1.923	<3.462 mg/kg	<0.000346 %		<LOD

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
15	chrysene	601-048-00-0	205-923-4	218-01-9	1.3 mg/kg		1.3 mg/kg	0.00013 %		
16	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1	24 mg/kg	1.126	27.021 mg/kg	0.0027 %		
17	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }	006-007-00-5			<1 mg/kg	1.884	<1.884 mg/kg	<0.000188 %		<LOD
18	dibenz[<i>a,h</i>]anthracene	601-041-00-2	200-181-8	53-70-3	0.14 mg/kg		0.14 mg/kg	0.000014 %		
19	fluoranthene	205-912-4	206-44-0		2.3 mg/kg		2.3 mg/kg	0.00023 %		
20	fluorene	201-695-5	86-73-7		0.23 mg/kg		0.23 mg/kg	0.000023 %		
21	indeno[1,2,3- <i>c</i>]pyrene	205-893-2	193-39-5		0.49 mg/kg		0.49 mg/kg	0.000049 %		
22	lead { lead compounds with the exception of those specified elsewhere in this Annex }	082-001-00-6			64 mg/kg		64 mg/kg	0.00064 %		
23	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7	0.3 mg/kg	1.353	0.406 mg/kg	0.0000406 %		
24	naphthalene	601-052-00-2	202-049-5	91-20-3	0.11 mg/kg		0.11 mg/kg	0.000011 %		
25	nickel { nickel dihydroxide }	028-008-00-X	235-008-5 [1] 234-348-1 [2]	12054-48-7 [1] 11113-74-9 [2]	19 mg/kg	1.579	30.01 mg/kg	0.003 %		
26	pH				7.4 pH		7.4 pH	7.4 pH		
27	phenanthrene	201-581-5	85-01-8		1.7 mg/kg		1.7 mg/kg	0.00017 %		
28	phenol	604-001-00-2	203-632-7	108-95-2	<1 mg/kg		<1 mg/kg	<0.0001 %		<LOD
29	pyrene	204-927-3	129-00-0		2.4 mg/kg		2.4 mg/kg	0.00024 %		
30	zinc { zinc oxide }	030-013-00-7	215-222-5	1314-13-2	48 mg/kg	1.245	59.746 mg/kg	0.00597 %		
					Total:		0.0265 %			

Key

User supplied data

Determinand values ignored for classification, see column 'Conc. Not Used' for reason

Determinand defined or amended by HazWasteOnline (see Appendix A)

Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration

<LOD

Below limit of detection

CLP: Note 1

Only the metal concentration has been used for classification

Classification of sample: WS073]



Non Hazardous Waste

Classified as 17 05 04

in the List of Waste

Sample details

Sample name:	WS073]	LoW Code:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:	0.4 m	Chapter:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
Moisture content:	17% (no correction)	Entry:	

Hazard properties

None identified

Determinands

Moisture content: 17% No Moisture Correction applied (MC)

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
1	acenaphthene	201-469-6	83-32-9		0.06 mg/kg		0.06 mg/kg	0.000006 %		
2	acenaphthylene	205-917-1	208-96-8		<0.05 mg/kg		<0.05 mg/kg	<0.000005 %		<LOD
3	anthracene	204-371-1	120-12-7		0.1 mg/kg		0.1 mg/kg	0.00001 %		
4	arsenic { arsenic trioxide }	033-003-00-0	215-481-4		8.3 mg/kg	1.32	10.959 mg/kg	0.0011 %		
5	benzo[<i>a</i>]anthracene	601-033-00-9	56-55-3		0.33 mg/kg		0.33 mg/kg	0.000033 %		
6	benzo[<i>a</i>]pyrene; benzo[<i>b</i>]fluoranthene	601-032-00-3	200-028-5		0.29 mg/kg		0.29 mg/kg	0.000029 %		
7	benzo[<i>b</i>]fluoranthene	601-034-00-4	205-911-9		0.35 mg/kg		0.35 mg/kg	0.000035 %		
8	benzo[<i>ghi</i>]perylene	205-883-8	191-24-2		0.16 mg/kg		0.16 mg/kg	0.000016 %		
9	benzo[<i>k</i>]fluoranthene	601-036-00-5	205-916-6		0.12 mg/kg		0.12 mg/kg	0.000012 %		
10	beryllium { beryllium oxide }	004-003-00-8	215-133-1		0.84 mg/kg	2.775	2.331 mg/kg	0.000233 %		
11	boron { boron tribromide/trichloride/trifluoride (combined) }		10294-33-4, 10294-34-5, 7637-07-2		0.7 mg/kg	13.43	9.401 mg/kg	0.00094 %		
12	cadmium { cadmium sulfide }	048-010-00-4	215-147-8	1	<0.2 mg/kg	1.285	<0.257 mg/kg	<0.00002 %		<LOD
13	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }	215-160-9	1308-38-9		19 mg/kg	1.462	27.77 mg/kg	0.00278 %		
14	chromium in chromium(VI) compounds { chromium(VI) oxide }	024-001-00-0	215-607-8		<1.8 mg/kg	1.923	<3.462 mg/kg	<0.000346 %		<LOD

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
15	chrysene	601-048-00-0	205-923-4	218-01-9	0.3 mg/kg		0.3 mg/kg	0.00003 %		
16	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1	15 mg/kg	1.126	16.888 mg/kg	0.00169 %		
17	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }	006-007-00-5			<1 mg/kg	1.884	<1.884 mg/kg	<0.000188 %		<LOD
18	di(2,2,4,4-tetrafluoroethyl) ether	601-041-00-2	200-181-8	53-70-3	<0.05 mg/kg		<0.05 mg/kg	<0.000005 %		<LOD
19	fluoranthene	205-912-4	206-44-0		0.59 mg/kg		0.59 mg/kg	0.000059 %		
20	fluorene	201-695-5	86-73-7		0.08 mg/kg		0.08 mg/kg	0.000008 %		
21	indene	205-893-2	193-39-5		0.13 mg/kg		0.13 mg/kg	0.000013 %		
22	lead { lead compounds with the exception of those specified elsewhere in this Annex }	082-001-00-6			19 mg/kg		19 mg/kg	0.00019 %		
23	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7	<0.3 mg/kg	1.353	<0.406 mg/kg	<0.0000406 %		<LOD
24	naphthalene	601-052-00-2	202-049-5	91-20-3	<0.05 mg/kg		<0.05 mg/kg	<0.000005 %		<LOD
25	nickel { nickel dihydroxide }	028-008-00-X	235-008-5 [1]	12054-48-7 [1]	19 mg/kg	1.579	30.01 mg/kg	0.003 %		
26	pH				7.3 pH		7.3 pH	7.3 pH		
27	phenanthrene	201-581-5	85-01-8		0.41 mg/kg		0.41 mg/kg	0.000041 %		
28	phenol	604-001-00-2	203-632-7	108-95-2	<1 mg/kg		<1 mg/kg	<0.0001 %		<LOD
29	pyrene	204-927-3	129-00-0		0.61 mg/kg		0.61 mg/kg	0.000061 %		
30	zinc { zinc oxide }	030-013-00-7	215-222-5	1314-13-2	43 mg/kg	1.245	53.523 mg/kg	0.00535 %		
					Total:		0.0181 %			

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: WS09[6]

Non Hazardous Waste
Classified as 17 05 04
in the List of Waste

Sample details

Sample name:	WS09[6]	LoW Code:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:	1.2 m	Chapter:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
Moisture content:	17% (no correction)	Entry:	

Hazard properties

None identified

Determinands

Moisture content: 17% No Moisture Correction applied (MC)

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
1	acenaphthene	201-469-6	83-32-9		1.5 mg/kg		1.5 mg/kg	0.00015 %		
2	acenaphthylene	205-917-1	208-96-8		0.23 mg/kg		0.23 mg/kg	0.00023 %		
3	anthracene	204-371-1	120-12-7		2.3 mg/kg		2.3 mg/kg	0.00023 %		
4	arsenic { arsenic trioxide }	033-003-00-0	215-481-4		10 mg/kg	1.32	13.203 mg/kg	0.00132 %		
5	benzo[<i>a</i>]anthracene	601-033-00-9	200-280-6		4.3 mg/kg		4.3 mg/kg	0.00043 %		
6	benzo[<i>a</i>]pyrene; benzo[<i>b</i>]fluoranthene	601-032-00-3	200-028-5		4.1 mg/kg		4.1 mg/kg	0.00041 %		
7	benzo[<i>b</i>]fluoranthene	601-034-00-4	205-911-9		4.3 mg/kg		4.3 mg/kg	0.00043 %		
8	benzo[<i>ghi</i>]perylene	205-883-8	191-24-2		1.8 mg/kg		1.8 mg/kg	0.00018 %		
9	benzo[<i>k</i>]fluoranthene	601-036-00-5	205-916-6		1.5 mg/kg		1.5 mg/kg	0.00015 %		
10	beryllium { beryllium oxide }	004-003-00-8	215-133-1		1.1 mg/kg	2.775	3.053 mg/kg	0.000305 %		
11	boron { boron tribromide/trichloride/trifluoride (combined) }		10294-33-4, 10294-34-5, 7637-07-2		2 mg/kg		26.86 mg/kg	0.00269 %		
12	cadmium { cadmium sulfide }	048-010-00-4	215-147-8	1	<0.2 mg/kg	1.285	<0.257 mg/kg	<0.00002 %		<LOD
13	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }		215-160-9		24 mg/kg	1.462	35.077 mg/kg	0.00351 %		
14	chromium in chromium(VI) compounds { chromium(VI) oxide }	024-001-00-0	215-607-8		<1.8 mg/kg	1.923	<3.462 mg/kg	<0.000346 %		<LOD

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
15	chrysene	601-048-00-0	205-923-4	218-01-9	4.2 mg/kg		4.2 mg/kg	0.00042 %		
16	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1	21 mg/kg	1.126	23.644 mg/kg	0.00236 %		
17	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }	006-007-00-5			<1 mg/kg	1.884	<1.884 mg/kg	<0.000188 %		<LOD
18	dibenz[<i>a,h</i>]anthracene	601-041-00-2	200-181-8	53-70-3	0.4 mg/kg		0.4 mg/kg	0.00004 %		
19	diesel petroleum group		68334-30-5, 68476-34-6, 94114-59-7, 1159170-26-9		75.5 mg/kg		75.5 mg/kg	0.00755 %		
20	ethylbenzene	601-023-00-4	202-849-4	100-41-4	<0.005 mg/kg		<0.005 mg/kg	<0.0000005 %		<LOD
21	fluoranthene	205-912-4	206-44-0		9.1 mg/kg		9.1 mg/kg	0.00091 %		
22	fluorene	201-695-5	86-73-7		2.2 mg/kg		2.2 mg/kg	0.00022 %		
23	indeno[1,2,3- <i>cd</i>]pyrene	205-893-2	193-39-5		1.5 mg/kg		1.5 mg/kg	0.00015 %		
24	lead { lead compounds with the exception of those specified elsewhere in this Annex }	082-001-00-6			40 mg/kg		40 mg/kg	0.004 %		
25	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7	<0.3 mg/kg	1.353	<0.406 mg/kg	<0.0000406 %		<LOD
26	naphthalene	601-052-00-2	202-049-5	91-20-3	0.94 mg/kg		0.94 mg/kg	0.000094 %		
27	nickel { nickel dihydroxide }	028-008-00-X	235-008-5 [1] 234-348-1 [2]	12054-48-7 [1] 11113-74-9 [2]	22 mg/kg	1.579	34.749 mg/kg	0.00347 %		
28	pH				7.2 pH		7.2 pH	7.2 pH		
29	phenanthrene	201-581-5	85-01-8		9.3 mg/kg		9.3 mg/kg	0.00093 %		
30	phenol	604-001-00-2	203-632-7	108-95-2	<1 mg/kg		<1 mg/kg	<0.0001 %		<LOD
31	pyrene	204-927-3	129-00-0		9.3 mg/kg		9.3 mg/kg	0.00093 %		
32	TPH (C6 to C40) petroleum group		TPH		252.397 mg/kg		252.397 mg/kg	0.0252 %		
33	zinc { zinc oxide }	030-013-00-7	215-222-5	1314-13-2	46 mg/kg	1.245	57.257 mg/kg	0.00573 %		
Total:							0.0626 %			

Key	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
<LOD	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Supplementary Hazardous Property Information

HP 3(i): Flammable "Flammable liquid waste: liquid waste having a flash point below 60°C or waste gas oil, diesel and light heating oils having a flash point > 55°C and <= 75°C"

Force this Hazardous property to non hazardous because Sample is not liquid.

Hazard Statements hit:

Flam. Liq. 3; H226 "Flammable liquid and vapour."

Because of determinands:

diesel petroleum group: (conc.: 0.00755%)

TPH (C6 to C40) petroleum group: (conc.: 0.0252%)

Classification of sample: WS02J31



Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:	WS02J31	Low Code:	Chapter:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:	0.9 m	Entry:		17 05 04 (Soil and stones other than those mentioned in 17 05 03)
Moisture content:	25% (no correction)			

Hazard properties

None identified

Determinands

Moisture content: 25% No Moisture Correction applied (MC)

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
1	acenaphthene	201-469-6	83-32-9		0.42 mg/kg		0.42 mg/kg	0.000042 %		
2	acenaphthylene	205-917-1	208-96-8		<0.05 mg/kg		<0.05 mg/kg	<0.000005 %		<LOD
3	anthracene	204-371-1	120-12-7		0.46 mg/kg		0.46 mg/kg	0.000046 %		
4	arsenic { arsenic trioxide }	215-481-4	1327-53-3		46 mg/kg	1.32	60.735 mg/kg	0.00607 %		
5	benzo[<i>a</i>]anthracene	200-280-6	56-55-3		1.2 mg/kg		1.2 mg/kg	0.00012 %		
6	benzo[<i>a</i>]pyrene; benzo[<i>b</i>]chrysene	200-028-5	50-32-8		1.2 mg/kg		1.2 mg/kg	0.00012 %		
7	benzo[<i>b</i>]fluoranthene	205-911-9	205-99-2		1.3 mg/kg		1.3 mg/kg	0.00013 %		
8	benzo[<i>ghi</i>]perylene	205-883-8	191-24-2		0.63 mg/kg		0.63 mg/kg	0.000063 %		
9	benzo[<i>k</i>]fluoranthene	205-916-6	207-08-9		0.61 mg/kg		0.61 mg/kg	0.000061 %		
10	beryllium { beryllium oxide }	215-133-1	1304-56-9		0.84 mg/kg	2.775	2.331 mg/kg	0.000233 %		
11	boron { boron trichloride/trifluoride (combined) }		10294-33-4, 10294-34-5, 7637-07-2		0.3 mg/kg	13.43	4.029 mg/kg	0.000403 %		
12	cadmium { cadmium sulfide }	215-147-8	1306-23-6	1	<0.2 mg/kg	1.285	<0.257 mg/kg	<0.00002 %		<LOD
13	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }	215-160-9	1308-38-9		21 mg/kg	1.462	30.693 mg/kg	0.00307 %		
14	chromium in chromium(VI) compounds { chromium(VI) oxide }	215-607-8	1333-82-0		<1.8 mg/kg	1.923	<3.462 mg/kg	<0.000346 %		<LOD

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
15	chrysene	205-923-4	278-01-9		1.4 mg/kg		1.4 mg/kg	0.00014 %		
16	copper { dicopper oxide: copper (I) oxide }	215-270-7	1317-39-1		32 mg/kg	1.126	36.028 mg/kg	0.0036 %		
17	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }				<1 mg/kg	1.884	<1.884 mg/kg	<0.000188 %		<LOD
18	dibenz[a,h]anthracene	200-181-8	53-70-3		0.25 mg/kg		0.25 mg/kg	0.000025 %		
19	fluoranthene	205-912-4	206-44-0		2.7 mg/kg		2.7 mg/kg	0.00027 %		
20	fluorene	201-695-5	86-73-7		0.3 mg/kg		0.3 mg/kg	0.00003 %		
21	indeno[123-cd]pyrene	205-893-2	193-39-5		0.54 mg/kg		0.54 mg/kg	0.000054 %		
22	lead { lead compounds with the exception of those specified elsewhere in this Annex }			1	97 mg/kg		97 mg/kg	0.0097 %		
23	mercury { mercury dichloride }	231-299-8	7487-94-7		<0.3 mg/kg	1.353	<0.406 mg/kg	<0.0000406 %		<LOD
24	naphthalene	202-049-5	91-20-3		0.12 mg/kg		0.12 mg/kg	0.000012 %		
25	nickel { nickel dithydroxide }	235-008-5 [1] 234-348-1 [2]	12054-48-7 [1] 11113-74-9 [2]		19 mg/kg	1.579	30.01 mg/kg	0.003 %		
26	pH				7.8 pH		7.8 pH	7.8 pH		
27	phenanthrene	201-581-5	85-01-8		1.9 mg/kg		1.9 mg/kg	0.00019 %		
28	phenol	203-632-7	108-95-2		<1 mg/kg		<1 mg/kg	<0.0001 %		<LOD
29	pyrene	204-927-3	129-00-0		2.6 mg/kg		2.6 mg/kg	0.000026 %		
30	zinc { zinc oxide }	215-222-5	1314-13-2		700 mg/kg	1.245	871.3 mg/kg	0.0871 %		
					Total:		0.115 %			

Key

User supplied data

Determinand values ignored for classification, see column 'Conc. Not Used' for reason

<LOD

Determinand defined or amended by HazWasteOnline (see Appendix A)

Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration

CLP: Note 1

Below limit of detection

Only the metal concentration has been used for classification

Appendix A: Classifier defined and non GB MCL determinands

- acenaphthene** (EC Number: 201-469-6, CAS Number: 83-32-9)
Description/Comments: Data from C&L Inventory Database
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 17 Jul 2015
Hazard Statements: Eye Irrit. 2; H319 , STOT SE 3; H335 , Skin Irrit. 2; H315 , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410 , Aquatic Chronic 2; H411
- acenaphthylene** (EC Number: 205-917-1, CAS Number: 208-96-8)
Description/Comments: Data from C&L Inventory Database
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 17 Jul 2015
Hazard Statements: Acute Tox. 4; H302 , Acute Tox. 1; H330 , Acute Tox. 1; H310 , Eye Irrit. 2; H319 , STOT SE 3; H335 , Skin Irrit. 2; H315
- anthracene** (EC Number: 204-371-1, CAS Number: 120-12-7)
Description/Comments: Data from C&L Inventory Database
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 17 Jul 2015
Hazard Statements: Eye Irrit. 2; H319 , STOT SE 3; H335 , Skin Irrit. 2; H315 , Skin Sens. 1; H317 , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410
- benz[ghi]perylene** (EC Number: 205-883-8, CAS Number: 191-24-2)
Description/Comments: Data from C&L Inventory Database, SDS Sigma Aldrich 28/02/2015
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 23 Jul 2015
Hazard Statements: Aquatic Acute 1; H400 , Aquatic Chronic 1; H410
- boron tribromide/trichloride/trifluoride (combined)** (CAS Number: 10294-33-4, 10294-34-5, 7637-07-2)
Description/Comments: Combines the hazard statements and the average of the conversion factors for boron tribromide, boron trichloride and boron trifluoride
Data source: N/A
Data source date: 06 Aug 2015
Hazard Statements: EUH014 , Acute Tox. 2; H330 , Acute Tox. 2; H300 , Skin Corr. 1A; H314 , Skin Corr. 1B; H314
- chromium(III) oxide (worst case)** (EC Number: 215-160-9, CAS Number: 1308-38-9)
Description/Comments: Data from C&L Inventory Database
Data source: <https://echa.europa.eu/information-on-chemicals/cl-inventory-database/-/discli/details/33806>
Data source date: 17 Jul 2015
Hazard Statements: Acute Tox. 4; H332 , Acute Tox. 4; H302 , Eye Irrit. 2; H319 , STOT SE 3; H335 , Skin Irrit. 2; H315 , Resp. Sens. 1; H334 , Skin Sens. 1; H317 , Repr. 1B; H360FD , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410
- salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex**
GB MCL index number: 006-007-00-5
Description/Comments: Conversion factor based on a worst case compound: sodium cyanide
Additional Hazard Statement(s): EUH032 >= 0.2 %
Reason for additional Hazards Statement(s):
20 Nov 2021 - EUH032 >= 0.2 % hazard statement sourced from: WM3, Table C12.2
- fluoranthene** (EC Number: 205-912-4, CAS Number: 206-44-0)
Description/Comments: Data from C&L Inventory Database
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 21 Aug 2015
Hazard Statements: Acute Tox. 4; H302 , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410
- fluorene** (EC Number: 201-695-5, CAS Number: 86-73-7)
Description/Comments: Data from C&L Inventory Database
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 06 Aug 2015
Hazard Statements: Aquatic Acute 1; H400 , Aquatic Chronic 1; H410
- indeno[123-cd]pyrene** (EC Number: 205-893-2, CAS Number: 193-39-5)
Description/Comments: Data from C&L Inventory Database
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 06 Aug 2015
Hazard Statements: Carc. 2; H351

● lead compounds with the exception of those specified elsewhere in this Annex

GB MCL index number: 082-001-00-6
Description/Comments: Least-worst case: IARC considers lead compounds Group 2A; Probably carcinogenic to humans; Lead REACH Consortium, following MCL protocols, considers many simple lead compounds to be Carcinogenic category 2
Additional Hazard Statement(s): Carc. 2; H351
Reason for additional Hazards Statement(s):
20 Nov 2021 - Carc. 2; H351 hazard statement sourced from: IARC Group 2A (Sup 7, 87) 2006; Lead REACH Consortium
www.reach-head.eu/substanceinformation.html. Review date 29/09/2015

● pH (CAS Number: PH)

Description/Comments: Appendix C4
Data source: WM3 1st Edition 2015
Data source date: 25 May 2015
Hazard Statements: None.

● phenanthrene (EC Number: 201-581-5, CAS Number: 85-01-8)

Description/Comments: Data from C&I Inventory Database
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 06 Aug 2015
Hazard Statements: Acute Tox. 4; H302, Eye Irrit. 2; H319, STOT SE 3; H335, Carc. 2; H351, Skin Sens. 1; H317, Aquatic Acute 1; H400, Aquatic Chronic 1; H410, Skin Irrit. 2; H315

● pyrene (EC Number: 204-927-3, CAS Number: 129-00-0)

Description/Comments: Data from C&I Inventory Database; SDS Sigma Aldrich 2014
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 21 Aug 2015
Hazard Statements: Skin Irrit. 2; H315, Eye Irrit. 2; H319, STOT SE 3; H335, Aquatic Acute 1; H400, Aquatic Chronic 1; H410

● diesel petroleum group (CAS Number: 66334-30-5, 66476-34-6, 94114-59-7, 1159170-26-9)

Description/Comments: Hazard statements taken from WM3 1st Edition 2015, Risk phrases: WM2 3rd Edition 2013
Data source: WM3 1st Edition 2015
Data source date: 25 May 2015
Hazard Statements: Flam. Liq. 3; H226, Skin Irrit. 2; H315, Acute Tox. 4; H332, Carc. 2; H351, Asp. Tox. 1; H304, STOT RE 2; H373, Aquatic Chronic 2; H411

● ethylbenzene (EC Number: 202-849-4, CAS Number: 100-41-4)

GB MCL index number: 601-023-00-4
Description/Comments:
Additional Hazard Statement(s): Carc. 2; H351
Reason for additional Hazards Statement(s):
20 Nov 2021 - Carc. 2; H351 hazard statement sourced from: IARC Group 2B (77) 2000

● TPH (C6 to C40) petroleum group (CAS Number: TPH)

Description/Comments: Hazard statements taken from WM3 1st Edition 2015, Risk phrases: WM2 3rd Edition 2013
Data source: WM3 1st Edition 2015
Data source date: 25 May 2015
Hazard Statements: Flam. Liq. 3; H226, Asp. Tox. 1; H304, STOT RE 2; H373, Muta. 1B; H340, Carc. 1B; H350, Repr. 2; H361d, Aquatic Chronic 2; H411

Appendix B: Rationale for selection of metal species

arsenic (arsenic trioxide)

Worst case species based on hazard statements

beryllium (beryllium oxide)

Worst case species based on hazard statements

boron (boron tribromide/trichloride/trifluoride (combined))

Worst case species based on hazard statements

cadmium (cadmium sulfide)

Worst case species based on hazard statements

chromium in chromium(III) compounds {chromium(III) oxide (worst case)}

Worst case species based on hazard statements

chromium in chromium(VI) compounds {chromium(VI) oxide}

Worst case species based on hazard statements

copper {dicopper oxide; copper (I) oxide}

Most likely common species

cyanides (salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex)

Worst case species

lead {lead compounds with the exception of those specified elsewhere in this Annex}

Worst case species based on hazard statements

mercury {mercury dichloride}

Worst case species based on hazard statements

nickel {nickel dihydroxide}

Worst case species based on hazard statements

zinc {zinc oxide}

Worst case species based on hazard statements

Appendix C: Version

HazWasteOnline Classification Engine: **WM3 1st Edition v1.2.GB - Oct 2021**
HazWasteOnline Classification Engine Version: 2024.135.6053.11209 (14 May 2024)
HazWasteOnline Database: 2024.135.6053.11209 (14 May 2024)

This classification utilises the following guidance and legislation:

- WM3 v1.2.GB - Waste Classification** - 1st Edition v1.2.GB - Oct 2021
CLP Regulation - Regulation 1272/2008/EC of 16 December 2008
1st ATP - Regulation 790/2009/EC of 10 August 2009
2nd ATP - Regulation 286/2011/EC of 10 March 2011
3rd ATP - Regulation 618/2012/EU of 10 July 2012
4th ATP - Regulation 487/2013/EU of 8 May 2013
Correction to 1st ATP - Regulation 758/2013/EU of 7 August 2013
5th ATP - Regulation 944/2013/EU of 2 October 2013
6th ATP - Regulation 605/2014/EU of 5 June 2014
WFD Annex III replacement - Regulation 1357/2014/EU of 18 December 2014
Revised List of Waste 2014 - Decision 2014/955/EU of 18 December 2014
7th ATP - Regulation 2015/1221/EU of 24 July 2015
8th ATP - Regulation (EU) 2016/918 of 19 May 2016
9th ATP - Regulation (EU) 2016/1179 of 19 July 2016
10th ATP - Regulation (EU) 2017/776 of 4 May 2017
HP14 amendment - Regulation (EU) 2017/997 of 8 June 2017
13th ATP - Regulation (EU) 2018/1480 of 4 October 2018
14th ATP - Regulation (EU) 2020/217 of 4 October 2019
15th ATP - Regulation (EU) 2020/1182 of 19 May 2020
The Chemicals (Health and Safety) and Genetically Modified Organisms (Contained Use)(Amendment etc.) (EU Exit) Regulations 2020 - UK: 2020 No. 1567 of 16th December 2020
The Waste and Environmental Permitting etc. (Legislative Functions and Amendment etc.) (EU Exit) Regulations 2020 - UK: 2020 No. 1540 of 16th December 2020
GB MCL List - version 1.1 of 09 June 2021
GB MCL List v2.0 - version 2.0 of 20th October 2023
GB MCL List v3.0 - version 3.0 of 11th January 2024
GB MCL List v4.0 - version 4.0 of 2nd March 2024

Appendix G Geotechnical Risk Register

Geotechnical hazard identification – desk study stage

Potential geotechnical hazards have been assessed in accordance with the general requirements of ICE/DETR Document ‘Managing Geotechnical Risk’ and the HE documents HD 41/15 and CD 622. The following pages set out the identified geotechnical risks and hazards which are associated with the proposed development and establish the approach which is to be taken to manage the risks including the geotechnical input and analysis.

Table G.1 is a preliminary assessment of possible geotechnical hazards at the site at Desk Study stage. This information is used to assist with ground investigation design.

Table G.1: Possible geotechnical hazards

Hazard	Comment	Hazard status based on desk study	
		Could be present and / or affect site (i.e. Plausible)	Unlikely to be present and/or affect site
Uncontrolled Made Ground (variable strength and compressibility).	Deeper Made Ground may be associated with the former structures.	✓	-
Soft / loose compressible ground (low strength and high settlement potential).	The Made Ground may be soft in consistency or loose in density.	✓	-
Shrink swell of the clay fraction of soils under the influence of vegetation.	Glacial Till underlies the site and mature trees are present on site boundaries.	✓	-
Variable lateral and vertical changes in ground conditions.	The Made Ground may vary laterally and vertically.	✓	-
High sulphates present in the soils.	The Made Ground may contain elevated sulphates.	✓	-
Adverse chemical ground conditions, (e.g. expansive slag).	Unlikely to pose a risk.	-	✓
Obstructions.	May be present associated with former structures.	✓	-
Existing below ground structures to remain (on or off-site tunnels, foundations, basements, and adjacent sub-structures).	Unlikely to pose a risk.	-	✓
Shallow groundwater.	Perched groundwater may be present on top of the Glacial Till or within granular layers.	✓	-
Changing groundwater conditions.	Seasonal Variations may affect the groundwater depth.	✓	-
Risk from erosion.	Unlikely to pose a risk.	-	✓
Risk from flooding.	Unlikely to pose a risk.	-	✓
Loose Made Ground, leading to difficulty with excavation and collapse of side walls.	If granular the shallow Made Ground may be loose in density.	✓	-
Slope stability issues – general slopes.	Unlikely to pose a risk.	-	✓
Slope stability issues – retaining walls.	Unlikely to pose a risk.	-	✓

Hazard	Comment	Hazard status based on desk study	
		Could be present and / or affect site (i.e. Plausible)	Unlikely to be present and/or affect site
Earthworks – settlement (due to placement of fill on soft / loose ground).	Unlikely to pose a risk. If earthworks are required reassessment will be required and the suitability of soils onsite for reuse as fill will require assessment.	-	✓
Earthworks – poor bearing capacity of new fill.		-	✓
Earthworks – unsuitability of site won material to be reused as fill.		-	✓
Solution features in Chalk.	Unlikely to pose a risk.	-	✓
Cavities in the Superficial Deposits due to solution features.	Unlikely to pose a risk.	-	✓
Dissolution (associated with “wet rock head”).	Unlikely to pose a risk.	-	✓
Brine extraction.	Unlikely to pose a risk.	-	✓
Mining.	Unlikely to pose a risk.	-	✓
Cambered ground with gulls possibly present.	Unlikely to pose a risk.	-	✓
Relict Slip Surfaces.	Unlikely to pose a risk.	-	✓
Solifluction.	Unlikely to pose a risk.	-	✓
Problematic soils (silts and rewetting etc.).	Unlikely to pose a risk.	-	✓

Geotechnical Hazard Identification – Following Ground Investigation

The preliminary Geotechnical Risk Register following Ground Investigation is set out in Table G.3.

The probability and impact of a hazard have been judged on a qualitative scale as set out in Table G.2. The degree of risk (R) is determined by combining an assessment of the probability (P) of the hazard occurring with an assessment of the impact (I) of the hazard and associated mitigation it will require if it occurs ($R = P \times I$).

Table G.2: Qualitative assessment of hazards and risks

P = Probability		I = Impact		R = Risk Rating (P x I)	
1	Very unlikely (VU)	1	Very Low	1 – 4	None / negligible
2	Unlikely (U)	2	Low	5 – 9	Minor
3	Plausible (P)	3	Medium	10 – 14	Moderate
4	Likely (Lk)	4	High	15 – 19	Substantial
5	Very Likely (VLk)	5	Very High	20 - 25	Severe

Table G.3: Geotechnical Risk Register

Hazard	Comment	Who is at Risk	Consequence	Risk Before Mitigation			Actions Required
				P	I	R	
Uncontrolled Made Ground (variable strength and compressibility).	Made Ground underneath the proposed building extends to 1.00m bgl and up to 1.55m in WS01 within a proposed landscaped area and may encroach into an external area.	Proposed Building.	Bearing capacity failure, settlement (total and differential).	3	4	12	Design foundations to found below Made Ground.
			Floor slab failure.	3	4	12	Design floor slabs as suspended.
		Roads and Pavements.	Settlement (total and differential) of roads and pavements.	3	2	6	Design roads and pavements using suitable geotechnical parameters and increase the sub-base and use geo-grids as appropriate.
		Services.	Settlement (differential), causing damage to services.	2	2	4	Settlements are not anticipated to be significant with regard to services. No additional design requirements envisaged.
		Soft Landscaping	Settlement (differential), in gardens.	2	2	4	It is unlikely that settlements will be significant with regard to soft landscaping.
		Construction staff, vehicles and plant operators.	Trafficking of the site in temporary conditions. Overturning of plant during construction.	3	3	9	Where soft spots encountered, over-excavation and replacement with suitable fill. Outline design of working platform to include geo-grid. Site inspection and watching brief by Contractor to review working platform frequently and regularly.

Hazard	Comment	Who is at Risk	Consequence	Risk Before Mitigation			Actions Required
				P	I	R	
Soft / loose ground (low strength and high settlement potential).	The shallow Glacial Till is soft to firm. Becoming stiff with depth.	Proposed Building	Foundation bearing capacity failure, settlement (total and differential).	3	4	12	Design foundations to found below any soft clays.
			Floor slab failure.	3	4	12	Design floor slab as suspended.
		Roads and Pavements.	Settlement (total and differential), of roads and pavements.		3		Design roads and pavements using suitable geotechnical parameters and increase the sub-base and use geo-grids as appropriate. If anticipated settlements are significant, and cannot be mitigated by design, over-excavate and replace soft soils.
		Services.	Settlement (differential), causing damage to services.	2	2	4	Settlements are not anticipated to be significant with regard to services. No additional design requirements envisaged.
		Gardens.	Settlement (differential), in gardens.	2	2	4	It is unlikely that settlements will be significant with regard to soft landscaping.
		Construction staff, vehicles and plant operators.	Trafficking of the site in temporary conditions. Overturning of plant during construction.	3	3	9	Where soft spots encountered, over-excavate and replace with suitable fill. Design working platform to suit the ground conditions. Outline design of working platform to include geo-grid if necessary. Site inspection and watching brief by Contractor to review working platform frequently and regularly.
Shrinkage / swelling of the clay fraction of soils under the influence of vegetation.	The clays of the medium volume change potential.	Foundations.	Shrinkage or heave of soils and associated damage to foundations.	3	4	12	Complete desiccation assessment if pad foundations are considered suitable. Utilise void formers to protect pad foundations or the top of piles from heave.
		Floor slabs.	Floor slab failure.	3	4	12	Design floor slab as suspended with a void, unless the warranty provider is satisfied the soil is not desiccated, or slabs are constructed when soils are not seasonally desiccated (i.e. during winter and spring).

Hazard	Comment	Who is at Risk	Consequence	Risk Before Mitigation			Actions Required
				P	I	R	
Shallow groundwater.	Post investigation monitoring found a perched water table at circa 0.60m bgl.	Construction staff, vehicles and plant operators.	Difficulty with excavation.	4	2	8	Contractor to appoint competent Temporary Works Designer to design temporary works, in accordance with BS 5975:2008+A1:2011. Temporary Works Designer to consider in their analysis the impact of, and requirements for, de-watering of excavations. Temporary Works Designer to consider in their analysis the impact of a variable water table. Any water that collects at the base of excavations to be removed as soon as practicable.
Loose Made Ground, leading to difficulty with excavation and collapse of side walls.	The ground investigation has indicated that there is a potential for loose soils and Made Ground to be present at the site.	Construction staff, vehicles and plant operators.	Ground failure, instability of plant and machinery.	3	4	12	As instability has been noted in all pits from surface, foundation options should be reviewed to ensure minimal excavation (e.g. piles).
			Risk of collapse of excavation.	3	3	9	Contractor to appoint competent Temporary Works Designer to design temporary works, in accordance with BS 5975:2008+A1:2011. Temporary Works Design to include recommendations for inspection of excavations. No person entry to unsupported excavations.
Unforeseen ground conditions - risk associated with limited data.	Ground investigation has been undertaken. However, additional information will be obtained during construction . Ground conditions are only defined at exploratory hole locations.	All aspects of the development		3	4	12	Designers to be contacted if conditions encountered are different to those identified during investigation. Regular inspections of excavations and earthworks for evidence of stability. Adequate investigation required to characterise the site and understand the potential risks.

Whilst the probability and impact of the hazard occurring can be reduced to a minimum by geotechnical design, the impact cannot be reduced below very low. The risk register will need to be up-dated, as necessary, to reflect design, additional information, data and experience as it is gained through the construction process.

Impacts of the design with regard to health and Safety considerations will need to be included by the designer at design stage.

Appendix H Plausible Source-Pathway- Receptor Contaminant Linkages

Summary of potential contaminant linkages

Table H.2 lists the plausible contaminant linkages which have been identified. These are considered as potentially unacceptable risks in line with guidelines published in LCRM (2023) and additional risk assessment is required.

Source – Pathway – Receptor Linkages have been assessed in general accordance with guidance in CIRIA Report C552 (Rudland *et al* 2001) but modified to add a 'no linkage' category and to remove low/moderate risk (See Table H.1).

It should be noted that whilst the risk assessment process undertaken in this report may identify potential risks to site demolition and redevelopment workers, consideration of occupational health and safety issues is beyond the scope of this report and need to be considered separately in the Construction Phase Health and Safety Plan.

Table H.1: Consequence versus probability assessment.

Probability	Consequence				
		Severe	Medium	Mild	Minor
	High Likelihood	Very high risk	High risk	Moderate risk	Low risk
	Likely	High risk	Moderate risk	Low risk	Very low risk
	Low Likelihood	Moderate risk	Low risk	Low risk	Very low risk
	Unlikely	Low risk	Very low risk	Very low risk	Very low risk
	No Linkage	No risk			

Table H.2: Exposure model – final source-pathway-receptor contaminant linkages

Sources	Possible Pathways	Receptors	Probability	Consequence	Risk Level	Comments
Pervasive PAHs and asbestos loose fibres in the Made Ground.	Ingestion, inhalation or direct contact.	Human Health.	Likely	Medium	Moderate	Pervasive PAHs and asbestos loose fibres are present within the shallow Made Ground (asbestos fibres only recorded in one out of the 8 samples tested). Mitigation required in the form of a simple cover system with a high visibility marker layer at the base.
Elevated Naphthalene concentrations within the Made Ground.	Direct Contact	Water Pipes	Likely	Medium	Moderate	The Made Ground contains concentrations of Naphthalene which exceed the PE threshold if water pipes are proposed in the Made Ground and not the Glacial Till they will have to be barrier pipes subject to liaison with Untied Utilities. If installed in the Glacial Till standard PE pipes will be suitable.
Locally elevated zinc within the Glacial Till.	Root uptake by plant	Plant Uptake	Unlikely	Mild	Low	Completed chemical analysis on subsoil (Glacial Till) to confirm it is chemical suitable for reuse within cover system and will not pose a risk to plant life. The elevated zinc found is likely to be a local hotspot.
Methane and carbon dioxide via migration through the weathered Chester Formation	Migration, build up and explosion.	Human Health - Site Users	Likely	Severe	Moderate	Should a piled solution be adopted there is a requirement to install Characteristic Situation 2 Ground Gas Protection Measures.
		Human Health - Neighbours	Low Likelihood	Medium	Low	
		Buildings on site	Likely	Severe	Moderate	

Appendix I Climate Change Considerations for CSM

Table I.1 summarises the considerations that have been made in relation the possible implications of predicted climate change. These considerations have been made with reference to prevailing guidance on climate change and land contamination (SoBRA (2022), CL:AIRE (2022), Environment Agency (2010)), and climate change information published by the Met Office and the Environment Agency.

Table I.1: Possible CSM considerations related to climate change.

Climate change type	Potential climate change induced effect	Possible considerations on CSM
Increase in frequency and severity of extreme rainfall events	Temporary increasing in groundwater levels	Given the development proposal will include predominately hardstanding, extreme rainfall is unlikely to have a considerable impact on the shallow perched groundwater which is likely local/discontinuous. The petroleum hydrocarbons present within the Made Ground locally are considered to be of low aqueous solubility. Therefore, groundwater increase is unlikely to impact their mobility. The hardstanding will reduce/limit infiltration limiting the mobilisation of leachable PAHs from the Made Ground.
	Increased surface run-off	Site is covered in concrete hardstanding with associated surface water drainage. Surface water run-off will impact drainage network (in terms of volume of water) but is not expected to impact underlying ground conditions.
	Land-based erosion	The site is not in close proximity to a surface water course.
	River flooding	The site lies within a Flood Zone 1 and considering its distance to the nearest water course the sites flood risk classification is unlikely to alter during the lifetime of the building.
Increase in frequency and severity of extreme cold and hot weather events	Soil freezing	Could cause failure of surface water drainage network (requiring repair) due to freeze/thaw action but not evident that this would cause a significant change to identified contaminant linkages.
	Soil desiccation/shrinkage	The presence of hardstanding across the majority of the site will offer protection to the shallow Glacial Till from the impacts of drier air temperatures.
	Land fires	Not relevant to current nature and location of site.
	Temporary drop in water (GW and/or SW) levels due to increased water abstraction demand	Underlying shallow aquifer does not have any licenced abstractions registered within 1km of the site. Impact of a drop in water levels in the Chester Formation is not expected to adversely affect identified contaminant linkages.
	Temporary drop in water levels (GW and/or SW) due to lower rainfall.	The petroleum hydrocarbons present within the Made Ground are heavy end with minimal potential for volatilization.
Long-term sea level rise	Coastal erosion	The site is not in close proximity to the coast.
	Saline intrusion and marine inundation	The site is not in close proximity to the coast and unlikely to be impacted by saline intrusions,
Long-term increase in rainfall	Increase in groundwater levels	The site is located within a river catchment that eFLAG predicts will see an increase of 1.63mm per day in groundwater recharge in winter months. No predicted changes in water levels are expected within the Chester Formation and the hardstanding will protect the perched groundwater from significant rises.
Long-term decrease in rainfall	Decrease in groundwater levels	Underlying shallow aquifer does not have any licenced abstractions registered within 1km of the site. Impact of a drop in water levels in the Chester Formation is not expected to adversely affect identified contaminant linkages.

Climate change type	Potential climate change induced effect	Possible considerations on CSM
Long-term change in seasonal temperatures	Change in soil temperature	Worst-case (RCP8.5) prediction for average summer temperatures in 2060-2080 in this area is 3-4 degrees Celsius. Soil temperature at depth below the site (considering the surface cover of buildings and concrete hardstanding) is not expected to rise by this amount and may see a much smaller rise in average temperature as a result of seasonal variation in temperature. A small increase in average soil temperature is not expected to have a significant effect on contaminant fate and transport.

Appendix J Preliminary UXO Risk Assessment

Preliminary Unexploded Ordnance (UXO) Risk Assessment

Project Name	The Limes, Owen Park
Client	Hydrock Consultants Limited
Site Address	The Limes, Owen Park, Fallowfield, Manchester, M14 6YZ
Report Reference	PA19649-00
Date	13/03/2024
Author	MT
Quality Assurance	AT

1st Line Defence

3 Maple Park, Essex Road, Hoddesdon. EN11 0EX

Tel +44 (0) 1992 245 020 Email info@1stlinedefence.co.uk

Web www.1stlinedefence.co.uk Company Reg No. 07717863



1ST LINE DEFENCE



Assessment Objective

This preliminary unexploded ordnance (UXO) risk assessment is a qualitative screening exercise to assess the likely potential of encountering UXO at the The Limes, Owen Park site. The assessment involves the consideration of the basic factors that affect the potential for UXO to be present at a site as outlined in Stage One of the UXO risk management process.

Background

This assessment uses the sources of information available in-house to 1st Line Defence Ltd to enable the placement of a development site in context with events that may have led to the presence of German air-delivered or Allied military UXO. The report will identify any immediate necessity for risk mitigation or additional research in the form of a Detailed UXO Risk Assessment. It makes use of 1st Line Defence's extensive historical archives, library and unique geo-databases, as well as internet resources, and is researched and compiled by UXO specialists and graduate researchers.

The assessment directly follows CIRIA C681 guidelines "Unexploded Ordnance, a Guide for the Construction Industry". The document will therefore assess the following factors:

- Basic Site Data
- Previous Military Use
- Indicators of potential aerial delivered UXO threat
- Consideration of any Mitigating Factors
- Extent of Proposed Intrusive Works
- Any requirement for Further Work

It should be noted that the vast majority of construction sites in the UK will have a low or negligible risk of encountering UXO and should be able to be screened out at this preliminary stage. The report is meant as a common sense 'first step' in the UXO risk management process. The content of the report and conclusions drawn are based on basic, preliminary research using the information available to 1st Line Defence at the time this report was produced. It should be noted that the only way to entirely negate risk from UXO to a project would be to support the works proposed with appropriate UXO risk mitigation measures. It is rarely possible to state that there is absolutely 'no' risk from UXO to a project.

Site Boundary



Risk Assessment Considerations	
Site location and description/current use	The site is located in Manchester, within the county of Greater Manchester. It is bordered to the north by residential properties and open ground, to the east by further residential properties, to the south by Richmond Park and to the west by Whitworth Lane. The site is currently occupied by hardstanding ground, in the form of a carpark. The site is approximately centred on the OS grid reference: SJ 85894 94335.
Are there any indicators of current/historical military activity on/close to the site?	No information could be found in-house to indicate that the site location has any former or current association with any military features. No features such as WWII defensive positions, encampments or firing ranges are recorded to have been located at the site. In addition, no information of ordnance being stored, produced, or disposed of within the proposed site boundary could be found. The closest Heavy Anti-Aircraft (HAA) battery was positioned approximately 280m south-east of the site in the vicinity of the Armitage Sports Centre. The exact location of this is unknown at this preliminary stage, but it is not thought likely to have directly affected the site.
What was the pre- and post-WWII history of the site?	The site was partially occupied by the Fallowfield Stadium, which was in use from 1892 to 1994.¹ Pre-war OS mapping dated 1934 shows the site to be occupied by a <i>Tennis Ground</i> in the northern section of the site, <i>Stands</i> and part of an <i>Athletic Ground</i> in the south of the site and the remainder of the site was occupied by open ground associated with the aforementioned. The site was bordered to the north by open ground, to the east by open ground and a building, to the south by an <i>Athletic Ground</i> and to the west by a roadway. Post-war OS mapping dated 1956 – 1964 shows the site composition to have changed slightly, with the <i>Tennis Ground</i> having been removed from the site's northern section. The site's direct surroundings have remained unchanged from pre-war mapping.
Was the area subject to bombing during WWII?	During WWII the site was situated within the County Borough of Manchester, which sustained an overall low density of bombing, with an average of 27.1 items recorded per 1,000 acres according to official Home Office bombing statistics. This amounted to 712 high explosive (HE) bombs, 18 parachute mines, seven oil bombs and one V-1 flying bomb; totalling 738 incidents over an area of 27,255 acres. Local bomb plot and damage mapping does not record any bomb strikes or damage on or directly bordering the site area. The closest bomb strike recorded is a land mine recorded approximately 150m north of the site, on the northern side of Old Hall Lane.
Is there any evidence of bomb damage on/close to the site?	It has not been possible at this preliminary stage to determine the extent of damage, if any, may have occurred on site. The closest area of damage noted on damage mapping is the destruction of four houses on the southern side of Old Hall Lane, at least 100m north of the site, which appears to be associated with the previously mentioned land mine.

¹ <https://rusholmearchive.org/fallowfield-stadium-1892-1994>

To what degree would the site have been subject to access?	Given that the site was occupied by a tennis grounds and athletics stadium during the war the site is considered to have experienced regular access and monitor throughout the war. Higher levels of access increases the likelihood that evidence of UXO would have been noticed and reported.
To what degree has the site been developed post-WWII?	The site has undergone significant post-war redevelopment since 1964, with the stadium and stands on site being removed and the entire site concreted over for use as a carpark at some point between 1964 and 2000.
What is the nature and extent of the intrusive works proposed?	The extent of proposed works was not known at the time of writing this report.

Summary and Conclusions

During WWII the site was situated within the County Borough of Manchester, which sustained an overall low density of bombing, with an average of 27.1 items recorded per 1,000 acres according to official Home Office bombing statistics.

Local bomb plot and damage mapping does not record any bomb strikes or damage on or directly bordering the site area. Given the low density of bombing across the district, with no positive evidence found to suggest any bombing/damage occurred within the site, the risk of encountering UXO is not considered significantly elevated above the 'background' level of risk for the region.

Recommendations

Given the findings of this preliminary report, the risk from UXO on site is not considered to be significantly elevated above the 'background level' for the region. It is therefore recommended that **no further research** be taken at this site. Whilst it would be possible to conduct a Detailed UXO Risk Assessment to analyse further archival resources, it is not thought likely that the acquisition of such records would significantly alter the findings of this report.

If the client has any anecdotal or empirical evidence of UXO risk on site, please contact 1st Line Defence.

It should be noted that although the risk from unexploded ordnance on this site has been assessed as low/minimal, this does not mean there is 'no' risk of encountering UXO. This preliminary report has been undertaken with due diligence, and all reasonable care has been taken to access and analyse relevant historical information. By necessity, when dealing with historical evidence, and when making assessments of UXO risk, various assumptions have to be made which we have discussed and justified within this report. Our reports take a common-sense and practical approach to the assessment of UXO risk, and we strive to be reasonable and pragmatic in our conclusions. As referenced, it would be possible to undertake further research into this site, but based on the evidence to hand, this is not deemed strictly necessary, and no reasonably justifiable requirement for proactive on-site mitigation has been identified.

It should however be stressed that if any suspect items are encountered during the proposed works, 1st Line Defence should be contacted for advice/assistance, and to re-assess the risk as necessary. Furthermore, we would recommend that ground personnel are always made aware of the potential for encountering UXO, what to look out for and what to do in the unlikely event that a suspect item is encountered, and that a UXO Risk Management Plan is put together for the proposed works. We would be happy to provide a template and guidance for this – contact us on 01992 245020. Should the scope of works change or additional works be proposed, 1st Line Defence should be contacted to re-evaluate the risk.

This report has been prepared by 1st Line Defence Limited with all reasonable care and skill. The report contains historical data and information from third party sources. 1st Line Defence Limited has sought to verify the accuracy and comprehensiveness of this information where possible but cannot be held accountable for any inherent errors. Furthermore, whilst every reasonable effort has been made to locate and access all relevant historical information, 1st Line Defence cannot be held responsible for any changes to risk level or mitigation recommendations resulting from documentation or other information which may come to light at a later date.

This report was written by, is owned by and is copyrighted to 1st Line Defence Limited. It contains important 1st Line Defence information which is disclosed only for the purposes of the client's evaluation and assessment of the project to which the report is about. The contents of this report shall not, in whole or in part be used for any other purpose apart from the assessment and evaluation of the project; be relied upon in any way by the person other than the client, be disclosed to any affiliate of the client's company who is not required to know such information, nor to any third party person, organisation or government, be copied or stored in any retrieval system, be reproduced or transmitted in any form by photocopying or any optical, electronic, mechanical or other means, without prior written consent of the Managing Director, 1st Line Defence Limited, Unit 3, Maple Park, Essex Road, Hoddesdon EN11 0EX. Accordingly, no responsibility or liability is accepted by 1st Line Defence towards any other person in respect of the use of this report or reliance on the information contained within it, except as may be designated by law for any matter outside the scope of this report.

1st Line Defence

Unit 3, Maple Park
Essex Road, Hoddesdon
Hertfordshire EN11 0EX

Call +44 (0) 1992 245 020

Email info@1stlinedefence.co.uk

Web www.1stlinedefence.co.uk



1ST LINE DEFENCE