



e3p

Phase II Geoenvironmental Site Assessment
Oakenrod School, Rochdale

Reference: 16-932-R1-1
Date: August 2023



PHASE II GEOENVIRONMENTAL SITE ASSESSMENT

Oakenrod School
Bury Road
Rochdale
OL11 4EU

Prepared for:
Hallmark Developments Ltd

Report Ref: 16-932-R1-1
Date Issued: August 2023

Oakenrod School, Rochdale

Phase II Geoenvironmental Site Assessment

August 2023

E3P

Taylor Road
Trafford Park
Urmston
Manchester
M41 7JQ

+ 44 (0) 161 707 9612
<https://e3p.co.uk>

Registered in England
CRN: 08725262

QUALITY ASSURANCE

PROJECT NUMBER	16-932		
VERSION	Version 1		
REMARKS	Final		
DATE	August 2023		
PREPARED BY	E Fearn		
QUALIFICATIONS	BSc (Hons), MSc, FGS		
CHECKED BY	R Walker		
QUALIFICATIONS	BSc (Hons), FGS, AIEMA, AMICE, MIEEnvSc, CEnv		
AUTHORISED BY	A Edgar		
QUALIFICATIONS	BSc, MSc, PIEMA, MIEEnvSc, CEnv		

EXECUTIVE SUMMARY

Site Address	Land south of Bury Road, Rochdale, OL11 4EU.	
Grid Reference	E 388723, N 413073.	
Site Area	~2.61 Ha.	
Proposed Development	Hallmark Developments Ltd are proposing to construct a low-rise residential development with associated estate roads, greenspace, pond and utility infrastructure.	
Current Site Use	The site is an irregular shaped parcel of land to the south of Bury Road. The site is currently undeveloped rough scrubland and woodland, with an area in the north east of the site utilised as a car park. The site is predominantly covered in concrete or asphalt hardstand in the north and dense woodland and vegetation in the south. Evidence of a basement remains in the centre of the site, associated with the former Mill building. Cobbles are also present surrounding this area, indicative of a former access road. A retaining wall has been identified along the northern boundary along Bury Road. A slope has been identified on the south eastern boundary down to the River Roch. The River Roch is approximately 1.00 m below site level. Japanese Knotweed and Himalayan Balsam were detected within large areas of the site.	
Site History	Historical mapping from pre 1860 suggests the site was formerly Oakenrod Woollen Mill with associated chimney, tank and reservoir across the majority of the site and residential dwellings in the north east of the site. A sluice from the River Roch also entered the site from the southern boundary until 1992. A school was then constructed in the north of the site around 1913. The mill remained in the south of the site, with a mill stream recorded in the centre of the site The 1959 mapping indicates that the residential dwellings in the north east of the site are no longer recorded. The main Mill building from 1989 is no longer recorded, with the northern Works building recorded until 2003. From the available aerial imagery from 2000 the school building in the north of the site is present, however the Works building has been demolished and the area recorded as dense woodland. The 2013 aerial imagery indicates that the school building has been demolished, with the site left as scrubland and woodland to the present day.	
Environmental Setting	Drift Geology	Glaciofluvial Deposits (north), Alluvium (south), None (east).
	Bedrock Geology	Pennine Lower Coal Measures.
	Faults	None recorded below the site.



Environmental Setting continued.	Hydrogeology	Secondary A Aquifer (drift) overlying Secondary A Aquifer (solid). No active groundwater abstractions have been identified within a 1 km radius.
	Hydrology	The River Roch is located adjacent to the south eastern site boundary. The River Roch is classified by the Environment Agency as a Main River.
	Flood Risk	The south of the site is within an EA Flood Zone 3.
Natural Landform and Geomorphology	The subject site is located directly north of the River Roch, and is currently largely level with a slope along the southern boundary down to the River Roch. However it is likely that it has been levelled and regraded over time due to the historical development as a school in the north and a Mill in the south. The ground beneath the former houses in the north eastern sector is also likely to have been levelled. There were also numerous bunds located across the site and the sluice in the south of the site which has been infilled. It is likely that the site sloped south down towards the River Roch and therefore the site has been the subject of level raising through upfilling prior to the historical development. A Flood Risk Activity Permit may be needed for any construction works completed adjacent to the River Roch.	
Previous Reports	A Phase 1 Habitat Survey has been completed for the site in December 2022 by Rachel Hacking Ecology.  Rachel Hacking Ecology – Extended Phase I Habitat Survey. Ref: Rev B. Dated December 2022. The key findings are summarised below.  Japanese Knotweed and Himalayan Balsam were detected within large areas of the site.  The proposed development has the potential to impact on Great Crested Newt, should this species be present, and further survey or mitigation will be required.  No buildings are present on site. Removal of trees has the potential to impact on bats and their roosts, should these be present.  No evidence of badger activity was identified Any retained trees and woodland on site should be protected during construction by fencing. A Groundsure report (Ref: GS8658359; dated April 2022) was also provided to E3P by Hallmark Developments Ltd. This was utilised during the production of this report for the site setting and historical mapping of the site.	



Previous Reports continued.	An Archaeological Evaluation report is also freely available online for the site, completed by Oxford Archaeology North (Ref: 2006-07/601; November 2006). The key findings are summarised below. ✿ The site is of some archaeological significance as it was occupied since the early seventeenth century by a series of textile mills. The first was a fulling mill. ✿ By the nineteenth century, a water-powered woollen mill occupied the site. The woollen mill, known as Oakenrod Mill was adapted to steam power by the mid-nineteenth century. ✿ By the end of the nineteenth century, the mill has been remodelled for use as a cotton waste mill and an additional factory block has been added. There is also evidence that the mill has been powered, by a turbine during the nineteenth century. ✿ The evaluation in September 2006 comprised the excavation of six targeted trenches, four in the area of Oakenrod Mill and two in the area of the site occupied by the fulling mill. ✿ The evaluation demonstrated the presence of significant remains of Oakenrod Mill, in particular the remains of the water-powered system were represented by two head-race tunnels, with an intact waterwheel pit and the turbine pit within the basement of the earliest mill building. It is anticipated that a further programme of archaeological work will be required prior to the redevelopment of the site, as the original mill block and smaller areas of the mid-nineteenth century block, are considered to be of high archaeological sensitivity.
Utility Locations	A full Ground Penetrating Radar (GPR) survey has not been undertaken for the site. However, a review of the available utility plans for the site indicate that a combined sewer is located in the north western corner of the site. BT Openreach infrastructure is present along the northern boundary and enters the site to a telegraph pole in the north. LV electricity cables are also present in the centre of the site, entering from the north eastern boundary. A HV electricity pylon is located off-site to the south west of the site.
Landfill Sites and Ground Gases	A historical landfill site is located 90m north of the subject site, named as Sandy Brow. No further information is available. Significant depths of Made Ground and the former infilled reservoir on site may pose a ground gas risk. Due to the presence of low-permeability drift deposits and the distance of the landfill from the subject site, it is considered that these will pose a lower degree of risk associated with hazardous ground gases to the proposed development.
Coal Mining	The site is not situated within a Coal Authority reporting area, therefore an assessment is not required.
Radon	The site is located within an area where 3–5% of properties are potentially affected by radon. Basic radon protection measures may be required.



Hazardous Installations	No hazardous installations that could potentially prejudice the proposed construction of highly sensitive residential dwellings have been identified on site. However, an electricity substation and HV pylon are located approximately 12m south west of the subject site.
--------------------------------	---

GROUND INVESTIGATION

Ground Investigation Works	E3P has completed an intrusive ground investigation comprising: ✳ 10 x mechanically excavated trial pits, ✳ 8 x window sample boreholes, ✳ 1 x cable percussive borehole, and ✳ Construction of environmental monitoring installations.
Ground Conditions	Made Ground – 0.00 m bgl to 2.35 m bgl Made Ground deposits were encountered within all exploratory hole locations to depths of between 0.20 m bgl and to a proven depth of 2.35 m bgl although, in general, Made Ground was encountered to a depth of less than 1.00 m bgl. The full depth of Made Ground was not proven in TP109 and TP110 in the centre of the site, due to instability in TP109 and compacted ground in TP110. It is inferred that these materials are associated with the Former Oakenrod Mill buildings. Made Ground deposits in the northern sector of the site generally comprise asphalt/concrete underlain by a black sandy gravel of mudstone, clinker and ash. This was underlain by a brown slightly gravelly sandy clay with gravel of mudstone, brick, concrete and ash. Whereas in the southern sector of the site the Made Ground generally comprises brown slightly clayey slightly gravelly fine to medium sand with gravel of brick, clinker, ash, concrete, ceramic, glass, plastic and timber. PEAT – 0.80 m bgl to 2.00 m bgl Peat was identified in one location in the north of the site at TP103 between 0.80 m bgl and 2.00 m bgl. The full depth of peat was not established due to water ingress within the excavation making the excavation walls unstable. DRIFT – 0.20 m bgl to 4.44 m bgl Drift deposits were encountered within the majority of exploratory locations with the exception of two locations where the full depth of Made Ground could not be proven. The drift deposits are varied, generally comprising a firm to very stiff medium to high strength brown sandy gravelly CLAY with gravel of mudstone. In the north of the site, at five locations (TP101, TP102, TP104, TP105 and WS103), a very soft to soft very low strength blueish grey slightly gravelly very sandy CLAY with gravel of mudstone was encountered at 0.70 m bgl and 2.35 m bgl. The CLAY is locally interbedded in TP106 in the north east of the site with brownish grey fine to medium GRAVEL of mudstone and sandstone.



Ground Conditions continued.	Within CP101 in the centre of the site, a very loose brown clayey silty SAND with gravel of sandstone was encountered between 0.30 m bgl and 1.50 m bgl. This was underlain by a medium dense grey silty clayey SAND with gravel of sandstone to 2.50 m bgl, where the stiff medium strength gravelly CLAY was encountered.
	SOLID – 0.40 m bgl to 5.39 m bgl The solid bedrock geology was encountered at depths between 0.40 m bgl and 3.30 m bgl, in the centre of the site to a maximum proven depth of 5.39 m bgl. The solid geology comprised dense weathered SANDSTONE and dense weathered SILTSTONE.
	GROUNDWATER – Groundwater was encountered between 0.90 m bgl and 3.00 m bgl during the ground investigation, flowing south towards the River Roch.

CONTAMINATED LAND ASSESSMENT

Human Health	The Tier 2 human health risk assessment identified concentrations of non-volatile, low-solubility heavy metals and hydrocarbon compounds that would present unacceptable degrees of theoretical risk to the identified receptors associated with direct exposure pathways. As such, it will be necessary to design and construct the proposed development in a manner that will ensure suitably validated cover systems for all areas of private garden, soft landscaping and public open space. Asbestos in the form of chrysotile has also been identified within two localised areas in Made Ground deposits at TP109 at 1.00 m bgl and WS106 at 0.20 m bgl. Asbestos quantification was undertaken to further assess where these soils may be placed, the levels detected were between 0.141% and 0.043% respectively. No visual signs of ACM were encountered during the ground investigation. It is considered that the development will be suitable for the intended use, subject to the careful management and placement of anthropogenic materials in accordance with the developed CSM. With regards to the elevated naphthalene, this presents a potential volatilisation to indoor air risk. These elevated concentrations have been identified within three areas of the site and are therefore considered to be localised hotspots associated with the historic site use of a former Mill. Therefore, during a process of cut/fill enabling works, a hotspot removal should be undertaken where these soils may be delineated and chemically validated to assess chemical suitability for retention on-site in an area of no future sensitivity, treatment or off-site disposal. Chemical analysis of the natural clay drift deposits has identified these soils to be acceptable for use as subsoil within the proposed garden areas; however, further chemical validation samples will be required to confirm this. There are no suitable sources of topsoil available on the site.
Controlled Waters	The Tier 2 controlled waters risk assessment identified the River Roch to the south east of the site as the main receptor. Widespread heavy metal and Polycyclic Aromatic Hydrocarbon (PAH) compound exceedances were identified in leachate, groundwater and surface water samples when compared to the Environmental Quality Standards. These exceedances are considered to be associated with the former on-site mill.



Controlled Waters continued.	An m-BAT assessment and Lead screening assessment were carried out for the site, which concluded that the compounds were not considered bioavailable. Based on the assessment, E3P does not consider the site to pose an unacceptable level of risk to surface waters including the River Roch. It should also be noted the site is currently uncapped and the proposed development will largely encapsulate the site, thus limiting the potential for infiltration and therefore leaching potential. However, further analysis of the surface water in the River Roch should be undertaken as groundworks progress, to ensure no future mobilisation of contaminants is not caused, which may pose a risk to the watercourse.
Ground Gas	Characteristic Situation 1 (pending completion of gas monitoring). The localised area of peat will require removal and excavation backfilling with inert material.
Potable Water Infrastructure	This will need to be confirmed following the completion of a UKWIR risk assessment. Post-remediation and enabling works ground conditions may be different from those identified during this site investigation. Current ground conditions indicate that barrier pipe will be required.

GEOTECHNICAL ASSESSMENT

Underground Obstructions	Brick and concrete have been encountered within the Made Ground, indicative of relict foundations from the former mill building and school building across the site, including a brick wall indicative of a basement and a cobbled road. The archaeological report from 2006 also indicated significant underground obstructions are present across the site. During a phase of cut-and-fill enabling works to create a developable platform, all below-ground obstructions will require grubbing out to the base of the Made Ground to enable the construction of proposed plots.
Allowable Bearing Pressure	The underlying natural clay drift deposits have been assessed as being stiff high strength with a net ABP in the order of 80 kN/m² at circa 1.00 m bgl increasing to 150–200 kN/m² at circa 2.00 m bgl. The localised area of granular drift deposits in the centre of the site has been assessed as being medium dense with a net ABP of 127 kN/m² at circa 2.00 m bgl. The shallow bedrock identified in the centre of the site has been assessed as being dense to very dense with a net ABP of 504 kN/m² at 2.00 m bgl.



Foundation Options	Given the significant variances in ground conditions on the site, prior to the detailed design of suitable foundations solutions, a programme of remediation and enabling works will be required to remove any buried obstructions, process the Made Ground, remove the geotechnically unsuitable peat deposits, and cut/fill the site to provide suitable development platform levels. Therefore, upon completion of these enabling works, it is likely that the most cost-effective option for the majority of the site would be to re-engineer the Made Ground using vibro stone columns (VSCs) to support a shallow strip or spread foundation. The exception to this would be in the location of the peat deposits and the soft CLAY strata. The peat materials in this area will require removal due to their poor geotechnical properties and the ground gas risk. Dependent on development levels, plots in this area may require a driven pile foundation. A controlled waters piling risk assessment will be required due to the contamination identified in the soils and the close proximity of the River Roch. Foundation depths within the conjectured influence of former, existing or proposed trees will need to be deepened to ensure that structural loading bears within the underlying target founding stratum, which cannot be subject to volumetric instability associated with fluctuation in moisture content.
Building Floor Slabs	Ground-bearing floor slabs are unlikely to be viable given the anticipated depths or reworked Made Ground > 600 mm and shallow cohesive soils. If required, this will require designing by a structural engineer.
Heave Precautions	Given that the site is underlain clay, heave precautions will be required to the internal face of a foundation less than 1.50 m in depth. Heave precautions will be required to the underside of floor slabs (where there is no 200 mm void) and pile ground beams are required within the modelled influencing distance of trees.
Soakaway Drainage	The Made Ground, shallow ground and underlying cohesive soils are impacted by low-level inorganic and hydrocarbon compounds which would preclude the use of infiltration drainage systems.
Sulphate Assessment	Concrete classification will be DS-1, AC-1s with an isolated area in the centre of the site being DS-2, AC-1s however this was identified within shallow Made Ground. These materials are likely to be removed during the remediation and enabling works at the site and therefore following these works, DS-1, AC-1s concrete classification is likely to be suitable.



CBR Design %	Granular soils can be re-engineered to ensure 5% within the subgrade during favourable climatic conditions. Natural clay soils will provide a CBR in the order of 3–5% during drier climatic periods. However, if water is allowed to shed onto the formation, the CBR will reduce to < 2%, which will require specialist engineering of the subgrade.
Cut/Fill	Development levels unknown at this time; however, cut-and-fill works are likely to be required to prepare the development platform.
Civil Engineering Excavations	The E3P intrusive ground investigation has identified the presence of weathered/competent bedrock at a shallow depth in the centre of the site, the presence of which may impede the excavation materials to form sewerage and drainage infrastructure and foundations.
Waste Characterisation	Any material that is to be disposed off-site should undergo assessment using Technical Guidance WM3: <i>Waste Classification – Guidance on the classification and assessment of waste</i>.

RECOMMENDATIONS

Based on the findings of the geoenvironmental site assessment, the following additional works are recommended to be completed in due course:

- ✳ Further investigation of inaccessible areas.
- ✳ Completion of ground gas monitoring.
- ✳ Radon specific assessment.
- ✳ Plot-specific foundation schedule (upon receipt of the final development levels).
- ✳ Arboricultural survey.
- ✳ Slope stability assessment
- ✳ Remediation and enabling works strategy.
- ✳ Controlled waters piling risk assessment.
- ✳ Construction phase Surface Water Management Plan and Flood Risk Activity Permit.



Table of Contents

EXECUTIVE SUMMARY	1
1. INTRODUCTION	11
1.1. Background	11
1.2. Proposed Development.....	11
1.3. Objectives	12
1.4. Scope of Works.....	12
1.5. Limitations	12
1.6. Confidentiality.....	13
2. GROUND INVESTIGATION.....	14
2.1. General Overview	14
2.2. Limitations of the Investigation	14
2.3. Scope of Investigation.....	14
2.4. In-Situ Standard Penetration Testing (SPT).....	15
2.5. Laboratory Analysis.....	15
3. GROUND AND GROUNDWATER CONDITIONS	17
3.1. Summary of Ground Conditions	17
3.2. Made Ground	17
3.3. Peat	18
3.4. Drift Deposits	18
3.5. Solid Geology	18
3.6. Groundwater	18
3.7. Visual and Olfactory Evidence of Contamination	19
3.8. Soil Consistency	19
3.9. Side Stability and Ease of Excavation	20
3.10. Particle Size Distribution	23
3.11. Soil Density/Moisture Content Relationship	23
3.12. pH and Sulphate	24
4. TIER 2 QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT	25
4.1. Human Health Risk Assessment.....	25
4.2. Controlled Waters Risk Assessment	30
4.2.1. Controlled Water Risk Assessment and Mitigation	38
4.2.2. m-BAT Assessment	38
4.2.3. Final Pb Screening Tool	39
4.2.4. Discussion of Controlled Waters Risk Assessment	39
4.3. Ground Gas Risk Assessment Methodology	40
4.4. Monitoring Methodology.....	41
4.5. Summary of Monitoring Results	43
4.5.1. Groundwater	43
4.5.2. Barometric Pressure	43
4.5.3. Gas Flow	43
4.5.4. Gas Concentrations	43
4.6. Conclusion	43
4.7. Building Gas Risk Mitigation	44
4.7.1. British Standard BS8485 (2015)+A1 (2019).....	44
4.7.2. NHBC	48
4.8. Potable Water Supply	49
4.9. Conceptual Site Model	51
5. GEOTECHNICAL ASSESSMENT	55
5.1. Site Preparation	55



5.2.	Foundation Conditions and Assessment of Potential Bearing Capacities	55
5.3.	Ground Floor Slabs	58
5.4.	Heave Precautions	59
5.5.	Highways Construction	60
5.6.	Drainage	60
5.7.	Concrete Durability	60
5.8.	Excavations	60
5.9.	Slope Stability	61
5.10.	Construction Activity and Inspection	62
5.11.	Geotechnical Risk Register	63
5.12.	Further Works	66
6.	CONCLUSIONS AND RECOMMENDATIONS.....	67
6.1.	Contaminated Land Assessment	67
6.2.	Geotechnical Assessment	68
APPENDIX I LIMITATIONS.....		69
APPENDIX II GLOSSARY		71
APPENDIX III DRAWINGS AND CROSS SECTION		74
APPENDIX IV PHOTOGRAPHS		76
APPENDIX V E3P EXPLORATORY HOLE LOGS		80
APPENDIX VI CHEMICAL TESTING RESULTS		81
APPENDIX VII ORIGIN OF TIER 2 GENERIC ASSESSMENT CRITERIA.....		82
APPENDIX VIII GEOTECHNICAL TESTING RESULTS.....		84

DRAWING LIST

16-932-001- Site Location Plan
16-932-002 - Proposed Development Plan
16-932-003 - Historical Features Plan
16-932-004 - Site Features Plan
16-932-005 - Exploratory Hole Location Plan
16-932-006 - Depth of Made Ground Plan
16-932-008 - Depth to Founding Strata Plan
16-932-010 - Conceptual Site Model
16-932-012 - Depth to Bedrock Plan
16-932-014 - Depth & Thickness of Peat Plan
16-932-019 - Remediation Issues Plan



1. INTRODUCTION

1.1. BACKGROUND

E3P has been commissioned by Hallmark Developments Ltd to undertake a detailed Phase II Geoenvironmental Site Assessment for a parcel of land to the south of Bury Road, Rochdale.

This report is required to determine potential contaminated land liabilities, remediation requirements and geotechnical engineering works that will be required as part of the proposed development for a proposed low-rise residential development.

1.2. PROPOSED DEVELOPMENT

Hallmark Developments Ltd are proposing to construct a low-rise residential development comprising 52 dwellings and associated estate road, greenspace with pond and utility infrastructure.

A snapshot of the proposed development layout is indicated in Figure 1.1.

FIGURE 1.1 SNAPSHOT OF PROPOSED DEVELOPMENT



1.3. OBJECTIVES

The objectives of the geoenvironmental assessment are as follows:

- ✦ Review historical plans, geology, hydrogeology, site sensitivity, floodplain issues, mining records and any local authority information available in order to complete a desk study in line with Environment Agency (EA) document *Land Contamination: Risk Management (LCRM) (2019)*.
- ✦ Undertake a preliminary stage of sampling and analysis to provide an overview of environmental issues identified.
- ✦ Assess the implications of any potential environmental risks, liabilities and development constraints associated with the site in relation to the future use of the site and in relation to off-site receptors.
- ✦ Assess the geotechnical information and provide preliminary recommendations in relation to foundations, pavement construction and floor slabs.
- ✦ Provide recommendations regarding future works required.

1.4. SCOPE OF WORKS

The scope of work includes the following elements:

- ✦ Detailed review of historic information;
- ✦ Design of suitable intrusive ground investigation;
- ✦ Window sample probeholes with, and construction of, environmental monitoring installations;
- ✦ Deep cable percussive boreholes with groundwater monitoring installations;
- ✦ Mechanically excavated trial pits;
- ✦ In-situ geotechnical testing;
- ✦ Chemical and geotechnical laboratory analysis;
- ✦ Groundwater monitoring and sampling;
- ✦ Ground gas monitoring;
- ✦ Contamination risk assessment and conceptual site model;
- ✦ Geotechnical assessment and interpretation; and
- ✦ Factual and interpretive reporting.

1.5. LIMITATIONS

The limitations of this report are presented in Appendix I.



1.6. CONFIDENTIALITY

E3P has prepared this report solely for the use of the client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from E3P; a charge may be levied against such approval.



2. GROUND INVESTIGATION

2.1. GENERAL OVERVIEW

A ground investigation has been designed based on the findings of the desk study, with exploratory holes advanced to target specific potential contaminant sources identified within the previous site investigations. The investigation has also been used to collect geotechnical information to assist in the design and construction of the proposed development.

Exploratory fieldwork was completed between 5 and 6 May 2023. The works are summarised in Table 2.1.

2.2. LIMITATIONS OF THE INVESTIGATION

There were the following limitations encountered during the ground investigation works.

- ✿ An area in the north of the site was not investigated as at the time of investigation, the area was being utilised as a car park.
- ✿ A large area in the south of the site was also not investigated as it was densely vegetated and contained large areas of Japanese Knotweed. This area also included the area of the former sluice.
- ✿ Two smaller areas of Japanese Knotweed were also identified in the north and east of the site, an easement of 2m was applied to these areas.

2.3. SCOPE OF INVESTIGATION

TABLE 2.1 SUMMARY OF FIELDWORK

POTENTIAL SOURCE/RATIONALE	LOCATION HOLE	TYPE	MAXIMUM DEPTH (m bgl)	MONITORING WELLS RESPONSE ZONE (m bgl)
General Ground Conditions Including the Presence/Nature of Obstructions (Former School Building)	WS101	Window Sample Probehole	4.05	0.50–2.00
	WS103		4.44	1.30–3.30
	TP103	Mechanically Excavated Trial Pit	2.00	N/A
	TP104		3.00	
	TP108		3.00	
Former Reservoir	WS102	Window Sample Probehole	2.34	0.50–1.00
General Ground Conditions Including the Presence/Nature of Obstructions (Former Oakenrod Mill)	WS104		1.37	N/A
	WS105		1.26	N/A
	WS105 A		1.31	N/A
	TP109	Mechanically Excavated Trial Pit	1.80	N/A
	TP110		0.90	
Former Chimney	WS104 A	Window Sample Probehole	1.40	0.50–1.00



POTENTIAL SOURCE/RATIONALE	LOCATION HOLE	TYPE	MAXIMUM DEPTH (m bgl)	MONITORING WELLS RESPONSE ZONE (m bgl)
Former Tank	WS106	Window Sample Probehole	1.78	0.60–1.60
General Ground Conditions Including the Presence/Nature of Obstructions	TP101	Mechanically Excavated Trial Pit	3.00	N/A
	TP102		2.30	
	TP105		2.80	
	TP107		2.60	
Former Mill Building	TP106		2.60	
Deeper Soil Horizons	CP101	Cable Percussive Borehole	5.39	N/A

Mechanically excavated trial pits were advanced to investigate ground conditions and to retrieve environmental samples, spatially distributed to offer the maximum site coverage whilst also being advanced to target specific contaminant sources.

Window sample probeholes were advanced to undertake in-situ detailed geotechnical testing, obtain environmental samples and install groundwater and ground gas monitoring wells.

A deeper cable percussive borehole was advanced to undertake in-situ geotechnical testing of the deeper soil horizons.

The sampling locations are illustrated in Drawing 16-932-005 (Appendix III). The ground conditions encountered are indicated on the logs, which are provided in Appendix V.

Return visits were made to monitor installations for groundwater level and gas concentrations. In addition, selected wells were purged and samples of groundwater were recovered for chemical analysis.

2.4. IN-SITU STANDARD PENETRATION TESTING (SPT)

In-situ geotechnical testing was conducted using the standard penetration test (SPT) and, where the ground is granular, a 60° cone (SPT(C)) was used instead of the sampling tube. The results are shown in the probehole logs in Appendix V and presented in Table 3.5 and discussed in Section 5.2.

2.5. LABORATORY ANALYSIS

Selected soil samples were submitted for a range of chemical analyses comprising:

- ✳ Metals.
- ✳ pH, total sulphate, water-soluble sulphate (2:1 extract).
- ✳ Sulphide.
- ✳ Cyanide.
- ✳ Phenols.



-  Total and speciated polycyclic aromatic hydrocarbons (PAHs).
-  Total Organic Carbon (TOC).
-  Asbestos identification and quantification.
-  Speciated and banded total petroleum hydrocarbon (TPH).

I2 Analytical undertook the analytical work and the testing results are included in Appendix VI and discussed in Section 4.

Selected samples were submitted to PSL Laboratory where the following geotechnical tests were undertaken:

-  Particle Size Distribution tests; and
-  Dry Density / Moisture Content Relationship tests.

Laboratory analysis sheets are included in Appendix VIII and are summarised in Section 3 and 5.



3. GROUND AND GROUNDWATER CONDITIONS

3.1. SUMMARY OF GROUND CONDITIONS

The ground investigation generally confirms the published geology and identifies the strata set out in Table 3.1.

TABLE 3.1 SUMMARY OF STRATA

HOLE	DEPTH TO STRATUM (m bgl)					
	MADE GROUND	SOFT CLAY	FIRM/STIFF/VERY STIFF CLAY	PEAT	SAND / GRAVEL	BED ROCK
TP101	0.00–1.00	1.00–3.00	–	–	–	–
TP102	0.00–1.20	1.20–2.30	–	–	–	–
TP103	0.00–0.80	–	–	0.80–2.00	–	–
TP104	0.00–0.70	0.70–2.10	2.10–3.00	–	–	–
TP105	0.00–2.35	2.35–2.80	–	–	–	–
TP106	0.00–0.95	–	0.95–2.00	–	2.00–2.60	–
TP107	0.00–0.80	–	0.80–2.60	–	–	–
TP108	0.00–1.40	–	1.40–3.00	–	–	–
TP109	0.00–1.80	–	–	–	–	–
TP110	0.00–0.90	–	–	–	–	–
WS101	0.00–2.00	–	2.00–4.05	–	–	–
WS102	0.00–0.40	–	0.40–1.80	–	–	1.80–2.34
WS103	0.00–1.20	1.20–3.00	3.00–4.44	–	–	–
WS104	0.00–0.60	–	0.60–1.37	–	–	–
WS104 A	0.00–0.80	–	0.80–1.40	–	–	–
WS105	0.00–0.20	–	0.20–0.40	–	–	0.40–1.26
WS105 A	0.00–0.20	–	0.20–0.90	–	–	0.90–1.31
WS106	0.00–1.10	–	1.10–1.78	–	–	–
CP101	0.00–0.30	–	2.50–3.30	–	0.30–2.50	3.30–5.39

3.2. MADE GROUND

Made Ground deposits were encountered within all exploratory hole locations to depths of between 0.20 m bgl and to a proven depth of 2.35 m bgl although, in general, Made Ground was encountered to a depth of less than 1.00 m bgl.

The full depth of Made Ground was not proven in TP109 and TP110 in the centre of the site, due to instability in TP109 and compacted ground in TP110. It is inferred that these materials are associated with the Former Oakenrod Mill buildings.



Made Ground deposits in the northern sector of the site generally comprise asphalt/concrete underlain by a black sandy gravel of mudstone, clinker and ash. This was underlain by a brown slightly gravelly sandy clay with gravel of mudstone, brick, concrete and ash. Whereas in the southern sector of the site the Made Ground generally comprises brown slightly clayey slightly gravelly fine to medium sand with gravel of brick, clinker, ash, concrete, ceramic, glass, plastic and timber.

A Depth of Made Ground Plan is presented as Drawing 16-932-006 in Appendix III.

3.3. PEAT

Peat was identified in one location in the north of the site at TP103 between 0.80 m bgl and 2.00 m bgl as pseudofibrous peat. The full depth of peat was not established due to water ingress within the excavation making the excavation walls unstable.

A Thickness and Depth of Peat Plan is presented as Drawing 16-932-013 in Appendix III.

3.4. DRIFT DEPOSITS

Drift deposits were encountered within the majority of exploratory locations with the exception of two locations where the full depth of Made Ground could not be proven. The drift deposits are varied, generally comprising a firm to very stiff medium to high strength brown sandy gravelly CLAY with gravel of mudstone.

In the north of the site, at five locations (TP101, TP102, TP104, TP105 and WS103), a very soft to soft very low strength blueish grey slightly gravelly very sandy CLAY with gravel of mudstone was encountered at 0.70 m bgl and 2.35 m bgl.

The CLAY is locally interbedded in TP106 in the north east of the site with brownish grey fine to medium GRAVEL of mudstone and sandstone.

Within CP101 in the centre of the site, a very loose brown clayey silty SAND with gravel of sandstone was encountered between 0.30 m bgl and 1.50 m bgl. This was underlain by a medium dense grey silty clayey SAND with gravel of sandstone to 2.50 m bgl, where the stiff medium strength gravelly CLAY was encountered.

3.5. SOLID GEOLOGY

The solid bedrock geology was encountered at depths between 0.40 m bgl and 3.30 m bgl, in the centre of the site to a maximum proven depth of 5.39 m bgl. The solid geology comprised dense weathered SANDSTONE and dense weathered SILTSTONE.

3.6. GROUNDWATER

Groundwater strikes were encountered as seepages and minor to moderate ingresses, inferred to be true groundwater due to its depth; and flowing south towards the River Roch. The groundwater is also inferred to be present above the shallow bedrock strata. The depth of the seepages are shown on the exploratory hole records in Appendix V and are summarised in Table 3.2.

TABLE 3.2 SUMMARY GROUNDWATER STRIKES

LOCATION	DEPTH TO STRIKE (m)	NOTES
TP101	2.00	Seepage
TP102	1.90	Minor ingress



LOCATION	DEPTH TO STRIKE (m)	NOTES
TP103	2.00	Minor ingress
TP106	2.50	Moderate ingress
TP107	2.50	Minor ingress
TP109	1.80	Moderate ingress
TP110	0.90	Seepage
WS101	3.00	Minor ingress
WS102	3.00	Minor ingress

3.7. VISUAL AND OLFACTORY EVIDENCE OF CONTAMINATION

Visual and olfactory evidence of potential contamination has been identified during the site investigation and these are summarised in Table 3.3.

TABLE 3.3 SUMMARY OF VISUAL AND OLFACTORY EVIDENCE OF CONTAMINATION

LOCATION	DEPTH (m)	STRATUM	NOTES
TP101	0.15–1.00	Made Ground	Ash and clinker
TP102	0.10–1.20	Made Ground	Ash and clinker
TP104	0.10–0.70	Made Ground	Ash and clinker
TP105	0.15–0.45	Made Ground	Ash and clinker
TP107	0.00–0.80	Made Ground	Ash
TP108	0.00–1.40	Made Ground	Clinker
WS101	0.80–2.00	Made Ground	Ash
WS102	0.20–0.40	Made Ground	Ash and clinker
WS103	0.10–1.20	Made Ground	Ash
WS104	0.10–0.60	Made Ground	Ash
WS104 A	0.10 – 0.80	Made Ground	Ash
WS106	0.00–1.10	Made Ground	Ash

3.8. SOIL CONSISTENCY

Undrained shear strength values were measured using field hand shear vane. Results of the tests are presented in Table 3.4, which indicate the clay soils to vary between firm and very stiff. Strength test data is generally consistent with the field descriptions of the aforementioned soils.

TABLE 3.4 SUMMARY OF HAND SHEAR VANE TESTS

LOCATION	DEPTH	SHEAR STRENGTH (kPa)	CALCULATED ALLOWABLE BEARING PRESSURE (kN/m ²)
TP101	1.40	31	72.85
TP101	2.00	30	70.50



LOCATION	DEPTH	SHEAR STRENGTH (kPA)	CALCULATED ALLOWABLE BEARING PRESSURE (kN/m ²)
TP101	2.60	35	82.25
TP104	1.00	30	70.50
TP104	1.60	30	70.50
TP104	2.20	45	105.75
TP104	2.80	45	105.75
TP107	1.00	44	103.40
TP107	1.50	52	122.20
TP107	2.00	78	183.30
TP108	1.60	42	98.70
TP108	2.00	47	110.45
TP108	2.30	57	133.95
TP108	2.80	56	131.60

Notes

ABP Calculated using Stroud and Butler et al 1974.

Results of the standard penetration tests, including undrained shear strengths derived from SPTs are included in Table 3.5.

3.9. SIDE STABILITY AND EASE OF EXCAVATION

The sides of the exploratory trial pit excavations appeared to be generally stable during excavation. At two locations, the side walls were unstable within Made Ground at 1.60 m bgl and within natural soft CLAY strata from 2.50 m bgl. The excavation was also unstable within TP103 where peat was encountered due to the ingress of water, the full depth of peat at this location was not penetrated.

The presence of brick and concrete cobbles within the Made Ground deposits meant that in certain places, excavation was slow through the Made Ground and in some places, Made Ground could not be fully penetrated due to instability (TP109 and TP110). The natural strata was excavated with relative ease.

Where the bedrock geology was encountered, this was generally penetrated due to the weathered nature of the SANDSTONE.



TABLE 3.5 STANDARD/CONE PENETRATION TEST RESULTS

BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE (N ₁) ₆₀	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m ²)	ALLOWABLE BEARING PRESSURE (kN/m ²)*
WS101	1.00	MG: Sandy clay	10	10.08	N/A	Medium strength	Stiff	50.41	103.64
WS101	2.00	Sandy CLAY	11	10.05	N/A	Medium strength	Stiff	50.24	103.30
WS101	3.00	Sandy CLAY	13	11.31	N/A	Medium strength	Stiff	56.53	116.22
WS101	3.70	Sandy CLAY	50	42.55	N/A	Very high strength	Very Stiff	212.75	437.42
WS102	1.00	Gravelly CLAY	18	18.15	N/A	High strength	Very Stiff	90.73	186.55
WS102	2.00	Weathered SANDSTONE	50	45.68	Dense	N/A	N/A	N/A	456.77
WS103	1.00	MG: Sandy clay	3	3.02	N/A	Very low strength	Soft	15.12	31.09
WS103	2.00	Sandy CLAY	1	0.91	N/A	Extremely low strength	Very Soft	4.57	9.39
WS103	3.00	Sandy CLAY	7	6.09	N/A	Low strength	Firm	30.44	62.58
WS103	4.00	Sandy CLAY	50	42.24	N/A	Very high strength	Very Stiff	211.21	434.25
WS104	1.00	Gravelly CLAY	50	50.41	N/A	Very high strength	Very Stiff	252.04	518.19
WS104 A	1.00	Gravelly CLAY	50	50.41	Very Dense	N/A	N/A	N/A	504.07
WS105	1.00	Weathered SANDSTONE	50	50.41	Very Dense	N/A	N/A	N/A	504.07



Oakenrod School, Rochdale

Phase II Geoenvironmental Site Assessment

August 2023

BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE (N ₁) ₆₀	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m ²)	ALLOWABLE BEARING PRESSURE (kN/m ²)*
WS105 A	1.00	Weathered SANDSTONE	50	50.41	Very Dense	N/A	N/A	N/A	504.07
CP101	1.20	Silty SAND	1	0.98	Very Loose	N/A	N/A	N/A	9.81
CP101	2.00	Clayey SAND	14	12.79	Medium Dense	N/A	N/A	N/A	127.90
CP101	3.00	Gravelly CLAY	16	13.91	N/A	Medium strength	Stiff	69.57	143.04
CP101	4.00	Weathered SILTSTONE	50	42.24	Dense	N/A	N/A	N/A	422.43
CP101	5.00	Weathered SILTSTONE	50	41.48	Dense	N/A	N/A	N/A	414.81

NOTES

* The Allowable Bearing Pressure (ABP) should be considered indicative.

The interpretation of in situ mass undrained shear strength (cu) data from SPT Blow Count (N) results and the influence of the Plasticity Index (PI) was reported in Standard Penetration Test in Insensitive Clays and Soft Rocks. Stroud (1974). The standard penetration test and the engineering properties of glacial materials subsequently. Stroud and Butler (1975) and (1989).

Allowable bearing pressure on sands. Soil Mechanics in Engineering Practice Terzaghi, K. & Peck, R.B. 1996.



3.10. PARTICLE SIZE DISTRIBUTION

Particle Size Distribution Tests have been undertaken on selected samples of granular material via wet sieve to obtain information on the soil fractions. The results are included in Table 3.6. The full results can be found in Appendix VIII.

TABLE 3.6 SUMMARY OF PARTICLE SIZE DISTRIBUTION TEST RESULTS

LOCATION	DEPTH (m)	SOIL FRACTION (%)			
		COBBLES	GRAVEL	SAND	SILT/CLAY
CP101	1.50	0	8	50	42
CP101	2.50	0	29	33	38
TP105	1.50	10	28	18	44
TP109	0.50	33	39	20	8

3.11. SOIL DENSITY/MOISTURE CONTENT RELATIONSHIP

Dry density/moisture content relationship analysis has been conducted on soils using via utilising proctor compaction tests utilising both a 2.5 kg and 4.5 kg rammer. The results of the tests have been summarised in Table 3.7. The full test results can be found in Appendix VIII.

TABLE 3.7 SUMMARY DRY DENSITY AND MOISTURE CONTENT

LOCATION	LABORATORY DESCRIPTION	TOP DEPTH (m)	METHOD OF COMPACTION	INITIAL MOISTURE CONTENT (%)	OPTIMUM MOISTURE CONTENT (%)	MATERIAL RETAINED ON 37.5 mm SIEVE (%)	MAX DRY DENSITY (mg/m ³)	MATERIAL RETAINED ON 20.0 mm TEST SIEVE (%)
TP105	Grey very gravelly sandy CLAY with cobbles.	1.50	4.5kg	24	15	19	1.90	3
TP109	Made Ground: Brown very sandy clayey gravel with many cobbles.	0.50	2.5kg	14	14	44	1.92	8

The proctor compaction tests have indicated that the materials on site are variable with the material in TP105 being wet of the optimum. It should be noted that if this material is excavated for use in a cut/fill operation careful consideration should be taken in the stabilisation of this material.

The Made Ground within TP109 has been determined as having an optimum moisture content. However, due to the presence of shallow groundwater across the site, this is unlikely to be the case throughout the entirety of the Made Ground strata.

Engineering of this type of material will need to be completed during dry weather periods only.



3.12. pH AND SULPHATE

Chemical analyses for pH and soluble sulphate content contained in Appendix V (summarised in Table 3.8), shows that the soils at the site generally meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with BRE *Special Digest 1* (2005).

Elevated sulphate concentrations meeting Class DS-2, AC-1s were noted within the Made Ground deposits in TP110 at 0.20 m bgl, likely associated with the brick encountered within the lithology of the Made Ground. These materials are likely to be removed during the remediation and enabling works at the site and therefore following these works, DS-1, AC-1s concrete classification is likely to be suitable.

TABLE 3.8 SUMMARY OF pH AND SULPHATE DATA

LOCATION	DEPTH (m)	SO ₄ IN 2:1 WATER/SOIL (g/l)	pH VALUE	CLASSIFICATION
TP101	0.60	0.019	6.7	DS-1, AC-1s
TP102	1.50	0.0033	6.8	DS-1, AC-1s
TP103	0.50	0.026	7.2	DS-1, AC-1s
TP104	0.60	0.015	7.2	DS-1, AC-1s
TP105	2.00	0.025	6.4	DS-1, AC-1s
TP106	0.30	0.0034	7.3	DS-1, AC-1s
TP106	1.60	0.0051	7.1	DS-1, AC-1s
TP108	0.40	0.0065	7.4	DS-1, AC-1s
TP108	1.50	0.0054	7.0	DS-1, AC-1s
TP109	1.00	0.013	8.1	DS-1, AC-1s
TP110	0.20	0.60	10.2	DS-2, AC-1s
WS101	2.20	0.019	6.7	DS-1, AC-1s
WS102	0.30	0.023	7.8	DS-1, AC-1s
WS102	1.30	0.024	6.6	DS-1, AC-1s
WS103	2.50	0.005	6.3	DS-1, AC-1s
WS104	0.50	0.027	7.9	DS-1, AC-1s
WS106	0.20	0.015	7.7	DS-1, AC-1s
WS106	1.30	0.0067	7.2	DS-1, AC-1s



4. TIER 2 QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT

E3P has undertaken a Tier 2 qualitative risk assessment to determine if any potential contaminants within the underlying soils and groundwater pose an unacceptable level of risk to the identified receptors.

4.1. HUMAN HEALTH RISK ASSESSMENT

At Tier 2 stage, the long-term (chronic) human health toxicity of the soil has been assessed by comparing the on-site concentrations of organic and inorganic compounds with reference values published in LQM/CIEH S4UL (S4UL3267).

The results of this comparison have been summarised in Table 4.1.

TABLE 4.1 SUMMARY OF INORGANIC AND HYDROCARBON TOXICITY ASSESSMENT FOR A RESIDENTIAL END USE

DETERMINANT	UNIT	GAC	N	MC	LOC. OF EX	PATH -WAY	ASSESSMENT
Arsenic	mg/kg	37	18	35	N/A	1	No Further Action
Cadmium	mg/kg	11	18	0.7	N/A	1	No Further Action
Chromium (VI)	mg/kg	6.0	18	<1.8	N/A	1	No Further Action
Lead	mg/kg	200	18	310	TP108 0.40m	1	Further Action
Mercury	mg/kg	1.2	18	0.5	N/A	4	No Further Action
Nickel	mg/kg	130	18	36	N/A	1	No Further Action
Selenium	mg/kg	250	18	<1.0	N/A	1	No Further Action
Copper	mg/kg	2400	18	110	N/A	1	No Further Action
Zinc	mg/kg	3700	18	170	N/A	1	No Further Action
Cyanide – Total	mg/kg	791	18	19	N/A	1	No Further Action
Phenols – Total	mg/kg	120	18	<1.0	N/A	1	No Further Action
Asbestos	Fibres	NFD	10	Chrysotile	TP109 1.00m WS106 0.20m	3	Further Action
Naphthalene	mg/kg	2.3	18	8.8 3.5 28	TP104 0.60m TP108 0.40m WS102 1.30m	4	Further Action
Acenaphthylene	mg/kg	170	18	1.3	N/A	2	No Further Action
Acenaphthene	mg/kg	210	18	32	N/A	1	No Further Action
Fluorene	mg/kg	170	18	22	N/A	1	No Further Action
Phenanthrene	mg/kg	95	18	120 150	TP104 0.60m WS102 1.30m	2	Further Action
Anthracene	mg/kg	2400	18	32	N/A	2	No Further Action
Fluoranthene	mg/kg	280	18	190	N/A	2	No Further Action
Pyrene	mg/kg	620	18	180	N/A	2	No Further Action
Benzo(a)Anthracene	mg/kg	7.2	18	18 16 93 11	TP101 0.60m TP103 0.50m TP104 0.60m TP108 0.40m	2	Further Action



DETERMINANT	UNIT	GAC	N	MC	LOC. OF EX	PATH-WAY	ASSESSMENT
				11 70	TP110 0.20m WS102 0.30m		
Chrysene	mg/kg	15	18	83 62	TP104 0.60m WS102 1.30m	2	Further Action
Benzo(b)Fluoranthene	mg/kg	2.6	18	16 16 90 12 5.2 12 72	TP101 0.60m TP103 0.50m TP104 0.60m TP108 0.40m TP109 1.00m TP110 0.20m WS102 0.30m	2	Further Action
Benzo(k)Fluoranthene	mg/kg	77	18	32	N/A	2	No Further Action
Benzo(a)Pyrene	mg/kg	2.2	18	13 12 75 9.6 3.8 8.9 54 3.2	TP101 0.60m TP103 0.50m TP104 0.60m TP108 0.40m TP109 1.00m TP110 0.20m WS102 0.30m WS106 0.20m	2	Further Action
Indeno(123-cd)Pyrene	mg/kg	27	18	35	TP104 0.60m	2	Further Action
Dibenzo(a,h)Anthracene	mg/kg	0.24	18	1.6 1.5 8.7 1.3 0.5 1.2 6.7 0.43	TP101 0.60m TP103 0.50m TP104 0.60m TP108 0.40m TP109 1.00m TP110 0.20m WS102 0.30m WS106 0.20m	2	Further Action
Benzo(ghi)Perylene	mg/kg	320	18	37	N/A	2	No Further Action
TPH C5-C6 (aliphatic)*	mg/kg	42	18	<1.0	N/A	4	No Further Action
TPH C6-C8 (aliphatic)*	mg/kg	100	18	<0.1	N/A	4	No Further Action
TPH C8-C10 (aliphatic)*	mg/kg	27	18	<0.1	N/A	4	No Further Action
TPH C10-C12 (aromatic)*	mg/kg	74	18	22	N/A	4	No Further Action
TPH C12-C16 (aromatic)*	mg/kg	140	18	150	N/A	4	No Further Action
TPH C16-C21 (aromatic)*	mg/kg	260	18	270 560	TP104 0.60m WS102 0.30m	1	Further Action
TPH C21-C35 (aromatic)*	mg/kg	1100	18	780	N/A	1	No Further Action

Notes

Main exposure pathways: 1 = soil ingestion, 2 = dermal contact and ingestion, 3 = dust inhalation, 4 = vapour inhalation (indoor).

Abbreviations: GAC = general assessment criteria, n = number of samples, MC = maximum concentration; Loc of Ex = location of exceedance; NFD = no fibres detected.



* The Tier 2 GAC for the hydrocarbon fraction is derived from the CIEH assessment for petroleum hydrocarbons Criteria Working Group (CWG) for both aliphatic and aromatic compounds. E3P has utilised the Tier 2 values for aliphatic compounds for the volatile and semi volatile fractions (C5-C12) and the Tier 2 values for aromatic compound for the non-volatile fractions (C12-C35). The comparison of a total (aliphatic/aromatic) compounds to an individual fraction is considered to be a conservative approach and satisfactory for the protection of human health.

Referring to Table 4.1, the result of this direct comparison indicates that the data exceeds the screening criteria for a residential end use for the following contaminants:

- ✳ Lead.
- ✳ Chrysotile.
- ✳ Naphthalene.
- ✳ Benzo(a)Anthracene.
- ✳ Chrysene.
- ✳ Benzo(b)Fluoranthene.
- ✳ Benzo(a)Pyrene.
- ✳ Indeno(123-cd)Pyrene.
- ✳ Dibenzo(a,h)Anthracene.
- ✳ Hydrocarbon Fractions C16–21.

Asbestos in the form of loose chrysotile fibrous debris and rope has been identified in the Made Ground in TP109 at 1.00 m bgl and WS106 at 0.20 m bgl.

The laboratory analysis confirms the assessment within the initial conceptual site model that the main constituents of concern were likely to be asbestos, PAHs, hydrocarbon compounds and heavy metals.

In relation to these exceedances, the following can be determined:

- ✳ The main exposure pathways based on the Tier 2 exceedances are:
 - Soil ingestion;
 - Vapour inhalation (indoor);
 - Dermal contact and ingestion;
 - Consumption of homegrown vegetables; and
 - Fibre/dust inhalation.
- ✳ The exceedances for all determinands are associated with Made Ground deposits between 0.20 m bgl and 1.30 m bgl.



HUMAN HEALTH RISK ASSESSMENT AND MITIGATION

All of the identified elevated concentrations have primary exposure pathways related to dermal contact and ingestion of soils, inhalation of particulate and consumption of homegrown vegetables. The chronic risk to human health associated with the elevated concentrations of inorganic heavy metals and non-volatile PAH and TPH compounds can be mitigated through the installation of a suitable cover system in all proposed private gardens, landscaping and public open space to remove any potential for direct exposure to impacted soils.

The specific design and installation process for the appropriate cover systems will be clearly defined within a site remediation and enabling works strategy.

With regards to the elevated naphthalene, these present a potential volatilisation to indoor air risk. These elevated concentrations have only been identified within three areas of the site and are therefore considered to be localised hotspots associated with the historic site use of a former mill. Therefore, during a process of cut/fill enabling works, a hotspot removal should be undertaken where these soils may be delineated and assessed.

Asbestos in the form of chrysotile has also been identified within two localised areas in Made Ground deposits at TP109 at 1.00 m bgl and WS106 at 0.20 m bgl. Asbestos quantification was undertaken to further assess where these soils may be placed, the levels detected were between 0.141% and 0.043% respectively. No visual signs of ACM were encountered during the ground investigation. Impacted soils should be managed according to the asbestos risk mitigation conceptual site model shown in Figure 4.1.

FIGURE 4.1 ASBESTOS RISK MITIGATION CONCEPTUAL SITE MODEL



Notes
ND None Detect



0.001% Soils may contain $\leq 0.001\%$ asbestos using composite testing to ensure there is no potential risk to human health. This value is present within areas where there may be a short term low level exposure of soils containing trace asbestos fibres by construction workers where an appropriate level of asbestos management is employed (dust suppression)

0.1% Soils at a depth of $>1.00\text{m}$ bgl may contain $<0.1\%$ asbestos using composite testing where they will not be likely to be disturbed in the future and will therefore be in an area of low sensitivity. Risk assessment completed in accordance with Asbestos JIWG risk assessment tools.

Undefined- this will be dependent upon soils encountered during earthworks, which may be placed at these depths to ensure no potential risk to human health.

Chemical analysis of the natural clay drift deposits has identified these soils to be acceptable for use as subsoil within the proposed garden areas; however, further chemical validation samples will be required to confirm this, in line with an agreed sampling frequency within a Remediation Strategy. There are no suitable sources of topsoil available on the site.



4.2. CONTROLLED WATERS RISK ASSESSMENT

E3P has undertaken a controlled waters risk assessment for the site based on the consideration of the conceptual site model and the sensitive receptors which are summarised in Table 4.2.

TABLE 4.2 CONTROLLED WATERS CONCEPTUAL MODEL AND SENSITIVITY PROFILE

DISCUSSION		SENSITIVITY RATING
Contaminant Source		
Made Ground Heavy metal, TPH and PAH contamination has been identified as present as a result of the Made Ground infill material from historical features on-site in the centre and north of the site.		High
Oakenrod Woolen Mill The presence of the former Woolen Mill on site would have produced contaminants which may have entered soils historically and potentially released contaminated effluent into the River Roch on the southeastern boundary of the site.		High
Pathway		
Vertical Migration Due to the majority of the site being underlain by cohesive drift deposits, vertical migration of contaminants is unlikely to occur as a result of the low permeability of the drift deposits. The presence of this low permeability drift will offer some protection to the underlying aquifer and inhibit lateral migration of any contaminants towards the canal.		Low
Lateral migration Lateral migration of contaminants is considered possible due to the presence of localised granular deposits across the site and the slope on the south eastern boundary of the site to the River Roch.		Medium
Receptor		
Aquifer Classification in Superficial Drift Deposits	Secondary A aquifer.	Medium
Aquifer Classification in Bedrock	Secondary A aquifer.	Medium
Groundwater Source Protection Zone or Drinking Water Safeguard Zone	The site is not affected.	Low
Distance to the Closest Groundwater Abstraction Point	None identified within a 1 km radius.	Low
Is the Site Located Within 50 m of a Surface Watercourse?	The River Roch is located on the south eastern boundary of the site.	High
The ICSM developed within the context of the site setting has viable pollutant pathway, which would be the lateral migration of potentially mobile phase-soluble contaminants towards adjacent River Roch, which lies circa 1.00 m below site level on the south eastern boundary.		



To ensure a robust appraisal of the identified risk to controlled waters, E3P has identified the sources of potential contamination that represent a risk to controlled waters from the initial CSM, we have then assessed the availability of ground investigation data in the form of analysis of the solid phase (soil) and dissolved phase within the perched groundwater or aquifer. The results of this assessment are presented in Table 4.3.

TABLE 4.3 QUALITATIVE RISK TO CONTROLLED WATERS FROM SOIL ANALYTICAL RESULTS

CONTAMINANT	ASSESSMENT RATING	DISCUSSION
BTEX > 1 mg/kg	The soil data analysis has not identified any detectable concentrations of TPH C5 to C6 that might otherwise be indicative of VOC impact.	None
Total VOC > 1 mg/kg		
Total SVOC > 1 mg/kg	PAH analysis has identified levels above the laboratory LOD across the site.	Further discussion
C5-C10 > 5 mg/kg	All concentrations are below or slightly exceeding the laboratory LOD.	None
C10-C12 > 10 mg/kg	Concentrations of C10-C12 have been recorded above 10 mg/kg in one localised area of the site, with a concentration recorded in WS102 at 0.30 m bgl with a concentration 22 mg/kg.	Further discussion
C12-C16 > 50 mg/kg	Concentrations of C12-C16 have been recorded in localised areas of the site and the maximum concentration was recorded within WS102 at 0.30 m bgl with a concentration 150 mg/kg.	Further discussion
Phenols > 2 mg/kg	All concentrations are below the laboratory LOD.	None
Naphthalene > 2 mg/kg	Concentrations of naphthalene above 2 mg/kg have been recorded in TP103 at 0.50 m bgl, TP104 at 0.60 m bgl, TP108 at 0.40 m bgl and WS102 0.30 m bgl.	Further discussion
Total PAH > 10 mg/kg	Total concentrations of low-solubility PAH compounds greater than 10 mg/kg have been detected throughout the site, with a maximum concentration recorded in TP104 at 0.60 m bgl at 1020 mg/kg.	Further discussion
PCB > 1 mg/kg	No potential sources of PCB have been identified	None
Heavy metals > 500 mg/kg	Concentrations of heavy metals above 500 mg/kg have not been recorded across the site.	None

The Tier 2 assessment has included a comparison of leachate analysis from samples of the Made Ground, groundwater and surface water samples to environmental quality standards (EQS), and where unavailable, the results will be compared to the Drinking Water Standards (DWS).

The EQS values have been selected as the main controlled water receptor is the adjacent River Roch on the south eastern boundary.

These are presented in Table 4.4 and Table 4.5.



TABLE 4.4 COMPARISON OF GROUNDWATER AND LEACHATE ANALYSIS WITH TIER 2 SCREENING LEVELS

DETERMINAND	UNIT	EQS ^{1,2}	DWS _{3,4}	NO. OF GW SAMPLES	MAX CONC. IN GROUNDWATER	LOCATION OF EXCEEDANCE	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE	ASSESSMENT
		AA								
Arsenic	µg/l	50	10	2	14.1	N/A	1	6.8	N/A	No Further Action
Cadmium	µg/l	0.08-0.25	5	2	<0.02	N/A	1	<0.08	N/A	No Further Action
Chromium (VI)	µg/l	3.4	–	2	<5.0	N/A	1	<5.0	N/A	No Further Action
Chromium (III)	µg/l	4.7	50	2	4.2	N/A	1	2.1	N/A	No Further Action
Copper	µg/l	1	2000	2	12 12	WS101 WS103	1	16	TP108 0.40m	Further Action
Total Cyanide	µg/l	1	50	2	7.7	WS101	1	100	TP108 0.40m	Further Action
Lead	µg/l	1.2	10	2	1.6	WS101	1	2.5	TP108 0.40m	Further Action
Mercury	µg/l	–	1.0	2	<0.05	N/A	1	<0.5	N/A	No Further Action
Nickel	µg/l	4	20	2	5.8	WS101	1	1.5	N/A	Further Action
Selenium	µg/l	–	10	2	9	N/A	1	<4.0	N/A	No Further Action
Zinc	µg/l	10.9	–	2	11	WS103	1	10	N/A	Further Action
pH		6–9		2	6.8–6.9	N/A	1	8	N/A	No Further Action
Polycyclic Aromatic Hydrocarbons										
Naphthalene	µg/l	2	10*	2	<0.01	N/A	1	<0.01	N/A	No Further Action
Anthracene	µg/l	0.1	10*	2	0.81	WS103	1	<0.01	N/A	Further Action
Benzo[b]fluoranthene	µg/l	0.00017*	10*	2	0.66	WS103	1	<0.01	N/A	Further Action
Benzo[k]fluoranthene	µg/l	0.00017*	10*	2	0.20	WS103	1	<0.01	N/A	Further Action
Benzo(a)pyrene	µg/l	0.00017*	10*	2	0.44	WS103	1	<0.01	N/A	Further Action
Indeno(123-cd)pyrene	µg/l	0.00017*	10*	2	0.22	WS103	1	<0.01	N/A	Further Action
Fluoranthene	µg/l	0.0063	10*	2	1.70	WS103	1	<0.01	N/A	Further Action



DETERMINAND	UNIT	EQS ^{1,2}	DWS _{3,4}	NO. OF GW SAMPLES	MAX CONC. IN GROUNDWATER	LOCATION OF EXCEEDANCE	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE	ASSESSMENT
		AA								
Benzo(ghi)perylene	µg/l	1.7–4	10*	2	0.27	N/A	1	<0.01	N/A	No Further Action
Aromatic Hydrocarbon										
TPH C5-C7 (benzene)	µg/l	10	1	2	<3.0	N/A	1	<3.0	N/A	No Further Action
TPH C7-C8 (toluene)	µg/l	74	700	2	<3.0	N/A	1	,3.0	N/A	No Further Action
TPH C8-C10 (xylene)	µg/l	30	300	2	<3.0	N/A	1	<3.0	N/A	No Further Action
TPH C10-C12 (naphthalene)	µg/l	2	90	2	<3.0	N/A	1	<10	N/A	No Further Action
TPH C12-C16	µg/l	–	90	2	20	N/A	1	<10	N/A	No Further Action
TPH C16-C35	µg/l	–	90	2	27	N/A	1	<10	N/A	No Further Action
Aliphatic Hydrocarbon										
TPH C5-C6	µg/l	–	1000 ⁵	2	<1.0	N/A	1	<1.0	N/A	No Further Action
TPH C6-C8	µg/l	–	1000 ⁵	2	<1.0	N/A	1	<1.0	N/A	No Further Action
TPH C8-C10	µg/l	–	300	2	<1.0	N/A	1	<1.0	N/A	No Further Action
TPH C10-C12	µg/l	–	300	2	<10	N/A	1	<10	N/A	No Further Action
TPH C12-C16	µg/l	–	300	2	<10	N/A	1	<10	N/A	No Further Action
TPH C16-C21	µg/l	–	300**	2	<10	N/A	1	<10	N/A	No Further Action
TPH C21-C35	µg/l	–	300**	2	<10	N/A	1	<10	N/A	No Further Action
Volatile Organic Compounds										
Tetrachloroethylene	µg/l	0.4	10	2	<3.0	N/A	–	–	–	No Further Action
Trichloroethylene	µg/l	10	10	2	<3.0	N/A	–	–	–	No Further Action
Trichlorobenzene	µg/l	0.4	–	2	<3.0	N/A	–	–	–	No Further Action
Trichloromethane	µg/l	2.5	–	2	<3.0	N/A	–	–	–	No Further Action



DETERMINAND	UNIT	EQS ^{1,2}	DWS _{3,4}	NO. OF GW SAMPLES	MAX CONC. IN GROUNDWATER	LOCATION OF EXCEEDANCE	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE	ASSESSMENT
		AA								
Dichloromethane	µg/l	20	200	2	<3.0	N/A	–	–	–	No Further Action
Carbon Tetrachloride	µg/l	12	3	2	<3.0	N/A	–	–	–	No Further Action
Vinyl Chloride	µg/l	–	0.3	2	<3.0	N/A	–	–	–	No Further Action

Notes

Solubility <0.01µg/l

AA – Annual Average

* Polyaromatic hydrocarbons (PAH) - Benzo(a)pyrene (BaP), Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(g,h,i)-perylene and Indeno(1,2,3-cd)-pyrene. Benzo(a)pyrene can be considered as a marker for the other PAHs, hence only benzo(a)pyrene needs to be monitored for comparison with the biota EQS or the corresponding AA-EQS in water

** There are no WHO Guideline Values for aliphatic fractions C16-C21 and C21-C35, therefore the guideline value for aliphatic fractions inclusive of C8-C16 (300µg/l) has been applied.

1. [The Water Framework Directive \(Standards and Classification\) Directions \(England and Wales\) 2015 \(legislation.gov.uk\)](#)
2. [The Water Supply \(Water Quality\) Regulations 2018 \(legislation.gov.uk\)](#)
3. [Guidelines for drinking-water quality, 4th edition, incorporating the 1st addendum \(who.int\)](#)
4. [CL:AIRE publishes Petroleum Hydrocarbons in Groundwater guidance \(claire.co.uk\)](#)
5. A total TPH criteria of 1000 mg/kg will act as a surrogate criterion for remaining aliphatic and aromatic TPH fractions.



TABLE 4.5 COMPARISON OF SURFACE ANALYSIS WITH TIER 2 SCREENING LEVELS

DETERMINAND	UNIT	EQS ^{1,2}	DWS _{3,4}	NO. OF SAMPLES	MAXIMUM CONCENTRATION IN SURFACE WATER	LOCATION OF EXCEEDANCE	ASSESSMENT
		AA					
Arsenic	µg/l	50	10	2	0.50	N/A	No Further Assessment
Cadmium	µg/l	0.08-0.25	5	2	<0.02	N/A	No Further Assessment
Chromium (VI)	µg/l	3.4	–	2	<5.0	N/A	No Further Assessment
Chromium (III)	µg/l	4.7	50	2	6.9	N/A	No Further Assessment
Copper	µg/l	1	2000	2	8.2 5.8	Upstream Downstream	Further Assessment
Total Cyanide	µg/l	1	50	2	<1.0	N/A	No Further Assessment
Lead	µg/l	1.2	10	2	0.2	N/A	No Further Assessment
Mercury	µg/l	–	1.0	2	<0.05	N/A	No Further Assessment
Nickel	µg/l	4	20	2	2.4	N/A	No Further Assessment
Selenium	µg/l	–	10	2	<0.6	N/A	No Further Assessment
Zinc	µg/l	10.9	–	2	12	Downstream	Further Assessment
pH		6–9		2	7.5	N/A	No Further Assessment
Naphthalene	µg/l	2	10*	2	<0.01	N/A	No Further Assessment
Anthracene	µg/l	0.1	10*	2	<0.01	N/A	No Further Assessment
Benzo[b]fluoranthene	µg/l	0.00017*	10*	2	<0.01	N/A	No Further Assessment
Benzo[k]fluoranthene	µg/l	0.00017*	10*	2	<0.01	N/A	No Further Assessment
Benzo(a)pyrene	µg/l	0.00017*	10*	2	<0.01	N/A	No Further Assessment
Indeno(123-cd)pyrene	µg/l	0.00017*	10*	2	<0.01	N/A	No Further Assessment
Fluoranthene	µg/l	0.0063	10*	2	<0.01	N/A	No Further Assessment
Benzo(ghi)perylene	µg/l	1.7–4	10*	2	<0.01	N/A	No Further Assessment



DETERMINAND	UNIT	EQS ^{1,2}	DWS _{3,4}	NO. OF SAMPLES	MAXIMUM CONCENTRATION IN SURFACE WATER	LOCATION OF EXCEEDANCE	ASSESSMENT
		AA					
TPH C5-C7 (benzene)	µg/l	10	1	2	<3.0	N/A	No Further Assessment
TPH C7-C8 (toluene)	µg/l	74	700	2	<3.0	N/A	No Further Assessment
TPH C8-C10 (xylene)	µg/l	30	300	2	<3.0	N/A	No Further Assessment
TPH C10-C12 (naphthalene)	µg/l	2	90	2	<3.0	N/A	No Further Assessment
TPH C12-C16	µg/l	–	90	2	<10	N/A	No Further Assessment
TPH C16-C35	µg/l	–	90	2	<10	N/A	No Further Assessment
TPH C5-C6	µg/l	–	1000 ⁵	2	<1.0	N/A	No Further Assessment
TPH C6-C8	µg/l	–	1000 ⁵	2	<1.0	N/A	No Further Assessment
TPH C8-C10	µg/l	–	300	2	<1.0	N/A	No Further Assessment
TPH C10-C12	µg/l	–	300	2	<10	N/A	No Further Assessment
TPH C12-C16	µg/l	–	300	2	<10	N/A	No Further Assessment
TPH C16 – C21	µg/l	–	300**	2	<10	N/A	No Further Assessment
TPH C21-C35	µg/l	–	300**	2	<10	N/A	No Further Assessment
Tetrachloroethylene	µg/l	0.4	10	2	<3.0	N/A	No Further Assessment
Trichloroethylene	µg/l	10	10	2	<3.0	N/A	No Further Assessment
Trichlorobenzene	µg/l	0.4	–	2	<3.0	N/A	No Further Assessment
Trichloromethane	µg/l	2.5	–	2	<3.0	N/A	No Further Assessment
Dichloromethane	µg/l	20	200	2	<3.0	N/A	No Further Assessment
Carbon Tetrachloride	µg/l	12	3	2	<3.0	N/A	No Further Assessment
Vinyl Chloride	µg/l	–	0.3	2	<3.0	N/A	No Further Assessment



Notes

Solubility <0.01µg/l

AA – Annual Average

* Polyaromatic hydrocarbons (PAH) - Benzo(a)pyrene (BaP), Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(g,h,i)-perylene and Indeno(1,2,3-cd)-pyrene. Benzo(a)pyrene can be considered as a marker for the other PAHs, hence only benzo(a)pyrene needs to be monitored for comparison with the biota EQS or the corresponding AA-EQS in water

** There are no WHO Guideline Values for aliphatic fractions C16-C21 and C21-C35, therefore the guideline value for aliphatic fractions inclusive of C8-C16 (300µg/l) has been applied.

1. [The Water Framework Directive \(Standards and Classification\) Directions \(England and Wales\) 2015 \(legislation.gov.uk\)](#)
2. [The Water Supply \(Water Quality\) Regulations 2018 \(legislation.gov.uk\)](#)
3. [Guidelines for drinking-water quality, 4th edition, incorporating the 1st addendum \(who.int\)](#)
4. [CL:AIRE publishes Petroleum Hydrocarbons in Groundwater guidance \(claire.co.uk\)](#)
5. A total TPH criteria of 1000 mg/kg will act as a surrogate criterion for remaining aliphatic and aromatic TPH fractions.



4.2.1. CONTROLLED WATER RISK ASSESSMENT AND MITIGATION

This comparison indicates that the data for the groundwater and leachate samples exceeds the EQS values for the following inorganic compounds:

- ✳ Copper.
- ✳ Lead.
- ✳ Cyanide.
- ✳ Nickel.
- ✳ Zinc.
- ✳ Anthracene
- ✳ Benzo[b]fluoranthene.
- ✳ Benzo[k]fluoranthene.
- ✳ Benzo(a)pyrene.
- ✳ Indeno(123-cd)pyrene.
- ✳ Fluoranthene.

This comparison indicates that the data for the surface water samples exceeds the EQS values for the following inorganic compounds:

- ✳ Copper.
- ✳ Zinc.

In relation to the elevated leachate analysis undertaken in Made Ground soils at TP108. Where leachate analysis has been undertaken, this can overstate the risk and is not wholly representative of the site characterisation, therefore following the receipt of supplementary groundwater samples which have sampled the true dissolved phase impact, TP108 in particular is not considered to be a significant site contaminant source.

4.2.2. M-BAT ASSESSMENT

Due to exceedances in both soils and leachate samples for copper, nickel and zinc, an m-BAT assessment has been completed to assess the bioavailability of the metals with respect to surface water receptors (River Roch). The chemical values from the groundwater analysis have been input into the assessment.

Where the Risk Characterisation Ratio (RCR) is greater than 1, this indicates the bioavailable concentration is above the EQS and the receptor is therefore at risk. In this instance, groundwater chemical data and slow flow monitoring data for DOC was input into the m-BAT for the onsite locations.

The m-BAT assessment has confirmed that copper, zinc and nickel are below the EQS and are therefore not considered bioavailable in the above locations on the site, due to the RCR values being below 1.



The chemical samples from the River Roch were also assessed within the tool and no RCR exceedances have been identified.

In light of the above assessment, E3P do not consider the site to pose an unacceptable level of risk to surface waters for copper, zinc and nickel. It should also be noted the site is currently uncapped and the proposed development will largely encapsulate the site, thus limiting the potential for infiltration and therefore leaching potential.

However, further analysis of the surface water in the River Roch should be undertaken as groundworks progress, to ensure no future mobilisation of contaminants is caused, which may pose a risk to the watercourse.

4.2.3. FINAL PB SCREENING TOOL

Lead is not included in the M-BAT tool as it is not a full bioavailable EQS, however, a separate assessment using the Pb screening tool has been completed for lead. The assessment confirms that there is no level of risk within WS101 (RCR- 0.07) and WS103 (RCR- 0.02) as the concentrations do not exceed the site-specific PNEC and the risk characterisation ratio of more than 1.0.

In light of the above assessment, E3P does not consider the site to pose an unacceptable level of risk to surface waters for lead.

4.2.4. DISCUSSION OF CONTROLLED WATERS RISK ASSESSMENT

Historically, the site has been subjected to a number of industrial uses including Oakenrod Woollen Mill and associated chimney, tank and reservoir. Chemical by-products of manufacturing processes and compounds within the Made Ground may have subsequently leached down into underlying ground and contaminated groundwater both within Made Ground and natural drift deposits.

The site is underlain by cohesive that is interbedded with granular drift deposits in localised areas. The granular deposits will afford less protection to the adjacent River Roch in comparison to where clay deposits have been identified in excess of 5.00 m in areas. Impacted groundwater has the potential to migrate laterally and vertically towards nearby controlled water receptors, including the river, as a result of this high permeability strata. Controlled water receptors are therefore deemed to be at a high sensitivity with respect to potential onsite contamination.

The source of the contaminants cannot be attributed to one area or point source on the site and the majority of the contamination is considered present on a site wide basis due to a legacy of historic site uses.

As the site is currently open, public space, with little hardstanding surface cover, rainfall is not being intercepted and subsequently infiltrates freely into the underlying Made Ground, potentially mobilising the identified contaminants.

The proposed development will create limited hardstanding cover across the site, thus reducing the amount of infiltration generated in these areas. This will in turn, reduce the amount of contaminants present in leachate off the site and reduce the risk further to the adjacent River Roch. However, further groundwater sampling will be required during the remediation and enabling works at the site to ensure no future mobilisation of contaminants and that the development does not pose a further risk to the River Roch.

In light of the above assessment, E3P does not consider the site to currently pose an unacceptable level of risk to the controlled water receptors.



4.3. GROUND GAS RISK ASSESSMENT METHODOLOGY

The potential impact on the development from ground gases has been assessed with reference to standards and guidelines published in:

- ✿ CIRIA Report 665 – Assessing risks posed by hazardous ground gases to buildings (2007).
- ✿ BS8485:2015+A1:2019 – Code of Practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings.

BS8485 provides guidance on the level of gas protection requirements based upon the characteristic situation (CS) and the proposed development based on building type.

Therefore, in accordance with BS8485, based on the measured flow rates and hazardous gas concentrations, individual hazardous gas flow rates (Q_{hg}) shall be derived for each monitoring point, from which the site characteristic hazardous gas flow rate (Q_{hgs}), and then the Characteristic Situation (CS) can be determined.

The following equation should be utilised:

$$Q_{hg} = q \left(\frac{C_{hg}}{100} \right)$$

Where:

q is the measured flow rate (in litres per hour) of combined gases from the monitoring standpipe
 C_{hg} is the measured hazardous gas concentration (in percentage volume/volume).

The subsequent derived gas screening value (GSV) should be the maximum Q_{hg} (flow rate x concentration as a percentage volume) for all the monitoring events.

A 'worst case check' may be carried out using the maximum recorded flow in any hole with the maximum concentration in any hole to present the plausible worst case conditions. Adoption of the worst case Q_{hg} requires thorough justification and reference to the CSM.

The final derived GSV can then be used to characterise the site as summarised in Table 4.6.



TABLE 4.6 SITE CHARACTERISATION BY GSV (BS8485:2015+A1:2019)

CS	HAZARD POTENTIAL	GSV (l/hr) FOR METHANE AND CARBON DIOXIDE	ADDITIONAL FACTORS
CS1	Very Low	< 0.07	Typically <1% methane concentration and <5% carbon dioxide concentration (otherwise consider an increase to CS2).
CS2	Low	< 0.70	Typical measured flow rate <70 l/h (otherwise consider an increase to CS3).
CS3	Moderate	< 3.5	N/A.
CS4	Moderate to High	< 15	N/A.
CS5	High	< 70	N/A.
CS6	Very High	> 70	N/A.

Notes

1. The CS is equivalent to the characteristic GSV in CIRIA C665.
2. The worst-case ground gas regime identified on the site, either methane or carbon dioxide, at the worst-case temporal conditions that the site may be expected to encounter should be considered.
3. Gas Screening Value is the Borehole Gas Volume Flow Rate, in litres per hour, multiplied by the concentration in the air stream of the particular gas being considered.
4. The Gas Screening Value thresholds should not generally be exceeded without the completion of a detailed ground gas risk assessment taking into account site-specific conditions.

4.4. MONITORING METHODOLOGY

Concentrations of methane (CH₄), carbon dioxide (CO₂) and oxygen (O₂) (hydrogen sulphide) were measured using a calibrated infrared gas analyser (GFM435) with gas flow rates measured using an integrated flow meter.

Gas measurements were recorded for a minimum of 500 seconds at each location, at which point the maximum concentration of CH₄ and CO₂, together with the lowest concentration of O₂ were recorded.

The results of the ground gas monitoring are presented in Table 4.7.

In addition to the raw data, the results for each individual standpipe have been assessed with reference to guidance provided in BS8485:2015. Based on the initial peak measured flow rates and hazardous gas concentrations, individual hazardous gas flow rates (Q_{hg}) have been derived for each monitoring point, from which an individual Characteristic Situation (CS) can ultimately be determined.



TABLE 4.7 SUMMARY OF GROUND GAS MONITORING RESULTS

WELL	STRATA	DATE	CH ₄ PEAK (%V/V)	CH ₄ STEADY (%V/V)	CH ₄ Q _{hg} (l/hr)	CO ₂ PEAK (%V/V)	CO ₂ STEADY (%V/V)	CO ₂ Q _{hg} (l/hr)	O ₂ (%V/V)	ATMOS (mb)	ATMOS. DYNAMIC	PEAK FLOW (l/hr)	STEADY FLOW (l/hr)	RESPONSE ZONE (m bgl)	DEPTH TO BASE (m bgl)	DEPTH TO WATER (m bgl)
WS101	Made Ground	19/06/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	20.3	994	Falling	0.10	0.10	0.50 – 2.00	2.08	1.86
		11/07/2023	0.10	0.10	0.0001	2.20	2.20	0.0022	17.9	992	Steady	0.10	0.10		2.09	1.80
WS102	Natural CLAY	19/06/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	20.5	994	Falling	0.10	0.10	0.50 – 1.00	1.17	0.94
		11/07/2023	0.10	0.10	0.0001	2.40	2.40	0.0024	16.8	992	Steady	0.10	0.10		1.17	0.70
WS103	Natural CLAY	19/06/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	20.6	993	Falling	0.10	0.10	1.30 – 3.30	2.85	2.46
		11/07/2023	0.10	0.10	0.0001	0.30	0.30	0.0003	20.6	992	Steady	0.10	0.10		1.24	Dry
WS104A	Made Ground	19/06/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	20.4	994	Falling	0.10	0.10	0.50 – 1.00	0.98	0.95
		11/07/2023	Monitoring well destroyed.												–	
WS106	Natural CLAY	19/06/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	20.3	994	Falling	0.10	0.10	0.60 – 1.60	1.68	1.49
		11/07/2023	Monitoring well destroyed.												–	

Notes

CIRIA Characteristic Situation		Q _{hg}		
	CS1	<0.07	Typical Max CO ₂ <5 % Typical Max CH ₄ <1 %	Values in BOLD exceed CS1 Thresholds
	CS2	<0.7	Flow rate not to exceed 70 l/hr otherwise consider increase to CS3	Values in BLUE denote water above level of response zone (flooded)
	CS3	<3.5		
	CS4	<15	Quantitative Risk Assessment required to evaluate scope of protective measures	



4.5. SUMMARY OF MONITORING RESULTS

4.5.1. GROUNDWATER

Groundwater across the site was recorded to fluctuate. Within WS103. The groundwater was noted to decrease, as on the second visit, the monitoring well was recorded as dry.

Within remaining monitoring wells, groundwater levels were observed to generally increase over the monitoring period, however, due to the predominantly low permeability cohesive Made Ground and drift stratum, it is likely that water levels are representative of surface water collecting within the standpipes and not a true representation of groundwater.

4.5.2. BAROMETRIC PRESSURE

Visit 1 was undertaken during a period of falling pressure and visit 2 was undertaken during a period of steady low pressure, with pressure recorded to be between 992 and 994 mbar.

It is therefore considered that the visits have been undertaken over representative conditions.

4.5.3. GAS FLOW

Throughout the monitoring period, flow rates were recorded to be 0.10 l/hr (limit of detection of the analyser).

4.5.4. GAS CONCENTRATIONS

The maximum methane value recorded within the monitoring wells was 0.10% v/v (limit of detection of the analyser).

Carbon dioxide concentrations were recorded at concentrations ranging from 0.10% v/v to 2.40% v/v (WS102).

4.6. CONCLUSION

The determined Characteristic Situation for each standpipe for each visit is presented in Table 4.8. This indicates that based on the peak flow rates the majority of the monitoring visits classify as Characteristic Situation (CS)1 – Very Low Gas Risk.

TABLE 4.8 GAS RISK PROFILE AND LOCATION

WELL	MAX FLOW (l/hr)	MAX CH ₄ (%V/V)	MAX CH ₄ Q _{hg} (l/hr)	MAX CO ₂ (%V/V)	MAX CO ₂ Q _{hg} (l/hr)	CHARACTERISTIC SITUATION	NHBC TRAFFIC LIGHT
WS101	0.10	0.10	0.0001	2.20	0.0022	CS1	Green
WS102	0.10	0.10	0.0001	2.40	0.0024	CS1	Green
WS103	0.10	0.10	0.0001	0.30	0.0003	CS1	Green
WS104A	0.10	0.10	0.0001	0.10	0.0001	CS1	Green
WS106	0.10	0.10	0.0001	0.10	0.0001	CS1	Green



E3P has assessed the previous variables and come to the following conclusions:

- ✳ Ground gas monitoring suggests that the site can be predominantly classified as CS1, and in these areas it is considered that gas protection measures will not be required.
- ✳ The site is predominantly underlain by glacial till of CLAY and interbedded SAND at depths of 0.20 m bgl to 4.40 m bgl.
- ✳ Made Ground has been encountered in localised areas at a maximum depth of 1.30 m bgl but more generally was encountered at a depth less than 0.80 m bgl.
- ✳ A localised area of peat has been identified in the north of the site at TP103. It is understood that the peat will be removed and backfilled with inert material, and it is therefore unlikely that this will cause any ongoing gas risk and it is considered that gas protection measures will not be required.
- ✳ With due consideration to the Conceptual Site Model and the absence of any persistent gas source and gas generation potential, it is considered by E3P that the site can be classified as CS1, and therefore no gas protection measures are required.
- ✳ However, where naphthalene is identified in three locations, there may be a requirement to install a VOC membrane where the hotspot is not delineated and treated, where impacted soils interact with the proposed location of plots.

It is recommended that the full ground gas assessment and recommended protection measures (if applicable) are agreed with the local authority prior to their adoption on site. Furthermore, all protection measures adopted should be validated by a suitably qualified engineer.

4.7. BUILDING GAS RISK MITIGATION

4.7.1. BRITISH STANDARD BS8485 (2015)+A1 (2019)

British Standard BS8485:2015+A1(2019) provides different types of property that require assessment. These building types are:

- ✳ **Type A Building** – Private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms are present. Probably conventional building construction (rather than civil engineering). Examples include private housing and some retail premises.
- ✳ **Type B Building** – Private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium sized rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels.

Based on the ground gas risk assessment and the proposed Type A Building, it is envisaged that a point score of 0 will be required for affected properties, as summarised in Table 4.9.



TABLE 4.9 BS8485 (2015)+A1(2019) POINTS REQUIRED FOR TYPE A AND TYPE B BUILDINGS

CHARACTERISTIC SITUATION	MINIMUM GAS PROTECTION SCORE (POINTS)	
	HIGH SENSITIVITY	
	TYPE A BUILDING	TYPE B BUILDING
1	0	0
2	3.5	3.5
3	4.5	4
4	6.5 ^{A)}	5.5 ^{A)}
5	— ^{B)}	6
6	— ^{B)}	— ^{B)}

BS8485 (2015)+A1(2019) Notes

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.

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, for example, high performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system such as in institutional and/or fully serviced contractual situations.

TABLE 4.10 SUMMARY OF GROUND GAS MITIGATION MEASURES – BS8485 (2015)+A1(2019)

GAS PROTECTION SCORES FOR THE STRUCTURAL BARRIER	SCORE ^A
Floor and Substructure Design	
Precast Suspended Segmental Subfloor (Beam and Block)	0
Cast in Situ Ground Bearing Floor Slab (With Only Nominal Mesh Reinforcement)	0.5
Cast in Situ Monolithic Reinforced Ground Bearing Raft or Reinforced Cast in Situ Suspended Floor Slab With Minimal Penetrations	1 or 1.5 ^B
Basement Floor and Walls Conforming to BS 8102:2009, Grade 2 Waterproofing ^{C D}	2
Basement Floor and Walls Conforming to BS 8102:2009, Grade 3 Waterproofing ^{C D}	2.5
Notes A) The scores are conditional on breaches of floor slabs, etc., being effectively sealed. B) To achieve a score of 1.5 the raft or suspended slab should be well reinforced to control cracking and have minimal penetrations cast in (see A.2.2.2). C) The score is conditional on the waterproofing being provided by a suitable structural barrier with the design and detailing of the walls and floor meeting the requirements for Type B protection. The score cannot be assigned for Type A (waterproof membrane) or Type C (drained cavity wall). D) If a membrane is installed beneath and around the basement to provide Type A waterproofing (BS 8102:2009), it can be assigned a gas protection score in accordance with Table 7, if it meets all the criteria for a gas resistant membrane in that table. When practical, utilities should enter the building above floor level with any conduit or meter housing being properly vented outside of the building.	



PROTECTION ELEMENT SYSTEM		SCORE	COMMENTS
Gas protection scores for ventilation protection measures			
(a) Pressure Relief Pathway – Usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building.		0.5	Whenever possible a pressure relief pathway (as a minimum) should be installed in all gas protection measures systems. If the layer has a low permeability and/or is not terminated in a venting trench (or similar), then the score is 0.
(b) Passive Subfloor Dispersal Layer – Media used to provide the dispersal layer are:  Clear void;  Polystyrene void former blanket;  Geocomposite void former blanket;  No fines gravel layer with gas drains; and  No fines gravel layer.	Very good performance	2.5	The ventilation effectiveness of different media depends on a number of different factors including the transmissivity of the medium, the width of the building, the side ventilation spacing and type and the thickness of the layer. The selected score should be assigned taking into account the recommendations in Annex B of BS 8485 (2015). Passive ventilation should be designed to meet at least “good performance”.
	Good performance	1.5	
(c) Active Dispersal Layer – Usually comprising fans with active abstraction (suction) from a subfloor dilution layer with roof level vents. The dilution layer may comprise a clear void or be formed of geocomposite or polystyrene void formers.		1.5 to 2.5	This system relies on continued serviceability of the pumps; therefore alarm and response systems should be in place. There should be robust management systems in place to ensure the continued maintenance of the system, including pumps and vents. Active ventilation should always be designed to meet at least “good performance”.
(d) Active Positive Pressurisation – Provided by the creation of a blanket of external fresh air beneath the building floor slab by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket.		1.5 to 2.5	This system relies on continued operation of the pumps; therefore alarm and response systems should be in place. The score assigned should be based on the efficient “coverage” of the building footprint and the redundancy of the system. Active ventilation should always be designed to meet at least “good performance”.



(e) Ventilated Car Park – Floor slab of occupied part of the building under consideration is underlain by a basement or undercroft car park.	4	Assumes that the car park is vented to deal with car exhaust fumes, designed to Buildings Regulations 2000, Approved Document F [9].
Gas Protection Score for the Gas Resistant Membrane		
Gas resistant membrane meeting all of the following criteria: ☒ Sufficiently impervious to the gases with a methane gas transmission rate < 40 ml/day/m²/atm (average) for sheet and joints (tested in accordance with BS ISO 151051 manometric method); ☒ 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. settlement if placed below a floor slab); ☒ Sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools); ☒ Capable, after installation, of providing a complete barrier to the entry of the relevant gas; and ☒ Verified in accordance with CIRIA C735.	2	The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation and integrity of joints. If a membrane is installed that does not meet all the criteria opposite then the score is zero.
A) Membrane with a methane gas transmission rate < 40.0 ml/day/m²/atm (average) for sheets and joints (tested in accordance with BS ISO 151051:2007 manometric method) is regarded as sufficiently impervious. B) For example, reinforced LDPE (virgin polymer) membranes having a minimum mass per unit area of 370 g/m² and not significantly less than 0.4 mm thickness between the reinforcement scrim (tested in accordance with Procedure D (2 mm diameter tip) of BS EN ISO 98631:2016) installed above floor slabs are considered sufficiently strong to meet the performance criteria (see also C.3). Thicker and more robust membranes or an additional membrane protection layer should be installed directly beneath cast in situ floor slabs.		



4.7.2. NHBC

The NHBC Traffic Light guidance can still be used where the development proposals are based on the 'typical house' used in the modelling for the traffic light classification system.

A typical house is defined as a house (up to three storeys) with <100 m² footprint and minimum 150 mm depth clear ventilated void achieving sub-slab ventilation of one complete air exchange per day.

NHBC expectations for verification to satisfy the Traffic Light gas regime classifications are as detailed in Table 4.11.

TABLE 4.11 TYPICAL NHBC EXPECTATION AND VERIFICATION REQUIREMENTS

GAS REGIME	MINIMUM GAS PROTECTION EXPECTATIONS	VERIFICATION OR INFORMATION REQUIREMENTS
Green	N/A – but need to comply with BR211 radon requirements, where applicable	
Amber 1	Ventilation – subfloor venting to achieve at least one air exchange per day (minimum 150 mm void height; 1500 mm² /m air vent opening or 500 mm² /m² floor area spaced at not more than 2 m centres on at least two opposing sides). Membrane – must be suitable for purpose. Membrane installation/design - to achieve complete integrity across entire building footprint. Penetrations and joints sealed.	Construction drawings – showing position of membrane; sealing details and ventilation points to be provided. Membrane specification – technical data sheet(s) for gas membrane (including gas permeability data) to be provided. Installation – photographic evidence of installed membrane may be requested.
Amber 2	Ventilation – subfloor venting to achieve at least one air exchange per day. Membrane – must be suitable for purpose (criterion detailed in BS8485 clause 7.2.4). Membrane installation and design to achieve complete integrity across entire building footprint. Penetrations and joints sealed. Installer – installers must be experienced and appropriately trained and/or qualified.	Construction drawings showing position of membrane, sealing details and ventilation points to be provided. Membrane specification – technical data sheet(s) for gas membrane (including gas permeability data) to be provided. Installation – third-party verification report with supporting evidence to be included (i.e. photographic evidence and certificates of conformity, observations relating to sealing, location of ventilators and standards of installation). Integrity testing – may be requested; testing plan to be agreed in advance.
Red	Standard residential housing is not generally acceptable without further ground gas risk assessment and/or possible remedial mitigation measures to reduce or remove the source of the ground gases.	



4.8. POTABLE WATER SUPPLY

This section provides a summary of the site investigation data with reference to the selection of potable water supply pipework. The assessment is made with reference to the UK Water Industry Research (UKWIR) publication "Guidance on the selection of Water Supply Pipes to be used in Brownfield Sites".

TABLE 4.12 PIPELINE SELECTION PE THRESHOLD CONCENTRATIONS

CONTAMINANT GROUP	PE-THRESHOLD (mg/kg)	CONCENTRATIONS AT CURRENT PIPELINE DEPTH (mg/kg)
Total VOC	0.5	N/A
Total BTEX And MTBE	0.1	N/A
Total SVOCs (Excluding PAH and those substances marked with an *)	2	N/A
EC5-EC10 Aliphatic and Aromatic Hydrocarbons	2	<1.20
EC10-EC16- Aliphatic and Aromatic Hydrocarbons	10	8.1
EC16-EC40 Aliphatic and Aromatic Hydrocarbons	500	139
Phenols (From SVOC Analysis)*	2	N/A
Cresols and Chlorinated Phenols (From SVOC Analysis)	2	N/A
Ethers*	0.5	N/A
Nitrobenzene*	0.5	N/A
Ketones*	0.5	N/A
Aldehydes*	0.5	N/A
Amines	Fail	N/A
Other Consideration		
Are there any exceedances of the PE threshold outside of the pipeline depth?	EC10–EC16 at TP101 at 0.60m, TP103 0.50m, TP104 0.60m, TP110 0.20m and WS102 at 0.30m. EC16–EC40 at TP104 0.60m, TP110 0.20m and WS102 at 0.30m.	
Is free product present in soil and groundwater?	None identified.	
Could hydrocarbon impact at greater depth than current pipeline depth be mobilised by rising groundwater levels?	No – heavy-end hydrocarbon impact and low solubility PAH has been identified within shallow Made Ground.	
Will soils impacted with above determinands likely be utilised elsewhere on site?	No.	
Will soils be imported to site as part of any future earth works	Currently unknown, however it is likely soils will be required to be imported to site. The importation of materials may affect the WIR Risk Assessment which should be updated after completion.	

Notes - Pipe line depth normally between 0.75m–1.35m



Based on the assessment of current site conditions it is likely that barrier pipe will be required at the proposed development.



4.9. CONCEPTUAL SITE MODEL

Following the completion of the intrusive site investigation, chemical analysis and risk assessment, the conceptual model shown in Table 4.13 has been prepared for the site.

TABLE 4.13 CONCEPTUAL MODEL

POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
PL1 PL2	Heavy Metals, non-volatile PAH (Made Ground)	Dermal contact. Dermal contact and ingestion.	Future site users. Off-site receptors.	Likely	High	LOW
Assessment: Lead has been identified within localised shallow Made Ground at TP108 at 0.40m bgl. Non-volatile PAHs have been identified within Made Ground at numerous locations across the site. Recommendation: Cover system to garden and landscaped areas will prevent exposure to future site users. Construction works completed with PPE and provision of welfare.						
PL3	ACM in Made Ground	Inhalation of dust.	Future site users. Buildings. Off-site land users.	Likely	High	LOW
Assessment: Asbestos in the form of loose chrysotile fibres and rope has been identified in the Made Ground in TP109 at 1.00 m bgl and WS106 at 0.20 m bgl. Recommendation: The soils will require placement in accordance with the asbestos CSM. Construction works completed with PPE and provision of welfare.						

POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
PL4	Volatile Contaminants such as naphthalene (Made Ground & Mill)	Inhalation of vapours. Migration through permeable strata and preferential pathways.	Future site users. Off-site receptors.	Likely	Moderate	LOW
Assessment: Elevated concentrations of naphthalene and TPH C16-C21 have been identified in the Made Ground in TP104 at 0.60m bgl, TP108 at 0.40m bgl and WS102 at 1.30m bgl. Recommendation: During a process of cut/fill enabling works, a hotspot removal should be undertaken where these soils may be chemically validated to assess chemical suitability for retention on-site in an area of no future sensitivity. If the hotspot removal is not completed, a VOC membrane will be required to affected plots.						
PL4	Methane, carbon dioxide (peat and potentially infilled features on and within 250 m of the site)	Inhalation of gas. Migration through permeable strata and preferential pathways. Explosion in confined spaces.	Future site users. Buildings. Off-site land users.	Low likelihood	Moderate	LOW
Assessment: Made Ground across the site and peat deposits in the north of the site have been identified as potential sources of hazardous ground gas. Glacial Till will likely restrict migration of any ground gas into shallow foundations. Recommendation: Initial monitoring suggests that the site can be classified as CS1/Green, however this will be confirmed on completion of the monitoring. Precautionary CS2/Amber 1 measures required.						

POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
PL5	Mobile contaminants such as metals, PAHs, hydrocarbons, volatile compounds (Made Ground & Mill)	Surface runoff. Migration through permeable strata and preferential pathways. Perched waters migration.	Groundwater (Secondary A aquifer). Surface water (River Roch).	Likely	Moderate	LOW
Assessment: Likely probability as significant sources of mobile contamination identified across the site within leachate, groundwater and surface water samples. Glacial Till across the site may reduce downward migration into the adjacent River Roch. The m-BAT assessment and the PB screening tool has confirmed that copper, zinc and nickel and lead are below the EQS values and are therefore not considered bioavailable, and therefore the site is unlikely to pose an unacceptable level of risk to the River Roch. Recommendation: Sampling of surface water required throughout the remediation and enabling earthworks on site to ensure no future mobilisation of contaminants is caused, which may pose a risk to the watercourse.						
PL6	Sulphate (potential ash within Made Ground)	Sulphate attack on concrete.	Building structure.	Likely	Moderate/Low	LOW
Assessment: The soils at the site meet class DS-1, AC-1s with an isolated area at TP110 at 0.20 m bgl meeting class DS-2, AC-1s. Recommendation: Concrete should be designed in accordance with the chemical testing results. However, it is likely that the shallow Made Ground within TP110 will be removed during any remediation and enabling works and therefore DC-1, AC-1s concrete classification may be suitable for the site.						

POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
PL7	Organic contaminants such as hydrocarbons, (Made Ground & Mill)	Ingestion of tainted water supply.	Future site users. Water pipes.	Likely	Moderate	LOW
Assessment: Elevated concentrations of TPH have not been identified at the proposed pipeline depth (0.75 m – 1.35 m). However, elevated concentrations of TPHs EC10-16 and EC16-40 have been identified at various locations across the site between 0.20 m bgl and 0.60 m bgl. Recommendation: Based on the assessment of current site conditions, it is likely that barrier pipe will be required. This will need to be confirmed with a UKWIR risk assessment post remediation upon the completion of any material importation to site.						
PL8	Phytotoxic contaminants (Made Ground)	Direct Contact (plant uptake).	Flora.	Likely	Low	LOW
Assessment: Contamination has been encountered within shallow Made Ground across the site which may be taken up by flora in soft landscaping. Recommendation: Installation of a clean cover system within any areas of soft landscaping to prevent plant uptake of contaminants.						

Main exposure pathways:

PL1 = soil ingestion, PL2 = dermal contact and ingestion, PL3 = dust inhalation; PL4 = Vapour/Gas Inhalation; PL5 = Vertical / Lateral Migration; PL6 = Corrosion of concrete; PL7=Tainting of water supply; PL8 = Uptake by plants.

5. GEOTECHNICAL ASSESSMENT

5.1. SITE PREPARATION

The site should be cleared and any vegetation below areas of proposed development stripped in accordance with Series 200 of the *Manual of Contract Documents for Highway Works (MCHW)*. This should include the following:

- ✦ Roots present below the footprint of proposed structures and infrastructure should be grubbed out and the resulting void infilled with suitable compacted engineered fill.
- ✦ Removal of all concrete hardstanding and obstructions within the Made Ground.
- ✦ Redundant services should be sealed off and grubbed out and replaced with suitable compacted engineered fill.
- ✦ Any buried structures and old foundations that have been encountered on site. These should be excavated from below the proposed development footprint with the resulting void backfilled.

5.2. FOUNDATION CONDITIONS AND ASSESSMENT OF POTENTIAL BEARING CAPACITIES

In due consideration of the identified ground conditions, in-situ and laboratory geotechnical testing, E3P has undertaken an assessment of the net safe allowable bearing pressure (ABP) within the underlying natural stratum to assist in the detailed design of foundations and infrastructure and determine the target founding stratum. The results of this assessment are summarised in Table 5.1.

TABLE 5.1 SUMMARY OF ABP

GRANULAR SOILS			
Description	Depth (Range m bgl)	Relative Density	Allowable Bearing Pressure (kN/m ²)
Clayey SAND (CP101)	2.00–2.45	Medium Dense	127
Weathered SILTSTONE (CP101)	4.00–5.45	Dense	422
Weathered SANDSTONE (WS102, WS104A, WS105 & WS105A)	1.00–2.45	Very Dense	504



COHESIVE SOILS			
Description	Depth (range m bgl)	Undrained Shear Strength (Cu) (kN/m ²)	Allowable Bearing Pressure (kN/m ²)
Very Soft to Firm Sandy CLAY (WS103)	2.00–3.45	4–30	9–62
Stiff to Very Stiff, Gravelly CLAY (WS102 & WS104)	1.00–1.45	90–252	186–518
Stiff to Very Stiff, Gravelly CLAY (CP101)	3.00–3.45	69	143
Stiff to Very Stiff Sandy CLAY	1.60–4.45	50–235	103–483

Based on the assessment of the relative undrained shear strength, relative in-situ densities and corresponding safe net allowable bearing pressure, the suitable target founding stratum has been identified as the underlying firm to very stiff glacial clays and localised areas of medium-dense sands.

However, given the significant variances in ground conditions on the site, prior to the detailed design of suitable foundations solutions, a programme of remediation and enabling works will be required to remove any buried obstructions, process the Made Ground and cut/fill the site to provide suitable development platform levels.

Therefore, upon completion of these enabling works, it is likely that the most cost effective option for the majority of the site would be to re-engineer the Made Ground using vibro stone columns (VSCs) to support a shallow strip or spread foundation.

To determine if VSC is viable at the subject site, E3P has completed a Ground Improvement Design Risk Matrix that is summarised in Table 5.2.



TABLE 5.2 GROUND IMPROVEMENT DESIGN RISK MATRIX

RISK ITEM	COMMENT	PASS/FAIL
Soft clays with an undrained shear strength less than 30 kN/m ²	CLAY soils are generally firm to stiff with Cu > 80 kN. Isolated areas of softer clay soils were encountered with Cu < 30 kN/m ² ; however, it is considered that these will either be piled or soft material excavated to remove the organic deposits.	PASS
Ground with peat layers close to foundation level or the base of the stone column, or where intermediate layers of peat are thicker than 200 mm, either as a single layer or the sum of the thicknesses of individual layers throughout the length of the stone column	Peat has been identified in the north of the site at TP103 of the site measuring a thickness of 1200mm between 0.80 m bgl and 2.00 m bgl. Five locations in the northern sector also have soft deposits; however, they are also within tree influence areas. It is therefore likely that plots overlying these areas will be piled.	PASS
Voided filled ground, e.g. old water tanks, pottery, glass bottles, concrete rubble or brick fill of unsuitable grading	Made Ground beneath the site will require removal and processing to render the site suitable for VSC.	PASS – on completion of enabling works
Loose or non-engineered fill not previously subject to rising or fluctuating water levels saturation	None identified.	PASS
Filled ground still settling or expected to settle under its own weight or due to the effects of surcharging/upfilling where there is a high organic content or where decay is continuing	None identified. It is considered that any Made Ground material has consolidated under self-weight settlement.	PASS
Fill, containing degradable material where organic material forms more than 15% of fill by volume	None identified.	PASS
Clays with a plasticity index greater than 40%	None identified.	PASS
Highly sensitive soils liable to collapse or remoulding	None identified.	PASS
Cohesive soils with trees in influencing distance	Plots where tree influence has been modelled and will either be subject to a piled or mass trench-fill solution.	PASS
Overall Risk Rating and Suitability for Vibratory Ground Improvement		PASS

The exception to this would be in the location of the peat deposits and the soft CLAY strata. Dependent on development levels, plots in this area may require a driven pile foundation.



Foundation depths should take account of the presence of existing and proposed trees, with foundations deepened locally to mitigate the potential for volumetric instability attributed to fluctuations in moisture content, in accordance with the requirements of NHBC standards.

It is recommended that at working drawing stage a foundation schedule is prepared for the development, taking account of the physical change of natural clay soils and the current/proposed locations of trees.

A summary of anticipated foundations is presented in Table 5.3.

TABLE 5.3 ANTICIPATED FOUNDATIONS

LOCATION	ANTICIPATED FOUNDING STRATA DEPTH (m bgl)	GROUND WATER (m bgl)	TARGET STRATUM	TREES	FOUNDATION TYPE	TYPE OF CONCRETE
WS101	2.45	3.00	Stiff CLAY	N	VSC / Pile	DS-1 AC-1s
WS102	0.85	1.00	V Stiff CLAY	Y	Shallow Strip	DS-1 AC-1s
WS103	>2.50	N/A	TBC	Y	VSC / Pile	DS-1 AC-1s
WS104	1.05	N/A	V Stiff CLAY	Y	Shallow Strip	DS-1 AC-1s
WS104A	1.25	N/A	V Stiff CLAY	Y	Shallow Strip	DS-1 AC-1s
WS105	0.85	N/A	Bedrock	Y	Shallow Strip	–
WS105A	0.75	N/A	Stiff CLAY	Y	Shallow Strip	–
WS106	1.55	N/A	V Stiff CLAY	Y	Mass Trench	DS-1 AC-1s
TP101	>2.50	2.00	TBC	N	VSC / Pile	DS-1 AC-1s
TP102	>2.50	1.90	TBC	N	VSC / Pile	DS-1 AC-1s
TP103	>2.50	2.00	TBC	Y	VSC / Pile	DS-1 AC-1s
TP104	2.45	N/A	Firm CLAY	Y	VSC / Pile	DS-1 AC-1s
TP105	>2.50	N/A	TBC	N	VSC / Pile	DS-1 AC-1s
TP106	1.40	2.50	Stiff CLAY	Y	Mass Trench	DS-1 AC-1s
TP107	1.25	2.50	Firm CLAY	N	Shallow Strip	–
TP108	1.85	N/A	Firm CLAY	Y	Mass Trench	DS-1 AC-1s
TP109	>2.50	N/A	TBC	N	VSC / Pile	DS-1 AC-1s
TP110	>2.50	N/A	TBC	Y	VSC / Pile	DS-2 AC-1s
CP101	1.85	N/A	MD SAND	N	Mass Trench	–

It is recommended that, at working drawing stage, a foundation schedule is prepared for the development taking account of the physical change of natural clay soils and the current/proposed locations of trees.

5.3. GROUND FLOOR SLABS

Current building control regulations require that where infilled ground is present to depths in excess of 600 mm, or where the substratum is variable in terms of the structure and settlement potential, or where clay soils are present within the influence of existing or proposed trees, a suspended floor slab is required.



In this instance, it is considered that for the majority of substructures, the underlying stratum would have in excess of 600 mm of infill and, as such, a suspended floor slab will be required.

Where a cast in-situ suspended slab is utilised with no subfloor void, appropriate compressible material (heave precautions) will be required in the construction of the substructure.

5.4. HEAVE PRECAUTIONS

The site has been proven to be underlain by clay soils, which are susceptible to volumetric instability due to fluctuations in moisture content, particularly within influencing distance of trees as per the NHBC/LABC conjectured zones of influence.

If the clay is deemed to be low plasticity, heave precautions are not required to the internal face of the external load-bearing walls (outside or within tree influence).

If a ground beam is to be constructed within the zone of tree influence, heave precautions are required to the underside of this and edge beams.

If the ground floor slab is to be constructed with a beam and block floor, a minimum subfloor void of 200 mm is required within any structures located in the zone of conjectured tree influence.

If the ground floor slab is constructed with a cast in-situ suspended floor slab, then heave precautions that can tolerate 50 mm of clay swelling are required within any part of the floor slab to be located within the zone of influence of a tree.

A summary of heave precautions is presented in Table 5.4.

TABLE 5.4 SUMMARY OF HEAVE PRECAUTIONS

		MINIMUM VOID DIMENSION FOR FOUNDATIONS, GROUND BEAMS AND SUSPENDED IN-SITU CONCRETE GROUND FLOORS		MINIMUM VOID DIMENSIONS UNDER PRECAST CONCRETE AND SUSPENDED TIMBER FLOORS
Plasticity Index of Soil	Required Foundation Depth (m)	Thickness of Void Former Against Side of Foundation or Ground Beam (mm)	Thickness of Void Former on Underside of Edge Beam and Floor Slab (mm)	Void Dimension (mm)
High Plasticity (> 40)	> 2.5	Engineer Design		Engineer Design
	2.0–2.5	35	150	300
	1.5–2.0	25	75	
Moderate Plasticity (20–40)	> 2.5	Engineer Design		Engineer Design
	2.0–2.5	25	100	250
	1.5–2.0	25	50	
Low Plasticity (< 20)	2.0–2.5	N/A	50	200
	> 2.0	No Special Precautions		



5.5. HIGHWAYS CONSTRUCTION

A programme of remediation and enabling works will be required to remediate the proposed road subgrade in accordance with the requirements of the Manual of Contract Documents for Highway Works Volume 1 Specification For Highway Works (Series 600-Earthworks) for a method compaction.

It is considered that the material can be re-engineered using method compaction to achieve a CBR in excess of 5% if works are completed in favourable climatic conditions.

5.6. DRAINAGE

The presence of substantial depths of Made Ground across some areas of the site may result in settlement. It is therefore recommended that drain runs are designed using steeper gradients and flexible joints to allow for some differential settlement.

Furthermore, the site is predominantly underlain by circa 1–2 m of likely low-permeability gravelly/sandy CLAY. Therefore, the use of soakaway drainage will be limited, and as the lateral continuity of the Made Ground cannot be assured, it is not recommended that soakaways are utilised for disposal of surface water runoff.

If soakaway drainage is to be considered, full BRE 365 testing must be completed to inform the detailed design.

5.7. CONCRETE DURABILITY

Chemical analyses for pH and soluble sulphate content contained in Appendix V, shows that the soils at the site generally meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with BRE *Special Digest 1* (2005).

Elevated sulphate concentrations meeting Class DS-2, AC-1s were noted within the Made Ground deposits in TP110 at 0.20 m bgl.

5.8. EXCAVATIONS

Trial pits were generally stable in both granular Made Ground and natural strata; as such, it is considered that near-surface excavations will be feasible. In areas where Made Ground exceeded 2 m, excavations were generally less stable.

Site observations indicated that excavations should be feasible in the near surface with normal plant; however, obstructions were identified in the near surface, including former foundations and former floor slabs. It is anticipated that any obstructions will be grubbed out during the reduced-level dig for the substructure works.

However, due to the depth and variability of the Made Ground and likelihood of trench collapse, it is considered that all excavations are supported or battered back in accordance with guidance contained in CIRIA R97.

If local pumping of groundwater is required during the advancement of excavations for the proposed foundations then consideration should be given to the potential for dewatering gravels in the surrounding areas that may cause structural damage to building substructures in close proximity to the site.



TABLE 5.5 CIVIL ENGINEERING EXCAVATION RISK MATRIX

RISK ITEM	PRESENT	COMMENT
Running Sands	No	No running sand has been identified.
Minor Water Ingress	Yes	Minor water ingress will require localised dewatering/sump pumping during the construction of site drainage infrastructure. Ingress of water into foundation excavation will potentially flood foundation excavations, limiting the viability of spread foundations to be constructed. The dewatering of gravels will be required.
Shallow Bedrock	Yes	Shallow bedrock has been identified within the centre of the site at depths less than 2 m below current ground levels, between 0.40 m bgl and 3.30 m bgl. The presence of bedrock will impede excavation for drainage infrastructure using traditional excavation plant and equipment.

5.9. SLOPE STABILITY

An embankment is present at the south eastern boundary leading down to the River Roch, which is at an approximate 1m lower elevation of this slope.

As and when detailed topographic information is available and in due consideration of the proposed development design, structural and infrastructure loading, a detailed slope stability model will be required. This model will seek to determine the potential for newly imposed loadings to generate a risk of instability or failure within the off-site embankment and the need for any mitigation measures such as piled foundations to transfer loadings below the base of the slope.



5.10. CONSTRUCTION ACTIVITY AND INSPECTION

The following activities and inspections should be incorporated into the site works:

- ✿ Due to the variability of the soils at the site, it is recommended that sufficient allowance is made for the inspection of formations and sub-formations to foundations and pavement construction.
- ✿ Excavations where access is required should be subject to a risk assessment from a competent person and, where appropriate, mitigation measures such as benching back the sides or use of support systems in accordance with CIRIA R97 should be utilised.
- ✿ It is considered that dewatering may be required, especially following periods of heavy rainfall. Removal of surface water and water within trenches should be possible with conventional sump pumping. Discharge of any water should be agreed with the relevant regulatory body and be undertaken under a trade effluent discharge, where required. Measures to remove silt and suspended solids may be required and consideration should be given to provision of space for settling tanks or an attenuation pond.
- ✿ Where access to confined spaces is required, appropriate mitigation measures should be addressed within the construction stage health and safety plan. Particular account should be taken of the gas results.
- ✿ The presence of potential contamination and mitigation measures should be addressed as part of the construction stage health and safety plan and should include measures to design out the risks, reduce their impact and, finally, to include the use of personnel protective equipment (PPE).



5.11. GEOTECHNICAL RISK REGISTER

POTENTIAL CONSTRAINT	ABNORMAL	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Remediation of contaminated soils		On site - centre	10	Elevated concentrations of naphthalene and TPH C16-21 associated with the historic land use as the Former Oakenrod Woollen Mill have been identified in the centre of the site. The material deemed to have a potential vapour risk will require hotspot removal, resulting the requirement to backfill the resulting void. Should significant backfill be needed deeper or specialist foundations may be required in those areas.
Bedrock		On site - centre	20	Shallow bedrock has been identified in the centre of the site, between 0.40 m bgl and 3.30 m bgl, this represents a significant risk in terms of the viability for excavations to install infrastructure using standard construction equipment.
Cohesive Stratum overlying shallow Bedrock (<3.00m)		On site - centre	20	Where a potential for volumetric instability is present in cohesive deposits over shallow bedrock a specialist pile design is required in order to prevent pile failure generated from heave. Piles may need to be socketed into the underlying bedrock through CFA method or a sleeve design applied to a pile precast.
Obstructions		All	100	Site has been subject to significant historical development and, while above-ground structures have been removed, potential subsurface obstruction from relict foundations, a chimney base in the centre of the site and slabs remain.
Artificially levelled and filled platforms		N/A	N/A	The site appears to have been levelled and artificially backfilled.
Retaining walls		Northern boundary	10	There is a retaining wall on the northern boundary of the site, which retains Bury Road to the north. This will need to be assessed by a structural engineer prior to development as it is integral to the stability of the road infrastructure to the north.
Trench collapse		All	100	Made Ground present beneath the site is likely to be loosely compacted and possibly prone to collapse.



POTENTIAL CONSTRAINT	ABNORMAL	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Mature trees		Periphery and south	40	Arboriculture survey will be required to determine areas of potential tree influence. The site is predominantly surfaced by hardstanding in the north, and dense woodland in the south and along the peripheries of the site.
Volume change potential clay		On site	100	The site is underlain by cohesive and interbedded granular soils. An assessment of the volume change potential will be required, and therefore heave precautions may be required at the site.
Peat		On site - north	10	Peat has been identified in one location in the north of the site between 0.80m bgl and 2.00 m bgl, this is a highly compressible stratum that represents a risk in terms of consolidation inducing failure to structures and infrastructure.
Running sands		N/A	N/A	Data searches indicate low risk.
Ground dissolution		N/A	N/A	Data searches indicate no hazard.
Concrete design		On site	5	DS-1, AC-1s with an isolated area in the centre of the site being DS-2, AC-1s however this was identified within shallow Made Ground.
Low-permeability ground		On site	100	Soakaways unlikely to be effective due to the presence of low permeability cohesive deposits and in areas of contaminated soil.
Services/sensitive structures		On site	20	A review of online services has identified a number of services (LV Electricity cable, BT Openreach and combined sewer) within the site boundary as well as the River Roch on the south eastern boundary which should be considered sensitive in this case. Piling may not be possible within close proximity to any sensitive infrastructure.
Abnormal foundation solutions		On site	30	Made Ground, peat and soft clays have been identified on site, that will be subject to volume change an abnormal foundation solution (VSC or Pile) may be required.



POTENTIAL CONSTRAINT	ABNORMAL	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Areas not investigated		North and south	40	An area in the north of the site was not investigated as at the time of investigation, the area was being utilised as a car park. A large area in the south of the site was also not investigated, including the area of the former sluice, as it was densely vegetated and contained large areas of Japanese Knotweed. Two areas of Japanese Knotweed were also identified in the north and east of the site, an easement of 2m was applied to these areas.
Surface water features		South eastern periphery	10	The River Roch is present adjacent to the south eastern site boundary.
Slope		South eastern periphery	10	A significant slope is identified on the south eastern boundary of the site down to the River Roch, detailed assessment and modelling is required to assess the long-term stability in both the temporary and permanent state associated with current, temporary and permanent loading



5.12. FURTHER WORKS

Based on the findings of the geoenvironmental site assessment, the following additional works are recommended to be completed in due course:

-  Further investigation of inaccessible areas.
-  Completion of ground gas monitoring.
-  Radon specific assessment.
-  Plot-specific foundation schedule (upon receipt of the final development levels).
-  Arboricultural survey.
-  Slope stability assessment
-  Remediation and enabling works strategy.
-  Controlled waters piling risk assessment.
-  Construction phase Surface Water Management Plan and Flood Risk Activity Permit.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. CONTAMINATED LAND ASSESSMENT

Human Health	The Tier 2 human health risk assessment identified site-wide concentrations of non-volatile, insoluble heavy metals and hydrocarbon compounds that would present unacceptable degrees of theoretical risk to the identified receptors associated with direct exposure pathways. As such, it will be necessary to design and construct the proposed development in a manner that will ensure suitably validated cover systems to all areas of private garden, soft landscaping and public open space. Asbestos in the form of chrysotile has also been identified within two localised areas in Made Ground deposits at TP109 at 1.00 m bgl and WS106 at 0.20 m bgl. Asbestos quantification was undertaken to further assess where these soils may be placed, the levels detected was between 0.141% and 0.043% respectively. No visual signs of ACM were encountered during the ground investigation; it is therefore likely that only trace fibres are present. It is considered that the development will be suitable for the intended use, subject to the careful management and placement of anthropogenic materials in accordance with the developed CSM. With regards to the elevated naphthalene, these present a potential volatilisation to indoor air risk. These elevated concentrations have only been identified within three areas of the site and are therefore considered to be localised hotspots associated with the historic site use of a former Mill. Therefore, during a process of cut/fill enabling works, a hotspot removal should be undertaken where these soils may be chemically validated to assess chemical suitability for retention on site in an area of no future sensitivity. Chemical analysis of the natural clay drift deposits has identified these soils to be acceptable for use as subsoil within the proposed garden areas; however, further chemical validation samples will be required to confirm this. There are no suitable sources of topsoil available on the site.
Controlled Waters	The Tier 2 controlled waters risk assessment identified the Rich Roch as the main receptor across the site. Widespread heavy metal and Polyaromatic Hydrocarbon compound exceedances were identified when leachate, groundwater and surface water samples were compared to the Environmental Quality Standards. An m-BAT assessment and PB Lead screening assessment was carried out for the site, this concluded that the compounds were not considered bioavailable. Based on the assessment, E3P do not consider the site to pose an unacceptable level of risk to surface waters including the River Roch. It should also be noted the site is currently predominantly uncapped and the proposed development will largely encapsulate the site, thus limiting the potential for infiltration and therefore leaching potential. However, further groundwater sampling will be required during the remediation and enabling works at the site to ensure no future mobilisation of contaminants and that the development does not pose a further risk to the River Roch.

	In light of the above assessment, E3P does not consider the site to currently pose an unacceptable level of risk to the controlled water receptors.
Ground Gas	Characteristic Situation 1 (pending completion of gas monitoring). The localised area of peat will require removal and the excavation backfilling with inert material. Where areas of volatile hotspots have not been removed, a VOC membrane will be required to the affected plots.
Potable Water	This will need to be confirmed following the completion of a UKWIR risk assessment. Post-remediation and enabling works ground conditions may be different from those identified during this site investigation. Current ground conditions indicate that barrier pipe will be required.

6.2. GEOTECHNICAL ASSESSMENT

Brick and concrete have been encountered within the Made Ground, indicative of relic foundations from the former Mill building and school building across the site.

During a phase of cut-and-fill enabling works to create a developable platform, all below-ground obstructions will require grubbing out to the base of the Made Ground to enable the construction of proposed plots.

The underlying natural clay drift deposits have been assessed as being stiff high strength with a net ABP in the order of 80 kN/m² at circa 1.00 m bgl increasing to 150–200 kN/m² at circa 2.00 m bgl.

The localised area of granular drift deposits in the centre of the site have been assessed as being medium dense with a net ABP of 127 kN/m² at circa 2.00 m bgl.

The shallow bedrock identified in the centre of the site has been assessed as being dense to very dense with a net ABP of 504 kN/m² at 2.00 m bgl.

Given the significant variances in ground conditions on the site, prior to the detailed design of suitable foundations solutions, a programme of remediation and enabling works will be required to remove any buried obstructions, process the Made Ground and cut/fill the site to provide suitable development platform levels.

Therefore, upon completion of these enabling works, it is likely that the most cost effective option for the majority of the site would be to re-engineer the Made Ground using vibro stone columns (VSCs) to support a shallow strip or spread foundation.

The exception to this would be in the location of the peat deposits and the soft CLAY strata. Dependent on development levels, plots in the area of soft CLAY area may require a driven pile foundation. The PEAT strata will require removal due to the materials being a ground gas risk and geotechnically unsuitable.

END OF REPORT

APPENDIX I LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between E3P and the client as indicated in Section 1.3.
2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.
3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.
4. During the site walkover, reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover, no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not been made known or accessible.
5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.
6. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.
7. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials, this is for indicative purposes only and do not constitute or replace full and proper surveys.
8. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.
9. E3P cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by E3P is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by E3P in this connection without their explicit written agreement there to by E3P.
10. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.

APPENDIX II

GLOSSARY

TERMS

ACM	Asbestos-containing material	MMP	Materials management plan
ADS	Acoustic design statement	ND	Not detected
AST	Above-ground storage tank	NDP	Nuclear density probe
BGS	British Geological Survey	NMP	Noise management plan
BSI	British Standards Institute	NPSE	Noise policy statement for England
BTEX	Benzene, toluene, ethylbenzene, xylenes	NR	Not recorded
CA	Coal Authority	PAH	Polycyclic aromatic hydrocarbon
CBR	California bearing ratio	PCB	Polychlorinated biphenyl
CIEH	Chartered Institute of Environmental Health	PI	Plasticity index
CIRIA	Construction Industry Research Association	PID	Photo ionisation detector
CLEA	Contaminated land exposure assessment	POS	Public open space
CML	Council of Mortgage Lenders	PPE	Personnel protective equipment
CoC	Contaminants of concern	ProPG	Professional practice guidance
CSM	Conceptual site model	QA	Quality assurance
DNAPL	Dense non-aqueous phase liquid (chlorinated solvents, PCB)	SGV	Soil guideline value
DWS	Drinking water standard	SPH	Separate-phase hydrocarbon
EA	Environment Agency	SPT	Standard penetration test
EQS	Environmental quality standard	SVOC	Semi-volatile organic compound
FFL	Finished floor level	TPH	Total and speciated petroleum hydrocarbon
GAC	General assessment criteria	TPH CWG	Total Petroleum Hydrocarbon (Criteria Working Group)
GL	Ground level	UKWIR	United Kingdom Water Infrastructure Risk
GSV	Gas screening value	UST	Underground storage tank
HCV	Health criteria value	VCC	Vibro-concrete column
ICSM	Initial conceptual site model	VOC	Volatile organic compound
LEL	Lower explosive limit	VRSC	Vibro-replacement stone columns
LMRL	Lower method reporting limit	VSC	Vibro-stone columns
LNAPL	Light non-aqueous phase liquid (petrol, diesel, kerosene)	WHO	World Health Organisation
MCV	Moisture condition value	WRAP	Waste and Resources Action Programme
MIBK	Methyl isobutyl ketone	WTE	Water table elevation

Oakenrod School, Rochdale

Phase II Geoenvironmental Site Assessment

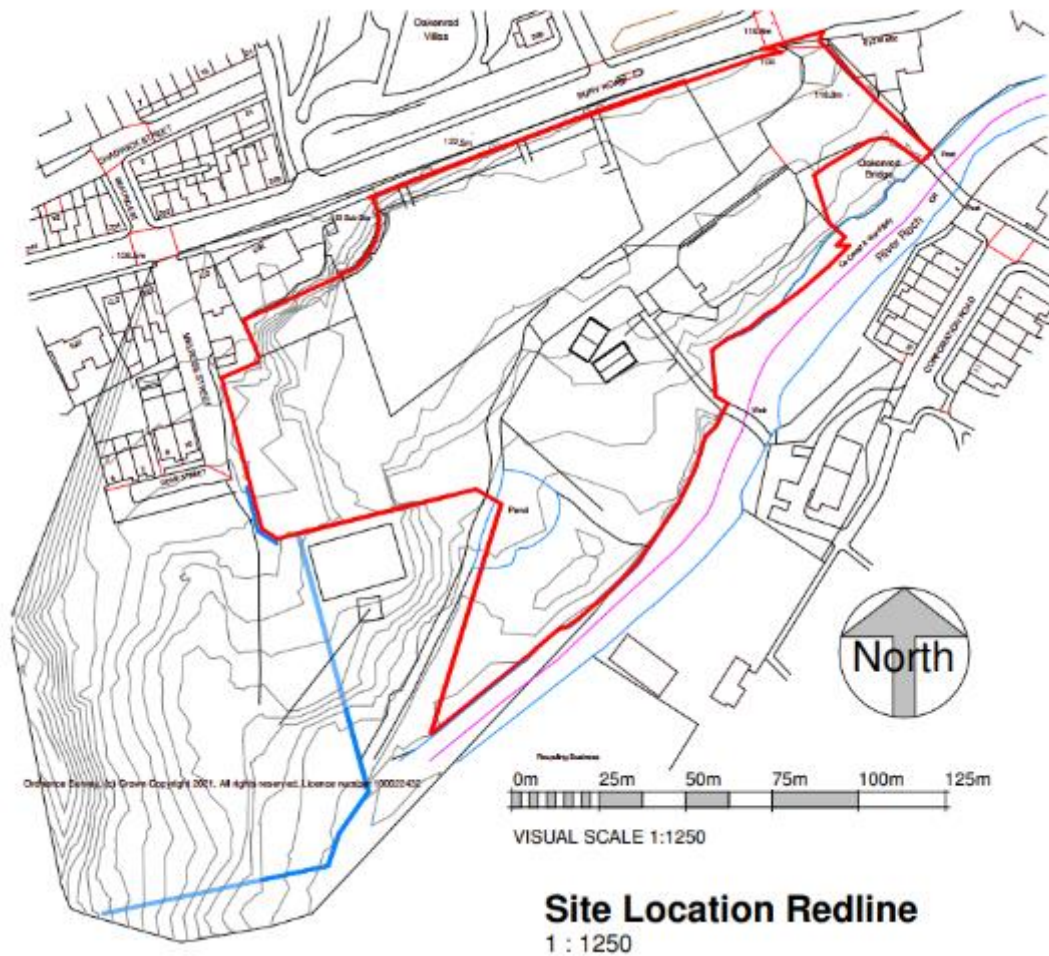
August 2023

m	Metres	ppm	Parts per million
km	Kilometres	mg/m³	Milligram per metre cubed
% v/v	Percent volume in air	m bgl	Metres below ground level
mb	Millibars (atmospheric pressure)	m bcl	Metre below cover level
l/hr	Litres per hour	mAOD	Metres above ordnance datum (sea level)
µg/l	Micrograms per litre (parts per billion)	kN/m²	Kilonewtons per metre squared
ppb	Parts per billion	µm	Micrometre
mg/kg	Milligrams per kilogram (parts per million)	SSRT	Site Specific Remediation Target
PSD	Particle Size Distribution	DD	Dry Density
CL:AIRE	Contaminated Land: Applications in Real Environments	Mc	Moisture Content
ρ	Bulk Density	GPR	Ground Penetrating Radar
NDP	Nuclear Density Probe	FFL	Finished Floor Level
LEL	Lower Explosive Limit	UKWIR	UK Water Industry Research
CIRIA	Construction Industry Research and Information Association	LOD	Limit of Detection

APPENDIX III

DRAWINGS AND CROSS SECTION

DRAWING 16-932-001 – SITE LOCATION PLAN

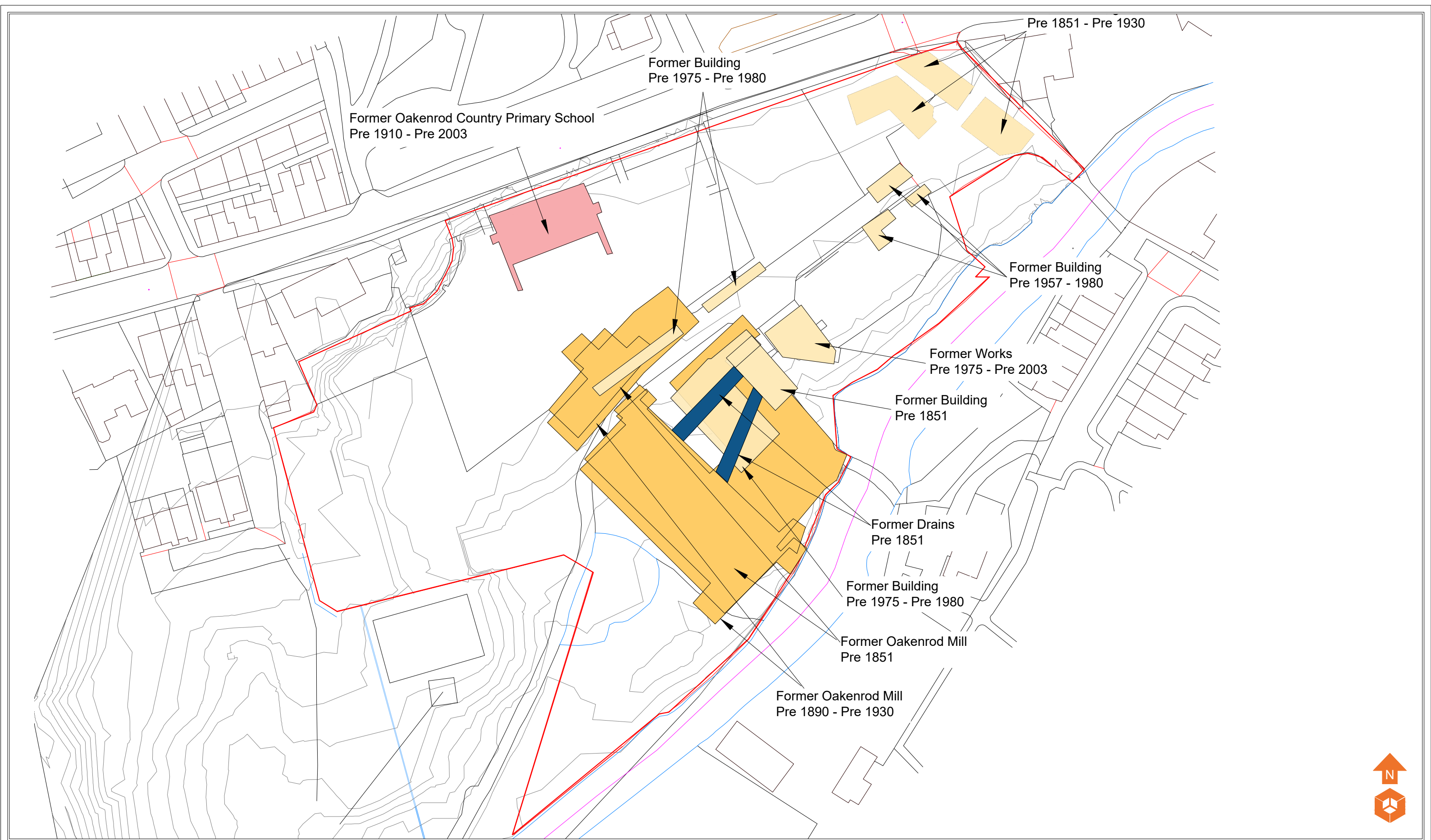




ITE PLAN - 1:500



Notes:					Client: Hallmark Developments Ltd		Job No: 16-932		Date: 26.07.2023			Environmental Engineering Partnership Ltd Taylor Road, Trafford Park Urmston, Manchester, M41 7JQ Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk										
							Drawing No: 002		Scale: NTS													
<table><tr><td>P1</td><td>REVA</td><td>26.07.2023</td><td>LM</td><td>EF</td></tr><tr><td>Phase</td><td>Issue</td><td>Date</td><td>Drawn</td><td>Checked</td></tr></table>					P1	REVA	26.07.2023	LM	EF	Phase	Issue	Date	Drawn	Checked	Job Title: Oakenrod School, Rochdale		Drawing Title: Proposed Development Plan				The client must not amend any drawing, design or other intellectual property produced by E3P Ltd without permission in writing from E3P Ltd in advance of any amendments being made. In the event that such written permission is not obtained in advance of the amendments being made, E3P Ltd shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.	
					P1	REVA	26.07.2023	LM	EF													
					Phase	Issue	Date	Drawn	Checked													



Site Features

- Former Buildings
- Former Drains
- Former Oakenrod Mill
- Former Oakenrod Country Primary School

Notes:

P1	REVA	17.08.2023	OW	EF
Phase	Issue	Date	Drawn	Checked

Client:

Hallmark Developments Ltd

Job Title:

Oakenrod School, Rochdale

Job No:

16-932

Drawing No:

003

Date:

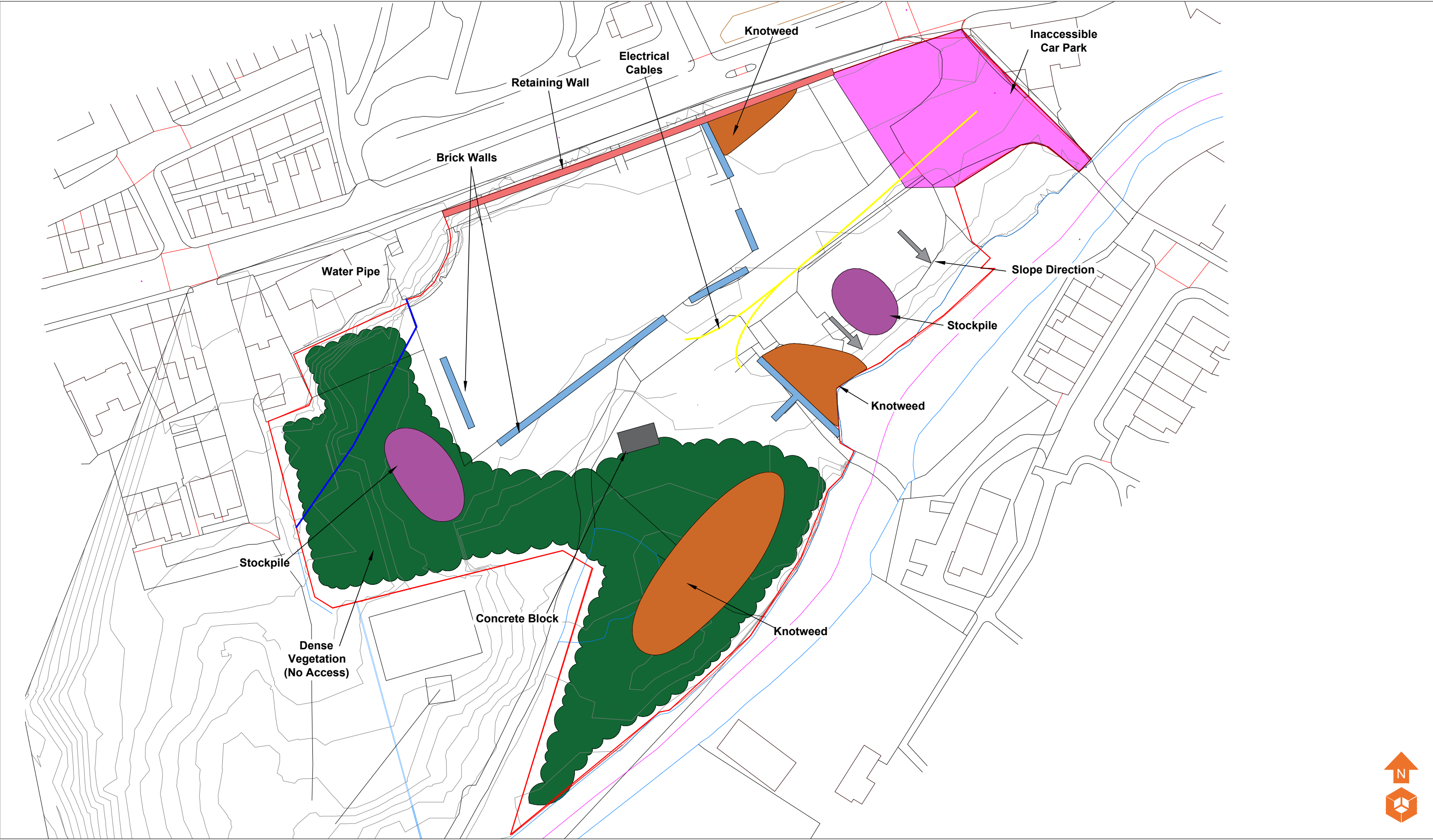
17.08.2023

Scale:

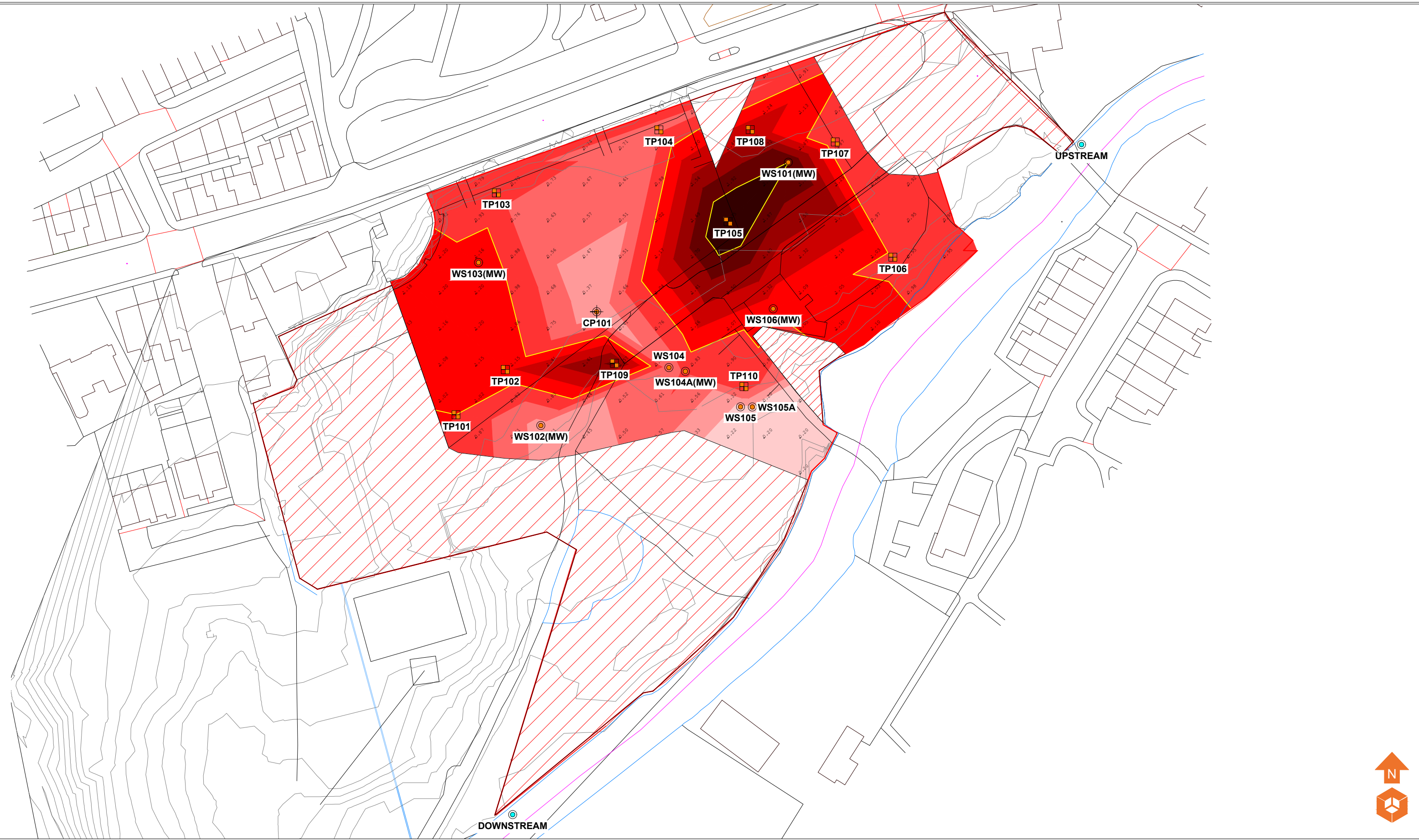
NTS

Environmental Engineering Partnership Ltd
Taylor Road, Trafford Park
Urmston, Manchester, M41 7JQ
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
Website: www.e3p.co.uk

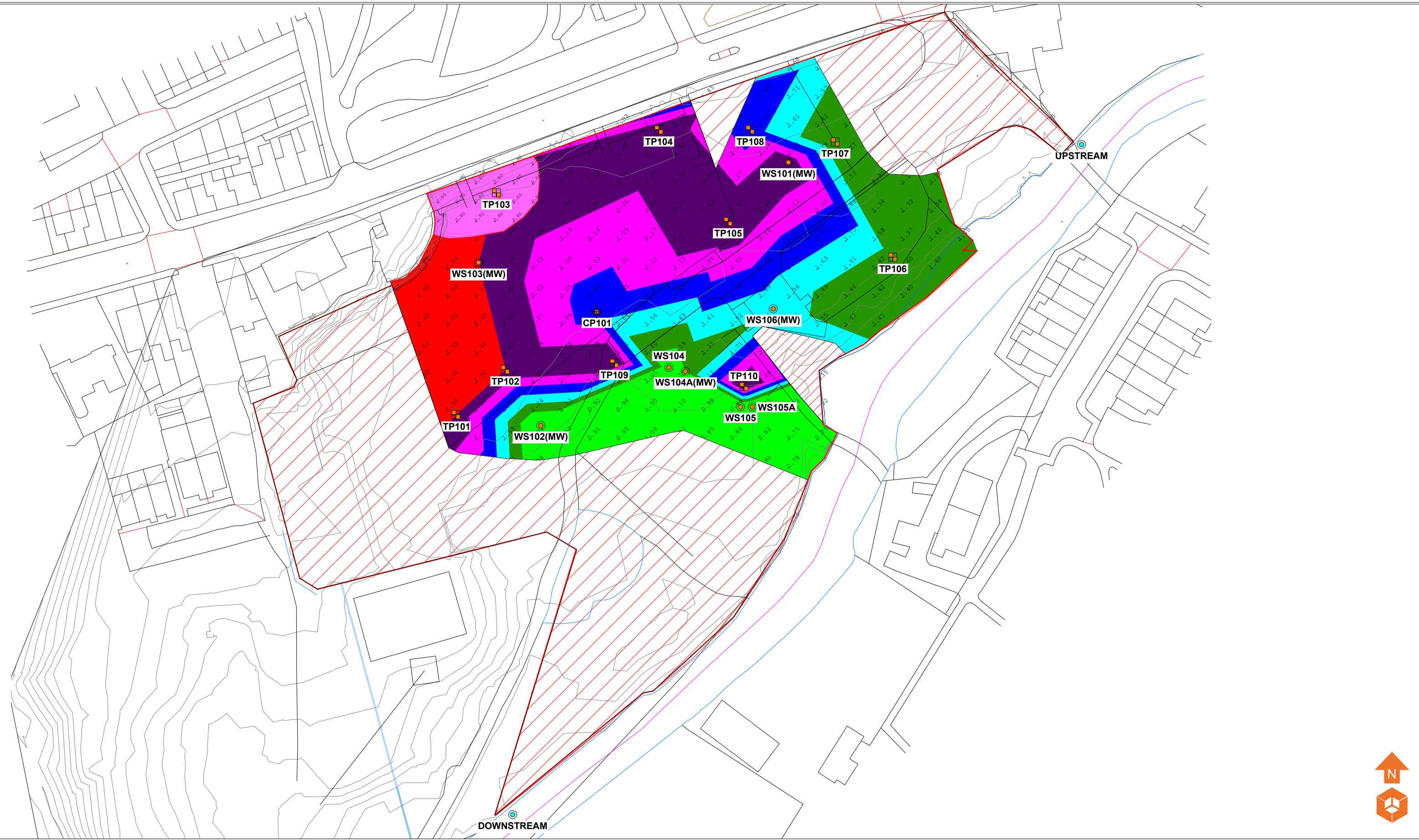
The client must not amend any drawing, design or other intellectual property produced by E3P Ltd without permission in writing from E3P Ltd in advance of any amendments being made. In the event that such written permission is not obtained in advance of the amendments being made, E3P Ltd shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.



Site Features Dense Vegetation Concrete Block Electrical Cables Culvert Brick Walls Knotweed Stockpile Inaccessible Car Park Slope Direction Retaining Wall Water Pipe	Notes:					Client: Hallmark Developments Ltd	Job No: 16-932	Date: 09.06.2023	e3p Environmental Engineering Partnership Ltd Taylor Road, Trafford Park Urmston, Manchester, M41 7JQ Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk
	P1 REVA 09.06.2023 HM GC					Job Title: Oakenrod School, Rochdale	Drawing No: 004	Scale: NTS	
	Phase Issue Date Drawn Checked						Drawing Title: Site Features Plan	The client must not amend any drawing, design or other intellectual property produced by E3P Ltd without permission in writing from E3P Ltd in advance of any amendments being made. In the event that such written permission is not obtained in advance of the amendments being made, E3P Ltd shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.	

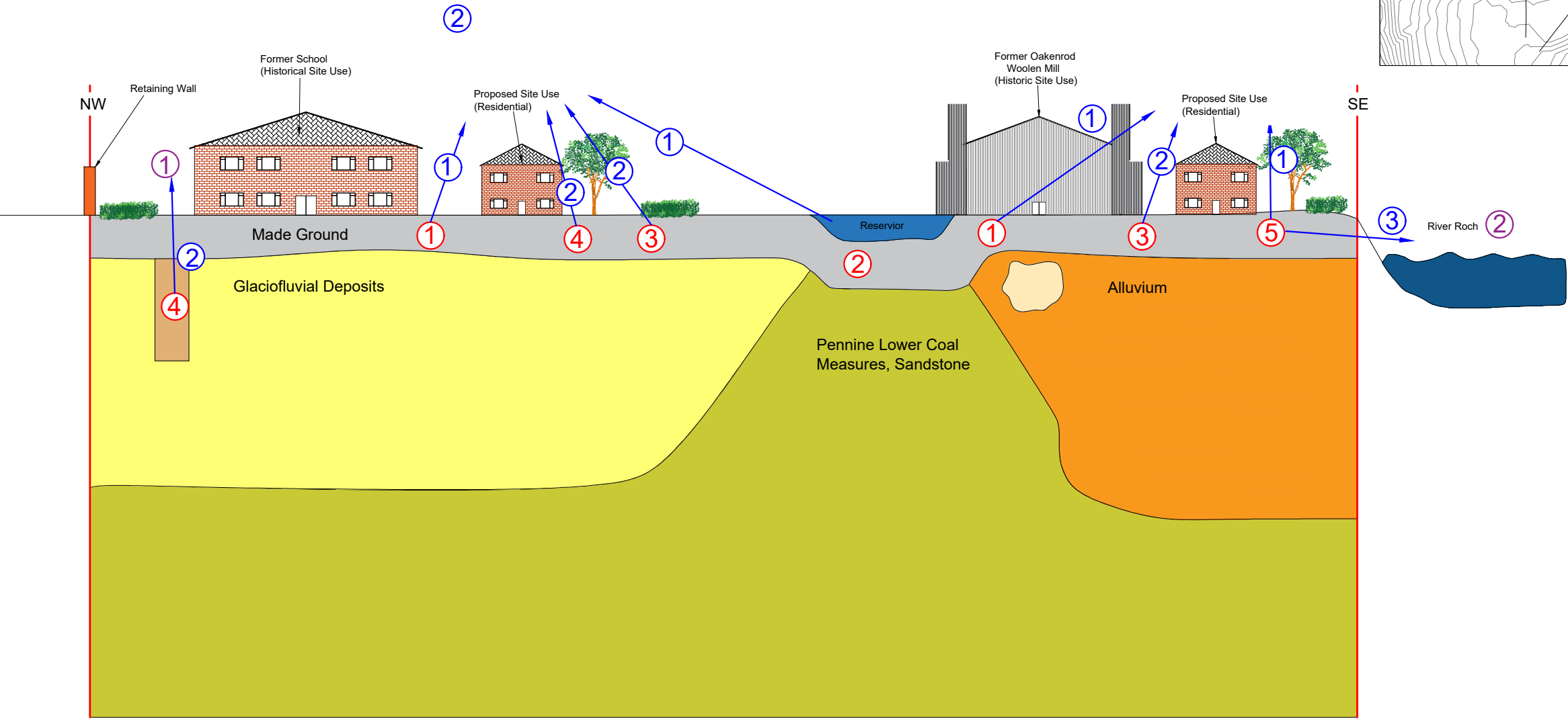
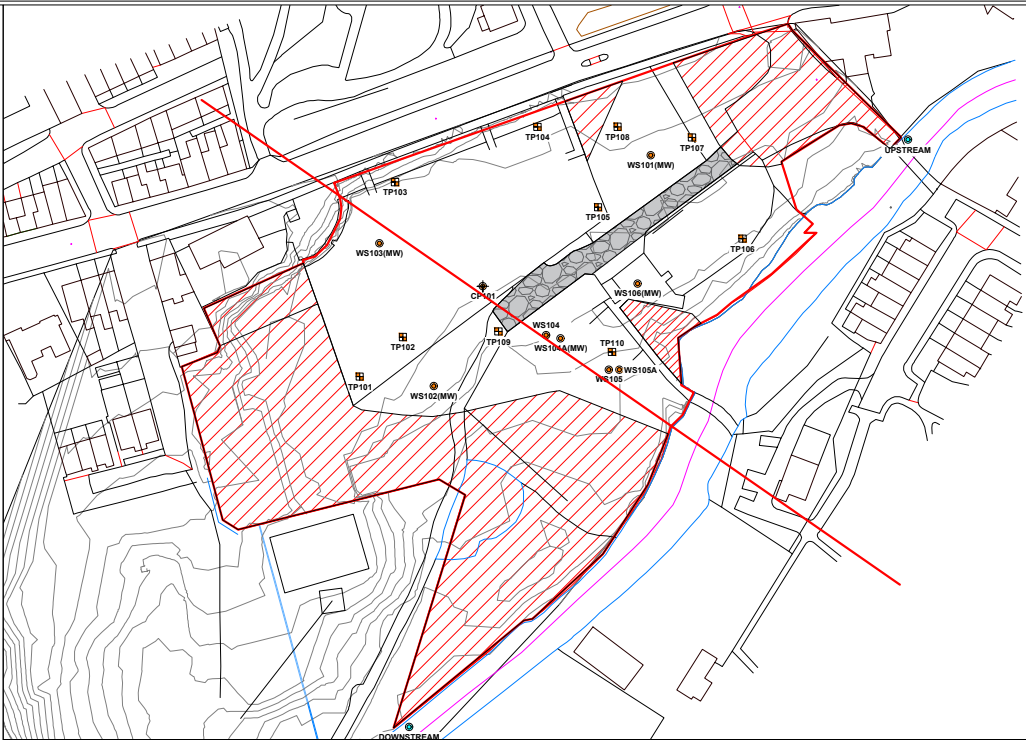


Location Symbols Approximate Window Sample Probehole Location Approximate Window Sample Probehole Location with install Approximate Trial Pit Location Approximate Cable Percussive Borehole Location Approximate Groundwater Sample Location Made Ground Depth (m) Depth of Made Ground 0.00 - 0.24m Depth of Made Ground 0.25 - 0.49m Depth of Made Ground 0.50 - 0.74m Depth of Made Ground 0.75 - 0.99m Depth of Made Ground 1.00 - 1.24m Depth of Made Ground 1.25 - 1.49m Depth of Made Ground 1.50 - 1.74m Depth of Made Ground 1.75 - 1.99m Depth of Made Ground >2.00m Key Inaccessible Areas (No Ground Investigation undertaken)					Notes:					Client: Hallmark Developments Ltd		Job No: 16-932		Date: 21.07.2023		e3p Environmental Engineering Partnership Ltd Taylor Road, Trafford Park Urmston, Manchester, M41 7JQ Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk	
					Job Title: Oakenrod School, Rochdale					Drawing No: 006		Scale: NTS		The client must not amend any drawing, design or other intellectual property produced by E3P Ltd without permission in writing from E3P Ltd in advance of any amendments being made. In the event that such written permission is not obtained in advance of the amendments being made, E3P Ltd shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.			
										Drawing Title: Depth of Made Ground Plan							
P1 REVA 21.07.2023 EB EF																	
Phase Issue Date Drawn Checked																	

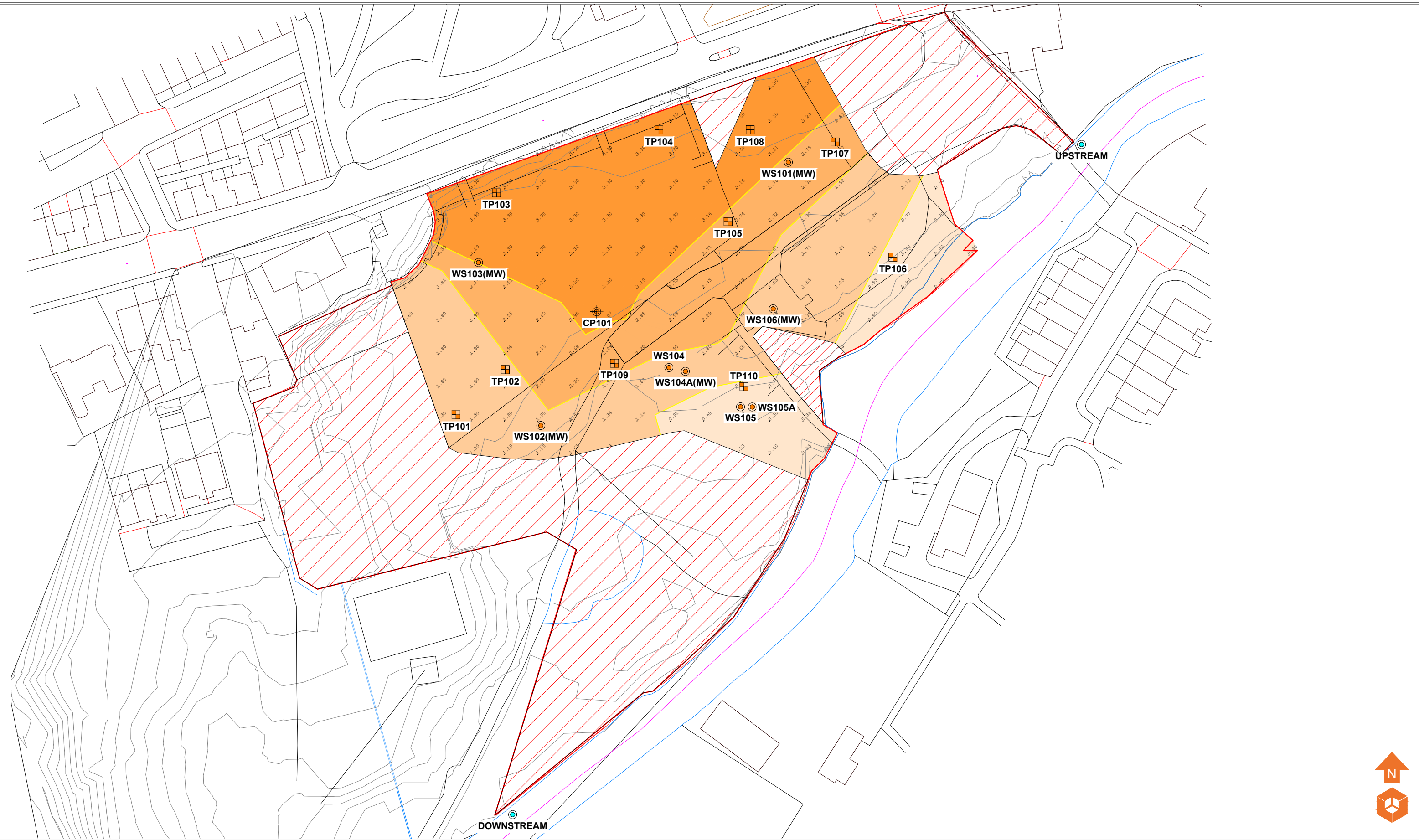


Location Symbols		Shallow Spread Footings		Key		Notes:		Client:		Job No:		Date:		 Environmental Engineering Partnership Ltd Taylor Road, Trafford Park Urmston, Manchester, M41 7JQ Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk			
 Approximate Window Sample Probehole Location  Approximate Window Sample Probehole Location with install  Approximate Trial Pit Location  Approximate Cable Percussive Borehole Location  Approximate Groundwater Sample Location		 Depth to Founding Strata 0.00 - 1.24m  Depth to Founding Strata 1.25 - 1.49m		 Inaccessible Areas (No Ground Investigation undertaken)				Hallmark Developments Ltd		16-932		24.07.2023					
		Mass Trench Fill Footings						Job Title:		Drawing No:		Scale:					
		 Depth to Founding Strata 1.50 - 1.74m  Depth to Founding Strata 1.75 - 1.99m  Depth to Founding Strata 2.00 - 2.24m								Oakenrod School, Rochdale		008		NTS			
		Engineered Footings								Drawing Title:		Depth to Founding Strata Plan		The client must not amend any drawing, design or other intellectual property produced by E3P Ltd without permission in writing from E3P Ltd in advance of any amendments being made. In the event that such written permission is not obtained in advance of the amendments being made, E3P Ltd shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.			
		 Depth to Founding Strata 2.25 - 2.49m  Depth to Founding Strata >2.50m															

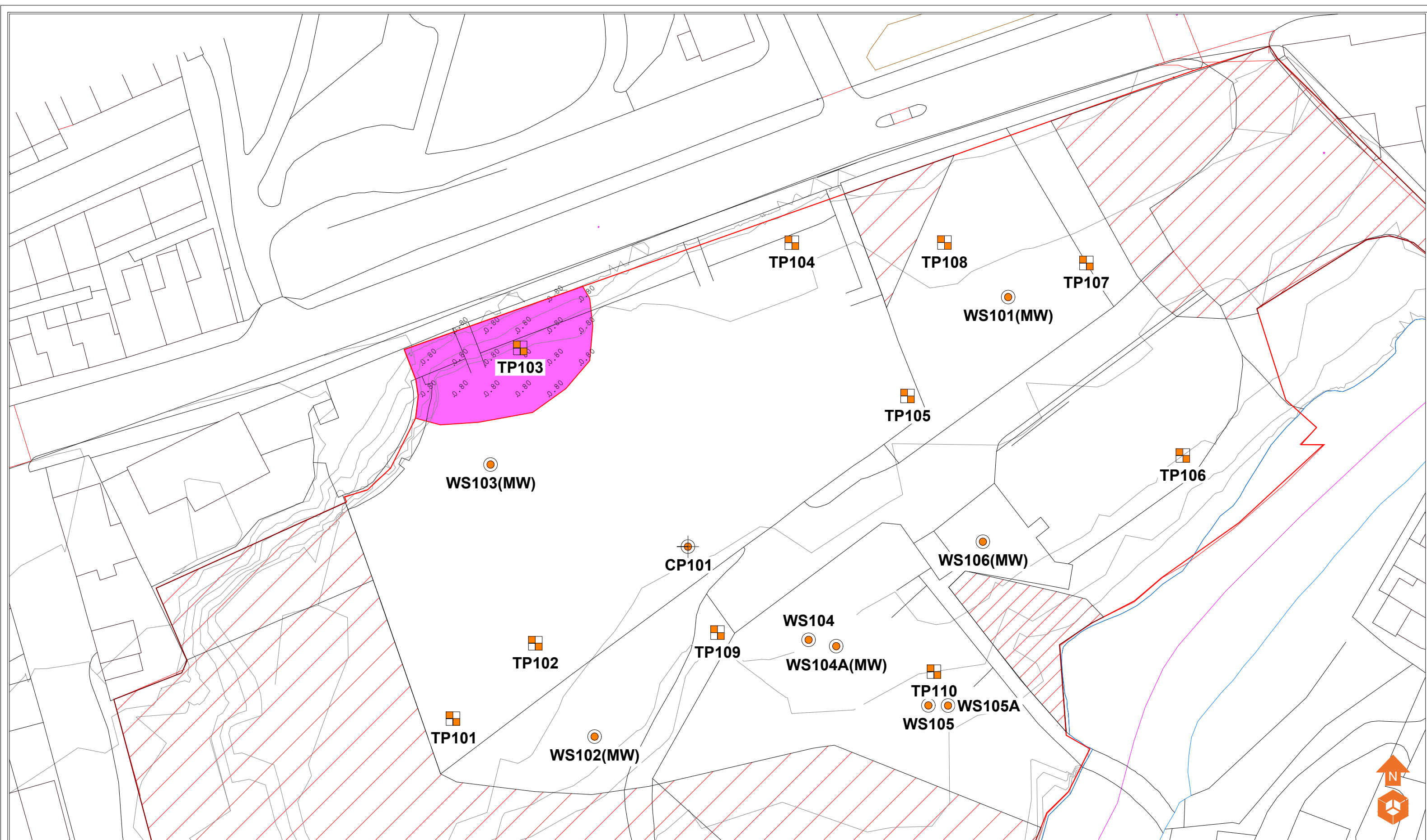
The client must not amend any drawing, design or other intellectual property produced by E3P Ltd without permission in writing from E3P Ltd in advance of any amendments being made. In the event that such written permission is not obtained in advance of the amendments being made, E3P Ltd shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.



Geology Key Made Ground Clay Sand Peat Sandstone Mudstone Groundwater Inferred Groundwater Flow Direction	Sources 1 Heavy Metals/PAHs 2 ACM 3 Volatiles 4 Ground Gas 5 Mobile Contam	Receptors 1 End User 2 River Roch	Pathways 1 Contact and Ingestion 2 Inhalation Dust/Gas/Vapours 3 Migration	Notes:	Client: Hallmark Developments Ltd	Job No: 16-932	Date: 17.08.2023	e3p Environmental Engineering Partnership Ltd Taylor Road, Trafford Park Urmston, Manchester, M41 7JQ Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk
					Drawing No: 010	Scale: 1:1000 @ A3		
				P1 Phase	REVA Issue	17.08.2023 Date	OW Drawn	



Location Symbols		Bedrock Depth (m)		Key		Notes:		Client: Hallmark Developments Ltd		Job No: 16-932		Date: 21.07.2023		Environmental Engineering Partnership Ltd Taylor Road, Trafford Park Urmston, Manchester, M41 7JG Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk									
	Approximate Window Sample Probehole Location		Depth of Bedrock 0.00 - 0.99m		Inaccessible Areas (No Ground Investigation undertaken)						Approximate Trial Pit Location		Depth of Bedrock 1.00 - 1.99m				Approximate Cable Percussive Borehole Location		Depth of Bedrock 2.00 - 2.99m		Approximate Groundwater Sample Location		Depth of Bedrock > 3.00m
						<table><tr><td>P1</td><td>REVA</td><td>21.07.2023</td><td>EB</td><td>EF</td></tr><tr><td>Phase</td><td>Issue</td><td>Date</td><td>Drawn</td><td>Checked</td></tr></table>		P1	REVA	21.07.2023	EB	EF	Phase	Issue	Date	Drawn	Checked	Job Title: Oakenrod School, Rochdale		Drawing Title: Depth of Bedrock Plan			
P1	REVA	21.07.2023	EB	EF																			
Phase	Issue	Date	Drawn	Checked																			



Location Symbols		Thickness of Peat		Key	
	Approximate Window Sample Probehole Location		Thickness of Peat 1.10 - 1.30m		Inaccessible Areas (No Ground Investigation undertaken)
	Approximate Window Sample Probehole Location with install				
	Approximate Trial Pit Location				
	Approximate Cable Percussive Borehole Location				
	Approximate Groundwater Sample Location				

Notes:				
P1	REVA	24.07.2023	LM	EF
Phase	Issue	Date	Drawn	Checked

Client:	
Hallmark Developments Ltd	
Job Title:	
Oakenrod School, Rochdale	

Job No:	16-932	Date:	24.07.2023
Drawing No:	013	Scale:	NTS
Drawing Title:		Depth and Thickness of Peat Plan	

Environmental Engineering Partnership Ltd
Taylor Road, Trafford Park
Urmston, Manchester, M41 7JQ
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
Website: www.e3p.co.uk

The client must not amend any drawing, design or other intellectual property produced by E3P Ltd without permission in writing from E3P Ltd in advance of any amendments being made. In the event that such written permission is not obtained in advance of the amendments being made, E3P Ltd shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.

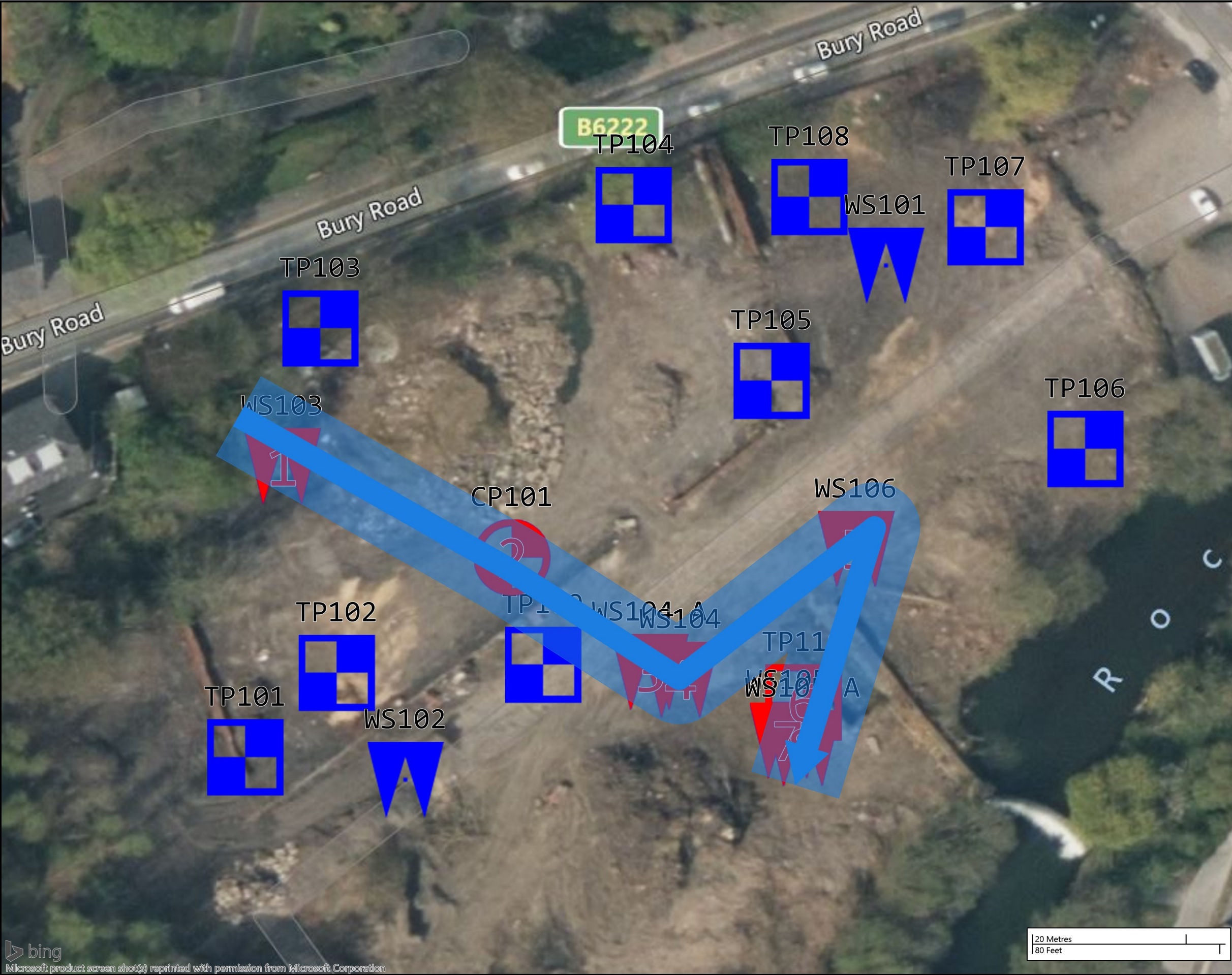
Project Id: 16932
Project Title: Oakenrod School
Location: Rochdale
Client: Hallmark Developments (NW) Ltd

Title: Site Plan
Scale: 1:500
Engineer:
Contractor:



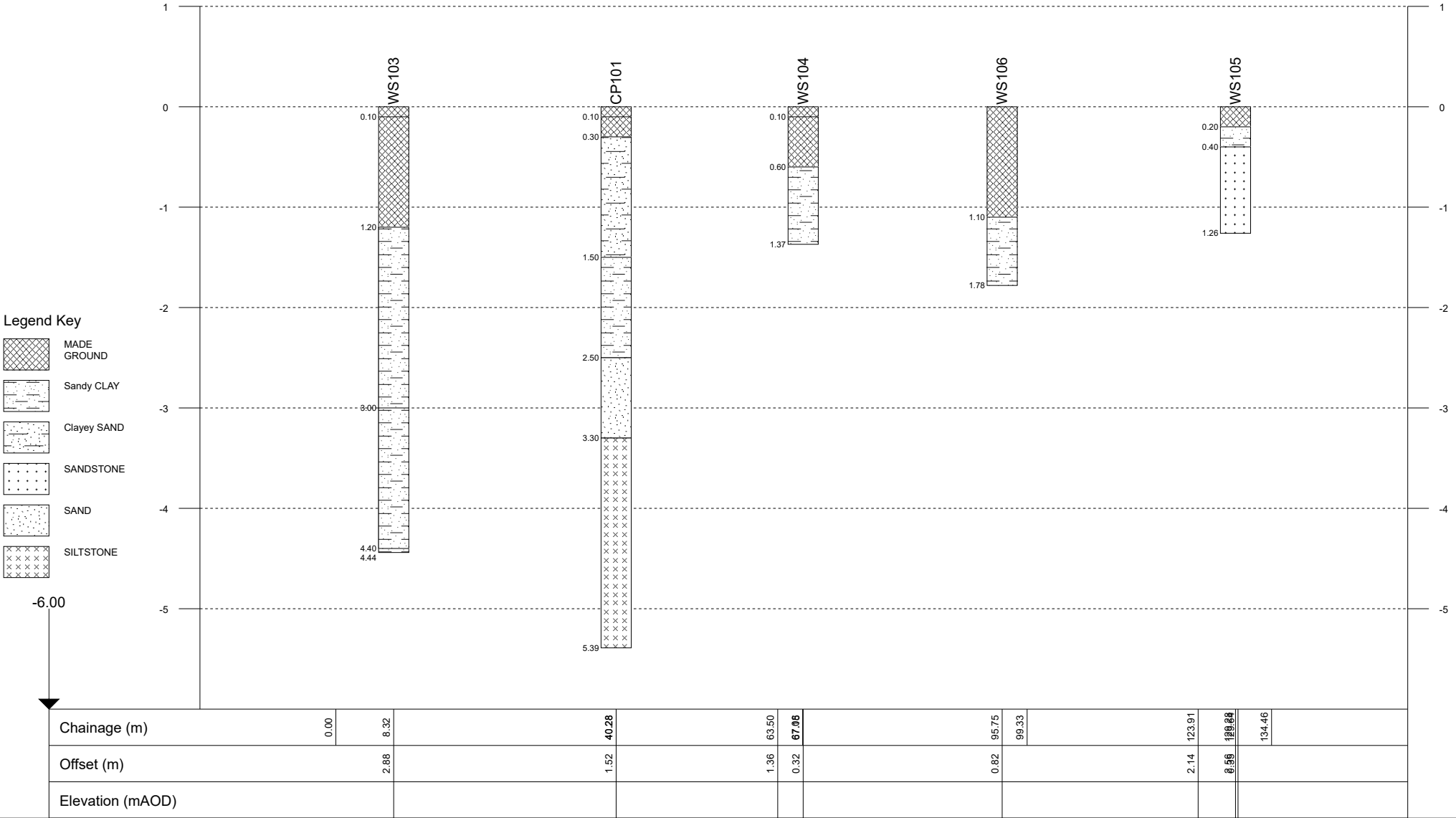
Legend Key

Sections - Section line 1

Locations By Type - Empty

Project Id: 16932
Project Title: Oakenrod School
Location: Rochdale
Client: Hallmark Developments (NW) Ltd

Title: Section line 1
Vertical Scale: 1:54
Horizontal Scale: 1:779
Engineer:



APPENDIX IV

PHOTOGRAPHS

Oakenrod School, Rochdale

Phase II Geoenvironmental Site Assessment

August 2023

PLATE 1 VIEW OF SITE – FACING NORTH EAST



PLATE 2 VIEW OF SITE FACING SOUTH WEST – DENSE VEGETATION



PLATE 3 DENSE VEGETATION IN SOUTH WEST



PLATE 4 BRICK WALL IN CENTRE OF THE SITE



Oakenrod School, Rochdale

Phase II Geoenvironmental Site Assessment

August 2023

PLATE 5 COBBLED ROAD IN CENTRE OF THE SITE



PLATE 6 RIVER ROCH ALONG SOUTH EASTERN BOUNDARY – FACING NORTH



APPENDIX V

E3P EXPLORATORY HOLE LOGS

Project Name: Oakenrod School	Project No. 16932	Co-ords: 388686.00 - 413081.00 Level:	Date 05/05/2023
Location: Rochdale	Dimensions (m): 1.80 Depth 3.00 0.80		Scale 1:30
Client: Hallmark Developments (NW) Ltd			Logged G. Calvert

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
 2.00	0.60	ES		0.15			MADE GROUND: Asphalt.	
				0.40			MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to subangular of mudstone with fragments of clinker and ash inclusions.	
							MADE GROUND: Brown clayey fine to medium sand. Gravel is fine to medium subangular to subrounded of sandstone and mudstone with frequent fragments of clinker, ceramic, brick and ash inclusions.	
	1.40	HVP	31	1.00			Soft low strength brown sandy CLAY.	1
	2.00 2.10	HVP ES	30	1.80			Soft low strength bluish grey slightly gravelly sandy CLAY. Gravel fine to medium subangular to subrounded of mudstone.	2
	2.60	HVP	35	3.00			End of Pit at 3.00m	3
								4

Trial Pit Photographs



Trial Pit 101

Trial Pit 101 Spoil

Remarks: 1. Complete. 2. Water strike encountered at 2.00m bgl as a seepage. 3. Reach of the excavator limited the advance of the pit. 4. Unstable from 2.50m bgl.

Stability: Unstable from 2.50m bgl.

Project Name: Oakenrod School	Project No. 16932	Co-ords: 388698.00 - 413092.00 Level:	Date 05/05/2023
Location: Rochdale	Dimensions (m): 2.00 Depth 2.30		Scale 1:30
Client: Hallmark Developments (NW) Ltd			Logged G. Calvert

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
▼ 1.90	0.20	ES		0.10			MADE GROUND: Asphalt.	
				0.30			MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to subangular of mudstone with fragments of clinker and ash inclusions.	
				1.20			MADE GROUND: Brown slightly gravelly sandy clay. Gravel is fine subangular to subrounded of sandstone and mudstone with frequent fragments of brick, concrete and ash inclusions.	1
	1.50	ES		2.30			Soft blueish grey slightly gravelly very sandy CLAY. Gravel is fine to medium subangular to subrounded of mudstone. (Too sandy to completed Hand Shear Vane test).	2
							End of Pit at 2.30m	3
								4

Trial Pit Photographs



Trial Pit 102

Trial Pit 102 Spoil

Remarks: 1. Complete. 2. High sand content inhibited the use of HSV between 1.20m to 2.30m bgl. 3. Water strike encountered at 1.90m bgl as a minor ingress.

Stability: Stable

Project Name: Oakenrod School	Project No. 16932	Co-ords: 388696.00 - 413137.00 Level:	Date 05/05/2023
Location: Rochdale	Dimensions (m): 1.90 Depth 2.00		Scale 1:30
Client: Hallmark Developments (NW) Ltd			Logged G. Calvert

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
 2.00				0.35			MADE GROUND: Concrete.	
	0.50	ES		0.80			MADE GROUND: Brown slightly clayey gravelly fine to medium sand with rare rootlets and occasional cobbles. Gravel is fine to coarse angular to subangular of sandstone and mudstone with fragments of brick, concrete, ceramic, timber. Cobbles are angular to subangular of sandstone and concrete.	1
	1.20	D					Brown pseudofibrous PEAT.	
				2.00			End of Pit at 2.00m	2
								3
								4

Trial Pit Photographs



Trial Pit 103

Trial Pit 103 Spoil

Remarks: 1. Terminated due to water ingress. 2. Water strike encountered at 2.00m bgl as a minor ingress with an organic odour. 3. Brick wall present on the eastern wall of the trial pit.

Stability: Stable

Project Name: Oakenrod School	Project No. 16932	Co-ords: 388737.00 - 413153.00 Level:	Date 05/05/2023
Location: Rochdale		Dimensions (m): 2.40 Depth 3.00	Scale 1:30
Client: Hallmark Developments (NW) Ltd			Logged G. Calvert

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.10			MADE GROUND: Asphalt.	
				0.30			MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to subangular of mudstone with fragments of clinker and ash inclusions.	
	0.60	ES		0.70			MADE GROUND: Brown slightly gravelly very sandy clay with rare rootlets. Gravel is fine to medium subangular to subrounded of sandstone and mudstone with fragments of clinker, timber, brick, concrete and tarmac.	
	1.00	HVP	30				Soft low strength dark grey sandy CLAY, with rare organics. (Organic odour).	1
	1.40	ES						
	1.60	HVP	30					
	2.20	HVP	45	2.10			Firm medium strength light grey sandy CLAY.	2
	2.80	HVP	45	3.00			End of Pit at 3.00m	3
								4

Trial Pit Photographs



Trial Pit 104



Trial Pit 104 Spoil

Remarks: 1. Complete.

Stability: Stable

Project Name: Oakenrod School	Project No. 16932	Co-ords: 388755.00 - 413130.00 Level:	Date 05/05/2023
Location: Rochdale	Dimensions (m): 2.10 Depth 2.80		Scale 1:30
Client: Hallmark Developments (NW) Ltd			Logged G. Calvert

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.15			MADE GROUND: Asphalt.	
				0.45			MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to subangular of mudstone with fragments of clinker and ash inclusions.	
	0.80	ES		0.85			MADE GROUND: Brown slightly clayey gravelly fine to medium sand. Gravel is fine to medium subangular to subrounded of sandstone, with fragments of brick, ceramic, timber and concrete.	1
	1.50	B					MADE GROUND: Brown mottled grey very sandy reworked clay. (Friable).	2
	2.00	ES		2.35			Firm light grey sandy CLAY.	
				2.80			End of Pit at 2.80m	3
								4

Trial Pit Photographs



Trial Pit 105



Trial Pit 105 Spoil

Remarks: 1. Complete. 2. Friable CLAY inhibited the use of HSV between 0.85m to 2.35m bgl.

Stability: Stable



e3p

Trial Pit Log

TrialPit No
TP106
Sheet 1 of 1

Project Name: Oakenrod School

Project No.
16932Co-ords: 388796.00 - 413121.00
Level:Date
05/05/2023

Location: Rochdale

Dimensions (m): 2.00

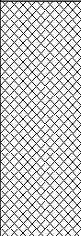
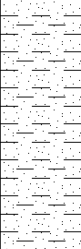
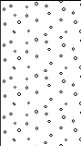
Scale
1:30

Client: Hallmark Developments (NW) Ltd

Depth
2.60

0.80

Logged
G. Calvert

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
 2.50	0.30	ES					MADE GROUND: Brown lightly clayey slightly gravelly fine to medium sand with rare rootlets ground level to 0.20m bgl. Gravel is fine to medium subangular to subrounded of sandstone, mudstone and fragments of brick, timber and concrete.	
				0.95			Firm brown mottled grey slightly gravelly sandy CLAY. Gravel is fine to medium subangular to subrounded of sandstone and mudstone.	1
	1.60	ES					Brownish grey fine to medium GRAVEL. Gravel is subangular to subrounded of mudstone and sandstone.	2
				2.00				
				2.60			End of Pit at 2.60m	3
								4

Trial Pit Photographs



Trial Pit 106



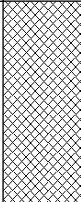
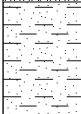
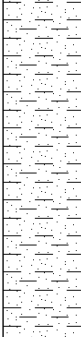
Trial Pit 106 Spoil

Remarks: 1. Complete. 2 .Water strike encountered at 2.50m bgl as a moderate ingress.

Stability: Stable



Project Name: Oakenrod School	Project No. 16932	Co-ords: 388783.00 - 413150.00 Level:	Date 05/05/2023
Location: Rochdale	Dimensions (m): 2.00 0.80		Scale 1:30
Client: Hallmark Developments (NW) Ltd	Depth 2.60		Logged G. Calvert

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.70	ES		0.80			MADE GROUND: Dark brown slightly clayey fine to medium sand with frequent rootlets and fragments of brick, concrete, plastic and ash inclusions.	
	1.00	D					Firm medium strength brown mottled grey sandy CLAY. Becoming stiff high strength from circa. 2.00m bgl.	1
	1.00 1.20	HVP ES	44					
	1.50	HVP	52					
	2.00	HVP	78					2
 2.50				2.60			End of Pit at 2.60m	3
								4

Trial Pit Photographs



Trial Pit 107

Trial Pit 107 Spoil

Remarks: 1. Complete. 2. Water strike encountered at 2.50m bgl as a minor ingress.

Stability: Stable

Project Name: Oakenrod School	Project No. 16932	Co-ords: 388760.00 - 413154.00 Level:	Date 05/05/2023
Location: Rochdale		Dimensions (m): 1.80 0.80	Scale 1:30
Client: Hallmark Developments (NW) Ltd		Depth 3.00	Logged G. Calvert

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.40	ES					MADE GROUND: Dark brown slightly clayey slightly gravelly fine to medium sand with occasional rootlets. Gravel is fine to medium subangular to subrounded of mudstone, with fragments of brick, clinker, concrete, ceramic, glass and timber.	1
	1.50 1.60	ES HVP	42	1.40			Firm medium strength grey mottled brown slightly gravelly sandy CLAY. Gravel is fine subangular to subrounded of sandstone and mudstone.	2
	2.00	HVP	47					
	2.30	HVP	57					
	2.80	HVP	56	3.00				
							End of Pit at 3.00m	3
								4

Trial Pit Photographs



Trial Pit 108

Trial Pit 108 Spoil

Remarks: 1. Complete.

Stability: Stable



e3p

Trial Pit Log

TrialPit No
TP109
Sheet 1 of 1

Project Name: Oakenrod School

Project No.
16932Co-ords: 388725.00 - 413093.00
Level:Date
05/05/2023

Location: Rochdale

Dimensions (m): 2.20

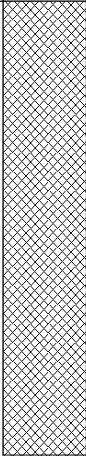
Scale
1:30

Client: Hallmark Developments (NW) Ltd

Depth
1.80

0.80

Logged
G. Calvert

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.50	B		1.80			MADE GROUND: Brown gravelly fine to medium sand. Gravel is medium subangular of mudstone and sandstone with fragments of brick, concrete, plastic and timber.	1
	1.00	ES						
 1.80							End of Pit at 1.80m	2
								3
								4

Trial Pit Photographs



Trial Pit 109



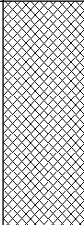
Trial Pit 109 Spoil

Remarks: 1. Terminated due to instability. 2. Water strike encountered at 1.80m bgl as a moderate ingress.

Stability: Unstable



Project Name: Oakenrod School	Project No. 16932	Co-ords: 388759.00 - 413088.00 Level:	Date 05/05/2023
Location: Rochdale		Dimensions (m): 1.50 Depth 0.90	Scale 1:30 Logged G. Calvert
Client: Hallmark Developments (NW) Ltd			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
 0.90	0.20	ES		0.90			MADE GROUND: Brown gravelly fine to medium sand. Gravel is medium subangular of mudstone and sandstone with fragments of brick, concrete, plastic and timber.	
							End of Pit at 0.90m	1
								2
								3
								4

Trial Pit Photographs



Remarks: 1. Terminated due to compacted ground. 2. Water Strike encountered at 0.80m bgl as a seepage.

Stability: Stable

Borehole Log

Borehole No.

WS101

Sheet 1 of 1

Project Name: Oakenrod School

Project No.
16932

Co-ords: 388770.00 - 413145.00

Hole Type
WS

Location: Rochdale

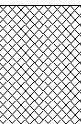
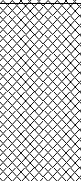
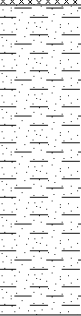
Level:

Scale
1:50

Client: Hallmark Developments (NW) Ltd

Dates: 05/05/2023 -

Logged By
G. Calvert

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.90 1.00	ES	N=10 (1,0/4,2,2,2)	0.80			MADE GROUND: Brown slightly clayey slightly gravelly fine to medium sand with rare rootlets. Gravel is fine to medium subangular to subrounded of sandstone, mudstone and fragments of brick, timber and concrete.	1
		2.00 2.20	ES	N=11 (0,1/2,3,3,3)	2.00			MADE GROUND: Brown slightly gravelly sandy clay. Gravel is fine subangular to subrounded of sandstone and mudstone with frequent fragments of brick, concrete and ash inclusions.	
		3.00		N=13 (3,3/3,3,3,4)				Stiff medium strength dark grey sandy CLAY, with rare organics. Becoming very stiff high strength at circa. 3.70m bgl. (Organic odour).	2
		3.70		50 (11,13/50 for 200mm)	4.05			End of borehole at 4.05 m	3
									4
									5
									6
									7
									8
									9
									10

Remarks

1. Refusal on bedrock. 2. Water strike encountered at 3.00m bgl. 3. Monitoring well installed. 4. Response zone 0.50m to 2.00m bgl.

Borehole Log

Borehole No.

WS102

Sheet 1 of 1

Project Name: Oakenrod School

Project No.
16932

Co-ords: 388707.00 - 413078.00

Hole Type
WS

Location: Rochdale

Level:

Scale
1:50

Client: Hallmark Developments (NW) Ltd

Dates: 05/05/2023 -

Logged By
G. Calvert

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.20			MADE GROUND: Concrete.	
					0.40			MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to subangular of mudstone with fragments of clinker and ash inclusions.	
		1.00 1.10	ES	N=18 (1,1/3,5,5,5)				Very stiff high strength grey mottled brown slightly sandy slightly gravelly CLAY. Gravel is fine subangular to subrounded of mudstone and sandstone.	1
		2.00		50 (8,14/50 for 190mm)	1.80			Dense weathered SANDSTONE.	2
					2.34			End of borehole at 2.34 m	
									3
									4
									5
									6
									7
									8
									9
									10

Remarks

1. Refusal on bedrock. 2. Monitoring well installed. 3. Response zone 0.50m to 1.00m bgl.

Borehole Log

Borehole No.

WS103

Sheet 1 of 1

Project Name: Oakenrod School

Project No.
16932

Co-ords: 388691.00 - 413119.00

Hole Type
WS

Location: Rochdale

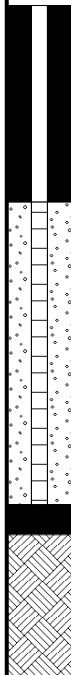
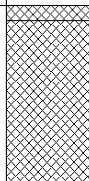
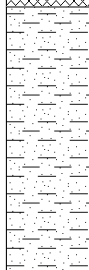
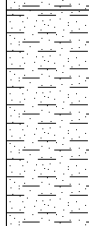
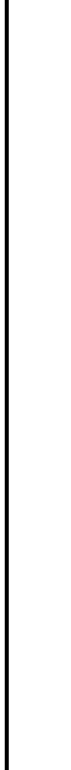
Level:

Scale
1:50

Client: Hallmark Developments (NW) Ltd

Dates: 05/05/2023 -

Logged By
G. Calvert

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10			0.10			MADE GROUND: Concrete.	
		0.80						MADE GROUND: Brown slightly gravelly sandy clay. Gravel is fine subangular to subrounded of sandstone and mudstone with frequent fragments of brick, concrete and ash inclusions.	1
		1.00	ES	N=3 (1,0/1,1,0,1)					
		1.20			1.20			Very soft extremely low strength blueish grey slightly gravelly very sandy CLAY. Gravel is fine to medium subangular to subrounded of mudstone.	2
		2.00		N=1 (0,1/1,0,0,0)					
		2.50	ES						
		3.00		N=7 (2,1/1,2,2,2)	3.00			Firm low strength bluish grey slightly gravelly very sandy CLAY. Gravel is fine to medium subangular to subrounded of mudstone. Becoming very stiff very high strength at circa. 4.00m bgl.	3
		4.00		50 (3,5/50 for 285mm)					4
		4.44			4.44			End of borehole at 4.44 m	5
									6
									7
									8
									9
									10

Remarks

1. Refusal on bedrock. 2. Monitoring well installed. 3. Response zone 1.30m to 3.30m bgl.



Borehole Log

Borehole No.

WS104

Sheet 1 of 1

Project Name: Oakenrod School

Project No.
16932

Co-ords: 388743.00 - 413091.00

Hole Type
WS

Location: Rochdale

Level:

Scale
1:50

Client: Hallmark Developments (NW) Ltd

Dates: 05/05/2023 -

Logged By
G. Calvert

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
			ES	50 (8,12/50 for 220mm)	0.10			MADE GROUND: Asphalt.	1
		0.75			0.60			MADE GROUND: Brown sandy gravel. Gravel is fine to medium subangular to subrounded of sandstone and ash inclusions.	
		1.00			1.37			Very stiff very high strength grey slightly sandy slightly gravelly CLAY. Gravel is fine subangular to subrounded of mudstone and sandstone.	
								End of borehole at 1.37 m	2
									3
									4
									5
									6
									7
									8
									9
									10

Remarks

1. Refusal on bedrock.





Borehole Log

Borehole No.

WS104 A

Sheet 1 of 1

Project Name: Oakenrod School

Project No.
16932

Co-ords: 388739.00 - 413092.00

Hole Type
WS

Location: Rochdale

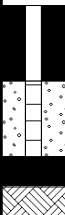
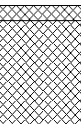
Level:

Scale
1:50

Client: Hallmark Developments (NW) Ltd

Dates: 05/05/2023 -

Logged By
G. Calvert

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		1.00		50 (11,13/50 for 245mm)	0.10			MADE GROUND: Asphalt.	1
					0.80			MADE GROUND: Brown sandy gravel. Gravel is fine to medium subangular to subrounded of sandstone and ash inclusions.	
					1.40			Very stiff very high strength grey mottled brown slightly sandy slightly gravelly CLAY. Gravel is fine subangular to subrounded of mudstone and sandstone.	
								End of borehole at 1.40 m	2
									3
									4
									5
									6
									7
									8
									9
									10

Remarks

1. Refusal on bedrock. 2. Monitoring well installed. 3. Response zone 0.50m to 1.00m bgl.





Borehole Log

Borehole No.

WS105

Sheet 1 of 1

Project Name: Oakenrod School

Project No.
16932

Co-ords: 388757.00 - 413083.00

Hole Type
WS

Location: Rochdale

Level:

Scale
1:50

Client: Hallmark Developments (NW) Ltd

Dates: 05/05/2023 -

Logged By
G. Calvert

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		1.00		50 (25 for 115mm/50 for 145mm)	0.20			MADE GROUND: Brown lightly clayey slightly gravelly fine to medium sand with rare rootlets. Gravel is fine to medium subangular to subrounded of sandstone, mudstone and fragments of brick and concrete. Grey mottled brown slightly sandy slightly gravelly CLAY. Gravel is fine subangular to subrounded of mudstone and sandstone. Dense weathered SANDSTONE. End of borehole at 1.26 m	1
					0.40				
					1.26				
									2
									3
									4
									5
									6
									7
									8
									9
									10

Remarks

1. Refusal on bedrock.





Borehole Log

Borehole No.

WS105 A

Sheet 1 of 1

Project Name: Oakenrod School

Project No.
16932

Co-ords: 388759.00 - 413082.00

Hole Type
WS

Location: Rochdale

Level:

Scale
1:50

Client: Hallmark Developments (NW) Ltd

Dates: 05/05/2023 -

Logged By
G. Calvert

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		1.00		50 (25 for 135mm/50 for 170mm)	0.20			MADE GROUND: Brown lightly clayey slightly gravelly fine to medium sand with rare rootlets. Gravel is fine to medium subangular to subrounded of sandstone, mudstone and fragments of brick and concrete. Grey mottled brown slightly sandy slightly gravelly CLAY. Gravel is fine subangular to subrounded of mudstone and sandstone. Dense weathered SANDSTONE. End of borehole at 1.31 m	1
					0.90				
					1.31				
									2
									3
									4
									5
									6
									7
									8
									9
									10

Remarks

1. Refusal on bedrock.



Borehole Log

Borehole No.

WS106

Sheet 1 of 1

Project Name: Oakenrod School

Project No.
16932

Co-ords: 388766.00 - 413108.00

Hole Type
WS

Location: Rochdale

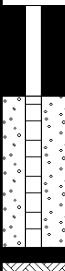
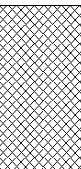
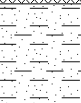
Level:

Scale
1:50

Client: Hallmark Developments (NW) Ltd

Dates: 05/05/2023 -

Logged By
G. Calvert

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES					MADE GROUND: Brown slightly gravelly sandy clay. Gravel is fine subangular to subrounded of sandstone and mudstone with frequent fragments of brick, concrete and ash inclusions.	
		1.00		13 (6 for 0mm/13 for 0mm)	1.10				1
		1.30	ES					Very stiff very high strength brown mottled grey slightly gravelly sandy CLAY. Gravel is fine to medium subangular to subrounded of sandstone and mudstone.	
		1.60		50 (25 for 70mm/50 for 105mm)	1.78				
								End of borehole at 1.78 m	2
									3
									4
									5
									6
									7
									8
									9
									10

Remarks

1. Refusal on bedrock. 2. Monitoring well installed. 3. Response zone 0.60m to 1.60m bgl.



Borehole Log

Borehole No.

CP101

Sheet 1 of 1

Project Name: Oakenrod School

Project No.
16932

Co-ords: 388721.00 - 413107.00

Hole Type
CP

Location: Rochdale

Level:

Scale
1:50

Client: Hallmark Developments (NW) Ltd

Dates: 06/05/2023 -

Logged By
G. Calvert

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	D		0.10			MADE GROUND: Asphalt.	
		0.30			0.30			MADE GROUND: Grey gravel. Gravel is fine to coarse angular to subrounded of limestone, ash and brick.	
		0.50	B					Very loose brown clayey silty SAND with gravel. Gravel is fine to coarse angular to rounded of sandstone.	1
		0.50	D						
		1.20		N=1 (1,0/0,0,0,1)					
		1.50	B		1.50			Medium dense grey silty clayey SAND with occasional gravel. Gravel is fine to coarse angular to subrounded of sandstone.	2
		1.50	D						
		2.00		N=14 (2,2/2,3,4,5)					
		2.50	B		2.50			Stiff medium strength brown grey sandy gravelly CLAY. Gravel is fine to medium subangular to subrounded of siltstone and sandstone.	3
		2.50	D						
		3.00		N=16 (2,2/3,4,4,5)					
		3.50	B		3.30			Dense grey weathered SILTSTONE.	
		3.50	D						
		4.00		50 (9,12/50 for 260mm)					4
		5.00		50 (7,10/50 for 235mm)	5.39				5
								End of borehole at 5.39 m	6
									7
									8
									9
									10

Remarks

1. Refusal on bedrock.



APPENDIX VI

CHEMICAL TESTING

RESULTS

Elizabeth Fearn
e3p
Taylor Road
Urmston
Manchester
M41 7JQ

e: efearn@e3p.co.uk

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 : 23-38065

Project / Site name:	Oakenrod	Samples received on:	06/06/2023
Your job number:	16-932	Samples instructed on/ Analysis started on:	08/06/2023
Your order number:	005124	Analysis completed by:	20/06/2023
Report Issue Number:	1	Report issued on:	20/06/2023
Samples Analysed:	1 leachate sample - 18 soil samples		


Signed:

Karolina Marek
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.

Analytical Report Number: 23-38065
Project / Site name: Oakenrod
Your Order No: 005124

Lab Sample Number				2705898	2705899	2705900	2705901	2705902
Sample Reference				TP101	TP103	TP104	TP105	TP106
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.60	0.50	0.60	2.00	0.30
Date Sampled				05/06/2023	05/06/2023	05/06/2023	05/06/2023	05/06/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	20	< 0.1
Moisture Content	%	0.01	NONE	21	12	13	23	8.1
Total mass of sample received	kg	0.001	NONE	0.3	0.3	0.3	0.3	0.3

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

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	6.7	7.2	7.2	6.4	7.3
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	720	910	560	450	360
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.019	0.026	0.015	0.025	0.0034
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	39	52	29	50	6.7
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	19.4	26.1	14.6	24.9	3.4
Sulphide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	1.8
Total Sulphur	mg/kg	50	MCERTS	830	390	320	320	250
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	5.9	2.1	3.4	3	1.5

Total Phenols

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

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	0.63	2.2	8.8	0.15	0.08
Acenaphthylene	mg/kg	0.05	MCERTS	0.2	< 0.05	1.3	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	4.2	4.7	16	0.26	0.12
Fluorene	mg/kg	0.05	MCERTS	2.9	3.5	11	0.17	0.09
Phenanthrene	mg/kg	0.05	MCERTS	33	34	120	1.5	0.97
Anthracene	mg/kg	0.05	MCERTS	8.9	7.4	32	0.26	0.26
Fluoranthene	mg/kg	0.05	MCERTS	41	38	190	1.4	1.4
Pyrene	mg/kg	0.05	MCERTS	38	33	180	1.3	1.5
Benzo(a)anthracene	mg/kg	0.05	MCERTS	18	16	93	0.64	1.2
Chrysene	mg/kg	0.05	MCERTS	15	15	83	0.67	1.2
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	16	16	90	0.67	1.6
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	5.1	4.9	32	0.26	0.64
Benzo(a)pyrene	mg/kg	0.05	MCERTS	13	12	75	0.6	1.4
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	5.6	5.2	35	0.29	0.63
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	1.6	1.5	8.7	< 0.05	0.22
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	6.3	5.7	37	0.36	0.71

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	209	199	1020	8.51	11.9
-----------------------------	-------	-----	-----------	-----	-----	------	------	------

Analytical Report Number: 23-38065
Project / Site name: Oakenrod
Your Order No: 005124

Lab Sample Number	2705898	2705899	2705900	2705901	2705902
Sample Reference	TP101	TP103	TP104	TP105	TP106
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.60	0.50	0.60	2.00	0.30
Date Sampled	05/06/2023	05/06/2023	05/06/2023	05/06/2023	05/06/2023
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	22	15	16	11	19
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	17	14	14	16	17
Copper (aqua regia extractable)	mg/kg	1	MCERTS	58	43	51	33	49
Lead (aqua regia extractable)	mg/kg	1	MCERTS	89	66	72	64	95
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	0.4	< 0.3	0.5	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	25	21	21	23	31
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	58	55	53	99	98

Petroleum Hydrocarbons

TPH (C5 - C6) HS_ID_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C6 - C8) HS_ID_TOTAL	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C8 - C10) HS_ID_TOTAL	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C10 - C12) EH_CU_ID_TOTAL	mg/kg	2	MCERTS	< 2.0	< 2.0	2.5	< 2.0	< 2.0
TPH (C12 - C16) EH_CU_ID_TOTAL	mg/kg	4	MCERTS	17	18	45	< 4.0	< 4.0
TPH (C16 - C21) EH_CU_ID_TOTAL	mg/kg	1	MCERTS	100	92	270	< 1.0	2.8
TPH (C21 - C35) EH_CU_ID_TOTAL	mg/kg	1	MCERTS	140	110	390	< 1.0	3.9
TPH (C35 - C40) EH_CU_ID_TOTAL	mg/kg	10	NONE	17	< 10	25	< 10	< 10
TPH Total C5 - C40 EH_CU+HS_ID_TOTAL	mg/kg	10	NONE	280	230	730	< 10	< 10

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

Analytical Report Number: 23-38065
Project / Site name: Oakenrod
Your Order No: 005124

Lab Sample Number				2705903	2705904	2705905	2705906	2705907
Sample Reference				TP106	TP108	TP108	TP109	TP110
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.60	0.40	1.50	1.00	0.20
Date Sampled				05/06/2023	05/06/2023	05/06/2023	05/06/2023	05/06/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	12	8.3	16	8.9	11
Total mass of sample received	kg	0.001	NONE	0.3	0.3	0.3	0.3	0.3

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	-	Chrysotile	-
Asbestos in Soil	Type	N/A	ISO 17025	-	Not-detected	-	Detected	Not-detected
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	-	-	0.141	-
Asbestos Quantification Total	%	0.001	ISO 17025	-	-	-	0.141	-
Asbestos Analyst ID	N/A	N/A	N/A	N/A	SCA	N/A	SCA	SCA

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.1	7.4	7	8.1	10.2
Total Cyanide	mg/kg	1	MCERTS	< 1.0	19	< 1.0	< 1.0	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	120	950	88	830	7500
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.0051	0.0065	0.0054	0.013	0.6
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	10	13	11	27	1200
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	5.1	6.5	5.4	13.3	600
Sulphide	mg/kg	1	MCERTS	1.2	< 1.0	< 1.0	< 1.0	5.2
Total Sulphur	mg/kg	50	MCERTS	100	650	79	350	2600
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	0.9	3.1	0.6	1.3	1.2

Total Phenols

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

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	3.5	< 0.05	0.2	1.2
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	0.21	< 0.05	0.15	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	3.8	< 0.05	0.17	3.2
Fluorene	mg/kg	0.05	MCERTS	< 0.05	2.6	< 0.05	0.13	2.2
Phenanthrene	mg/kg	0.05	MCERTS	0.08	21	< 0.05	3.3	18
Anthracene	mg/kg	0.05	MCERTS	< 0.05	4.2	< 0.05	0.76	4.9
Fluoranthene	mg/kg	0.05	MCERTS	0.06	27	< 0.05	11	29
Pyrene	mg/kg	0.05	MCERTS	0.07	23	< 0.05	9.4	25
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	11	< 0.05	4.8	11
Chrysene	mg/kg	0.05	MCERTS	< 0.05	11	< 0.05	4.5	10
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	12	< 0.05	5.2	12
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	5	< 0.05	2.1	3.7
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	9.6	< 0.05	3.8	8.9
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	4.8	< 0.05	2	4.4
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	1.3	< 0.05	0.5	1.2
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	5.4	< 0.05	2.2	5.2

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	< 0.80	145	< 0.80	49.9	141
-----------------------------	-------	-----	-----------	--------	-----	--------	------	-----

Analytical Report Number: 23-38065
Project / Site name: Oakenrod
Your Order No: 005124

Lab Sample Number				2705903	2705904	2705905	2705906	2705907
Sample Reference				TP106	TP108	TP108	TP109	TP110
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.60	0.40	1.50	1.00	0.20
Date Sampled				05/06/2023	05/06/2023	05/06/2023	05/06/2023	05/06/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	9.8	35	1.3	11	10
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	0.7	0.5
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	22	19	14	29	20
Copper (aqua regia extractable)	mg/kg	1	MCERTS	38	99	10	110	41
Lead (aqua regia extractable)	mg/kg	1	MCERTS	28	310	11	170	68
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	0.5	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	36	34	10	32	16
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	75	210	26	140	170

Petroleum Hydrocarbons

TPH (C5 - C6) HS_ID_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C6 - C8) HS_ID_TOTAL	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C8 - C10) HS_ID_TOTAL	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C10 - C12) EH_CU_ID_TOTAL	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	2.2
TPH (C12 - C16) EH_CU_ID_TOTAL	mg/kg	4	MCERTS	< 4.0	7.8	< 4.0	6.1	60
TPH (C16 - C21) EH_CU_ID_TOTAL	mg/kg	1	MCERTS	< 1.0	35	< 1.0	34	260
TPH (C21 - C35) EH_CU_ID_TOTAL	mg/kg	1	MCERTS	< 1.0	70	< 1.0	92	780
TPH (C35 - C40) EH_CU_ID_TOTAL	mg/kg	10	NONE	< 10	< 10	< 10	13	130
TPH Total C5 - C40 EH_CU+HS_ID_TOTAL	mg/kg	10	NONE	< 10	120	< 10	150	1200

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

Analytical Report Number: 23-38065
Project / Site name: Oakenrod
Your Order No: 005124

Lab Sample Number				2705908	2705909	2705910	2705911	2705912
Sample Reference				WS101	WS102	WS102	WS103	WS104
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				2.20	0.30	1.30	2.50	0.50
Date Sampled				05/06/2023	05/06/2023	05/06/2023	05/06/2023	05/06/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	69	< 0.1	< 0.1	73
Moisture Content	%	0.01	NONE	17	2.9	6.5	5.4	1.8
Total mass of sample received	kg	0.001	NONE	0.3	0.3	0.3	0.3	0.3

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

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	6.7	7.8	6.6	6.3	7.9
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	150	440	190	110	190
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.019	0.023	0.024	0.005	0.027
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	39	45	47	10	53
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	19.3	22.7	23.5	5	26.6
Sulphide	mg/kg	1	MCERTS	17	< 1.0	2	2.2	< 1.0
Total Sulphur	mg/kg	50	MCERTS	1000	390	130	180	69
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	1.2	2.7	1	1.4	0.4

Total Phenols

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

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	28	0.25	< 0.05	0.1
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	0.58	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	32	0.17	< 0.05	0.06
Fluorene	mg/kg	0.05	MCERTS	< 0.05	22	0.12	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.22	150	0.77	0.45	0.3
Anthracene	mg/kg	0.05	MCERTS	< 0.05	32	0.13	0.09	0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.31	170	0.72	0.52	0.43
Pyrene	mg/kg	0.05	MCERTS	0.28	140	0.56	0.49	0.37
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.18	70	0.24	0.22	0.17
Chrysene	mg/kg	0.05	MCERTS	0.21	62	0.35	0.24	0.18
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	0.29	72	0.24	0.16	0.24
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	0.12	27	0.13	0.07	0.08
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.18	54	0.16	0.12	0.15
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	27	< 0.05	< 0.05	0.08
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	6.7	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.13	30	< 0.05	< 0.05	0.09

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	1.92	933	3.84	2.36	2.3
-----------------------------	-------	-----	-----------	------	-----	------	------	-----

Analytical Report Number: 23-38065
Project / Site name: Oakenrod
Your Order No: 005124

Lab Sample Number				2705908	2705909	2705910	2705911	2705912
Sample Reference				WS101	WS102	WS102	WS103	WS104
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				2.20	0.30	1.30	2.50	0.50
Date Sampled				05/06/2023	05/06/2023	05/06/2023	05/06/2023	05/06/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	3.5	17	2.9	1.7	4.7
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	18	18	19	15	12
Copper (aqua regia extractable)	mg/kg	1	MCERTS	21	63	20	21	14
Lead (aqua regia extractable)	mg/kg	1	MCERTS	25	44	17	14	9.9
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	20	33	23	16	14
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	58	73	72	40	39

Petroleum Hydrocarbons

TPH (C5 - C6) HS_ID_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C6 - C8) HS_ID_TOTAL	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C8 - C10) HS_ID_TOTAL	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C10 - C12) EH_CU_ID_TOTAL	mg/kg	2	MCERTS	< 2.0	22	< 2.0	< 2.0	< 2.0
TPH (C12 - C16) EH_CU_ID_TOTAL	mg/kg	4	MCERTS	< 4.0	150	< 4.0	< 4.0	< 4.0
TPH (C16 - C21) EH_CU_ID_TOTAL	mg/kg	1	MCERTS	< 1.0	560	< 1.0	< 1.0	2.7
TPH (C21 - C35) EH_CU_ID_TOTAL	mg/kg	1	MCERTS	< 1.0	770	< 1.0	< 1.0	3.2
TPH (C35 - C40) EH_CU_ID_TOTAL	mg/kg	10	NONE	< 10	44	< 10	< 10	< 10
TPH Total C5 - C40 EH_CU+HS_ID_TOTAL	mg/kg	10	NONE	< 10	1600	< 10	< 10	< 10

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

Analytical Report Number: 23-38065
Project / Site name: Oakenrod
Your Order No: 005124

Lab Sample Number	2705913	2705914	2705915
Sample Reference	WS106	WS106	TP102
Sample Number	None Supplied	None Supplied	None Supplied
Depth (m)	0.20	1.30	1.50
Date Sampled	05/06/2023	05/06/2023	05/06/2023
Time Taken	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status
Stone Content	%	0.1	NONE
Moisture Content	%	0.01	NONE
Total mass of sample received	kg	0.001	NONE

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	Chrysotile	-	-
Asbestos in Soil	Type	N/A	ISO 17025	Detected	-	-
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	0.043	-	-
Asbestos Quantification Total	%	0.001	ISO 17025	0.043	-	-
Asbestos Analyst ID	N/A	N/A	N/A	SCA	N/A	N/A

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.7	7.2	6.8
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	710	250	100
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.015	0.0067	0.0033
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	30	13	6.6
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	14.9	6.7	3.3
Sulphide	mg/kg	1	MCERTS	< 1.0	1.2	1.6
Total Sulphur	mg/kg	50	MCERTS	420	200	100
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	2.2	0.7	0.6

Total Phenols

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

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	0.42	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	0.07	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	0.79	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	0.6	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	4.9	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	1.5	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	7.6	< 0.05	< 0.05
Pyrene	mg/kg	0.05	MCERTS	6.5	< 0.05	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	4	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	3.6	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	4.4	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	1.4	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	3.2	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	1.4	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.43	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	1.6	< 0.05	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	42.2	< 0.80	< 0.80
-----------------------------	-------	-----	-----------	------	--------	--------

Analytical Report Number: 23-38065
 Project / Site name: Oakenrod
 Your Order No: 005124

Lab Sample Number				2705913	2705914	2705915
Sample Reference				WS106	WS106	TP102
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.20	1.30	1.50
Date Sampled				05/06/2023	05/06/2023	05/06/2023
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status			
Heavy Metals / Metalloids						
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	12	6.2	1.7
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.6	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	33	22	14
Copper (aqua regia extractable)	mg/kg	1	MCERTS	62	20	15
Lead (aqua regia extractable)	mg/kg	1	MCERTS	130	20	11
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	35	20	14
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	130	50	49

Petroleum Hydrocarbons

TPH (C5 - C6) HS_ID_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0
TPH (C6 - C8) HS_ID_TOTAL	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1
TPH (C8 - C10) HS_ID_TOTAL	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1
TPH (C10 - C12) EH_CU_ID_TOTAL	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0
TPH (C12 - C16) EH_CU_ID_TOTAL	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0
TPH (C16 - C21) EH_CU_ID_TOTAL	mg/kg	1	MCERTS	12	< 1.0	< 1.0
TPH (C21 - C35) EH_CU_ID_TOTAL	mg/kg	1	MCERTS	46	< 1.0	< 1.0
TPH (C35 - C40) EH_CU_ID_TOTAL	mg/kg	10	NONE	< 10	< 10	< 10
TPH Total C5 - C40 EH_CU+HS_ID_TOTAL	mg/kg	10	NONE	60	< 10	< 10

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

Analytical Report Number: 23-38065
Project / Site name: Oakenrod
Your Order No: 005124

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

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

Quantitative Analysis

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

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

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

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
2705906	TP109	1.00	157	Loose Fibrous Debris & Rope	Chrysotile	0.141	0.141
2705913	WS106	0.20	161	Loose Fibrous Debris	Chrysotile	0.043	0.043

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



4041



Analytical Report Number: 23-38065

Project / Site name: Oakenrod

Your Order No: 005124

Lab Sample Number				2705916
Sample Reference				TP108
Sample Number				None Supplied
Depth (m)				0.40
Date Sampled				05/06/2023
Time Taken				None Supplied
Analytical Parameter (Leachate Analysis)	Units	Limit of detection	Accreditation Status	

General Inorganics

pH (automated)	pH Units	N/A	ISO 17025	8
Total Cyanide	µg/l	10	ISO 17025	100

Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10
----------------------------	------	----	-----------	------

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	NONE	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	NONE	< 0.01
Benzo(ghi)perylene	µg/l	0.01	NONE	< 0.01

Total PAH

Total EPA-16 PAHs	µg/l	0.2	NONE	< 0.2
-------------------	------	-----	------	-------

Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	1	ISO 17025	6.8
Cadmium (dissolved)	µg/l	0.08	ISO 17025	< 0.08
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0
Chromium (dissolved)	µg/l	0.4	ISO 17025	2.1
Copper (dissolved)	µg/l	0.7	ISO 17025	16
Lead (dissolved)	µg/l	1	ISO 17025	2.5
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5
Nickel (dissolved)	µg/l	0.3	ISO 17025	1.5
Selenium (dissolved)	µg/l	4	ISO 17025	< 4.0
Zinc (dissolved)	µg/l	0.4	ISO 17025	10

Monoaromatics & Oxygenates

Benzene	µg/l	3	ISO 17025	< 3.0
Toluene	µg/l	3	ISO 17025	< 3.0
Ethylbenzene	µg/l	3	ISO 17025	< 3.0
p & m-xylene	µg/l	3	ISO 17025	< 3.0
o-xylene	µg/l	3	ISO 17025	< 3.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	10	NONE	< 10

Petroleum Hydrocarbons

TPH1 (C10 - C40) EH_ID_TOTAL_MS	µg/l	10	NONE	< 10
--	------	----	------	------



4041



Analytical Report Number: 23-38065

Project / Site name: Oakenrod

Your Order No: 005124

Lab Sample Number				2705916
Sample Reference				TP108
Sample Number				None Supplied
Depth (m)				0.40
Date Sampled				05/06/2023
Time Taken				None Supplied
Analytical Parameter (Leachate Analysis)	Units	Limit of detection	Accreditation Status	
TPH-CWG - Aliphatic >C5 - C6 _{HS, 1D, AL}	µg/l	1	ISO 17025	< 1.0##
TPH-CWG - Aliphatic >C6 - C8 _{HS, 1D, AL}	µg/l	1	ISO 17025	< 1.0##
TPH-CWG - Aliphatic >C8 - C10 _{HS, 1D, AL}	µg/l	1	ISO 17025	< 1.0##
TPH-CWG - Aliphatic >C10 - C12 _{EH, 1D, AL, MS}	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic >C12 - C16 _{EH, 1D, AL, MS}	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic >C16 - C21 _{EH, 1D, AL, MS}	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic >C21 - C35 _{EH, 1D, AL, MS}	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic (C5 - C35) _{HS+EH, 1D, AL, MS}	µg/l	10	NONE	< 10

TPH-CWG - Aromatic >C5 - C7 _{HS, 1D, AR}	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aromatic >C7 - C8 _{HS, 1D, AR}	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aromatic >C8 - C10 _{HS, 1D, AR}	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aromatic >C10 - C12 _{EH, 1D, AR, MS}	µg/l	10	NONE	< 10
TPH-CWG - Aromatic >C12 - C16 _{EH, 1D, AR, MS}	µg/l	10	NONE	< 10
TPH-CWG - Aromatic >C16 - C21 _{EH, 1D, AR, MS}	µg/l	10	NONE	< 10
TPH-CWG - Aromatic >C21 - C35 _{EH, 1D, AR, MS}	µg/l	10	NONE	< 10
TPH-CWG - Aromatic (C5 - C35) _{HS+EH, 1D, AR, MS}	µg/l	10	NONE	< 10

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

Analytical Report Number : 23-38065

Project / Site name: Oakenrod

* 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 *
2705898	TP101	None Supplied	0.6	Brown clay and sand with gravel.
2705899	TP103	None Supplied	0.5	Brown clay and sand with gravel.
2705900	TP104	None Supplied	0.6	Brown clay and sand with gravel.
2705901	TP105	None Supplied	2	Brown clay and sand with gravel and stones.
2705902	TP106	None Supplied	0.3	Brown loam and clay with gravel and vegetation.
2705903	TP106	None Supplied	1.6	Brown clay and sand with gravel.
2705904	TP108	None Supplied	0.4	Brown loam and sand with gravel.
2705905	TP108	None Supplied	1.5	Brown clay and sand with vegetation.
2705906	TP109	None Supplied	1	Brown loam and sand with gravel and vegetation.
2705907	TP110	None Supplied	0.2	Brown loam and sand with gravel.
2705908	WS101	None Supplied	2.2	Brown clay and sand with gravel.
2705909	WS102	None Supplied	0.3	Brown loam and sand with gravel and stones.
2705910	WS102	None Supplied	1.3	Brown clay and sand.
2705911	WS103	None Supplied	2.5	Brown clay and sand.
2705912	WS104	None Supplied	0.5	Brown sand with gravel and stones.
2705913	WS106	None Supplied	0.2	Brown loam and clay with gravel and vegetation.
2705914	WS106	None Supplied	1.3	Brown clay and sand with gravel.
2705915	TP102	None Supplied	1.5	Brown clay and sand.

Analytical Report Number : 23-38065

Project / Site name: Oakenrod

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
BS EN 12457-1 (2:1) Leachate Prep	2:1 (as recieved, moisture adjusted) end over end extraction with water for 24 hours. Eluate filtered prior to analysis.	In-house method based on BSEN12457-1.	L043-PL	W	NONE
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Metals by ICP-OES in leachate	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Hexavalent chromium in leachate	Determination of hexavalent chromium in leachate by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	ISO 17025
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols in leachate	Determination of phenols in leachate by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Speciated EPA-16 PAHs in leachate	Determination of PAH compounds in leachate by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
pH at 20oC in leachate (automated)	Determination of pH in leachate by electrometric measurement.	In house method.	L099B	W	ISO 17025
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-PL	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS

Analytical Report Number : 23-38065

Project / Site name: Oakenrod

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
TPH1 (Leachates)	Determination of dichloromethane extractable hydrocarbons in leachate by GC-MS.	In-house method	L070-PL	W	NONE
TPHCWG (Leachates)	Determination of dichloromethane extractable hydrocarbons in leachate by GC-MS.	In-house method	L070-PL	W	ISO 17025
Total cyanide in leachate	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
BTEX and MTBE in leachates (Monoaromatics)	Determination of BTEX and MTBE in leachates by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	MCERTS
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in house method based on references.	HSE Report No: 83/1996, HSG 248, HSG 264 & SCA Blue Book (draft).	A006-PL	D	ISO 17025
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-PL	W	MCERTS

Analytical Report Number : 23-38065

Project / Site name: Oakenrod

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
D.O. for Gravimetric Quant if Screen/ID positive	Dependent option for Gravimetric Quant if Screen/ID positive scheduled.	In house asbestos methods A001 & A006.	A006-PL	D	NONE
Sulphate, water soluble, in soil (1hr extraction)	Sulphate, water soluble, in soil (1hr extraction)	In-house method	L038-PL	D	MCERTS

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

For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).

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

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30°C. Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

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

##Quality control parameter has a high recovery (outside of limit); however the associated result is below the reporting limit, other checks applied prior to reporting the data have been accepted. The result should be considered as being deviating and may be compromised.



4041



Georgia
e3p
Taylor Road
Urmston
Manchester
M41 7JQ

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

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

e: Gcalrert@e3p.co.uk

Analytical Report Number : 23-40401

Project / Site name:	Oakenrod School	Samples received on:	20/06/2023
Your job number:	16-932	Samples instructed on/ Analysis started on:	20/06/2023
Your order number:	005255	Analysis completed by:	27/06/2023
Report Issue Number:	1	Report issued on:	27/06/2023
Samples Analysed:	4 water samples		


Signed:

Joanna Wawrzeczko
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.



4041



Analytical Report Number: 23-40401
Project / Site name: Oakenrod School

Your Order No: 005255

Lab Sample Number				2720755	2720756	2720757	2720758
Sample Reference				WS101	WS103	RIVER UPSTREAM	RIVER DOWNSTREAM
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				19/06/2023	19/06/2023	19/06/2023	19/06/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status				

General Inorganics

pH (L005B)	pH Units	N/A	ISO 17025	6.8	6.9	7.4	7.5
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	7.7	< 1.0	< 1.0	< 1.0
Dissolved Organic Carbon (DOC)	mg/l	0.1	ISO 17025	48.9	17.5	6.97	6.78

Total Phenols

Total Phenols (monohydric)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
----------------------------	------	---	-----------	-------	-------	-------	-------

Heavy Metals / Metalloids

Calcium (dissolved)	mg/l	0.012	ISO 17025	93	88	25	24
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0	< 5.0

Arsenic (dissolved)	µg/l	0.15	ISO 17025	14.1	1.63	0.49	0.5
Cadmium (dissolved)	µg/l	0.02	ISO 17025	< 0.02	< 0.02	< 0.02	< 0.02
Chromium (dissolved)	µg/l	0.2	ISO 17025	4.2	1.7	1.8	6.9
Copper (dissolved)	µg/l	0.5	ISO 17025	12	12	8.2	5.8
Lead (dissolved)	µg/l	0.2	ISO 17025	1.6	0.5	< 0.2	0.2
Manganese (dissolved)	µg/l	0.05	ISO 17025	2900	440	2	2
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	5.8	2.9	2.4	2.3
Selenium (dissolved)	µg/l	0.6	ISO 17025	1.2	9	< 0.6	< 0.6
Zinc (dissolved)	µg/l	0.5	ISO 17025	6.8	11	8.4	12

Monoaromatics & Oxygenates

Benzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Toluene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Ethylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
p & m-xylene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
o-xylene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0

Petroleum Hydrocarbons

TPH1 (C10 - C40) EH_ID_TOTAL_MS	µg/l	10	ISO 17025	< 10	37	< 10	< 10
--	------	----	-----------	------	----	------	------

TPH-CWG - Aliphatic >C5 - C6 HS_ID_AL	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8 HS_ID_AL	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10 HS_ID_AL	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12 EH_ID_AL_MS	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16 EH_ID_AL_MS	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21 EH_ID_AL_MS	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35 EH_ID_AL_MS	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35) HS+EH_ID_AL_MS	µg/l	10	NONE	< 10	< 10	< 10	< 10

TPH-CWG - Aromatic >C5 - C7 HS_ID_AR	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8 HS_ID_AR	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10 HS_ID_AR	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12 EH_ID_AR_MS	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C12 - C16 EH_ID_AR_MS	µg/l	10	NONE	< 10	20	< 10	< 10
TPH-CWG - Aromatic >C16 - C21 EH_ID_AR_MS	µg/l	10	NONE	< 10	17	< 10	< 10
TPH-CWG - Aromatic >C21 - C35 EH_ID_AR_MS	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C35) HS+EH_ID_AR_MS	µg/l	10	NONE	< 10	37	< 10	< 10



4041



Analytical Report Number: 23-40401
Project / Site name: Oakenrod School

Your Order No: 005255

Lab Sample Number				2720755	2720756	2720757	2720758
Sample Reference				WS101	WS103	RIVER UPSTREAM	RIVER DOWNSTREAM
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				19/06/2023	19/06/2023	19/06/2023	19/06/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status				

VOCs

Chloromethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Chloroethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Bromomethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Vinyl Chloride	µg/l	3	NONE	< 3.0	< 3.0	< 3.0	< 3.0
Trichlorofluoromethane	µg/l	3	NONE	< 3.0	< 3.0	< 3.0	< 3.0
1,1-Dichloroethene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Cis-1,2-dichloroethene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,1-Dichloroethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
2,2-Dichloropropane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Trichloromethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,1,1-Trichloroethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,2-Dichloroethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,1-Dichloropropene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Trans-1,2-dichloroethene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Benzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Tetrachloromethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,2-Dichloropropane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Trichloroethene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Dibromomethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Bromodichloromethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Cis-1,3-dichloropropene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Trans-1,3-dichloropropene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Toluene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,1,2-Trichloroethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,3-Dichloropropane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Dibromochloromethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Tetrachloroethene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,2-Dibromoethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Chlorobenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,1,1,2-Tetrachloroethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Ethylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
p & m-Xylene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Styrene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Tribromomethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
o-Xylene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,1,2,2-Tetrachloroethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Isopropylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Bromobenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
n-Propylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
2-Chlorotoluene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
4-Chlorotoluene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,3,5-Trimethylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
tert-Butylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,2,4-Trimethylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
sec-Butylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,3-Dichlorobenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
p-Isopropyltoluene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,2-Dichlorobenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,4-Dichlorobenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0



4041



Analytical Report Number: 23-40401
Project / Site name: Oakenrod School

Your Order No: 005255

Lab Sample Number				2720755	2720756	2720757	2720758
Sample Reference				WS101	WS103	RIVER UPSTREAM	RIVER DOWNSTREAM
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				19/06/2023	19/06/2023	19/06/2023	19/06/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status				
Butylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,2-Dibromo-3-chloropropane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,2,4-Trichlorobenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Hexachlorobutadiene##	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,2,3-Trichlorobenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0

SVOCs

Aniline	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Phenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
2-Chlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Bis(2-chloroethyl)ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
1,3-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
1,2-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
1,4-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Bis(2-chloroisopropyl)ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
2-Methylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Hexachloroethane	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Nitrobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
4-Methylphenol	µg/l	0.05	NONE	7	< 0.05	< 0.05	< 0.05
Isophorone	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
2-Nitrophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
2,4-Dimethylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Bis(2-chloroethoxy)methane	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
1,2,4-Trichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
2,4-Dichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
4-Chloroaniline	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Hexachlorobutadiene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
4-Chloro-3-methylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
2,4,6-Trichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
2,4,5-Trichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
2-Methylnaphthalene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
2-Chloronaphthalene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Dimethylphthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
2,6-Dinitrotoluene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	0.4	< 0.01	< 0.01
2,4-Dinitrotoluene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Dibenzofuran	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
4-Chlorophenyl phenyl ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Diethyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
4-Nitroaniline	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	µg/l	0.01	ISO 17025	< 0.01	0.27	< 0.01	< 0.01
Azobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Bromophenyl phenyl ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Hexachlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	1.7	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	0.81	< 0.01	< 0.01
Carbazole	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Dibutyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Anthraquinone	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	1.7	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	1.3	< 0.01	< 0.01



4041



Analytical Report Number: 23-40401
Project / Site name: Oakenrod School

Your Order No: 005255

Lab Sample Number				2720755	2720756	2720757	2720758
Sample Reference				WS101	WS103	RIVER UPSTREAM	RIVER DOWNSTREAM
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				19/06/2023	19/06/2023	19/06/2023	19/06/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status				
Butyl benzyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	0.59	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	0.5	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	0.66	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	0.2	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	0.44	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	0.22	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	0.27	< 0.01	< 0.01
3&4-Methylphenol	µg/l	0.1	NONE	7	< 0.10	< 0.10	< 0.10

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

Analytical Report Number : 23-40401

Project / Site name: Oakenrod School

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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.	L012-PL	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, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
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-PL	W	ISO 17025
Monohydric phenols in water - LOW LEVEL 1 ug/l	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 (skalar)	L080-PL	W	ISO 17025
Semi-volatile organic compounds in water	Determination of semi-volatile organic compounds in leachate by extraction in dichloromethane followed by GC-MS.	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	ISO 17025
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 USEPA8260	L073B-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Low level total cyanide 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 (Skalar)	L080-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In house method.	L099-PL	W	ISO 17025

Analytical Report Number : 23-40401
Project / Site name: Oakenrod School

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
TPH1 (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS.	In-house method	L070-PL	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 30oC. Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

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

- Quality control parameter has a high recovery (outside of limit); however the associated result is below the reporting limit, other checks applied prior to reporting the data have been accepted. The result should be considered as being deviating and may be compromised.

APPENDIX VII

ORIGIN OF TIER 2 GENERIC ASSESSMENT CRITERIA

Oakenrod School, Rochdale

Phase II Geoenvironmental Site Assessment

August 2023

CONSTITUENT	ORIGIN OF RISK ASSESSMENT VALUE
Arsenic	2014 LQM/CIEH S4ULs
Cadmium	2014 LQM/CIEH S4ULs
Chromium	2014 LQM/CIEH S4ULs
Lead	2014 LQM/CIEH S4ULs
Mercury	2014 LQM/CIEH S4ULs – methylmercury
Nickel	2014 LQM/CIEH S4ULs
Selenium	2014 LQM/CIEH S4ULs
Copper	2014 LQM/CIEH S4ULs
Zinc	2014 LQM/CIEH S4ULs
Cyanide – Total	2014 LQM/CIEH S4ULs
Phenols – Total	2014 LQM/CIEH S4ULs
Naphthalene	General assessment criteria (GAC) developed by CIEH/LQM Suitable 4 Use Levels with supporting data from SR3, SR7 and existing Tox report where applicable. 1% SOM.
Acenaphthylene	
Acenaphthene	
Fluorene	
Phenanthrene	
Anthracene	
Fluoranthene	
Pyrene	
Benzo(a)Anthracene	
Chrysene	
Benzo(b/k)Fluoranthene ⁽ⁱⁱⁱ⁾	
Benzo(a)Pyrene	
Indeno(123-cd)Pyrene	
Dibenzo(a,h)Anthracene	
Benzo(ghi)Perylene	
TPH C ₅ -C ₆ (aliphatic)	
TPH C ₆ -C ₈ (aliphatic)	
TPH C ₈ -C ₁₀ (aliphatic)	
TPH C ₁₀ -C ₁₂ (aliphatic)	
TPH C ₁₂ -C ₁₆ (aromatic)	
TPH C ₁₆ -C ₂₁ (aromatic)	
TPH C ₂₁ -C ₃₅ (aromatic)	

APPENDIX VIII

GEOTECHNICAL TESTING

RESULTS



LABORATORY REPORT



Contract Number: PSL23/4445

Report Date: 10 July 2023

Client's Reference: 005121

Client Name: E3P
Taylor Road
Urmston
Manchester
M41 7JQ

For the attention of: Elizabeth Fearn/Georgia Calvert

Contract Title: Oakenrod

Date Received: 9/6/2023

Date Commenced: 9/6/2023

Date Completed: 07/07/2023

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

Checked and Approved Signatories:

A Watkins
(Director)

R Berriman
(Quality Manager)

S Royle
(Laboratory Manager)

L Knight
(Assistant Laboratory Manager)

S Eyre
(Senior Technician)


M Fennell
(Senior Technician)

5 – 7 Hexthorpe Road,
Hexthorpe,
Doncaster,
DN4 0AR
Tel: 01302 768098
Email: rberriman@prosoils.co.uk
awatkins@prosoils.co.uk

Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

[illegible]

Oakenrod

Contract No:

PSL23/4445

Client Ref:

005121

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

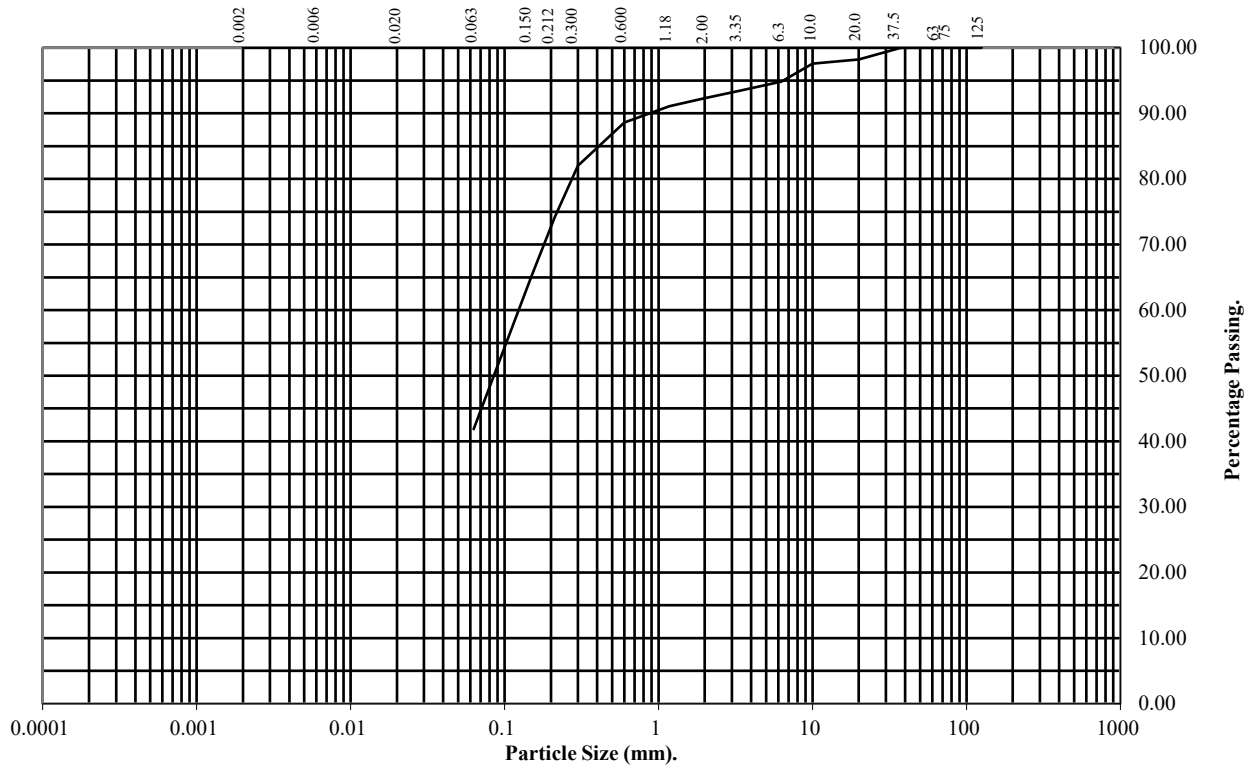
Hole Number: CP101

Top Depth (m): 1.50

Sample Number:

Base Depth(m):

Sample Type: Bulk



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	98
10	98
6.3	95
3.35	93
2	92
1.18	91
0.6	89
0.3	82
0.212	74
0.15	65
0.063	42

Soil Fraction	Total Percentage
Cobbles	0
Gravel	8
Sand	50
Silt/Clay	42

Remarks:

See Summary of Soil Descriptions



Oakenrod

Contract No:
PSL23/4445
Client Ref:
005121

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

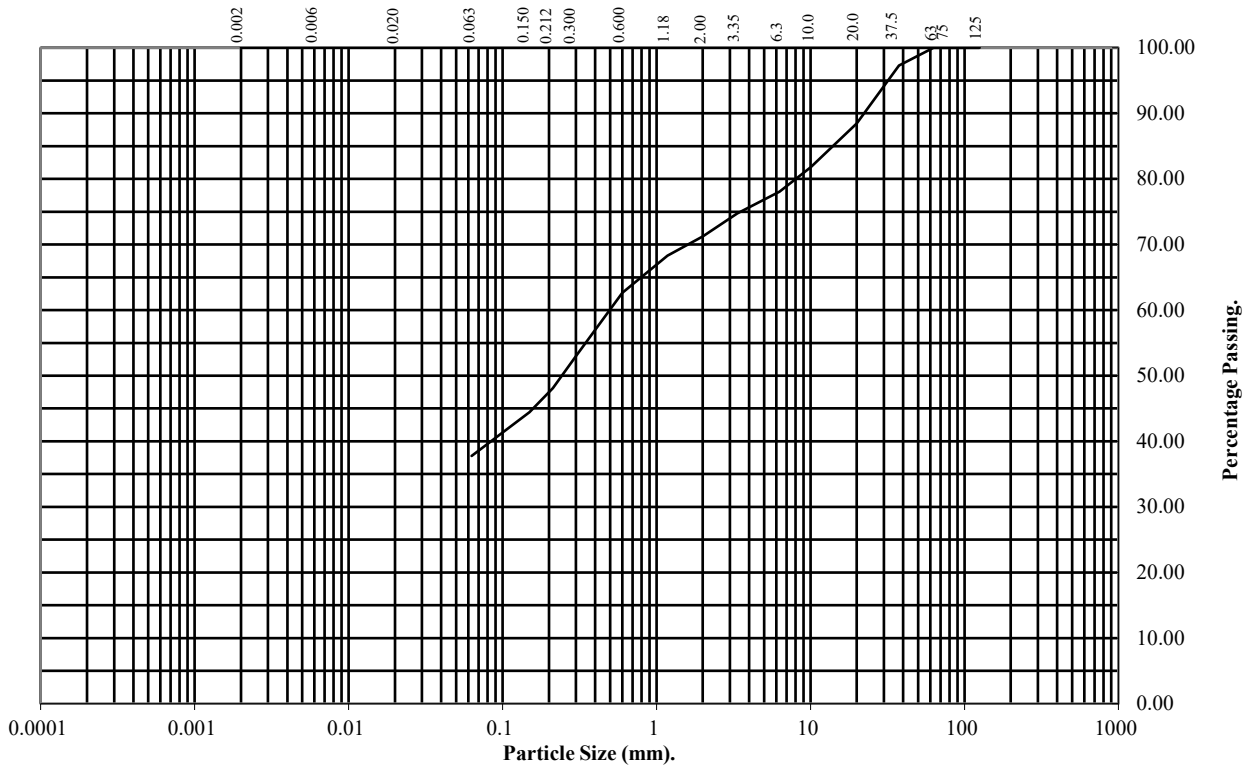
Hole Number: CP101

Top Depth (m): 2.50

Sample Number:

Base Depth(m):

Sample Type: Bulk



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	97
20	88
10	82
6.3	78
3.35	75
2	71
1.18	68
0.6	63
0.3	53
0.212	48
0.15	44
0.063	38

Soil Fraction	Total Percentage
Cobbles	0
Gravel	29
Sand	33
Silt/Clay	38

Remarks:

See Summary of Soil Descriptions



Oakenrod

Contract No:
PSL23/4445
Client Ref:
005121

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

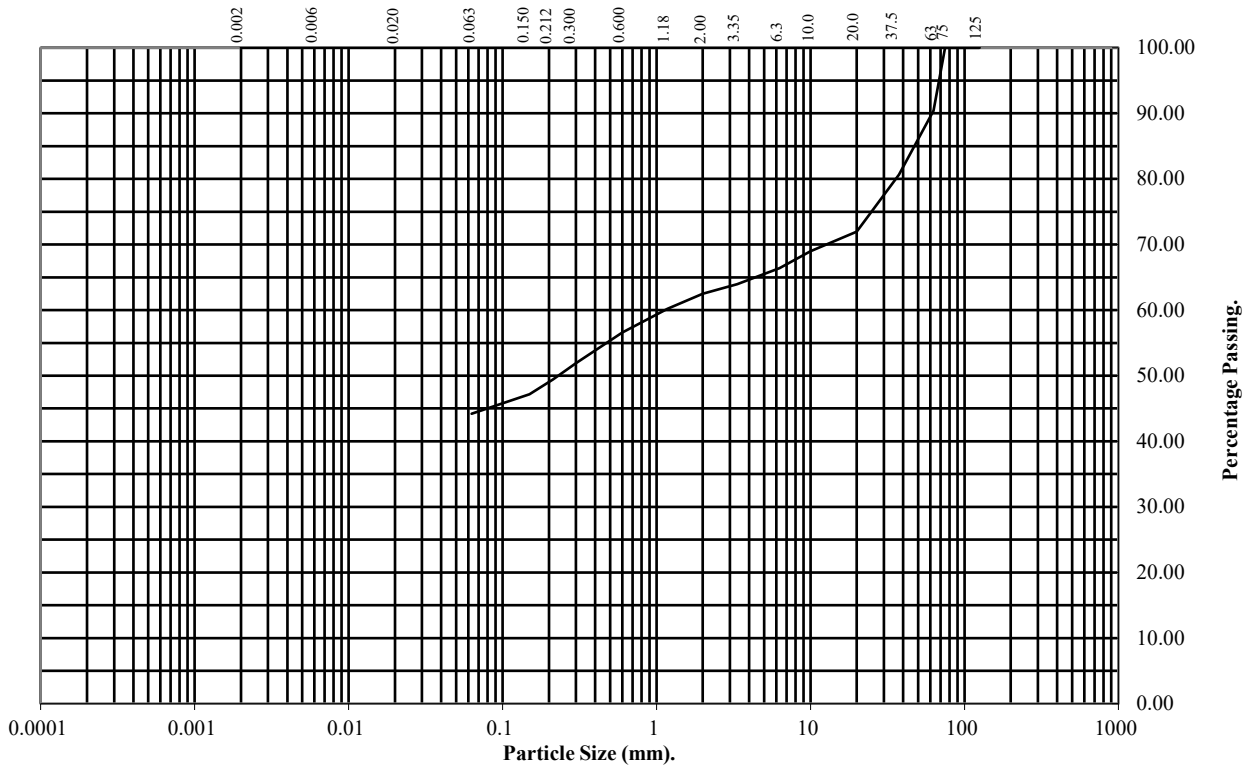
Hole Number: TP105

Top Depth (m): 1.50

Sample Number:

Base Depth(m):

Sample Type: Bulk



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	90
37.5	81
20	72
10	69
6.3	66
3.35	64
2	62
1.18	60
0.6	57
0.3	52
0.212	49
0.15	47
0.063	44

Soil Fraction	Total Percentage
Cobbles	10
Gravel	28
Sand	18
Silt/Clay	44

Remarks:

See Summary of Soil Descriptions



Oakenrod

Contract No:
PSL23/4445
Client Ref:
005121

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

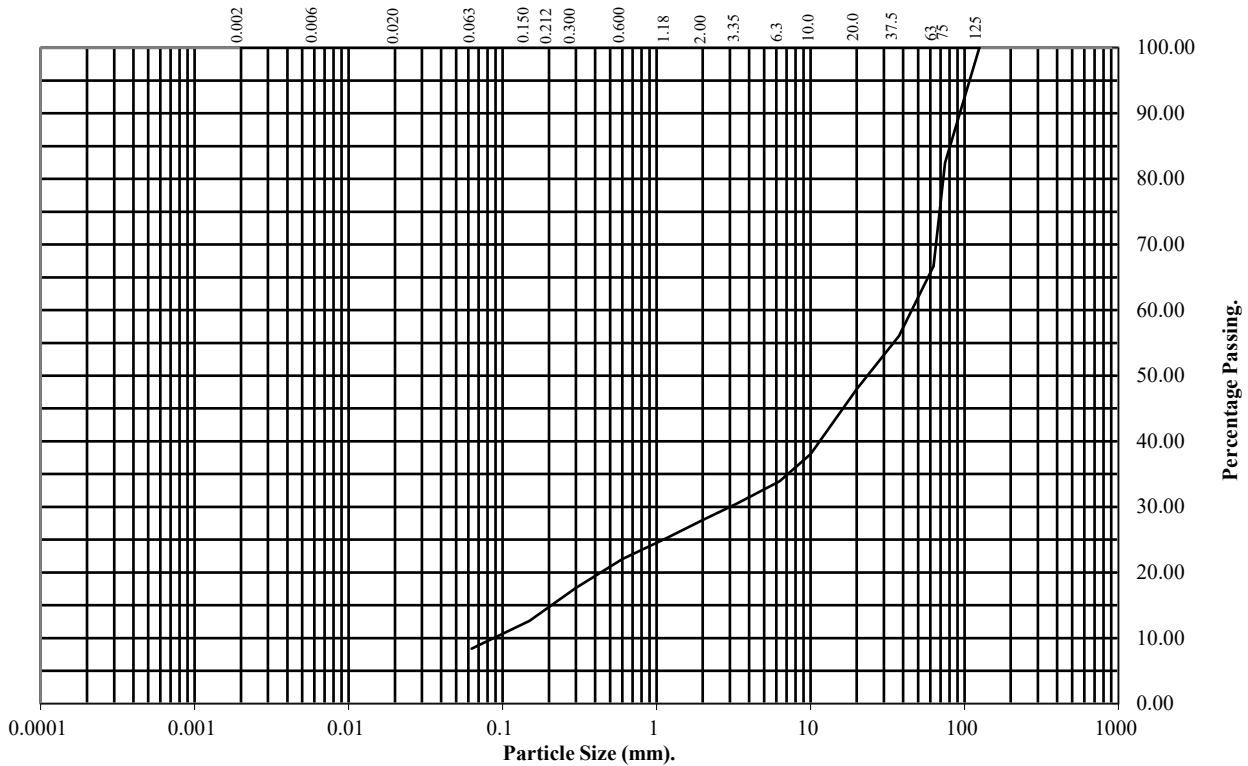
Hole Number: TP109

Top Depth (m): 0.50

Sample Number:

Base Depth(m):

Sample Type: Bulk



BS Test Sieve (mm)	Percentage Passing
125	100
75	82
63	67
37.5	56
20	48
10	38
6.3	34
3.35	31
2	28
1.18	25
0.6	22
0.3	18
0.212	15
0.15	13
0.063	8

Soil Fraction	Total Percentage
Cobbles	33
Gravel	39
Sand	20
Silt/Clay	8

Remarks:

See Summary of Soil Descriptions



Oakenrod

Contract No:
PSL23/4445
Client Ref:
005121

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

Non compliance with BS 1377 : Part 4 : Clause 3.6 : 1990

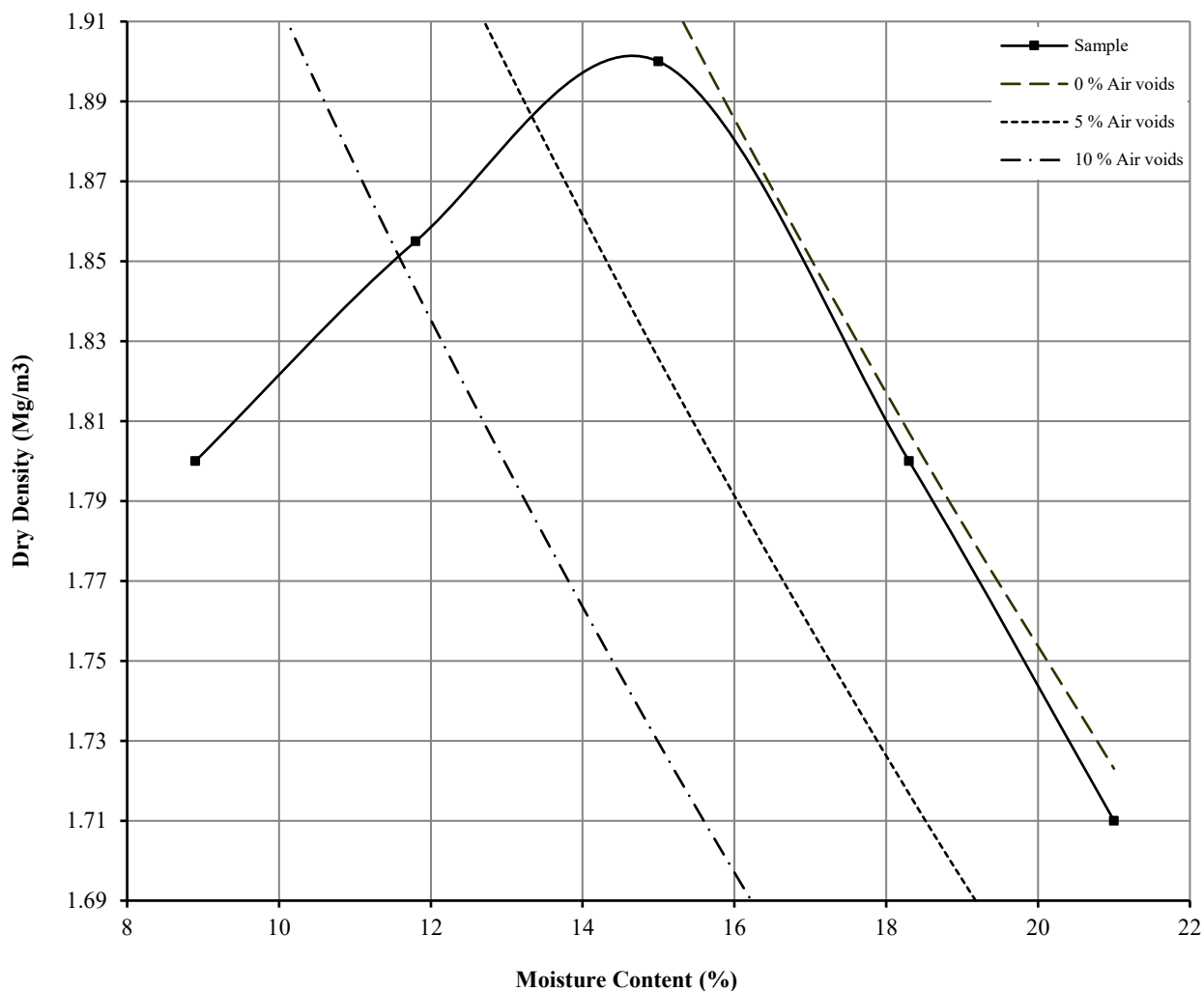
Hole Number: TP105

Top Depth (m) : 1.50

Sample Number:

Base Depth (m) :

Sample Type: Bulk



Initial Moisture Content:	24	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m3):	2.7	Assumed	Material Retained on 37.5 mm Test Sieve (%):	19
Maximum Dry Density (Mg/m3):	1.90		Material Retained on 20.0 mm Test Sieve (%):	3
Optimum Moisture Content (%):	15			
Remarks See summary of soil descriptions				

		Oakenrod	Contract
			PSL23/4445
			Client Ref
			005121

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

Non compliance with BS 1377 : Part 4 : Clause 3.4 : 1990

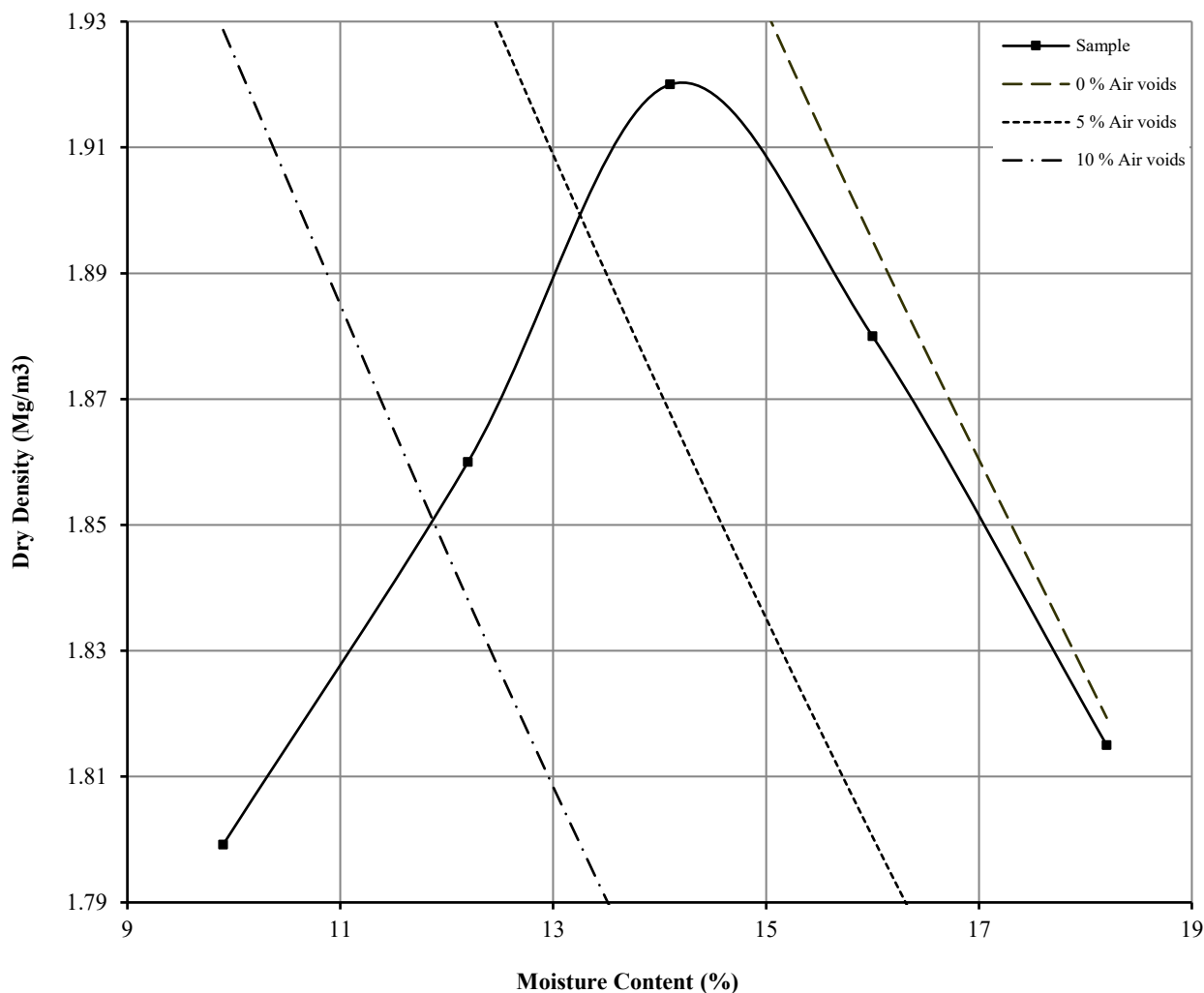
Hole Number: TP109

Top Depth (m) : 0.50

Sample Number:

Base Depth (m) :

Sample Type: Bulk



Initial Moisture Content:	14	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m ³):	2.72	Assumed	Material Retained on 37.5 mm Test Sieve (%):	44
Maximum Dry Density (Mg/m ³):	1.92		Material Retained on 20.0 mm Test Sieve (%):	8
Optimum Moisture Content (%):	14			
Remarks See summary of soil descriptions				

 	Oakenrod	Contract
		PSL23/4445
		Client Ref
		005121