

Phase II Geoenvironmental Site Assessment

Site: Willow Street, Bury

Reference: 17-285-R1

Date: April 24





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QUALITY ASSURANCE

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R1-2	Final				

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EXECUTIVE SUMMARY

Site Address	50 Maxwell St, Bury BL9 7PY
Grid Reference	381800E 411040N
Site Area	0.25 Ha
Proposed Development	The client intends to construct a low-rise residential development comprising two apartment blocks with associated gardens, estate roads and infrastructure.
Current Site Use	The site is a rectangular shaped parcel of land located to the east of Bury town centre. The site is split into two distinct areas characterised by an elevation change of approx. 2 m and separated by a brick retaining wall. The north and west sector comprises an apartment block in the north with associated carparking and landscaping in the west. The south and east sector comprises a car park and disused commercial units/warehouses and storage sheds.
Site History	The site remained undeveloped until circa pre 1956 when commercial buildings were constructed. The building in the north of the site was redeveloped into residential flats between 2003 to 2005. The commercial buildings in the south of the site remain. Domestic garages were present in the centre of the site from circa 1985 to 2000.



ENVIRONMENTAL SETTING

Geology	Drift Geology	Till (Devensian – CLAY) across the site.
	Bedrock Geology	Pennine Lower Coal Measures Formation - MUDSTONE, SILTSTONE AND SANDSTONE
	Faults	Fault trending northwest to southeast noted approximately 100 m north of the site.
Geomorphology	It is considered that the natural landform may have sloped notably downwards towards the east. In light of the natural setting and current topography, the site has likely been subject to upfilling to create a level developable platform.	
Hydrogeology	No aquifer is recorded by the BGS in the drift deposits. The underlying aquifer in the Coal Measures is recorded as Secondary A.	
	No groundwater abstractions are located within 1km of the site.	
Hydrology	No watercourses noted within 250 m of the site.	
	The site is located within Flood Zone 1 - no risk of flooding	
Utility Locations	A formal drainage survey has not been completed. However, during GPR clearance for the exploratory locations indicates numerous private services were identified. Statutory utility plans show gas and electrical services to be present. A low-pressure gas main enters in the east, running south connecting to the northeast wall of the commercial unit. Low voltage electric cables run along the north and east boundaries entering in the east and connecting to the commercial building at the same point as the gas.	
Landfill Sites and Waste Sites	No landfill sites (current or historic) are located within 250m of the Site.	
Radon	Radon Class 3 - 3-5% of homes are estimated to be at or above the Action Level. Basic radon protection measures required.	
Unexploded Ordnance	Low risk UXO area - no further works required.	
PFAS	No potential current or historical sources of PFAS have been identified on site. No further risk assessment required.	
Hazardous Installations	No hazardous installations that could potentially prejudice the proposed construction of highly sensitive residential dwellings have been identified within influencing distance of the subject site.	

PREVIOUS REPORTS

The following previous reports have been completed for the site:

-  Phase 1: Preliminary Risk Assessment Ref: LKC 23 1019-A1-PRA

A full summary of findings is provided in Section 1



E3P GROUND INVESTIGATION

Ground Works	E3P has completed an intrusive ground investigation comprising: 6 x window sample boreholes, 5 x environmental monitoring installations.
Ground Conditions	Made Ground – 0.0 m bgl to 4.00 m bgl Made Ground deposits were encountered within all exploratory hole locations to depths of between 0.90 m and 4.00 m bgl. It should be noted that within WS103 where Made Ground was encountered to 4.00 m bgl, the recovery of material was poor, and this is therefore an estimated depth of Made Ground. Made Ground deposits from ground level to 0.30 m bgl comprise tarmac underlain by MOT. Underlying the tarmac and MOT, Made Ground deposits are varied, comprising interbedded reworked clay, sand and gravel. Reworked clays were encountered within four exploratory locations (WS101, WS104, WS105 and WS106) and comprise grey and brown gravelly sandy clay. Gravel is fine to coarse angular to subrounded of mudstone, sandstone, ash, brick. With the exception of WS101, reworked clay deposits were encountered directly overlying natural strata. Granular Made Ground deposits were encountered within all exploratory locations apart from WS106. Granular Made Ground generally comprises brownish black and grey clayey very sandy gravel with localised areas comprising brown clayey gravelly fine to medium sand. Gravel is fine to coarse angular to subrounded of mudstone, brick, wood, concrete, ash, glass, slag and clinker. In WS105 granular Made Ground comprises and infilled natural sand underlain by a geotextile membrane, suggesting it is part of a cover system. Drift – 0.90 m bgl to 5.45 m bgl Drift deposits were encountered within all exploratory locations to a maximum proven depth of 5.45 m bgl. The drift deposits comprise a generally firm low strength to stiff medium strength sandy gravelly CLAY with gravel of mudstone. Localised soft very low strength sandy CLAY was encountered within WS103 and WS104 at 4.00 m bgl. Localised very stiff very high strength sandy gravelly CLAY was encountered within WS106 at 3.00 m bgl. Solid – 2.70 m bgl to >5.45 m bgl The solid bedrock geology was encountered within two exploratory locations (WS101 and WS105) with depth to rockhead varying between 2.70 and 4.50 m bgl. The solid geology comprises grey weathered MUDSTONE. Groundwater Groundwater strikes were encountered as seepages within WS101 at 3.00m bgl. During post site investigation monitoring groundwater levels were observed between 0.57m (WS105) and 3.21m bgl (WS101) to date.



CONTAMINATED LAND ASSESSMENT

Human Health	Laboratory analysis identified the localised presence of elevated non-volatile PAHs, heavy metals, volatile naphthalene and SVOCs within Made Ground deposits on site. These exceedances are associated within general Made Ground and are not attributed to a specific source. The risk to chronic human health associated with the elevated concentrations on inorganic heavy metals and non-volatile PAH 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. With regards to the elevated naphthalene and SVOCs, these present a potential volatilisation to indoor air risk. These elevated concentrations have been identified within the vicinity of WS101 and WS104 and these are therefore considered to be localised hotspots. Therefore, during a process of cut/fill enabling works, a hotspot removal could be undertaken where these soils may be chemically validated to assess chemical suitability for retention on site in an area of no future sensitivity. Should the site be piled, and the material left in-situ, a vapour membrane may be required.
Controlled Waters	No elevated levels of contaminants in leachate or groundwater samples have been identified compared to the DWS values. One exceedance of zinc has been identified when compared to EWS values as there is no DWS value for zinc. The risk of this is negated, however, due to the lack of surface water receptor within influencing distance of the site. In the absence of any sources of mobile contaminants, no exceedances in GW when compared to DWS values and low sensitivity of the underlying receptor (Coal Measures), the site is considered to pose no unacceptable level of risk to controlled waters.
Ground Gas	Initial ground gas monitoring indicates the majority of the site can be classified as CS1/Green and no gas protection measures will be required. Precautionary CS2 measures should be considered for WS101 due to elevated carbon dioxide. The final ground gas protection regime should be confirmed on completion of the monitoring.
Potable Infrastructure	Water Based on the assessment of current site conditions it is likely that barrier pipe will be required at the proposed development
Conclusions	Unsuitable materials have been identified within the areas of Made Ground on site. Where proposed buildings are to be constructed in these areas, hotspot removal may be required to remove the source of contamination. Should the site be piled and the material left in-situ, a vapour membrane and subfloor void should be installed during the build phase to mitigate minor ingress.

COAL MINING ASSESSMENT

Preliminary Assessment	The site is not within a development high risk area.
Recommendations	No further assessment is required.



GEOTECHNICAL ASSESSMENT

Underground Obstructions & Subterranean hazards	Site has been subject to historical development and, while above-ground structures have been removed, potential subsurface obstruction from relict foundations may remain. No significant obstructions were identified in the site investigation. As part of the process of creating a suitable platform for development, all subterranean obstructions will need to be excavated and removed beneath new structures and infrastructure. This will facilitate the construction of the proposed plots as intended.
Allowable Capacity Bearing	The underlying natural clay drift deposits have been evaluated and found to generally be soft very low strength to firm low strength with a net Allowable Bearing Capacity (ABC) of 34.74–78.17 kN/m² from 2.00–5.00 meters below ground level (bgl). Localised areas of stiff medium strength CLAY with a net ABC of 103.30–136.46 kN/m² has been encountered from 2.00–5.00 m bgl. One localised area of very stiff very high strength CLAY with a net ABC of 447.00 kN/m² has been encountered in WS106 at 3.00 m bgl. The underlying MUDSTONE bedrock has been assessed as having a net ABC of 434.83.00 kN/m² at 3.00 m bgl.
Foundation Options	Deep Made Ground to a depth of >2.00 m bgl in five of the six boreholes indicates the proposed structures will likely require an engineered foundation solution comprising either ground improved by vibro stone columns (VSC) or the use of driven piled foundations. Due to low strength clays with $C_u < 30$ kN/m² underlying variable Made Ground, a programme of reengineering works will be required prior to the placement of VSC. Reengineering work will likely comprise the removal of unsuitable material from Made Ground and removal of low strength clays. Due to the loadings of the proposed structures, ground improvement by VSC would result in an estimated ABC of 125 kN/m². An alternative foundation option would be the use of mini piled foundations capable of transferring the loads to competent strata, being the underlying stiff clay/weathered bedrock at circa >5.00 m bgl.
Foundations Near Trees	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.
Heave Precautions Near Trees	Given that the underlying clay is of low volume change potential, heave precautions will not be required to the internal face of a foundation less than 1.5 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.
Building Floor Slabs	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.
Soakaway Drainage	BRE 365 Soakaway testing has not been completed for the purpose of this report, however, due to the depths of Made Ground and underlying cohesive soils, soakaway drainage is not considered viable.



Sulphate Assessment	Concrete classification will be DS1 AC1s.
Highway Infrastructure 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.
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.
Enabling Earthworks	Development levels are unknown at this time; however, significant cut-and-fill works are not anticipated to be required to prepare the development platform. As part of the earthworks design, materials should be assessed and characterised prior to re-use in the construction of upfill to a geotechnical design. All future earthworks should be completed in accordance with a Geotechnical Design Report (GDR) that will consider the ground model within the context of the potential for settlement induced by surcharge from earthworks, dynamic and permanent loading of the development and all known hazards.
Civil Engineering Excavations	No shallow bedrock has been encountered (<2.50m bgl). Shallow groundwater may necessitate the need for de-watering.
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> . This can be done upon request and inline with the Environment Agency sampling frequencies.

RECOMMENDATIONS

Based on the findings of the Geoenvironmental site assessment and the various conclusions drawn, the following additional works are recommended to be completed in due course:

-  Post-demolition investigation within area not previously accessible.
-  Arboricultural Survey for trees on boundary of site.
-  Geotechnical Design Report (GDR)
-  Geotechnical Earthworks Strategy (infrastructure).
-  Remediation and Enabling Works Strategy.
-  Ground Gas Addendum on completion of the ground gas monitoring.



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17-285-R1-003 - Historical Features Plan
17-285-R1-004 - Site Features Plan
17-285-R1-005 - Exploratory Hole Location Plan
17-285-R1-006 - Depth of Made Ground Plan
17-285-R1-015 - Development Constraints Plan



1. INTRODUCTION

1.1. BACKGROUND

Shape Consulting Engineers (the client) commissioned E3P to undertake a Phase II Geoenvironmental Site Assessment at Willow Street, Bury; herein referred to as the site.

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 low-rise residential development.

1.2. PROPOSED DEVELOPMENT

Shape Engineering Consultants intends to construct a low-rise residential development comprising two apartment blocks with associated gardens, estate roads and infrastructure.

A snapshot of the Proposed Development Layout is indicated in Figure 1 below and Drawing 17-285-R2 (APPENDIX IV)

Figure 1 Snapshot of Proposed Development



1.3. OBJECTIVES AND SCOPE

The objectives of the geoenvironmental investigation are as follows:

- Review historical plans, geology, hydrogeology, site sensitivity, floodplain issues, mining records and any local authority information available to complete a desk study in line with Environment Agency (EA) document Land Contamination: Risk Management (LCRM) (updated June 2023).



-  Undertake a phase of sampling and analysis to provide an overview of the environmental issues identified.
-  Assess the implications of any potential environmental risks, liabilities and development constraints associated with the site concerning the site's future use and off-site receptors.
-  Assess the geotechnical information and provide recommendations concerning foundations, pavement construction and floor slabs.
-  Assess the coal mining-related information and provide recommendations regarding any future treatment; and,
-  Provide recommendations regarding future works required.

1.4. SCOPE OF WORKS

The scope of works includes the elements included in Table 1.

Table 1 Scope of Works

GROUND INVESTIGATION
 Design of suitable ground investigation
 Window sample probeholes with the construction of environmental monitoring installations
 Soil and groundwater sampling
TESTING AND MONITORING
 In-situ geotechnical testing
 Chemical and geotechnical analysis
 Groundwater monitoring
 Ground gas monitoring
ASSESSMENT AND REPORTING
 Factual and interpretative reporting
 Contamination risk assessment and conceptual site model
 Geotechnical assessment and interpretation



1.5. PREVIOUS REPORTS

The following previous site investigation reports have been provided to E3P for review:

Table 2 Previous Reports

AUTHOR	TITLE / REFERENCE	CLIENT	DATE
LK Consult	Phase 1: Preliminary Risk Assessment Ref: LKC 23 1019-A1-PRA	Shape Consulting Engineers	15/3/2023

The key findings of the previous site investigation reports are summarised below, and where necessary, data has been used to support the E3P geoenvironmental site assessment.

Site Use

Residential apartments in the north of the site. Commercial units, storage units and car parking across the remaining of site. A retaining wall is present on site noted to be in good condition with no crack, bulging or damage noted in the brickwork.

Site History

The site remained undeveloped until circa pre 1956 when commercial buildings were present in the south of the site and a residential building in the north. The building in the north of the site was redeveloped into residential flats between 2003 to 2005. The commercial buildings in the south of the site remain. Domestic garages were present in the centre of the site from circa 1985 to 2000.

Preliminary Conceptual Site Model

Identified potential pollutant linkages:

- ✿ Made Ground associated with construction and demolition (likely) – Heavy metals, PAHs, ACM and TPH. Dermal contact and ingestion and inhalation of dust for construction workers and end site users
- ✿ Volatile contamination (low likelihood) – TPH, SVOC, VOC. Inhalation of vapours for construction workers and end site users
- ✿ Hazardous ground gas associated with Made Ground (unlikely). Explosion in confined space
- ✿ Contaminated Groundwater (low likelihood). Migration of contamination to underlying secondary A aquifer.

Preliminary Geotechnical Risk Assessment

- ✿ Retaining wall identified on site to the south side of the existing residential apartments. Approximately 2.0m in height. Visually in good condition with weepholes present for drainage; no cracks, bulging or damage noted in the brickwork.
- ✿ Unknown depth and constituent of Made Ground across the site. Initial information indicates relatively shallow Made Ground. Possible in-ground structures from previous developments. Unlikely to be a suitable founding strata unless engineering work is undertaken.



1.6. LIMITATIONS

The limitations of this report are presented in APPENDIX I.

1.7. RISK CLASSIFICATION

The description of risk classification and the likely action required as set out in CIRIA C552 are included in APPENDIX III.

1.8. 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 report's contents, written approval must be sought from E3P; a charge may be levied against such consent.



2. E3P 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 summarised in Section 4.0.

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 on 6th February 2024. The works are summarised in Table 3.

2.2. SCOPE OF INVESTIGATION

A summary of the fieldwork completed are included in Table 3

Summary of Fieldwork

Table 3 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	WS101	Window Sample Probehole	5.35	2.50–4.50
	WS102		5.45	1.00–5.00
	WS103		5.45	1.00–3.00
	WS104		5.45	1.00–3.00
	WS105		3.33	0.50–1.50
	WS106		3.41	1.00–2.00

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

The sampling locations are illustrated in Drawing 17-285-005 (APPENDIX IV). The ground conditions encountered are indicated on the logs, which are provided in APPENDIX VI.

The locations were surveyed by GPS to Ordnance Survey with an accuracy of <10mm.

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

2.3. 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 and presented in Table 22 and discussed in Section 5.0.



2.4. LABORATORY ANALYSIS

Selected soil samples were submitted for a range of chemical and geotechnical analysis, summarised in Table 4.

Table 4 Summary of Laboratory Analysis

CHEMICAL ANALYSIS

-  Metals
-  pH, total sulphate, water-soluble sulphate (2:1 extract)
-  Sulphide
-  Cyanide
-  Phenols
-  Total and speciated polycyclic aromatic hydrocarbons (PAHs)
-  Semi-Volatile Organic Compounds (SVOCs)
-  Volatile Organic Compounds (VOCs)
-  Asbestos identification and quantification
-  Speciated and banded total petroleum hydrocarbons (TPHs)
-  Total Organic Carbon (TOC)

GEOTECHNICAL ANALYSIS

-  Atterberg limits determinations
-  Moisture content
-  Single-stage triaxial tests
-  Oedometer tests



2.5. STORAGE, PRESERVATION AND TRANSPORT OF SAMPLES

Measures taken to ensure the quality and integrity of the collected samples, from collection to receipt of the samples by the laboratory, are summarised in Table 5.

Table 5 Sample Integrity Information

SUBJECT	CHEMICAL SAMPLING	
Storage	Soil	Groundwater
	Glass jars supplied by the laboratory were used for the collection of soil samples to be analysed for VOCs. Plastic tubs were used to collect soil samples for metals analysis, PFAS testing and asbestos screening.	Glass vials supplied by the laboratory were used for the collection of samples to be analysed for VOCs. Samples to be analysed for lower volatility compounds were stored in laboratory-prepared glass jars. Samples to be tested for PFAS compounds were stored in laboratory-supplied HDPE bottles.
Preservation	Soil and groundwater sample containers were filled to minimise headspace prior to sealing and stored at a low temperature within cool boxes with cooling aids to minimise the loss of volatile contaminants and reduce microbial activity during the collection of samples. Cooling aids that may contain PFAS compounds (such as blue ice) were not utilised to prevent cross-contamination with samples.	
Sample Integrity	Soil	Groundwater
	Dedicated disposable nitrile gloves were worn and changed between sample collections to prevent cross-contamination.	Groundwater samples were collected using dedicated plastic tubing, which was changed between monitoring well locations to prevent cross-contamination.
	Hand tools were decontaminated with PFAS free detergent and rinsed with PFAS free water between sampling events.	Interface probes were decontaminated with PFAS free detergent and rinsed with PFAS free water between monitoring wells.
	PFAS free stationary was used to label all samples.	PFAS free stationary was used to label all samples.
Transport	Samples were stored and shipped in dedicated sample boxes provided by the laboratory. Sample details were recorded on the laboratory chain of custody form enclosed with the samples prior to dispatch. Scheduling information for the samples was confirmed with the laboratory via email.	

Chemical analysis has been undertaken by an accredited laboratory with the testing results summarised and discussed in Section 4 and the testing certificates included in APPENDIX VII.

Geotechnical samples were collected as required per location immediately after excavation, labelled and sealed to minimise moisture loss. The geotechnical samples were collected and couriered by a dedicated courier to an accredited geotechnical testing laboratory.

The testing results are summarised and discussed in Section 6 and the testing certificates included in APPENDIX VIII.



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 6.

Table 6 Summary of Strata

HOLE	DEPTH TO STRATUM (M BGL)					
	MADE GROUND	SOFT CLAY	FIRM CLAY	STIFF CLAY	VERY STIFF CLAY	MUDSTONE BEDROCK
WS101	0.0–2.20	–	2.20–4.50	–	–	4.50–5.35
WS102	0.0–2.40	–	2.40–5.00	5.00–5.45	–	–
WS103	0.0–4.00	4.00–5.00	5.00–5.45	–	–	–
WS104	0.0–3.60	3.60–5.00	5.00–5.45	–	–	–
WS105	0.0–2.20	–	2.20–2.70	–	–	2.70–3.33
WS106	0.0–0.90	–	0.90–1.80	1.80–3.00	3.00–3.40	–

3.2. MADE GROUND

Made Ground deposits were encountered within all exploratory hole locations to depths of between 0.90 m and 4.00 m bgl. It should be noted that within WS103 where Made Ground was encountered to 4.00 m bgl, the recovery of material was poor, and this is therefore an estimated depth of Made Ground.

Made Ground deposits from ground level to 0.30 m bgl comprise tarmac underlain by MOT. Underlying the tarmac and MOT, Made Ground deposits are varied, comprising interbedded reworked clay, sand and gravel.

Reworked clays were encountered within four exploratory locations (WS101, WS104, WS105 and WS106) and comprise grey and brown gravelly sandy clay. Gravel is fine to coarse angular to subrounded of mudstone, sandstone, ash, brick. With the exception of WS101, reworked clay deposits were encountered directly overlying natural strata.

Granular Made Ground deposits were encountered within all exploratory locations apart from WS106. Granular Made Ground generally comprises brownish black and grey clayey very sandy gravel with localised areas comprising brown clayey gravelly fine to medium sand. Gravel is fine to coarse angular to subrounded of mudstone, brick, wood, concrete, ash, glass, slag and clinker. In WS105 granular Made Ground comprises and infilled natural sand underlain by a geotextile membrane, suggesting it is part of a cover system.

A Depth of Made Ground Plan is presented as Drawing 17-285-006 in APPENDIX IV.

3.3. DRIFT DEPOSITS

Drift deposits were encountered within all exploratory locations to a maximum proven depth of 5.45 m bgl. The drift deposits comprise a generally firm low strength to stiff medium strength sandy gravelly CLAY with gravel of mudstone. The strength of the clay generally increases with depth.



Localised soft very low strength sandy CLAY was encountered within WS103 and WS104 at 4.00 m bgl.

Localised very stiff very high strength sandy gravelly CLAY was encountered within WS106 at 3.00 m bgl.

3.4. SOLID GEOLOGY

The solid bedrock geology was encountered within two exploratory locations (WS101 and WS105) with depth to rockhead varying between 2.70 and 4.50 m bgl. The solid geology comprises grey weathered MUDSTONE.

3.5. GROUNDWATER

The depth of the groundwater strikes are shown on the exploratory hole records in APPENDIX VI and are summarised in Table 7 below.

Table 7 Summary of Groundwater Strikes

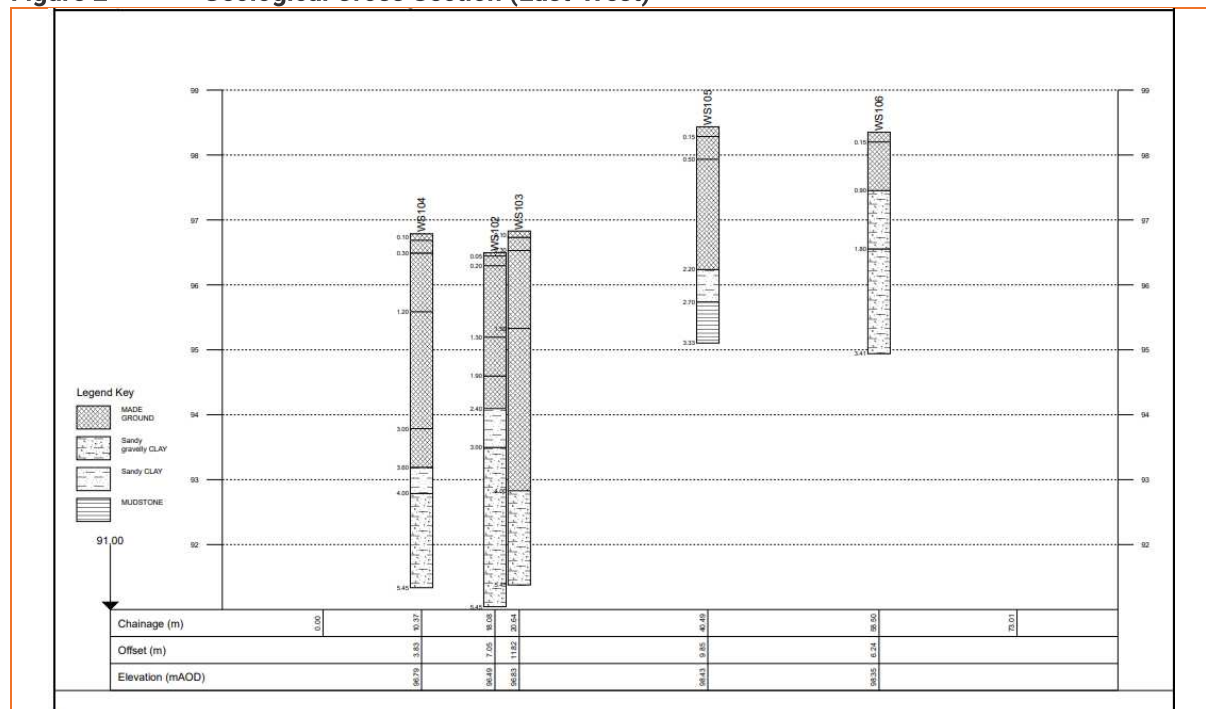
LOCATION	DEPTH TO STRIKE (M)	NOTES
WS101	3.0	Strike within natural CLAY

Monitoring was undertaken using an electronic dip meter and interface probe to record the depth to groundwater and the thickness of any free-phase hydrocarbon product, if present. These results are summarised in Table 16.

3.6. GEOLOGICAL CROSS SECTION

A geological cross section is included in APPENDIX IV and a snapshot is shown below in Figure 2

Figure 2 Geological Cross Section (East-West)





3.7. VISUAL AND OLFACTORY EVIDENCE OF CONTAMINATION

Visual evidence of potential contamination has been identified during the site investigation and these are summarised in Table 8.

Table 8 Summary of Visual and Olfactory Evidence of Contamination

LOCATION	DEPTH (M)	STRATUM	NOTES
WS101	0.20-2.20	Made Ground	Ash
WS102	0.20-1.30	Made Ground	Ash, slag and clinker
WS103	0.30-1.50	Made Ground	Ash
WS104	1.20-3.00	Made Ground	Ash, slag and clinker
WS106	0.15-0.90	Made Ground	Ash

3.8. OBSTRUCTIONS

No obstructions were identified during the course of the intrusive investigation. Obstructions, however, are anticipated beneath the existing structures and further site investigation should be completed following demolition.



4. TIER 2 QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT

E3P has undertaken a Tier 2 qualitative land risk assessment with respect to human health, controlled waters and ground gas to determine if any potential contaminants within the underlying soils and groundwater pose an unacceptable level of risk to the identified receptors.

4.1. DEVIATING SAMPLES

Best practice sampling procedures including the use of appropriate sampling containers and adhering to the laboratory holding times for each contaminant analysis, were undertaken in order to avoid samples being deviating.

4.2. SAMPLE ANALYSIS POPULATION

Table 9 summarises the chemical analysis testing scheduled.

Table 9 Summary of Testing Schedule

TYPE OF SAMPLE	NO. OF SAMPLES	DETERMINANDS
Made Ground	6	Speciated PAH
	6	pH, total metals, asbestos ID, TOC
	6	Speciated TPH
	1	VOCs and SVOCs
	1	Leachable metals
Natural CLAY	3	Speciated PAH, pH, total metals, TOC, Speciated TPH

4.3. 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).

Where Tier 2 screening values are not provided by LQM, other screening values have been used and these are referenced in Table 10.

The Tier 2 screening values for residential with plant uptake have been utilised for this assessment due to the proposed development being a residential end use. To remain conservative at an early stage, the screening values based on a 1% SOM have been utilised for this assessment.

The results of the comparison have been summarised in Table 10.



Table 10 Summary of Inorganic and Hydrocarbon Toxicity Assessment for a Residential End Use (without plant uptake)

DETERMINANT	UNIT	GAC	N	MC	LOC. OF EX	PL	ASSESSMENT
Arsenic	mg/kg	40	9	45	WS102 0.5 m	1	Further Action
Cadmium	mg/kg	85	9	0.4	N/A	1	No Further Action
Chromium (VI)	mg/kg	6	9	0	N/A	1	No Further Action
Lead	mg/kg	310	9	150	N/A	1	No Further Action
Mercury	mg/kg	1.2	9	0.4	N/A	4	No Further Action
Nickel	mg/kg	180	9	46	N/A	1	No Further Action
Selenium	mg/kg	430	9	0	N/A	1	No Further Action
Copper	mg/kg	7100	9	190	N/A	1	No Further Action
Zinc	mg/kg	40000	9	98	N/A	1	No Further Action
Cyanide – Total	mg/kg	791	9	1	N/A	1	No Further Action
Phenols – Total	mg/kg	210	9	0	N/A	1	No Further Action
Asbestos	Fibres	NFD	6	ND	N/A	3	No Further Action
Naphthalene	mg/kg	2.3	9	3.7	WS104 1.8 m	4	Further Action
Acenaphthylene	mg/kg	2900	9	0.6	N/A	2	No Further Action
Acenaphthene	mg/kg	3000	9	6.7	N/A	1	No Further Action
Fluorene	mg/kg	2800	9	5.3	N/A	1	No Further Action
Phenanthrene	mg/kg	1300	9	31	N/A	2	No Further Action
Anthracene	mg/kg	31000	9	8.1	N/A	2	No Further Action
Fluoranthene	mg/kg	1500	9	37	N/A	2	No Further Action
Pyrene	mg/kg	3700	9	32	N/A	2	No Further Action
Benzo(a)Anthracene	mg/kg	11	9	15	WS104 1.8 m	2	Further Action
Chrysene	mg/kg	30	9	14	N/A	2	No Further Action
Benzo(b)Fluoranthene	mg/kg	3.9	9	16	WS104 1.8 m	2	Further Action
Benzo(k)Fluoranthene	mg/kg	110	9	7	N/A	2	No Further Action
Benzo(a)Pyrene	mg/kg	3.2	9	14	WS104 1.8 m	2	Further Action
Indeno(123-cd)Pyrene	mg/kg	45	9	6	N/A	2	No Further Action
Dibenzo(a,h)Anthracene	mg/kg	0.31	9	1.5 0.53	WS104 1.8 m WS101 0.8 m	2	Further Action
Benzo(ghi)Perylene	mg/kg	360	9	6.3	N/A	2	No Further Action
TPH C5-C6 (aliphatic)*	mg/kg	42	9	0	N/A	4	No Further Action
TPH C6-C8 (aliphatic)*	mg/kg	100	9	0	N/A	4	No Further Action
TPH C8-C10 (aliphatic)*	mg/kg	27	9	0	N/A	4	No Further Action
TPH C10-C12 (aromatic)*	mg/kg	250	9	0	N/A	4	No Further Action
TPH C12-C16 (aromatic)*	mg/kg	1800	9	0	N/A	4	No Further Action
TPH C16-C21 (aromatic)*	mg/kg	1900	9	18	N/A	1	No Further Action
TPH C21-C35 (aromatic)*	mg/kg	1900	9	82	N/A	1	No Further Action

Notes

PL1 = soil ingestion, PL2 = dermal contact and ingestion, PL3 = dust inhalation; PL4 = Vapour/Gas Inhalation

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

The pathway noted in the table is the primary pathway, however it may not be the only pathway of that contaminant

* 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 10, the results of this direct comparison indicates that the data exceeds the screening criteria for a residential end use for the following contaminants:

Inorganics

- ✳️ Arsenic

Organics

- ✳️ Naphthalene
- ✳️ Benzo(a)anthracene
- ✳️ Benzo(b)Fluoranthene
- ✳️ Benzo(a)pyrene
- ✳️ Dibenzo(a,h)Anthracene

No significant concentrations of VOCs were identified in the soils submitted for chemical analysis.

The following elevated SVOCs above the LOD have been identified in WS101 at 0.80 m bgl:

- ✳️ 4-methylphenol
- ✳️ 4-chloroaniline
- ✳️ 2-methylnaphthalene
- ✳️ Anthraquinone

4.3.1. EXPOSURE PATHWAYS

The main exposure pathways based on the Tier 2 exceedances are:

- ✳️ Soil ingestion (PL1);
- ✳️ Dermal contact and ingestion (PL2);
- ✳️ Vapour inhalation (indoor) (PL4);

4.3.2. HUMAN HEALTH RISK ASSESSMENT AND MITIGATION

Inorganic Heavy Metals

All of the identified elevated concentrations have primary exposure pathways related to ingestion of soils (PL1) and dermal contact and ingestion of soils (PL2). The risk to chronic human health associated with the elevated concentrations on inorganic heavy metals and non-volatile PAH 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 the site remediation and enabling works strategy.



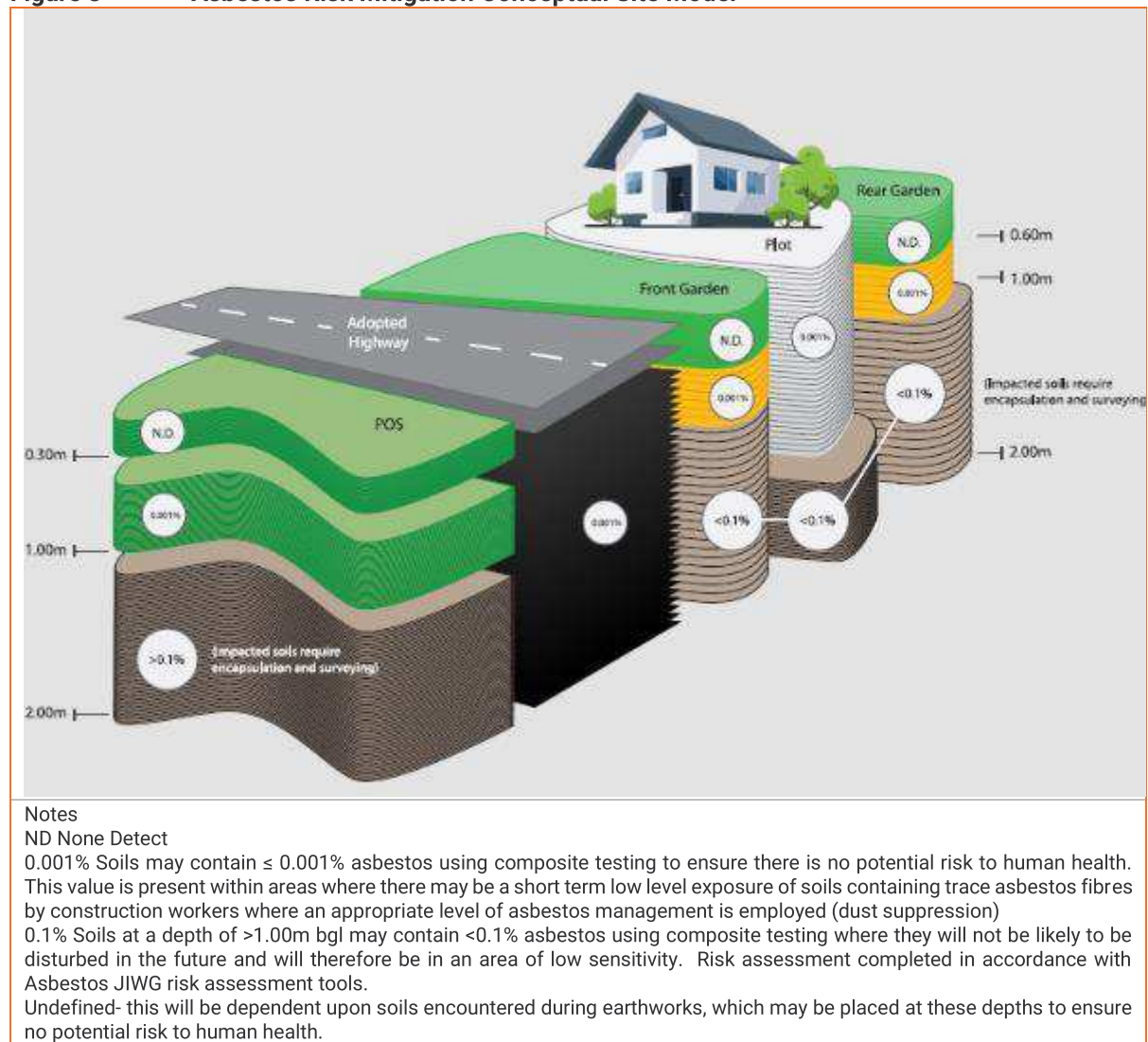
Organic Contamination

With regards to the elevated naphthalene and SVOCs, these present a potential volatilisation to indoor air risk. These elevated concentrations have been identified within the vicinity of WS101 and WS104 and these are therefore considered to be localised hotspots. Therefore, further investigation is required or during a process of cut/fill enabling works, a hotspot removal could be undertaken where these soils may be chemically validated to assess chemical suitability for retention on site in an area of no future sensitivity. Should the site be piled and the impacted soils left in-situ, a vapour membrane will likely be required.

Asbestos

Asbestos has not been identified in any of the tested samples. No visual signs of ACM were encountered during the ground investigation. Should asbestos be identified on site impacted soils should be managed according to the asbestos risk mitigation conceptual site model shown in Figure 3.

Figure 3 Asbestos Risk Mitigation Conceptual Site Model



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 may be required to meet regulatory sampling frequency.



4.4. 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 11.

Table 11 Controlled Waters Conceptual Model and Sensitivity Profile

DISCUSSION		SENSITIVITY RATING
Contaminant Source		
Made Ground Leachable heavy metal and PAH contamination may be present as a result of the potential Made Ground infill material. No source of VOCs and SVOCs have been identified on site.		Low/Moderate
Pathway		
Vertical Migration Due to the majority of the site being underlain by cohesive clay deposits, vertical migration of contaminants is likely to be inhibited as a result of the low permeability drift deposits. The clay deposits are typically less than 5m in thickness and in some areas less than 2m in thickness.		Moderate
Lateral Migration Lateral migration of contaminants is considered possible due to the presence of granular Made Ground across the site. Migration east-west will be inhibited due to the presence of the retaining wall running north-south through the site.		Moderate
Receptor		
Aquifer Classification in Superficial Drift Deposits	Secondary (undifferentiated)	Low
Aquifer Classification in Bedrock	Secondary A	Moderate
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?	No surface watercourses are located within 50 m of the site.	Low

The ICSM developed within the context of the site setting has identified a viable pollutant pathway, which would be the downward migration of potentially mobile phase-soluble contaminants towards the underlying Secondary A Aquifer.

The Tier 2 assessment in line with LCRM (2023) has included a comparison of leachate analysis from samples of the Made Ground and groundwater samples to drinking water standards (DWS).

No comparison has been made to the environmental water quality standards (EQS) due to the lack of a surface water course within influencing distance of the site. Where DWS values are not available a comparison has been made to the EQS.

Groundwater samples were obtained utilising a bailer.

These are presented in Table 12



Table 12 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	1	<0.15	N/A	1	1.8	N/A	No Further Action
Cadmium	µg/l	0.25	5	1	0.03	N/A	1	<0.08	N/A	No Further Action
Chromium (VI)	µg/l	3.4	–	1	N/A	N/A	1	<5.0	N/A	No Further Action
Chromium (III)	µg/l	4.7	50	1	0.9	N/A	1	0.5	N/A	No Further Action
Copper	µg/l	1	2000	1	12	N/A	1	8.3	N/A	No Further Action
Total Cyanide	µg/l	1	50	1	<1.0	N/A	1	<1.0	N/A	No Further Action
Lead	µg/l	1.2	10	1	<0.2	N/A	1	<1.0	N/A	No Further Action
Mercury	µg/l	–	1.0	1	<0.05	N/A	1	<0.5	N/A	No Further Action
Nickel	µg/l	4	20	1	18	N/A	1	0.9	N/A	No Further Action
Selenium	µg/l	–	10	1	0.9	N/A	1	<4.0	N/A	No Further Action
Zinc	µg/l	10.9	–	1	7.7	N/A	1	16	WS103 0.9 m	Further Action
pH	6–9			1	6.9	N/A	1	8	N/A	No Further Action
Polycyclic Aromatic Hydrocarbons										
Naphthalene	µg/l	2	10*	1	<0.01	N/A	1	0.72	N/A	No Further Action
Anthracene	µg/l	0.1	10*	1	0.62	N/A	1	<0.01	N/A	No Further Action
Benzo[b]fluoranthene	µg/l	0.00017*	10*	1	3.6	N/A	1	<0.01	N/A	No Further Action
Benzo[k]fluoranthene	µg/l	0.00017*	10*	1	1.4	N/A	1	<0.01	N/A	No Further Action
Benzo(a)pyrene	µg/l	0.00017*	10*	1	3.5	N/A	1	<0.01	N/A	No Further Action
Indeno(123-cd)pyrene	µg/l	0.00017*	10*	1	1.4	N/A	1	<0.01	N/A	No Further Action
Fluoranthene	µg/l	0.0063	10*	1	6.7	N/A	1	<0.01	N/A	No Further Action
Benzo(ghi)perylene	µg/l	1.7–4	10*	1	1.6	N/A	1	<0.01	N/A	No Further Action
Aromatic Hydrocarbon										
TPH C5-C7 (benzene)	µg/l	10	1	1	<1.0	N/A	1	<1.0	N/A	No Further Action
TPH C7-C8 (toluene)	µg/l	74	700	1	<1.0	N/A	1	<1.0	N/A	No Further Action
TPH C8-C10 (xylene)	µg/l	30	300	1	<1.0	N/A	1	<1.0	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								
TPH C10-C12 (naphthalene)	µg/l	2	90	1	<10	N/A	1	<10	N/A	No Further Action
TPH C12-C16	µg/l	–	90	1	10	N/A	1	<10	N/A	No Further Action
TPH C16-C35	µg/l	–	90	1	70	N/A	1	<10	N/A	No Further Action
Aliphatic Hydrocarbon										
TPH C5-C6	µg/l	–	1000 ⁵	1	<1.0	N/A	1	<1.0	N/A	No Further Action
TPH C6-C8	µg/l	–	1000 ⁵	1	<1.0	N/A	1	<1.0	N/A	No Further Action
TPH C8-C10	µg/l	–	300	1	<1.0	N/A	1	<1.0	N/A	No Further Action
TPH C10-C12	µg/l	–	300	1	<10	N/A	1	<10	N/A	No Further Action
TPH C12-C16	µg/l	–	300	1	<10	N/A	1	<10	N/A	No Further Action
TPH C16-C21	µg/l	–	300**	1	<10	N/A	1	<10	N/A	No Further Action
TPH C21-C35	µg/l	–	300**	1	<10	N/A	1	<10	N/A	No Further Action
Volatile Organic Compounds										
Tetrachloroethylene	µg/l	0.4	10	1	<3.0	N/A	1	N/A	N/A	No Further Action
Trichloroethylene	µg/l	10	10	1	<3.0	N/A	1	N/A	N/A	No Further Action
Trichlorobenzene	µg/l	0.4	–	1	<3.0	N/A	1	N/A	N/A	No Further Action
Trichloromethane	µg/l	2.5	–	1	<3.0	N/A	1	N/A	N/A	No Further Action
Dichloromethane	µg/l	20	200	1	<3.0	N/A	1	N/A	N/A	No Further Action
Carbon Tetrachloride	µg/l	12	3	1	<3.0	N/A	1	N/A	N/A	No Further Action
Vinyl Chloride	µg/l	–	0.3	1	<3.0	N/A	1	N/A	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.



4.4.1. CONTROLLED WATER RISK ASSESSMENT AND MITIGATION

This comparison indicates that the data exceeds the EQS and DWS values for the following inorganic compounds:

Table 13 Summary of Controlled Waters Risk Assessment

EXCEEDANCE OF EQS	EXCEEDANCE OF DWS
 Zinc	N/A

In relation to the elevated zinc this was an isolated occurrence from leachate analysis undertaken in Made Ground soils at WS103.

It should be noted that leaching tests were undertaken alongside groundwater and surface water testing. The leachate test is aggressive (de-ionised water) and is not in aqueous equilibrium (steady state) within the solid sample. This may cause rapid dissolution and overestimation of the aqueous phase concentrations compared to groundwater in contact with contaminated soils. Although dissolution may be reduced for highly hydrophobic contaminants, such as B(a)P it is likely that the initial leaching will remove the most readily available hydrocarbons and subsequent flushing would reduce the leachable concentrations.

4.4.2. DISCUSSION OF CONTROLLED WATERS RISK ASSESSMENT

Historically the site has undergone development and demolition of commercial/residential units and domestic garages, resulting in a variable thickness of Made Ground overlying the drift deposits. No significant and/or point sources of mobile contamination have been identified on site.

No elevated levels of contaminants in leachate or groundwater samples have been identified compared to the DWS values.

A single exceedance of zinc has been identified when compared to EWS values (absence of DWS value) for zinc. The risk of this is negated, however, due to the lack of surface water receptor within influencing distance of the site.

As there is no identified source of mobile contamination; no exceedances of contaminants compared to the DWS values; low permeability clay overlying the bedrock aquifer inhibiting the vertical migration of contaminants, and no surface water receptor within influencing distance of the site, the site is not considered to pose an unacceptable level of risk to controlled waters.



4.5. GROUND GAS RISK ASSESSMENT

4.5.1. RATIONALE

Hazardous ground gas qualitative risk assessment is based on a conceptual site model (CSM) similar to that used for soil and groundwater contamination sources (i.e., source pathway receptor pollutant linkages).

The risk can be assessed based on knowledge of the ground conditions and CSM and a measure of hazardous gas concentrations and gas flow at the site within monitoring standpipes.

4.5.2. SOURCES AND PATHWAYS OF GROUND GAS

Table 14 summarises the potential sources and pathways of ground gas within the context of the recorded site setting and proposed development.

Table 14 Identified Potential Sources of Ground Gas

SOURCE

Made Ground

Made Ground was encountered within all exploratory hole locations to a maximum proven depth of 4.00 m bgl (WS103), however, typically Made Ground deposits were encountered at depths less than 2.50 m bgl. The Made Ground typically comprises reworked cohesive soils and / or granular deposits.

No significant putrescible material have been recorded within the Made Ground. As the Made Ground beneath the site is largely inert fill and reworked clay and as such, the potential for significant gas generation within these strata is limited.

Drift Strata

No sources of ground gas have been identified within the drift strata.

Drift deposits were encountered within all exploratory locations to a maximum proven depth of 5.45m bgl and typically comprise a firm low strength to stiff medium strength sandy gravelly CLAY with gravel of mudstone.

Solid Strata

The solid bedrock geology was encountered within two exploratory locations (WS101 and WS105) with depth to rockhead varying between 2.70 and 4.50 m bgl. The solid geology comprises grey weathered MUDSTONE.

The site is located within a Coal Mining Reporting Area, however not within the development high risk area. There are no mine entries, coal outcrops, past or probable shallow coal mine workings beneath or close to the site. The risk from underground coal workings is therefore considered to be very low and no further works are deemed to be required in relation to coal mining.

Landfill Sites

There are no active or historical landfills within 250 m of the site.

Other Gases

The BGS reports that full radon protective measures are not necessary in the construction of new dwellings or extensions. PAH analysis has identified levels above the laboratory limits of detection (LOD) throughout the site.



The CIRIA C665 guidance on gas risk assessment includes recommendations for periods and frequencies for monitoring visits. These recommendations take into account the nature of the proposed development and the likely generation potential of the source.

The proposed development comprises private residential properties, which would be classified as a Type A development (high sensitivity) in accordance with BS8485:2015+A1:2019. However, it is considered that the likely generation potential of the identified gas sources (taking into account the likelihood of future increases in gas generation) would be best classified as low.

Therefore within the context of the proposed residential end-use and ground gas generation potential, the gas assessment requires six visits over three months, with at least two sets of readings at low or falling atmospheric pressure.

4.5.3. 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 15.



Table 15 Site Characterisation by GSV (BS8485:2015)

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.

It should be noted that in the first instance, this assessment has been carried out in accordance with BS8485:2015+A1(2019) and the thresholds given in

4.5.4. 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 300 seconds (5 minutes) at each location, increasing to 600 seconds if elevated concentrations identified, 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 16.

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.

4.5.5. SUMMARY OF MONITORING RESULTS

Table 16 presents of the ground gas and groundwater monitoring results to date.



Table 16 Summary of Ground Gas Monitoring Results

WELL	DATE	CH ₄ INITIAL (%V/V)	CH ₄ STEADY (%V/V)	CH ₄ GSV (l/hr)	CO ₂ INITIAL (%V/V)	CO ₂ STEADY (%V/V)	CO ₂ GSV (l/hr)	O ₂ (%V/V)	ATMOS (mb)	ATMOS. DYNAMIC	FLOW (l/hr)	RESPONSE ZONE (m bgl)	DEPTH TO BASE (m bgl)	DEPTH TO WATER (m bgl)
WS101	21/02/2024	0.1	0.1	0.0001	2.9	2.9	0.0029	14.3	981	Falling	0.1	2.5-4.5	4.07	2.63
	05/03/2024	0.1	0.1	0.0001	5.1	5.1	0.0051	10.6	999	Rising	0.1		4.10	3.21
	26/03/2024	0.1	0.1	0.0001	5.4	5.4	0.0054	11.2	978	Falling	0.1		4.09	3.07
WS103	21/02/2024	0.1	0.1	0.0001	0.4	0.1	0.0004	20.1	979	Falling	0.1	1.0-3.0	2.92	Dry
	05/03/2024	0.1	0.1	0.0001	0.5	0.5	0.0005	20.1	1000	Rising	0.1		2.93	Dry
	26/03/2024	0.1	0.1	0.0001	0.5	0.5	0.0005	19.7	1000	Falling	0.1		2.93	Dry
WS104	21/02/2024	0.1	0.1	0.0001	2.7	0.4	0.0027	19.7	979	Falling	0.1	1.0-3.0	2.99	Dry
	05/03/2024	0.1	0.1	0.0001	2.5	2.5	0.0025	15.8	999	Rising	0.1		3.01	Dry
	26/03/2024												3.00	Dry
WS105	21/02/2024	0.1	0.1	0.0001	0.1	0.1	0.0001	20.2	982	Falling	0.1	0.5-1.5	1.42	0.57*
	05/03/2024	0.1	0.1	0.0001	1.1	1.1	0.0011	15.4	999	Rising	0.1		1.43	0.89
	26/03/2024	0.1	0.1	0.0001	0.7	0.7	0.0007	18.4	978	Falling	0.1		1.44	0.99
WS106	21/02/2024	0.1	0.1	0.0001	0.2	0.2	0.0002	20.1	981	Falling	0.1	1.0-2.0	2.19	0.65*
	05/03/2024	0.1	0.1	0.0013	2.7	2.7	0.0351	13.6	998	Rising	1.3		2.19	1.91*
	26/03/2024	0.1	0.1	0.0009	0.9	0.5	0.0081	20.2	979	Falling	0.9		2.2	1.93*



4.5.6. GROUNDWATER

The water level within several of the monitoring wells was recorded to be above the top of the response zone (flooded) on a number of occasions, as summarised in Table 17, thus rendering some of the monitoring data unreliable. Therefore, each time a flooded well was encountered, the well was bailed and left to re-equilibrate. Wells were re-monitored after a period of 20–30 minutes.

Table 17 **Flooded Monitoring Well Data**

WELL	VISIT 1 21/02/2024	VISIT 2 05/03/2024	VISIT 3	VISIT 4	VISIT 5	VISIT 6
WS101	-	-	-			
WS103	-	-	-			
WS104	-	-	-			
WS105	Flooded	-	Flooded			
WS106	Flooded	Flooded*	Flooded			

*Well bailed and left to recharge, however, well remained flooded after recharge rendering the monitoring data unreliable

4.5.7. BAROMETRIC PRESSURE

Visits 1 and 3 were undertaken during a period of relatively low/falling pressure, with pressure recorded to between 977 and 982 m bar.

Visit 2 and was undertaken during a period of rising pressure with the pressure recorded at 999 m bar.

Future visits will be scheduled to target other atmospheric conditions.

4.5.8. GAS FLOW

Throughout the monitoring period, the majority of flow rates were recorded to be 0.1 l/hr (limit of detection of the analyser).

During visits 2 and 3, in well WS106 an initial flow of 1.3 and 0.9 l/hr respectively was measured which fell to 0.1 l/hr within the first minute of monitoring. This likely due to a build up of pressure due to a high water level in the well.

4.5.9. GAS CONCENTRATIONS

The maximum methane value recorded within the monitoring wells was 0.1% v/v (limit of detection of the analyser).

Carbon dioxide concentrations were recorded at concentrations ranging from 0.1% v/v to 5.4% v/v (WS101 visit 3).

4.5.10. RADON RISK

Ground gas monitoring to date suggests that the site will fall into the bracket for Characteristic Situation 1, however, the site is in an area where between 3% and 5% of homes are above the Radon Action Level, therefore basic radon protection measures will need to be incorporated into any proposed new dwellings.



All sites registered from 1st December 2022 onwards will have been assessed against the updated radon maps by NHBC and will be required to have radon protection measures installed in accordance with the updated mapping.

Figure 4 indicates that based on the 3% - 5% area observed, the site falls under a Radon Potential Class of 3 within the User Guide for the HPA-BGS Joint Radon Potential Dataset for Great Britain (Ref: IR/11/044, dated 2011). A Radon potential class of 3 indicates that basic Radon Measures are required in all new dwellings, as shown in Figure 5.

Figure 4 Radon Affected Area Potential Class

Radon Potential Class*	Is the property in a Radon Affected Area?	Additional information
1	No	The property is in a Lower probability radon area (less than 1% of homes are estimated to be at or above the Action Level). The property is not in a radon affected area.
2	Yes	The property is in an Intermediate probability radon area (1 to 3% of homes are estimated to be at or above the Action Level). The property is in a radon affected area.
3	Yes	The property is an Intermediate probability radon area (3 to 5% of homes are estimated to be at or above the Action Level). The property is in a radon affected area.
4	Yes	The property is in an Intermediate probability radon area (5 to 10% of homes are estimated to be at or above the Action Level). The property is in a radon affected area.
5	Yes	The property is in a Higher probability radon area (10 to 30% of homes are estimated to be at or above the Action Level). The property is in a radon affected area.
6	Yes	The property is in a Higher probability radon area (more than 30% of homes are estimated to be at or above the Action Level). The property is in a radon affected area.

*The Radon Potential Class number should not be included in answers.

Source: User Guide for the HPA-BGS Joint Radon Potential Dataset for Great Britain (Ref: IR/11/044, dated 2011)



Figure 5 Radon Affected Area Measures Required

Radon Potential Class*	What level of radon protective measures are required for new buildings in England and Wales?	What level of radon protective measures are required for new dwellings in Scotland?
1	None**	None**
2	None	Stage 1
3	Basic	Stage 1
4	Basic	Stage 1
5	Full	Stage 2
6	Full	Stage 2

*The Radon Potential Class number should not be included in answers.

** in 2008 HPA recommended that building regulations be amended to ensure that all new buildings, extensions etc. include basic radon protective measures. At the time of writing, relevant UK authorities were considering this advice.

Source: User Guide for the HPA-BGS Joint Radon Potential Dataset for Great Britain (Ref: IR/11/044, dated 2011)

Basic radon protection measures are required to be installed as Section 5.1 of BRE211_2015: Radon Guidance on protective measures for new buildings.

Section 5.1 of BRE211_2015 states:

"For basic protection measures, the damp-proof course (DPC) to a cavity wall should be in the form of a cavity tray to prevent radon from entering the building through the cavity. Sealing of joints in the barrier and sealing around service penetrations are also required. It is important that attention is paid to detailing and workmanship in jointing of the barrier.

If good standards of design and workmanship are applied to the provision of a 1200 gauge damp-proof barrier to the floor sealed to a DPC/cavity tray through the walls, adequate protection from radon will be provided along with the general function of excluding moisture."

For all new dwellings constructed after 1st September 2023, in line with changes to the British Board of Agrément (BBA) building standards, plots requiring basic radon measures will require a specialized Radon Membrane, with minimum thickness of 0.4mm thick (1600 gauge) suitably installed and validated.



4.5.11. CONCLUSION

The determined Characteristic Situation for each standpipe for each visit is presented in Table 18. 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 18 Gas Risk Profile and Location

WELL	DEPTH TO WATER (m bgl)	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
WS101	2.63	0.1	0.100	0.001	5.400	0.005	CS2
WS103	Dry	0.1	0.100	0.001	0.500	0.001	CS1
WS104	Dry	0.1	0.100	0.001	2.700	0.003	CS1
WS105	0.57	0.1	0.100	0.001	1.100	0.001	CS1
WS106	0.65	1.3	0.100	0.001	2.700	0.035	CS1

Initial ground gas monitoring indicates the majority of the site can be classified as CS1/Green and no gas protection measures will be required.

The area within the vicinity of WS101 is currently classified as CS2 as a precautionary measure due to marginally elevated carbon dioxide and will be confirmed on completion of the monitoring period.

The final ground gas protection regime should be decided upon completion of the monitoring.

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.



4.6. 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 19 Pipeline Selection PE Threshold Concentrations

CONTAMINANT GROUP	PE-THRESHOLD (MG/KG)	CONCENTRATIONS AT CURRENT PIPELINE DEPTH (MG/KG)
Total VOC	0.5	<1.0
Total BTEX And MTBE	0.1	<5.0
Total SVOCs (Excluding PAH and those substances marked with an *)	2	2.9
EC5-EC10 Aliphatic and Aromatic Hydrocarbons	2	<1.0
EC10-EC16- Aliphatic and Aromatic Hydrocarbons	10	13
EC16-EC40 Aliphatic and Aromatic Hydrocarbons	500	89
Phenols (From SVOC Analysis)*	2	<0.2
Cresols and Chlorinated Phenols (From SVOC Analysis)	2	<0.1
Ethers*	0.5	NA
Nitrobenzene*	0.5	NA
Ketones*	0.5	NA
Aldehydes*	0.5	NA
Amines	Fail	NA
Other Consideration		
Are there any exceedances of the PE threshold outside of the pipeline depth?	Yes exceedances have been encountered within WS101 at 1.80 m bgl.	
Is free product present in soil and groundwater?	Free product has not been encountered within the groundwater.	
Could hydrocarbon impact at greater depth than current pipeline depth be mobilised by rising groundwater levels?	Yes – heavy end hydrocarbon impact and low solubility PAH has been identified within Made Ground below pipeline depth within WS101. Groundwater levels are generally significantly deeper than pipeline depth. Where impact at greater depth has been identified (WS104), rising groundwater could mobilise contamination to pipeline depth.	
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 that soils will be required to be imported to site subsoil and topsoil will be imported to site.	

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.



4.7. DEVELOPED CONCEPTUAL SITE MODEL

Following the completion of the intrusive site investigation, chemical analysis and risk assessment, the conceptual model shown in Table 20 has been prepared for the site.

Table 20 Developed Conceptual Model

CONTAMINANT RISK			LIKELIHOOD	SEVERITY	MITIGATION DISCUSSION	RESIDUAL RISK
SOURCES	MIGRATION PATHWAYS	RECEPTORS				
SOIL						
HUMAN HEALTH						
Made Ground Metals (arsenic) – encountered within WS102 at 0.50 m bgl Made Ground Non-volatile PAHs – encountered within WS101 at 1.80 m bgl	Accidental ingestion and/or dermal contact with contaminated soil and/or leachate. PL1/PL2	Human Health – construction workers Human Health – end users	Likely	Medium	Minor exceedances of heavy metals and non-volatile PAHs with a viable pollutant pathway of dermal contact and ingestion of soils. This poses a human health risk to future end users and construction workers. Recommendation: Construction works to be completed with appropriate PPE and welfare facilities. 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.	Low
Made Ground Volatile PAHs (naphthalene) encountered in WS104 at 1.80 m bgl	Inhalation of vapours. PL4 Migration through permeable strata	Human Health – end users Human Health – Off-site receptors	Likely	High	Elevated semi-volatile contamination has been encountered within two locations on site. There is a potential for the	Low



CONTAMINANT RISK			LIKELIHOOD	SEVERITY	MITIGATION DISCUSSION	RESIDUAL RISK
SOURCES	MIGRATION PATHWAYS	RECEPTORS				
Made Ground Elevated SVOCs encountered within WS101 at 0.80 m bgl.	and preferential pathways.				migration of vapours into indoor spaces creating a risk to end users. Recommendation: During a process of cut/fill enabling works, two hotspot removals should be undertaken in the areas of the encountered elevations. These soils may be chemically validated to assess chemical suitability for retention on site in an area of no future sensitivity. Should the site be piled and the material left in-situ, a vapour membrane will likely be required. Visual evidence of contamination has been identified in a number of locations in the form of ash, slag and clinker. Therefore a watching brief should be completed during remediation works.	
Made Ground Asbestos (Asbestos containing materials (ACM) and loose fibres)	Inhalation (of fibres). Construction works disturbing bound material and releasing fibres. PL3	Human Health - Site personnel, end land users, and users of adjacent sites	Low likelihood	High	No fibres have been identified within Made Ground samples tested. However, the presence of ACM cannot be entirely discounted. Risk of inhalation of fibres during Ground Investigation and construction works. Disturbance of ACMs and dust derivatives from	Very low



CONTAMINANT RISK			LIKELIHOOD	SEVERITY	MITIGATION DISCUSSION	RESIDUAL RISK
SOURCES	MIGRATION PATHWAYS	RECEPTORS				
					construction would increase risk to adjacent sites. Recommendation: Should asbestos be encountered during enabling works construction works to be completed with PPE and provision of welfare.	
Made Ground Sulphate from potential ash within the Made Ground.	Sulphate attack on concrete. PL6	Building concrete	Unlikely	Low	Due to the presence of Made Ground on the Site, the potential for sulphate in ash deposits is high which may impact the proposed building concrete. Recommendation: Classification will be DS-1 AC-1s. Construction works to be completed with appropriate PPE and welfare facilities.	Very low
Made Ground Organic contaminants such as hydrocarbons, solvents	Ingestion of tainted water supply. PL7	Human Health – End Users Water pipeline	Likely	High	Elevated contamination identified at pipeline depth within WS101 (0.75–1.35 m). Contamination within the potential to rise to pipeline depth has been encountered within WS104. Recommendation: Barrier pipe is likely to be required following a pipeline risk assessment.	Low
Made Ground Phytotoxic contaminants	Direct contact (plant uptake). PL8	Flora	Likely	Medium	Likely probability as contamination has been encountered within Made Ground, which may be taken up by flora in soft landscaping/gardens. Recommendation:	Very low



CONTAMINANT RISK			LIKELIHOOD	SEVERITY	MITIGATION DISCUSSION	RESIDUAL RISK
SOURCES	MIGRATION PATHWAYS	RECEPTORS				
					Installation of growing medium for plants as part of suitable cover system	
CONTROLLED WATERS						
Made Ground Volatile PAHs (naphthalene) encountered in WS104 at 1.80 m bgl Made Ground Elevated SVOCs encountered within WS101 at 0.80 m bgl.	Leaching of contaminants from Made Ground through infiltration and percolation of rainwater. PL5	Controlled waters, underlying Secondary aquifer A	Low likelihood	Medium	Leachate testing of Made Ground has indicated contaminants within Made Ground have a low leaching potential. The development of the proposed hardstanding on site will reduce the leachate produced from contaminated soils, and therefore reduce the impact to groundwater.	Very low
		Infrastructure and services	Low likelihood	Medium	The development of hardstanding on site will reduce the leachate produced from contaminated soils. Infrastructure and services shall be designed to resist chemical attack and ingress.	Very low
Groundwater	Contact with contaminated groundwater. PL2	Human Health – site personnel	Unlikely	Medium	Groundwater is known to be below construction level and as such, is expected to not rise above ground level or the final level of the road.	Very low
	Contaminants leached from the Made Ground and from off-site sources may be mobilised to greater distances	Controlled waters, underlying Secondary aquifer A	Unlikely	Medium	No exceedances have been identified above the DWS values. Recommendation: No further assessment required.	Very low



CONTAMINANT RISK			LIKELIHOOD	SEVERITY	MITIGATION DISCUSSION	RESIDUAL RISK
SOURCES	MIGRATION PATHWAYS	RECEPTORS				
	through advective flow. PL5					
GROUND GAS						
Ground gases Methane and carbon dioxide within Made Ground	Inhalation of ground gas. PL4	Human Health – site personnel	Likely	High	Initial ground gas monitoring indicates the majority of the site can be classified as CS1. Precautionary CS2 measures may be required in the locality of WS101 due to elevated marginally elevated carbon dioxide. Recommendations: The final ground gas protection regime should be decided upon completion of the monitoring.	Low
		Human Health – end users	Likely	High		Low
	Accumulation of ground gas in confined spaces (asphyxiation or explosion)	Infrastructure and services	Likely	Medium		Low
Radon	Inhalation of ground gas. PL4	Human Health – site personnel	Likely	Medium	The site is in an area where between 3% and 5% of homes are above the Radon Action Level, therefore basic radon protection measures will need to be incorporated into any proposed new dwellings.	Very low
	Accumulation of ground gas in confined spaces (carcinogenic)	Human Health – end users	Likely	Medium		Very low

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.

LEVEL OF RISK

Very Low	
Low	
Low/Moderate	
Moderate	
Moderate/High	
High	



5. GEOTECHNICAL ASSESSMENT

5.1. SOIL CONSISTENCY

Undrained shear strength values were measured using laboratory undrained triaxial tests. Results of the tests are presented in Table 21, which indicate the clay soils to vary between stiff and very stiff. Strength test data is generally consistent with the field descriptions of the aforementioned soils.

Results of the standard penetration tests, including undrained shear strengths derived from SPTs are included in Table 22.

Table 21 Summary of Undrained Shear Strength in Triaxial Compression – Laboratory Test				
LOCATION	SAMPLE DEPTH (m)	LAB DESCRIPTION	UNDRAINED SHEAR STRENGTH (kN/m ²)	CONSISTENCY
WS101	2.50–3.00	Stiff, brown, gravelly, sandy CLAY	110	Stiff

5.2. SIDE STABILITY AND EASE OF EXCAVATION

The sides of WS103 collapsed within the Made Ground strata.

The natural strata was excavated with relative ease.



Table 22 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)	ALLOWABL E BEARING CAPACITY (kN/m ²)*
WS101	1.00	MADE GROUND	10	10.08	Medium Dense	N/A	N/A	N/A	100.81
	2.00	Gravelly CLAY	5	4.57	N/A	Low Strength	Firm	22.84	46.96
	3.00	Gravelly CLAY	8	6.96	N/A	Low Strength	Firm	34.79	71.52
	4.00	Gravelly CLAY	9	7.60	N/A	Low Strength	Firm	38.02	78.17
	5.00	MUDSTONE	50	41.48	Dense	N/A	N/A	N/A	414.81
WS102	1.00	MADE GROUND	9	9.07	Loose	N/A	N/A	N/A	90.73
	2.00	MADE GROUND	7	6.39	Loose	N/A	N/A	N/A	63.95
	3.00	Gravelly CLAY	5	4.35	N/A	Low Strength	Firm	21.74	44.70
	4.00	Gravelly CLAY	9	7.60	N/A	Low Strength	Firm	38.02	78.17
	5.00	Gravelly CLAY	16	13.27	N/A	Medium Strength	Stiff	66.37	136.46
WS103	1.00	MADE GROUND	10	10.08	Medium Dense	N/A	N/A	N/A	100.81
	2.00	MADE GROUND	8	7.31	Loose	N/A	N/A	N/A	73.08
	3.00	MADE GROUND	10	8.70	Loose	N/A	N/A	N/A	86.97
	4.00	Inferred CLAY	4	3.38	N/A	Very Low Strength	Soft	16.90	34.74
	5.00	Inferred CLAY	8	6.64	N/A	Low Strength	Firm	33.18	68.23
WS104	1.00	MADE GROUND	10	10.08	Medium Dense	N/A	N/A	N/A	100.81
	2.00	MADE GROUND	7	6.39	Loose	N/A	N/A	N/A	63.95
	3.00	MADE GROUND	6	5.22	Loose	N/A	N/A	N/A	52.18
	4.00	Sandy CLAY	4	3.38	N/A	Very Low Strength	Soft	16.90	34.74
	5.00	Sandy CLAY	5	4.15	N/A	Low Strength	Firm	20.74	42.64
WS105	1.00	MADE GROUND	6	6.05	Loose	N/A	N/A	N/A	60.49
	2.00	MADE GROUND	11	10.05	Medium Dense	N/A	N/A	N/A	100.49
	3.00	MUDSTONE	50	43.48	Dense	N/A	N/A	N/A	434.83
WS106	1.00	Sandy CLAY	7	7.06	N/A	Low Strength	Firm	35.29	72.55
	2.00	Sandy CLAY	11	10.05	N/A	Medium Strength	Stiff	50.24	103.30
	3.00	Sandy CLAY	50	43.48	N/A	Very High Strength	Very Stiff	217.41	447.00



NOTES

* The Allowable Bearing Capacity (ABC) should be considered indicative.

The interpretation of in situ mass undrained shear strength (c_u) 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 capacity on sands. Soil Mechanics in Engineering Practice Terzaghi, K. & Peck, R.B. 1996.



5.3. CONSOLIDATION

One undisturbed sample of Glacial Till was submitted for oedometer analysis. The results are provided in Table 23.

Table 23 Oedometer Consolidation Results

LOCATION	DEPTH (M)	SAMPLE TYPE	MOISTURE CONTENT (%)	OEDOMETER CONSOLIDATION		
				PRESSURE RANGE (kPa)	Mv (m ² /MN)	Cv (m ² /year)
WS102	3.5–4.0	U100	33	0–75	1.184	1.606
				75–150	0.541	2.101
				150–300	0.246	1.071
				300–600	0.130	0.998
				600–75	0.036	6.625

When considered at over-burden pressure with an additional load of 600 kPa the coefficient of volume compressibility (Mv) ranged from 0.036 m²/MN up to 1.184 m²/MN. The material is considered to be low to medium compressibility.

The rate at which settlement is likely to occur is determined by the coefficient of consolidation (Cv). As shown in Table 23, the coefficient ranges from 0.998m²/yr to 6.625 m²/yr. The rate at which settlement will occur is increased by the presence of sand within the Glacial Till and it is likely that settlement will occur over a period of months to years.

5.4. SOIL PLASTICITY

The liquid and plastic limits of samples of natural in-situ clay are determined using the cone penetrometer method and the rolling thread test. These tests enable determination of an average plasticity index (PI) for each “type” of clay, although judgement is applied where variable results are reported.

PI can be related to shrinkability (low, medium or high) and then to minimum founding depth.

E3P typically only consider a soil to be shrinkable if the proportion finer than 63 µm is > 35%.

PI results are compared against guidance given in the NHBC standards, Chapter 4.2 (revised January 2014), which advocates the use of modified plasticity index (I_p), defined as:

$$I_p = I_p \times (\% < 425 \mu\text{m}/100)$$

In other words, if PI is 30%, but the soil contains 80% < 425 µm, then I_p = 30 × 80/100 = 24%.

It should be noted that in accordance with the requirements of BS 1377, the % passing the 425 µm sieve is routinely reported by testing labs.

E3P apply engineering judgement where PI results are spread over a range of classifications. Consideration is given to the average values for each particular soil type (differentiate between residual soil and alluvium), the number of results in each class and the actual values.

The Atterberg limits determinations, summarised in



Table 24, show the clay to be of predominantly low plasticity with discrete areas of moderate plasticity clay.



Table 24 Summary of Plasticity Index Test results

LOCATION	DEPTH (M)	NATURAL MOISTURE CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	PASSING 425 MM SIEVE (%)	MODIFIED PLASTICITY INDEX	NHBC VOLUME CHANGE POTENTIAL
WS102	3.00	42	26	48	22	92	20.24	Medium
WS102	4.00	31	22	36	14	76	10.64	Low
WS101	3.00	15	18	30	12	58	6.96	Low
WS106	2.00	18	18	29	11	85	9.35	Low

The results of the Atterberg limits testing confirmed that the soils would be deemed to be “Low/Medium Potential” in accordance with the classification system utilised by the LABC/NHBC industry guidance.

5.5. PH AND SULPHATE

Chemical analyses for pH and soluble sulphate content contained in APPENDIX VII (summarised in Table 25), shows that the soils at the site meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with BRE *Special Digest 1* (2005).

Table 25 Summary of pH and Sulphate Data

LOCATION	DEPTH (M)	SO ₄ IN 2:1 WATER/SOIL (G/L)	PH VALUE	CLASSIFICATION
WS104	1.80	0.409	8.1	DS-1 AC-1s
WS104	3.80	0.0233	7.3	DS-1 AC-1s
WS103	2.60	0.0233	8.6	DS-1 AC-1s
WS102	0.50	0.0515	7.7	DS-1 AC-1s
WS101	0.80	0.0053	7.9	DS-1 AC-1s
WS101	3.50	0.017	7.7	DS-1 AC-1s
WS105	0.90	0.01	7.8	DS-1 AC-1s
WS106	1.70	0.0258	6.8	DS-1 AC-1s

5.5.1. HIGHWAYS AND CONCRETE

MCHW Series 600 provides a criteria of 1500mg/l for water-soluble sulfate within 500mm of any concrete structure.

A second criteria of 300 mg/l is given with respect to soils within 500mm of steel structures.



5.6. GROUNDWATER

Table 26 Summary of Groundwater Strikes

LOCATION	DEPTH (M BGL)	DESCRIPTION OF STRIKE	STRATA	EVIDENCE OF CONTAMINATION
Site Investigation Waterstrike Information				
WS101	3.00	Seepage	CLAY	None
Location	Depth Range (m bgl)	Period of monitoring (May-September)	Weather conditions during monitoring	Comments
Groundwater Monitoring Summary from Installations				
WS101	2.63-3.21	February-March	Overcast/Rain	
WS103	Dry	February-March	Overcast/Rain	
WS104	Dry	February-March	Overcast/Rain	
WS105	0.57-0.89	February-March	Overcast/Rain	Flooded on visits 1 and 3
WS106	0.48-0.60	February-March	Overcast/Rain	Flooded on visit 1, 2 and 3

The presence of groundwater appears common to bedrock levels both within the drift overlying and the bedrock. Groundwater has not been encountered in the wells placed within granular Made Ground Strata (WS103 and WS104).

5.6.1. INFLUENCING FUNCTIONAL WATERBODIES

The site is not located within the influencing distance of a waterbody. Long term monitoring of groundwater has not been conducted as a part of this investigation (to date) and interpreted levels are approximate and may be dependant on seasonal variation. It should be noted that seasonal variation is likely to result in potentially significant changes in groundwater levels beneath the site.

The water table can have significant effects on the foundation of a building, including:

-  **Soil settlement:** Changes in the water table can cause soil to expand or contract, which can result in foundation settlement or movement. This can lead to cracks in the foundation, walls, or floors of a building.
-  **Soil erosion:** High water tables can cause soil erosion, which can lead to the loss of soil support beneath the foundation. This can result in foundation settling or movement, which can be dangerous for the stability of the structure.
-  **Hydrostatic pressure:** When the water table rises, the water exerts hydrostatic pressure on the foundation. This can cause foundation walls to crack or bow, which can compromise the structural integrity of the building.
-  **Moisture infiltration:** High water tables can result in moisture infiltration into the foundation and surrounding soil. This can lead to mold growth, decay, and deterioration of building materials.
-  **Drainage problems:** Poor drainage around a building can cause water to pool around the foundation, increasing the likelihood of soil erosion and hydrostatic pressure. This can lead to foundation settling or movement, and can also cause flooding in the basement or crawl space.



It is important to consider the effects of the water table on the foundation when designing and constructing a building. Proper drainage and foundation waterproofing can help to mitigate the effects of the water table on the foundation and improve the longevity and stability of the structure.

5.7. SITE PREPARATION

Our assessment has been based on the fact that the site will 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.
- ☛ Demolition of all existing buildings and removal of all concrete hardstanding.
- ☛ Redundant services should be sealed off and grubbed out and replaced with suitable compacted engineered fill.
- ☛ Buried structures and old foundations have been encountered on site. These should be excavated from below the proposed development footprint with the resulting void backfilled.

5.8. 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 safe allowable bearing capacity (ABC) 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 27.

Table 27 Summary of ABC

SOLID GEOLOGY			
Description	Depth (Range m bgl)	Relative Density	Allowable Bearing Capacity (kN/m ²)
Gravelly SAND	3.00–5.35	Dense	415–435
COHESIVE SOILS			
Description	Depth (range m bgl)	Undrained Shear Strength (Cu) (kN/m ²)	Allowable Bearing Capacity (kN/m ²)
Soft very low strength gravelly sandy CLAY	4.00–5.00	16.9	34.7
Firm low strength gravelly sandy CLAY	1.00–5.00	20.7–38.0	42.6–78.2
Stiff medium strength sandy gravelly CLAY	2.00–5.00	50.2–66.4	103.3–136.5
Very stiff very high strength gravelly CLAY	3.00	217.4	447

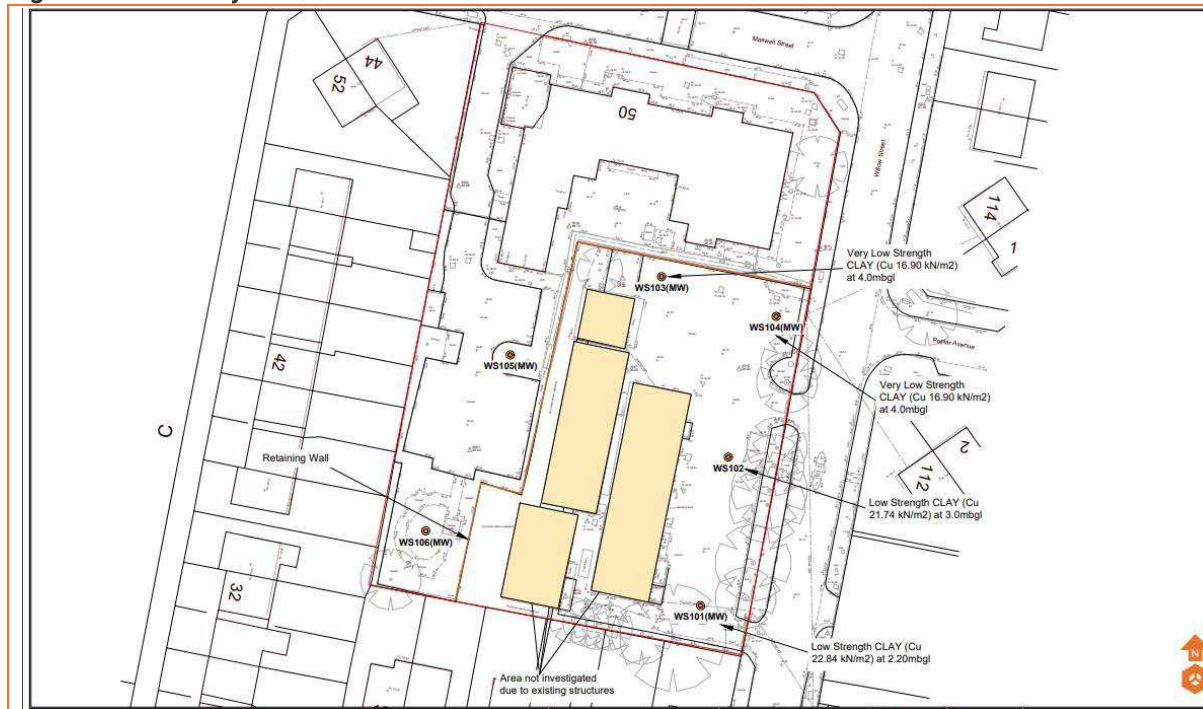


5.9. FOUNDATIONS OPTIONS APPRAISAL

Based on the assessment of the relative undrained shear strength, relative in-situ densities and corresponding safe allowable bearing capacity, the following recommendations have been developed for the site of the potential foundation solutions that may be adopted for the future residential development. The suitable target founding stratum has been identified as the underlying areas of stiff glacial CLAY and/or MUDSTONE bedrock.

To enable a detailed appraisal,
Figure 6 below identifies key constraints and considerations with respect to the foundation recommendations.

Figure 6 Key Geotechnical Foundation Constraints



Following this assessment, the following foundation recommendations have been determined:

- ✳ Within the footprint of the proposed building, the depth of Made Ground varies from 2.20 to 4.00 m bgl.
- ✳ Much of the underlying CLAY is soft to firm with an undrained shear strength less than 30kN/m².
- ✳ Therefore, an engineered foundation solution is likely to be required comprising (VSCs) or a piled foundation onto the glacial clays or underlying bedrock.



To determine if VSC is viable at the subject site, E3P has completed a Ground Improvement Design Risk Matrix that is summarised in Table 28.

Table 28 Ground Improvement Design Risk Matrix

RISK ITEM	COMMENT	PASS/FAIL
Soft clays with an undrained shear strength less than 30 kN/m²	Areas of soft to firm clay have been identified throughout the site. with a $C_u < 30 \text{ kN/m}^2$. Made Ground and soft CLAY will require reengineering to ensure a $C_u > 30 \text{ kN/m}^2$	PASS – on completion of enabling works
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	None identified	PASS
Voided filled ground, e.g. old water tanks, pottery, glass bottles, concrete rubble or brick fill of unsuitable grading	Made Ground within the vicinity of WS101 and WS104 will require removal and processing to render this area of the site suitable for VSC. The existing buildings substructure will also require excavation and processing into a graded aggregate suitable for vibro treatment.	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	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 – on completion of enabling works



Due to low strength clays with $C_u < 30 \text{ kN/m}^2$ underlying variable Made Ground, a programme of reengineering works will be required prior to the placement of VSC. Reengineering work will likely comprise the removal of unsuitable material from Made Ground and removal of low strength clays. Due to the loadings of the proposed structures on site, ground improvement by VSC would result in an estimated ABC of 125 kN/m^2 .

A second foundation option would be the use of mini piled foundations to pile through unsuitable Made Ground and low strength clay and found onto the underlying stiff clay/weathered bedrock at circa $>5.00 \text{ m bgl}$.

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.

At this time it is not possible to accurately define the foundation types due to the absence of a detailed tree survey and final development levels; however, based on our extensive experience of similar sites, we would anticipate that the final foundation solution would be ground improvement by VSC or mini piled foundations onto the underlying stiff clay/weathered bedrock.

5.10. 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.

In clay soils if the foundation depth is greater than 1.5m, allowance should be made in the design for heave. This must incorporate either a clear void of a specified minimum depth under the suspended floor, or a proprietary compressible material/void former below the underside of the floor construction.

Ground bearing slabs should not be used in ground conditions where heave can occur or where the foundation depth is greater than 1.5m. Under these circumstances a suspended floor construction should be used.



5.11. SETTLEMENT

The site has been appraised through desk based information and site investigation data in order to inform geotechnical risk where possible. Table 29 below has been formulated to determine if settlement risks are required to be further appraised. Where any item is determined to be appraised a settlement appraisal for the site should be prepared upon receipt of development levels and layout.

Table 29 Summary of Geotechnical Information for Settlement

RISK	COMMENT	ASSESSMENT
Site is located in an area deemed to be at Risk from Ground Dissolution from desk based information	The site is at a low risk area of ground dissolution based on BGS data searches.	No Further Assessment
Site is in an area where geology is reported as having a compressible risk from desk based information	None identified	No Further Assessment
Do historical maps indicate relic excavation features such as opencast or ponds that have been infilled.	None identified	No Further Assessment
Has the site been proven to be underlain by anthropogenic materials to an unknown specification?	Yes filled ground to a maximum proven depth of 4.00 m bgl.	Further Assessment
Have Oedometers and/or ground conditions reported compressible stratum on site?	None identified	No Further Assessment
Have High walls been identified on site that could result in differential settlement?	None identified	No Further Assessment
Has any evidence been observed on site indicating settlement (non structural assessment)	None identified	No Further Assessment
Is voided ground present beneath the site?	None identified	No Further Assessment
Is the site in an area where a mobile groundwater regime is present in influencing distance of foundations and infrastructure?	None identified	No Further Assessment
Will the site be subject to changes in site levels that may induce heave or settlement?	Site levels are unlikely to drastically change during development	No Further Assessment

There will be a requirement for the turning of Made Ground and grubbing out of any obstructions and relict features.



5.12. 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 conjectures zones of influence.

The clay has been determined as being of predominantly low volume change potential with discreet areas of medium volume change potential. Table 30 shows where heave precautions are required for a trench fill, pier and beam and pile and beam foundation types which are in the zone of influence of trees which are to remain or be removed.

Table 30 Position of Heave Precautions

SITUATION	TRENCH FILL	PIER AND BEAM	PILE AND BEAM
External trench fill and pier foundations. Unless NHBC is satisfied that the soil is not desiccated compressible material should be provided to the:	Inside faces of external wall foundations deeper than 1.5m, based on the appropriate tree height.	All faces of pier foundations deeper than 1.5m, based on the appropriate tree height.	N/A
External ground beams. Unless NHBC is satisfied that the soil is not desiccated, compressible material or void formers should be provided to the:	N/A	Inside faces	Inside faces
Internal trench fill foundations and ground beams. Compressible material required:	No	No	No
External and internal ground beams. Compressible material, void former or void should be provided to the underside of:	N/A	All	All
Heave precautions required for proposed trees where the soil is not desiccated:	No	No	No

Note: Information taken from NHBC Standards 2024, Chapter 4.2, Table 8 – Position of heave precautions

A summary of heave precautions is presented in Table 31.

Table 31 Summary of Heave Precautions

VOLUME CHANGE POTENTIAL	VOID DIMENSION AGAINST SIDE OF FOUNDATION AND GROUND BEAM	VOID DIMENSION UNDER GROUND BEAMS, AND SUSPENDED IN-SITU CONCRETE GROUND FLOOR	VOID DIMENSION UNDER SUSPENDED PRECAST CONCRETE AND TIMBER FLOORS ⁽¹⁾
High	35mm	150mm	300mm
Medium	25mm	100mm	250mm
Low	0mm	50mm	200mm



In addition to the requirements of the 'Drainage' section, drainage near trees should incorporate additional provisions. Where there is a volume change potential within the ground, the provisions include:

- ✳ Increased falls to cater for any ground movement.
- ✳ Deeper and wider backfill of granular material.
- ✳ A drainage system that is capable of movement should heave and shrinkage occur.
- ✳ Drainage pipes should not be encased in concrete.
- ✳ Additional clearance is required where drains pass through the structure of a building to allow for additional movement.

5.13. 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.

Bulk earthworks to construct highways to the underside of capping. Enabling works contractor will need to complete CBRs to determine the capping layer etc

5.14. DRAINAGE

Where loose or soft materias have been identified at drainage invert levels, there will need to be consideration for the use of reinforced pipe bedding.

Shrinkage and heave of clay soils can affect pipelines. To protect against the effects of heave, drainage should be designed:

- ✳ To take account of potential ground movement as shown in Table 32 , including where pipes and services pass through substructure walls or foundations.
- ✳ With gradients which may need to be steeper.
- ✳ To use alternative means of catering for the movement when sufficient falls cannot be provided, for example, by deepening the excavation and laying pipework on a granular bedding of suitable thickness to reduce the extent of potential movement.

Table 32 Potential Ground Movement for Drainage

VOLUME CHANGE POTENTIAL	HIGH	MEDIUM	LOW
Potential ground movement	150mm	100mm	50mm

5.15. EXCAVATIONS

Trial pits have not been undertaken onsite. WS103 collapsed in Made Ground strata to 4.00 m bgl.

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.

Table 33 Civil Engineering Excavation Risk Matrix

RISK ITEM	PRESENT	COMMENT
Running Sands	No	No running sand has been identified.
Minor Water Ingress	No	No mine water has been identified
Shallow Bedrock	Yes	No shallow bedrock <2.50m bgl has been encountered.

5.16. CONSTRUCTION ACTIVITY AND INSPECTION

The following activities and inspections should be incorporated in to 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 subformations 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).

5.17. DEVELOPED GEOTECHNICAL RISK REGISTER

POTENTIAL ABNORMAL CONSTRAINT	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Remediation of Contaminated Soils	WS101 WS104	TBC	Hotspot removal may be required for the elevated Naphthalene and SVOCs in WS104 and WS101 respectively, resulting the requirement to backfill the resulting void. Should significant backfill be needed deeper or specialist foundations may be required in those areas. Should the site be piled and the material left in-situ, a vapour membrane should will likely be required.
Bedrock	N/A	N/A	None recorded at <2.50m bgl.
Cohesive Stratum Overlying Shallow Bedrock (<3.00m)	All	100	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 historical development and, while above-ground structures have been removed, potential subsurface obstruction from relict foundations may remain
Artificially Levelled and Filled Platforms	All	100	The site appears to have been levelled and artificially backfilled.
Retaining Walls	N-S through the centre of site	10	There is a retaining wall running through the centre of the site. This will need to be assessed by a structural engineer prior to development.
Trench Collapse	All	100	Made Ground present beneath the site is likely to be loosely compacted and possibly prone to collapse.
Mature Trees	Eastern boundary	20	Arboriculture survey required to determine areas of potential tree influence. The site is predominantly surfaced by hardstanding, however a number of semi mature trees are present on the soft standing area in the east of the site.
Volume Change Potential Clay	WS102	20	The cohesive soils have been assessed as being low/medium volume change potential. Where the clay is deemed to be medium plasticity, heave precautions may be required to the internal face of the external load-bearing walls (outside or within tree influence).

POTENTIAL ABNORMAL CONSTRAINT	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Concrete Design	All	100	Soils meet concrete classification DS-1 AC-1s
Low-Permeability Ground	Site	100	Soakaways unlikely to be effective in areas where low permeability cohesive deposits are present or where areas of potentially contaminated soil and groundwater are present.
Services/Sensitive Structures	All	100	A review of online services has identified a number of services within the site boundary. Piling may not be possible within close proximity to any sensitive infrastructure.
Abnormal Foundation Solutions	TBC	TBC	Due to the depth of Made Ground and the presence of soft clays, it is likely that a deeper foundation solution will be required for the proposed structures.
Enabling Earthworks	TBC	TBC	All proposed earthworks will need to be designed by a suitably qualified geotechnical engineer in accordance with NHBC Chapter 4.6. The earthworks design will incorporate a Geotechnical Specification for Earthworks that will define protocols to ensure no unacceptable future risk.

5.18. FURTHER WORKS

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

-  Further post-demolition site investigation in areas not previously accessible.
-  Arboricultural Survey.
-  Geotechnical Design Report (GDR)
-  Geotechnical Earthworks Strategy (infrastructure).
-  Remediation and enabling works strategy.
-  Ground Gas Addendum on completion of the ground gas monitoring.

END OF REPORT

APPENDIX I

LIMITATIONS



GENERAL

1. This report and any associated works (together comprising the "Services") were compiled and carried out by E3P for the client (as present in Section 1) under the E3P "Terms of Business" or with those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed and outlined in the body of the report.
2. Unless explicitly agreed otherwise, in writing, this report has been prepared under E3P Standard Terms and Business as included within our proposal to the Client.
3. Project-specific appointment documents may be agreed upon at our discretion and a charge may be levied for both the time to review and finalise appointment documents and also for associated changes to the appointment terms. E3P reserves the right to amend the fee should any changes to the appointment terms create an increased risk to E3P.
4. The report needs to be considered in light of the proposal and associated limitations of scope. The report needs to be read in full and isolated sections cannot be used without full reference to other elements of the report and any previous works referenced within the report.

PHASE 1 GEOENVIRONMENTAL AND PRELIMINARY RISK ASSESSMENTS

5. Coverage: This section covers reports with the following titles or combination of titles: Phase 1; Desktop Study; Geoenvironmental Assessment; Development Appraisal; Preliminary Environmental Risk Assessment; Constraints Report; Due Diligence Report; Geotechnical Development Review; Environmental Statement; Environmental Chapter; Baseline Environmental Assessment; Project Scope Summary Report (PSSR), Program Environmental Impact Report (PEIR), Geotechnical Development Risk Register; Agricultural Land Assessment; Mineral Safeguarding Assessment; Desk Top Coal Mining Risk Assessment; Hydrogeological Appraisal; Construction Environmental Management Plan; and Site Water Management Plan.
6. The works undertaken to prepare this report comprised a study of available and easily documented information from a variety of sources (including the Client), together with (where appropriate) a brief walkover inspection of the Site and correspondence with relevant authorities and other interested parties. Due to the short timescales associated with these projects responses may not have been received from all parties. E3P cannot be held responsible for any disclosures that are provided post-production of our report and will not automatically update our report.
7. The opinions given in this report have been dictated by the finite data on which they are based and are relevant only for the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in this report, E3P reserves the right to review such information and, if warranted, to modify the opinions accordingly.
8. It should be noted that any risks identified in this report are perceived risks based on the information reviewed. Actual risks can only be assessed following intrusive investigations of the site.



9. 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 does not constitute or replace full and proper surveys completed by suitably qualified and experienced specialists in these fields.
10. E3P does not warrant work/data undertaken/provided by others.

INTRUSIVE INVESTIGATION REPORTS

11. Coverage: The following report titles (or combination) may cover this category of work:
 Geoenvironmental Site Investigation; Geotechnical Assessment; GIR (Ground Investigation Reports); Preliminary Environmental And Geotechnical Risk Assessment; Preliminary Summary; Coal Mining Risk Assessment, Ground Gas Addendum; and, Geotechnical Risk Register.
12. The investigation has been undertaken to provide information concerning either:
 - I. The type and degree of contamination present at the site in order to allow a generic quantitative risk assessment to be undertaken; or
 - II. Information on the soil properties present at the site to allow for geotechnical development constraints to be considered.
13. The scope of the investigation was selected on the basis of the specific development and land use scenario proposed by the Client and may be inappropriate to another form of development or scheme. If the development layout was not known at the time of the investigation the report findings may need revisiting once the development layout is confirmed.
14. Unless otherwise specified in the scope of works, any site drawing(s) provided in this report is (are) not meant to be an accurate base plan but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (intrusive and sample locations etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.
15. For contamination purposes, the objectives of the investigation are limited to establishing the risks associated with potential contamination sources with the potential to cause harm to human health, building materials, the environment (including adjacent land), or controlled waters.
16. For geotechnical investigations, the purpose is to broadly consider potential development constraints associated with the physical property of the soils underlying the site within the context of the proposed future or continued use of the site, as stated within the report.
17. The amount of exploratory work, soil property testing and chemical testing undertaken has necessarily been restricted by various factors which may include accessibility, the presence of services; existing buildings; current site usage or short timescales. The exploratory holes completed assess only a small percentage of the area in relation to the overall size of the Site, and as such can only provide a general indication of conditions.



18. The number of sampling points and the methods of sampling and testing do not preclude the possible existence of contamination where concentrations may be significantly higher than those actually encountered or ground conditions that vary from those identified. In addition, there may be exceptional ground conditions elsewhere on the site which have not been disclosed by this investigation and which have therefore not been taken into account in this report.
19. The inspection, testing and monitoring records relate specifically to the investigation points and the timeframe that the works were undertaken. They will also be limited by the techniques employed. As part of this assessment, E3P has used reasonable skill and care to extrapolate conditions between these points based on assumptions to develop our interpretation and conclusions.
20. The assumption made in forming our conclusions is that the ground and groundwater conditions (both chemically and physically) are the same as have been encountered during the works undertaken at the specific points of investigation and at the time of the investigation.
21. Conditions can change between investigation points both spatially and over time and these interpretations should therefore be considered indicative. The assessment of extreme weather events and their impact on ground conditions is not within the scope of E3P's work.
22. The risk assessment and opinions provided are based on currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values. Specific assumptions associated with the risk assessment process have been outlined within the body or associated appendix of the report.
23. Additional investigations may be required in order to satisfy relevant planning conditions or to resolve any engineering and environmental issues.
24. Where soil contamination concentrations recorded as part of this investigation are used for commentary on the potential waste classification of soils for disposal purposes, these should be classed as indicative only. Due consideration should be given to the variability of contaminant concentrations taken from targeted samples versus bulk excavated soils and the potential variability of contaminant concentrations between sampling locations. Where major waste disposal operations are considered, targeted waste classification investigations should be designed and the waste classification and any subsequent disposal option agreed upon with licenced subcontractors and/or the relevant regulators.
25. The results of the asbestos testing are factually reported and interpretation is given as to how this relates to the previous use of the site, the types of ground encountered and site conceptualisation. This does not however constitute a formal asbestos assessment. These results should be treated cautiously and should not be relied upon to provide detailed and representative information on the delineation, type and extent of bulk ACMs and/or trace loose asbestos fibres within the soil matrix at the site.
26. If costs have been included in relation to additional site works, and/or site remediation works these must be considered as indicative only and must be confirmed by a qualified quantity surveyor.



EUROCODE 7: GEOTECHNICAL DESIGN

27. On 1st April 2010, BS EN 1997-1:2004 (Eurocode 7: Geotechnical Design – Part 1) became the mandatory baseline standard for geotechnical ground investigations.
28. In terms of geotechnical design for foundations, slopes, retaining walls and earthworks, EC7 sets guidance on design procedures including specific guidance on the numbers and spacings of boreholes for geotechnical design, there are limits to methods of ground investigation and the quality of data obtained and there are also prescriptive methods of assessing soil strengths and methods of design. Unless otherwise explicitly stated, the work has not been undertaken in accordance with EC7. A standard geotechnical interpretative report will not meet the requirements of the Geotechnical Design Report (GDR) under Eurocode 7. The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. The report is likely to represent a Ground Investigation Report (GIR) under the Eurocode 7 guidance.

DETAILED QUANTITATIVE RISK ASSESSMENTS AND REMEDIATION AND ENABLING WORK STRATEGY REPORTS

29. These reports build upon previous report versions and associated notes. The scope of the investigation, further testing and monitoring and associated risk assessments were selected based on the specific development and land use scenario proposed by the Client and may not be appropriate to another form of development or scheme layout. The risk assessment and opinions provided are based on currently available approaches in the generation of Site Specific Assessment Criteria relating to contamination concentrations and are not considered to represent a risk in a specific land use scenario to a specific receptor. No liability can be accepted for the retrospective effects of any future changes or amendments to these values, associated models or associated guidance.
30. The outputs of the Detailed Quantitative Risk Assessments are based upon the manipulation of standard risk assessment models. These are our interpretation of the risk assessment criteria.
31. Before adoption on-site, assessment criteria will need to be discussed and agreed upon with the Regulatory Authorities prior to adoption on site. The regulatory discussion and engagement process may result in an alternative interpretation being determined and agreed. The process and timescales associated with the Regulatory Authority engagement are not within the control of E3P. All costs and programmes presented as a result of this process should be validated by a quantity surveyor and should be presumed to be indicative.
32. E3P does not accept liability for any subcontract work that has not been completed in strict accordance with an approved E3P Remediation and Enabling Works Strategy.

GEOTECHNICAL DESIGN REPORT (GDR)

33. The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. All the relevant information needs to be provided to allow for a GDR to be produced.



MONITORING (INCLUDING REMEDIATION MONITORING REPORTS AND BUILD PHASE MITIGATION)

34. These reports are factual and comprise monitoring, normally groundwater and ground gas and data provided by contractors as part of earthworks or remedial works.
35. The data is presented and will be compared with assessment criteria.

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
m	Metres	ppm	Parts per million
km	Kilometres	mg/m³	Milligram per metre cubed
% v/v	Percent volume in air	m bgl 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

RISK CLASSIFICATION



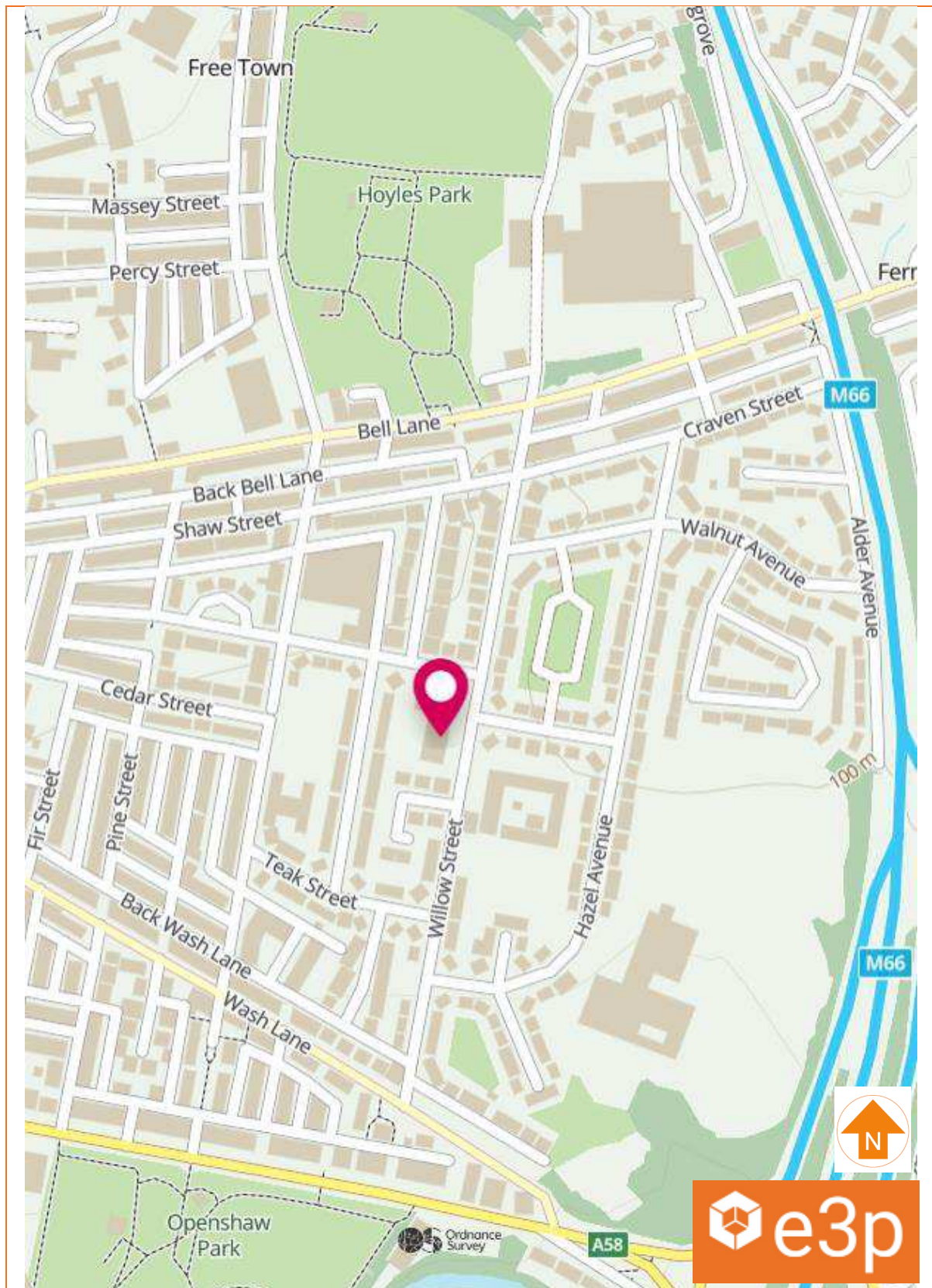
Risk Classification

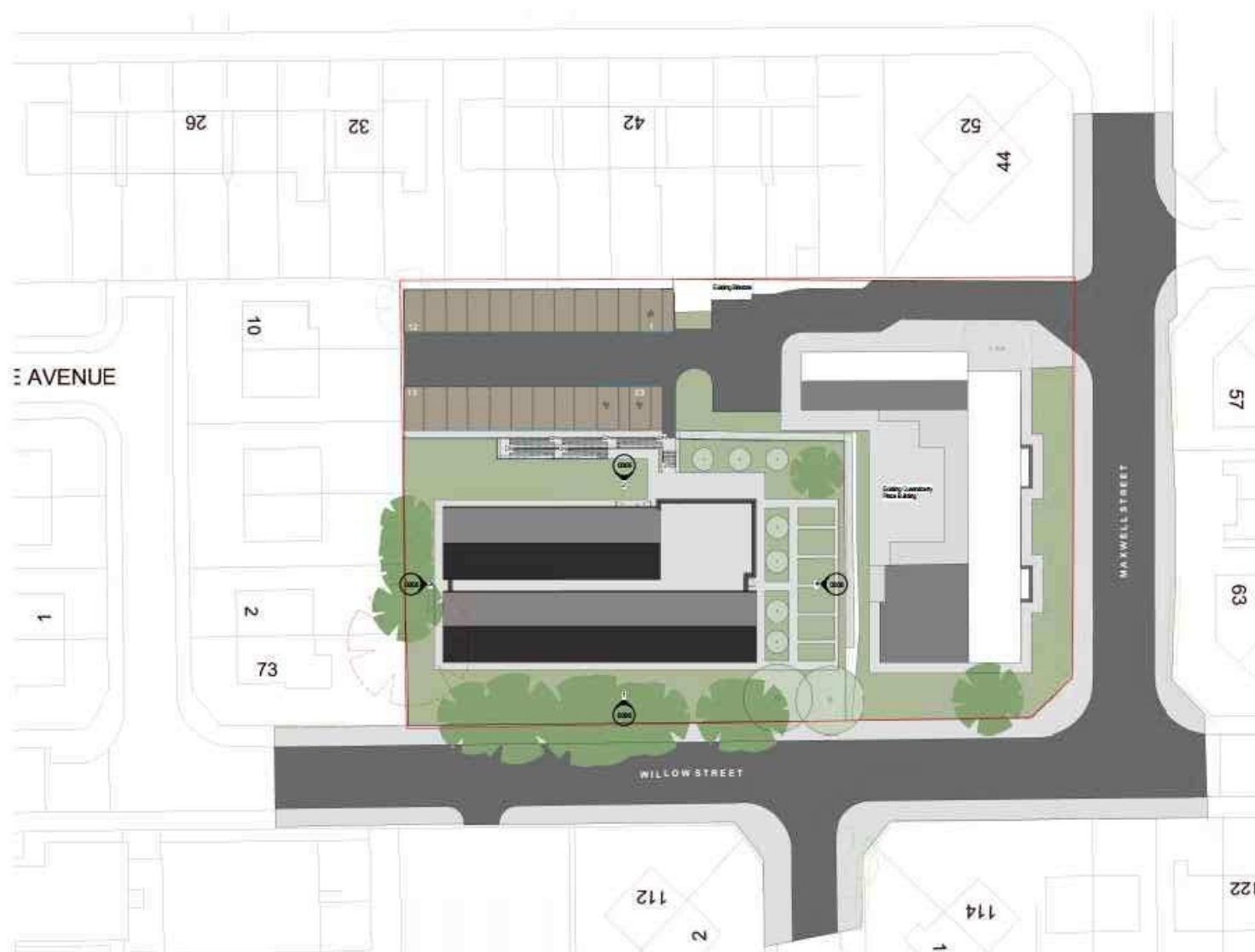
RISK	DEFINITION
Low	There are unlikely to be significant contaminated land liabilities/geotechnical constraints associated with the property.
Low Moderate	There are unlikely to be significant contaminated land liabilities/geotechnical constraints associated with the property with regard to the proposed use. However, minor issues may require further consideration in the event of future redevelopment of the Site.
Moderate	Some potential contaminated land liabilities/geotechnical constraints are likely to affect the property as a result of historical and/or current activities. The risks identified are unlikely to pose an immediate significant issue but the purchaser/developer may wish to make further enquiries of the vendor or undertake further environmental improvements. Redevelopment of the Site will likely require further site investigation.
Moderate High	Some potentially significant contaminated land liabilities/geotechnical constraints have been identified at the property that requires further assessment, including intrusive ground investigations.
High	Significant potential contaminated land liabilities/geotechnical constraints have been identified at the property. Further assessment including intrusive ground investigation will be required to determine the level of risk and associated liability.

APPENDIX IV DRAWINGS



DRAWING 17-285-001 – Site Location Plan





Notes:					
P1	REVA	28.03.2024	OW	JB	AS
Phase	Issue	Date	Drawn	Checked	PM

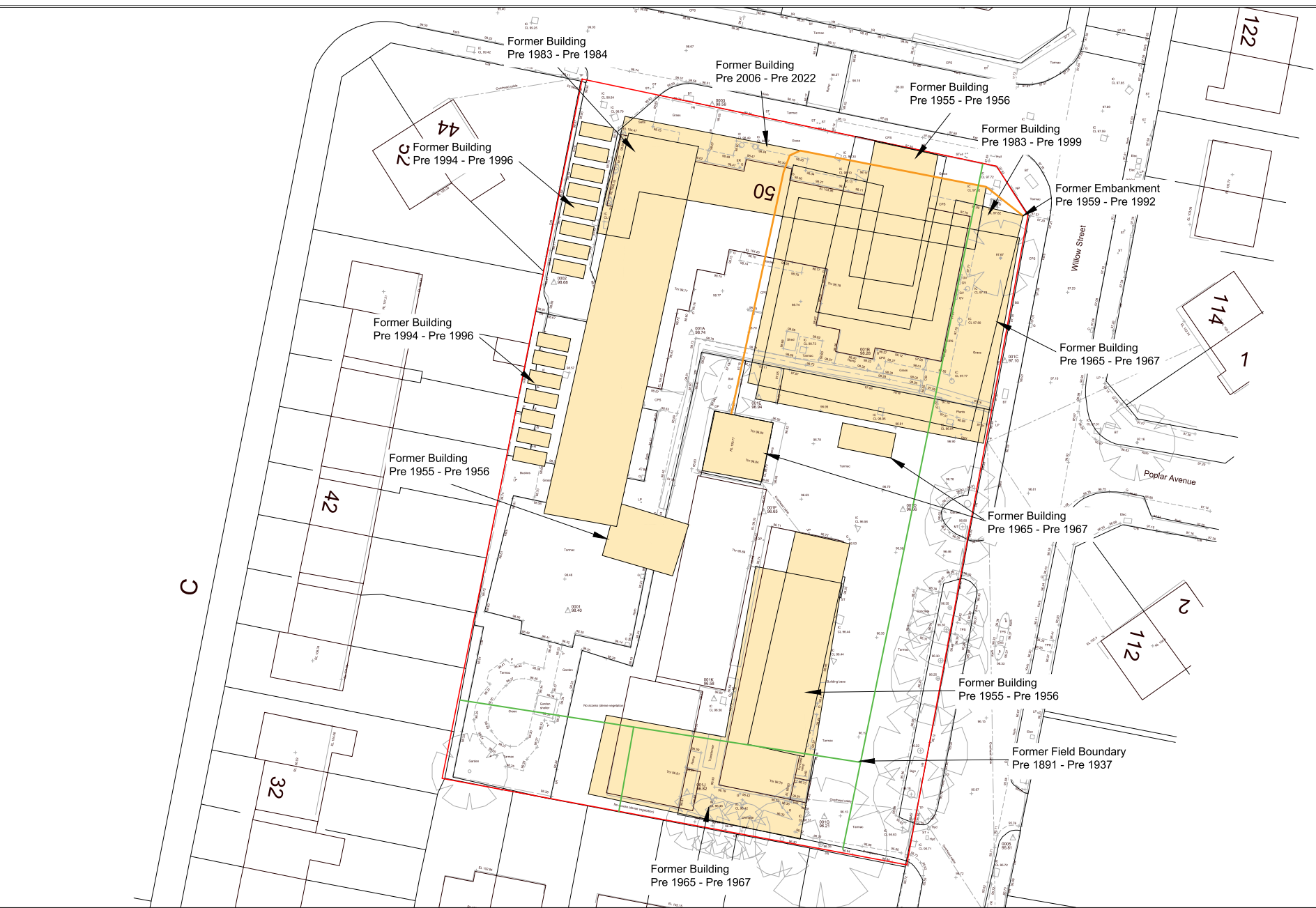
Client:	
Shape Consulting Engineers	
Job Title:	
Willow Street, Bury	

Job No:	17-285	Date:	28.03.2024
Drawing No:	002	Scale:	NTS @ A3
Drawing Title:		Proposed Development 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.



Historical Features					
	Former Buildings				
	Former Field Boundary				
	Former Embankment				

Notes:					
P1	REVA	28.03.2024	OW	JB	AS
Phase	Issue	Date	Drawn	Checked	PM

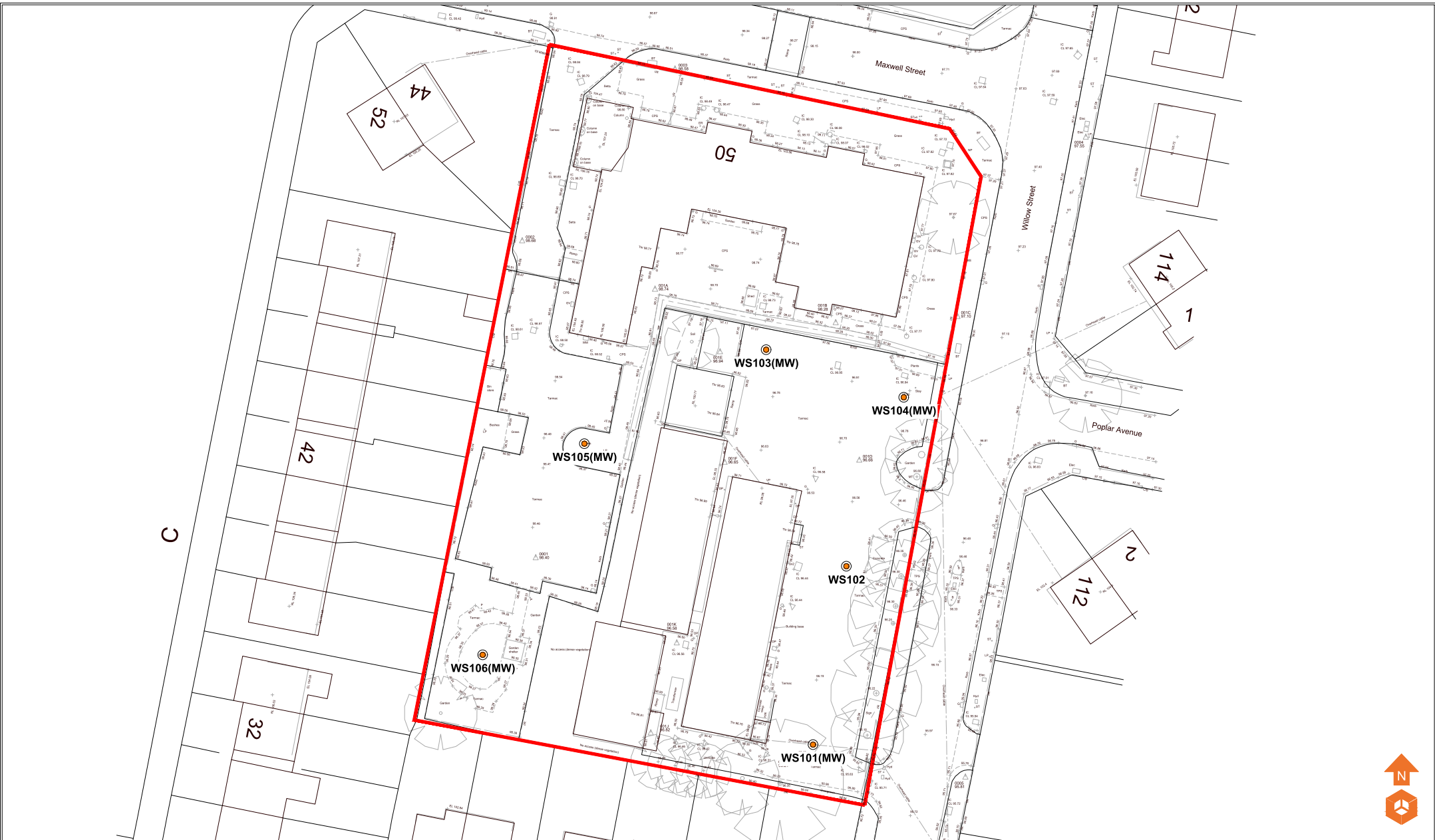
Client:	
Shape Consulting Engineers	
Job Title:	
Willow Street, Bury	

Job No:	
17-285	
Drawing No:	
003	
Date:	
28.03.2024	
Scale:	
NTS @ A3	
Drawing Title:	
Historical Features Plan	

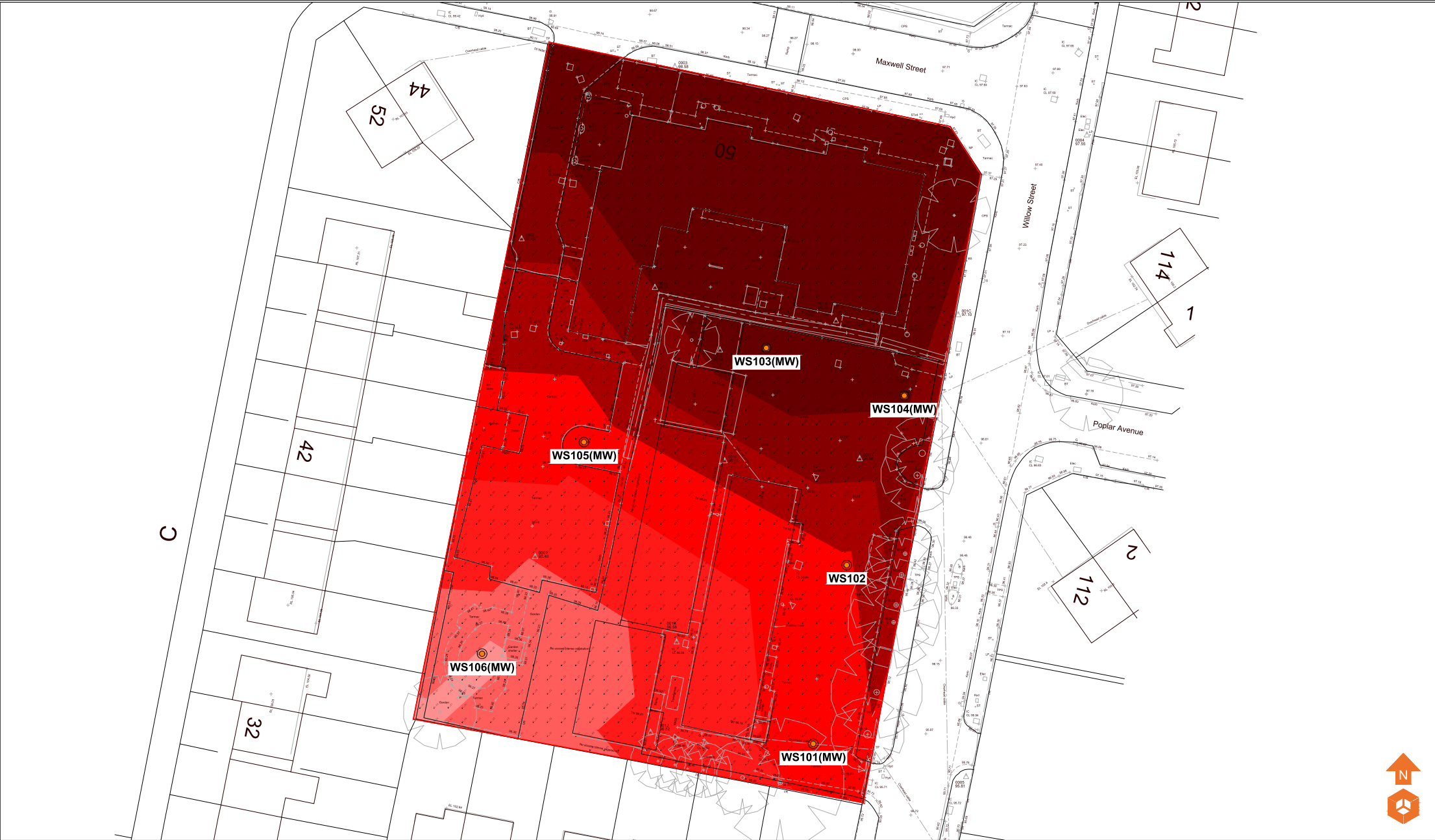


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Website: www.e3p.co.uk

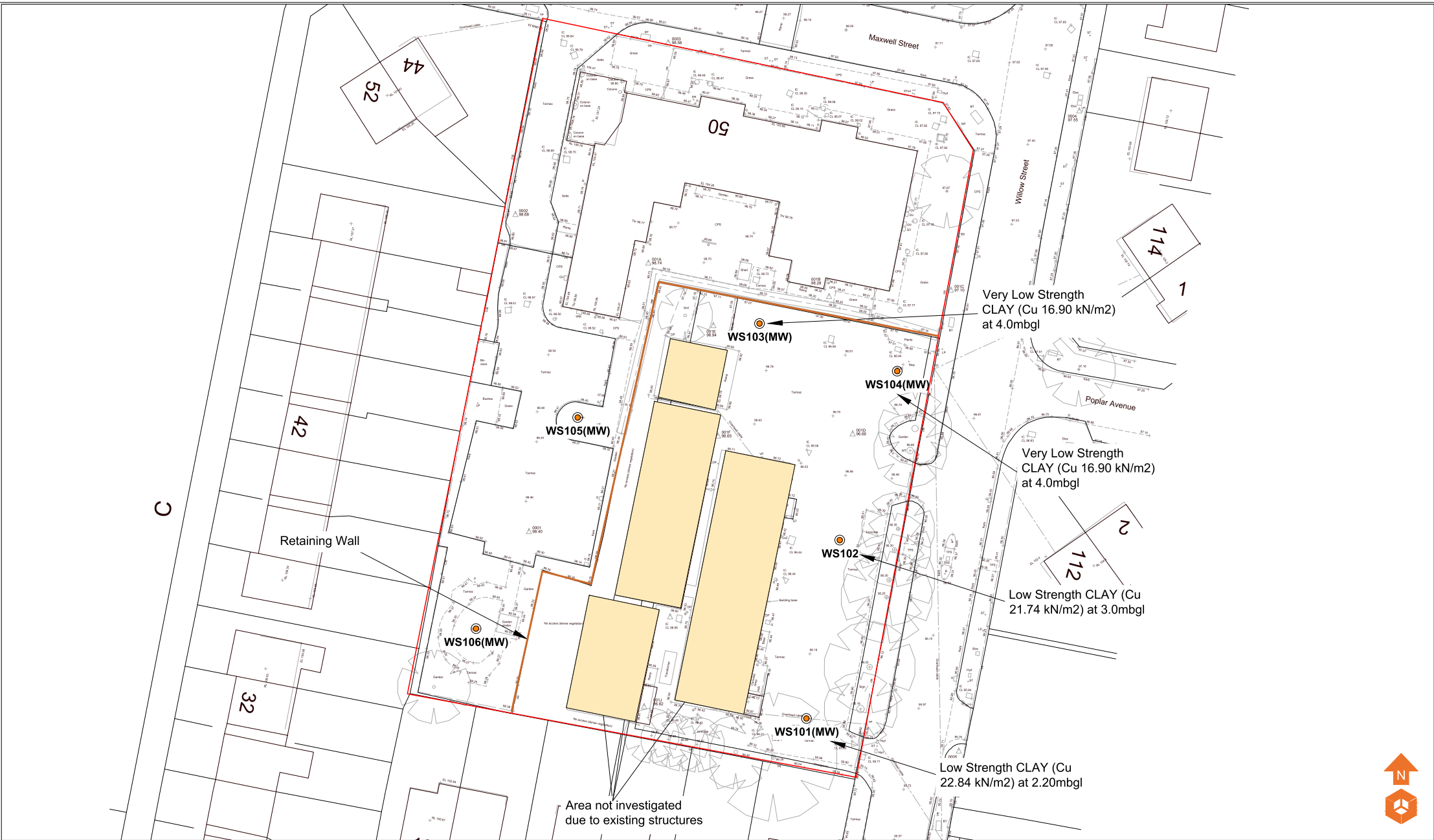
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Location Symbols  Approximate Window Sample Probehole Location  Approximate Window Sample Probehole Location with Install	Notes:						Client: Shape Consulting Engineers		Job No: 17-285	Date: 21.03.2024	 Environmental Engineering Partnership Ltd Taylor Road, Trafford Park Urmston, Manchester, M41 7JQ Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk		
									Drawing No: 005	Scale: NTS @ A3			
	P1	REVB	21.03.2024	OW	JB	AS	Job Title: Willow Street, Bury		Drawing Title: Exploratory Hole Location 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	31.01.2024	CB	AS	AS							
						Phase	Issue	Date	Drawn	Checked	PM		



Location Symbols Approximate Window Sample Probehole Location Approximate Window Sample Probehole Location with Install		Made Ground Depth (m) Depth of Made Ground 0.00 - 0.89m Depth of Made Ground 0.90 - 1.39m Depth of Made Ground 1.40 - 1.89m Depth of Made Ground 1.90 - 2.39m Depth of Made Ground 2.40 - 2.89m Depth of Made Ground 2.90 - 3.39m Depth of Made Ground > 3.40m		Notes:		Client: Shape Consulting Engineers		Job No: 17-285		Date: 28.03.2024		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 28.03.2024 OW JB AS Phase Issue Date Drawn Checked PM		Job Title: Willow Street, Bury		Drawing No: 006		Scale: NTS @ A3		Drawing Title: Depth of Made Ground 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
- Area Not Investigated Due To Existing Structures
- Retaining Wall

Notes:

P1	REVA	28.03.2024	OW	JB	AS
Phase	Issue	Date	Drawn	Checked	PM

Client:

Shape Consulting Engineers

Job Title:

Willow Street, Bury

Job No:

17-285

Drawing No:

015

Date:

28.03.2024

Scale:

NTS @ A3

Drawing Title:

Development Constraints Plan



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APPENDIX V

PHOTOGRAPHS

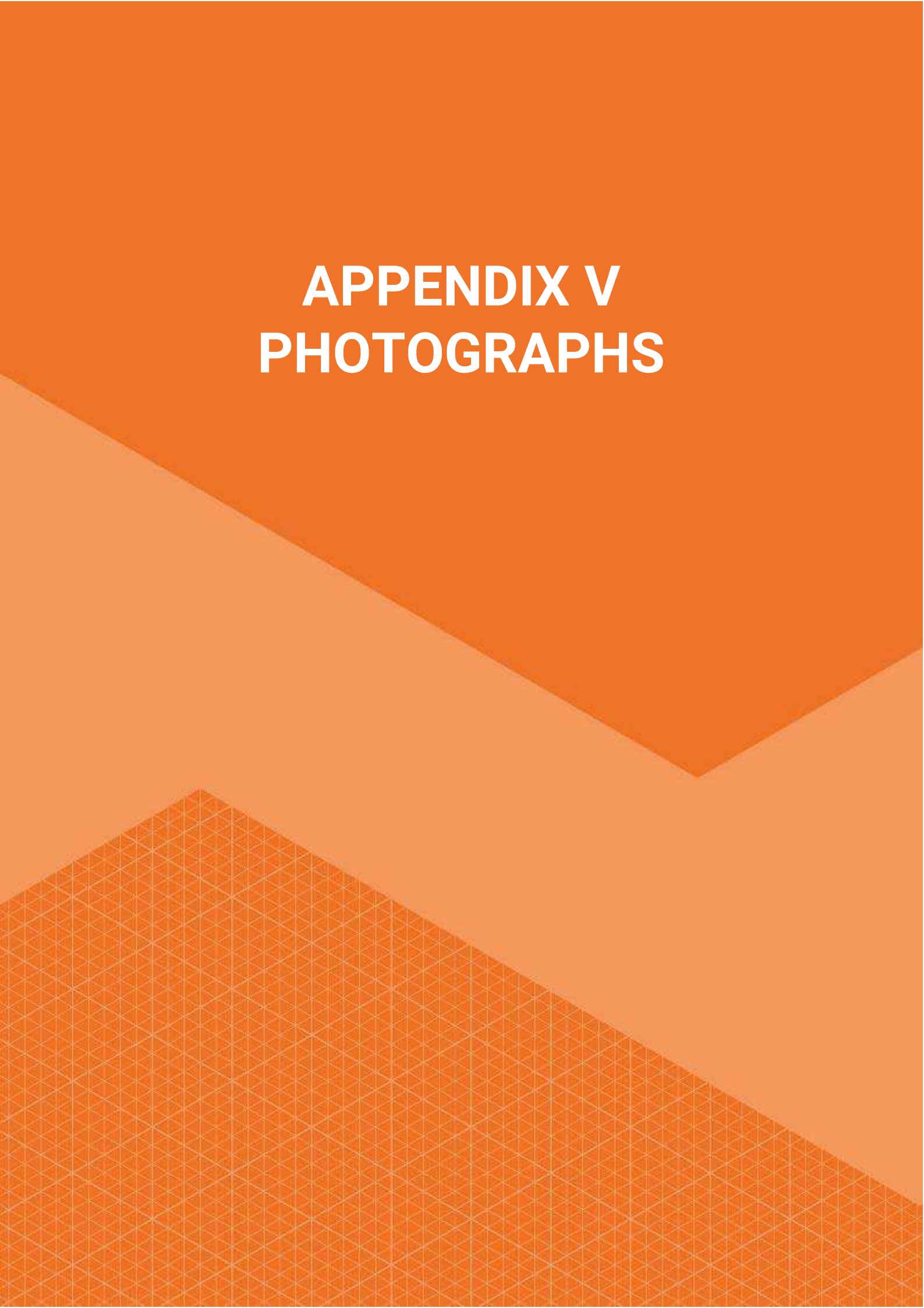
The background of the page is composed of several geometric shapes in shades of orange. A large, dark orange shape occupies the top right. A lighter orange shape is on the left, meeting the dark one. At the bottom, there is a large triangular area filled with a fine, light-colored grid pattern, which also overlaps with the other shapes.



PLATE 1 CARPARK AND STORAGE UNITS IN EAST OF SITE



PLATE 2 COMMERCIAL UNIT AND CARPARK IN SOUTHEAST OF SITE





PLATE 3 SOFTSTANDING AREA AND WINDOW SAMPLE INSTALL IN SOUTHWEST OF SITE (WS106)



PLATE 4 WINDOW SAMPLE CORE (WS104)





PLATE 5 **NORTHEAST OF CARPARK IN SOUTHEAST OF SITE**



PLATE 6 **WINDOW SAMPLE INSTALL CARPARK (WS103)**



APPENDIX VI

EXPLORATORY HOLE LOGS

					Borehole Log			Borehole No. WS101 Sheet 1 of 1				
Project Name: Willow Street					Project No. 17285		Co-ords: 381817.56 - 411011.73		Hole Type WS			
Location: Bury					Level: 96.11		Scale 1:50		Logged By J.Beer			
Client: Shape					Dates: 06/02/2024 -							
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description				
		Depth (m)	Type	Results								
			0.05 0.20	ES	N=10 (2,2/2,3,3,2)	96.06 95.91	MADE GROUND: Tarmac. MADE GROUND: Grey gravel. Gravel is fine to coarse angular to subangular of mudstone. MADE GROUND: Brown gravelly sandy clay. Gravel is fine to coarse angular to subangular of ash, brick and mudstone.	1				
			1.20			94.91						
			1.90 2.00	ES	N=5 (2,2/2,1,1,1)	2.20	93.91	MADE GROUND: Greyish brown sandy gravel. Gravel is fine to coarse angular to subangular of brick, ash, concrete and glass.	2			
			2.50 - 3.00	U		3.00	93.11	Firm low strength light brown mottled grey sandy gravelly CLAY. Gravel is fine to medium subangular to subrounded of mudstone.	3			
			3.00 3.00	D	N=8 (1,1/1,2,2,3)	4.50	91.61	Firm low strength grey slightly sandy gravelly CLAY. Gravel is fine to medium subangular to subrounded of mudstone.	4			
			3.50	ES	N=9 (2,2/3,2,2,2)							
			4.00	D	50 (5,10/50 for 195mm)	5.35	90.76	Grey weathered MUDSTONE bedrock.	5			
			5.00 5.00									
			End of borehole at 5.35 m									6
												7
									8			
									9			
									10			
Remarks 1. Complete. 2. Monitoring well installed. Response zone 2.50 to 4.50 m bgl.												

					Borehole Log			Borehole No. WS102 Sheet 1 of 1		
Project Name: Willow Street					Project No. 17285		Co-ords: 381818.25 - 411030.14		Hole Type WS	
Location: Bury							Level: 96.49		Scale 1:50	
Client: Shape							Dates: 06/02/2024 -		Logged By J.Beer	
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
					0.05	96.44		MADE GROUND: Tarmac.		
					0.20	96.29		MADE GROUND: Grey gravel. Gravel is fine to coarse angular to subangular of mudstone.		
		0.50	ES					MADE GROUND: Brownish black slightly clayey very gravelly fine to medium sand. Gravel is fine to coarse angular to subangular of mudstone, brick, glass, ash, slag and clinker.		
		1.00		N=9 (2,2/2,3,2,2)						
					1.30	95.19		MADE GROUND: Greyish light brown very sandy gravel. Gravel is fine to coarse angular to subangular of mudstone, brick and concrete.		
		1.60	ES							
		2.00		N=7 (2,3/2,2,2,1)	1.90	94.59		MADE GROUND: Light brown slightly gravelly clayey fine to medium sand. Gravel is fine to medium subangular of mudstone, brick and wood.		
					2.40	94.09		Firm grey mottled orange sandy CLAY.		
		2.70	ES							
		3.00	D	N=5 (3,2/2,1,1,1)	3.00	93.49		Firm low strength grey slightly gravelly sandy CLAY. Gravel is fine subangular to subrounded of mudstone. Becoming stiff medium strength at 5.00 m bgl.		
3.00										
		3.50 - 4.00	U							
		4.00	D	N=9 (1,1/1,2,3,3)						
		4.00								
		5.00	D	N=16 (2,3/3,3,5,5)						
		5.00								
					5.45	91.04		End of borehole at 5.45 m		
Remarks 1. Complete.										

						Borehole Log				Borehole No. WS103 Sheet 1 of 1				
Project Name: Willow Street						Project No. 17285		Co-ords: 381809.74 - 411047.18		Hole Type WS				
Location: Bury								Level: 96.83		Scale 1:50				
Client: Shape								Dates: 06/02/2024 -		Logged By J.Beer				
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description						
		Depth (m)	Type	Results										
				ES	N=10 (2,3/3,3,2,2)	0.10	96.73		MADE GROUND: Tarmac. MADE GROUND: Brown clayey sandy gravel. Gravel is fine to coarse angular to subrounded of mudstone and brick. MADE GROUND: Brownish black clayey gravelly fine to medium sand. Gravel is fine to coarse angular to subangular of mudstone, brick, concrete and ash.					
						0.30	96.53							
						0.90								
						1.00								
						1.50	95.33							
						2.00								
						2.60								
						3.00								
						4.00	92.83							
						5.00								
				ES	N=4 (2,2/1,1,1,1)	4.00	92.83		No recovery. Assumed natural CLAY due to depth of base of made ground in other locations. Soft very low strength at 4.00 m bgl. Becoming firm low strength at 5.00 m bgl.					
						5.00								
						5.45	91.38							
						End of borehole at 5.45 m								
Remarks 1. Complete. 2. No recovery 4.00 to 5.45 m bgl. 3. Hole collapse to 4.00 m bgl. Attempted to redrill but hole continued to collapse. 4. Monitoring well installed. Repsonse zone 1.00 to 3.00 m bgl.														

						Borehole Log				Borehole No. WS104 Sheet 1 of 1					
Project Name: Willow Street						Project No. 17285		Co-ords: 381822.05 - 411042.93		Hole Type WS					
Location: Bury								Level: 96.79		Scale 1:50					
Client: Shape								Dates: 06/02/2024 -		Logged By J.Beer					
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description							
		Depth (m)	Type	Results											
		0.70 1.00 1.80 2.00 2.00 - 3.00 3.00 3.80 4.00 5.00 5.00	ES ES B ES D	N=10 (2,2/2,3,3,2) N=7 (2,3/3,2,1,1) N=6 (2,2/2,1,2,1) N=4 (2,2/1,1,1,1) N=5 (2,1/1,1,2,1)	0.10	96.69	MADE GROUND: Tarmac. MADE GROUND: Brown clayey sandy gravel. Gravel is fine to coarse angular to subrounded of mudstone and brick. MADE GROUND: Light brown gravelly very sandy clay. Gravel is fine to medium angular to subrounded of mudstone, sandstone and brick.								
					0.30	96.49									
					1.20	95.59									
									MADE GROUND: Brownish black clayey very sandy gravel. Gravel is fine to coarse angular to subangular of mudstone, sandstone, brick, wood, slag, ash and clinker.		1				
													2		
														3	
															4
															5
															6
															7
										8					
										9					
										10					
Remarks															
1. Complete. 2. Monitoring well installed. Response zone 1.00 to 3.00 m bgl.															

						Borehole Log		Borehole No. WS105 Sheet 1 of 1				
Project Name: Willow Street						Project No. 17285		Co-ords: 381791.59 - 411038.92		Hole Type WS		
Location: Bury						Level: 98.43		Scale 1:50		Logged By J.Beer		
Client: Shape						Dates: 06/02/2024 -						
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description				
		Depth (m)	Type	Results								
		0.10	ES		0.15	98.28		MADE GROUND: Brown slightly gravelly clayey fine to medium sand with rootlets . Gravel is fine to medium subangular to subrounded of mudstone. (Topsoil). MADE GROUND: Light brown clayey fine to medium sand. Geotextile membrane at base of strata. MADE GROUND: Grey gravelly sandy clay (reworked). Gravel is fine to medium subangular to subrounded of mudstone and brick.		1		
			0.50	97.93								
		0.90 1.00	ES	N=6 (1,1/2,2,1,1)								
								Firm to stiff brown sandy CLAY.		2		
		2.00		N=11 (2,2/3,2,3,3)	2.20	96.23						
					2.70	95.73		Grey weathered MUDSTONE bedrock.		3		
		3.00 3.00	D	50 (5,9/50 for 180mm)	3.33	95.10						
							-----End of borehole at 3.33 m				4	
												5
												6
												7
												8
												9
												10
Remarks 1. Terminated due to refusal on weathered bedrock. 2. Monitoring well installed. Response zone 0.50 to 1.50 m bgl.												

						Borehole Log			Borehole No. WS106 Sheet 1 of 1		
Project Name: Willow Street						Project No. 17285		Co-ords: 381779.73 - 411017.88		Hole Type WS	
Location: Bury						Level: 98.35		Scale 1:50			
Client: Shape						Dates: 06/02/2024 -		Logged By J.Beer			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description			
		Depth (m)	Type	Results							
		0.10	ES	N=7 (1,1/1,2,2,2)	0.15	98.20		MADE GROUND: Brown slightly gravelly clayey fine to medium sand with rootlets . Gravel is fine to medium subangular to subrounded of mudstone. (Topsoil).	1		
		1.00			0.90	97.45		MADE GROUND: Brown gravelly sandy clay. Gravel is fine to coarse angular to subangular of ash, brick and mudstone.			
		1.70	ES		1.80	96.55		Firm low strength orangish brown mottled grey gravelly sandy CLAY. Gravel is fine to medium subangular to subrounded of mudstone.			
		2.00	D	N=11 (2,2/2,3,2,4)				Stiff medium strength brown slightly sandy gravelly CLAY. Gravel is fine to medium subangular to subrounded of mudstone. Becoming very stiff very high strength at 3.00 m bgl.	2		
		2.00									
		3.00	D	50 (6,10/50 for 255mm)					3		
		3.00									
					3.41	94.94		End of borehole at 3.41 m	4		
									5		
									6		
							7				
							8				
							9				
							10				
Remarks											
1. Terminated due to refusal on very stiff CLAY. 2. Monitoring well installed. Response zone 1.00 to 2.00 m bgl.											

APPENDIX VII CHEMICAL TESTING RESULTS



e3p
Taylor Road
Urmston
Manchester

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: jbeer@e3p.co.uk

Analytical Report Number : 24-002061

Project / Site name:	Willow Street	Samples received on:	07/02/2024
Your job number:	17 285	Samples instructed on/ Analysis started on:	07/02/2024
Your order number:	00 7373	Analysis completed by:	14/02/2024
Report Issue Number:	1	Report issued on:	16/02/2024
Samples Analysed:	9 soil samples - 1 leachate sample		

Signed:

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

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

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

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

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

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

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

Analytical Report Number: 24-002061
Project / Site name: Willow Street
Your Order No: 00 7373

Lab Sample Number				112199	112200	112201	112202	112203
Sample Reference				WS104	WS104	WS103	WS102	WS101
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.80	3.80	2.60	0.50	0.80
Date Sampled				06/02/2024	06/02/2024	06/02/2024	06/02/2024	06/02/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		

Stone Content	%	0.1	NONE	22	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	17	14	18	14	16
Total mass of sample received	kg	0.1	NONE	0.5	0.5	0.5	0.5	0.5

Asbestos

Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	Not-detected	-	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	KWB	-	KWB	KWB	KWB

General Inorganics

pH (L099)	pH Units	N/A	MCERTS	8.1	7.3	8.6	7.7	7.9
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	1	< 1.0	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	1400	190	1500	630	130
Water Soluble SO ₄ 1hr extraction	mg/kg	2.5	MCERTS	820	47	47	100	11
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	409	23.3	23.3	51.5	5.32
Sulphide	mg/kg	1	MCERTS	73	15	32	< 1.0	< 1.0
Total Sulphur	mg/kg	50	MCERTS	2100	520	880	740	160
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	2.2	0.8	1	1.6	1.4

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	3.7	0.08	0.1	0.24	0.69
Acenaphthylene	mg/kg	0.05	MCERTS	0.12	< 0.05	< 0.05	< 0.05	0.6
Acenaphthene	mg/kg	0.05	MCERTS	6.7	< 0.05	0.07	0.16	0.17
Fluorene	mg/kg	0.05	MCERTS	5.3	< 0.05	< 0.05	0.13	0.42
Phenanthrene	mg/kg	0.05	MCERTS	31	0.17	0.54	1.2	3.3
Anthracene	mg/kg	0.05	MCERTS	8.1	< 0.05	0.12	0.32	0.74
Fluoranthene	mg/kg	0.05	MCERTS	37	0.21	0.73	2.2	5.9
Pyrene	mg/kg	0.05	MCERTS	32	0.18	0.69	2.1	7
Benzo(a)anthracene	mg/kg	0.05	MCERTS	15	0.08	0.4	1.2	3.8
Chrysene	mg/kg	0.05	MCERTS	14	0.09	0.4	1.1	4.1
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	16	0.09	0.47	1.3	3.1
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	7	< 0.05	0.21	0.54	1
Benzo(a)pyrene	mg/kg	0.05	MCERTS	14	0.07	0.41	0.95	2.9
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	6	< 0.05	0.19	0.43	1.2
Dibenzo(a,h)anthracene	mg/kg	0.05	MCERTS	1.5	< 0.05	< 0.05	< 0.05	0.53
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	6.3	< 0.05	0.23	0.47	1.5

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	203	0.97	4.56	12.3	-
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Analytical Report Number: 24-002061
Project / Site name: Willow Street
Your Order No: 00 7373

Lab Sample Number				112199	112200	112201	112202	112203
Sample Reference				WS104	WS104	WS103	WS102	WS101
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.80	3.80	2.60	0.50	0.80
Date Sampled				06/02/2024	06/02/2024	06/02/2024	06/02/2024	06/02/2024
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	15	8.8	14	45	15
Barium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-	-	-	-	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-	-	-	-	-
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	16	19	7.9	66	22
Copper (aqua regia extractable)	mg/kg	1	MCERTS	72	21	25	190	39
Lead (aqua regia extractable)	mg/kg	1	MCERTS	45	38	130	150	51
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	0.4	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	31	26	10	46	26
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	54	67	51	95	98

Petroleum Hydrocarbons

TPH (>C5 - C10) HS_1D_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (>C5 - C6) HS_1D_TOTAL	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (>C6 - C8) HS_1D_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (>C8 - C10) HS_1D_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (>C10 - C12) EH_CU_1D_TOTAL_#1_#2	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH (>C12 - C16) EH_CU_1D_TOTAL_#1_#2	mg/kg	4	MCERTS	18	< 4.0	8.4	< 4.0	13
TPH (>C16 - C21) EH_CU_1D_TOTAL_#1_#2	mg/kg	10	MCERTS	82	< 10	18	15	36
TPH (>C21 - C35) EH_CU_1D_TOTAL_#1_#2	mg/kg	10	MCERTS	140	< 10	16	70	53
TPH (>C35 - C40) EH_CU_1D_TOTAL_#1_#2	mg/kg	10	MCERTS	< 10	< 10	< 10	14	< 10
TPH Total >C5 - C40 EH_CU+HS_1D_TOTAL_#1_#2	mg/kg	10	NONE	250	< 10	43	99	100
TPH (C10 - C40) EH_CU_1D_TOTAL_#1_#2	mg/kg	10	MCERTS	250	< 10	43	99	100

Analytical Report Number: 24-002061
Project / Site name: Willow Street
Your Order No: 00 7373

Lab Sample Number				112199	112200	112201	112202	112203
Sample Reference				WS104	WS104	WS103	WS102	WS101
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.80	3.80	2.60	0.50	0.80
Date Sampled				06/02/2024	06/02/2024	06/02/2024	06/02/2024	06/02/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					

VOCs

Chloromethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Chloroethane	µg/kg	5	NONE	-	-	-	-	< 5.0
Bromomethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Vinyl Chloride	µg/kg	5	NONE	-	-	-	-	< 5.0
Trichlorofluoromethane	µg/kg	5	NONE	-	-	-	-	< 5.0
1,1-Dichloroethene	µg/kg	5	NONE	-	-	-	-	< 5.0
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	5	NONE	-	-	-	-	< 5.0
Trans 1,2-dichloroethylene	µg/kg	5	NONE	-	-	-	-	< 5.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	-	-	-	-	< 5.0
1,1-Dichloroethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
2,2-Dichloropropane	µg/kg	5	NONE	-	-	-	-	< 5.0
Chloroform	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,1,1-Trichloroethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,2-Dichloroethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,1-Dichloropropene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Cis-1,2-dichloroethene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Benzene	µg/kg	5	MCERTS	-	-	-	-	< 5.0
Carbontetrachloride	µg/kg	5	NONE	-	-	-	-	< 5.0
1,2-Dichloropropane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Trichloroethene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Dibromomethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Bromodichloromethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Cis-1,3-dichloropropene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Trans-1,3-dichloropropene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Toluene	µg/kg	5	MCERTS	-	-	-	-	< 5.0
1,1,2-Trichloroethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,3-Dichloropropane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Dibromochloromethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Tetrachloroethene	µg/kg	5	NONE	-	-	-	-	< 5.0
1,2-Dibromoethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Chlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,1,1,2-Tetrachloroethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	-	-	-	-	< 5.0
p & m-Xylene	µg/kg	5	MCERTS	-	-	-	-	< 5.0
Styrene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Bromoform	µg/kg	5	NONE	-	-	-	-	< 5.0
o-Xylene	µg/kg	5	MCERTS	-	-	-	-	< 5.0
Isopropylbenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,1,2,2-Tetrachloroethane	µg/kg	5	NONE	-	-	-	-	< 5.0
Bromobenzene	µg/kg	5	NONE	-	-	-	-	< 5.0
n-Propylbenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
2-Chlorotoluene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
4-Chlorotoluene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,3,5-Trimethylbenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
tert-Butylbenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,2,4-Trimethylbenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
sec-Butylbenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,3-Dichlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
p-Isopropyltoluene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,4-Dichlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,2-Dichlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0

Analytical Report Number: 24-002061
 Project / Site name: Willow Street
 Your Order No: 00 7373

Lab Sample Number				112199	112200	112201	112202	112203
Sample Reference				WS104	WS104	WS103	WS102	WS101
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.80	3.80	2.60	0.50	0.80
Date Sampled				06/02/2024	06/02/2024	06/02/2024	06/02/2024	06/02/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		
Butylbenzene				µg/kg	5	NONE	-	< 5.0
1,2-Dibromo-3-chloropropane				µg/kg	5	ISO 17025	-	< 5.0
1,2,4-Trichlorobenzene				µg/kg	5	ISO 17025	-	< 5.0
Hexachlorobutadiene				µg/kg	5	NONE	-	< 5.0
1,2,3-Trichlorobenzene				µg/kg	5	ISO 17025	-	< 5.0

Analytical Report Number: 24-002061
Project / Site name: Willow Street
Your Order No: 00 7373

Lab Sample Number				112199	112200	112201	112202	112203
Sample Reference				WS104	WS104	WS103	WS102	WS101
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.80	3.80	2.60	0.50	0.80
Date Sampled				06/02/2024	06/02/2024	06/02/2024	06/02/2024	06/02/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		

SVOCs

Aniline	mg/kg	0.1	NONE	-	-	-	-	< 0.1
Phenol	mg/kg	0.2	ISO 17025	-	-	-	-	< 0.2
2-Chlorophenol	mg/kg	0.1	MCERTS	-	-	-	-	< 0.1
Bis(2-chloroethyl)ether	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
1,3-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
1,2-Dichlorobenzene	mg/kg	0.1	MCERTS	-	-	-	-	< 0.1
1,4-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
Bis(2-chloroisopropyl)ether	mg/kg	0.1	MCERTS	-	-	-	-	< 0.1
2-Methylphenol	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
Hexachloroethane	mg/kg	0.05	ISO 17025	-	-	-	-	< 0.05
Nitrobenzene	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
4-Methylphenol	mg/kg	0.2	NONE	-	-	-	-	0.3
Isophorone	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
2-Nitrophenol	mg/kg	0.3	NONE	-	-	-	-	< 0.3
2,4-Dimethylphenol	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
Bis(2-chloroethoxy)methane	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
1,2,4-Trichlorobenzene	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
2,4-Dichlorophenol	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
4-Chloroaniline	mg/kg	0.1	NONE	-	-	-	-	0.3
Hexachlorobutadiene	mg/kg	0.1	MCERTS	-	-	-	-	< 0.1
4-Chloro-3-methylphenol	mg/kg	0.1	NONE	-	-	-	-	< 0.1
2,4,6-Trichlorophenol	mg/kg	0.1	NONE	-	-	-	-	< 0.1
2,4,5-Trichlorophenol	mg/kg	0.2	NONE	-	-	-	-	< 0.2
2-Methylnaphthalene	mg/kg	0.1	NONE	-	-	-	-	0.4
2-Chloronaphthalene	mg/kg	0.1	MCERTS	-	-	-	-	< 0.1
Dimethylphthalate	mg/kg	0.1	MCERTS	-	-	-	-	< 0.1
2,6-Dinitrotoluene	mg/kg	0.1	NONE	-	-	-	-	< 0.1
2,4-Dinitrotoluene	mg/kg	0.2	NONE	-	-	-	-	< 0.2
Dibenzofuran	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
4-Chlorophenyl phenyl ether	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
Diethyl phthalate	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
4-Nitroaniline	mg/kg	0.2	NONE	-	-	-	-	< 0.2
Azobenzene	mg/kg	0.3	NONE	-	-	-	-	< 0.3
Bromophenyl phenyl ether	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
Hexachlorobenzene	mg/kg	0.2	MCERTS	-	-	-	-	< 0.20
Carbazole	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
Dibutyl phthalate	mg/kg	0.2	NONE	-	-	-	-	< 0.2
Anthraquinone	mg/kg	0.3	NONE	-	-	-	-	1.9
Butyl benzyl phthalate	mg/kg	0.3	NONE	-	-	-	-	< 0.3

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

Analytical Report Number: 24-002061
Project / Site name: Willow Street
Your Order No: 00 7373

Lab Sample Number				112204	112205	112206	112207
Sample Reference				WS101	WS105	WS106	WS106
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				3.50	0.90	0.10	1.70
Date Sampled				06/02/2024	06/02/2024	06/02/2024	06/02/2024
Time Taken				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
Moisture Content	%	0.01	NONE	13	13	25	14
Total mass of sample received	kg	0.1	NONE	0.5	0.5	0.5	0.5

Asbestos

Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	-	Not-detected	Not-detected	-
Asbestos Analyst ID	N/A	N/A	N/A	-	KWB	KWB	-

General Inorganics

pH (L099)	pH Units	N/A	MCERTS	7.7	7.8	-	6.8
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	300	150	-	170
Water Soluble SO ₄ 1hr extraction	mg/kg	2.5	MCERTS	34	20	-	52
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	17	10	-	25.8
Sulphide	mg/kg	1	MCERTS	< 1.0	1.1	-	3
Total Sulphur	mg/kg	50	MCERTS	140	150	-	130
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	0.3	1	-	0.8

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	0.29	0.14	0.12	0.18
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	0.05	0.4	0.14	< 0.05
Fluorene	mg/kg	0.05	MCERTS	0.06	0.31	0.1	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.35	2.6	1.1	0.18
Anthracene	mg/kg	0.05	MCERTS	0.08	0.53	0.23	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.44	3	1.8	0.23
Pyrene	mg/kg	0.05	MCERTS	0.38	2.5	1.7	0.23
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.16	1.2	0.85	0.08
Chrysene	mg/kg	0.05	MCERTS	0.18	1.2	0.93	0.08
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	0.13	1.2	1.3	0.08
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	0.11	0.65	0.31	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.12	1.2	0.89	0.06
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	0.47	0.43	< 0.05
Dibenzo(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	0.11	0.11	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	0.52	0.52	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	2.35	16.1	10.4	1.12
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Analytical Report Number: 24-002061
Project / Site name: Willow Street
Your Order No: 00 7373

Lab Sample Number				112204	112205	112206	112207
Sample Reference				WS101	WS105	WS106	WS106
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				3.50	0.90	0.10	1.70
Date Sampled				06/02/2024	06/02/2024	06/02/2024	06/02/2024
Time Taken				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	7.7	11	9.2	8.3
Barium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	130	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-	-	0.65	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-	-	0.5	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	0.4	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	21	19	-	18
Copper (aqua regia extractable)	mg/kg	1	MCERTS	4.9	33	40	19
Lead (aqua regia extractable)	mg/kg	1	MCERTS	5.8	39	74	16
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	38	25	13	22
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	19	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	57	83	76	66

Petroleum Hydrocarbons

TPH (>C5 - C10) HS_1D_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0
TPH (>C5 - C6) HS_1D_TOTAL	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1
TPH (>C6 - C8) HS_1D_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0
TPH (>C8 - C10) HS_1D_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0
TPH (>C10 - C12) EH_CU_1D_TOTAL_#1_#2	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0
TPH (>C12 - C16) EH_CU_1D_TOTAL_#1_#2	mg/kg	4	MCERTS	< 4.0	6.3	< 4.0	< 4.0
TPH (>C16 - C21) EH_CU_1D_TOTAL_#1_#2	mg/kg	10	MCERTS	< 10	14	< 10	< 10
TPH (>C21 - C35) EH_CU_1D_TOTAL_#1_#2	mg/kg	10	MCERTS	< 10	15	21	< 10
TPH (>C35 - C40) EH_CU_1D_TOTAL_#1_#2	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10
TPH Total >C5 - C40 EH_CU+HS_1D_TOTAL_#1_#2	mg/kg	10	NONE	< 10	35	29	< 10
TPH (C10 - C40) EH_CU_1D_TOTAL_#1_#2	mg/kg	10	MCERTS	< 10	35	29	< 10

Analytical Report Number: 24-002061
Project / Site name: Willow Street
Your Order No: 00 7373

Lab Sample Number				112204	112205	112206	112207
Sample Reference				WS101	WS105	WS106	WS106
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				3.50	0.90	0.10	1.70
Date Sampled				06/02/2024	06/02/2024	06/02/2024	06/02/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status				

VOCs

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



Analytical Report Number: 24-002061
Project / Site name: Willow Street
Your Order No: 00 7373

Lab Sample Number				112204	112205	112206	112207
Sample Reference				WS101	WS105	WS106	WS106
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				3.50	0.90	0.10	1.70
Date Sampled				06/02/2024	06/02/2024	06/02/2024	06/02/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status				
Butylbenzene	µg/kg	5	NONE	-	-	-	-
1,2-Dibromo-3-chloropropane	µg/kg	5	ISO 17025	-	-	-	-
1,2,4-Trichlorobenzene	µg/kg	5	ISO 17025	-	-	-	-
Hexachlorobutadiene	µg/kg	5	NONE	-	-	-	-
1,2,3-Trichlorobenzene	µg/kg	5	ISO 17025	-	-	-	-

Analytical Report Number: 24-002061
Project / Site name: Willow Street
Your Order No: 00 7373

Lab Sample Number				112204	112205	112206	112207
Sample Reference				WS101	WS105	WS106	WS106
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				3.50	0.90	0.10	1.70
Date Sampled				06/02/2024	06/02/2024	06/02/2024	06/02/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status	

SVOCs

Aniline	mg/kg	0.1	NONE	-	-	-	-
Phenol	mg/kg	0.2	ISO 17025	-	-	-	-
2-Chlorophenol	mg/kg	0.1	MCERTS	-	-	-	-
Bis(2-chloroethyl)ether	mg/kg	0.2	MCERTS	-	-	-	-
1,3-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-	-	-
1,2-Dichlorobenzene	mg/kg	0.1	MCERTS	-	-	-	-
1,4-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-	-	-
Bis(2-chloroisopropyl)ether	mg/kg	0.1	MCERTS	-	-	-	-
2-Methylphenol	mg/kg	0.3	MCERTS	-	-	-	-
Hexachloroethane	mg/kg	0.05	ISO 17025	-	-	-	-
Nitrobenzene	mg/kg	0.3	MCERTS	-	-	-	-
4-Methylphenol	mg/kg	0.2	NONE	-	-	-	-
Isophorone	mg/kg	0.2	MCERTS	-	-	-	-
2-Nitrophenol	mg/kg	0.3	NONE	-	-	-	-
2,4-Dimethylphenol	mg/kg	0.3	MCERTS	-	-	-	-
Bis(2-chloroethoxy)methane	mg/kg	0.3	MCERTS	-	-	-	-
1,2,4-Trichlorobenzene	mg/kg	0.3	MCERTS	-	-	-	-
2,4-Dichlorophenol	mg/kg	0.3	MCERTS	-	-	-	-
4-Chloroaniline	mg/kg	0.1	NONE	-	-	-	-
Hexachlorobutadiene	mg/kg	0.1	MCERTS	-	-	-	-
4-Chloro-3-methylphenol	mg/kg	0.1	NONE	-	-	-	-
2,4,6-Trichlorophenol	mg/kg	0.1	NONE	-	-	-	-
2,4,5-Trichlorophenol	mg/kg	0.2	NONE	-	-	-	-
2-Methylnaphthalene	mg/kg	0.1	NONE	-	-	-	-
2-Chloronaphthalene	mg/kg	0.1	MCERTS	-	-	-	-
Dimethylphthalate	mg/kg	0.1	MCERTS	-	-	-	-
2,6-Dinitrotoluene	mg/kg	0.1	NONE	-	-	-	-
2,4-Dinitrotoluene	mg/kg	0.2	NONE	-	-	-	-
Dibenzofuran	mg/kg	0.2	MCERTS	-	-	-	-
4-Chlorophenyl phenyl ether	mg/kg	0.3	MCERTS	-	-	-	-
Diethyl phthalate	mg/kg	0.2	MCERTS	-	-	-	-
4-Nitroaniline	mg/kg	0.2	NONE	-	-	-	-
Azobenzene	mg/kg	0.3	NONE	-	-	-	-
Bromophenyl phenyl ether	mg/kg	0.2	MCERTS	-	-	-	-
Hexachlorobenzene	mg/kg	0.2	MCERTS	-	-	-	-
Carbazole	mg/kg	0.3	MCERTS	-	-	-	-
Dibutyl phthalate	mg/kg	0.2	NONE	-	-	-	-
Anthraquinone	mg/kg	0.3	NONE	-	-	-	-
Butyl benzyl phthalate	mg/kg	0.3	NONE	-	-	-	-

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



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Analytical Report Number: 24-002061

Project / Site name: Willow Street

Your Order No: 00 7373

Lab Sample Number				112208
Sample Reference				WS103
Sample Number				None Supplied
Depth (m)				0.90
Date Sampled				06/02/2024
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 (Low Level 1 µg/l)	µg/l	1	NONE	< 1.0

Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	0.72
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	0.19
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
Dibenzo(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	0.16	NONE	0.91
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Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	1	ISO 17025	1.8
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	0.5
Copper (dissolved)	µg/l	0.7	ISO 17025	8.3
Lead (dissolved)	µg/l	1	ISO 17025	< 1.0
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5
Nickel (dissolved)	µg/l	0.3	ISO 17025	0.9
Selenium (dissolved)	µg/l	4	ISO 17025	< 4.0
Zinc (dissolved)	µg/l	0.4	ISO 17025	16



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Analytical Report Number: 24-002061

Project / Site name: Willow Street

Your Order No: 00 7373

Lab Sample Number				112208
Sample Reference				WS103
Sample Number				None Supplied
Depth (m)				0.90
Date Sampled				06/02/2024
Time Taken				None Supplied
Analytical Parameter (Leachate Analysis)	Units	Limit of detection	Accreditation Status	

Petroleum Hydrocarbons

TPH - Aliphatic >C5 - C6 HS_1D_AL	µg/l	1	ISO 17025	< 1.0
TPH - Aliphatic >C6 - C8 HS_1D_AL	µg/l	1	ISO 17025	< 1.0
TPH - Aliphatic >C8 - C10 HS_1D_AL	µg/l	1	ISO 17025	< 1.0
TPH - Aliphatic >C10 - C12 EH_1D_AL_#1_#2_MS	µg/l	10	NONE	< 10
TPH - Aliphatic >C12 - C16 EH_1D_AL_#1_#2_MS	µg/l	10	NONE	< 10
TPH - Aliphatic >C16 - C21 EH_1D_AL_#1_#2_MS	µg/l	10	NONE	< 10
TPH - Aliphatic >C21 - C35 EH_1D_AL_#1_#2_MS	µg/l	10	NONE	< 10
TPH - Aliphatic >C5 - C35 HS+EH_1D_AL_#1_#2_MS	µg/l	10	NONE	< 10

TPH - Aromatic >EC5 - EC7 HS_1D_AR	µg/l	1	ISO 17025	< 1.0
TPH - Aromatic >EC7 - EC8 HS_1D_AR	µg/l	1	ISO 17025	< 1.0
TPH - Aromatic >EC8 - EC10 EH_1D_AR_#1_#2_MS	µg/l	1	ISO 17025	< 1.0
TPH - Aromatic >EC10 - EC12 EH_1D_AR_#1_#2_MS	µg/l	10	NONE	< 10
TPH - Aromatic >EC12 - EC16 EH_1D_AR_#1_#2_MS	µg/l	10	NONE	< 10
TPH - Aromatic >EC16 - EC21 EH_1D_AR_#1_#2_MS	µg/l	10	NONE	< 10
TPH - Aromatic >EC21 - EC35 EH_1D_AR_#1_#2_MS	µg/l	10	NONE	< 10

TPH (C10 - C40) EH_1D_TOTAL_#1_#2_MS	µg/l	10	NONE	< 10
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VOCs

MTBE (Methyl Tertiary Butyl Ether)	µg/l	3	NONE	< 3.0
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

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

Analytical Report Number : 24-002061

Project / Site name: Willow Street

* 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 *
112199	WS104	None Supplied	1.8	Brown clay and sand with gravel and stones
112200	WS104	None Supplied	3.8	Brown clay and sand
112201	WS103	None Supplied	2.6	Brown sand with gravel and brick
112202	WS102	None Supplied	0.5	Brown loam and sand with clinker and gravel
112203	WS101	None Supplied	0.8	Brown clay and sand with gravel
112204	WS101	None Supplied	3.5	Brown clay and loam with gravel and vegetation
112205	WS105	None Supplied	0.9	Brown sandy clay with gravel
112206	WS106	None Supplied	0.1	Brown clay and loam with gravel and vegetation
112207	WS106	None Supplied	1.7	Brown clay and sand

Analytical Report Number : 24-002061

Project / Site name: Willow Street

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
Asbestos identification in Soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques	In-house method based on HSG 248, 2021	A001B	D	ISO 17025
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate (Walkley Black Method)	In-house method	L009B	D	MCERTS
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	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight	In-house method based on British Standard Methods and MCERTS requirements.	L019B	D	NONE
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L038B	D	MCERTS
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES	In-house method based on Second Site Properties version 3	L038B	D	MCERTS
Total sulphate (as SO ₄ in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES	In-house method	L038B	D	MCERTS
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES	In-house method	L038B	D	MCERTS
Sulphate, water soluble, in soil (1hr extraction)	Sulphate, water soluble, in soil (1hr extraction)	In-house method	L038B	D	MCERTS
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	L039B	W	ISO 17025
Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds (including PAH) in soil by extraction in dichloromethane and hexane followed by GC-MS	In-house method based on USEPA 8270	L064B	D	MCERTS
Total petroleum hydrocarbons with carbon banding by GC-MS/GC-MS HS in leachate	Determination of total petroleum hydrocarbons in leachate by GC-MS/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	L070B/L088	W	ISO 17025
Total petroleum hydrocarbons by GC-MS/GC-MS HS in leachate	Determination of total petroleum hydrocarbons in leachate by GC-MS/GC-MS HS	In-house method	L070B/L088	W	NONE
BTEX and/or Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS	In-house method based on USEPA 8260	L073B	W	MCERTS
BTEX and/or Volatile organic compounds in leachate	Determination of volatile organic compounds in leachate by headspace GC-MS	In-house method based on USEPA 8260	L073B	W	ISO 17025

Analytical Report Number : 24-002061

Project / Site name: Willow Street

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
Total petroleum hydrocarbons by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS	In-house method	L076B/L088	D/W	MCERTS
Hexavalent chromium in leachate	Determination of hexavalent chromium in leachate by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	In-house method	L080	W	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	W	MCERTS
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	MCERTS
Total cyanide (low level) 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	L080	W	NONE
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	L080	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement	In-house method	L099	D	MCERTS
pH at 20°C in leachate (automated)	Determination of pH in leachate by electrometric measurement	In-house method	L099	W	ISO 17025
Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in leachate	SVOCs and PAHs in leachate	In-house method	L102B		ISO 17025
Organic 2:1 Leachate		In-house method	L020B	W	NONE

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

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

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

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



4041

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Analytical Report Number : 24-004903

Project / Site name:	Willow Street Barry	Samples received on:	22/02/2024
Your job number:		Samples instructed on/ Analysis started on:	22/02/2024
Your order number:	007487	Analysis completed by:	29/02/2024
Report Issue Number:	1	Report issued on:	29/02/2024
Samples Analysed:	1 water sample		

Signed:

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

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

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

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

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

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

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



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Analytical Report Number: 24-004903
Project / Site name: Willow Street Barry

Your Order No: 007487

Lab Sample Number				125573
Sample Reference				WS101
Sample Number				None Supplied
Depth (m)				None Supplied
Date Sampled				21/02/2024
Time Taken				None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status	

General Inorganics

pH (L099)	pH Units	N/A	ISO 17025	6.9
Total Cyanide (Low Level 1 µg/l)	µg/l	1	NONE	< 1.0
Dissolved Organic Carbon (DOC)	mg/l	0.1	ISO 17025	1.76

Total Phenols

Total Phenols (Monohydric) Low Level 1ug/l	µg/l	1	NONE	< 1.0
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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	0.19
Fluorene	µg/l	0.01	ISO 17025	0.11
Phenanthrene	µg/l	0.01	ISO 17025	1.5
Anthracene	µg/l	0.01	ISO 17025	0.62
Fluoranthene	µg/l	0.01	ISO 17025	6.7
Pyrene	µg/l	0.01	ISO 17025	6.1
Benzo(a)anthracene	µg/l	0.01	ISO 17025	3.2
Chrysene	µg/l	0.01	ISO 17025	3.2
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	3.6
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	1.4
Benzo(a)pyrene	µg/l	0.01	ISO 17025	3.5
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	1.4
Dibenzo(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	1.6

Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	0.15	ISO 17025	< 0.15
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.03
Chromium (dissolved)	µg/l	0.2	ISO 17025	0.9
Copper (dissolved)	µg/l	0.5	ISO 17025	12
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2
Manganese (dissolved)	µg/l	0.05	ISO 17025	25
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	18
Selenium (dissolved)	µg/l	0.6	ISO 17025	0.9
Zinc (dissolved)	µg/l	0.5	ISO 17025	7.7

Calcium (dissolved)	mg/l	0.012	ISO 17025	72
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0



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Analytical Report Number: 24-004903
Project / Site name: Willow Street Barry

Your Order No: 007487

Lab Sample Number				125573
Sample Reference				WS101
Sample Number				None Supplied
Depth (m)				None Supplied
Date Sampled				21/02/2024
Time Taken				None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status	

Petroleum Hydrocarbons

TPH - Aliphatic >C5 - C6 HS_ID_AL	µg/l	1	ISO 17025	< 1.0
TPH - Aliphatic >C6 - C8 HS_ID_AL	µg/l	1	ISO 17025	< 1.0
TPH - Aliphatic >C8 - C10 HS_ID_AL	µg/l	1	ISO 17025	< 1.0
TPH - Aliphatic >C10 - C12 EH_ID_AL_#1_#2_MS	µg/l	10	NONE	< 10
TPH - Aliphatic >C12 - C16 EH_ID_AL_#1_#2_MS	µg/l	10	NONE	< 10
TPH - Aliphatic >C16 - C21 EH_ID_AL_#1_#2_MS	µg/l	10	NONE	< 10
TPH - Aliphatic >C21 - C35 EH_ID_AL_#1_#2_MS	µg/l	10	NONE	< 10
TPH - Aliphatic >C5 - C35 HS+EH_ID_AL_#1_#2_MS	µg/l	10	NONE	< 10

TPH - Aromatic >EC5 - EC7 HS_ID_AR	µg/l	1	ISO 17025	< 1.0
TPH - Aromatic >EC7 - EC8 HS_ID_AR	µg/l	1	ISO 17025	< 1.0
TPH - Aromatic >EC8 - EC10 HS_ID_AR	µg/l	1	ISO 17025	< 1.0
TPH - Aromatic >EC10 - EC12 EH_ID_AR_#1_#2_MS	µg/l	10	NONE	< 10
TPH - Aromatic >EC12 - EC16 EH_ID_AR_#1_#2_MS	µg/l	10	NONE	10
TPH - Aromatic >EC16 - EC21 EH_ID_AR_#1_#2_MS	µg/l	10	NONE	40
TPH - Aromatic >EC21 - EC35 EH_ID_AR_#1_#2_MS	µg/l	10	NONE	30
TPH - Aromatic >EC5 - EC35 HS+EH_ID_AR_#1_#2_MS	µg/l	10	NONE	80

TPH (C10 - C40) EH_ID_TOTAL_#1_#2_MS	µg/l	10	NONE	80
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Analytical Report Number: 24-004903
Project / Site name: Willow Street Barry

Your Order No: 007487

Lab Sample Number				125573
Sample Reference				WS101
Sample Number				None Supplied
Depth (m)				None Supplied
Date Sampled				21/02/2024
Time Taken				None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status	

VOCs

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



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Analytical Report Number: 24-004903
Project / Site name: Willow Street Barry

Your Order No: 007487

Lab Sample Number				125573
Sample Reference				WS101
Sample Number				None Supplied
Depth (m)				None Supplied
Date Sampled				21/02/2024
Time Taken				None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status	
Butylbenzene	µg/l	3	ISO 17025	< 3.0
1,2-Dibromo-3-chloropropane	µg/l	3	ISO 17025	< 3.0
1,2,4-Trichlorobenzene	µg/l	3	ISO 17025	< 3.0
Hexachlorobutadiene	µg/l	3	ISO 17025	< 3.0
1,2,3-Trichlorobenzene	µg/l	3	ISO 17025	< 3.0

SVOCs

Aniline	µg/l	0.05	NONE	< 0.05
Phenol	µg/l	0.05	NONE	< 0.05
2-Chlorophenol	µg/l	0.05	NONE	< 0.05
Bis(2-chloroethyl)ether	µg/l	0.05	NONE	< 0.05
1,3-Dichlorobenzene	µg/l	0.05	NONE	< 0.05
1,2-Dichlorobenzene	µg/l	0.05	NONE	< 0.1
1,4-Dichlorobenzene	µg/l	0.05	NONE	< 0.05
Bis(2-chloroisopropyl)ether	µg/l	0.05	NONE	< 0.05
2-Methylphenol	µg/l	0.05	NONE	< 0.05
Hexachloroethane	µg/l	0.05	NONE	< 0.05
Nitrobenzene	µg/l	0.05	NONE	< 0.05
4-Methylphenol	µg/l	0.05	NONE	< 0.05
Isophorone	µg/l	0.05	NONE	< 0.05
2-Nitrophenol	µg/l	0.05	NONE	< 0.05
2,4-Dimethylphenol	µg/l	0.05	NONE	< 0.05
Bis(2-chloroethoxy)methane	µg/l	0.05	NONE	< 0.05
1,2,4-Trichlorobenzene	µg/l	0.05	NONE	< 0.05
2,4-Dichlorophenol	µg/l	0.05	NONE	< 0.05
4-Chloroaniline	µg/l	0.05	NONE	< 0.05
Hexachlorobutadiene	µg/l	0.05	NONE	< 0.05
4-Chloro-3-methylphenol	µg/l	0.05	NONE	< 0.05
2,4,6-Trichlorophenol	µg/l	0.05	NONE	< 0.05
2,4,5-Trichlorophenol	µg/l	0.05	NONE	< 0.05
2-Methylnaphthalene	µg/l	0.05	NONE	< 0.05
2-Chloronaphthalene	µg/l	0.05	NONE	< 0.05
Dimethylphthalate	µg/l	0.05	NONE	< 0.05
2,6-Dinitrotoluene	µg/l	0.05	NONE	< 0.05
2,4-Dinitrotoluene	µg/l	0.05	NONE	< 0.1
Dibenzofuran	µg/l	0.05	NONE	< 0.05
4-Chlorophenyl phenyl ether	µg/l	0.05	NONE	< 0.05
Diethyl phthalate	µg/l	0.05	NONE	< 0.05
4-Nitroaniline	µg/l	0.05	NONE	< 0.05
Azobenzene	µg/l	0.05	NONE	< 0.05
Bromophenyl phenyl ether	µg/l	0.05	NONE	< 0.05
Hexachlorobenzene	µg/l	0.05	NONE	< 0.050
Carbazole	µg/l	0.05	NONE	< 0.05
Dibutyl phthalate	µg/l	0.05	NONE	< 0.05
Anthraquinone	µg/l	0.05	NONE	< 0.05
Butyl benzyl phthalate	µg/l	0.05	NONE	< 0.05
3+4-Methylphenol	µg/l	0.1	NONE	< 0.10

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



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**Analytical Report Number : 24-004903****Project / Site name: Willow Street Barry****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	L012B	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved organic carbon in water by TOC/DOC NDIR Analyser	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037B	W	ISO 17025
Total petroleum hydrocarbons with carbon banding by GC-MS in water	Determination of total petroleum hydrocarbons in water by GC-MS/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	L070B	W	NONE
Total petroleum hydrocarbons by GC-MS in water	Determination of total petroleum hydrocarbons in water by GC-MS/GC-MS HS	In-house method	L070B	W	NONE
BTEX and/or Volatile organic compounds in water	Determination of volatile organic compounds in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA 8260	L073B	W	ISO 17025
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW	L080	W	ISO 17025
Monohydric phenols (low level) in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	NONE
Total cyanide (low level) in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	NONE
Total petroleum hydrocarbons by GC-MS HS in water	Determination of total petroleum hydrocarbons in water by GC-MS HS	In-house method	L088	W	ISO 17025
pH at 20°C in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In-house method	L099	W	ISO 17025
Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in water	Determination of semi-volatile organic compounds (including PAH) in leachate by extraction in dichloromethane followed by GC-MS	In-house method based on USEPA 8270	L102B	W	ISO 17025
Phenols in water by GC-MS	Determination of phenols in water by GC-MS	In-house method	L102B	W	NONE
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	L039B	W	ISO 17025

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

APPENDIX VIII

GEOTECHNICAL TESTING

RESULTS



LABORATORY REPORT



Contract Number: PSL24/1030

Report Date: 27 February 2024

Client's Reference: 17-285

Client Name: E3P
Taylor Road
Urmston
Manchester
M41 7JQ

For the attention of: Jonny Beer

Contract Title: Willow Street

Date Received: 8/2/2024

Date Commenced: 8/2/2024

Date Completed: 27/2/2024

Notes: Opinions and Interpretations are outside the UKAS Accreditation

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

Checked and Approved Signatories:

A Watkins
(Managing Director)

R Berriman
(Associate Director)

S Royle
(Laboratory Manager)

L Knight
(Assistant Laboratory Manager) (Senior Technical Coordinator)

S Eyre

T Watkins
(Senior Technician)

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Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

[illegible]

Willow Street

Contract No:

PSL24/1030

Client Ref:

17-285

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

[illegible]

SYMBOLS : NP : Non Plastic

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



Willow Street

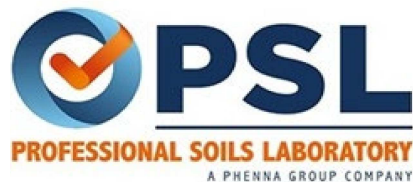
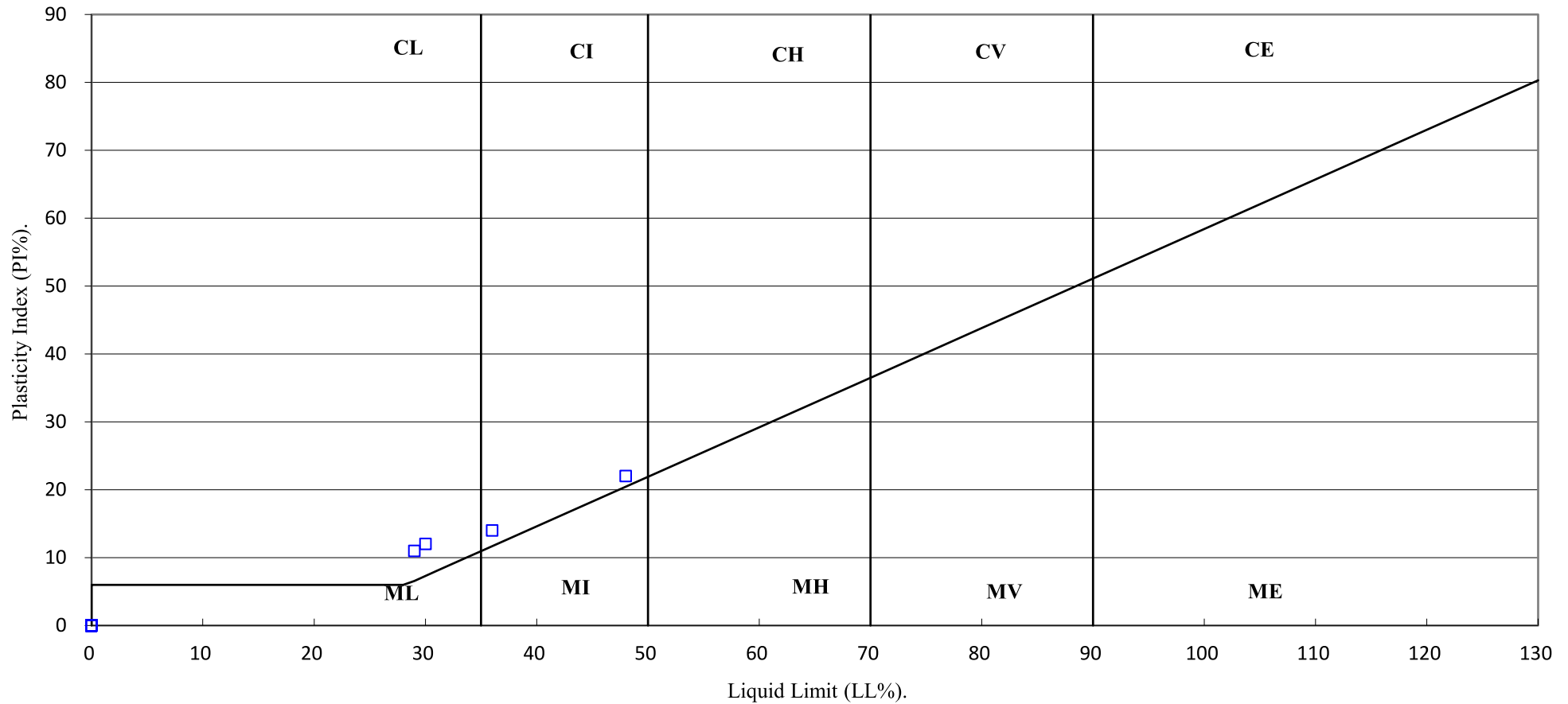
Contract No:

PSL24/1030

Client Ref:

17-285

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



Willow Street

Contract No:

PSL24/1030

Client Ref:

17-285

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

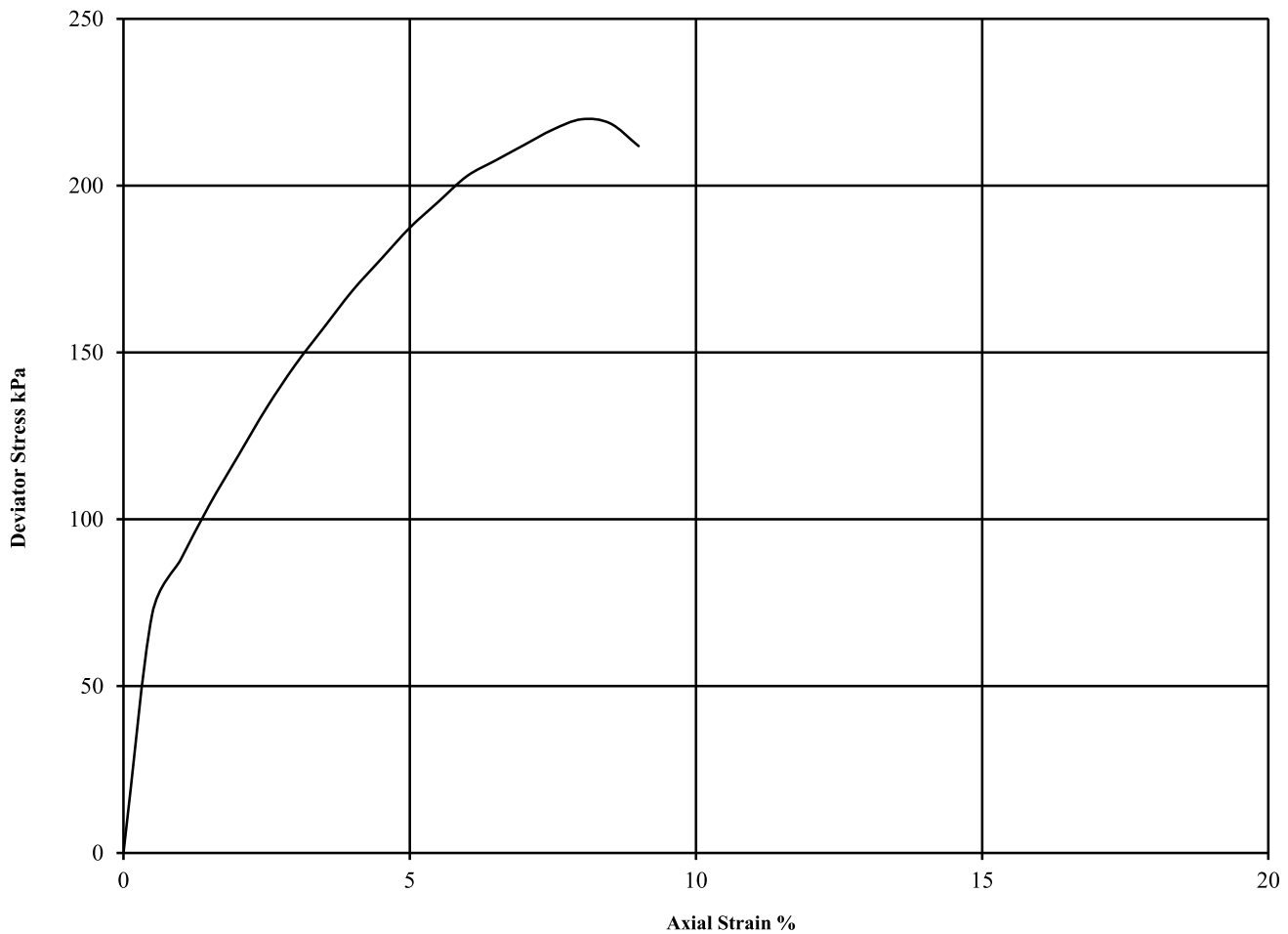
Hole Number: WS101

Top Depth (m): 2.50

Sample Number:

Base Depth (m): 3.00

Sample Type U



Diameter (mm):		38	Height (mm):		76	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.89 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	16	2.16	1.86	55	220	110	8.0	Plastic	



Willow Street

Contract No:
PSL24/1030
Client Ref:
17-285

ONE DIMENSIONAL CONSOLIDATION TEST

BS 1377: Part 5: 1990: Clause 3

Hole Number: WS102

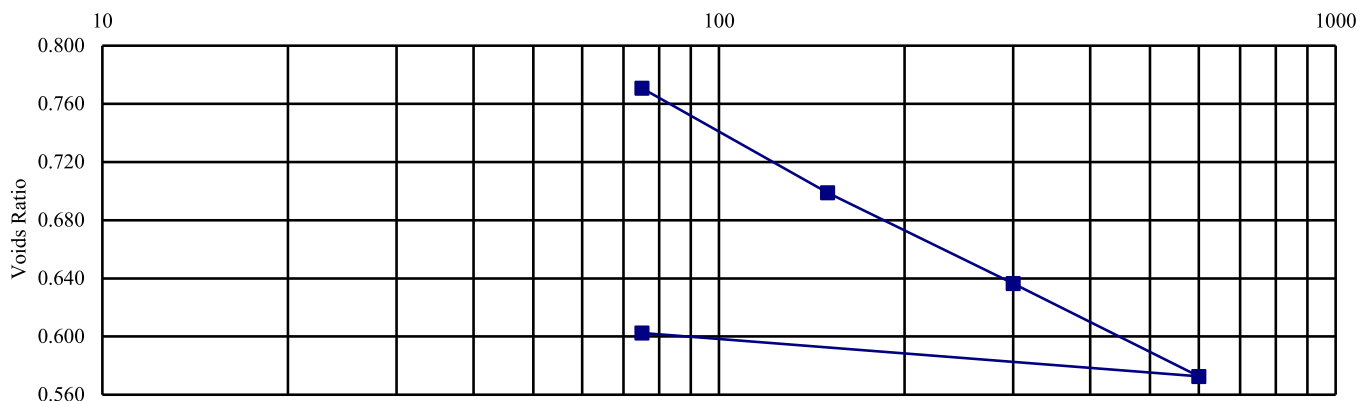
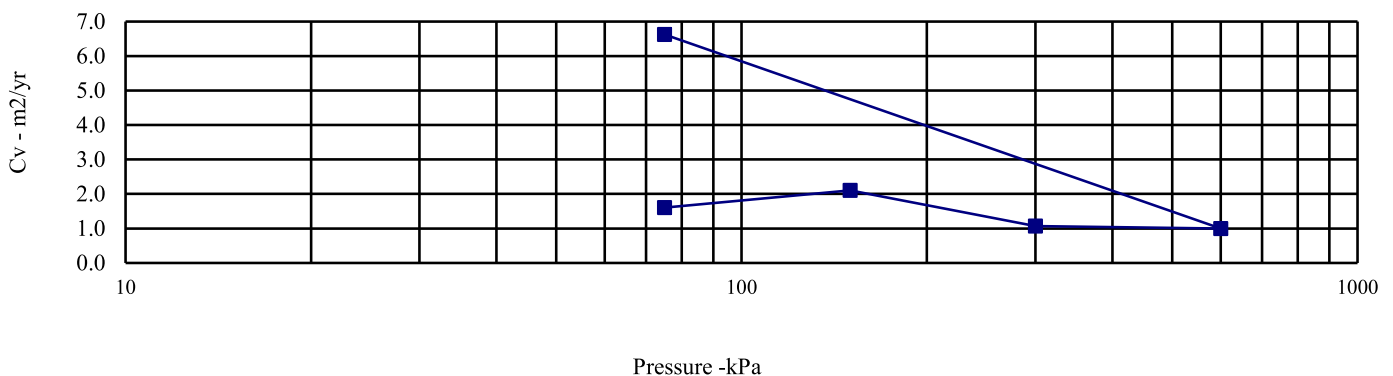
Top Depth (m): 3.50

Sample Number:

Base Depth (m) : 4.00

Sample Type: U

Initial Conditions		Pressure Range		Mv	Cv	Specimen location	
Moisture Content (%):	33	kPa		m2/MN	m2/yr	within tube:	Top
Bulk Density (Mg/m3):	1.82	0	75	1.184	1.606	Method used to	
Dry Density (Mg/m3):	1.36	75	150	0.541	2.101	determine CV:	T90
Voids Ratio:	0.943	150	300	0.246	1.071	Nominal temperature	
Degree of saturation:	93.6	300	600	0.130	0.998	during test ' C:	20
Height (mm):	20.03	600	75	0.036	6.625	Remarks:	
Diameter (mm)	75.005					See summary of soil descriptions	
Particle Density (Mg/m3):	2.65						
Assumed							



Willow Street

Contract No:
PSL24/1030
Client Ref:
17-285

APPENDIX IX

ORIGIN OF CHEMICAL

ASSESSMENT CRITERIA



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 Sutable 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)	

