



e3p

Phase II Geoenvironmental Site Assessment
Brassey Street, Middleton

Reference: 16-124-R2-1
Date: 08 December 2022



PHASE II GEOENVIRONMENTAL SITE ASSESSMENT

Brassey Street
Middleton
Manchester
M24 6AR

Prepared for:



Report Ref: 16-124-R2-1

Date Issued: 08 December 2022

Brassey Street

Phase II Geoenvironmental Site Assessment

December 2022

E3P

Taylor Road
Trafford Park
Urmston
Manchester
M41 7JQ

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

Registered in England
CRN: 08725262

QUALITY ASSURANCE

PROJECT NUMBER	16-124-R2		
VERSION	Version 1		
REMARKS	Final		
DATE	Date		
PREPARED BY	H.Morgan		
QUALIFICATIONS	BA, MSc, FGS		
CHECKED BY	J Sheridan		
QUALIFICATIONS	MeSci, FGS		
AUTHORISED BY	M. Dyer		
QUALIFICATIONS	BSc(Hons), FGS, AIEMA, MIEnvSc, CEnv		

EXECUTIVE SUMMARY

Site Address	Land off Brassey Street, Middleton, M24 6AR.	
Grid Reference	E 387503 N406558	
Site Area	0.06 Ha.	
Proposed Development	Rochdale Metropolitan Borough Council intends to construct a mid-rise residential development comprising 6 residential apartment units over three storeys with associated landscaped areas, estate parking and utility infrastructure.	
Current Site Use	The subject site is a rectangular-shaped parcel of land located adjacent to 135 Brassey Street, approximately 1 km to the northeast of Middleton town centre. The site currently comprises an openly accessible parcel of maintained open green space associated with the neighbouring Boarshaw working men's club. Mature trees are present in the northeast corner and at the western boundary.	
Site History	The earliest mapping showed the site to comprise several fields separated by field boundaries. Terraced residential properties were constructed pre-1893 and were later demolished pre-1975, after which point the site remained vacant.	
Environmental Setting	Drift Geology	Glacial Till – SAND and GRAVEL
	Bedrock Geology	Pennine Lower Coal Measures Formation – MUDSTONE, SILTSTONE, and SANDSTONE.
	Faults	The nearest geological fault is located circa 91m southwest of the site trending roughly east to west.
	Hydrogeology	Secondary A bedrock and superficial aquifer are recorded. No groundwater abstraction licenses are recorded within 1km of the site boundary.
	Hydrology	The nearest off-site surface water feature is Whit Brook located 43m southeast. Due to the local topography, it is likely that any shallow groundwater if present will flow in a south-westerly direction into Whit Brook.
	Flood Risk	Unaffected by flooding from rivers. The site is at moderate risk for groundwater flooding.
Previous Reports	The following previous reports have been prepared for the site and are summarised in Section 2.1 of this report:  E3P Phase I Geo-Environmental Site Assessment Ref: 16-124-R1, dated September 2022	
Utility Locations	A formal survey has not been completed. Statutory service plans do not record any services on-site.	
Landfill Sites and Ground Gases	No landfill sites (current or historic) are located within 250 m of the site. The site has undergone some historic development and ground working, the Made Ground associated with the historic development may produce hazardous ground gases such as methane and carbon dioxide.	
Radon	Less than 1% of houses above the 'Action Level' – no special precautions are required.	



Coal Mining/Land Stability	The site is located within a Coal Authority defined development high risk area and workings are recorded in the Arley Seam beneath the site at a depth of 159 m. Unrecorded shallow workings are also considered probable, associated with the Cannel Coal seam that is recorded to outcrop to the north of the site, dipping south beneath the site. Geological maps indicate the Black Mine (BkM) to outcrop immediately north of the site, dipping beneath the site. The Black Mine seam is inferred to represent the Cannel Seam recorded by the Coal Authority. Several mine entries are also recorded to the north, west and south of the site, associated with Tonge Colliery and Boarshaw Pit, indicating a legacy of mining in the wider area. Log annotations for the mapped mine entries on the 6-inch map record drift to 64-65 ft (19.5-20 m) bgl over sandstone, with coal at 79 and 96 ft (22.5 and 29 m). Based on the above, there is a moderate risk from shallow coal mining beneath the site (<30 m bgl).
Brine Workings	The proposed development is not situated within a brine working area.
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.
Initial Conceptual Site Model	The following potential off-site sources of contamination have been identified ✿ Made Ground – Heavy Metals, Speciated Polycyclic Aromatic Hydrocarbons (PAH), Total Petroleum Hydrocarbons (TPH), asbestos and ground gas (CO₂ and CH₄). ✿ Historical Mine Gas – CO₂ and CH₄. The following potential off-site sources of contamination have been identified: ✿ Boarshaw Bleach, Dye and Print Works and infilled reservoirs – 80 m northeast. ✿ Boarshaw Cotton Mill – 225 m. Given the proposed development will comprise apartments with limited soft landscaping, the potential for direct contact is therefore reduced. The risk to future residential end users is considered low/moderate Controlled waters receptors are identified as the underlying Secondary A drift and bedrock aquifers, together with the off-site Whit Brook. Significant sources of mobile contamination have not been identified. The overall risk to controlled waters from the site is considered low. Made Ground, potential unrecorded shallow mine workings and infilled reservoirs (80 m northeast) are all potential sources of ground gas to the site. The underlying natural drift is likely to comprise moderate permeability granular strata, thus providing a viable migration pathway. The risk from ground gas is considered moderate.



GROUND INVESTIGATION

Ground Investigation Works	E3P has completed an intrusive ground investigation comprising: ✿ 6 x Mechanically excavated trial pits ✿ 4 x Window sample boreholes with 3 x environmental monitoring well installation ✿ 3 x Rotary open hole boreholes to 40 m
Ground Conditions	MADE GROUND – 0.00 m bgl to 1.60 m bgl Made Ground deposits were encountered within all exploratory hole locations to depths of between 0.60 m and 1.60 m bgl and generally comprised of black, clayey, gravelly sand with mudstone, sandstone and brick in the majority of locations. Frequent sandstone slabs and cobbles were encountered, together with intact bricks and occasional wood. DRIFT – 0.60 m bgl to 17.90 m bgl The drift deposits generally comprise of a medium dense orangish brown, slightly gravelly fine to coarse SAND with gravel of sandstone and mudstone. Stiff brown slightly sandy slightly gravelly CLAY with gravel of fine to medium subangular to subrounded of sandstone mudstone was encountered from 4.10 and 4.20 m bgl in WS101 and WS102 in the west of the site respectively, and also in the RB102 and RB103 from 3.00 and 3.40 m bgl respectively. SOLID – 17.90 m bgl to >40.0 m bgl The solid bedrock geology was encountered from between 17.90 m and 20.00 m bgl as alternating grey and brown MUDSTONE and grey SANDSTONE. COAL fragments were encountered in a number of rotary boreholes interbedded within the MUDSTONE between the depths of 21.5 m to 30.0 m bgl. No intact coal seams or workings (voids, broken ground or loss of flush) were recorded.

CONTAMINATED LAND ASSESSMENT

Human Health	The Tier 1 human health risk assessment identified concentrations of non-volatile PAH and heavy metals compounds in exceedance of Residential End Use with Plant Uptake GAC values in three locations. As such, it will be necessary to design and construct the proposed development in a manner that will ensure suitably validated cover systems to all areas of private garden, soft landscaping and public open space. A suitable 600 mm clean cover system would be to be acceptable to mitigate these risks to future end users of the site. Chemical analysis of the natural drift deposits has identified these soils to be acceptable for use as subsoil within the proposed garden areas; however, further chemical validation samples will be required to confirm this. A number of chemical exceedances have been identified within Topsoil and TP101 and TP103. Further chemical testing will be needed to assess the suitability of site won topsoil for use within gardens.
----------------------------	--



Controlled Waters	Elevated heavy metals have been identified within the leachate analysis are believed to be isolated to the Made Ground material to a maximum proven depth of 1.60 m bgl. Given the absence of shallow groundwater which may mobilise the identified contaminants, there is considered to be a low risk to controlled waters and the wider environment as no complete pollutant linkage can be determined.
Ground Gas	Characteristic Situation 1 (pending completion of gas monitoring).
Potable Water Infrastructure	Barrier pipe unlikely to be required. This will need to be confirmed following the completion of a UKWIR risk assessment. Post-remediation and enabling works ground conditions may be different from those identified during this site investigation.

COAL MINING ASSESSMENT

Coal Mining	E3P has completed 3 no. 40 m rotary boreholes to investigate shallow mine workings. The findings are summarised as follows: ✿ The depth to rockhead is consistent with nearby mine entry records/logs. ✿ Based on 16 degree dip from horizontal and subcrop c. 20 m north, coal would be expected c. 23 m bgl in the north of the site, dipping to c. 31 m in the south. The occurrence of coal fragments in the mudstone at depths between 21.60 and 30.00 m bgl therefore coincides with the anticipated depth at which the Black Mine/Cannel seam might be anticipated. ✿ No intact coal seams were encountered, which may be indicative of poor quality coal close to crop. The Coal Authority indicate that the western extent of the seam is unproven, thus suggesting it may not be present. ✿ No evidence of workings e.g. broken ground, loss of flush or voids was recorded. The overall risk from mining related hazards is therefore considered to be low.
--------------------	---

GEOTECHNICAL ASSESSMENT

Underground Obstructions	Concrete and brick obstructions have been encountered within the Made Ground, indicative of relic foundations from the former building. During enabling works to create a developable platform, all below-ground obstructions will require grubbing out to the base of the Made Ground to enable the construction of proposed plots.
Allowable Bearing Pressure	The underlying natural granular drift deposits have been assessed as being medium dense to dense, high-strength with a SPT 'N' Value of between 18 and 50, and estimated allowable bearing capacity of >100 kN/m ² at 1.00 m bgl.



Foundation Options	We would anticipate that the final foundation solution to comprise: - Shallow strip/mass trench foundations bearing on medium dense SAND (depth subject to proposed loadings). - Ground improvement using vibro stone columns (VSC) to support reinforced foundations. Should drill and grout treatment be required, this would preclude the adoption of piled foundations.
Building Floor Slabs	Ground-bearing floor slabs are unlikely to be viable given the anticipated depths or reworked Made Ground > 600 mm and shallow cohesive soils.
Heave Precautions	The site has been proven to be underlain by shallow granular strata, with deeper CLAY soils encountered from 3.00 m bgl. Subject to levels/formation, heave precautions are unlikely to be required. Should clay soils be encountered at shallow (<2.50 m) depth, reference to NHBC guidance should be made in respect of heave precautions and foundations may require deepening.
Soakaway Drainage	The underlying granular soils are likely to be of moderate permeability. Soakaway testing was outside of the scope of this investigation. If soakaway drainage is to be considered, full BRE 365 testing must be completed to inform the detailed design.
Sulphate Assessment	Concrete classification will be DS1 AC1s.
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%.
Cut/Fill	Development levels unknown at this time; however, due to the sites uniform topography, levels are not considered likely to change significantly.
Waste Characterisation	Any material that is to be disposed off-site should undergo assessment using Technical Guidance WM3: <i>Waste Classification – Guidance on the classification and assessment of waste</i> .

RECOMMENDATIONS

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

- Completion of ground gas monitoring programme
- Remediation and enabling works strategy
- Plot-specific foundation schedule (upon receipt of the final development levels)
- UKWIR risk assessment.



Table of Contents

1. INTRODUCTION	8
1.1. Background	8
1.2. Proposed Development.....	8
1.3. Objectives	8
1.4. Scope of Works.....	9
1.5. Limitations	9
1.6. Confidentiality.....	9
2. GROUND INVESTIGATION.....	10
2.1. Previous Site Investigations.....	10
2.1.1. E3P Phase I Geo-Environmental Site Assessment Ref: 16-124-R1, dated September 2022	10
2.2. General Overview	10
2.3. Scope of Investigation.....	11
2.4. In-Situ Standard Penetration Testing (SPT).....	11
2.5. Laboratory Analysis.....	11
3. GROUND AND GROUNDWATER CONDITIONS	13
3.1. Summary of Ground Conditions	13
3.2. Made Ground	13
3.3. Drift Deposits	13
3.4. Solid Geology.....	14
3.5. Groundwater	14
3.6. Visual and Olfactory Evidence of Contamination	14
3.7. Soil Consistency	14
3.8. Side Stability and Ease of Excavation	18
3.9. Particle Size Distribution	18
3.10. Soil Infiltration.....	18
3.11. pH and Sulphate	18
4. TIER I QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT	20
4.1. Deviating Samples.....	20
4.2. Human Health Risk Assessment.....	20
4.2.1. Discussion	23
4.3. Controlled Waters Risk Assessment.....	24
4.3.1. Discussion	30
4.4. Ground Gas Risk Assessment Methodology	30
4.5. Monitoring Methodology	32
4.6. Summary of Monitoring Results	34
4.6.1. Groundwater.....	34
4.6.2. Barometric pressure	34
4.6.3. Gas Flow.....	34
4.6.4. Gas Concentrations	34
4.7. Conclusion	34
4.8. Potable Water Supply	35
4.9. Conceptual Site Model	37
5. COAL MINING RISK ASSESSMENT	40
5.1. Summary of Desk Based Coal Mining Risk Assessment	40
5.2. Scope of Intrusive Ground Investigation.....	40
5.2.1. Rotary Boreholes to Investigate Workings in Coal.....	40
5.3. Summary of Coal Mining Issues.....	41



6. GEOTECHNICAL ASSESSMENT	42
6.1. Proposed Development.....	42
6.2. Summary of Ground Conditions	42
6.3. Site Preparation	42
6.4. Foundation Conditions and Assessment of Potential Bearing Capacities	42
6.5. Ground Floor Slabs	44
6.6. Heave Precautions	44
6.7. Highways Construction	44
6.8. Drainage	45
6.9. Concrete Durability	45
6.10. Excavations	45
6.11. Slope Stability	45
6.12. Construction Activity and Inspection	46
6.13. Geotechnical Risk Register	47
6.14. Further Works	49
7. CONCLUSIONS AND RECOMMENDATIONS.....	50
7.1. Contaminated Land Assessment	50
7.2. Coal Mining	51
7.3. Geotechnical Assessment	51
APPENDIX I LIMITATIONS.....	53
APPENDIX II GLOSSARY	55
APPENDIX III DRAWINGS	58
APPENDIX IV PHOTOGRAPHS	60
APPENDIX V E3P EXPLORATORY HOLE LOGS	63
APPENDIX VI CHEMICAL TESTING RESULTS	64
APPENDIX VII ORIGIN OF TIER I GENERIC ASSESSMENT CRITERIA.....	65
APPENDIX VIII GEOTECHNICAL TESTING RESULTS.....	67
APPENDIX IX COAL AUTHORITY REPORT	68

DRAWING LIST

16-124-002 - Proposed Development Plan
16-124-003 - Site Features Plan
16-124-004 - Historical Features Plan
16-124-005 - Exploratory Hole Location Plan
16-124-006 - Depth of Made Ground Plan
16-124-010 - Conceptual Site Model
16-124-012 - Depth to Bedrock Plan



1. INTRODUCTION

1.1. BACKGROUND

E3P Ltd has been commissioned by AJ Cocker Associates (the client) on behalf of Rochdale Borough Council to undertake a Phase II Geoenvironmental Site Assessment for a parcel of land off Brassey Street, Middleton, M24 6AR.

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 site redevelopment.

1.2. PROPOSED DEVELOPMENT

It is proposed to construct a three storey residential apartment development comprising of 6 apartments with associated gardens and parking spaces. Drawing 16-124-002 (Appendix III) identifies the proposed development layout.

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

FIGURE 1.1 SNAPSHOT OF THE PROPOSED DEVELOPMENT



1.3. OBJECTIVES

The objectives of the geoenvironmental assessment are as follows:



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

1.4. SCOPE OF WORKS

The scope of work includes the following elements:

- ✦ Detailed review of historic information;
- ✦ Design of suitable intrusive ground investigation;
- ✦ 4 no. window sample probeholes with 3 no. environmental monitoring installations;
- ✦ 6 no. mechanically excavated trial pits;
- ✦ 3 no. rotary open-hole boreholes;
- ✦ In-situ geotechnical testing;
- ✦ Chemical and geotechnical laboratory analysis;
- ✦ Groundwater monitoring and sampling;
- ✦ Ground gas monitoring;
- ✦ Contamination risk assessment and conceptual site model;
- ✦ Geotechnical assessment and interpretation; and
- ✦ Factual and interpretive reporting.

1.5. LIMITATIONS

The limitations of this report are presented in Appendix I.

1.6. CONFIDENTIALITY

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



2. GROUND INVESTIGATION

2.1. PREVIOUS SITE INVESTIGATIONS

2.1.1. E3P PHASE I GEO-ENVIRONMENTAL SITE ASSESSMENT REF: 16-124-R1, DATED SEPTEMBER 2022

Pertinent points from Phase 1 are summarised as follows:

The site is underlain by superficial Glacial Till comprising sand and gravel and solid geology of the Pennine Lower Coal Measures Formation.

The site is located within a Coal Authority defined development high risk area and workings are recorded in the Arley Seam beneath the site at a depth of 159 m. Unrecorded shallow workings are also considered probable, associated with the Cannel Coal seam that is recorded to outcrop to the north of the site and dip beneath the site. Log annotations for locally mapped mine entries on the 6-inch map record drift to 64-65 ft (19.5-20 m) bgl over sandstone, with coal at 79 and 96 ft (22.5 and 29 m). Based on this information, there is a moderate risk from shallow coal mining beneath the site (<30 m bgl).

Potential on-site sources of contamination include Made Ground and historical mine gas. Potential off-site sources of contamination include Boarshaw Bleach, Dye and Print Works and infilled reservoirs located 80 m northeast and Boarshaw Cotton Mill located 225 m from site.

Made Ground may underlie the site, associated with historical development within the site boundary, which may contain contaminants such as heavy metals, non-volatile PAH and asbestos. Given the proposed development will comprise apartments with limited soft landscaping, the potential for direct contact is therefore reduced. **The risk to future residential end users from soil contamination is considered low/moderate.**

Controlled waters receptors are identified as the underlying Secondary A drift and bedrock aquifers, together with the off-site Whit Brook. Significant sources of mobile contamination have not been identified on the site that may present a direct risk to controlled waters. **The overall risk to controlled waters from the site is considered low.**

Made Ground, potential unrecorded shallow mine workings and infilled reservoirs (80 m northeast) are all potential sources of ground gas to the site. The underlying natural drift is likely to comprise moderate permeability granular strata, thus providing a viable migration pathway. **The risk from ground gas is considered moderate.**

2.2. GENERAL OVERVIEW

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

Exploratory fieldwork was completed between 14th June 2022 and 12th September 2022. The works are summarised in Table 2.1.



2.3. SCOPE OF INVESTIGATION

TABLE 2.1 SUMMARY OF FIELDWORK

POTENTIAL SOURCE/RATIONALE	LOCATION HOLE	TYPE	MAXIMUM DEPTH (m bgl)	MONITORING WELLS RESPONSE ZONE (m bgl)
General Ground Conditions Including the Presence/Nature of Obstructions	WS101	Window Sample Probehole	5.45	2.0–5.0
	WS102		5.45	0.5–1.0
	WS103		4.45	N/A
	WS104		5.45	1.5–4.0
	TP101	Trial Pit	2.40	N/A
	TP102		2.50	N/A
	TP103		2.80	N/A
	TP104		2.50	N/A
	TP105		2.40	N/A
	TP106		3.00	N/A
	RB101	Rotary Borehole	40.00	N/A
	RB102		40.00	N/A
	RB103		40.00	N/A

Mechanically excavated trial pits were advanced to investigate ground conditions and to retrieve environmental samples and spatially distributed to offer the maximum site coverage.

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

The series of rotary boreholes were advanced to investigate the potential presence of shallow mine workings. These boreholes were drilled in accordance with the CA permissions process and industry best practice.

The sampling locations are illustrated in Drawing 16-124-005 (Appendix III). The ground conditions encountered are indicated on the logs, which are provided in Appendix V.

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

2.4. IN-SITU STANDARD PENETRATION TESTING (SPT)

In-situ geotechnical testing was conducted using the standard penetration test (SPT) and, where the ground is granular, a 60° cone (SPT(C)) was used instead of the sampling tube. The results are shown in the probehole logs in Appendix V and presented in Table 3.2 and discussed in Section 3.7.

2.5. LABORATORY ANALYSIS

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



-  Metals.
-  pH, total sulphate, water-soluble sulphate (2:1 extract).
-  Sulphide.
-  Cyanide.
-  Phenols.
-  Total and speciated polycyclic aromatic hydrocarbons (PAHs).
-  Semi Volatile Organic Compounds (SVOC).
-  Volatile Organic Compounds (VOC).
-  Asbestos identification and quantification.
-  Speciated and banded total petroleum hydrocarbon (TPH).

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

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

-  Atterberg limits determinations; and
-  Single-stage triaxial tests.

Laboratory analysis results are included in Appendix VI.



3. GROUND AND GROUNDWATER CONDITIONS

3.1. SUMMARY OF GROUND CONDITIONS

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

TABLE 3.1 SUMMARY OF STRATA

HOLE	DEPTH TO STRATUM (m bgl)			
	MADE GROUND	STIFF CLAY	SAND	BEDROCK
TP101	0.00–0.70	–	0.70–2.40	–
TP102	0.00–1.20	–	1.20–2.50	–
TP103	0.00–1.20	–	1.20–2.80	–
TP104	0.00–1.10	–	1.10–2.50	–
TP105	0.00–1.10	–	1.10–2.40	–
TP106	0.00–1.60	–	1.60–3.00	–
WS101	0.00–1.30	–	1.30–5.45	–
WS102	0.00–1.20	4.10–5.45	1.20–4.10	–
WS103	0.00–0.60	–	0.60–4.45	–
WS104	0.00–0.90	–	0.90–5.45	–
RB101	0.00–0.20	13.00–20.00	0.20–13.00	20.00–40.00
RB102	0.00–1.10	3.00–17.90	1.10–3.00	17-90–40.00
RB103	0.00–1.10	3.40–18.20	1.10–3.40	18.20–40.00

3.2. MADE GROUND

Made Ground deposits were encountered within all exploratory hole locations to depths of between 0.60 m and 1.60 m bgl.

Made Ground deposits comprise of black, clayey, gravelly sand with mudstone, sandstone and brick in the majority of locations. Frequent sandstone slabs and cobbles were encountered, together with intact bricks and occasional wood and metal inclusions (demolition rubble) as the ground becomes lighter in colour with depth. Made Ground deposits are generally consistent cross the site.

A Depth of Made Ground Plan is presented as Drawing 16-124-006 in Appendix III.

3.3. DRIFT DEPOSITS

Drift deposits were encountered within all of the exploratory locations. The drift deposits are observed to be consistent within the exploratory locations, generally comprising a medium dense orange brown, slightly gravelly fine to coarse SAND with gravel of sandstone and mudstone.

Stiff brown slightly sandy slightly gravelly CLAY with gravel of fine to medium subangular to subrounded of sandstone mudstone was encountered from 4.10 and 4.20 m bgl in WS101 and WS102 in the west of the site respectively, and also in the RB102 AND RB103 from 3.00 and 3.40 m bgl respectively.



3.4. SOLID GEOLOGY

The solid bedrock geology was encountered between 17.90 m and 20.00 m bgl as alternating grey and brown MUDSTONE with grey SANDSTONE.

COAL fragments were encountered in a number of rotary boreholes interbedded within the MUDSTONE between the depths of 21.5 m to 30.0 m bgl. No workings (voids, broken ground or loss of flush) were encountered in any of the rotary holes advanced during the site investigation.

A Depth to Bedrock Plan presented as Drawing 16-124-012 in Appendix III.

3.5. GROUNDWATER

Groundwater was not encountered during the fieldwork or during the subsequent monitoring visits.

3.6. VISUAL AND OLFACTORY EVIDENCE OF CONTAMINATION

Visual and olfactory evidence of potential contamination has not been identified during the site investigation other than presence of Made Ground containing anthropogenic inclusions.

3.7. SOIL CONSISTENCY

Undrained shear strength values were unable to be measured using hand shear vanes and triaxial laboratory testing due to lack of suitable recovered CLAY material during the site investigation.

Soil consistency was measured using in situ SPT and CPT window sample testing as summarised in Table 3.2.



TABLE 3.2 STANDARD/CONE PENETRATION TEST RESULTS

BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE (N ₁) ₆₀	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m ²)	ALLOWABLE BEARING PRESSURE (kN/m ²)*
WS101	1	MADE GROUND: Reddish grey very sandy gravel.	16	16.13	Medium Dense	N/A	N/A	N/A	161.30
WS101	2	Orange brown gravelly fine to coarse SAND.	28	25.58	Medium Dense	N/A	N/A	N/A	255.79
WS101	3	Orange brown gravelly fine to coarse SAND.	16	13.91	Medium Dense	N/A	N/A	N/A	139.14
WS101	4	Orange brown gravelly fine to coarse SAND.	15	12.67	Medium Dense	N/A	N/A	N/A	126.73
WS101	5	Stiff brown sandy slightly silty gravelly CLAY.	14	11.61	N/A	Medium strength	Stiff	58.07	119.40
WS102	1	MADE GROUND: brown very sandy gravel.	11	11.09	Medium Dense	N/A	N/A	N/A	110.90
WS102	2	Orange brown sandy GRAVEL.	21	19.18	Medium Dense	N/A	N/A	N/A	191.84



BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE (N ₁) ₆₀	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m ²)	ALLOWABLE BEARING PRESSURE (kN/m ²)*
WS102	3	Orange brown sandy GRAVEL.	18	15.65	Medium Dense	N/A	N/A	N/A	156.54
WS102	4	Brown fine to coarse SAND.	19	16.05	Medium Dense	N/A	N/A	N/A	160.52
WS102	5	Stiff brown slightly silty sandy CLAY.	14	11.61	N/A	Medium strength	Stiff	58.07	119.40
WS103	1	Orange brown gravelly fine to coarse SAND.	22	22.18	Medium Dense	N/A	N/A	N/A	221.79
WS103	2	Orange brown gravelly fine to coarse SAND.	23	21.01	Medium Dense	N/A	N/A	N/A	210.11
WS103	3	Orange brown gravelly fine to coarse SAND.	29	25.22	Medium Dense	N/A	N/A	N/A	252.20
WS103	4	Orange brown gravelly fine to coarse SAND.	18	15.21	Medium Dense	N/A	N/A	N/A	152.07
WS103	5	Orange brown gravelly fine to coarse SAND.	30	24.89	Medium Dense	N/A	N/A	N/A	248.89



BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE (N ₁) ₆₀	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m ²)	ALLOWABLE BEARING PRESSURE (kN/m ²)*
WS104	1	Orange brown gravelly fine to coarse SAND.	20	20.16	Medium Dense	N/A	N/A	N/A	201.63
WS104	2	Orange brown gravelly fine to coarse SAND.	50	91.35	Dense	N/A	N/A	N/A	456.77
WS104	3	Orange brown gravelly fine to coarse SAND.	38	33.05	Dense	N/A	N/A	N/A	330.47
WS104	4	Orange brown gravelly fine to coarse SAND.	50	42.24	Dense	N/A	N/A	N/A	422.43

Notes

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

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

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



3.8. SIDE STABILITY AND EASE OF EXCAVATION

The sides of the exploratory trial pit excavations appeared to be generally stable during excavation.

The presence of brick and concrete cobbles within the Made Ground deposits meant that in certain places, excavation was slow through the Made Ground and in some places. The natural strata was excavated with relative ease.

3.9. PARTICLE SIZE DISTRIBUTION

Particle Size Distribution Tests have been undertaken on selected samples of granular material via wet sieve to obtain information on the soil fractions.

The results are summarised in Table 3.3 with full results presented in Appendix VIII.

TABLE 3.3 SUMMARY OF PARTICLE SIZE DISTRIBUTION TEST RESULTS

LOCATION	DEPTH (m)	SOIL FRACTION (%)			
		COBBLES	GRAVEL	SAND	SILT/CLAY
TP101	2.00 (Natural)	0	52	42	6
TP104	1.20 (Natural)	0	32	64	4

3.10. SOIL INFILTRATION

The site has been found to be underlain by highly permeable granular deposits which may support sustainable soakaway drainage systems.

Soakaway testing was outside of the scope of investigation. If SUDS drainage is proposed, testing in accordance with BRE365 should be carried out to suitably inform the design.

3.11. pH AND SULPHATE

Chemical analyses for pH and soluble sulphate content contained in Appendix VI (summarised in Table 3.4), shows that the soils at the site generally meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with BRE *Special Digest 1* (2005).



TABLE 3.4 SUMMARY OF pH AND SULPHATE DATA

LOCATION	DEPTH (m)	STRATA	SO ₄ IN 2:1 WATER/SOIL (g/l)	pH VALUE	CLASSIFICATION
TP101	0.2	TOPSOIL	0.0077	7.4	AC-1s / DS-1
TP102	0.5	MADE GROUND	0.0072	7.8	AC-1s / DS-1
TP102	1.5	SAND	0.0024	8.1	AC-1s / DS-1
TP103	0.1	TOPSOIL	0.0510	7.0	AC-1s / DS-1
TP104	0.5	MADE GROUND	0.0072	8.0	AC-1s / DS-1
WS102	2.5	GRAVEL	<0.0013	8.0	AC-1s / DS-1
WS103	0.2	GRAVEL	0.0330	12.2	AC-1s / DS-1
WS103	2.5	SAND	0.0039	8.4	AC-1s / DS-1



4. TIER I QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT

E3P has undertaken a Tier 1 qualitative risk assessment to determine if any potential contaminants within the underlying soils and groundwater pose an unacceptable level of risk to the identified receptors.

4.1. DEVIATING SAMPLES

Deviating samples were to be avoided during the ground investigation by using best practice sampling procedures including use of appropriate sampling containers and adhering to the laboratory holding times for each contaminant analysis undertaken.

Deviations were not identified within any of the soil or groundwater samples analysed throughout the investigation.

4.2. HUMAN HEALTH RISK ASSESSMENT

At Tier 1 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 generic acceptance criteria (GAC) values published in LQM/CIEH S4UL (S4UL3267) relevant to a residential end use with plant uptake and conservative soil organic matter (SOM) of 1%.

Where Tier 1 screening values are not provided by LQM, other screening values have been used and these are referenced in Table 4.1.

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



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

DETERMINANT	UNIT	GAC	N	MC	LOC. OF EX	PATH-WAY	ASSESSMENT
Arsenic	mg/kg	37	8	86	TP103 (0.10)	1	Further Action
Cadmium	mg/kg	11	0	0	N/A	1	No Further Action
Chromium (VI)	mg/kg	6.0	1	2.5	N/A	1	No Further Action
Lead	mg/kg	200	8	230, 1100, 280	TP101 (0.20) TP102 (0.50) TP103 (0.10)	1	Further Action
Mercury	mg/kg	1.2	2	1.1	N/A	4	No Further Action
Nickel	mg/kg	130	8	32	N/A	1	No Further Action
Selenium	mg/kg	250	0	0	N/A	1	No Further Action
Copper	mg/kg	2400	8	110	N/A	1	No Further Action
Zinc	mg/kg	3700	8	370	N/A	1	No Further Action
Cyanide – Total	mg/kg	791	1	1.1	N/A	1	No Further Action
Phenols – Total	mg/kg	120	0	0	N/A	1	No Further Action
Asbestos	Fibres	NFD	n/a	NFD	N/A	3	No Further Action
Naphthalene	mg/kg	2.3	0	0	N/A	4	No Further Action
Acenaphthylene	mg/kg	170	0	0	N/A	2	No Further Action
Acenaphthene	mg/kg	210	0	0	N/A	1	No Further Action
Fluorene	mg/kg	170	0	0	N/A	1	No Further Action
Phenanthrene	mg/kg	95	3	3.2	N/A	2	No Further Action
Anthracene	mg/kg	2400	3	0.82	N/A	2	No Further Action
Fluoranthene	mg/kg	280	4	6.2	N/A	2	No Further Action
Pyrene	mg/kg	620	4	5.7	N/A	2	No Further Action
Benzo(a)Anthracene	mg/kg	7.2	4	3.7	N/A	2	No Further Action
Chrysene	mg/kg	15	4	3.2	N/A	2	No Further Action
Benzo(b)Fluoranthene	mg/kg	2.6	4	3.3	TP103 (0.10)	2	Further Action
Benzo(k)Fluoranthene	mg/kg	77	4	1.7	N/A	2	No Further Action
Benzo(a)Pyrene	mg/kg	2.2	4	2.4 3.1	TP101 (0.20) TP103 (0.10)	2	Further Action
Indeno(123-cd)Pyrene	mg/kg	27	3	1.6	N/A	2	No Further Action
Dibenzo(a,h)Anthracene	mg/kg	0.24	2	0.35 0.45	TP101 (0.20) TP103 (0.10)	2	Further Action
Benzo(ghi)Perylene	mg/kg	320	3	2	N/A	2	No Further Action
TPH C5-C6 (aliphatic)*	mg/kg	42	0	0	N/A	4	No Further Action
TPH C6-C8 (aliphatic)*	mg/kg	100	0	0	N/A	4	No Further Action
TPH C8-C10 (aliphatic)*	mg/kg	27	0	0	N/A	4	No Further Action
TPH C10-C12 (aromatic)*	mg/kg	74	0	0	N/A	4	No Further Action



DETERMINANT	UNIT	GAC	N	MC	LOC. OF EX	PATH-WAY	ASSESSMENT
TPH C12-C16 (aromatic)*	mg/kg	140	0	0	N/A	4	No Further Action
TPH C16-C21 (aromatic)*	mg/kg	260	4	22	N/A	1	No Further Action
TPH C21-C35 (aromatic)*	mg/kg	1100	4	78	N/A	1	No Further Action

Notes

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

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

* The Tier 1 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 1 values for aliphatic compounds for the volatile and semi volatile fractions (C5-C12) and the Tier 1 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.

** Atkins ATRISK

*** USEPA Risk Management Levels

Referring to Table 4.1, the results of this direct comparison indicate contaminant concentrations in exceedance of the GAC values for residential end use with plant uptake for the following contaminants:

- ☛ Heavy Metals
 - Lead
 - Arsenic
- ☛ Non-volatile Polycyclic Aromatic Hydrocarbon (PAH)
 - Benzo(b)Fluoranthene
 - Benzo(a)Pyrene
 - Dibenzo(a,h)Anthracene.

No significant sources were identified and no visual / olfactory evidence of volatile contamination was encountered to warrant testing for VOCs.

No asbestos containing material or fibres were detected during the site investigation and subsequent chemical testing of soils.

It should be noted that the above mentioned exceedances have also been compared to less conservative GAC values (residential end use without plant uptake and 6% SOM) and concentrations of lead and Dibenzo(a,h)Anthracene remain in exceedance.

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



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

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

-  Soil ingestion
-  Dermal contact and ingestion
-  Consumption of homegrown vegetables

The exceedances for all determinants are associated with shallow Made Ground deposits (0.10–0.50 m).

4.2.1. DISCUSSION

All of the identified elevated concentrations have primary exposure pathways related to dermal contact and ingestion of soils and consumption of homegrown vegetables. 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. Where hardstanding is present, this is considered to break the pollutant linkage and thus no further remediation is considered necessary.

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

No visual signs of ACM were encountered during the ground investigation and chemical analysis has not identified any asbestos fibre content within any of the samples analysed. If asbestos is encountered during the remediation and enabling works impacted soils should be managed according to the asbestos risk mitigation conceptual site model shown in Figure 4.1.



FIGURE 4.1 ASBESTOS RISK MITIGATION CONCEPTUAL SITE MODEL



Notes

ND None Detect

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

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

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

Chemical analysis of the natural drift deposits has identified these soils to be acceptable for use as subsoil within the proposed garden areas; however, further chemical validation samples will be required to confirm this. A number of chemical exceedances have been identified within Topsoil and TP 101 and TP 103. Further chemical testing will be needed to assess the suitability of site won topsoil for use within gardens.

4.3. CONTROLLED WATERS RISK ASSESSMENT

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



TABLE 4.2 CONTROLLED WATERS CONCEPTUAL MODEL AND SENSITIVITY PROFILE

DISCUSSION		SENSITIVITY RATING
Contaminant Source		
Made Ground Low solubility heavy metal and PAH contamination are present within areas of shallow Made Ground associated with previous phases of development, which have potential to leach into underlying soils.		Low/Moderate
Pathway		
Vertical Migration The site is underlain by a secondary A bedrock aquifer. The soil strata comprise a sequence of c. 3-5 m of granular deposits underlain by sandy CLAY (reduced permeability) to 17-20 m bgl. The clay deposits will offer protection to the underlying bedrock aquifer. In the absence of shallow perched groundwater, it is unlikely that any soil contamination will be mobilised, thus further reducing the risk to the underlying aquifer.		Low
Lateral migration The Whit Brook located 43 m southeast. Lateral migration of contaminants is considered possible due to the presence of granular deposits underlying the site. However, in the absence of shallow perched groundwater, it is unlikely that any soil contamination will be mobilised, thus reducing the risk to the nearby surface water course.		Low
Receptor		
Aquifer Classification in Superficial Drift Deposits	Secondary A aquifer	Moderate
Aquifer Classification in Bedrock	Secondary A aquifer	Moderate
Groundwater Source Protection Zone or Drinking Water Safeguard Zone	The site is not affected	Low
Distance to the Closest Groundwater Abstraction Point	No active groundwater abstraction licences are recorded within 1 km of the site boundary.	Low
Is the Site Located Within 50 m of a Surface Watercourse?	The nearest off-site surface water feature is Whit Brook located 43 m southeast.	High
The ICSM developed within the context of the site setting has identified the following potential pollutant linkages: - Primary – Lateral migration towards the Whit Brook - Secondary – Downward migration towards the underlying Secondary A aquifer		

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

The results of this assessment are presented in Table 4.3.



TABLE 4.3 QUALITATIVE RISK TO CONTROLLED WATERS FROM SOIL ANALYTICAL RESULTS

CONTAMINANT	ASSESSMENT RATING	DISCUSSION
BTEX > 1 mg/kg	The soil data analysis has not identified any detectable concentrations of VOCs above 1 mg/kg or TPH C5 to C6 that might otherwise be indicative of VOC impact.	None
Total VOC > 1 mg/kg		
Total SVOC > 1 mg/kg	SVOC analysis recorded concentrations below the laboratory LOD.	None
C5-C10 > 5 mg/kg	All concentrations are below the laboratory LOD.	None
C10-C12 > 10 mg/kg	All concentrations are below the laboratory LOD.	None
C12-C16 > 50 mg/kg	All concentrations are below the laboratory LOD.	None
Phenols > 2 mg/kg	Concentration of total phenols were found to be in excess of 2.6 in a leachate analysis for WS104 at a depth of 0.4 m bgl.	Further discussion
Naphthalene > 2 mg/kg	All concentrations are below the laboratory LOD.	None
Total PAH > 10 mg/kg	Total concentrations of low-solubility PAH compounds greater than 10 mg/kg have been detected within the Made Ground in two locations, with a maximum concentration recorded in TP101 at 25.2 mg/kg and TP103 34.8 mg/kg.	Further discussion
PCB > 1 mg/kg	No potential sources of PCB have been identified.	None
Heavy metals > 500 mg/kg	Concentrations of heavy metals above 500 mg/kg have been recorded in TP101 (1100 mg/kg Lead).	Further discussion

The Tier I assessment has included a comparison of leachate analysis from samples of the Made Ground to environmental quality standards (EQS) in the first instance and drinking water standards (DWS) where values are absent.

These are presented in Table 4.4.



TABLE 4.4 COMPARISON OF LEACHATE ANALYSIS WITH TIER 1 SCREENING LEVELS

DETERMINAND	UNIT	EQS ^{1, 2, 3}	DWS _{3,4,5}	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE & Depth (m bgl)	ASSESSMENT
		AA					
Arsenic	µg/l	50	10	2	5.3	–	No Further Action
Cadmium	µg/l	0.08-0.25	5	2	<0.08	–	No Further Action
Chromium (VI)	µg/l	3.4	–	2	<5.0	–	No Further Action
Chromium (III)	µg/l	4.7	50	2	2.4	–	No Further Action
Copper	µg/l	1	2000	2	18.0 14.0	WS102 (0.50) WS104 (0.50)	Further Action
Total Cyanide	µg/l	1	50	2	<1.0	–	No Further Action
Lead	µg/l	1.2	10	2	7.9 14.0	WS102 (0.50) WS104 (0.50)	Further Action
Mercury	µg/l	–	1.0	2	<0.5	–	No Further Action
Nickel	µg/l	4	20	2	2.2	–	No Further Action
Selenium	µg/l	–	10	2	<4.0	–	No Further Action
Zinc	µg/l	10.9	–	2	14.0 20.0	WS102 (0.50) WS104 (0.50)	Further Action
pH	6–9			2	n/a	–	No Further Action
Naphthalene	µg/l	2	10*	2	<0.01	–	No Further Action
Anthracene	µg/l	0.1	10*	2	<0.01	–	No Further Action
Benzo[b]fluoranthene	µg/l	0.00017*	10*	2	<0.01	–	No Further Action
Benzo[k]fluoranthene	µg/l	0.00017*	10*	2	<0.01	–	No Further Action
Benzo(a)pyrene	µg/l	0.00017*	10*	2	<0.01	–	No Further Action
Indeno(123-cd)pyrene	µg/l	0.00017*	10*	2	<0.01	–	No Further Action
Fluoranthene	µg/l	0.0063	10*	2	<0.01	–	No Further Action



DETERMINAND	UNIT	EQS ^{1, 2, 3}	DWS _{3,4,5}	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE & Depth (m bgl)	ASSESSMENT
		AA					
Benzo(ghi)perylene	µg/l	1.7–4	10*	2	<0.01	–	No Further Action
TPH C5-C6 (benzene)	µg/l	10	1	2	<1.0	–	No Further Action
TPH C6-C8 (toluene)	µg/l	74	700	2	<1.0	–	No Further Action
TPH C8-C10 (ethyl benzene)	µg/l	20	300	2	<1.0	–	No Further Action
TPH C10-C12 (xylene)	µg/l	30	500	2	<1.0	–	No Further Action
TPH C10-C12 (xylene)	µg/l	30	500	2	<10	–	No Further Action
TPH C12-C16	µg/l	2	90 ⁵	2	<10	–	No Further Action
TPH C16-C35	µg/l	50#	90 ⁵	2	<10	–	No Further Action
TPH C5-C6	µg/l	–	15000	2	<1.0	–	No Further Action
TPH C6-C8	µg/l	–	15000	2	<1.0	–	No Further Action
TPH C8-C10	µg/l	–	300	2	<1.0	–	No Further Action
TPH C10-C12	µg/l	–	300	2	<10	–	No Further Action
TPH C12-C16	µg/l	–	300	2	<10	–	No Further Action
TPH C16-C21	µg/l	–	300**	2	<10	–	No Further Action
TPH C21-C35	µg/l	–	300**	2	<10	–	No Further Action
Tetrachloroethylene	µg/l	0.4	10	2	n/a	–	No Further Action
Trichloroethylene	µg/l	10	10	2	n/a	–	No Further Action
Trichlorobenzene	µg/l	0.4	–	2	n/a	–	No Further Action
Trichloromethane	µg/l	2.5	–	2	n/a	–	No Further Action
Dichloromethane	µg/l	20	200	2	n/a	–	No Further Action



DETERMINAND	UNIT	EQS ^{1, 2, 3}	DWS _{3,4,5}	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE & Depth (m bgl)	ASSESSMENT
		AA					
Carbon Tetrachloride	µg/l	12	3	2	n/a	–	No Further Action
Vinyl Chloride	µg/l	–	0.3	2	n/a	–	No Further Action

Notes

Solubility <0.01µg/l

AA – Annual Average

MAC- Maximum Admissible Concentration

* 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 Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations (2015)
2. Directive establishing a framework for Community action in the field of water policy (Water Framework Directive)
3. Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances
4. Council Directive on the quality of water intended for human consumption (Drinking Water Directive)
5. WHO Guidelines for Drinking Water Quality. Third edition (2004)



This comparison indicates that concentrations of the following contaminants exceed the GAC values for EQS and DWS:

-  Copper
-  Lead
-  Zinc

The results of this direct comparison indicate that the metals copper, lead and zinc exceed the EQS annual average (AA) within the leachate samples taken within the Made Ground but do not exceed the DWS, with the exception of lead which was found to be in exceedance of both the EQS and the DWS.

4.3.1. DISCUSSION

Historically, the site has been the site of a number of historic residential houses with associated gardens. This past land use leaves little opportunity for large concentrations of leachable contaminants to migrate through the Made Ground into the underlying natural drift deposits.

The heavy metals identified within the leachate analysis are believed to be isolated to the Made Ground material to a maximum proven depth of 1.60 m bgl. Given the absence of shallow groundwater which may mobilise the identified contaminants, there is considered to be a low risk to controlled waters and the wider environment as no complete pollutant linkage can be determined.

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

The proposed development will create hardstanding cover across the site, thus reducing the amount of infiltration generated. This will in turn, reduce the amount of contaminants present in leachate off the site and reduce the risk further to the underlying aquifer and adjacent canal.

4.4. GROUND GAS RISK ASSESSMENT METHODOLOGY

The following sourced of ground gas were identified within the E3P Phase 1 Geo-Environmental Assessment (Ref: 16-142-R1, September 2022):

-  Made Ground
-  Potential unrecorded shallow mine workings
-  Infilled reservoirs (80 m north east)

The risk from ground gas was concluded to be moderate.

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

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



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

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

The following equation should be utilised:

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

Where:

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

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

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

The final derived GSV can then be used to characterise the site as summarised in Table 4.5.



TABLE 4.5 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.

4.5. MONITORING METHODOLOGY

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

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

The results of the ground gas monitoring are presented in Table 4.6.

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



TABLE 4.6 SUMMARY OF GROUND GAS MONITORING RESULTS

WELL	STRATA	DATE	CH ₄ PEAK (%V/V)	CH ₄ STEADY (%V/V)	CH ₄ Q _{hg} (l/hr)	CO ₂ PEAK (%V/V)	CO ₂ STEADY (%V/V)	CO ₂ Q _{hg} (l/hr)	O ₂ (%V/V)	ATMOS (mb)	ATMOS. DYNAMIC	PEAK FLOW (l/hr)	STEADY FLOW (l/hr)	RESPONSE ZONE (m bgl)	DEPTH TO BASE (m bgl)	DEPTH TO WATER (m bgl)
WS101	Natural CLAY Drift	27/09/2022	0.1	0.1	0.0001	1.6	1.6	0.0016	18.9	989	Low/Falling	0.1	0.1	2.00 – 5.00	4.80	Dry
		13/10/2022	0.1	0.1	0.0001	0.1	0.1	0.0001	18	1005	Falling	0.1	0.1		4.85	4.70
		01/11/2022	0.1	0.1	0.0001	2.1	2.1	0.0021	18	988	Rising	0.1	0.1		4.85	4.77
		16/11/2022	0.1	0.1	0.0001	0.1	0.1	0.0001	19.9	978	Low/Falling	0.1	0.1		4.85	4.78
WS102	Made Ground	27/09/2022	0.1	0.1	0.0001	1.6	1.6	0.0016	19	989	Low/Falling	0.1	0.1	0.50 – 1.00	0.80	Dry
		13/10/2022	0.1	0.1	0.0001	0.1	0.1	0.0001	18	1003	Falling	0.1	0.1		0.90	Dry
		01/11/2022	0.1	0.1	0.0001	2.2	2.1	0.0022	17.7	1003	Rising	0.1	0.1		0.9	Dry
		16/11/2022	0.1	0.1	0.0001	0.1	0.1	0.0001	19.9	1003	Low/Falling	0.1	0.1		0.9	Dry
WS103	Natural CLAY Drift	27/09/2022	0.1	0.1	0.0001	1.2	1.1	0.0012	19.3	989	Low/Falling	0.1	0.1	1.50 – 3.50	3.65	Dry
		13/10/2022	0.1	0.1	0.0001	0.1	0.1	0.0001	18	1003	Falling	0.1	0.1		3.70	Dry
		01/11/2022	0.1	0.1	0.0001	0.1	0.1	0.0001	20.3	988	Rising	0.1	0.1		3.66	Dry
		16/11/2022	0.1	0.1	0.0001	0.1	0.1	0.0001	19.9	977	Low/Falling	0.1	0.1		3.66	3.6

Notes

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



4.6. SUMMARY OF MONITORING RESULTS

4.6.1. GROUNDWATER

The monitoring wells were generally found to be dry or 'wet at base' during the majority of the ground gas monitoring visits.

WS101 found to contain a small volume of groundwater from the second visit onwards, although not enough to obtain a representative groundwater sample. It is likely that this represents perched groundwater from rainfall as opposed to true ground water.

4.6.2. BAROMETRIC PRESSURE

Visits 1 and visit 4 were undertaken during a period of low/falling pressure, with pressure recorded to be 989 mbar and 977 respectively. A relatively high barometric pressure was recorded during visit 2 which recorded a pressure of 1005 mbar.

It is considered that the gas monitoring visits undertaken so far have been representative of a variety of different barometric conditions.

4.6.3. GAS FLOW

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

4.6.4. 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 1.6% v/v (WS101, WS102).

4.7. CONCLUSION

The determined Characteristic Situation for each standpipe for each visit is presented in Table 4.7. This indicates that based on the peak flow rates the majority of the monitoring visits classify as Characteristic Situation (CS)1 – Very Low Gas Risk.

TABLE 4.7 GAS RISK PROFILE AND LOCATION

WELL	DATE	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	NHBC TRAFFIC LIGHT
WS101	27/09/2022	Dry	0.1	0.1	0.0001	1.6	0.0016	CS1	Green
	13/10/2022	4.7	0.1	0.1	0.0001	0.1	0.0001	CS1	Green
	01/11/2022	4.77	0.1	0.1	0.0001	2.1	0.0021	CS1	Green
	16/11/2022	4.78	0.1	0.1	0.0001	0.1	0.0001	CS1	Green



WELL	DATE	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	NHBC TRAFFIC LIGHT
WS102	27/09/2022	Dry	0.1	0.1	0.0001	1.6	0.0016	CS1	Green
	13/10/2022	Dry	0.1	0.1	0.0001	0.1	0.0001	CS1	Green
	01/11/2022	Dry	0.1	0.1	0.0001	2.1	0.0021	CS1	Green
	16/11/2022	Dry	0.1	0.1	0.0001	0.1	0.0001	CS1	Green
WS103	27/09/2022	Dry	0.1	0.1	0.0001	1.2	0.0012	CS1	Green
	13/10/2022	Dry	0.1	0.1	0.0001	0.1	0.0001	CS1	Green
	01/11/2022	Dry	0.1	0.1	0.0001	0.1	0.0021	CS1	Green
	16/11/2022	3.6	0.1	0.1	0.0001	0.1	0.0001	CS1	Green

Data to date indicates a CS1 classification. Completion of the full gas monitoring programme will be required to fully appraise the gas risk.

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.

4.8. POTABLE WATER SUPPLY

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

TABLE 4.8 PIPELINE SELECTION PE THRESHOLD CONCENTRATIONS

Contaminant Group	PE-threshold (mg/kg)	Concentrations at <u>Current</u> pipeline depth (mg/kg)
Total VOC	0.5	<1.0
Total BTEX And MTBE	0.1	N/A
Total SVOCs (Excluding PAH and those substances marked with an *)	2	N/A
EC5-EC10 Aliphatic and Aromatic Hydrocarbons	2	<1.0
EC10-EC16- Aliphatic and Aromatic Hydrocarbons	10	<4.0
EC16-EC40 Aliphatic and Aromatic Hydrocarbons	500	78
Phenols (From SVOC Analysis)*	2	N/A
Cresols and Chlorinated Phenols (From SVOC Analysis)	2	NA
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?	None	
Is free product present in soil and groundwater?	None	
Could hydrocarbon impact at greater depth than current pipeline depth be mobilised by rising groundwater levels?	No – groundwater is >5.0 m bgl.	
Will soils impacted with above determinands likely be utilised elsewhere on site?	Unknown at this stage.	
Will soils be imported to site as part of any future earth works	Unknown at this stage.	

Notes

Pipe line depth normally between 0.75m – 1.35m

Based on the assessment of current site conditions it is likely that PE pipe will be suitable for the proposed development. A United Utilities Pipe Line Risk Assessment will be required on completion of enabling works.



4.9. CONCEPTUAL SITE MODEL

Following the completion of the intrusive site investigation, chemical analysis and risk assessment, the conceptual model shown in Table.14 has been prepared for the site.

TABLE 4.9 CONCEPTUAL MODEL

POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
PL1 PL2	Heavy Metals, non-volatile PAH (Made Ground)	Dermal contact. Dermal contact and ingestion.	Future site users. Off-site receptors.	Likely	Moderate	LOW
Discussion: Heavy metals (arsenic and lead) and non-volatile PAH compounds have been identified within the Made Ground between depths of 0.10 and 0.50 m. Recommendation: Cover system to garden and landscaped areas will prevent exposure to future site users. Construction works completed with PPE and provision of welfare.						
PL3	ACM (Made Ground)	Inhalation of dust.	Future site users. Buildings. Off-site land users.	Unlikely	Low	LOW
Assessment: No asbestos containing material has been identified during the site investigation and further laboratory testing of samples has not identified any asbestos fibres. However, due to the age of the historic buildings and Made Ground present beneath the site, there still remains potential for asbestos containing materials to be present onsite. Recommendation: Cover system to garden and landscaped areas will prevent exposure to future site users. Construction works completed with PPE and provision of welfare.						



POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
PL4	Methane, carbon dioxide (Made Ground, coal measures and potentially infilled features within 250 m of the site)	Inhalation of gas. Migration through permeable strata and preferential pathways. Explosion in confined spaces.	Future site users. Buildings. Off-site land users.	Low likelihood	Moderate	Low
Assessment: Relatively shallow Made Ground deposits have been identified as potential sources of hazardous ground gas. Potential unrecorded shallow mine workings and infilled reservoirs (80 m north east) are all potential sources of ground gas to the site. Monitoring to date has not detected any elevated CH₄/CO₂ concentrations. Recommendation: Initial monitoring suggests that the site can be classified as CS1/Green, however this will be confirmed on completion of the monitoring. Precautionary CS2/Amber 1 measures required.						
PL5	Mobile contaminants such as metals, PAHs, hydrocarbons, volatile compounds (Made Ground)	Surface runoff. Migration through permeable strata and preferential pathways. Perched waters migration.	Groundwater (secondary A aquifer). Surface water (Whit Brook).	Low likelihood	Low	Low
Assessment: Results gain from leachate analysis of samples gathered during the site investigation have identified a number of heavy metal exceedances compared to EQS and DWS values. Given the absence of shallow groundwater which may mobilise the identified contaminants, there is considered to be a low risk to controlled waters and the wider environment as no complete pollutant linkage can be determined. Recommendation: Limit surface water infiltration and manage surface water disposal during the construction phase.						



POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
PL6	Sulphate (potential ash within Made Ground)	Sulphate attack on concrete.	Building structure.	Likely	Moderate/Low	Low

Assessment:

The soils at the site meet class DS-1, AC-1s.

Recommendation:

Concrete should be designed in accordance with the chemical testing results.

Notes:

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



5. COAL MINING RISK ASSESSMENT

5.1. SUMMARY OF DESK BASED COAL MINING RISK ASSESSMENT

A Coal Mining Risk Assessment was included within the E3P Phase 1 Geo-Environmental Assessment (Ref: 16-142-R1, September 2022). The key points are summarised as follows:

- ✿ The site is located within a Coal Authority defined development high-risk area and workings are recorded in the Arley Seam beneath the site at a depth of 159 m. Unrecorded shallow workings are also considered probable, associated with the Cannel Coal seam that is recorded to outcrop to the north of the site
- ✿ Geological maps indicate the Black Mine (BkM) to outcrop immediately north of the site, dipping beneath the site. (The Black Mine seam is inferred to represent the Cannel Seam recorded by the Coal Authority. Several mine entries are also recorded to the north, west and south of the site, associated with Tonge Colliery and Boarshaw Pit, indicating a legacy of mining in the wider area.
- ✿ Log annotations for the mapped mine entries on the 6 inch map record drift to 64-65 ft (19.50-20.00 m) bgl over sandstone, with coal at 79 and 96 ft (22.50 and 29.00 m).
- ✿ Based on the above, there is considered to be a moderate risk from shallow coal mining beneath the site (<30 m bgl).

5.2. SCOPE OF INTRUSIVE GROUND INVESTIGATION

In due consideration of the potential presence of a nearby outcrop within the Cannel Coal Seam an area of potential shallow mine workings a series of rotary boreholes have been advanced in accordance with Coal Authority Permission to assess the potential presence of shallow workings within this seam and the potential for ground instability to induce a future subsidence event within the proposed development.

5.2.1. ROTARY BOREHOLES TO INVESTIGATE WORKINGS IN COAL

Three rotary boreholes have been advanced at the locations detailed within the E3P exploratory borehole location plan at positions to intersect the potential coal seams and assess the potential for any workings.

TABLE 5.1 ROTARY BOREHOLES

ROTARY BOREHOLE	DEPTH TO ROCKHEAD (m bgl)	DEPTH TO COAL (m bgl)	EVIDENCE OF MINING ACTIVITY/SEAM	REMARKS
RB101	20.00	Coal fragments between 21.60 - 24.00	Mudstone described as 'fractured' 22.60 - 24.00	No loss of flush or voids.
RB102	17.90	Coal fragments between 23.80 - 26.90	N/A	No loss of flush or voids.
RB103	18.20	Coal fragments between 24.50 - 30.00	N/A	No loss of flush or voids.



5.3. SUMMARY OF COAL MINING ISSUES

E3P has reviewed the historical geological mapping and CA information, in addition to completing three 40 m rotary boreholes to investigate shallow mine workings. The findings are summarised as follows:

- ✚ The depth to rockhead is consistent with nearby mine entry records/logs.
- ✚ Based on 16 degree dip from horizontal and subcrop c. 20 m north, coal would be expected c. 23 m bgl in the north of the site, dipping to c. 31 m in the south. The occurrence of coal fragments in the mudstone at depths between 21.60 and 30.00 m bgl therefore coincides with the anticipated depth at which the Black Mine/Cannel seam might be anticipated.
- ✚ No intact coal seams were encountered, which may be indicative of poor quality coal close to crop. The Coal Authority indicate that the western extent of the seam is unproven, thus suggesting it may not be present.
- ✚ No evidence of workings e.g. broken ground, loss of flush or voids was recorded.

The overall risk from mining related hazards is therefore considered to be low.



6. GEOTECHNICAL ASSESSMENT

6.1. PROPOSED DEVELOPMENT

Rochdale Metropolitan Borough Council intend to construct a mid-rise residential development comprising 6 residential apartment units over three storeys with associated landscaped areas, estate parking and utility infrastructure. Drawing 16-124-002 (Appendix III) identifies the proposed development layout.

6.2. SUMMARY OF GROUND CONDITIONS

- ✳ Made Ground – generally consists of greyish brown very sandy GRAVEL. The gravel consists of brick and concrete with occasional cobbles and inclusions of metal and wood to a maximum proven depth of 1.6 m bgl.
- ✳ Drift – orange brown gravelly SAND, underlain by cohesive deposits of stiff brown sandy CLAY to a maximum depth of 20.0 m bgl.
- ✳ Solid – Brown and grey MUDSTONE and SANDSTONE between the depths of 17.9 m bgl and 40.0 m bgl.

6.3. SITE PREPARATION

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

- ✳ Roots present below the footprint of proposed structures and infrastructure should be grubbed out and the resulting void infilled with suitable compacted engineered fill.
- ✳ 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.

6.4. FOUNDATION CONDITIONS AND ASSESSMENT OF POTENTIAL BEARING CAPACITIES

In due consideration of the identified ground conditions, in-situ and laboratory geotechnical testing, E3P has undertaken an assessment of the net safe allowable bearing pressure (ABP) within the underlying natural stratum to assist in the detailed design of foundations and infrastructure and determine the target founding stratum. The results of this assessment are summarised in Table 6.1.



TABLE 6.1 SUMMARY OF ABP

GRANULAR SOILS			
Description	Depth (Range m bgl)	Relative Density	Allowable Bearing Pressure (kN/m ²)
Gravelly SAND	1.00–5.45	Medium Dense – Very Dense	110–456.77
COHESIVE SOILS			
Description	Depth (range m bgl)	Undrained Shear Strength (Cu) (kN/m ²)	Allowable Bearing Pressure (kN/m ²)
Stiff, Sandy CLAY	5.00–5.45	58	119

Based on the assessment of the relative undrained shear strength, relative in-situ densities and corresponding safe net allowable bearing pressure, the suitable target founding stratum has been identified as the medium-dense sands underlying the site.

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 to comprise:

- 🔧 Shallow strip/mass trench foundations bearing on medium dense SAND (depth subject to proposed loadings).
- 🔧 Ground improvement using vibro stone columns (VSC) to support reinforced foundations.

Before the construction of foundations the underlying existing building footprint and building material must be remediated with all existing foundations and underground structures grubbed out to provide suitable development platform levels.

Should shallow clays be encountered at intervening locations, 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.

A summary of anticipated foundations is presented in Table 6.2.

TABLE 6.2 ANTICIPATED FOUNDATIONS

LOCATION	ANTICIPATED FOUNDING STRATA DEPTH (m bgl)	GROUND WATER (m bgl)	TARGET STRATUM	TREES	COAL	FOUNDATION TYPE	TYPE OF CONCRETE
WS101	1.65	N/A	MD SAND	Y	N/A	Mass Trench	DS-1 AC-1s
WS102	1.55	N/A	MD SAND	N	N/A	Mass Trench	DS-1 AC-1s
WS103	0.95	N/A	MD SAND	N	N/A	Shallow Strip	DS-1 AC-1s
WS104	1.25	N/A	MD SAND	N	N/A	Shallow Strip	DS-1 AC-1s
TP101	1.15	N/A	MD SAND	N	N/A	Shallow Strip	DS-1 AC-1s



LOCATION	ANTICIPATED FOUNDING STRATA DEPTH (m bgl)	GROUND WATER (m bgl)	TARGET STRATUM	TREES	COAL	FOUNDATION TYPE	TYPE OF CONCRETE
TP102	1.55	N/A	MD SAND	N	N/A	Mass Trench	DS-1 AC-1s
TP103	1.55	N/A	MD SAND	N	N/A	Mass Trench	DS-1 AC-1s
TP104	1.45	N/A	MD SAND	N	N/A	Mass Trench	DS-1 AC-1s
TP105	1.45	N/A	MD SAND	N	N/A	Mass Trench	DS-1 AC-1s
TP106	1.95	N/A	MD SAND	N	N/A	Mass Trench	DS-1 AC-1s

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.

6.5. 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.

6.6. HEAVE PRECAUTIONS

The site has been proven to be underlain by shallow granular strata, with deeper CLAY soils encountered from 4.10 and 4.20 m bgl in WS101 and WS102 in the west of the site respectively, and also in the RB102 AND RB103 from 3.00 and 3.40 m bgl respectively.

Subject to levels, heave precautions are unlikely to be required. Should clay soils be encountered at shallow (<2.50 m) depth, reference to NHBC guidance should be made in respect of heave precautions and foundations may require deepening.

6.7. HIGHWAYS CONSTRUCTION

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

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



6.8. DRAINAGE

Soakaway testing was outside of the scope of this investigation. If soakaway drainage is to be considered, full BRE 365 testing must be completed to inform the detailed design.

6.9. CONCRETE DURABILITY

Based upon the results of the chemical analyses it is considered that subsurface concrete can be designed in accordance with Design Sulphate Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with the recommendations provided in BRE *Special Digest 1* (2005).

6.10. EXCAVATIONS

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

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, it is considered that all excavations are supported or battered back in accordance with guidance contained in CIRIA R97.

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

TABLE 6.4 CIVIL ENGINEERING EXCAVATION RISK MATRIX

RISK ITEM	PRESENT	COMMENT
Running Sands	No	No running sand has been identified.
Minor Water Ingress	No	Ingress of water into foundation excavation will potentially flood foundation excavations, limiting the viability of spread foundations to be constructed.
Shallow Bedrock	No	Shallow bedrock has not been identified on site

6.11. SLOPE STABILITY

During the site investigation there were no nearby slopes identified within or in close proximity to the site boundary. A slope stability assessment will not be necessary in relation to this site.



6.12. CONSTRUCTION ACTIVITY AND INSPECTION

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

- ✳ It is recommended that sufficient allowance is made for the inspection of formations and sub-formations to foundations and pavement construction.
- ✳ Excavations where access is required should be subject to a risk assessment from a competent person and, where appropriate, mitigation measures such as benching back the sides or use of support systems in accordance with CIRIA R97 should be utilised.
- ✳ Should dewatering 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).



6.13. GEOTECHNICAL RISK REGISTER

POTENTIAL CONSTRAINT	ABNORMAL	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Remediation of contaminated soils		On site	30	The contamination identified on site can be mitigated by a suitable 600 mm cover system.
Bedrock		-	-	Shallow bedrock has not been identified.
Obstructions		All	100	Site has been subject to significant historical development and, while above-ground structures have been removed, potential obstructions from relict foundations should be anticipated. Trial pits encountered demolition rubble within the Made Ground.
Retaining walls		-	-	No retaining structures are present onsite.
Trench collapse		All	100	Made Ground and granular soils beneath the site may be prone to collapse.
Mature trees		Northern and Southern boundary of the site	20	Site is underlain by granular (non-shrinkable soils).
Volume change potential clay		-	-	Low risk.
Running sands		-	-	Data searches indicate low risk.
Ground dissolution		-	-	Data searches indicate no hazard.
Concrete design		All	-	Site has been categorised as AC-1s/DC-1.
Low-permeability ground		-	-	Soakaways likely to be effective in areas where permeable granular deposits are present. BRE 365 assessment required if SUDS drainage proposed.
Services/sensitive structures		-	-	A review of online services has identified no active services currently in use onsite.



Brassey Street, Middleton

Phase II Geoenvironmental Site Assessment

December 2022

POTENTIAL CONSTRAINT	ABNORMAL	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Abnormal foundation solutions	-	-	-	In most probability the most appropriate foundation solutions shall be the use of shallow strip and mass trench fill.
Areas not investigated	-	-	-	N/A
Surface water features	-	-	-	Whit Brook is located 43 m south east.
Mining	-	-	-	E3P has completed 3 no. 40 m rotary boreholes to investigate shallow mine workings. The findings are summarised as follows: ✿ No intact coal seams were encountered. ✿ No evidence of workings e.g. broken ground, loss of flush or voids was recorded. The overall risk from mining related hazards is considered to be low.



6.14. FURTHER WORKS

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

-  Completion of ground gas monitoring programme
-  Remediation and enabling works strategy
-  Plot-specific foundation schedule (upon receipt of the final development levels)
-  UKWIR risk assessment.



7. CONCLUSIONS AND RECOMMENDATIONS

7.1. CONTAMINATED LAND ASSESSMENT

Human Health	The Tier 1 human health risk assessment identified concentrations of non-volatile PAH and heavy metals compounds in exceedance of Residential End Use with Plant Uptake GAC values in three locations. As such, it will be necessary to design and construct the proposed development in a manner that will ensure suitably validated cover systems to all areas of private garden, soft landscaping and public open space. A suitable 600 mm clean cover system would be to be acceptable to mitigate these risks to future end users of the site. Chemical analysis of the natural drift deposits has identified these soils to be acceptable for use as subsoil within the proposed garden areas; however, further chemical validation samples will be required to confirm this. A number of chemical exceedances have been identified within Topsoil and TP101 and TP103. Further chemical testing will be needed to assess the suitability of site won topsoil for use within gardens.
Controlled Waters	Elevated heavy metals have been identified within the leachate analysis are believed to be isolated to the Made Ground material to a maximum proven depth of 1.60 m bgl. Given the absence of shallow groundwater which may mobilise the identified contaminants, there is considered to be a low risk to controlled waters and the wider environment as no complete pollutant linkage can be determined.
Ground Gas	Characteristic Situation 1 (pending completion of gas monitoring).
Potable Water	Based on the assessment of current site conditions it is likely that PE pipe will be suitable for the proposed development. This will need to be confirmed following the completion of a UKWIR risk assessment. Post-remediation and enabling works ground conditions may be different from those identified during this site investigation.



7.2. COAL MINING

Coal Mining	E3P has completed 3 no. 40 m rotary boreholes to investigate shallow mine workings. ✿ The depth to rockhead is consistent with nearby mine entry records/logs. ✿ Based on 16 degree dip from horizontal and subcrop c. 20 m north, coal would be expected c. 23 m bgl in the north of the site, dipping to c. 31 m in the south. The occurrence of coal fragments in the mudstone at depths between 21.60 and 30.00 m bgl therefore coincides with the anticipated depth at which the Black Mine/Cannel seam might be anticipated. ✿ No intact coal seams were encountered, which may be indicative of poor quality coal close to crop. The Coal Authority indicate that the western extent of the seam is unproven, thus suggesting it may not be present. No evidence of workings e.g. broken ground, loss of flush or voids was recorded. The overall risk from mining related hazards is therefore considered to be low.
---------------------------	--

7.3. GEOTECHNICAL ASSESSMENT

Concrete and brick obstructions have been encountered within the Made Ground, indicative of relic foundations from the former building, with evidence of existing foundations on the north wester corner of the site.

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

The underlying natural sand drift deposits have been assessed as being medium dense to dense, high-strength with a SPT N Value of between 18 and 50 and ABP of >100 at c. 1.0 m bgl.

Due to the sites uniform topography it is unlikely that the site will require a significant amount of cut-and-fill enabling works in order to develop a suitable working platform.

Based on the assessment of the relative undrained shear strength, relative in-situ densities and corresponding safe net allowable bearing pressure, the suitable target founding stratum has been identified as the medium-dense SAND underlying the site.

We would anticipate that the final foundation solution to comprise:

- ✿ Shallow strip/mass trench foundations bearing on medium dense SAND (depth subject to proposed loadings).
- ✿ Ground improvement using vibro stone columns (VSC) to support reinforced foundations.

Should shallow clays be encountered at intervening locations, 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.



END OF REPORT



APPENDIX I LIMITATIONS

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



APPENDIX II

GLOSSARY

TERMS

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



Brassey Street

Phase II Geoenvironmental Site Assessment
December 2022

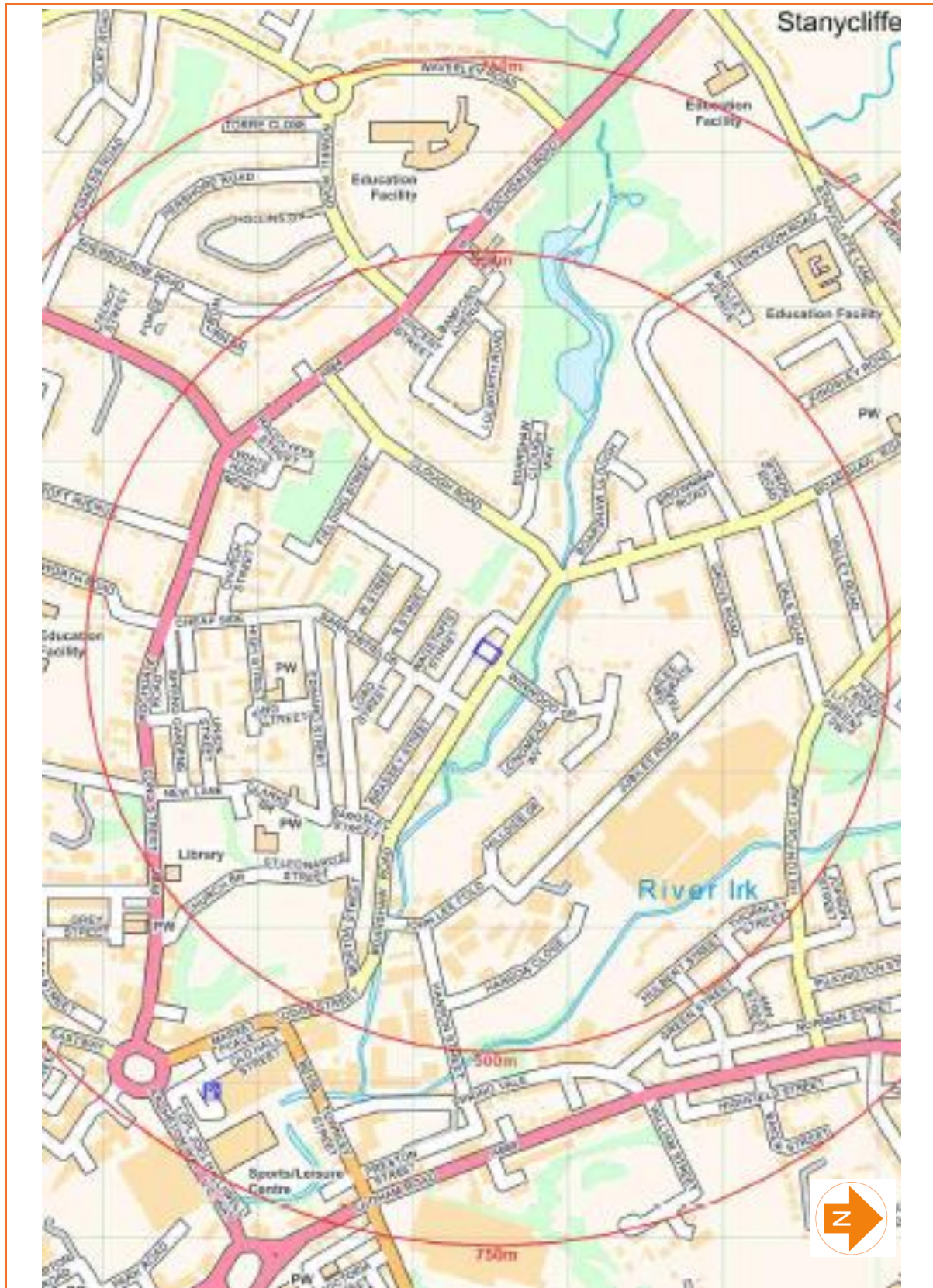
MIBK	Methyl isobutyl ketone	WTE	Water table elevation
m	Metres	ppm	Parts per million
km	Kilometres	mg/m³	Milligram per metre cubed
% v/v	Percent volume in air	m bgl bgl	Metres below ground level
mb	Millibars (atmospheric pressure)	m bcl	Metre below cover level
l/hr	Litres per hour	mAOD	Metres above ordnance 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

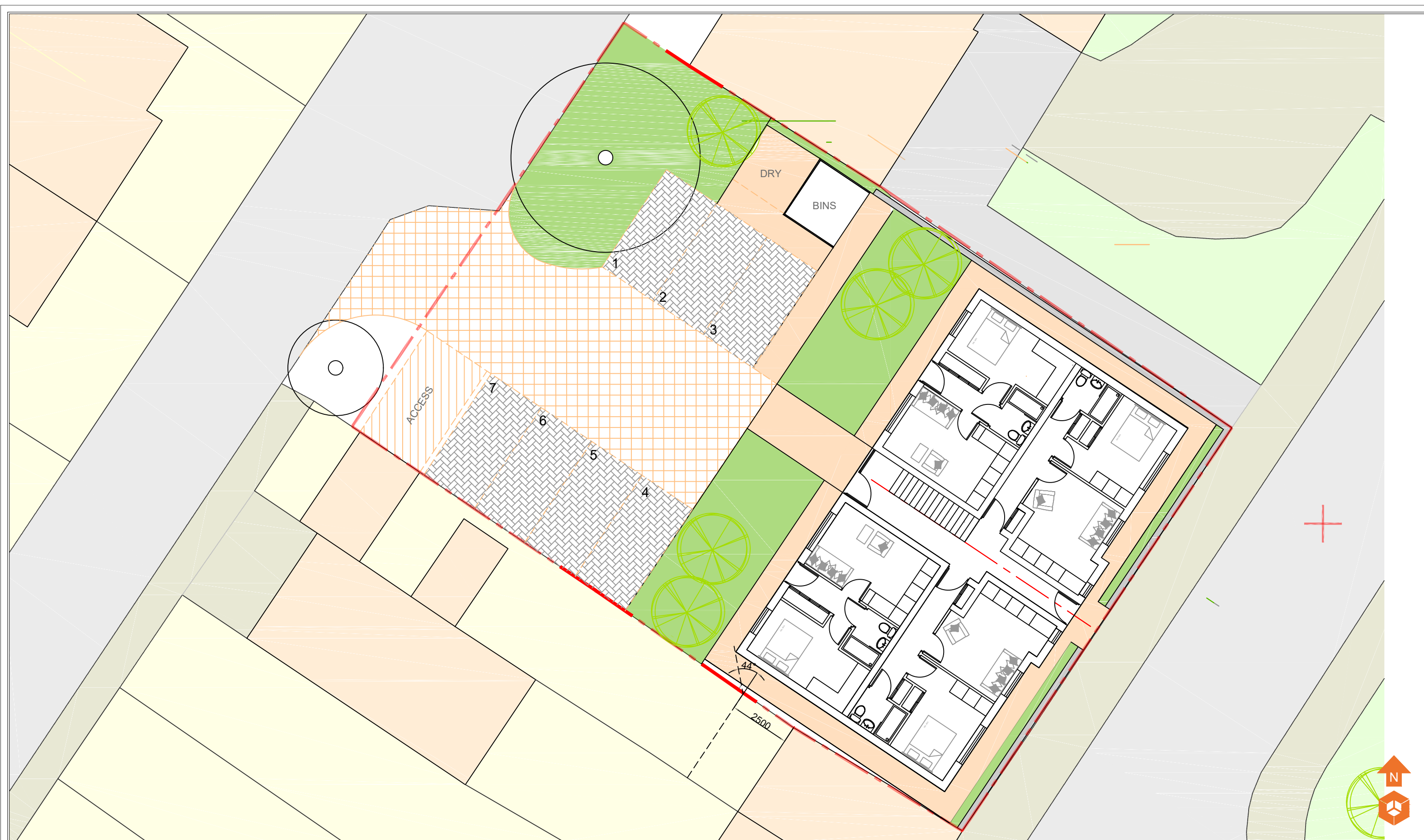


APPENDIX III

DRAWINGS

DRAWING 16-124-001 – SITE LOCATION PLAN





Notes:				
P1	REVA	14.09.2022	HM	JS
Phase	Issue	Date	Drawn	Checked

Client:	Healey Consulting
Job Title:	Brassey Street, Middleton

Job No:	16-124	Date:	14.09.2022
Drawing No:	002	Scale:	NTS
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.



Site Features				
	Street Light			
	Grass			
	Electrical Street Cabinet			
	Mature Tree			

Notes:				
P1	REVA	14.09.2022	HM	JS
Phase	Issue	Date	Drawn	Checked

Client:
Healey Consulting
Job Title:
Brassey Street, Middleton

Job No:
16-124
Drawing No:
003

Date:
14.09.2022
Scale:
NTS



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

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



Historical Features

- Former Field Boundaries (Pre 1851 - Pre 1893)
- Former Field Boundaries (Pre 1851 - Pre 1893)
- Former Residential Buildings (Pre 1893 - Pre 1967)

Notes:

P1	REVA	14.09.2022	HM	JS
Phase	Issue	Date	Drawn	Checked

Client:

Healey Consulting

Job Title:

Brassey Street,
Middleton

Job No:

16-124

Drawing No:

004

Date:

14.09.2022

Scale:

NTS



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

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



Location Symbols

- Approximate Window Sample Probehole Location
- Approximate Window Sample Probehole Location with Install
- Approximate Trial Pit Location

Notes:

P1	REVA	27.09.2022	CB	JS
Phase	Issue	Date	Drawn	Checked

Client:

Healey Consulting

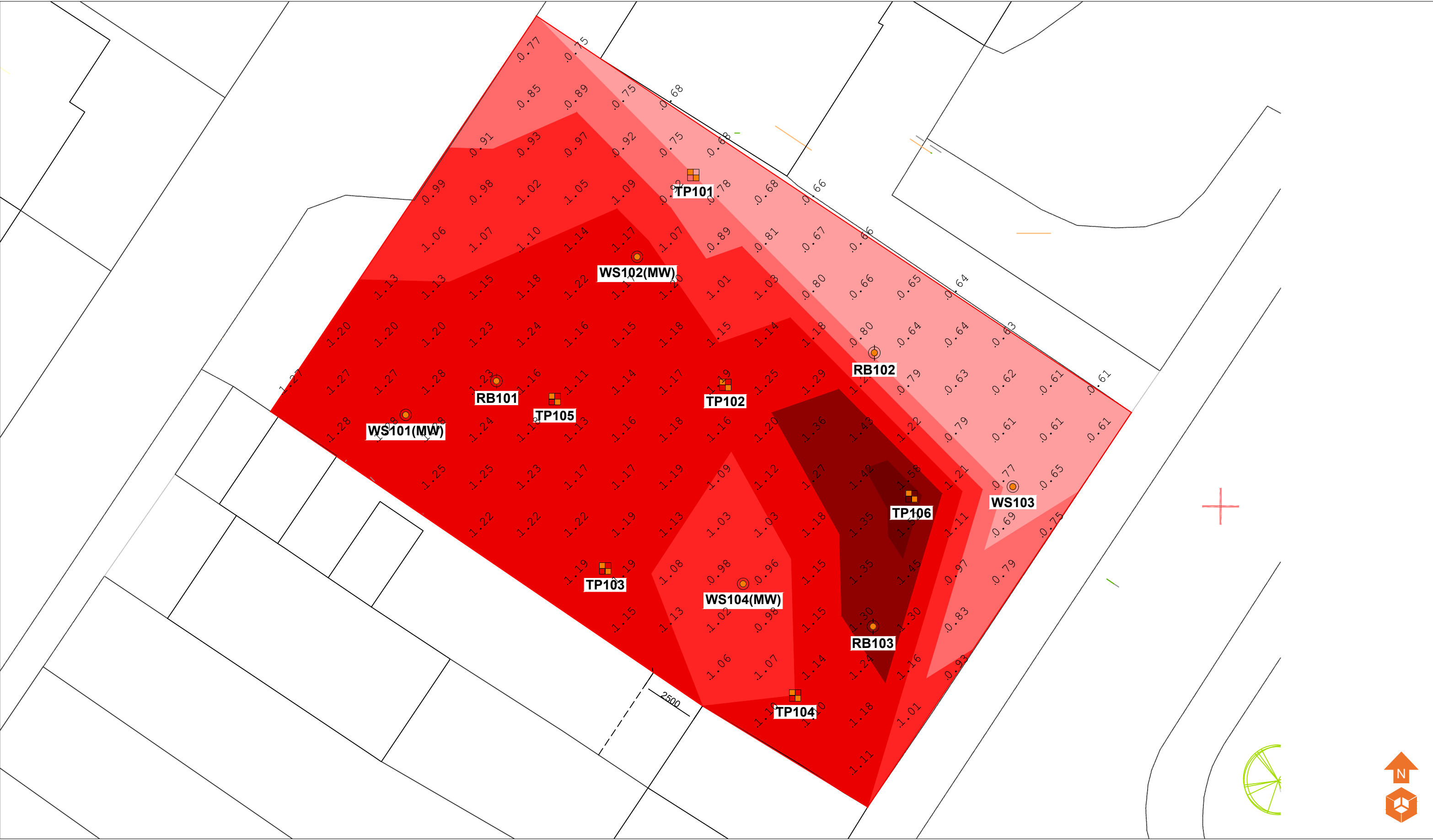
Job Title:

Brassey Street,
Middleton

Job No:	16-124	Date:	27.09.2022
Drawing No:	005	Scale:	NTS

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

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



Location Symbols

WS101

Approximate Window Sample Probehole Location

WS102(MW)

Approximate Window Sample Probehole Location with Install

TP101

Approximate Trial Pit Location

Made Ground Depth (m)

Depth of Made Ground 0.50 - 0.69m

Depth of Made Ground 0.70 - 0.89m

Depth of Made Ground 0.90 - 1.09m

Depth of Made Ground 1.10 - 1.29m

Depth of Made Ground 1.30 - 1.49m

Depth of Made Ground >1.50m

Notes:

P1

Phase

REVA

Issue

14.10.2022

Date

LM

Drawn

HM

Checked

Client:

Healey Consulting

Job Title:

Brassey Street,
Middleton

Job No:

16-124

Drawing No:

006

Date:

14.10.2022

Scale:

NTS

e3p

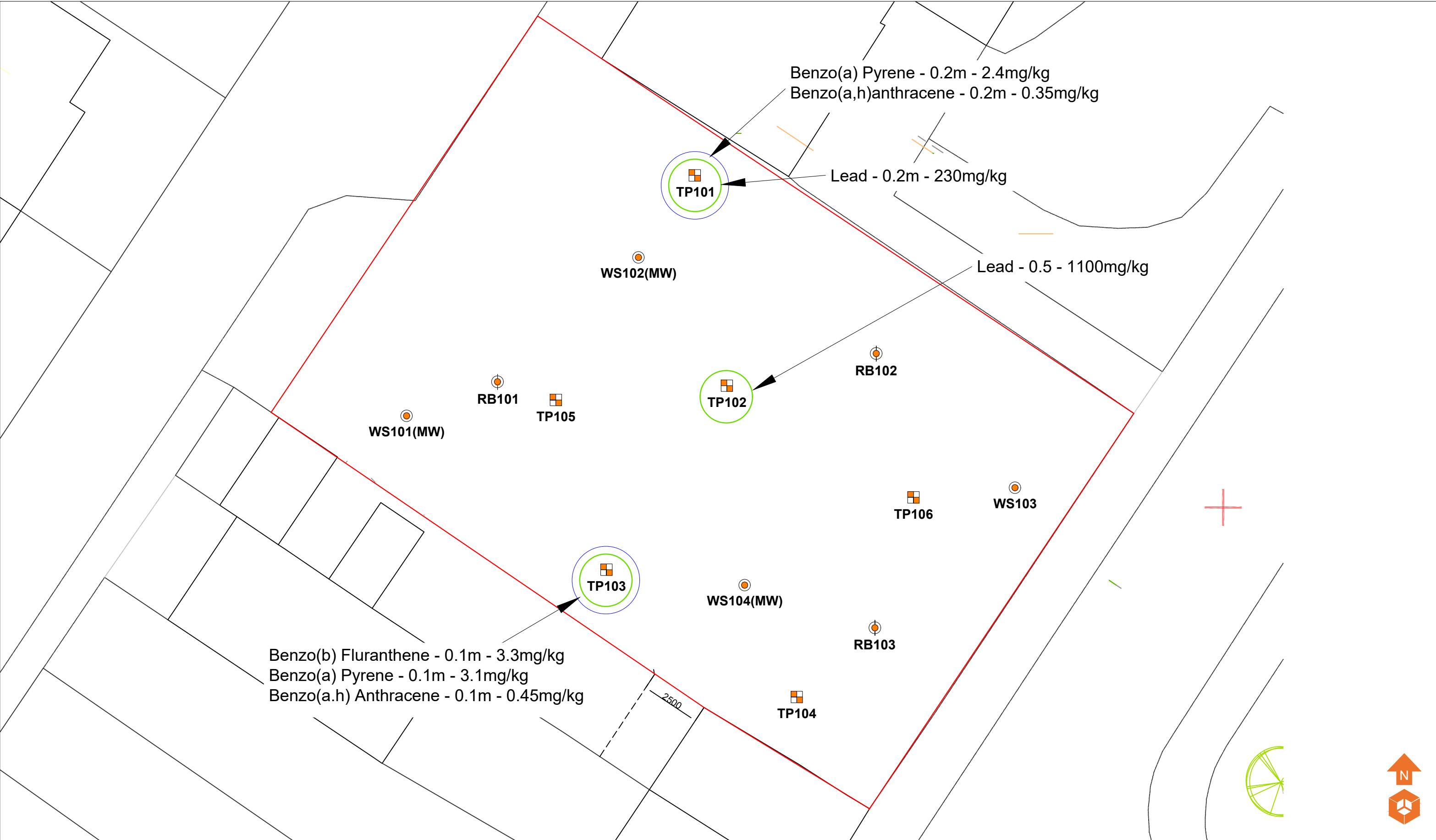
Environmental Engineering
Partnership Ltd
Taylor Road, Trafford Park
Urmston, Manchester, M41 7JQ
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
Website: www.e3p.co.uk

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

Depth of Made Ground Plan



Location Symbols WS101 Approximate Window Sample Probehole Location WS101(MW) Approximate Window Sample Probehole Location with Install TP101 Approximate Trial Pit Location RB101 Approximate Rotary Borehole Location	Bedrock Depth (m) Depth to Bedrock 13.00 - 13.99m Depth to Bedrock 14.99 - 15.99m Depth of to Bedrock 16.00 - 16.99m Depth of to Bedrock 17.00 - 17.99m Depth of to Bedrock 18.00 - 18.99m Depth of to Bedrock >1.50m
---	--



Location Symbols WS101 Approximate Window Sample Probehole Location WS101(MW) Approximate Window Sample Probehole Location with Install TP101 Approximate Trial Pit Location

APPENDIX IV

PHOTOGRAPHS

PLATE 1

WESTERN SECTOR OF THE SITE



PLATE 2

EASTERN SECTOR OF THE SITE



PLATE 3 GRAVELLY SAND MATERIAL – TP103



PLATE 4 HISTORIC FOUNDATIONS – TP101



APPENDIX V

E3P EXPLORATORY HOLE LOGS

Project Name: Brassey Street	Project No. 16124	Co-ords: 387497.00 - 406567.00 Level:	Date
Location: Middleton		Dimensions (m): 2.50 Depth 2.40	Scale 1:30
Client: Healey Consulting			Logged H.Morgan

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10 0.10	ES		0.20			MADE GROUND: Black clayey gravelly sand. Gravel is fine to medium subangular to subrounded of sandstone mudstone and brick. (Topsoil)	
				0.70			MADE GROUND: Greyish brown very sandy gravel. Gravel is fine to coarse angular to subrounded of sandstone brick and concrete. With frequent sandstone slabs and intact bricks.	
	1.00 1.00	ES					Orange brown slightly gravelly fine to coarse SAND. Gravel is fine to coarse subrounded to rounded of sandstone.	1
				1.90			Orange brown gravelly fine to coarse SAND. Gravel is fine to coarse subrounded to rounded of sandstone.	2
	2.00 2.00	B		2.40			End of Pit at 2.40m	3
								4

Trial Pit Photographs



Trial Pit 101

Trial Pit 101 Spoil

Remarks: 1. Stable 2. Old lead pipe at 0.4m bgl

Stability: Stable.

Project Name: Brassey Street	Project No. 16124	Co-ords: 387499.00 - 406561.00 Level:	Date
Location: Middleton		Dimensions (m): 2.00 Depth 2.50	Scale 1:30 Logged H.Morgan
Client: Healey Consulting			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20			0.20			MADE GROUND: Black clayey gravelly sand. Gravel is fine to medium subangular to subrounded of sandstone mudstone and brick. (Topsoil)	
	0.50 0.50	ES					MADE GROUND: Greyish brown very sandy gravel. Gravel is fine to coarse angular to subrounded of sandstone brick and concrete. With frequent sandstone cobbles and intact bricks. With constituents of wood and metal.	1
	1.20			1.20				
	1.50 1.50	ES					Orange brown gravelly fine to coarse SAND. Gravel is fine to coarse subrounded to rounded of sandstone.	2
	2.50			2.50			End of Pit at 2.50m	3
								4

Trial Pit Photographs



Trial Pit 102

Trial Pit 102 Spoil

Remarks: 1. Stable 2. Roots at 0.2m bgl

Stability: Stable.

Project Name: Brassey Street	Project No. 16124	Co-ords: 387494.00 - 406552.00 Level:	Date
Location: Middleton		Dimensions (m): 2.00 0.70	Scale 1:30
Client: Healey Consulting		Depth 2.80	Logged H.Morgan

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10 0.10	ES		0.20			MADE GROUND: Black clayey gravelly sand. Gravel is fine to medium subangular to subrounded of sandstone mudstone and brick. (Topsoil)	
				1.20			MADE GROUND: Greyish brown slightly clayey very sandy gravel. Gravel is fine to coarse angular to subrounded of sandstone mudstone brick and concrete. With frequents sandstone cobbles and intact brick.	1
	1.50 1.50	ES					Orange brown gravelly fine to coarse SAND. Gravel is fine to coarse subrounded to rounded of sandstone. With frequent sandstone cobbles.	2
				2.80			End of Pit at 2.80m	3
								4

Trial Pit Photographs



Trial Pit 103



Trial Pit 103 Spoil

Remarks: 1. Stable

Stability: Stable.

Project Name: Brassey Street	Project No. 16124	Co-ords: 387504.00 - 406545.00 Level:	Date
Location: Middleton		Dimensions (m): 2.00 Depth 2.50	Scale 1:30 Logged H.Morgan
Client: Healey Consulting			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.50 0.50	ES		0.20			MADE GROUND: Black clayey gravelly sand. Gravel is fine to medium subangular to subrounded of sandstone mudstone and brick. (Topsoil) MADE GROUND: Brown very clayey gravelly fine to coarse sand. Gravel is fine to coarse subangular to subrounded of sandstone mudstone brick concrete and coal. With frequent large sandstone cobbles.	1
	1.20 1.20	B		1.10			Orange brown gravelly fine to coarse SAND. Gravel is fine to coarse subrounded to rounded of sandstone. With infrequent sandstone cobbles.	2
				2.50			End of Pit at 2.50m	3
								4

Trial Pit Photographs



Trial Pit 104



Trial Pit 104 Spoil

Remarks: 1. Stable

Stability: Stable.

Project Name: Brassey Street	Project No. 16124	Co-ords: 387494.00 - 406559.00 Level:	Date
Location: Middleton		Dimensions (m): 2.00 Depth 2.40	Scale 1:30
Client: Healey Consulting		0.70	Logged H.Morgan

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10 0.10	ES		0.20			MADE GROUND: Black clayey gravelly sand. Gravel is fine to medium subangular to subrounded of sandstone mudstone and brick. (Topsoil)	
							MADE GROUND: Brown very sandy gravel. Gravel is fine to coarse angular to subrounded of sandstone brick and concrete. With frequent sandstone slabs and intact bricks.	
				1.10				1
	1.50 1.50	ES		1.70			Orange brown slightly gravelly fine to coarse SAND. Gravel is fine to coarse subrounded to rounded of sandstone.	
							Orange brown gravelly fine to coarse SAND. Gravel is fine to coarse subrounded to rounded of sandstone. With infrequent sandstone cobbles.	2
				2.40			End of Pit at 2.40m	3
								4

Trial Pit Photographs



Trial Pit 105



Trial Pit 105 Spoil

Remarks: 1. Stable

Stability: Stable.

Project Name: Brassey Street	Project No. 16124	Co-ords: 387504.00 - 406555.00 Level:	Date
Location: Middleton	Dimensions (m): 2.00 Depth 3.00 0.70		Scale 1:30
Client: Healey Consulting			Logged H.Morgan

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10 0.10	ES		0.20			MADE GROUND: Black clayey gravelly sand. Gravel is fine to medium subangular to subrounded of sandstone mudstone and brick. (Topsoil) MADE GROUND: Greyish brown clayey very sandy gravel. Gravel is fine to coarse angular to subrounded of sandstone mudstone brick concrete and ceramic.	1
	1.50 1.50	ES		1.40 1.60			MADE GROUND: Orange brown very gravelly fine to coarse sand. Gravel is fine to coarse angular to subrounded of sandstone and brick. Orange brown gravelly fine to coarse SAND. Gravel is fine to coarse subrounded to rounded of sandstone.	2
				3.00			End of Pit at 3.00m	3
								4

Trial Pit Photographs



Trial Pit 106



Trial Pi 106 Spoil

Remarks: 1. Stable

Stability: Stable.

Borehole Log

Borehole No.

WS101

Sheet 1 of 1

Project Name: Brassey Street

Project No.
16124

Co-ords: 387487.00 - 406557.00

Hole Type
WS

Location: Middleton

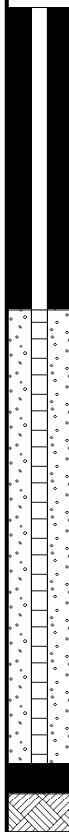
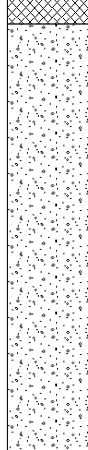
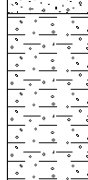
Level:

Scale
1:50

Client: Healey Consulting

Dates: -

Logged By
H.Morgan

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
					0.20			MADE GROUND: Black clayey gravelly sand. Gravel is fine to medium subangular to subrounded of sandstone mudstone and brick. (Topsoil)		
		1.00 1.10	ES	N=16 (2,3/3,3,3,7)	1.30			MADE GROUND: Medium dense reddish grey very sandy gravel. Gravel is fine to coarse angular to subrounded of sandstone brick and concrete.	1	
		2.00		N=28 (7,7/8,8,6,6)				Medium dense orange brown gravelly fine to coarse SAND. Gravel is fine to coarse to subrounded to rounded of sandstone.	2	
		3.00		N=16 (6,5/4,4,4,4)					3	
		4.00 4.00	D	N=15 (3,3/3,4,4,4)	4.20			Stiff medium strength brown sandy slightly silty gravelly CLAY. Gravel is fine to medium to subrounded to subrounded of sandstone mudstone.	4	
		5.00 5.00	D	N=14 (3,3/4,4,3,3)	5.45				5	
		End of borehole at 5.45 m								6
										7
										8
										9
								10		

Remarks

Borehole Log

Borehole No.

WS102

Sheet 1 of 1

Project Name: Brassey Street

Project No.
16124

Co-ords: 387496.00 - 406563.00

Hole Type
WS

Location: Middleton

Level:

Scale
1:50

Client: Healey Consulting

Dates: -

Logged By
H.Morgan

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20			MADE GROUND: Black clayey gravelly sand. Gravel is fine to medium subangular to subrounded of sandstone mudstone and brick. (Topsoil)	
		0.50	ES					MADE GROUND: Medium dense brown very sandy gravel. Gravel is fine to coarse angular to subrounded of sandstone brick and concrete. With frequent sandstone cobbles and intact bricks.	1
		1.00		N=11 (2,2/2,2,2,5)	1.20			Orange brown sandy gravel. Gravel is fine to coarse angular to subrounded of sandstone.	2
		2.00		N=21 (6,6/6,5,5,5)					3
		2.50	ES						4
		3.00		N=18 (3,4/4,4,5,5)					5
		3.60							6
		4.00		N=19 (4,4/4,5,5,5)	4.10			Medium dense brown fine to coarse SAND.	7
		5.00						Stiff medium strength brown slightly silty sandy CLAY. Gravel is fine to medium subangular to subrounded of sandstone mudstone.	8
		5.00	D	N=14 (3,4/4,4,3,3)	5.45				9
End of borehole at 5.45 m									10

Remarks

Borehole Log

Borehole No.

WS103

Sheet 1 of 1

Project Name: Brassey Street

Project No.
16124

Co-ords: 387511.00 - 406553.00

Hole Type
WS

Location: Middleton

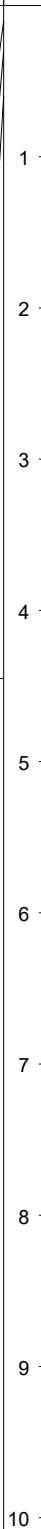
Level:

Scale
1:50

Client: Healey Consulting

Dates: -

Logged By
H.Morgan

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.10			MADE GROUND: Black clayey gravelly sand. Gravel is fine to medium subangular to subrounded of sandstone mudstone and brick. (Topsoil)	
					0.30				
					0.60				
		1.00		N=22 (3,4/4,6,6,6)				MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to subrounded of concrete.	
								MADE GROUND: Grey brown sandy clayey gravel. Gravel is fine to coarse angular to subrounded of sandstone mudstone brick and concrete.	
								Medium dense orange brown gravelly fine to coarse SAND. Gravel is fine to coarse angular to subrounded of sandstone.	
		2.00	ES	N=23 (4,5/5,6,6,6)					
		2.50							
		3.00							
		4.00		N=18 (4,5/5,5,4,4)					
					4.45			End of borehole at 4.45 m	
		5.00		N=30 (5,5/7,7,7,9)					

Remarks

Borehole Log

Borehole No.

WS104

Sheet 1 of 1

Project Name: Brassey Street

Project No.
16124

Co-ords: 387498.00 - 406550.00

Hole Type
WS

Location: Middleton

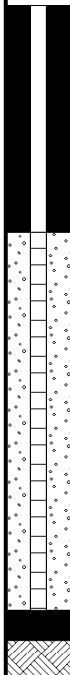
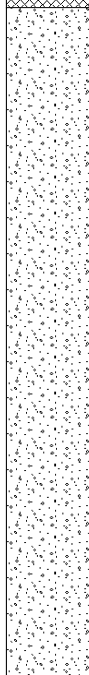
Level:

Scale
1:50

Client: Healey Consulting

Dates: -

Logged By
H.Morgan

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	ES		0.20			MADE GROUND: Black clayey gravelly sand. Gravel is fine to medium subangular to subrounded of sandstone mudstone and brick. (Topsoil)	
		0.50	ES					MADE GROUND: Brown very clayey sandy gravel. Gravel is fine to coarse angular to subrounded of sandstone brick and concrete.	1
		1.00		N=20 (2,3/3,5,5,7)	0.90			Medium dense orange brown gravelly fine to coarse SAND. Gravel is fine to coarse subrounded to rounded of sandstone.	
		2.00		50 (7,9/50 for 225mm)					2
		3.00		N=38 (8,8/10,10,9,9)					3
		4.00		N=50 (5,8/8,12,16,14)					4
					5.45			End of borehole at 5.45 m	5
									6
									7
									8
									9
									10

Remarks



Borehole Log

Borehole No.

RB101

Sheet 1 of 4

Project Name: Brassey Street

Project No.
16124

Co-ords: 387489.00 - 406559.00

Hole Type
BH

Location: Middleton

Level:

Scale
1:50

Client: Healey Consulting

Dates: 10/10/2022 -

Logged By
D.P. Drilling

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20			MADE GROUND: Black clayey gravelly sand. Gravel is fine to medium subangular to subrounded of sandstone mudstone and brick. (Topsoil)	
					1.20			MADE GROUND: Brown very sandy gravel. Gravel is fine to coarse angular to subrounded of sandstone brick and concrete. With frequent sandstone cobbles of sandstone and intact brick.	1
								Stiff brown sandy gravelly CLAY. Gravel is fine to medium subangular to subrounded of sandstone and mudstone.	2
									3
									4
									5
									6
									7
									8
									9
					9.30			Brown fine to coarse SAND.	10

Continued on next sheet

Remarks

1. Complete 2. Drilled water flushing







Borehole Log

Borehole No.

RB101

Sheet 3 of 4

Project Name: Brassey Street

Project No.
16124

Co-ords: 387489.00 - 406559.00

Hole Type
BH

Location: Middleton

Level:

Scale
1:50

Client: Healey Consulting

Dates: 10/10/2022 -

Logged By
D.P. Drilling

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					21.60			Grey MUDSTONE.	21
								Dark brown MUDSTONE. With infrequent coal fragments.	22
								Very fractured MUDSTONE. With frequent coal fragments.	23
					24.00			Grey MUDSTONE.	24
					26.40			Dark grey MUDSTONE.	26
					29.00			Dark grey MUDSTONE. With frequent coal fragments.	29
					29.70			Grey MUDSTONE.	30

Continued on next sheet

Remarks

1. Complete 2. Drilled water flushing





Borehole Log

Borehole No.

RB101

Sheet 4 of 4

Project Name: Brassey Street

Project No.
16124

Co-ords: 387489.00 - 406559.00

Hole Type
BH

Location: Middleton

Level:

Scale
1:50

Client: Healey Consulting

Dates: 10/10/2022 -

Logged By
D.P. Drilling

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					32.60				31
									32
									33
									34
									35
									36
									37
									38
									39
					40.00				40

Grey SANDSTONE. With MUDSTONE bands.

End of borehole at 40.00 m

Remarks

1. Complete 2. Drilled water flushing





Borehole Log

Borehole No.

RB102

Sheet 1 of 4

Project Name: Brassey Street

Project No.
16124

Co-ords: 387504.00 - 406561.00

Hole Type
BH

Location: Middleton

Level:

Scale
1:50

Client: Healey Consulting

Dates: 12/10/2022 -

Logged By
D.P. Drilling

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20			MADE GROUND: Black clayey gravelly sand. Gravel is fine to medium subangular to subrounded of sandstone mudstone and brick. (Topsoil)	
					1.10			MADE GROUND: Brown very sandy gravel. Gravel is fine to coarse angular to subrounded of sandstone brick and concrete. With frequent sandstone cobbles of sandstone and intact brick.	1
					1.50			Orange brown sandy GRAVEL. Gravel is fine to coarse angular to subrounded of sandstone. Brown fine to coarse SAND.	2
					3.00			Stiff brown sandy CLAY.	3
									4
									5
									6
									7
									8
									9
									10

Continued on next sheet

Remarks

1. Complete 2. Drilled water flushing







Borehole Log

Borehole No.

RB103

Sheet 1 of 4

Project Name: Brassey Street

Project No.
16124

Co-ords: 387504.00 - 406548.00

Hole Type
BH

Location: Middleton

Level:

Scale
1:50

Client: Healey Consulting

Dates: 11/10/2022 -

Logged By
D.P. Drilling

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20			MADE GROUND: Black clayey gravelly sand. Gravel is fine to medium subangular to subrounded of sandstone mudstone and brick. (Topsoil)	
					1.10			MADE GROUND: Brown very sandy gravel. Gravel is fine to coarse angular to subrounded of sandstone brick and concrete. With frequent sandstone cobbles of sandstone and intact brick. Brown fine to coarse SAND.	1
					3.40			Stiff brown sandy gravelly CLAY. Gravel is fine to medium subangular to subrounded of sandstone and mudstone.	2
					8.00			Stiff grey sandy gravelly CLAY. Gravel is fine to medium subangular to subrounded of sandstone and mudstone.	3
									4
									5
									6
									7
									8
									9
									10

Continued on next sheet

Remarks

1. Complete 2. Drilled water flushing







Borehole Log

Borehole No.

RB103

Sheet 4 of 4

Project Name: Brassey Street

Project No.
16124

Co-ords: 387504.00 - 406548.00

Hole Type
BH

Location: Middleton

Level:

Scale
1:50

Client: Healey Consulting

Dates: 11/10/2022 -

Logged By
D.P. Drilling

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					32.20			Grey MUDSTONE. With SANDSTONE bands.	31
					32.90			Grey SANDSTONE. With MUDSTONE bands.	32
								Grey MUDSTONE. With SANDSTONE bands.	33
									34
									35
									36
									37
									38
									39
					40.00				40

Remarks

1. Complete 2. Drilled water flushing



APPENDIX VI

CHEMICAL TESTING

RESULTS

Henry Morgan
e3p
Taylor Road
Urmston
Manchester
M41 7JQ

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

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

e:

Analytical Report Number : 22-85240

Project / Site name:	Brassey Street	Samples received on:	20/09/2022
Your job number:	16-124	Samples instructed on/ Analysis started on:	20/09/2022
Your order number:	002942	Analysis completed by:	28/09/2022
Report Issue Number:	1	Report issued on:	28/09/2022
Samples Analysed:	2 leachate samples - 8 soil samples		


Signed:

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

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

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

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

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

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

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

Analytical Report Number: 22-85240
Project / Site name: Brassey Street
Your Order No: 002942

Lab Sample Number	2431179	2431180	2431181	2431182	2431183
Sample Reference	TP101	TP102	TP102	TS103	TP104
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.20	0.50	1.50	0.10	0.50
Date Sampled	15/09/2022	15/09/2022	15/09/2022	15/09/2022	15/09/2022
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Stone Content	%	0.1	NONE	< 0.1	29
Moisture Content	%	0.01	NONE	17	8.2
Total mass of sample received	kg	0.001	NONE	0.4	0.4

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

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.4	7.8	8.1	7	8
Total Cyanide	mg/kg	1	MCERTS	< 1.0	1.1	< 1.0	< 1.0	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	770	1100	110	1800	320
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.0077	0.0072	0.0024	0.051	0.0072
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	15	14	4.8	100	14
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	7.7	7.2	2.4	50.8	7.2
Sulphide	mg/kg	1	MCERTS	6.8	14	3.8	9.1	1.3
Total Sulphur	mg/kg	50	MCERTS	340	650	51	1700	230
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	3.9	2.3	0.3	4.3	1.5

Total Phenols

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

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	2.1	0.65	< 0.05	3.2	< 0.05
Anthracene	mg/kg	0.05	MCERTS	0.52	0.13	< 0.05	0.82	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	4.3	1.3	< 0.05	6.2	< 0.05
Pyrene	mg/kg	0.05	MCERTS	4	1.2	< 0.05	5.7	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	2.5	0.84	< 0.05	3.7	< 0.05
Chrysene	mg/kg	0.05	MCERTS	2.4	0.79	< 0.05	3.2	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	2.3	0.85	< 0.05	3.3	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	1.7	0.61	< 0.05	1.5	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	2.4	0.84	< 0.05	3.1	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	1.3	0.45	< 0.05	1.6	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.36	< 0.05	< 0.05	0.45	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	1.4	0.55	< 0.05	2	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	25.2	8.2	< 0.80	34.8	< 0.80
-----------------------------	-------	-----	--------	------	-----	--------	------	--------

Analytical Report Number: 22-85240
Project / Site name: Brassey Street
Your Order No: 002942

Lab Sample Number	2431179	2431180	2431181	2431182	2431183
Sample Reference	TP101	TP102	TP102	TS103	TP104
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.20	0.50	1.50	0.10	0.50
Date Sampled	15/09/2022	15/09/2022	15/09/2022	15/09/2022	15/09/2022
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	20	36	5.4	86	16
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	2.5	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	13	26	7.8	14	15
Copper (aqua regia extractable)	mg/kg	1	MCERTS	44	110	9.7	59	30
Lead (aqua regia extractable)	mg/kg	1	MCERTS	230	1100	12	280	61
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	0.5	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	15	32	8.5	17	17
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	180	370	34	180	42

Petroleum Hydrocarbons

TPH (C5 - C6) HS_ID_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C6 - C8) HS_ID_TOTAL	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C8 - C10) HS_ID_TOTAL	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C10 - C12) EH_CU_ID_TOTAL	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH (C12 - C16) EH_CU_ID_TOTAL	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
TPH (C16 - C21) EH_CU_ID_TOTAL	mg/kg	1	MCERTS	22	6.5	< 1.0	19	< 1.0
TPH (C21 - C35) EH_CU_ID_TOTAL	mg/kg	1	MCERTS	44	13	< 1.0	39	< 1.0
TPH (C35 - C40) EH_CU_ID_TOTAL	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	< 10
TPH Total C5 - C40 EH_CU+HS_ID_TOTAL	mg/kg	10	MCERTS	66	20	< 10	58	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number: 22-85240
Project / Site name: Brassey Street
Your Order No: 002942

Lab Sample Number				2431184	2431185	2431186
Sample Reference				WS102	WS103	WS103
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				2.50	0.20	2.50
Date Sampled				15/09/2022	15/09/2022	15/09/2022
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status			
Stone Content	%	0.1	NONE	< 0.1	52	24
Moisture Content	%	0.01	NONE	5.4	5.7	2.5
Total mass of sample received	kg	0.001	NONE	0.4	0.4	0.4

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

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8	12.2	8.4
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	< 50	3700	80
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	< 0.0013	0.033	0.0039
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	< 2.5	67	7.9
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	< 1.3	33.4	3.9
Sulphide	mg/kg	1	MCERTS	< 1.0	11	< 1.0
Total Sulphur	mg/kg	50	MCERTS	< 50	1500	< 50
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	0.1	1.5	0.1

Total Phenols

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

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.67	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05	0.64	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	0.38	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	0.38	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.36	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.26	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	0.36	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	3.05	< 0.80
-----------------------------	-------	-----	--------	--------	------	--------

Analytical Report Number: 22-85240
Project / Site name: Brassey Street
Your Order No: 002942

Lab Sample Number				2431184	2431185	2431186
Sample Reference				WS102	WS103	WS103
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				2.50	0.20	2.50
Date Sampled				15/09/2022	15/09/2022	15/09/2022
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status			
Heavy Metals / Metalloids						
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	3.1	12	4.5
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	4.6	65	11
Copper (aqua regia extractable)	mg/kg	1	MCERTS	6.7	41	7.2
Lead (aqua regia extractable)	mg/kg	1	MCERTS	3.7	120	6.3
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	1.1	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	5	23	12
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	16	100	27

Petroleum Hydrocarbons

TPH (C5 - C6) HS_ID_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0
TPH (C6 - C8) HS_ID_TOTAL	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1
TPH (C8 - C10) HS_ID_TOTAL	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1
TPH (C10 - C12) EH_CU_ID_TOTAL	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0
TPH (C12 - C16) EH_CU_ID_TOTAL	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0
TPH (C16 - C21) EH_CU_ID_TOTAL	mg/kg	1	MCERTS	< 1.0	9.4	< 1.0
TPH (C21 - C35) EH_CU_ID_TOTAL	mg/kg	1	MCERTS	< 1.0	78	< 1.0
TPH (C35 - C40) EH_CU_ID_TOTAL	mg/kg	10	MCERTS	< 10	21	< 10
TPH Total C5 - C40 EH_CU+HS_ID_TOTAL	mg/kg	10	MCERTS	< 10	110	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample



4041



Analytical Report Number: 22-85240

Project / Site name: Brassey Street

Your Order No: 002942

Lab Sample Number				2431187	2431188
Sample Reference				WS102	WS104
Sample Number				None Supplied	None Supplied
Depth (m)				0.50	0.50
Date Sampled				15/09/2022	15/09/2022
Time Taken				None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	Units	Limit of detection	Accreditation Status		

General Inorganics

pH (automated)	pH Units	N/A	ISO 17025	7.9	8.2
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	< 1.0	< 1.0

Total Phenols

Total Phenols (monohydric)	µg/l	1	ISO 17025	1.9	2.6
----------------------------	------	---	-----------	-----	-----

Speciated PAHs

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

Total PAH

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

Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	1	ISO 17025	3.9	5.3
Cadmium (dissolved)	µg/l	0.08	ISO 17025	< 0.08	< 0.08
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0
Chromium (dissolved)	µg/l	0.4	ISO 17025	2.4	1.3
Copper (dissolved)	µg/l	0.7	ISO 17025	18	14
Lead (dissolved)	µg/l	1	ISO 17025	7.9	14
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5	< 0.5
Nickel (dissolved)	µg/l	0.3	ISO 17025	2	2.2
Selenium (dissolved)	µg/l	4	ISO 17025	< 4.0	< 4.0
Zinc (dissolved)	µg/l	0.4	ISO 17025	14	20

Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	10	NONE	< 10	< 10



4041



Analytical Report Number: 22-85240

Project / Site name: Brassey Street

Your Order No: 002942

Lab Sample Number				2431187	2431188
Sample Reference				WS102	WS104
Sample Number				None Supplied	None Supplied
Depth (m)				0.50	0.50
Date Sampled				15/09/2022	15/09/2022
Time Taken				None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	Units	Limit of detection	Accreditation Status		

Petroleum Hydrocarbons

TPH1 (C10 - C40) EH_1D_TOTAL_#1_#2_MS	µg/l	10	NONE	< 10	< 10
--	------	----	------	------	------

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

TPH-CWG - Aromatic >C5 - C7 HS_1D_AR	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8 HS_1D_AR	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10 HS_1D_AR	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12 EH_1D_AR_#1_#2_MS	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aromatic >C12 - C16 EH_1D_AR_#1_#2_MS	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aromatic >C16 - C21 EH_1D_AR_#1_#2_MS	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aromatic >C21 - C35 EH_1D_AR_#1_#2_MS	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aromatic (C5 - C35) HS+EH_1D_AR_#1_#2_MS	µg/l	10	NONE	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number : 22-85240

Project / Site name: Brassey 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 *
2431179	TP101	None Supplied	0.2	Brown loam and sand with gravel and vegetation.
2431180	TP102	None Supplied	0.5	Brown loam and sand with gravel and stones.
2431181	TP102	None Supplied	1.5	Brown sand with gravel.
2431182	TS103	None Supplied	0.1	Brown loam and clay with gravel and vegetation.
2431183	TP104	None Supplied	0.5	Brown clay and loam with gravel and vegetation.
2431184	WS102	None Supplied	2.5	Brown sand with gravel.
2431185	WS103	None Supplied	0.2	Brown loam and sand with gravel and stones.
2431186	WS103	None Supplied	2.5	Brown sand with gravel and stones.

Analytical Report Number : 22-85240

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

Analytical Report Number : 22-85240

Project / Site name: Brassey 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
TPH1 (Leachates)	Determination of dichloromethane extractable hydrocarbons in leachate by GC-MS.	In-house method	L070-PL	W	NONE
TPHCWG (Leachates)	Determination of dichloromethane extractable hydrocarbons in leachate by GC-MS.	In-house method	L070-PL	W	ISO 17025
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
BTEX and MTBE in leachates (Monoaromatics)	Determination of BTEX and MTBE in leachates by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	MCERTS
Total cyanide in leachate - 1µg/l	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-PL	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-PL	W	MCERTS
Sulphate, water soluble, in soil (1hr extraction)	Sulphate, water soluble, in soil (1hr extraction)	In-house method	L038-PL	D	MCERTS

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

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

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

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

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

Analytical Report Number : 22-85240

Project / Site name: Brassey 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
----------------------	-------------------------------	-----------------------------	---------------	--------------------	----------------------

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

APPENDIX VII

ORIGIN OF TIER I GENERIC 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 Suitable 4 Use Levels with supporting data from SR3, SR7 and existing Tox report where applicable. 1% SOM.
Acenaphthylene	
Acenaphthene	
Fluorene	
Phenanthrene	
Anthracene	
Fluoranthene	
Pyrene	
Benzo(a)Anthracene	
Chrysene	
Benzo(b/k)Fluoranthene ⁽ⁱⁱⁱ⁾	
Benzo(a)Pyrene	
Indeno(123-cd)Pyrene	
Dibenzo(a,h)Anthracene	
Benzo(ghi)Perylene	
TPH C₅-C₆ (aliphatic)	
TPH C₆-C₈ (aliphatic)	
TPH C₈-C₁₀ (aliphatic)	
TPH C₁₀-C₁₂ (aliphatic)	
TPH C₁₂-C₁₆ (aromatic)	
TPH C₁₆-C₂₁ (aromatic)	
TPH C₂₁-C₃₅ (aromatic)	



APPENDIX VIII

GEOTECHNICAL TESTING

RESULTS

TEST REPORT

Client e3p

Address Taylor Road
Trafford Park
Urmston
Manchester
M41 7JQ

Contract Brassey Street

Job Number MRN 4287/95
Date of Issue 23 September 2022
Page 1 of 3

Approved Signatories

S J Hutchings, O P Davies

Notes

- 1 All remaining samples and remnants from this contract will be disposed 28 days from the date of this report unless you notify us to the contrary.
- 2 Result certificates, in this report, not bearing a UKAS mark, are not included in our UKAS accreditation schedule.
- 3 Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.
- 4 Certified that the samples have been examined and tested in accordance with the terms of the contract/order and unless otherwise stated conform to the standards/specifications quoted.
- 5 The results included within the report are representative of the samples submitted for analysis.
- 6 This certificate should not be reproduced, except in full, without the express permission of the laboratory.



Andrew House, Hadfield Street, Dukinfield, Cheshire SK16 4QX Tel: 0161 475 0870
Email: enquiries@murrayrix.com Website: www.murrayrix.com

Also at: London: 020 8523 1999

Murray Rix is the trading name of Murray Rix (Northern) Limited. Registered in England 2878361

TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

BS 1377: PART 2: Clause 9.2: 1990

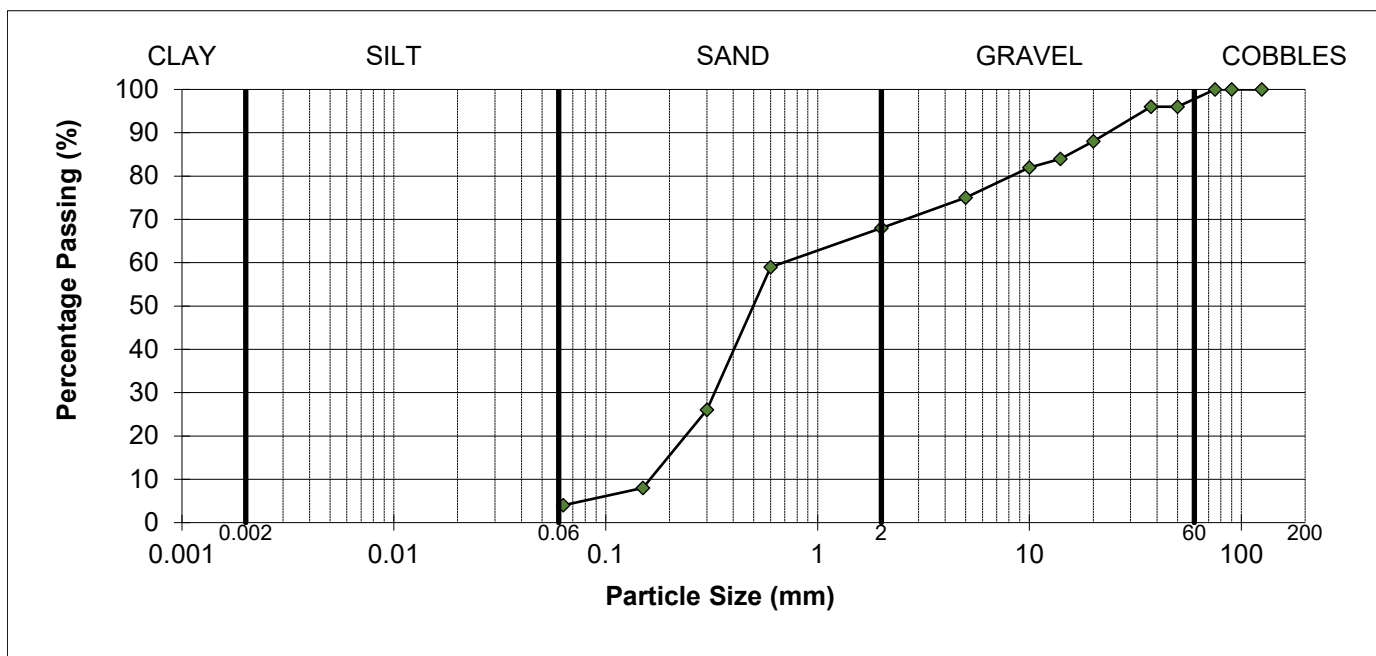
Determination of Moisture Content in accordance with BS 1377: PART 2: Clause 3: 1990 (Oven Dry)

CLIENT	e3p
SITE	Brassey Street
JOB NUMBER	MRN 4287/94

SAMPLE LABEL	TP104	DATE SAMPLED	Not advised
LAB SAMPLE No	116805	DATE RECEIVED	16-Sep-22
DATE TESTED	20-Sep-22	SAMPLED BY	Client

MATERIAL	Orange brown SAND
ADVISED SOURCE	As client & site above

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100		10	82	
90	100		5	75	
75	100		2	68	
50	96		0.6	59	
37.5	96		0.3	26	
20	88		0.15	8	
14	84		0.063	4	



REMARKS

SIGNED



NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

23-Sep-22

TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

BS 1377: PART 2: Clause 9.2: 1990

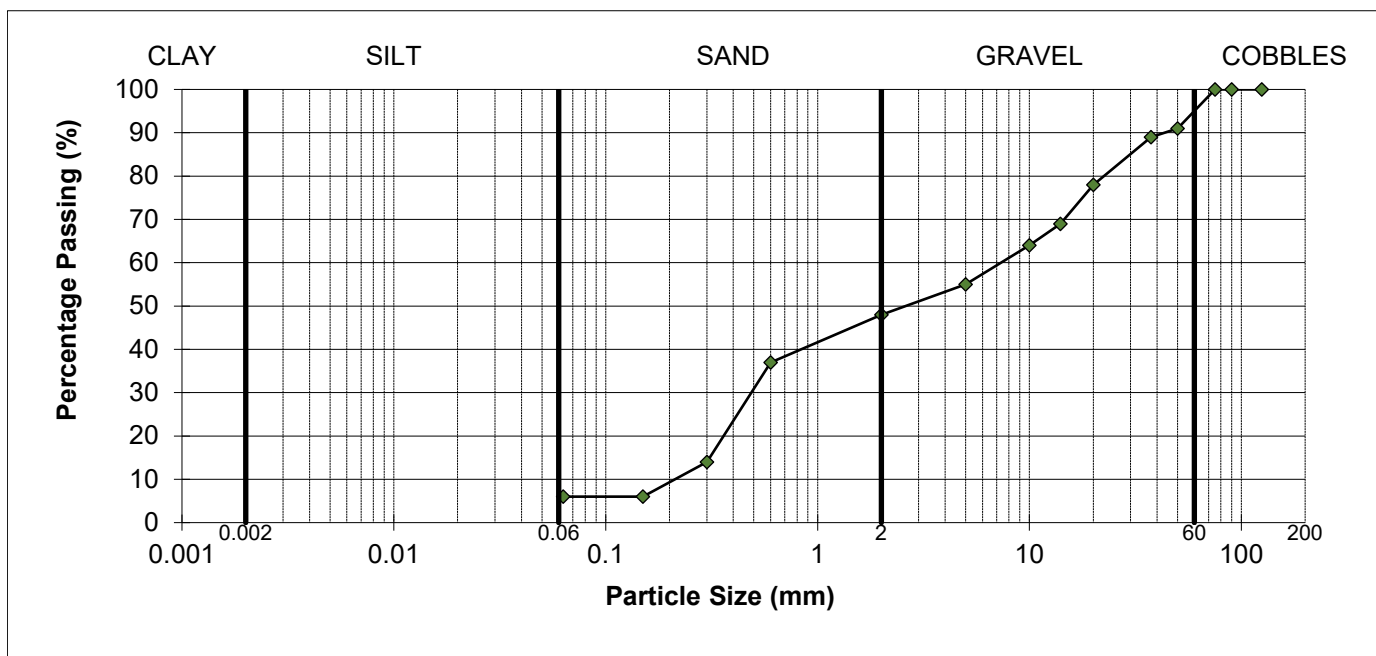
Determination of Moisture Content in accordance with BS 1377: PART 2: Clause 3: 1990 (Oven Dry)

CLIENT	e3p
SITE	Brassey Street
JOB NUMBER	MRN 4287/94

SAMPLE LABEL	TP101	DATE SAMPLED	Not advised
LAB SAMPLE No	116804	DATE RECEIVED	16-Sep-22
DATE TESTED	20-Sep-22	SAMPLED BY	Client

MATERIAL	Orange brown SAND & GRAVEL
ADVISED SOURCE	As client & site above

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100		10	64	
90	100		5	55	
75	100		2	48	
50	91		0.6	37	
37.5	89		0.3	14	
20	78		0.15	6	
14	69		0.063	6	



REMARKS

SIGNED



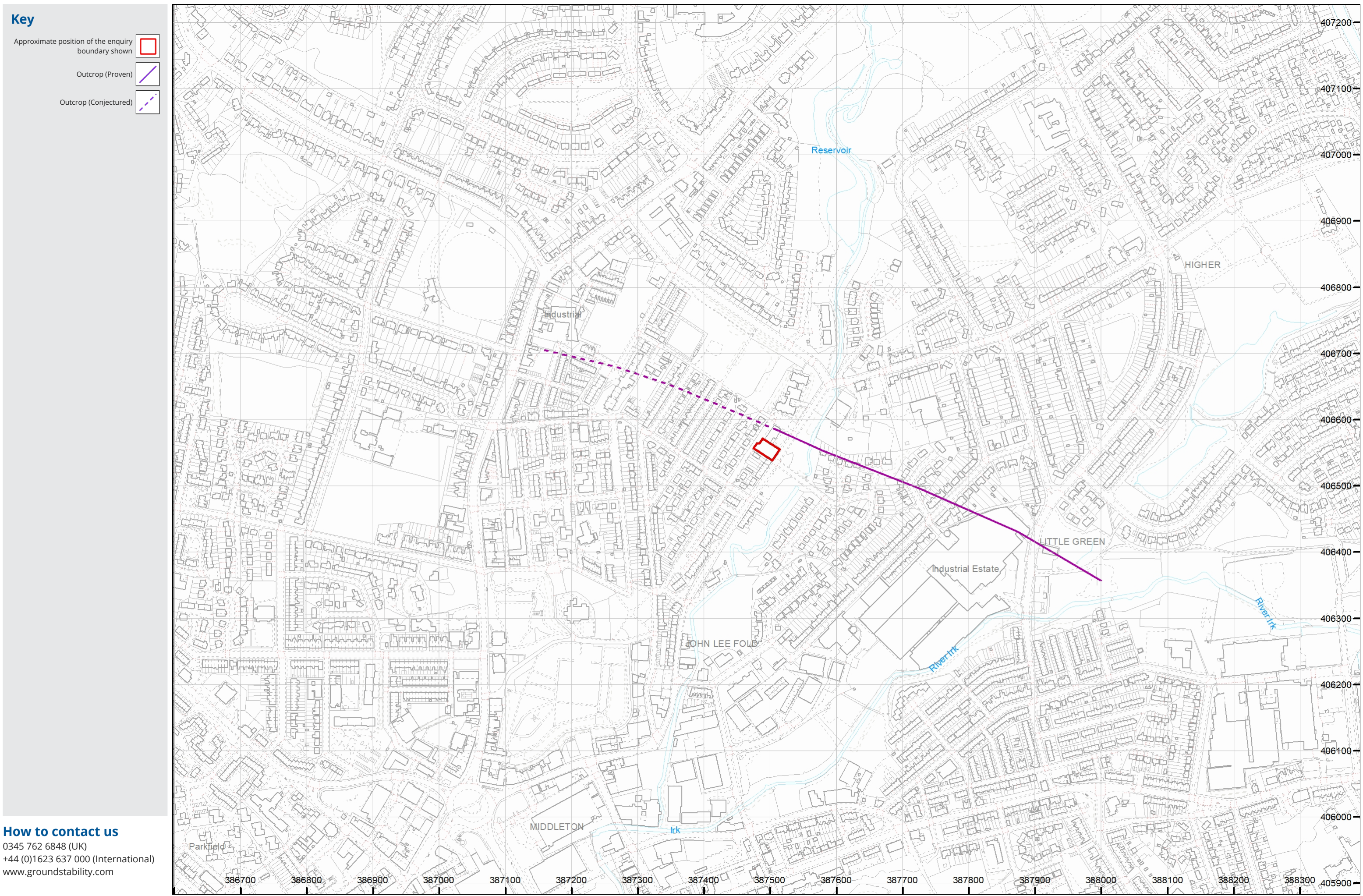
NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

23-Sep-22

The map highlights any specific surface or subsurface features within or near to the boundary of the site.



APPENDIX IX

COAL AUTHORITY REPORT



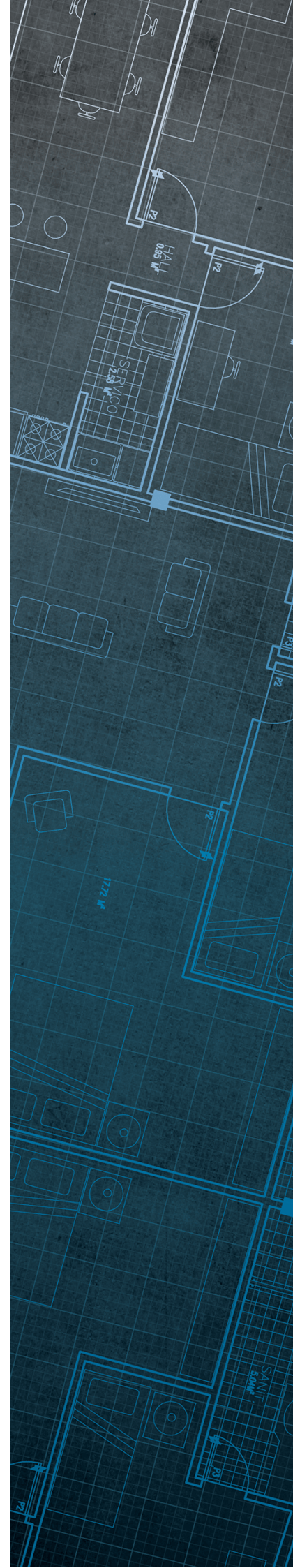
The Coal
Authority

Consultants Coal Mining Report

Boarshaw Working Mens Club
Dixon Street
Middleton
Rochdale
M24 6GB

Date of enquiry:	5 September 2022
Date enquiry received:	5 September 2022
Issue date:	5 September 2022

Our reference:	51003309357001
Your reference:	002812



Consultants

Coal Mining Report

This report is based on and limited to the records held by the Coal Authority at the time the report was produced.

Client name

E3P

Enquiry address

Boarshaw Working Mens Club
Dixon Street
Middleton
Rochdale
M24 6GB

How to contact us

0345 762 6848 (UK)
+44 (0)1623 637 000 (International)

200 Lichfield Lane
Mansfield
Nottinghamshire
NG18 4RG

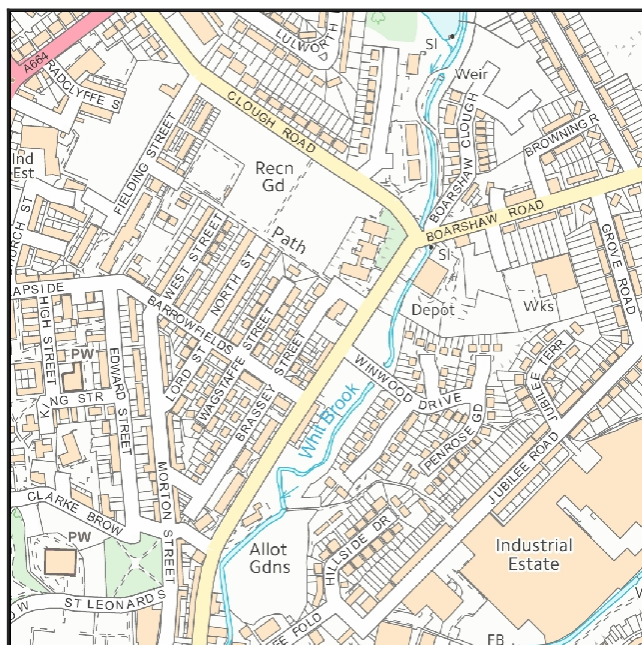
www.groundstability.com

 @coalauthority

 /company/the-coal-authority

 /thecoalauthority

 /thecoalauthority



Approximate position of property



Reproduced by permission of Ordnance Survey on behalf of HMSO. © Crown copyright and database right 2018. All rights reserved.

Ordnance Survey Licence number: 100020315

Section 1 – Mining activity and geology

Past underground mining

Colliery	Seam	Mineral	Coal Authority reference	Depth (m)	Direction to working	Dipping rate of seam worked (degrees)	Dipped direction of seam worked	Extraction thickness (cm)	Year last mined
unnamed	ARLEY	Coal	3W5I	159	North-East	7.8	South-West	150	1874

Probable unrecorded shallow workings

Yes.

Spine roadways at shallow depth

No spine roadway recorded at shallow depth.

Mine entries

None recorded within 100 metres of the enquiry boundary.

Abandoned mine plan catalogue numbers

The following abandoned mine plan catalogue numbers intersect with some, or all, of the enquiry boundary:

73	16820	
----	-------	--

Please contact us on 0345 762 6848 to determine the exact abandoned mine plans you require based on your needs.

Outcrops

Seam name	Mineral	Seam workable	Distance to outcrop (m)	Direction to outcrop	Bearing of outcrop
CANNEL	Coal	Yes	20.0	North-East	293
CANNEL	Coal	Yes	22.4	North-East	294

Geological faults, fissures and breaklines

No faults, fissures or breaklines recorded.

Opencast mines

None recorded within 500 metres of the enquiry boundary.

Coal Authority managed tips

None recorded within 500 metres of the enquiry boundary.

Section 2 – Investigative or remedial activity

Please refer to the 'Summary of findings' map (on separate sheet) for details of any activity within the area of the site boundary.

Site investigations

None recorded within 50 metres of the enquiry boundary.

Remediated sites

None recorded within 50 metres of the enquiry boundary.

Coal mining subsidence

The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994.

There is no current Stop Notice delaying the start of remedial works or repairs to the property.

The Coal Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

Mine gas

None recorded within 500 metres of the enquiry boundary.

Mine water treatment schemes

None recorded within 500 metres of the enquiry boundary.

Section 3 – Licensing and future mining activity

Future underground mining

None recorded.

Coal mining licensing

None recorded within 200 metres of the enquiry boundary.

Court orders

None recorded.

Section 46 notices

No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.

Withdrawal of support notices

The property is not in an area where a notice to withdraw support has been given.

The property is not in an area where a notice has been given under section 41 of the Coal Industry Act 1994, cancelling the entitlement to withdraw support.

Payments to owners of former copyhold land

The property is not in an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

Section 4 – Further information

The following potential risks have been identified and as part of your risk assessment should be investigated further.

Development advice

The site is within an area of historical coal mining activity. Should you require advice and/or support on understanding the mining legacy, its risks to your development or what next steps you need to take, please contact us.

For further information on specific site or ground investigations in relation to any issues raised in Section 4, please call us on 0345 762 6848 or email us at groundstability@coal.gov.uk.

Section 5 – Data definitions

The datasets used in this report have limitations and assumptions within their results. For more guidance on the data and the results specific to the enquiry boundary, please **call us on 0345 762 6848** or **email us at groundstability@coal.gov.uk**.

Past underground coal mining

Details of all recorded underground mining relative to the enquiry boundary. Only past underground workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination, will be included.

Probable unrecorded shallow workings

Areas where the Coal Authority believes there to be unrecorded coal workings that exist at or close to the surface (less than 30 metres deep).

Spine roadways at shallow depth

Connecting roadways either, working to working, or, surface to working, both in-seam and cross measures that exist at or close to the surface (less than 30 metres deep), either within or within 10 metres of the enquiry boundary.

Mine entries

Details of any shaft or adit either within, or within 100 metres of the enquiry boundary including approximate location, brief treatment details where known, the mineral worked from the mine entry and conveyance details where the mine entry has previously been sold by the Authority or its predecessors British Coal or the National Coal Board.

Abandoned mine plan catalogue numbers

Plan numbers extracted from the abandoned mines catalogue containing details of coal and other mineral abandonment plans deposited via the Mines Inspectorate in accordance with the Coal Mines Regulation Act and Metalliferous Mines Regulation Act 1872. A maximum of 9 plan extents that intersect with the enquiry boundary will be included. This does not infer that the workings and/or mine entries shown on the abandonment plan will be relevant to the site/property boundary.

Outcrops

Details of seam outcrops will be included where the enquiry boundary intersects with a conjectured or actual seam outcrop location (derived by either the British Geological Survey or the Coal Authority) or intersects with a defined 50 metres buffer on the coal (dip) side of the outcrop. An indication of whether the Coal Authority believes the seam to be of sufficient thickness and/or quality to have been worked will also be included.

Geological faults, fissures and breaklines

Geological disturbances or fractures in the bedrock. Surface fault lines (British Geological Survey derived data) and fissures and breaklines (Coal Authority derived data) intersecting with the enquiry boundary will be included. In some circumstances faults, fissures or breaklines have been known to contribute to surface subsidence damage as a consequence of underground coal mining.

Opencast mines

Opencast coal sites from which coal has been removed in the past by opencast (surface) methods and where the enquiry boundary is within 500 metres of either the licence area, site boundary, excavation area (high wall) or coaling area.

Coal Authority managed tips

Locations of disused colliery tip sites owned and managed by the Coal Authority, located within 500 metres of the enquiry boundary.

Site investigations

Details of site investigations within 50 metres of the enquiry boundary where the Coal Authority has received information relating to coal mining risk investigation and/or remediation by third parties.

Remediated sites

Sites where the Coal Authority has undertaken remedial works either within or within 50 metres of the enquiry boundary following report of a hazard relating to coal mining under the Coal Authority's Emergency Surface Hazard Call Out procedures.

Coal mining subsidence

Details of alleged coal mining subsidence claims made since 31 October 1994 either within or within 50 metres of the enquiry boundary. Where the claim relates to the enquiry boundary confirmation of whether the claim was accepted, rejected or whether liability is still being determined will be given. Where the claim has been discharged, whether this was by repair, payment of compensation or a combination of both, the value of the claim, where known, will also be given.

Details of any current 'Stop Notice' deferring remedial works or repairs affecting the property/site, and if so the date of the notice.

Details of any request made to execute preventative works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991. If yes, whether any person withheld consent or failed to comply with any request to execute preventative works.

Mine gas

Reports of alleged mine gas emissions received by the Coal Authority, either within or within 500 metres of the enquiry boundary that subsequently required investigation and action by the Coal Authority to mitigate the effects of the mine gas emission.

Mine water treatment schemes

Locations where the Coal Authority has constructed or operates assets that remove pollutants from mine water prior to the treated mine water being discharged into the receiving water body.

These schemes are part of the UK's strategy to meet the requirements of the Water Framework Directive. Schemes fall into 2 basic categories: Remedial – mitigating the impact of existing pollution or Preventative – preventing a future pollution incident.

Mine water treatment schemes generally consist of one or more primary settlement lagoons and one or more reed beds for secondary treatment. A small number are more specialised process treatment plants.

Future underground mining

Details of all planned underground mining relative to the enquiry boundary. Only those future workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination will be included.

Coal mining licensing

Details of all licenses issued by the Coal Authority either within or within 200 metres of the enquiry boundary in relation to the under taking of surface coal mining, underground coal mining or underground coal gasification.

Court orders

Orders in respect of the working of coal under the Mines (Working Facilities and Support) Acts of 1923 and 1966 or any statutory modification or amendment thereof.

Section 46 notices

Notice of proposals relating to underground coal mining operations that have been given under section 46 of the Coal Mining Subsidence Act 1991.

Withdrawal of support notices

Published notices of entitlement to withdraw support and the date of the notice. Details of any revocation notice withdrawing the entitlement to withdraw support given under Section 41 of the Coal Industry Act 1994.

Payment to owners of former copyhold land

Relevant notices which may affect the property and any subsequent notice of retained interests in coal and coal mines, acceptance or rejection notices and whether any compensation has been paid to a claimant.

