



e3p

Phase II Geoenvironmental Site Assessment
Fairways Lodge, Prestwich

Reference: 17-206-R2-1
Date: December 2023



PHASE II GEOENVIRONMENTAL SITE ASSESSMENT

Fairways Lodge
George Street
Prestwich
Greater Manchester
M25 9WS

Prepared for:
McCarthy & Stone Ltd

McCARTHY STONE
Life, well lived

Report Ref: 17-206-R2-1
Date Issued: December 2023

Fairways Lodge, Prestwich

Phase II Geoenvironmental Site Assessment

December 2023

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EXECUTIVE SUMMARY

Site Address	Fairways Lodge, George Street, Prestwich, Greater Manchester, M25 9WS	
Grid Reference	E 381724, N 402447	
Site Area	0.61 Ha	
Proposed Development	McCarthy & Stone proposes to construct a retirement home comprising c. 32 one-bed apartments and 20 two-bed apartments with associated infrastructure, car parking and soft landscaping.	
Current Site Use	The site comprises an irregular shaped parcel of land located to the south of George Street in Prestwich. The recently constructed Bellway Homes development site is located adjacent to the east and south. Fairways Lodge (hotel and leisure club) covers the majority of the site, with hardstanding car park areas in the north and east of the site. Mature trees are present along the northern and western site boundaries, with additional sporadic trees and areas of soft standing. Himalayan Balsam was noted in the southeast sector.	
Site History	Historical mapping from 1848 suggests that ponds/reservoirs were present on site, likely associated with the adjacent Bleach and Dye Works to the south. The reservoir furthest north was no longer recorded by 1932 and a Bowling Green was installed in the centre of the site with a small Pavilion. The reservoir in the south appears to have been infilled by 1973. The current building was constructed by 1988 and was recorded as a Club. The building was later noted to be the Village Hotel. No significant changes have occurred since circa 1988.	
Environmental Setting	Drift Geology	Hummocky Glacial Deposits – SAND and GRAVEL
	Bedrock Geology	Chester Sandstone Formation (northern sector) Pennine Upper Coal Measures Formation (southern sector) Collyhurst Sandstone Formation (southwest sector)
	Faults	A fault is recorded through the central southern sector of the site, trending NW to SE, with the downthrow to the northeast.
	Hydrogeology	Secondary A Aquifer (drift) overlying Secondary A and Principal Aquifers (solid). The closest groundwater abstraction is located 222 m southwest at Prestwich Golf Club for spray irrigation. There are no potable abstractions within 1 km.
	Hydrology	Singleton Brook is located 151 m south.
	Flood Risk	Unaffected by flooding from rivers.



Previous Reports	The following report has previously been completed for the site:  E3P – Phase I Geoenvironmental Site Assessment (Ref: 17-206-R1-1, dated September 2023). The pertinent points are summarised in Section 2.1.
Utility Locations	A utility survey has been completed which has identified foul sewers and surface water sewers in the north and west of the site. BT and Low Voltage electricity cables enter the building from the north.
Landfill Sites and Ground Gases	Two historical landfill sites are located within 250 m. The closest is located 80 m southeast at the former Mountheath Industrial Park, however the site has now been remediated to form the Bellway Homes development. The landfill received waste from 1979 to 1980, the material is recorded as originating from general construction works and is not domestic refuse. A historical landfill is also recorded 195 m southwest at Heathlands Drive. No further details are available. The site has undergone some historical development and ground working. The Made Ground associated with the historical development may produce hazardous ground gases such as methane and carbon dioxide.
Radon	Unaffected – no special precautions required.
Coal Mining/Land Stability	The site is not located within a Coal Authority deemed High-Risk Development Area. There are no outcrops or mine shaft entries in close proximity. No further assessment is required in relation to coal mining.
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.

GROUND INVESTIGATION

Ground Investigation Works	E3P has completed an intrusive ground investigation comprising:  6 x window sample probeholes; and  Construction of environmental monitoring installations.
Ground Conditions	Made Ground – 0.00 m bgl to 3.80 m bgl Made Ground deposits were encountered within all exploratory hole locations to depths of between 0.50 m and 3.80 m bgl although, in general, Made Ground was encountered to a depth of less than 1.00 m bgl. In WS105 in the location of the former reservoir, Made Ground was identified to 3.80 m bgl comprising reworked topsoil overlying dark brown to grey gravelly sand with mudstone, sandstone, ash and brick. Plant debris was noted in the very silty sand between 1.00 – 2.60 m bgl. Across the remainder of the site, Made Ground generally comprises asphalt overlying brown to black sandy gravel and gravelly sand with mudstone, sandstone, brick and ash.



Ground Conditions	DRIFT – 0.50 m bgl to >5.45 m bgl Drift deposits were encountered within all exploratory hole locations at depths of between 0.50 m and 5.45 m bgl. The drift deposits generally comprise medium dense to dense slightly gravelly fine to medium SAND with mudstone and sandstone. Beneath the organic soils in WS105, brown sandy clayey SILT was encountered to the base of the borehole at 5.45 m bgl.
	SOLID The solid bedrock geology was not encountered during the ground investigation. Historical (~1850) borehole records for the site adjacent to the south suggest that sandstone bedrock is present at ~25.0m bgl. A deep E3P borehole identified red weathered SANDSTONE at 26.50 m bgl.
	GROUNDWATER – Groundwater was not encountered during the ground investigation. Subsequent monitoring recorded groundwater between 2.10 m and 3.86 m bgl.

CONTAMINATED LAND ASSESSMENT

Human Health	The Tier 2 human health risk assessment identified exceedances of the GAC for non-volatile PAH compounds, total mercury and asbestos.
	Asbestos in the form of amosite has been identified in the granular Made Ground in WS105 at 0.80 m bgl. Quantification analysis was undertaken and the sample was identified to contain loose fibres at <0.001% volume/weight.
	The risk to chronic human health associated with the elevated concentrations of non-volatile PAH compounds can be mitigated through the installation of a suitable cover system in all proposed gardens, landscaping and public open space to remove any potential for direct exposure to impacted soils.
	The specific design and installation process for the appropriate cover systems will be clearly defined within the site remediation and enabling works strategy.
	Speciation is required to assess whether elemental mercury is present which may pose a risk to future site users through vapour inhalation. If elemental mercury is identified, it may be necessary to delineate and excavate the soils and place in an area of low sensitivity such as POS. If it is proven that there is no elemental mercury, a clean cover system will be sufficient.
	No visual signs of ACM were encountered during the ground investigation; it is therefore likely that only trace fibres are present. Impacted soils should be managed according to the asbestos risk mitigation conceptual site model.
	Chemical analysis of the natural granular drift deposits has identified these soils to be acceptable for use as subsoil within the proposed garden areas; however, further chemical validation samples will be required to confirm this.
	There are no suitable sources of topsoil available on the site.
	Further post-demolition investigations are required to confirm the findings of this initial assessment as and when full and unrestricted access is available.



Controlled Waters	The Tier 2 controlled waters risk assessment indicates that the data exceeds the EQS value for zinc. No DWS is available for zinc, therefore, to be conservative, the value has been compared to the EQS standard. Groundwater samples could not be obtained, therefore the assessment has been completed using leachate samples. Where leachate analysis has been undertaken, this can overstate the risk and is not wholly representative of the site characterisation. Historically, the site has been subjected to extensive infilling, with a number of infilled ponds/reservoirs. To date investigation has not been completed beneath the existing building footprint. The risk associated with the former bleach and dye works to the south of the site is reduced, given the land has been remediated. The site is underlain by a generally uniform geology of slightly gravelly SAND with localised stratum of SILT. The granular deposits will afford less protection to the underlying secondary A and principal aquifers. Zinc is generally of low solubility and mobility and is therefore unlikely to migrate towards the underlying principal aquifer. Given that there are no potable groundwater abstractions within 1 km, there is considered to be a low risk to controlled waters and the wider environ as no complete pollutant linkage can be determined. Based on the above, there is considered to be no unacceptable level of risk to the controlled water receptors. Supplementary groundwater samples are recommended to confirm the initial assessment.
Ground Gas	Initial ground gas monitoring has identified elevated concentrations of carbon dioxide within all monitoring wells. Significantly elevated methane has also been identified in WS105 in the location of the infilled reservoir. Further investigation will be required to determine the extent of organic materials within the location of the former infilled ponds/reservoirs. Following a process of site remediation and enabling works, it is likely that the site will be classified as CS2 or CS3. Post remediation ground gas monitoring will be required to confirm the ground gas classification.
Potable Water Infrastructure	This will need to be confirmed following the completion of a UKWIR risk assessment. Post-remediation and enabling works ground conditions may be different from those identified during this site investigation.



GEOTECHNICAL ASSESSMENT

Underground Obstructions	Significant obstructions will be present beneath the existing building. During a phase of cut-and-fill enabling works to create a developable platform, all below-ground obstructions will require grubbing out to the base of the Made Ground to enable the construction of proposed structures.
Allowable Bearing Pressure	The underlying natural sand drift deposits have been assessed as being medium dense to dense with a net allowable bearing pressure (ABP) in the order of 155 – 444 kN/m² between 1.00 – 4.45 m bgl. The sandy clayey SILT identified in WS105 is medium dense to dense between 4.00 – 5.45 m bgl with an ABP in the range of 228 – 315 kN/m².
Foundation Options	Based on the assessment of the relative undrained shear strength, relative in-situ densities and corresponding safe net allowable bearing pressure, the suitable target founding stratum has been identified as the underlying medium dense to dense sands. However, prior to the detailed design of suitable foundations solutions, a programme of remediation and enabling works will be required to remove the buried obstructions and cut/fill the site to provide suitable development platform levels. At this stage, given that the majority of the proposed structure overlies the existing building where site investigation has not been undertaken, further post-demolition site investigation including deep boreholes will be required to fully characterise the site to determine the final foundation solution. Depending on the required loadings, the underlying medium dense sand may provide a suitable bearing stratum for mass trench foundations, however the ground conditions under the existing building have not been proven therefore further assessment is required to confirm this. In the absence of detailed ground conditions beneath the existing building, it is likely that the most cost effective option for the majority of the site would be to re-engineer the Made Ground using vibro stone columns (VSCs) to support a shallow strip or spread foundation. Deep Made Ground with organic materials and plant debris has been identified. Further investigation is required to determine the extent of such deposits. Where significant depths of peat or soft organic deposits are identified in the location of the infilled reservoirs, driven piled foundations may be required.
Building 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. Following enabling works, the site will likely have a variable thickness of Made Ground, that may extend to significant depth in places. Given the structures that are proposed, if a ground bearing floor slab is required, it is considered that settlement analysis and detailed design in order to accommodate variability of the formation and account for differential settlement will be required.



	Given the depth of Made Ground and its loose/variable nature, it will be necessary to undertake some form of Ground Improvement work to ensure the total and differential settlement is within tolerable limits for the Uniformly Distributed Load of the floor slab and any external reinforced concrete yards / hardstanding.
Heave Precautions	No shallow clay soils have been identified, therefore heave precautions are not likely to be required.
Soakaway Drainage	Soakaway drainage is not recommended due to the presence of deep Made Ground in areas of the site and potential for contaminant leaching and migration.
Sulphate Assessment	The soils meet class DS-1 AC-1s.
CBR Design %	Granular soils can be re-engineered to ensure 5% within the subgrade during favourable climatic conditions.
Cut/Fill	Development levels unknown at this time; however, an element of cut-and-fill works will be required to prepare the development platform.
Civil Engineering Excavations	The ground investigation has identified deep Made Ground in the location of the infilled reservoir. Allowances should be made for battering back excavations and provisions of supports for open trenches.
Waste Characterisation	Any material that is to be disposed off-site should undergo assessment using Technical Guidance WM3: <i>Waste Classification – Guidance on the classification and assessment of waste</i> .

RECOMMENDATIONS

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

- ✿ Further investigation of inaccessible areas (post-demolition site investigation).
- ✿ Speciated mercury analysis.
- ✿ Geotechnical earthworks strategy (infrastructure).
- ✿ Remediation and enabling works strategy.
- ✿ Post remediation ground gas monitoring.



TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
1. INTRODUCTION	9
1.1. Background	9
1.2. Proposed Development.....	9
1.3. Objectives	10
1.4. Scope of Works.....	10
1.5. Limitations	10
1.6. Confidentiality.....	10
2. GROUND INVESTIGATION.....	11
2.1. Previous Reports	11
2.2. General Overview	12
2.3. Limitations of the Investigation	12
2.4. Scope of Investigation.....	12
2.5. In-Situ Standard Penetration Testing (SPT).....	13
2.6. Laboratory Analysis.....	13
3. GROUND AND GROUNDWATER CONDITIONS	14
3.1. Summary of Ground Conditions	14
3.2. Made Ground	14
3.3. Drift Deposits	14
3.4. Solid Geology.....	14
3.5. Groundwater	15
3.6. Visual and Olfactory Evidence of Contamination	15
3.7. Soil Consistency	15
3.8. pH and Sulphate	18
4. TIER 2 QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT	19
4.1. Human Health Risk Assessment.....	19
4.2. Controlled Waters Risk Assessment	23
4.2.1. Controlled Water Risk Assessment and Mitigation	27
4.2.2. Discussion of Controlled Waters Risk Assessment	27
4.3. Ground Gas Risk Assessment Methodology	27
4.4. Monitoring Methodology.....	29
4.5. Summary of Monitoring Results	31
4.5.1. Groundwater	31
4.5.2. Barometric pressure	31
4.5.3. Gas Flow	31
4.5.4. Gas Concentrations	31
4.6. Conclusion	31
4.7. Building Gas Risk Mitigation	32
4.7.1. British standard bs8485 (2015)+A1 (2019)	32
4.8. Potable Water Supply	36
4.9. Conceptual Site Model	37
5. GEOTECHNICAL ASSESSMENT	41
5.1. Proposed Development.....	41
5.2. Site Preparation	41
5.3. Foundation Conditions and Assessment of Potential Bearing Capacities	41
5.4. Ground Floor Slabs	42
5.5. Heave Precautions	43
5.6. Highways Construction	43
5.7. Drainage	43



5.8.	Concrete Durability	43
5.9.	Excavations	43
5.10.	Construction Activity and Inspection	44
5.11.	Geotechnical Risk Register	45
5.12.	Further Works	47
6.	CONCLUSIONS AND RECOMMENDATIONS.....	48
6.1.	Contaminated Land Assessment	48
6.2.	Geotechnical Assessment	49
APPENDIX I LIMITATIONS.....		50
APPENDIX II GLOSSARY		52
APPENDIX III DRAWINGS		55
APPENDIX IV PHOTOGRAPHS		57
APPENDIX V E3P EXPLORATORY HOLE LOGS		60
APPENDIX VI CHEMICAL TESTING RESULTS.....		61
APPENDIX VII ORIGIN OF TIER 2 GENERIC ASSESSMENT CRITERIA.....		62

DRAWING LIST

17-206-001 - Site Location Plan
17-206-002 - Proposed Development Plan
17-206-003 - Historical Features Plan
17-206-004 - Site Features Plan
17-206-005 - Exploratory Hole Location Plan
17-206-006 - Depth of Made Ground Plan
17-206-008 - Depth to Founding Strata Plan
17-206-010 - Conceptual Site Model
17-206-018 - Contamination Exceedances Plan



1. INTRODUCTION

1.1. BACKGROUND

E3P has been commissioned by McCarthy & Stone to undertake a detailed Phase II Geoenvironmental Site Assessment for Fairways Lodge in Prestwich, Greater Manchester.

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 residential care home development.

1.2. PROPOSED DEVELOPMENT

McCarthy & Stone proposes to construct a retirement home comprising c. 32 one-bed apartments and 20 two-bed apartments with associated infrastructure, car parking and soft landscaping. Drawing 17 206-002 (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 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)* (July 2023).
- ✦ 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:

- ✦ Design of suitable intrusive ground investigation;
- ✦ Window sample probeholes with, and construction of, environmental monitoring installations;
- ✦ 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 REPORTS

The following previous report has been completed for the site:

- ✳ E3P – Phase I Geoenvironmental Site Assessment (Ref: 17-206-R1-1, dated September 2023).

The pertinent points are summarised below:

- ✳ Mature trees are present along the northern and western site boundaries, with additional sporadic trees and areas of soft standing. Invasive plant species including Himalayan Balsam were noted in the south of the site.
- ✳ Above-ground storage tanks (AST) were historically located at the southern site boundary. No further hazardous material storage has been identified.
- ✳ The building present on-site was constructed prior to 1988 and therefore ACM may have been used within the building fabric. ACM may have been used in the former structures on-site and may not have been correctly managed during demolition. ACM (fibres and fragments) may therefore be present within the underlying Made Ground soils.
- ✳ A utility survey has been completed which has identified foul sewers and surface water sewers in the north and west of the site.
- ✳ Two historical landfill sites are located within 250 m. The closest is located 80 m southeast at the former Mountheath Industrial Park, however the site has now been remediated to form the Bellway Homes development. The landfill received waste from 1979 to 1980, the material is recorded as originating from general construction works and is not domestic refuse.
- ✳ Made Ground associated with the infilled ponds/reservoirs and construction and demolition activities may contain heavy metals, PAHs, TPHs and ACM.
- ✳ The former tanks located at the southern site boundary are a potential source of PAHs, TPHs, SVOCs and VOCs. However, investigation completed as part of the E3P works on the adjacent site did not identify any evidence of contamination in the location of the historical tanks.
- ✳ The former bleach and dye works to the south of the site has been remediated, therefore no residual impact is anticipated.
- ✳ The former bleach and dye works historically located to the south of the site is a potential source of mobile contamination, however the site has been remediated and no impact was identified in the deep borehole drilled into the bedrock aquifer.
- ✳ Made Ground and potential organic deposits may produce hazardous ground gases such as carbon dioxide and methane which have associated asphyxiation and explosive risks.
- ✳ It is likely there will be significant Made Ground fill deposits and obstructions. The existing building will require demolition, with all relict foundations grubbing out before the proposed development's construction.



- ✚ Several historically infilled ponds and reservoirs are present within the site boundary, which are potential sources of alluvial deposits, silts and possible organic peat deposits, and potential depths of Made Ground
- ✚ An abnormal engineering solution may be required where there is significant thickness of Made Ground, tree influence, loose granular soils or soft cohesive deposits.

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. The investigation has also been used to collect geotechnical information to assist in the design and construction of the proposed development.

Exploratory fieldwork was completed on the 27 September 2023. The works are summarised in Table 2.1.

2.3. LIMITATIONS OF THE INVESTIGATION

The ground investigation was limited by the existing building however exploratory locations were advanced within external areas to target historical features where possible and within proximity to the proposed building.

Further investigation will be required when the site is freely accessible.

2.4. 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	3.39	1.00–3.00
	WS102		2.81	N/A
	WS103		4.44	1.00–4.00
	WS104		4.45	N/A
Former Reservoir/Historic Tanks (south of site boundary)	WS105		5.45	1.00–2.50
General Ground Conditions Including the Presence/Nature of Obstructions	WS106		4.42	1.00–4.00

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

The sampling locations are illustrated in Drawing 17-206-005 (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.



2.5. 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 5.

2.6. 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).
-  Asbestos identification and quantification.
-  Banded total petroleum hydrocarbon (TPH).
-  Total organic carbon (TOC).
-  Leachate analysis.

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



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 ASPHALT	MADE GROUND TOPSOIL	MADE GROUND	GRAVELLY SAND	SAND	SILT
WS101	0.00–0.10	–	0.10–0.60	0.60–1.00	1.00–3.39	–
WS102	0.00–0.10	–	0.10–0.50	0.50–1.50	1.50–2.81	–
WS103	0.00–0.10	–	0.10–0.55	0.55–1.90 3.50–4.44	1.90–3.50	–
WS104	0.00–0.10	–	0.10–0.80	2.00–4.45	0.80–2.00	–
WS105	–	0.00–0.10	0.10–3.80	–	–	3.80–5.45
WS106	0.00–0.10	–	0.10–0.60	0.60–1.40 2.50–4.42	1.40–2.50	–

3.2. MADE GROUND

Made Ground deposits were encountered within all exploratory hole locations to depths of between 0.50 m and 3.80 m bgl although, in general, Made Ground was encountered to a depth of less than 1.00 m bgl.

In WS105 in the location of the former reservoir, Made Ground was identified to 3.80 m bgl comprising reworked topsoil overlying dark brown to grey gravelly sand with mudstone, sandstone, ash and brick. Plant debris was noted in the very silty sand between 1.00 m – 2.60 m bgl.

Across the remainder of the site, Made Ground generally comprises asphalt overlying brown to black sandy gravel and gravelly sand with mudstone, sandstone, brick, and ash to a maximum proven depth of 0.80 m bgl.

A Depth of Made Ground Plan is presented as Drawing 17-206-006 in Appendix III.

3.3. DRIFT DEPOSITS

Drift deposits were encountered within all exploratory hole locations at depths of between 0.50 m and 5.45 m bgl. The drift deposits generally comprise medium dense to dense slightly gravelly fine to medium SAND with mudstone and sandstone.

Beneath the organic soils in WS105, brown sandy clayey SILT was encountered to the base of the borehole at 5.45 m bgl.

3.4. SOLID GEOLOGY

The solid bedrock geology was not encountered during the ground investigation.



Historical (~1850) borehole records for the site adjacent to the south suggest that sandstone bedrock is present at ~25.0m bgl. A deep borehole undertaken by E3P on the adjacent site identified red weathered SANDSTONE at 26.50 m bgl.

3.5. GROUNDWATER

Groundwater strikes were not encountered during the ground investigation.

Monitoring was undertaken using an electronic dip meter and interface probe to record the depth to groundwater and the thickness of any free-phase hydrocarbon product, if present. These results are summarised in Table 4.6.

3.6. VISUAL AND OLFACTORY EVIDENCE OF CONTAMINATION

Visual and olfactory evidence of potential contamination has not been identified during the site investigation.

3.7. SOIL CONSISTENCY

Results of the standard penetration tests, including undrained shear strengths derived from SPTs are included 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	1.00	SAND	17	17.14	Medium Dense	N/A	N/A	N/A	171.39
WS101	2.00	SAND	34	31.06	Dense	N/A	N/A	N/A	310.60
WS101	3.00	SAND	50	43.48	Dense	N/A	N/A	N/A	434.83
WS102	1.00	Slightly gravelly SAND	18	18.15	Medium Dense	N/A	N/A	N/A	181.47
WS102	2.00	Gravelly SAND	41	37.46	Dense	N/A	N/A	N/A	374.55
WS102	2.50	Gravelly SAND	50	44.41	Dense	N/A	N/A	N/A	444.09
WS103	1.00	Gravelly SAND	19	19.15	Medium Dense	N/A	N/A	N/A	191.55
WS103	2.00	SAND	18	16.44	Medium Dense	N/A	N/A	N/A	164.44
WS103	3.00	SAND	27	23.48	Medium Dense	N/A	N/A	N/A	234.81
WS103	4.00	Gravelly SAND	50	42.24	Dense	N/A	N/A	N/A	422.43
WS104	1.00	SAND	17	17.14	Medium Dense	N/A	N/A	N/A	171.39
WS104	2.00	Gravelly SAND	35	31.97	Dense	N/A	N/A	N/A	319.74
WS104	3.00	Gravelly SAND	29	25.22	Medium Dense	N/A	N/A	N/A	252.20
WS104	4.00	Gravelly SAND	50	42.24	Dense	N/A	N/A	N/A	422.43
WS105	1.00	MADE GROUND	39	39.32	Dense	N/A	N/A	N/A	393.18
WS105	2.00	MADE GROUND	5	4.57	Loose	N/A	N/A	N/A	45.68
WS105	3.00	MADE GROUND	22	19.13	Medium Dense	N/A	N/A	N/A	191.32
WS105	4.00	Sandy clayey SILT	27	22.81	Medium Dense	N/A	N/A	N/A	228.11



BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE (N ₁) ₆₀	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m ²)	ALLOWABLE BEARING PRESSURE (kN/m ²)*
WS105	5.00	Sandy clayey SILT	38	31.53	Dense	N/A	N/A	N/A	315.26
WS106	1.00	Slightly gravelly SAND	18	18.15	Medium Dense	N/A	N/A	N/A	181.47
WS106	2.00	SAND	17	15.53	Medium Dense	N/A	N/A	N/A	155.30
WS106	3.00	SAND and GRAVEL	33	28.70	Medium Dense	N/A	N/A	N/A	286.99
WS106	4.00	SAND and GRAVEL	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. pH AND SULPHATE

Chemical analyses for pH and soluble sulphate content contained in Appendix VI (summarised in Table 3.3), shows that the soils at the site generally meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1 in accordance with BRE *Special Digest 1* (2005).

TABLE 3.3 SUMMARY OF pH AND SULPHATE DATA

LOCATION	DEPTH (m)	SO ₄ IN 2:1 WATER/SOIL (g/l)	pH VALUE	CLASSIFICATION
WS101	0.50	0.09	7.4	DS-1, AC-1
WS102	0.80	0.052	6.6	DS-1, AC-1
WS104	1.60	0.067	7.7	DS-1, AC-1
WS105	0.80	0.0083	8.2	DS-1, AC-1
WS105	1.50	0.047	7.2	DS-1, AC-1
WS106	1.80	0.0075	6.5	DS-1, AC-1



4. TIER 2 QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT

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

4.1. HUMAN HEALTH RISK ASSESSMENT

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

Where Tier 2 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

DETERMINANT	UNIT	GAC	N	MC	LOC. OF EX	PATH-WAY	ASSESSMENT
Arsenic	mg/kg	37	9	37	-	1	No Further Action
Cadmium	mg/kg	11	9	<0.2	-	1	No Further Action
Chromium (VI)	mg/kg	6.0	9	<1.8	-	1	No Further Action
Lead**	mg/kg	200	9	180	-	1	No Further Action
Mercury	mg/kg	1.2	9	3.1	WS101 0.50 m	4	Further Action
Nickel	mg/kg	130	9	42	-	1	No Further Action
Selenium	mg/kg	250	9	<1.0	-	1	No Further Action
Copper	mg/kg	2400	9	110	-	1	No Further Action
Zinc	mg/kg	3700	9	57	-	1	No Further Action
Cyanide – Total	mg/kg	791	9	<1.0	-	1	No Further Action
Phenols – Total	mg/kg	120	6	<1.0	-	1	No Further Action
Asbestos	Fibres	NFD	9	<0.001%	WS105 0.80 m	3	Further Action
Naphthalene	mg/kg	2.3	9	0.42	-	4	No Further Action
Acenaphthylene	mg/kg	170	9	0.06	-	2	No Further Action
Acenaphthene	mg/kg	210	9	0.87	-	1	No Further Action
Fluorene	mg/kg	170	9	0.38	-	1	No Further Action
Phenanthrene	mg/kg	95	9	5.8	-	2	No Further Action
Anthracene	mg/kg	2400	9	1.1	-	2	No Further Action
Fluoranthene	mg/kg	280	9	11	-	2	No Further Action
Pyrene	mg/kg	620	9	11	-	2	No Further Action
Benzo(a)Anthracene	mg/kg	7.2	9	5.2	-	2	No Further Action
Chrysene	mg/kg	15	9	5.3	-	2	No Further Action
Benzo(b)Fluoranthene	mg/kg	2.6	9	7.1 2.8	WS103 0.40 m WS101 0.50 m	2	Further Action
Benzo(k)Fluoranthene	mg/kg	77	9	2.0	-	2	No Further Action
Benzo(a)Pyrene	mg/kg	2.2	9	5.4 2.4	WS103 0.40 m WS101 0.50 m	2	Further Action
Indeno(123-cd)Pyrene	mg/kg	27	9	3.0	-	2	No Further Action
Dibenzo(a,h)Anthracene	mg/kg	0.24	9	0.70 0.33	WS103 0.40 m WS101 0.50 m	2	Further Action
Benzo(ghi)Perylene	mg/kg	320	9	3.6	-	2	No Further Action
TPH C5-C6 (aliphatic)*	mg/kg	42	9	<0.1	-	4	No Further Action
TPH C6-C8 (aliphatic)*	mg/kg	100	9	<0.1	-	4	No Further Action
TPH C8-C10 (aliphatic)*	mg/kg	27	9	<0.1	-	4	No Further Action
TPH C10-C12 (aromatic)*	mg/kg	74	9	<2.0	-	4	No Further Action
TPH C12-C16 (aromatic)*	mg/kg	140	9	<4.0	-	4	No Further Action



DETERMINANT	UNIT	GAC	N	MC	LOC. OF EX	PATH-WAY	ASSESSMENT
TPH C16-C21 (aromatic)*	mg/kg	260	9	27	-	1	No Further Action
TPH C21-C35 (aromatic)*	mg/kg	1100	9	52	-	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 2 GAC for the hydrocarbon fraction is derived from the CIEH assessment for petroleum hydrocarbons Criteria Working Group (CWG) for both aliphatic and aromatic compounds. E3P has utilised the Tier 2 values for aliphatic compounds for the volatile and semi volatile fractions (C5-C12) and the Tier 2 values for aromatic compound for the non-volatile fractions (C12-C35). The comparison of a total (aliphatic/aromatic) compounds to an individual fraction is considered to be a conservative approach and satisfactory for the protection of human health.

** CL:AIRE C4SL

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

- ✚ Total Mercury
- ✚ Benzo(b)Fluoranthene
- ✚ Benzo(a)Pyrene
- ✚ Dibenzo(a,h)Anthracene
- ✚ Asbestos (Amosite <0.001%)

Asbestos in the form of amosite has been identified in the granular Made Ground in WS105 at 0.80 m bgl. Quantification analysis was undertaken, and the sample was identified to contain loose fibres at <0.001% volume/weight.

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

- ✚ The main exposure pathways based on the Tier 2 exceedances are:
 - Soil ingestion;
 - Vapour inhalation (indoor);
 - Dermal contact and ingestion;
 - Consumption of homegrown vegetables; and
 - Fibre/dust inhalation.
- ✚ The exceedances for all determinands are associated with Made Ground deposits (0.40 – 0.80 m).



HUMAN HEALTH RISK ASSESSMENT AND MITIGATION

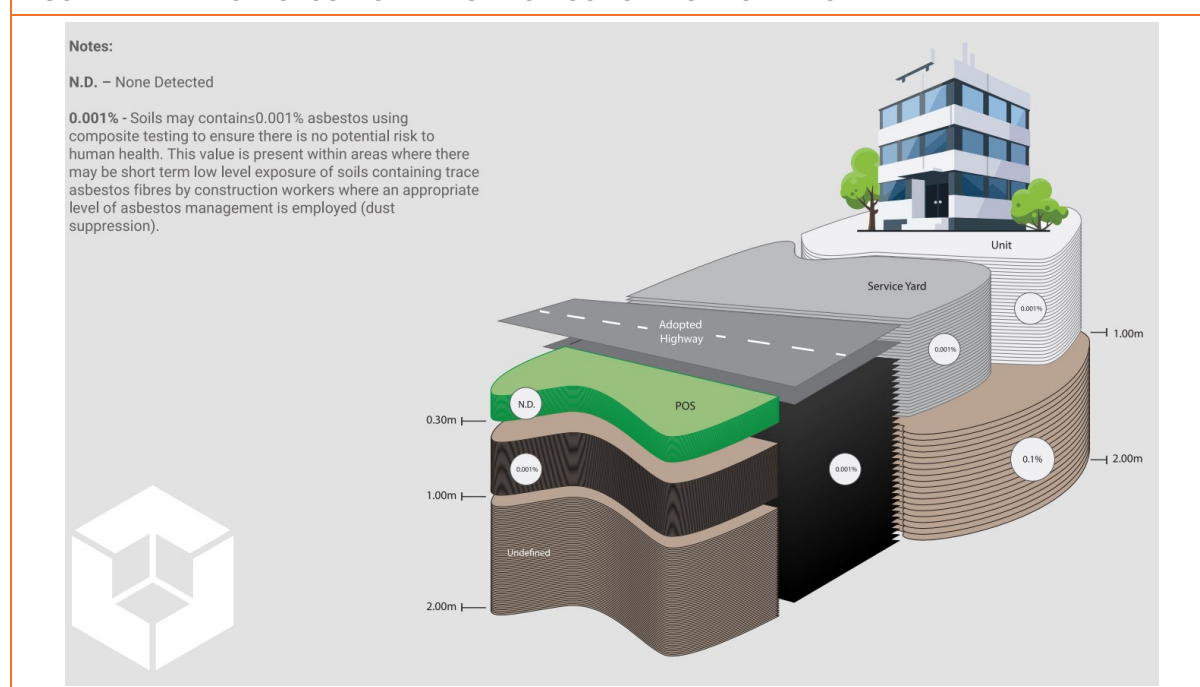
All of the identified elevated concentrations have primary exposure pathways related to dermal contact and ingestion of soils, inhalation of particulate and consumption of homegrown vegetables. The risk to chronic human health associated with the elevated concentrations of non-volatile PAH compounds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

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

Elevated total mercury has been identified in WS101 at 0.50 bgl. Mercury comes in three different forms; elemental mercury, inorganic mercury and organic mercury (or methyl mercury), each with a specific GAC value. Elemental mercury is volatile (vapour inhalation risk) and therefore has the most conservative GAC value of 1.2 mg/kg, which is applied in the first instance when comparing total mercury concentrations. Speciation is required to assess whether elemental mercury is present which may pose a risk to future site users through vapour inhalation. If elemental mercury is identified, it may be necessary to delineate and excavate the soils and place them in an area of low sensitivity such as POS. If it is proven that there is no elemental mercury, a clean cover system will be sufficient.

Asbestos trace fibres (<0.001%) was identified within WS105 at 0.80 m bgl. No visual signs of ACM were encountered during the ground investigation; it is therefore likely that only trace fibres are present. 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 ≤ 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 >1.00m 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 granular drift deposits has identified these soils to be acceptable for use as subsoil within the proposed garden areas; however, further chemical validation samples will be required to confirm this. There are no suitable sources of topsoil available on the site.

Further post-demolition investigations are required to confirm the findings of this initial assessment as and when full and unrestricted access is available.

4.2. CONTROLLED WATERS RISK ASSESSMENT

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

TABLE 4.2 CONTROLLED WATERS CONCEPTUAL MODEL AND SENSITIVITY PROFILE

DISCUSSION		SENSITIVITY RATING
Contaminant Source		
Made Ground, Infilled Ponds/Reservoirs Heavy metal and PAH contamination may be present as a result of the potential Made Ground infill material from historical features on-site and historically infilled reservoirs.		Low
Historical Tanks (southern boundary) The former tanks located at the southern site boundary are a potential source of PAHs, TPHs, SVOCs and VOCs. However, the investigation completed as part of the E3P works on the adjacent site did not identify any evidence of contamination in the location of the historical tanks therefore contamination on site is considered low.		Low
Pathway		
Vertical Migration Due to the majority of the site being underlain by granular drift deposits, vertical migration of contaminants is likely to occur as a result of the high permeability of the drift deposits.		High
Lateral migration Lateral migration of contaminants is considered possible due to the presence of granular drift deposits across the site.		High
Receptor		
Aquifer Classification in Superficial Drift Deposits	Secondary A aquifer	Medium
Aquifer Classification in Bedrock	Principal Aquifer and Secondary A Aquifer.	High
Groundwater Source Protection Zone or Drinking Water Safeguard Zone	The site is not affected.	Low
Distance to the Closest Groundwater Abstraction Point	The closest groundwater abstraction is located 222 m southwest for spray irrigation at Prestwich Golf Club. There are no further groundwater abstractions within 1 km.	Medium
Is the Site Located Within 50 m of a Surface Watercourse?	No surface water features are located within 50 m of the site boundary.	Low



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

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

TABLE 4.3 QUALITATIVE RISK TO CONTROLLED WATERS FROM SOIL ANALYTICAL RESULTS

CONTAMINANT	ASSESSMENT RATING	DISCUSSION
BTEX > 1 mg/kg	The soil data analysis has not identified any detectable concentrations of TPH C5 to C6 that might otherwise be indicative of VOC impact.	None
Total VOC > 1 mg/kg		
Total SVOC > 1 mg/kg	As above.	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	All concentrations are below the laboratory LOD.	None
Naphthalene > 2 mg/kg	Concentrations of naphthalene are less than 2.0 mg/kg.	None
Total PAH > 10 mg/kg	Total concentrations of low-solubility PAH compounds greater than 10 mg/kg have been detected throughout the site, with a maximum concentration recorded in WS103 at 63 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 are less than 500 mg/kg.	None

The Tier 2 assessment has included a comparison of leachate analysis from samples of the Made Ground to drinking water standards (DWS) in the first instance and the absence of these to the environmental quality standards (EQS).

These are presented in Table 4.4.

Groundwater samples could not be obtained as there was insufficient groundwater within the boreholes during monitoring.



TABLE 4.4 COMPARISON OF LEACHATE ANALYSIS WITH TIER 2 SCREENING LEVELS

DETERMINAND	UNIT	EQS ^{1,2}	DWS _{3,4}	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE	ASSESSMENT
		AA					
Arsenic	µg/l	50	10	1	2.4	N/A	No Further Action
Cadmium	µg/l	0.08-0.25	5	1	<0.08	N/A	No Further Action
Chromium (VI)	µg/l	3.4	–	1	<5.0	N/A	No Further Action
Chromium (III)	µg/l	4.7	50	1	3.4	N/A	No Further Action
Copper	µg/l	1	2000	1	33	N/A	No Further Action
Total Cyanide	µg/l	1	50	1	<1.0	N/A	No Further Action
Lead	µg/l	1.2	10	1	6.6	N/A	No Further Action
Mercury	µg/l	–	1.0	1	<0.5	N/A	No Further Action
Nickel	µg/l	4	20	1	4.3	N/A	No Further Action
Selenium	µg/l	–	10	1	<4.0	N/A	No Further Action
Zinc	µg/l	10.9	–	1	40	WS105 1.50 m	Further Discussion
pH	6–9			1	7.5	N/A	No Further Action
Polycyclic Aromatic Hydrocarbons							
Naphthalene	µg/l	2	10*	1	<0.01	N/A	No Further Action
Anthracene	µg/l	0.1	10*	1	<0.01	N/A	No Further Action
Benzo[b]fluoranthene	µg/l	0.00017*	10*	1	<0.01	N/A	No Further Action
Benzo[k]fluoranthene	µg/l	0.00017*	10*	1	<0.01	N/A	No Further Action
Benzo(a)pyrene	µg/l	0.00017*	10*	1	<0.01	N/A	No Further Action
Indeno(123-cd)pyrene	µg/l	0.00017*	10*	1	<0.01	N/A	No Further Action
Fluoranthene	µg/l	0.0063	10*	1	<0.01	N/A	No Further Action
Benzo(ghi)perylene	µg/l	1.7–4	10*	1	<0.01	N/A	No Further Action
Aromatic Hydrocarbon							
TPH C5-C7 (benzene)	µg/l	10	1	1	<1.0	N/A	No Further Action
TPH C7-C8 (toluene)	µg/l	74	700	1	<1.0	N/A	No Further Action
TPH C8-C10 (xylene)	µg/l	30	300	1	<1.0	N/A	No Further Action
TPH C10-C12 (naphthalene)	µg/l	2	90	1	<10	N/A	No Further Action
TPH C12-C16	µg/l	–	90	1	<10	N/A	No Further Action
TPH C16-C35	µg/l	–	90	1	<10	N/A	No Further Action
Aliphatic Hydrocarbon							
TPH C5-C6	µg/l	–	1000 ⁵	1	<1.0	N/A	No Further Action
TPH C6-C8	µg/l	–	1000 ⁵	1	<1.0	N/A	No Further Action



DETERMINAND	UNIT	EQS ^{1,2}	DWS _{3,4}	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE	ASSESSMENT
		AA					
TPH C8-C10	µg/l	–	300	1	<1.0	N/A	No Further Action
TPH C10-C12	µg/l	–	300	1	<10	N/A	No Further Action
TPH C12-C16	µg/l	–	300	1	<10	N/A	No Further Action
TPH C16-C21	µg/l	–	300**	1	<10	N/A	No Further Action
TPH C21-C35	µg/l	–	300**	1	<10	N/A	No Further Action

Notes

Solubility <0.01µg/l

AA – Annual Average

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

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

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



4.2.1. CONTROLLED WATER RISK ASSESSMENT AND MITIGATION

The Tier 2 controlled waters risk assessment indicates that the data exceeds the EQS value for zinc. No DWS is available for zinc, therefore, to be conservative, the value has been compared to the EQS standard.

Groundwater samples could not be obtained, therefore the assessment has been completed using leachate samples. Where leachate analysis has been undertaken, this can overstate the risk and is not wholly representative of the site characterisation.

4.2.2. DISCUSSION OF CONTROLLED WATERS RISK ASSESSMENT

Historically, the site has been subjected to extensive infilling, with a number of infilled ponds/reservoirs. To date, the investigation has not been completed beneath the existing building footprint. The risk associated with the former bleach and dye works to the south of the site is reduced, given the land has been remediated.

The soil analysis complete to date does not suggest a risk to controlled waters.

The site is underlain by a generally uniform geology, generally slightly gravelly SAND with a localised stratum of SILT. The granular deposits will afford less protection to the underlying secondary A and principal aquifers.

Zinc is generally of low solubility and mobility and is therefore unlikely to migrate towards the underlying principal aquifer.

Given that there are no potable groundwater abstractions within 1 km, there is considered to be a low risk to controlled waters and the wider environ as no complete pollutant linkage can be determined.

Based on the above, there is considered to be no unacceptable level of risk to the controlled water receptors.

Supplementary groundwater samples are recommended to confirm the initial assessment. Deep boreholes are likely required to further investigate the deeper ground conditions therefore deeper groundwater monitoring wells should be installed and monitored to assess the groundwater and risk to identified receptors.

4.3. GROUND GAS RISK ASSESSMENT METHODOLOGY

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

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

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



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

The following equation should be utilised:

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

Where:

q is the measured flow rate (in litres per hour) of combined gases from the monitoring standpipe

C_{hg} is the measured hazardous gas concentration (in percentage volume/volume).

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

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

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



TABLE 4.5 SITE CHARACTERISATION BY GSV (BS8485:2015+A1:2019)

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

Notes

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

4.4. MONITORING METHODOLOGY

Concentrations of methane (CH₄), carbon dioxide (CO₂) and oxygen (O₂) 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+A1:2019. 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 SAND Drift	16/10/2023	0.1	0.1	0.0001	0.1	0.1	0.0001	21.1	1013	Falling	0.1	0.1	1.00-3.00	2.85	2.65
		10/11/2023	0.1	0.1	0.0001	7.3	7.2	0.0073	13.3	983	Rising	0.1	0.1		2.86	2.10
		27/11/2023	0.1	0.1	0.0001	0.1	0.1	0.0001	20.3	1000	Steady	0.1	0.1		2.85	2.30
		07/12/2023	0.1	0.1	0.0001	6.4	6.4	0.0064	13.5	996	Falling	0.1	0.1		2.85	1.90
WS103	Natural SAND Drift	16/10/2023	0.1	0.1	0.0001	0.1	0.1	0.0001	20.6	1012	Falling	0.1	0.1	1.00-4.00	3.90	Dry
		10/11/2023	0.1	0.1	0.0001	6.8	6.8	0.0068	13.7	983	Rising	0.1	0.1		3.90	3.86
		27/11/2023	0.1	0.1	0.0001	0.1	0.1	0.0001	20.3	1000	Steady	0.1	0.1		3.90	3.85
		07/12/2023	0.1	0.1	0.0001	6.4	6.4	0.0064	13.5	996	Falling	0.1	0.1		3.92	3.90
WS105	Made Ground	16/10/2023	0.1	0.1	0.0001	0.1	0.1	0.0001	20.5	1012	Falling	0.1	0.1	1.00-2.50	2.35	Dry
		10/11/2023	63.0	18.1	0.0630	23.0	6.9	0.0230	14.8	983	Rising	0.1	0.1		2.35	Dry
		27/11/2023	0.1	0.1	0.0001	0.1	0.1	0.0001	20.3	1000	Steady	0.1	0.1		2.35	Dry
		07/12/2023	66.3	19.1	0.0663	22.0	6.9	0.022	14.2	995	Falling	0.1	0.1		2.35	Dry
WS106	Natural SAND Drift	16/10/2023	Monitoring well inaccessible due to vehicles											1.00-4.00	-	-
		10/11/2023														
		27/11/2023														
		07/12/2023														

Notes

CIRIA Characteristic Situation		Q _{hg}			
	CS1	<0.07	Typical Max CO2 <5 % Typical Max CH4 <1 %	Values in BOLD exceed CS1 Thresholds	
	CS2	<0.7	Flow rate not to exceed 70 l/hr otherwise consider increase to CS3	Values in BLUE denote water above level of response zone (flooded)	
	CS3	<3.5			
	CS4	<15	Quantitative Risk Assessment required to evaluate scope of protective measures		



4.5. SUMMARY OF MONITORING RESULTS

4.5.1. GROUNDWATER

WS105 was noted to be dry during all monitoring visits to date while WS103 was recorded as dry during the first monitoring visit.

Groundwater was recorded between 1.90 m and 3.86 m bgl.

4.5.2. BAROMETRIC PRESSURE

Visits 1 and 4 were undertaken during periods of falling pressure. Visit 2 was undertaken during a period of low rising pressure, with pressure noted to be 983 mbar. Visits 2 and 4 were also noted to be undertaken during relatively low atmospheric pressure ranging from 983 to 996 mBar.

Further visits will be undertaken over representative conditions.

4.5.3. GAS FLOW

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

4.5.4. GAS CONCENTRATIONS

Methane was recorded as 0.1% v/v (limit of detection of the analyser) in WS101 and WS103. Significantly elevated methane was recorded in WS105 during the second and fourth monitoring visits with a concentration of 63% v/v and 66% v/v respectively.

The maximum carbon dioxide concentrations were recorded at concentrations ranging from 0.1% v/v to 23.0 % v/v (WS105). Elevated carbon dioxide was recorded within all monitoring locations during the second and fourth visits at concentrations ranging from 6.4% v/v (WS101) to 23% v/v (WS105).

Depleted oxygen concentrations have also been recorded during the second and fourth monitoring visits where elevated carbon dioxide and methane were recorded.

4.6. CONCLUSION

The determined Characteristic Situation for each standpipe for each visit is presented in Table 4.7.

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
WS101	16/10/2023	2.65	0.1	0.1	0.0001	0.1	0.0001	CS1
	10/11/2023	2.10	0.1	0.1	0.0001	7.3	0.0073	CS2
	27/11/2023	2.30	0.1	0.1	0.0001	0.1	0.0001	CS1
	07/12/2023	1.90	0.1	0.1	0.0001	6.4	0.0064	CS2



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
WS103	16/10/2023	Dry	0.1	0.1	0.0001	0.1	0.0001	CS1
	10/11/2023	3.86	0.1	0.1	0.0001	6.8	0.0068	CS2
	27/11/2023	3.85	0.1	0.1	0.0001	0.1	0.0001	CS1
	07/12/2023	3.90	0.1	0.1	0.0001	6.4	0.0064	CS2
WS105	16/10/2023	Dry	0.1	0.1	0.0001	0.1	0.0001	CS1
	10/11/2023	Dry	0.1	63.0	0.0630	23.0	0.0230	CS2
	27/11/2023	Dry	0.1	0.1	0.0001	0.1	0.0001	CS1
	07/12/2023	Dry	0.1	66.3	0.0663	22.0	0.022	CS2

Initial ground gas monitoring has identified elevated concentrations of carbon dioxide within all monitoring wells during the second and fourth visits. Significantly elevated methane has also been identified in WS105 during two monitoring visits (66.3% v/v) which is located within the infilled reservoir.

Further investigation will be required to determine the extent of organic materials within the location of the former infilled ponds/reservoirs.

Initial monitoring indicates that a requirement for CS2 is required for the proposed development. Post remediation ground gas monitoring will be required to confirm the ground gas classification.

4.7. BUILDING GAS RISK MITIGATION

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

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

Type A Building – Private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms are present. Probably conventional building construction (rather than civil engineering). Examples include private housing and some retail premises.

Type B Building – Private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium sized rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels.

Based on the ground gas risk assessment and the proposed Type B Building, it is envisaged that a point score of 3.5 will be required for affected properties, as summarised in Table 4.8.



TABLE 4.8 BS8485 (2015)+A1(2019) POINTS REQUIRED FOR TYPE A AND TYPE B BUILDINGS

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

BS8485 (2015)+A1(2019) Notes

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

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

TABLE 4.9 SUMMARY OF GROUND GAS MITIGATION MEASURES – BS8485 (2015)+A1(2019)

GAS PROTECTION SCORES FOR THE STRUCTURAL BARRIER		SCORE ^A
Floor and Substructure Design		
Precast Suspended Segmental Subfloor (Beam and Block)		0
Cast in Situ Ground Bearing Floor Slab (With Only Nominal Mesh Reinforcement)		0.5
Cast in Situ Monolithic Reinforced Ground Bearing Raft or Reinforced Cast in Situ Suspended Floor Slab With Minimal Penetrations		1 or 1.5 ^B
Basement Floor and Walls Conforming to BS 8102:2009, Grade 2 Waterproofing ^{C D}		2
Basement Floor and Walls Conforming to BS 8102:2009, Grade 3 Waterproofing ^{C D}		2.5
Notes A) The scores are conditional on breaches of floor slabs, etc., being effectively sealed. B) To achieve a score of 1.5 the raft or suspended slab should be well reinforced to control cracking and have minimal penetrations cast in (see A.2.2.2). C) The score is conditional on the waterproofing being provided by a suitable structural barrier with the design and detailing of the walls and floor meeting the requirements for Type B protection. The score cannot be assigned for Type A (waterproof membrane) or Type C (drained cavity wall). D) If a membrane is installed beneath and around the basement to provide Type A waterproofing (BS 8102:2009), it can be assigned a gas protection score in accordance with Table 7, if it meets all the criteria for a gas resistant membrane in that table. When practical, utilities should enter the building above floor level with any conduit or meter housing being properly vented outside of the building.		
PROTECTION ELEMENT SYSTEM	SCORE	COMMENTS
Gas protection scores for ventilation protection measures		
(a) Pressure Relief Pathway – Usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building.	0.5	Whenever possible a pressure relief pathway (as a minimum) should be installed in all gas protection measures systems. If the layer has a low permeability and/or is not terminated in a venting trench (or similar), then the score is 0.



(b) Passive Subfloor Dispersal Layer – Media used to provide the dispersal layer are: ✳ Clear void; ✳ Polystyrene void former blanket; ✳ Geocomposite void former blanket; ✳ No fines gravel layer with gas drains; and ✳ No fines gravel layer.	Very good performance 2.5 Good performance 1.5	The ventilation effectiveness of different media depends on a number of different factors including the transmissivity of the medium, the width of the building, the side ventilation spacing and type and the thickness of the layer. The selected score should be assigned taking into account the recommendations in Annex B of BS 8485 (2015). Passive ventilation should be designed to meet at least “good performance”.
(c) Active Dispersal Layer – Usually comprising fans with active abstraction (suction) from a subfloor dilution layer with roof level vents. The dilution layer may comprise a clear void or be formed of geocomposite or polystyrene void formers.	1.5 to 2.5	This system relies on continued serviceability of the pumps, therefore alarm and response systems should be in place. There should be robust management systems in place to ensure the continued maintenance of the system, including pumps and vents. Active ventilation should always be designed to meet at least “good performance”.
(d) Active Positive Pressurisation – Provided by the creation of a blanket of external fresh air beneath the building floor slab by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket.	1.5 to 2.5	This system relies on continued operation of the pumps, therefore alarm and response systems should be in place. The score assigned should be based on the efficient “coverage” of the building footprint and the redundancy of the system. Active ventilation should always be designed to meet at least “good performance”.
(e) Ventilated Car Park – Floor slab of occupied part of the building under consideration is underlain by a basement or undercroft car park.	4	Assumes that the car park is vented to deal with car exhaust fumes, designed to Buildings Regulations 2000, Approved Document F [9].
Gas Protection Score for the Gas Resistant Membrane		



Gas resistant membrane meeting all of the following criteria: ✳ Sufficiently impervious to the gases with a methane gas transmission rate < 40 ml/day/m²/atm (average) for sheet and joints (tested in accordance with BS ISO 151051 manometric method); ✳ Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions; ✳ Sufficiently strong to withstand in service stresses (e.g. settlement if placed below a floor slab); ✳ Sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools); ✳ Capable, after installation, of providing a complete barrier to the entry of the relevant gas; and ✳ Verified in accordance with CIRIA C735.	2	The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation and integrity of joints. If a membrane is installed that does not meet all the criteria opposite then the score is zero.
A) Membrane with a methane gas transmission rate < 40.0 ml/day/m²/atm (average) for sheets and joints (tested in accordance with BS ISO 151051:2007 manometric method) is regarded as sufficiently impervious. B) For example, reinforced LDPE (virgin polymer) membranes having a minimum mass per unit area of 370 g/m² and not significantly less than 0.4 mm thickness between the reinforcement scrim (tested in accordance with Procedure D (2 mm diameter tip) of BS EN ISO 98631:2016) installed above floor slabs are considered sufficiently strong to meet the performance criteria (see also C.3). Thicker and more robust membranes or an additional membrane protection layer should be installed directly beneath cast in situ floor slabs.		



4.8. 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 4.10 PIPELINE SELECTION PE THRESHOLD CONCENTRATIONS

Contaminant Group	PE-threshold (mg/kg)	Concentrations at <u>Current</u> pipeline depth (mg/kg)
Total VOC	0.5	N/A
Total BTEX And MTBE	0.1	N/A
Total SVOCs (Excluding PAH and those substances marked with an *)	2	N/A
EC5-EC10 Aliphatic and Aromatic Hydrocarbons	2	<1.0
EC10-EC16- Aliphatic and Aromatic Hydrocarbons	10	<6.0
EC16-EC40 Aliphatic and Aromatic Hydrocarbons	500	<60
Phenols (From SVOC Analysis)*	2	N/A
Cresols and Chlorinated Phenols (From SVOC Analysis)	2	N/A
Ethers*	0.5	N/A
Nitrobenzene*	0.5	N/A
Ketones*	0.5	N/A
Aldehydes*	0.5	N/A
Amines	Fail	N/A
Other Consideration		
Are there any exceedances of the PE threshold outside of the pipeline depth?	No	
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 hydrocarbon impact has been identified to date.	
Will soils impacted with above determinands likely be utilised elsewhere on site?	N/A	
Will soils be imported to site as part of any future earth works	Currently unknown. The importation of materials may affect the WIR Risk Assessment which should be updated after completion.	

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

Based on the assessment of current site conditions it is likely that PE pipe will be suitable for the proposed development.



4.9. CONCEPTUAL SITE MODEL

Following the completion of the intrusive site investigation, chemical analysis and risk assessment, the conceptual model shown in Table 4.11 has been prepared for the site.

TABLE 4.11 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
Assessment: Elevated concentrations of non-volatile PAH have been identified in the Made Ground between depths of 0.40 m and 0.50 m bgl.						
Recommendation: Cover system to garden and landscaped areas will prevent exposure to future site users. Construction works completed with PPE and provision of welfare.						
PL3	ACM in Made Ground	Inhalation of dust.	Future site users. Buildings. Off-site land users.	Likely	Moderate	LOW
Assessment: Asbestos in the form of loose amosite fibres has been identified in the Made Ground in WS105 at 0.80 m bgl. Asbestos may be present within the existing building.						
Recommendation: The soils will require placement in accordance with the asbestos CSM. Construction works completed with PPE and provision of welfare. A pre-demolition asbestos survey will be required.						



POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
PL4	Volatile Contaminants (Made Ground, works, infilled reservoirs)	Inhalation of vapours. Migration through permeable strata and preferential pathways.	Future site users. Off-site receptors.	Likely	Moderate	To be determined
Assessment: Elevated total mercury has been identified in WS101 at 0.50 bgl. Recommendation: Speciation is required to assess whether elemental mercury is present which may pose a risk to future site users through vapour inhalation. If elemental mercury is identified, it may be necessary to delineate and excavate the soils and place them in an area of low sensitivity such as POS. If it is proven that there is no elemental mercury, a clean cover system will be sufficient. A post demolition ground investigation will be required to confirm the initial findings.						
PL4	Methane, carbon dioxide (Made Ground, infilled reservoirs, and potentially infilled features on and within 250 m of the site)	Inhalation of gas. Migration through permeable strata and preferential pathways. Explosion in confined spaces.	Future site users. Buildings. Off-site land users.	Likely	Moderate	LOW
Assessment: Deep Made Ground and organic deposits have been identified as potential sources of hazardous ground gas. Initial ground gas monitoring has identified elevated carbon dioxide in all monitoring wells. Significantly elevated methane has also been identified in WS105 in the location of the infilled reservoir. Recommendation: Further investigation will be required to determine the extent of organic materials within the location of the former infilled ponds/reservoirs. Initial monitoring indicates that a requirement for CS2 is required for the proposed development. Post-remediation ground gas monitoring will be required to confirm the ground gas classification.						



POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
PL5	Mobile contaminants such as hydrocarbons (Made Ground, infilled reservoirs, historical tanks)	Surface runoff. Migration through permeable strata and preferential pathways. Perched waters migration.	Groundwater (secondary A and principal aquifers).	Low Likelihood	Low	LOW
Assessment: The soil and leachate analysis completed to date does not suggest a risk to controlled waters.						
Recommendation: Supplementary groundwater samples are recommended to confirm the initial assessment.						
PL6	Sulphate (potential ash within Made Ground)	Sulphate attack on concrete.	Building structure.	Low Likelihood	Low	LOW
Assessment: The soils at the site meet generally class DS-1, AC-1.						
Recommendation: Concrete should be designed in accordance with the chemical testing results.						
PL7	Organic contaminants such as hydrocarbons, and solvent (Made Ground, works infilled reservoirs)	Ingestion of tainted water supply.	Future site users. Water pipes.	Low Likelihood	Moderate	LOW
Assessment: No elevated concentrations of TPH have been identified at the proposed pipeline depth (0.75 m – 1.35 m).						
Recommendation: Based on the assessment of current site conditions, it is likely that PE pipe will be suitable. This will need to be confirmed with a UKWIR risk assessment post-remediation.						



POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
PL8	Phytotoxic contaminants (Made Ground)	Direct Contact (plant uptake).	Flora.	Low Likelihood	Low	LOW
Assessment: Contamination has been encountered within shallow Made Ground across the site which may be taken up by flora in soft landscaping.						
Recommendation: Installation of a clean cover system within any areas of soft landscaping to prevent plant uptake of contaminants.						

Main exposure pathways:

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



5. GEOTECHNICAL ASSESSMENT

5.1. PROPOSED DEVELOPMENT

McCarthy & Stone proposes to construct a retirement home comprising c. 32 one bed apartments and 20 two bed apartments with associated infrastructure, car parking and soft landscaping. Drawing 17 206-002 (Appendix III) identifies the proposed development layout.

5.2. 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.
- ✿ Demolition of all existing buildings and removal of all hardstanding.
- ✿ Redundant services should be sealed off, grubbed out and replaced with suitable compacted engineered fill.
- ✿ Buried structures and old foundations should be excavated from below the proposed development footprint with the resulting void backfilled.

5.3. FOUNDATION CONDITIONS AND ASSESSMENT OF POTENTIAL BEARING CAPACITIES

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

TABLE 5.1 SUMMARY OF ABP

GRANULAR SOILS			
Description	Depth (Range m bgl)	Relative Density	Allowable Bearing Pressure (kN/m ²)
SAND	1.00–3.45	Medium Dense	155–235
SAND	2.00–3.45	Dense	311–435
Gravelly SAND	1.00–3.45	Medium Dense	181–287
Gravelly SAND	2.00–4.45	Dense	320–444
SILT (WS105)	4.00–5.45	Medium Dense – Dense	228–315*

Notes * ABP may be reduced where granular soils are saturated.

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



However, prior to the detailed design of suitable foundations solutions, a programme of remediation and enabling works will be required to remove the buried obstructions and cut/fill the site to provide suitable development platform levels.

At this stage, given that the majority of the proposed structure overlies the existing building where site investigation has not been undertaken, further post-demolition site investigation including deep boreholes will be required to fully characterise the site to determine the final foundation solution.

Depending on the required loadings, the underlying medium dense sands may provide a suitable bearing stratum for mass trench foundations, however the ground conditions under the existing building have not been proven therefore further assessment is required to confirm this.

In the absence of detailed ground conditions beneath the existing building, it is likely that the most cost effective option for the majority of the site would be to re-engineer the Made Ground using vibro stone columns (VSCs) to support a shallow strip or spread foundation. Deep Made Ground with organic materials and plant debris has been identified. Further investigation is required to determine the extent of such deposits.

Where significant depths of peat or soft organic deposits are identified in the location of the infilled reservoirs, driven piled foundations may be required as this will render the site unsuitable for Ground Improvement such as VSC.

5.4. 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.

Following enabling works, the site will likely have a variable thickness of Made Ground, that may extend to significant depth in places. Given the structures that are proposed, if a ground bearing floor slab is required, it is considered that settlement analysis and detailed design in order to accommodate variability of the formation and account for differential settlement will be required.

Given the depth of Made Ground and its loose/variable nature, it will be necessary to undertake some form of Ground Improvement work to ensure the total and differential settlement is within tolerable limits for the Uniformly Distributed Load of the floor slab and any external reinforced concrete yards / hardstanding.

A traditional solution which comprises the excavation of the upper stratum of Made Ground prior to re-engineering and compaction as a structural upfill may be considered. Limitations with this approach would be attributed to the inherent variability of the material and issues arising from fluctuations in moisture content, which are exaggerated during periods of seasonal variance with increased precipitation and reduced evaporation.

Where a ground-bearing floor slab is to be constructed within the conjectured zone of tree influence, the clay will need to be removed to ensure that any desiccated soil cannot swell and induce heave to the structure. Alternatively, it may be possible to design the structure to resist the influence of clay heave using exaggerated sub-base and additional reinforcement within the slab to be designed by the structural engineer.



5.5. HEAVE PRECAUTIONS

No shallow clay soils have been identified, therefore heave precautions are not likely to be required.

If shallow cohesive soils are identified following additional site investigation, an assessment of heave and tree influence will need to be undertaken to determine the volume change potential of these materials.

5.6. HIGHWAYS CONSTRUCTION

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

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

5.7. DRAINAGE

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

As the lateral continuity of the Made Ground cannot be assured, it is not recommended that soakaways are utilised for disposal of surface water runoff.

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

5.8. 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-1 in accordance with the recommendations provided in BRE *Special Digest 1* (2005).

5.9. EXCAVATIONS

Site observations indicated that excavations should be feasible in the near surface with normal plant; however, obstructions will be present beneath the existing building. It is anticipated that any obstructions will be grubbed out during the reduced-level dig for the substructure works.

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

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

TABLE 5.4 CIVIL ENGINEERING EXCAVATION RISK MATRIX

RISK ITEM	PRESENT	COMMENT
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Running Sands	No	No running sand has been identified.
Minor Water Ingress	No	Minor water ingress will require localised dewatering/sump pumping during the construction of site drainage infrastructure. Ingress of water into foundation excavation will potentially flood foundation excavations, limiting the viability of spread foundations to be constructed.
Shallow Bedrock	No	Shallow bedrock has not been identified.

5.10. CONSTRUCTION ACTIVITY AND INSPECTION

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

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



5.11. GEOTECHNICAL RISK REGISTER

POTENTIAL CONSTRAINT	ABNORMAL	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Remediation of contaminated soils		TBC	TBC	Further investigation is required post demolition. Material deemed to have a potential vapour risk may require hotspot removal, resulting the requirement to backfill the resulting void. Should significant backfill be needed deeper or specialist foundations may be required in those areas.
Obstructions		All	60	Obstructions will be present associated with the existing building and infrastructure.
Artificially levelled and filled platforms		All	100	The site appears to have been levelled and artificially backfilled.
Trench collapse		All	100	Made Ground present beneath the site is likely to be loosely compacted and possibly prone to collapse.
Infilled reservoirs/ponds		Centre	5	The former infilled reservoirs/ponds will need to be identified and investigated to assess the nature of materials and extent of any organic or deleterious elements.
Mature trees		Periphery	TBC	Arboriculture survey is required to determine areas of potential tree influence. Mature trees are present along the site boundaries.
Volume change potential clay		N/A	N/A	No shallow clay soils have been identified, therefore heave precautions are not likely to be required.
Peat		TBC	TBC	Plant debris was identified in the Made Ground in WS105 between 1.00 – 2.60 m bgl.
Running sands		N/A	N/A	Data searches indicate low risk.
Concrete design		All	N/A	The soils generally meet class DS-1, AC-1. The natural sand in WS106 at 1.80 m is classified as DS-1, AC-2z due to a pH value of 6.5.



Fairways Lodge, Prestwich

Phase II Geoenvironmental Site Assessment

December 2023

POTENTIAL CONSTRAINT	ABNORMAL	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Services/sensitive structures		All	TBC	A review of online services has identified a number of services within the site boundary. Piling may not be possible within close proximity to any sensitive infrastructure.
Abnormal foundation solutions		TBC	TBC	An engineered foundation solution is likely to be required due to the presence of underground obstructions and areas of deep Made Ground and organic deposits.
Areas not investigated		Existing Building	50	Investigation will be required in the location of the existing building.



5.12. FURTHER WORKS

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

-  Further investigation of inaccessible areas (post-demolition site investigation).
-  Speciated mercury analysis.
-  Geotechnical earthworks strategy (infrastructure).
-  Remediation and enabling works strategy.
-  Post remediation ground gas monitoring.



6. CONCLUSIONS AND RECOMMENDATIONS

6.1. CONTAMINATED LAND ASSESSMENT

Human Health	The Tier 2 human health risk assessment identified exceedances of the GAC for non-volatile PAH compounds, total mercury and asbestos. Asbestos in the form of amosite has been identified in the granular Made Ground in WS105 at 0.80 m bgl. Quantification analysis was undertaken and the sample was identified to contain loose fibres at <0.001% volume/weight. The risk to chronic human health associated with the elevated concentrations of non-volatile PAH compounds can be mitigated through the installation of a suitable cover system in all proposed gardens, landscaping and public open space to remove any potential for direct exposure to impacted soils. The specific design and installation process for the appropriate cover systems will be clearly defined within the site remediation and enabling works strategy. Speciation is required to assess whether elemental mercury is present which may pose a risk to future site users through vapour inhalation. If elemental mercury is identified, it may be necessary to delineate and excavate the soils and place in an area of low sensitivity such as POS. If it is proven that there is no elemental mercury, a clean cover system will be sufficient. No visual signs of ACM were encountered during the ground investigation; it is therefore likely that only trace fibres are present. Impacted soils should be managed according to the asbestos risk mitigation conceptual site model. Chemical analysis of the natural granular drift deposits has identified these soils to be acceptable for use as subsoil within the proposed garden areas; however, further chemical validation samples will be required to confirm this. There are no suitable sources of topsoil available on the site. Further post-demolition investigations are required to confirm the findings of this initial assessment as and when full and unrestricted access is available.
Controlled Waters	The soil and leachate analysis completed to date does not suggest a risk to controlled waters. Supplementary groundwater samples are recommended to confirm the initial assessment.
Ground Gas	Elevated carbon dioxide and methane has been recorded during initial monitoring visits therefore the site is currently assessed as CS2 and ground gas mitigation measures will be required. Further post-remediation gas monitoring is required, however an allowance for CS2 measures should be included at this time.
Potable Water	This will need to be confirmed following the completion of a UKWIR risk assessment. Post-remediation and enabling works ground conditions may be different from those identified during this site investigation.



6.2. GEOTECHNICAL ASSESSMENT

Significant obstructions will be present beneath the existing building.

The underlying natural sand drift deposits have been assessed as being medium dense to dense with a net allowable bearing pressure (ABP) in the order of 155 – 444 kN/m² between 1.00 – 4.45 m bgl.

The sandy clayey SILT identified in WS105 is medium dense to dense between 4.00 – 5.45 m bgl with an ABP in the range of 228 – 315 kN/m².

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

However, prior to the detailed design of suitable foundations solutions, a programme of remediation and enabling works will be required to remove the buried obstructions and cut/fill the site to provide suitable development platform levels.

At this stage, given that the majority of the proposed structure overlies the existing building where site investigation has not been undertaken, further post-demolition site investigation including deep boreholes will be required to fully characterise the site to determine the final foundation solution.

Depending on the required loadings, the underlying medium dense sands may provide a suitable bearing stratum for mass trench foundations, however, the ground conditions under the existing building have not been proven therefore further assessment is required to confirm this.

In the absence of detailed ground conditions beneath the existing building, it is likely that the most cost effective option for the majority of the site would be to re-engineer the Made Ground using vibro stone columns (VSCs) to support a shallow strip or spread foundation. Deep Made Ground with organic materials and plant debris has been identified. Further investigation is required to determine the extent of such deposits.

Where significant depths of peat or soft organic deposits are identified in the location of the infilled reservoirs, driven piled foundations may be required as this will render the site unsuitable for Ground Improvement such as VSC.

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



Fairways Lodge, Prestwich

Phase II Geoenvironmental Site Assessment
December 2023

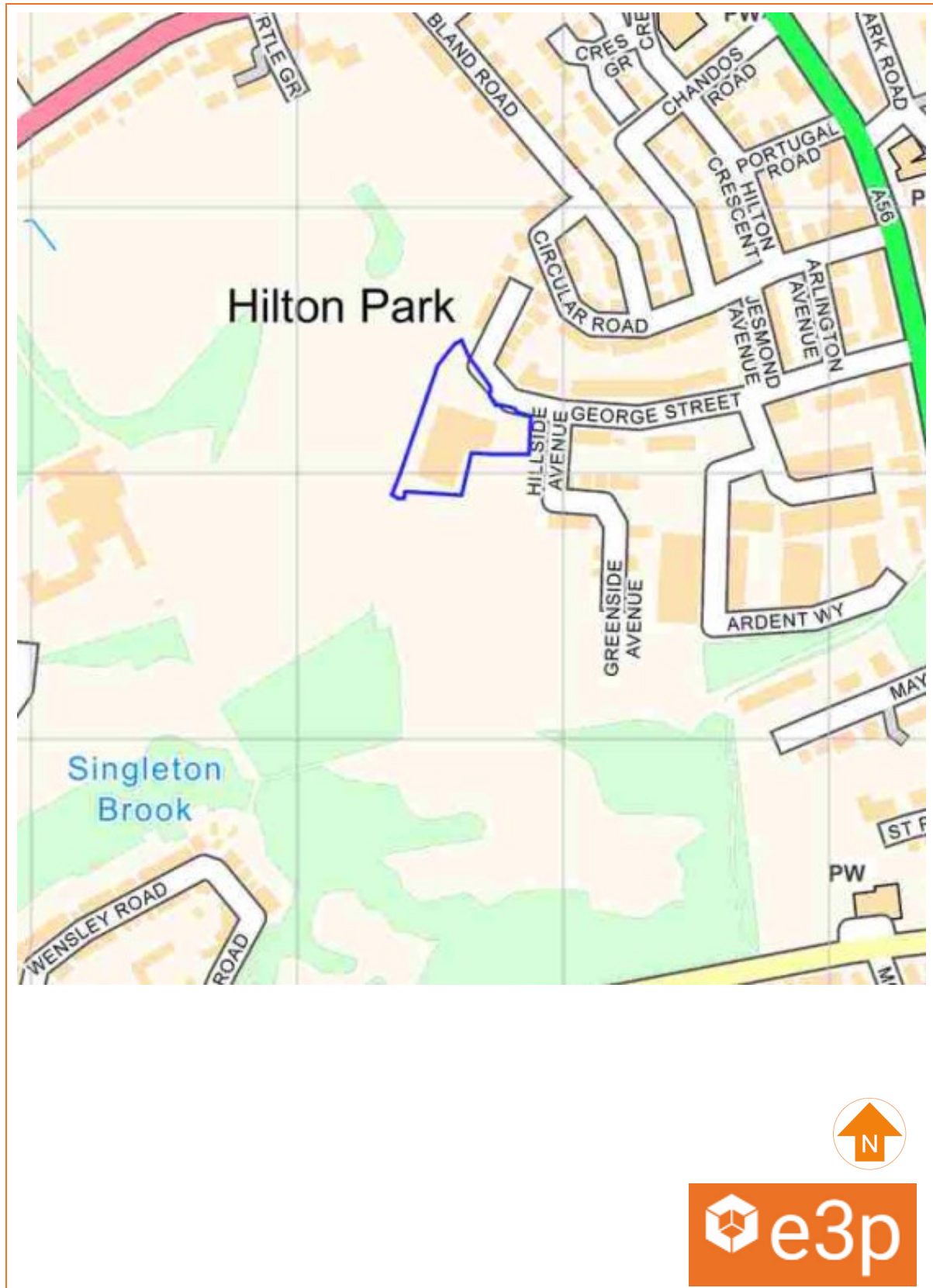
MIBK	Methyl isobutyl ketone	WTE	Water table elevation
m	Metres	ppm	Parts per million
km	Kilometres	mg/m³	Milligram per metre cubed
% v/v	Percent volume in air	m bgl bgl	Metres below ground level
mb	Millibars (atmospheric pressure)	m bcl	Metre below cover level
l/hr	Litres per hour	mAOD	Metres above ordnance 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 17-206-001 – SITE LOCATION PLAN





Notes:					
P1	REVA	18.09.2023	EB	NS	NS
Phase	Issue	Date	Drawn	Checked	PM

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Job Title:	Fairways Lodge, Prestwich

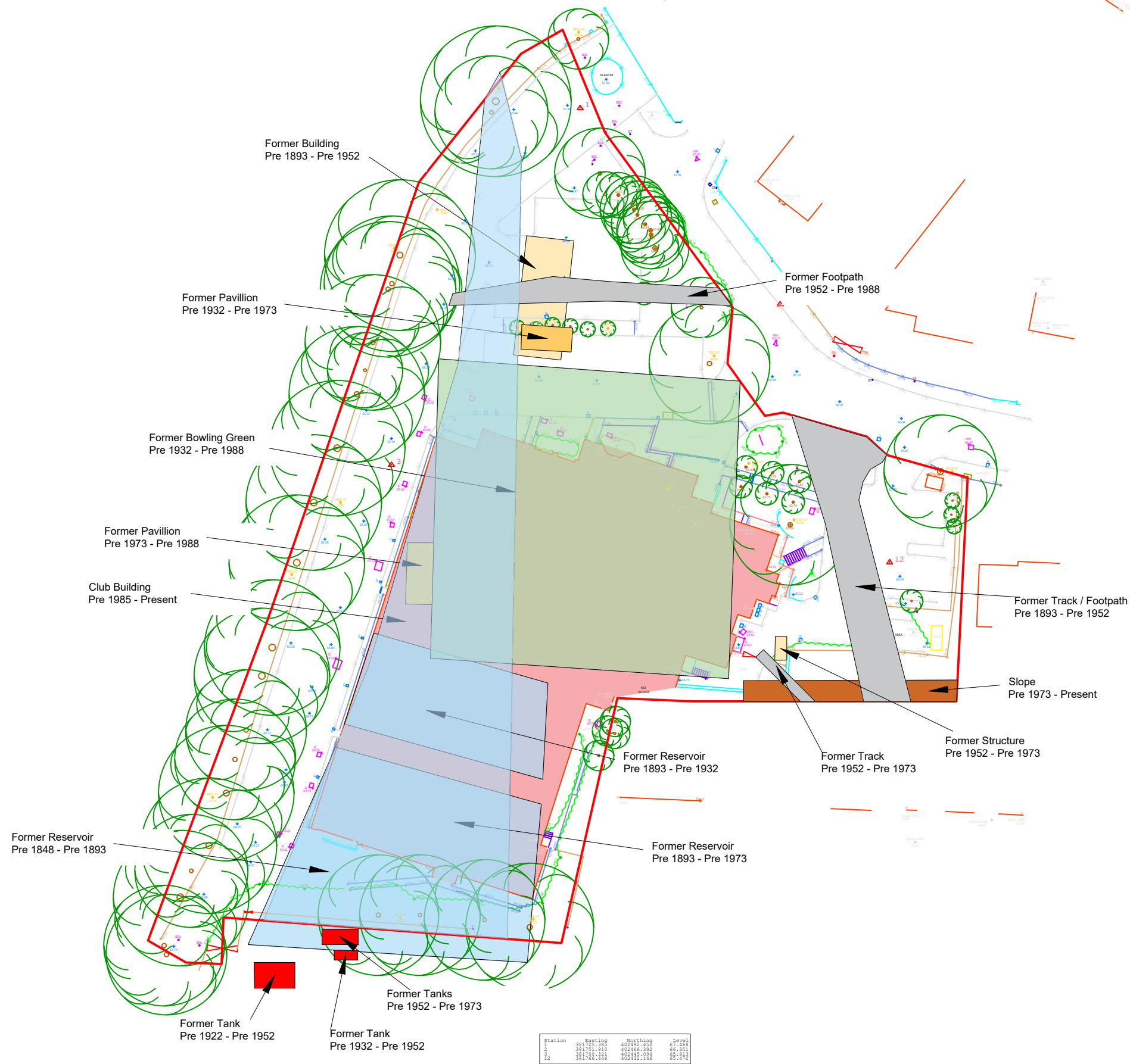
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Drawing No:	002

Date:	18.09.2023
Scale:	NTS@ A3



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

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Historical Features

- Former Reservoirs
- Club Building
- Former Bowling Green
- Former Pavilions
- Former Building / Structure
- Former Tanks
- Former Footpaths / Tracks
- Slope

Notes:

P1	REVB	19.09.2023	EB	NS	NS
Phase	Issue	Date	Drawn	Checked	PM

Client:

McCarthy & Stone

Job Title:

Fairways Lodge,
Prestwich

Job No:

17-206

Drawing No:

003

Date:

19.09.2023

Scale:

NTS@ A3

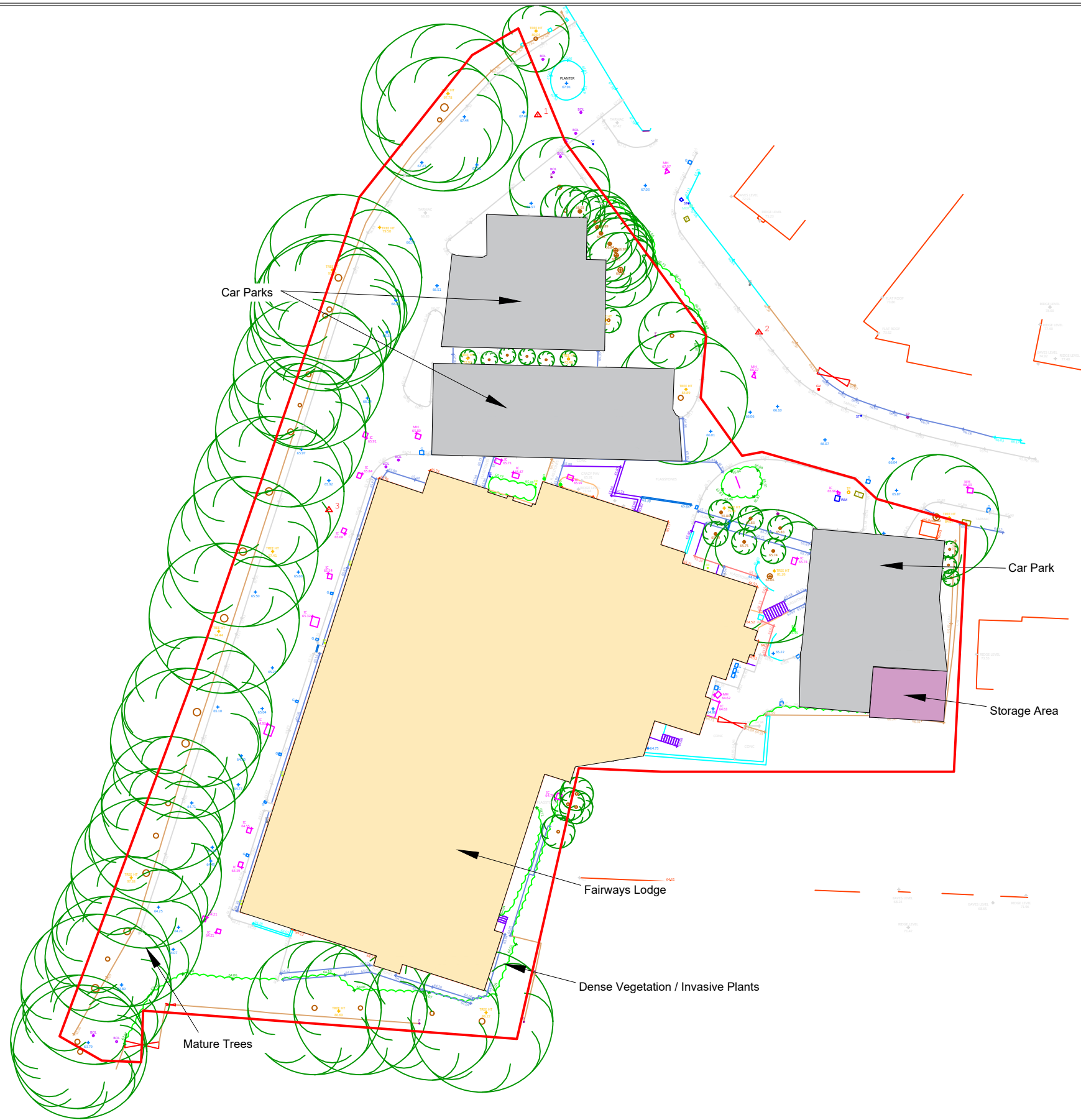
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Historical Features
Plan



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Site Features

- Fairways Lodge
- Storage Area
- Car Parks
- Mature Trees

Notes:

P1	REVB	19.09.2023	EB	NS	NS
P1	REVA	18.09.2023	EB	NS	NS
Phase	Issue	Date	Drawn	Checked	PM

Client:

McCarthy & Stone

Job Title:

Fairways Lodge,
Prestwich

Job No:

17-206

Drawing No:

004

Date:

19.09.2023

Scale:

NTS@ A3

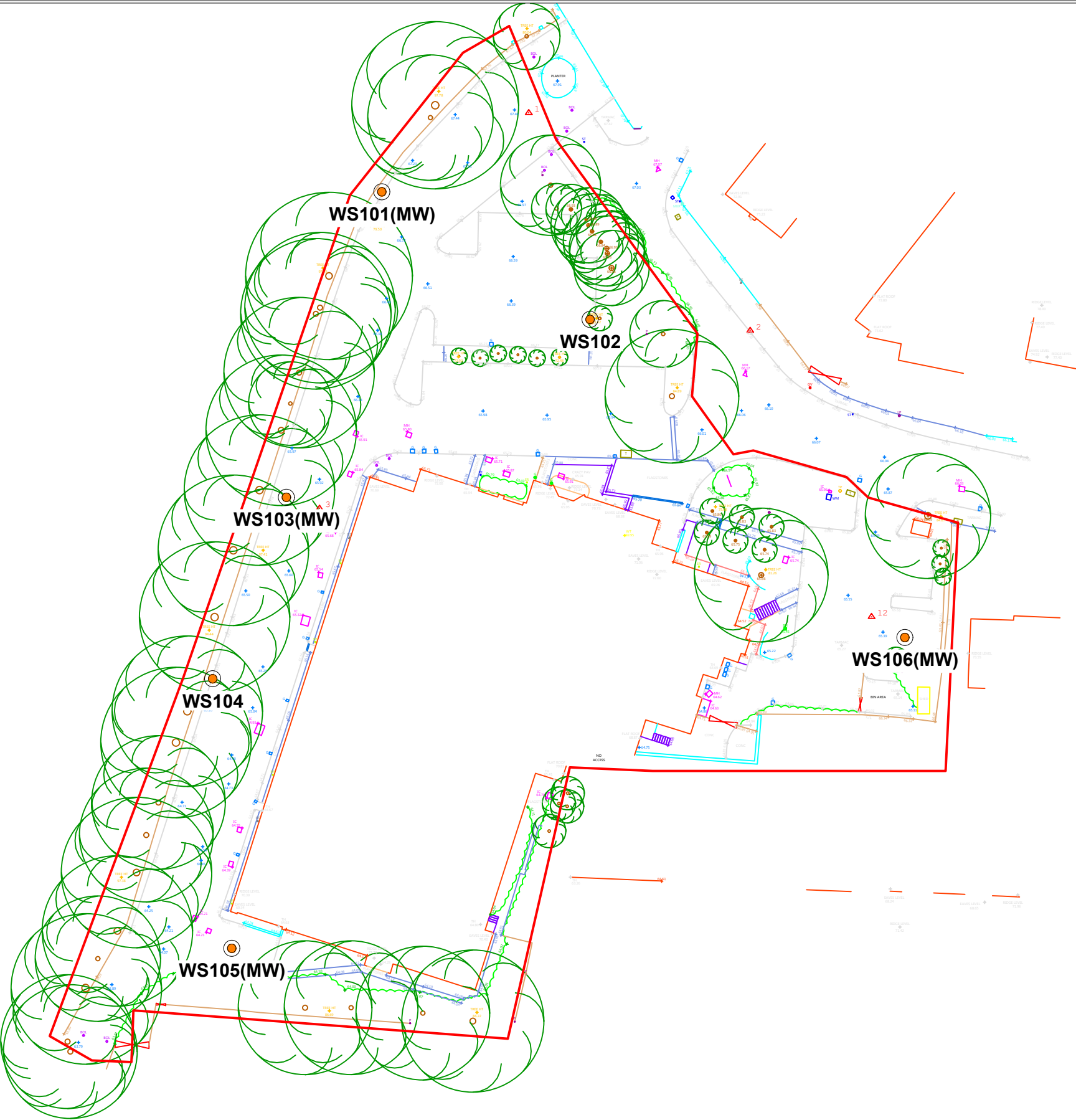


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Drawing Title:

Site Features Plan

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Location Symbols

WS101 Approximate Window Sample Probehole Location

WS101(MW) Approximate Window Sample Probehole Location with Install

Notes:					
P1	REVC	20.11.2023	OW	NS	NS
P1	REVB	17.11.2023	OW	NS	NS
P1	REVA	20.09.2023	EB	ND	NS
Phase	Issue	Date	Drawn	Checked	PM

Client:	McCarthy & Stone
Job Title:	Fairways Lodge, Prestwich

Job No:	17-206
Drawing No:	005

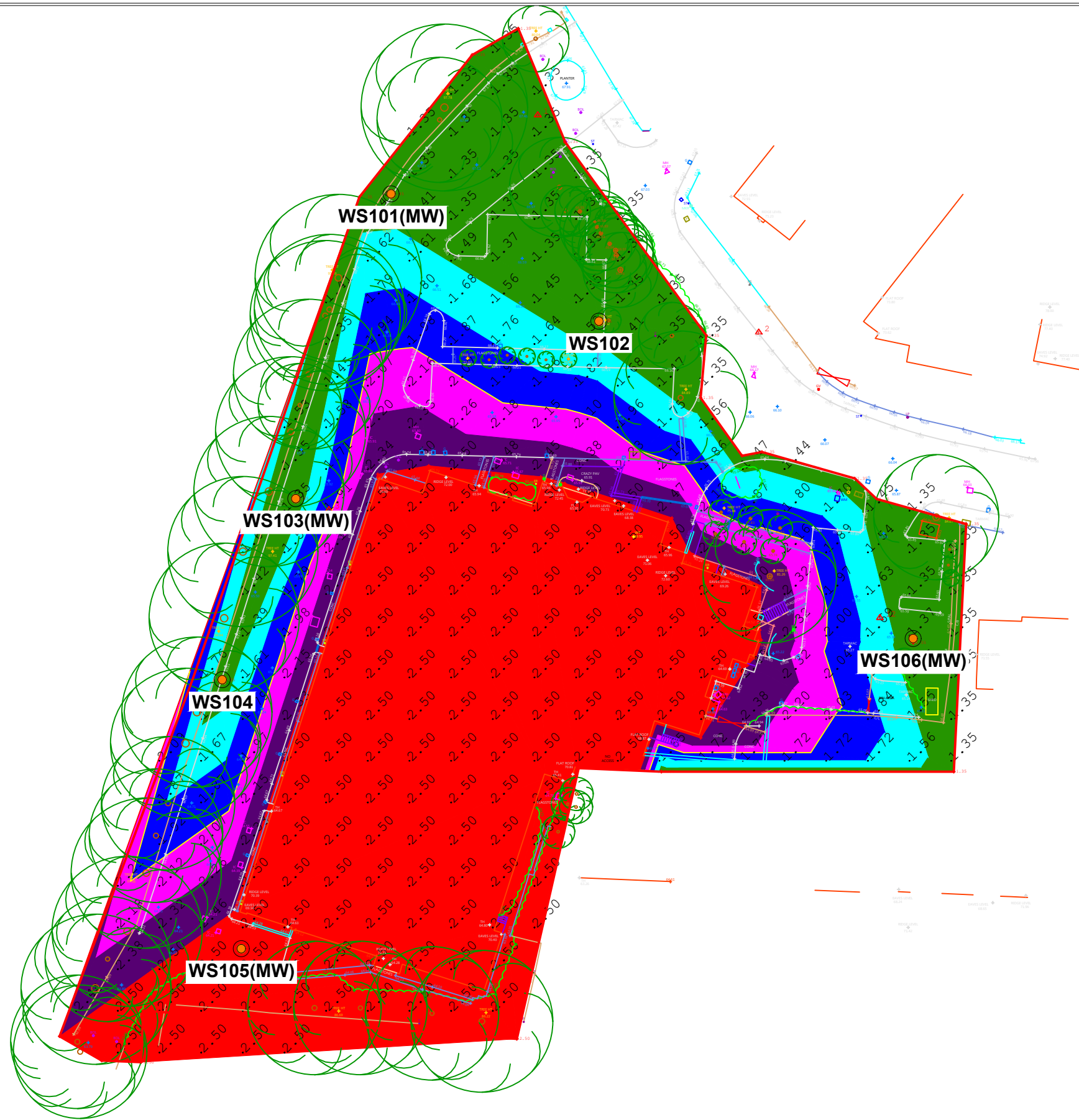
Date:	20.11.2023
Scale:	NTS@ A3



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Drawing Title:	Exploratory Hole Location Plan
----------------	--------------------------------

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Location Symbols

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

Shallow Spread Footings

-  Depth to Founding Strata 0.00 - 1.24m
-  Depth to Founding Strata 1.25 - 1.49m

Mass Trench Fill Footings

-  Depth to Founding Strata 1.50 - 1.74m
-  Depth to Founding Strata 1.75 - 1.99m
-  Depth to Founding Strata 2.00 - 2.24m

Engineered Footings

-  Depth to Founding Strata 2.25 - 2.49m
-  Depth to Founding Strata >2.50m

Notes:

P1	REVB	20.11.2023	OW	NS	NS
P1	REVA	17.11.2023	OW	NS	NS
Phase	Issue	Date	Drawn	Checked	PM

Client:

McCarthy &
Stone

Job Title:

Fairways Lodge,
Prestwich

Job No:

17-206

Drawing No:

008

Date:

20.11.2023

Scale:

NTS@ A3

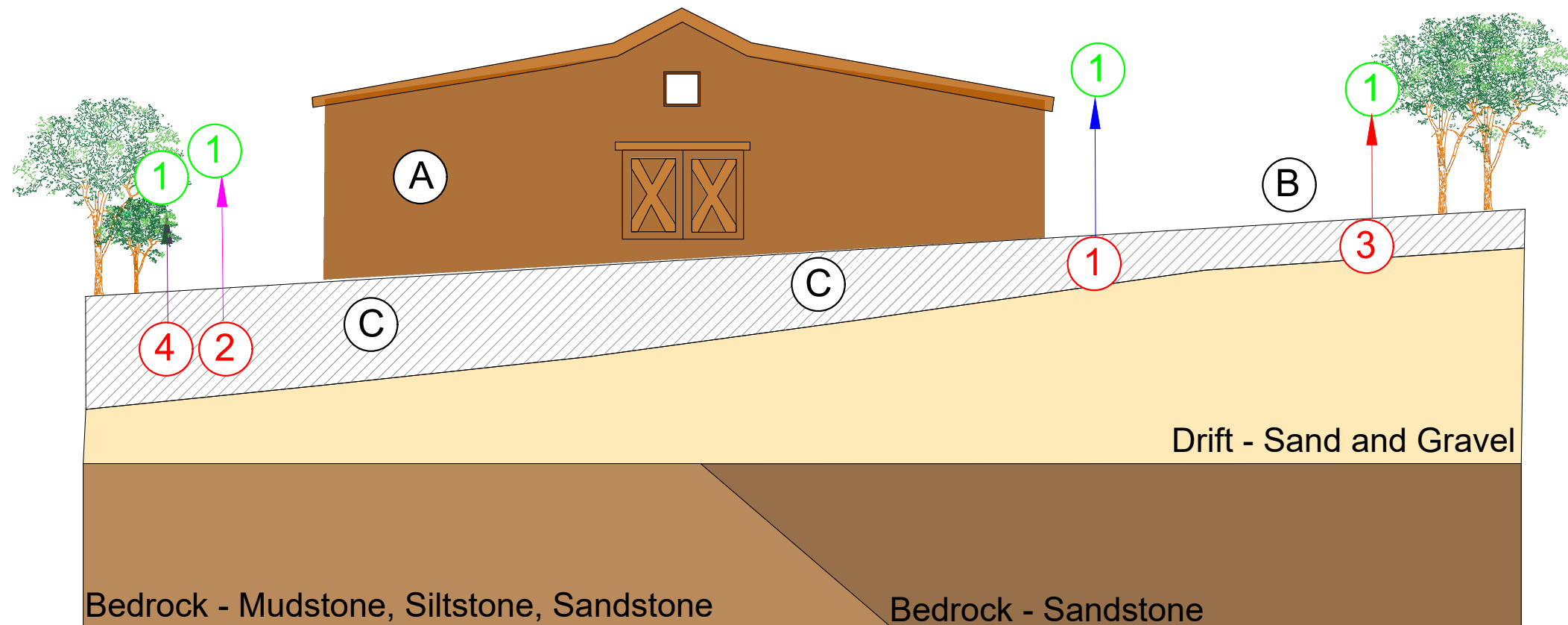
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Depth of Founding Strata
Plan

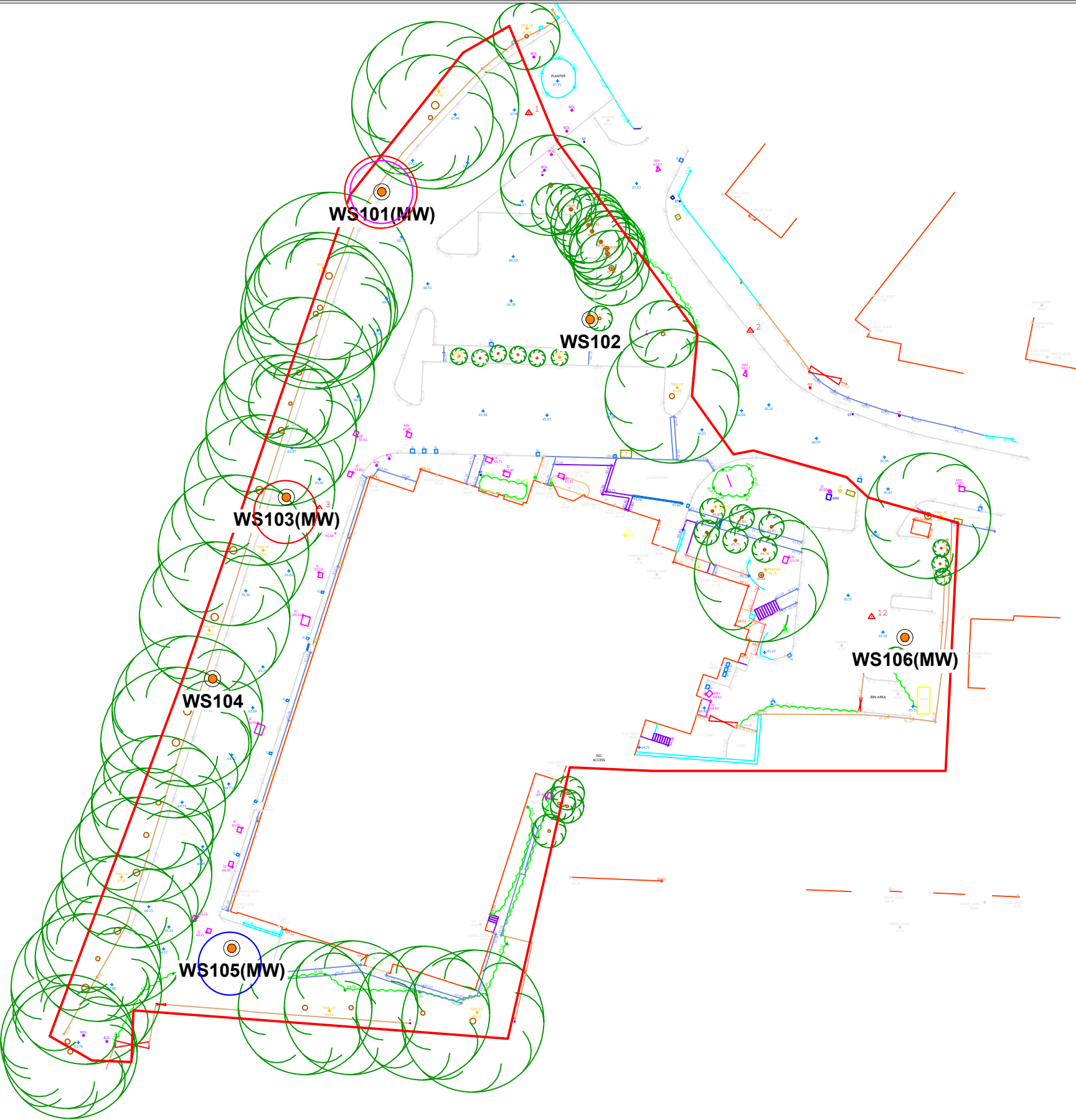


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Geology Key Made Ground Drift - Sand and Gravel Bedrock - Mudstone, Siltstone and Sandstone Bedrock - Sandstone	Sources 1 Heavy Metals, Non Volatile PAH's (Made Ground, Infilled Reservoirs) 2 Asbestos (Made Ground, Infilled Pond, Existing Building) 3 Possible Volatile Mercury (MG) 4 Hazardous Ground Gases (MG, Infilled Pond)	Pathways Dermal Contact / Ingestion Vapour Inhalation Inhalation / Accumulation Dust Inhalation	Receptors 1 Future End Users	Site Features A Lodge Buildings B Car Park C Infilled Reservoir	Notes:					Client: McCarthy & Stone		Job No: 17-206		Date: 17.11.2023		e3p Environmental Engineering Partnership Ltd Taylor Road, Trafford Park Urmston, Manchester, M41 7JQ Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk				
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P1	REVA	17.11.2023	OW	NS																
Phase	Issue	Date	Drawn	Checked																



Location Symbols

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

Contamination Exceedances

- Mercury
- Asbestos
- Non-volatile PAH

Notes:

P1	REVB	20.11.2023	OW	NS	NS
P1	REVA	17.11.2023	OW	NS	NS
Phase	Issue	Date	Drawn	Checked	PM

Client:

McCarthy & Stone

Job Title:

Fairways Lodge,
Prestwich

Job No:

17-206

Drawing No:

018

Date:

20.11.2023

Scale:

NTS@ A3



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APPENDIX IV

PHOTOGRAPHS

PLATE 1 WS101 ARISINGS



PLATE 2 WS103 ARISINGS



PLATE 3 WS105 ARISINGS



PLATE 4 WS106 ARISINGS



APPENDIX V

E3P EXPLORATORY HOLE LOGS

Borehole Log

Borehole No.

WS101

Sheet 1 of 1

Project Name: Fairways Lodge

Project No.
17206

Co-ords: 381710.22 - 402480.76

Hole Type
WS

Location: Prestwich

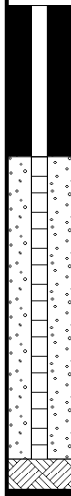
Level: 66.92

Scale
1:50

Client: McCarthy & Stone

Dates: 27/09/2023 -

Logged By
J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10			0.10	66.82		MADE GROUND: Asphalt.	
		0.30	ES		0.40	66.52		MADE GROUND: Grey sandy gravel with cobbles. Gravel is fine to coarse, angular to subangular of mudstone and sandstone.	
		0.50	ES +TUB		0.60	66.32		MADE GROUND: Blackish red gravelly fine to coarse sand. Gravel is fine to medium, subangular to subrounded of brick and ash	
		1.00		N=17 (7,6/5,4,4,4)	1.00	65.92		Greyish brown slightly clayey slightly gravelly fine to medium SAND with rootlets. Gravel is fine, subangular to subrounded of mudstone (Relic Topsoil).	1
		1.70	ES					Brown slightly clayey slightly gravelly fine to medium SAND. Gravel is fine, subrounded of mudstone.	2
		2.00		N=34 (8,8/8,9,8,9)				Medium dense light brown fine to medium SAND. Becoming dense at 2.00 m bgl.	
		3.00		50 (10,13/50 for 240mm)					3
					3.39	63.53		End of borehole at 3.39 m	4
									5
									6
									7
									8
									9
									10

Remarks

1. Refusal on dense SAND 2. Monitoring Well Installed 3. Response Zone 1.00-3.00mbgl.



Borehole Log

Borehole No.

WS102

Sheet 1 of 1

Project Name: Fairways Lodge

Project No.
17206

Co-ords: 381729.90 - 402474.24

Hole Type
WS

Location: Prestwich

Level: 66.54

Scale
1:50

Client: McCarthy & Stone

Dates: 27/09/2023 -

Logged By
J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10			0.10	66.44		MADE GROUND: Asphalt.	
		0.35	ES		0.30	66.24		MADE GROUND: Brown gravel. Gravel is fine to coarse, subangular to subrounded of mudstone and sandstone.	
		0.80	ES		0.40	66.14		MADE GROUND: Brown very gravelly fine to medium sand. Gravel is fine to medium, angular to subrounded of mudstone and slag.	
		1.00		N=18 (3,4/4,5,4,5)	0.50	66.04		MADE GROUND: Blackish grey slightly gravelly fine to medium sand. Gravel is fine, subangular to subrounded of ash.	1
					1.00	65.54		Greyish brown slightly clayey slightly gravelly fine to medium SAND with rootlets. Gravel is fine, subangular to subrounded of mudstone (Relic Topsoil).	
		2.00		N=41 (7,9/9,11,10,11)	1.50	65.04		Medium dense brown slightly gravelly fine to medium SAND. Gravel is fine to medium, subangular to subrounded of mudstone and sandstone.	2
		2.50		50 (25 for 110mm/50 for 200mm)	2.00	64.54		Light brown fine to medium SAND.	
					2.81	63.73		Dense light brown gravelly fine to medium SAND.	3
								End of borehole at 2.81 m	
									4
									5
									6
									7
									8
									9
									10

Remarks

1. Refusal on dense SAND 2.No monitoring well installed



Borehole Log

Borehole No.

WS103

Sheet 1 of 1

Project Name: Fairways Lodge

Project No.
17206

Co-ords: 381695.28 - 402438.97

Hole Type
WS

Location: Prestwich

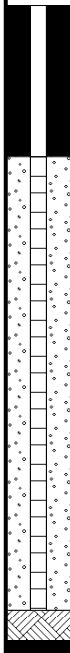
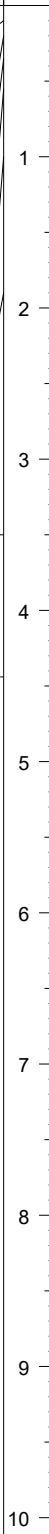
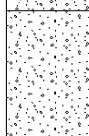
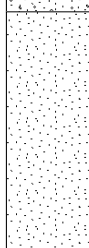
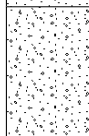
Level: 65.70

Scale
1:50

Client: McCarthy & Stone

Dates: 27/09/2023 -

Logged By
J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	ES		0.10	65.60		MADE GROUND: Asphalt.	
		0.20			0.20	65.50		MADE GROUND: Black very gravelly fine to medium sand. Gravel is fine to medium, subangular of ash and sandstone.	
		0.35			0.35	65.35		MADE GROUND: Red brick. Recovered as fine to coarse, angular to subangular gravel of brick.	
		0.55			0.55	65.15		MADE GROUND: Greyish black gravelly fine to medium sand. Gravel is fine to medium subangular to subrounded of mudstone.	
		0.90	ES	N=19 (4,5/4,5,5,5)	1.00	64.70		MADE GROUND: Greyish black gravelly fine to medium sand. Gravel is fine to medium subangular to subrounded of mudstone.	
		1.00						Greyish brown slightly gravelly fine to medium SAND. Gravel is fine, subangular-subrounded of mudstone.	
		2.00	ES	N=18 (4,4/4,5,4,5)	1.90	63.80		Medium dense orangish brown gravelly fine to medium SAND. Gravel is fine subangular to subrounded of mudstone.	
		2.50						Medium dense orangish brown fine to medium SAND	
		3.00							
		3.50							
		4.00		50 (9,12/50 for 290mm)				Dense brown gravelly fine to medium SAND. Gravel is fine to medium subangular to subrounded of mudstone, sandstone and coal.	
					4.44	61.26		End of borehole at 4.44 m	

Remarks

1. Refusal on dense SAND 2. Monitoring Well Installed 3. Response Zone 1.00-4.00mbgl.



Borehole Log

Borehole No.

WS104

Sheet 1 of 1

Project Name: Fairways Lodge

Project No.
17206

Co-ords: 381687.46 - 402415.94

Hole Type
WS

Location: Prestwich

Level: 64.97

Scale
1:50

Client: McCarthy & Stone

Dates: 27/09/2023 -

Logged By
J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	ES	N=17 (5,4/4,5,4,4)	0.10	64.87		MADE GROUND: Asphalt.	1 2 3 4 5 6 7 8 9 10
		0.40			0.60	64.37		MADE GROUND: Blackish brown gravelly fine to medium sand. Gravel is fine to medium, subrounded of mudstone, brick and ash.	
		1.00			0.80	64.17		MADE GROUND: Concrete. (Recovered as subangular cobbles of concrete.)	
		1.60			1.00	63.97		Brown fine to medium SAND.	
		2.00	ES	N=35 (9,10/9,8,9,9)	2.00	62.97		Medium dense light brown fine to medium SAND.	
		3.00						Dense orangish brown gravelly fine to medium SAND. Gravel is fine to coarse, subrounded of mudstone, sandstone and coal. Becoming medium dense at 3.00 m bgl. Becoming dense at 4.00 m bgl.	
		4.00							
									
									
									
				50 (8,10/50 for 295mm)	4.45	60.52		End of borehole at 4.45 m	

Remarks

1. Refusal 2. No Monitoring Well Installed



Borehole Log

Borehole No.

WS105

Sheet 1 of 1

Project Name: Fairways Lodge

Project No.
17206

Co-ords: 381696.54 - 402391.48

Hole Type
WS

Location: Prestwich

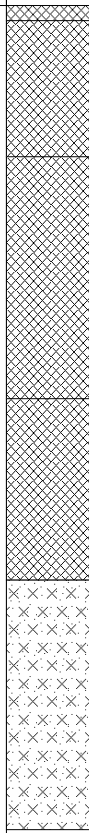
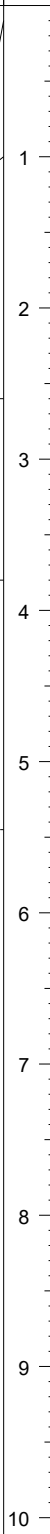
Level: 64.17

Scale
1:50

Client: McCarthy & Stone

Dates: 27/09/2023 -

Logged By
J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10			0.10	64.07		MADE GROUND: Brown slightly gravelly clayey fine to medium sand with rootlets. Gravel is fine, subangular to subrounded of mudstone (topsoil).	
		0.80	ES					MADE GROUND: Dark brown very gravelly fine to coarse sand. Gravel is fine to coarse, angular to subrounded of mudstone, sandstone, ash and brick.	
		1.00		N=39 (1,13/22,15,1,1)	1.00	63.17		MADE GROUND: Brownish grey very silty fine to medium sand with plant debris and organic odour.	
		1.50	ES +TUB						
		2.00		N=5 (1,0/0,1,2,2)					
		2.60			2.60	61.57		MADE GROUND: Grey gravelly clayey silty fine to medium sand. Gravel is fine to medium, angular to subrounded of mudstone, sandstone and brick.	
		2.80	ES						
		3.00		N=22 (4,5/4,6,6,6)					
		3.80			3.80	60.37		Medium dense greyish brown sandy clayey SILT. No recovery 4.00-5.00 m bgl. (Dense from 5.00m bgl).	
		4.00		N=27 (3,4/5,7,7,8)					
		5.00							
		5.45		N=38 (9,11/11,10,8,9)	5.45	58.72		End of borehole at 5.45 m	

Remarks

1. Complete 2. Monitoring Well Installed 3. Response Zone 1.00-2.50mbgl.

Borehole Log

Borehole No.

WS106

Sheet 1 of 1

Project Name: Fairways Lodge

Project No.
17206

Co-ords: 381770.05 - 402428.74

Hole Type
WS

Location: Prestwich

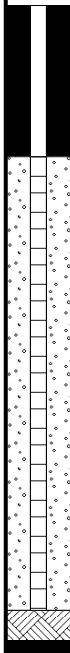
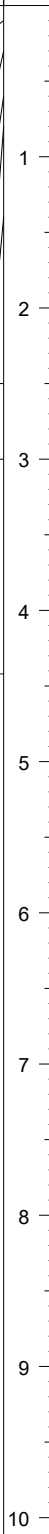
Level: 65.38

Scale
1:50

Client: McCarthy & Stone

Dates: 27/09/2023 -

Logged By
J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	ES	N=18 (2,2/4,4,5,5)	0.10	65.28		MADE GROUND: Asphalt.	
		0.30			0.30	65.08		MADE GROUND: Brown gravel. Gravel is fine to coarse, subangular to subrounded of mudstone and sandstone.	
		0.60			0.60	64.78		MADE GROUND: Brownish black slightly gravelly fine to medium sand. Gravel is fine, subangular to subrounded of ash.	
		0.80			0.80	64.58		MADE GROUND: Brownish black slightly gravelly fine to medium sand. Gravel is fine, subangular to subrounded of ash.	
		1.00	ES	N=17 (3,5/4,4,4,5)	1.40	63.98		Greyish brown slightly clayey slightly gravelly fine to medium sand. Gravel is fine, subangular to subrounded of mudstone (Relic Topsoil).	
		1.80			2.00			Medium dense yellowish brown slightly gravelly fine to medium sand. Gravel is fine to medium, subrounded-rounded of mudstone	
		2.00			2.50	62.88		Medium dense light brown fine to medium sand.	
		3.00			3.00	62.38		Brown gravelly fine to medium sand. Gravel is fine to medium, subangular to subrounded of mudstone, sandstone and coal	
		4.00			4.42	60.96		Medium dense brown sand and gravel. Gravel is fine to coarse, subangular to subrounded of mudstone and sandstone. Becoming dense at 4.00 m bgl.	
								End of borehole at 4.42 m	

Remarks

1. Refusal on SAND and GRAVEL 2. Monitoring Well Installed 3. Response Zone 1.00-4.00mbgl.

APPENDIX VI

CHEMICAL TESTING

RESULTS

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Analytical Report Number : 23-59575-2

Replaces Analytical Report Number: 23-59575, issue no. 1
Client sampling date amended.
Sample Date added at clients request

Project / Site name:	Fairways Lodge	Samples received on:	28/09/2023
Your job number:	17-206	Samples instructed on/ Analysis started on:	29/09/2023
Your order number:	006343	Analysis completed by:	06/10/2023
Report Issue Number:	2	Report issued on:	09/11/2023
Samples Analysed:	1 leachate sample - 9 soil samples		



Signed:

Joanna Szwarzak
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

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

Analytical Report Number: 23-59575
Project / Site name: Fairways Lodge
Your Order No: 006343

Lab Sample Number				2829507	2829508	2829509	2829510	2829511
Sample Reference				WS101	WS102	WS102	WS103	WS104
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.50	0.35	0.80	0.40	1.60
Date Sampled				27/09/2023	27/09/2023	27/09/2023	27/09/2023	27/09/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	12	3.3	5.3	9.6	7.2
Total mass of sample received	kg	0.001	NONE	0.9	0.3	0.3	0.3	0.3

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

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.4	-	6.6	-	7.7
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	760	-	520	-	340
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.09	-	0.052	-	0.067
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	180	-	100	-	130
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	89.7	-	52.3	-	67.1
Sulphide	mg/kg	1	MCERTS	16	-	< 1.0	-	1.8
Total Sulphur	mg/kg	50	MCERTS	660	-	300	-	160
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	2.3	-	1.5	-	0.4

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	0.33	0.42	< 0.05	0.11	< 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	0.87	< 0.05
Fluorene	mg/kg	0.05	MCERTS	0.06	< 0.05	< 0.05	0.38	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.69	0.26	< 0.05	5.8	< 0.05
Anthracene	mg/kg	0.05	MCERTS	0.17	< 0.05	< 0.05	1.1	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	2.6	0.29	< 0.05	11	< 0.05
Pyrene	mg/kg	0.05	MCERTS	2.9	0.29	< 0.05	11	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	1.9	0.17	< 0.05	5.2	< 0.05
Chrysene	mg/kg	0.05	MCERTS	1.9	0.2	< 0.05	5.3	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	2.8	0.19	< 0.05	7.1	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	1.2	0.07	< 0.05	2	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	2.4	0.14	< 0.05	5.4	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	1.4	< 0.05	< 0.05	3	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.33	< 0.05	< 0.05	0.7	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	1.4	< 0.05	< 0.05	3.6	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	20.1	2.03	< 0.80	63	< 0.80
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Analytical Report Number: 23-59575
Project / Site name: Fairways Lodge
Your Order No: 006343

Lab Sample Number				2829507	2829508	2829509	2829510	2829511
Sample Reference				WS101	WS102	WS102	WS103	WS104
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.50	0.35	0.80	0.40	1.60
Date Sampled				27/09/2023	27/09/2023	27/09/2023	27/09/2023	27/09/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	27	22	14	23	4.6
Barium (aqua regia extractable)	mg/kg	1	MCERTS	-	800	-	91	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-	3.2	-	0.66	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-	0.4	-	0.6	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	20	-	11	-	5.7
Copper (aqua regia extractable)	mg/kg	1	MCERTS	110	98	55	41	6.1
Lead (aqua regia extractable)	mg/kg	1	MCERTS	170	36	67	180	6.4
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	3.1	< 0.3	< 0.3	0.8	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	32	42	20	12	5.1
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	71	-	19	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	56	29	42	57	25

Petroleum Hydrocarbons

TPH (C5 - C6) HS_1D_TOTAL	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C6 - C8) HS_1D_TOTAL	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C8 - C10) HS_1D_TOTAL	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C10 - C12) EH_CU_1D_TOTAL	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH (C12 - C16) EH_CU_1D_TOTAL	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
TPH (C16 - C21) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	11	< 10	< 10	27	< 10
TPH (C21 - C35) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	44	< 10	< 10	52	< 10
TPH (C35 - C40) EH_CU_1D_TOTAL	mg/kg	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH Total C5 - C40 EH_CU+HS_1D_TOTAL	mg/kg	10	NONE	62	< 10	12	88	< 10

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

Analytical Report Number: 23-59575
Project / Site name: Fairways Lodge
Your Order No: 006343

Lab Sample Number				2829512	2829513	2829514	2829515
Sample Reference				WS105	WS105	WS106	WS106
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.80	1.50	0.50	1.80
Date Sampled				27/09/2023	27/09/2023	27/09/2023	27/09/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status				
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	10	18	14	4.5
Total mass of sample received	kg	0.001	NONE	0.3	0.9	0.4	0.3

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

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.2	7.2	-	6.5
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	450	250	-	58
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.0083	0.047	-	0.0075
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	17	93	-	15
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	8.3	46.6	-	7.5
Sulphide	mg/kg	1	MCERTS	2.8	14	-	< 1.0
Total Sulphur	mg/kg	50	MCERTS	260	710	-	< 50
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	1.3	2	-	0.2

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	0.06	0.09	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.06	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	0.05	0.12	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	0.06	0.17	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.16	0.4	1.7	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	0.1	0.31	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.2	0.53	2.6	< 0.05
Pyrene	mg/kg	0.05	MCERTS	0.23	0.58	2.7	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.12	0.29	1.3	< 0.05
Chrysene	mg/kg	0.05	MCERTS	0.14	0.32	1.4	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	0.2	0.36	1.6	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	0.24	0.09	0.75	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.13	0.3	1.3	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.07	0.13	0.71	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.18	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.08	0.16	0.82	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	1.57	3.43	15.9	< 0.80
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Analytical Report Number: 23-59575
Project / Site name: Fairways Lodge
Your Order No: 006343

Lab Sample Number				2829512	2829513	2829514	2829515
Sample Reference				WS105	WS105	WS106	WS106
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.80	1.50	0.50	1.80
Date Sampled				27/09/2023	27/09/2023	27/09/2023	27/09/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status				
Heavy Metals / Metalloids							
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	8.1	5.7	37	2.7
Barium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	150	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-	-	0.74	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-	-	0.5	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	9.1	9.5	-	4.5
Copper (aqua regia extractable)	mg/kg	1	MCERTS	34	22	65	9.8
Lead (aqua regia extractable)	mg/kg	1	MCERTS	37	25	150	4.3
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	11	8.3	14	5.8
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	30	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	41	40	30	24

Petroleum Hydrocarbons

TPH (C5 - C6) HS_1D_TOTAL	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C6 - C8) HS_1D_TOTAL	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C8 - C10) HS_1D_TOTAL	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C10 - C12) EH_CU_1D_TOTAL	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0
TPH (C12 - C16) EH_CU_1D_TOTAL	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0
TPH (C16 - C21) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10
TPH (C21 - C35) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	32	< 10	40	< 10
TPH (C35 - C40) EH_CU_1D_TOTAL	mg/kg	10	NONE	18	< 10	< 10	< 10
TPH Total C5 - C40 EH_CU+HS_1D_TOTAL	mg/kg	10	NONE	53	< 10	52	< 10

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



Analytical Report Number: 23-59575
Project / Site name: Fairways Lodge
Your Order No: 006343

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

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

Quantitative Analysis

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

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

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

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
2829512	WS105	0.80	178	Loose Fibres	Amosite	< 0.001	< 0.001

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



4041



Analytical Report Number: 23-59575

Project / Site name: Fairways Lodge

Your Order No: 006343

Lab Sample Number				2829516
Sample Reference				WS105
Sample Number				None Supplied
Depth (m)				1.50
Date Sampled				27/09/2023
Time Taken				None Supplied
Analytical Parameter (Leachate Analysis)	Units	Limit of detection	Accreditation Status	

General Inorganics

pH (automated)	pH Units	N/A	ISO 17025	7.5
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	< 1.0

Total Phenols

Total Phenols (monohydric)	µg/l	1	ISO 17025	1.8
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Speciated PAHs

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

Total PAH

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

Arsenic (dissolved)	µg/l	1	ISO 17025	2.4
Cadmium (dissolved)	µg/l	0.08	ISO 17025	< 0.08
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0
Chromium (dissolved)	µg/l	0.4	ISO 17025	3.4
Copper (dissolved)	µg/l	0.7	ISO 17025	33
Lead (dissolved)	µg/l	1	ISO 17025	6.6
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5
Nickel (dissolved)	µg/l	0.3	ISO 17025	4.3
Selenium (dissolved)	µg/l	4	ISO 17025	< 4.0
Zinc (dissolved)	µg/l	0.4	ISO 17025	40

Monoaromatics & Oxygenates

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



4041



Analytical Report Number: 23-59575

Project / Site name: Fairways Lodge

Your Order No: 006343

Lab Sample Number				2829516
Sample Reference				WS105
Sample Number				None Supplied
Depth (m)				1.50
Date Sampled				27/09/2023
Time Taken				None Supplied
Analytical Parameter (Leachate Analysis)	Units	Limit of detection	Accreditation Status	

Petroleum Hydrocarbons

TPH1 (C10 - C40) EH_1D_TOTAL_MS	µg/l	10	NONE	< 10
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TPH-CWG - Aliphatic >C5 - C6 HS_1D_AL	µg/l	1	NONE	< 1.0
TPH-CWG - Aliphatic >C6 - C8 HS_1D_AL	µg/l	1	NONE	< 1.0
TPH-CWG - Aliphatic >C8 - C10 HS_1D_AL	µg/l	1	NONE	< 1.0
TPH-CWG - Aliphatic >C10 - C12 EH_1D_AL_MS	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic >C12 - C16 EH_1D_AL_MS	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic >C16 - C21 EH_1D_AL_MS	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic >C21 - C35 EH_1D_AL_MS	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic (C5 - C35) HS+EH_1D_AL_MS	µg/l	10	NONE	< 10

TPH-CWG - Aromatic >C5 - C7 HS_1D_AR	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aromatic >C7 - C8 HS_1D_AR	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aromatic >C8 - C10 HS_1D_AR	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aromatic >C10 - C12 EH_1D_AR_MS	µg/l	10	NONE	< 10
TPH-CWG - Aromatic >C12 - C16 EH_1D_AR_MS	µg/l	10	NONE	< 10
TPH-CWG - Aromatic >C16 - C21 EH_1D_AR_MS	µg/l	10	NONE	< 10
TPH-CWG - Aromatic >C21 - C35 EH_1D_AR_MS	µg/l	10	NONE	< 10
TPH-CWG - Aromatic (C5 - C35) HS+EH_1D_AR_MS	µg/l	10	NONE	< 10

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

Analytical Report Number : 23-59575
Project / Site name: Fairways Lodge

* 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 *
2829507	WS101	None Supplied	0.5	Brown loam and clay with gravel and vegetation.
2829508	WS102	None Supplied	0.35	Brown loam and clay with clinker and gravel
2829509	WS102	None Supplied	0.8	Brown loam and clay with gravel and vegetation.
2829510	WS103	None Supplied	0.4	Brown loam and clay with gravel.
2829511	WS104	None Supplied	1.6	Brown sand with gravel.
2829512	WS105	None Supplied	0.8	Brown clay and sand with gravel.
2829513	WS105	None Supplied	1.5	Brown sandy clay with gravel.
2829514	WS106	None Supplied	0.5	Brown loam and clay with gravel and vegetation.
2829515	WS106	None Supplied	1.8	Brown sand with gravel.

Analytical Report Number : 23-59575

Project / Site name: Fairways Lodge

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
BS EN 12457-1 (2:1) Leachate Prep	2:1 (as recieved, moisture adjusted) end over end extraction with water for 24 hours. Eluate filtered prior to analysis.	In-house method based on BSEN12457-1.	L043-PL	W	NONE
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Metals by ICP-OES in leachate	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Hexavalent chromium in leachate	Determination of hexavalent chromium in leachate by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-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. Refer to CoA for analyte specific accreditation.	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

Analytical Report Number : 23-59575

Project / Site name: Fairways Lodge

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total 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
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. Refer to CoA for analyte specific accreditation	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
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in house method based on references.	HSE Report No: 83/1996, HSG 248, HSG 264 & SCA Blue Book (draft).	A006-PL	D	ISO 17025
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
D.O. for Gravimetric Quant if Screen/ID positive	Dependent option for Gravimetric Quant if Screen/ID positive scheduled.	In house asbestos methods A001 & A006.	A006-PL	D	NONE
Sulphate, water soluble, in soil (1hr extraction)	Sulphate, water soluble, in soil (1hr extraction)	In-house method	L038-PL	D	MCERTS

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

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

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

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

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

Analytical Report Number : 23-59575

Project / Site name: Fairways Lodge

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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Information in Support of Analytical Results

List of HWOL Acronyms and Operators

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

APPENDIX VII

ORIGIN OF TIER 2 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)	

