



e3p

Phase I & II Geoenvironmental Site Assessment
Castleton Sidings
Rochdale

Reference: 14-768-R1-3
Date: 13th March 2023



PHASE I & II GEOENVIRONMENTAL SITE ASSESSMENT

Land to the South of Heywood Road
Castleton Sidings
Rochdale
OL11 3AU

Prepared for:
Kellen Homes



Report Ref: 14-768-R1-3
Date Issued: 13th March 2023

Castleton Sidings, Rochdale

Phase II Geoenvironmental Site Assessment
March 2023

E3P

Taylor Road
Trafford Park
Urmston
M41 7JQ

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

Registered in England.
CRN: 807255262

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DATE	May 2021	April 2022	13 March 2023
PREPARED BY	E Fearn	H Morgan	G Calvert
QUALIFICATIONS	BSc (Hons), MSc, FGS	Ba, IEMA	BSc (Hons), FGS
CHECKED BY	J Sheridan	J Sheridan	J Sheridan
QUALIFICATIONS	MeSci (Hons), FGS	MeSci (Hons), FGS	MeSci (Hons), FGS
AUTHORISED BY	M. Dyer	M. Dyer	
QUALIFICATIONS	BSc (Hons), FGS, AIEMA, MIEEnvSc, CEnv	BSc (Hons), FGS, AIEMA, MIEEnvSc, CEnv	



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EXECUTIVE SUMMARY

Site Address	Castleton Sidings, Heywood Road, Rochdale OL113AU
Grid Reference	E 387930, N 410140
Site Area	Approximately 6.0 Ha.
Proposed Development	Kellen Homes are considering the proposed acquisition and future redevelopment of the site for a hybrid planning application comprising the following: - Full planning application for residential development, including access, car parking, landscaping, open space and associated engineering and infrastructure including an electric substation and foul water pump station. - Outline planning permission with all matters reserved for the principle of development to facilitate the East Lancashire Railway (ELR) extension.
Current Site Use	The site is a roughly semi-circular shaped parcel of land to the south of Heywood Road In Rochdale and to the west of Castleton railway station. Live railway lines are present along the eastern site boundary and the site itself forms derelict railway sidings open to the adjacent active railway. The southwestern quarter of the site falls within a designated area of greenbelt and the north eastern quarter falls within an area of network rail operated land. All former structures except for an active signal box have now been removed; however, track sidings, ballast, and relict hardstanding and concrete slabs remain. Self-seeded vegetation and young trees have now grown across the site and along the periphery. A raised area of concrete hardstanding is present in the southern sector, with demolition rubble stockpiled creating a steep ramp. A void is evident beneath this raised area on the very southern boundary, which appears to be associated with a large, voided area just off the south-western boundary.
Site History	A review of the pertinent Ordnance Survey mapping dating from circa 1850 to the present day confirmed the following land use: - Earliest historical mapping (1851) shows the site to comprise agricultural land with the railway shown to be present along the southern boundary and brick kiln/clay pits immediately to the northwest. - By 1893, the site was in use as railway sidings with an engineering stores and saw mills with chimneys located in the west. Ancillary structures encroached the western sector together with wetlands/possible marshes encroaching the central northern sector. - Tanks and a gasometer are later shown in the centre north and north east respectively, together with an earth working/embankment in the centre of the site, which moves north over time (likely associated with raising levels to create a level platform for expansion of the railway sidings).



Site History	- By 1956 the engineering works / sawmill had been removed and by 1970s a welding shop, travelling crane, engineering shed, electricity substation and tanks are indicated to be present in the central sector of the site. - Aerial imagery between 2000-2005 shows the site to be covered by hardstanding/ballast, tracks, sheds and various structures. The site appears to have been dismantled/demolished sometime between 2005 and 2013.	
Environmental Setting	Drift Geology	Glacio-fluvial sand and gravel deposits across the majority of the site
	Bedrock Geology	Lacustrine (clays) along the south western border.
	Faults	A geological fault is located through the northern sector of the site, orientated north west to south east.
	Hydrogeology	Unproductive and Secondary A strata (drift) overlying Secondary A aquifer (solid). No groundwater abstractions have been identified within a 1 km radius.
	Hydrology	There are no surface water courses within influencing distance of the site. However, drainage ditches are located along the northern site boundary, which may feed into water courses further afield.
	Flood Risk	Unaffected by flooding from rivers.
Previous Reports	There are no previous reports available to E3P relating to the subject site.	
Utility Locations	A full ground penetrating radar (GPR) survey has not been undertaken. However, the following services have been identified: - A 6 kV electricity cable is shown to enter the site from the north and run along the northern boundary and loop back in the centre of the site. - Overhead pylons electricity cables are located off-site to the south, in close proximity of the far south western extent of the site. - Overhead BT cables also enter from the housing estate to the north and follow the northern boundary, diverting south in the approximate centre of the site. - A live railway is present along the east and south of the site.	
Landfill Sites and Ground Gases	Historical landfill located c. 475 m north west of site: Land South of Chadwick Lane, Heywood, Rochdale Received Inert, Industrial, Commercial, Household and Special Waste between 31/12/1984 and 31/12/1986. Given the time passed since last deposit and distance to the site, the risk from migrating ground gas from this source is reduced.	
Radon	Unaffected – no special precautions required.	



Coal Mining/Land Stability	The site is located within a coal mining reporting area, and the Arley Coal seam is indicated to subcrop beneath the eastern half of the site. A narrow development high risk zone associated with this seam is mapped on the western side of the conjectured crop. Surrounding BGS boreholes indicate the thickness of overlying drift deposits to be in excess of 80 m bgl, thus significantly reducing the risk of any workings/void propagating upwards and resulting in subsidence at the surface. Verbal consultation with the Coal Authority indicated that, due to the depth of the seam, they don't not consider it likely that the seam has been worked. The risk from coal mining related hazards is therefore considered low. However, precautionary drilling in the location of the seam and development high risk zone was conducted to confirm the anticipated ground conditions.
Brine Workings	The site is not located within an area deemed to be at risk from ground instability arising from historic brine pumping activities and/or salt extraction.
Hazardous Installations	Given the history of the site as railway sidings and recorded tanks, electrical substations and engine sheds, it is considered likely that hazardous waste streams may have been generated.

GROUND INVESTIGATION

Ground Investigation Works	Exploratory fieldwork was completed in three phases as follows: ✳ Preliminary site investigation – between 4th and 18th March 2021 ▪ 24 x mechanically excavated trial pits, ▪ 14 x window sample boreholes with monitoring installations, ▪ 2 x cable percussive boreholes, ▪ 2 x Rotary open hole boreholes. ✳ Additional trial pitting to target / delineate peat identified in preliminary site investigation – 16th June 2021 ▪ 14 x Mechanically excavated trial pits, ✳ Further rotary probing on 40 m grid to bottom out peat and shallow soil sampling of southwestern POS area – between 19th and 28th July 2021 ▪ 7 x Hand excavated pits, ▪ 26 x Rotary open holes ▪ Stockpile sampling
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Ground Conditions	Made Ground – 0.00 m bgl to 6.60 m bgl Made Ground deposits have been encountered within all of the exploratory hole locations from ground level to a maximum proven depth of 6.60 m bgl (R0227). The full depth of Made Ground remained unproven in c. 50% of exploratory hole locations. The material generally comprises a black slightly clayey gravelly medium sand / sandy gravel. Gravel constituents predominantly include mudstone, brick, clinker, coal, and ceramic with less frequent inclusions of metal, shale, glass and timber/wood. Obstructions (reinforced concrete slabs and redundant services) were encountered frequently across the site, together with visual and olfactory evidence of (hydrocarbon) contamination.
	PEAT – 2.70 m bgl to 7.80 m bgl Blackish brown pseudo fibrous PEAT was encountered beneath the Made Ground in 26 no. locations. The peat encountered beneath the site was found to range in thickness from 0.20 to 2.60 m thick (CP102), although was predominantly 1.0 m thick or less, and noted to be generally thicker towards the south and west of the site.
	DRIFT – 0.70 m bgl to >60.50 m bgl Drift deposits were encountered beneath the Made Ground and Peat (where proven) and comprised of alternating SAND/GRAVEL and sandy CLAY and extending to depths in excess of 60.50 m bgl (RB101). Where encountered, shallowest drift deposits were noted to be predominantly granular. Drift deposits were generally described as follows: ✚ Medium dense light brown variably slightly clayey SAND with occasional gravel of fine to coarse angular to rounded of sandstone. Loose silty sand was encountered in WS103 from 4.50 m bgl. The granular soils were also noted to be loose and collapsing in TP207 and TP212 ✚ Light brown sandy GRAVEL of medium subangular to rounded mudstone and sandstone. ✚ Stiff to very stiff medium to high strength sandy CLAY with occasional gravel of fine to coarse angular to rounded mudstone. At one location (CP101), directly beneath the Made Ground, a soft very low strength brown sandy CLAY was encountered between 4.20 m and 5.00 m bgl.
	SOLID The solid geology was not encountered within the deeper cable holes or rotary open holes across the site. A nearby BGS borehole indicates rockhead at circa 81.00 m bgl.
	GROUNDWATER Groundwater strikes were generally encountered as seepages between 1.20 m and 4.80 m bgl. During the subsequent monitoring visits, the monitoring wells were predominantly found to be dry or containing only small volumes of water.



CONTAMINATED LAND ASSESSMENT

Human Health

Exceedances of heavy metals, non-volatile PAH, naphthalene, toluene, TPH C8-C35 and mercury have been identified at various locations across the site (including in the POS area and stockpile in the Network Rail retained land) between 0.50 m bgl and 4.90 m bgl. Asbestos in the form of chrysotile (<0.001%wt/wt) has also been identified in TP112. Visual and olfactory evidence of hydrocarbon impact was also identified at several locations across site.

The risk to chronic human health associated with the elevated concentrations of inorganic heavy metals, non-volatile PAH compounds and trace asbestos can be mitigated through the installation of a suitable cover system. Given the widespread distribution of the contamination, the cover system would be required in all proposed private gardens, landscaping, and public open space to remove any potential for direct exposure to impacted soils.

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

In relation to the exceedances of S/VOCs mercury and visual and olfactory evidence of hydrocarbon impact identified at several locations across site, ordinarily, delineation and removal of volatile impacted material would be recommended. However, given the spread and depth of encounter, it is considered that the contamination is widespread, and it would be impractical and costly to excavate.

A vapour risk assessment has therefore been carried out, which has concluded a low overall risk from hydrocarbons and S/VOCs, except in the vicinity of WS110. It is considered the risks at this location can be mitigated through a localised hotspot delineation and excavation of impacted soils.

High concentrations of volatile TPH fractions and Naphthalene have also been recorded in TP211 at 1.90 m bgl (southwest of site) but have not been the subject of direct targeted monitoring due to lack of installations within the immediate vicinity. Further investigation to confirm the source and nature of the contamination will be necessary and it is likely that delineation and excavation of impacted soils will be required to remove the risk from vapour emission. Further investigation in other locations of observed significant odours / contamination impact (including WS104 and WS105) is also required.

Further assessment of mercury in soils is also recommended on a site wise basis. This testing should be supplemented by speciation to determine the spread and level of elemental (volatile) mercury present in the soils to fully appraise the risk to end users and potentially zone the site into discrete areas requiring further assessment/delineation.

It is considered that chemical analysis of the natural clay drift deposits will identify these soils to be acceptable for use as subsoil within the proposed garden areas subject to further chemical validation; however, given the depth of Made Ground on-site, it is unlikely that subsoils will be excavated.

There are no suitable sources of topsoil available on the site.



Tier 2 Vapour Risk Assessment	Analytical Thermal Desorption (ATD) tubes have been installed within five pre-existing wells and sampling was completed via active pump sampling using a pump and rotometer to collect the required 10 litre volume of air. Each ATD tube in each location has been tested for the following set of compounds: ✳ Naphthalene ✳ Aliphatic / Aromatic Banding TPH Compounds ✳ BTEX Compounds In order to determine if the vapour concentrations detected would generate a risk to human health, the results have been assessed against the Tolerable Daily Intake values (TDIs) for the relevant compound or group. TPH C10-C12 aromatic has been found marginally in exceedances of the SSSV within WS110 in the east of the site. To avoid the requirement for specialist VOC resistant membranes in the vicinity of WS110, a process of delineation and subsequent excavation of the soils is recommended. The resulting void will then require validation and excavated soils may be suitable for retention in an area of no future sensitivity (proposed POS in the west of the site) or removal from site. Mercury vapour analysis was conducted using SKC 520 Series elemental mercury passive samplers installed at five locations. The limit of detection of the samplers was 0.2 µg and the site specific screening guideline value (SSSGV) has been calculated to be 0.0643038 µg/m³. It is noted that the LOD is 0.2 µg, which is higher than the SSSGV. It must therefore it must be assumed that the true concentrations may be up to 0.19 µg. Further assessment of mercury in soils is recommended on a site wise basis. This testing should be supplemented by speciation to determine the spread and level of elemental (volatile) mercury present in the soils to fully appraise the risk to end users and potentially zone the site into discrete areas requiring further assessment/delineation.
Controlled Waters	The site sits at an approximate elevation of 130-135 m AOD and is inferred to slope very gently down to the southwest. The land to the north west and Roeacre Brook (circa 150 m to the north west) is noted to be at a lower elevation (~125 m AOD) and thus down hydraulic gradient of the site. Although this is considered outside of typical influencing distance, a surface water drain is present along the northern boundary, which may act as a conduit for site derived contamination to enter nearby watercourses. It is noted that at the ditch was dry at the time of the initial phase of works but has been assumed to be ephemeral. Surface water courses are therefore considered to be the primary receptor given the extensive thickness of drift (>60.0 m) and absence of a nearby water abstraction borehole. High concentrations of naphthalene and aromatic hydrocarbon fractions were recorded in the initial groundwater sample taken from WS105 (sample-1, March 2021) in the centre west of the site. Further sampling of WS105(sample-2) was therefore undertaken in November 2021. The results again showed high concentrations of naphthalene and aromatic hydrocarbon fractions, together with heavy metals and non-volatile PAHs.



	Water samples taken from surrounding boreholes to the north west (WS101 and RO223) and west (RO221) of WS105 contained elevated heavy metal concentrations (copper, nickel and zinc), but did not identify elevated volatile compounds, thus indicating no significant migration of volatile contamination towards the west or north west i.e. down-hydraulic gradient and in the direction of the Roeacre Brook / peripheral drainage channels. An M-BAT assessment has been completed to assess the risk to surface water networks and aquatic life from heavy metals, which calculated a Risk Characterisation Ratio (RCR) less than 1 for all except Manganese. Due to the very conservative screening value for manganese, this is widely found in exceedance and therefore not considered to pose a major risk and would not require remediation. In light of this assessment, E3P do not consider the site to pose an unacceptable level of risk to surface waters for copper, zinc and nickel. However, further analysis of the surface water in the peripheral (accessible) drainage ditches should be undertaken as groundworks progress, to ensure no future mobilisation of contaminants is caused, which may pose a risk to the nearby Roeacre Brook. Further sampling of surrounding monitoring wells to the west and south of WS105 is also recommended to confirm the extent of the volatile impact in the vicinity of WS105 to ascertain whether the identified impact is an isolated occurrence or a plume.
Ground Gas	In consideration of the nature of the site, historical land uses, and prevalence of S/VOC impacted soils (albeit generally low vapour risk), E3P consider that gas protection measures in accordance with a CS2 (NHBC Amber 1) classification should be incorporated in all residential properties constructed at the site. Soils impacted with volatiles (WS111) or with obvious olfactory / visual evidence of potential hydrocarbon or volatile impact (for example, but not limited to, WS104, W105, and TP211) should be further investigated and allowances made for delineation, excavation, and removal.
Potable Water	Based on the assessment of current site conditions it is likely that barrier pipe will be required at the proposed development. This will need to be confirmed following the completion of a UKWIR risk assessment. Post-remediation and enabling works ground conditions may be different from those identified during this site investigation.

COAL MINING ASSESSMENT

Coal Mining	The Arley Coal seam is conjectured to subcrop beneath the north east of the site. However, a nearby BGS borehole indicates drift deposits to extend to circa 80 m bgl. Verbal consultation with the Coal Authority indicated that, due to the depth of the seam, they do not consider it likely that the seam has been worked. The risk from coal mining related hazards was therefore concluded to be low but it was considered prudent to carry out intrusive investigation to confirm the assessment.
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	Two ~60.0 m deep rotary boreholes have therefore been advanced within the narrow development high risk area associated with the Arley Coal seam, in accordance with Coal Authority Permission ref: 21608. Ground conditions were found to comprise alternating bands of cohesive and granular drift to depths in excess of 60.5 m bgl. Rockhead was not proven due to extensive drift and difficulties drilling at depth leading to termination of the boreholes at circa 60.0 m bgl in granular drift. No evidence of shallow coal seams or historic shallow coal workings was recorded. Based on the confirmed ground conditions, it is likely that any coal seams will be at significant depth and thus highly unlikely to have been worked at this location. Even if the seam has been worked, it is considered that the overlying thickness of drift would be sufficient to mitigate the risk of subsidence at the surface. No further investigation is proposed.
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GEOTECHNICAL ASSESSMENT

Underground Obstructions	Obstructions were encountered at three locations during the first phase of the investigation: TP103 (Concrete slab with probable services beneath at 0.70 m bgl), WS106a (double concrete slab at 0.50 m bgl and WS114a (ballast/cobble obstruction at 0.70 m bgl), and a further four locations during the third phase of investigation: RO214, RO219, RO220 and RO224 at depths between 0.30 m – 0.70 m bgl, described as reinforconcrete/railwayway obstructions. Redundant services were also encountered at a number of locations within the Mage Ground including electrical cabling, polyethylene pipes, drainage infrastructure etc. During a phase of cut-and-fill enabling works to create a developable platform, all below-ground obstructions will require grubbing out to the base of the Made Ground to enable the construction of proposed plots.
Allowable Bearing Pressure	Deep Made Ground deposits have been encountered across much of the development area, as such, the potential for adoption of traditional shallow foundations in natural strata will be limited to the north west of the site. The underlying natural clay drift deposits have been assessed as being firm low strength to very stiff very high strength with a net allowable bearing pressure (ABP) in the order of 85–313 kN/m² at circa 1.50 – 5.00 m bgl increasing to 173–256 kN/m² at circa 9.50 – 14.50 m bgl. Soft sandy CLAY was identified in CP101 at 4.00 m bgl, with an ABP of 26 kN/m². Granular drift deposits are loose to medium dense with a net ABP in the order of 75–113 kN/m² at circa 3.00 – 5.00 m bgl increasing to 130–294 kN/m² at circa 6.50 – 11.00 m bgl.
Foundation Options	Made Ground deposits extend to proven depths of up to 6.60 m bgl (RO227). PEAT has been encountered beneath the Made Ground in the majority of (deep) exploratory hole locations extending to a maximum proven depth of 7.80 m bgl (RO210 and RO228). The peat encountered beneath the site was found to range in thickness from 0.20 to 2.60 m thick (CP102), although was predominantly 1.0 m thick or less, and noted to be generally thicker towards the south and west of the site.



	Made Ground and Peat are not considered to be suitable founding strata due to their variable and compressible nature respectively. Adoptable foundation solutions are therefore as follows: ✳ Traditional strip / deep mass trench foundations bearing onto suitable firm/stiff CLAY or medium dense SAND – limited to the north west of the development area where natural strata was encountered at shallow depth (<2.50 m bgl). ✳ Driven piled foundations will be required for plots across the remainder of the site. However, detailed consideration must be given to working in proximity to the live rail infrastructure. ✳ Alternative solutions may include Controlled Modulus Columns (CMC) or rigid inclusion ground improvement. It should be noted that these systems are not currently accepted by NHBC but may be accepted by other warranty providers. The preferred Building Control and warranty provider must accept the use of such a solution if it is to be adopted. Where piled foundations are adopted, controlled waters and associated generation of pollutant pathways will need to be adequately assessed. Consideration must be given to the settlement characteristic of the recently deposited Made Ground and will require modelling when a detailed layout with levels becomes available.
Building Floor Slabs	Ground-bearing floor slabs will not be viable given the depths of reworked Made Ground > 600 mm and presence of compressible peat.
Heave Precautions	Given that the underlying clay is of low volume change potential, heave precautions will not be required to the internal face of a foundation less than 1.5 m in depth. Heave precautions will be required to the underside of floor slabs (where there is no 200 mm void) and pile ground beams are required within the modelled influencing distance of trees.
Soakaway Drainage	Due to the lateral and vertical extent of Made Ground across the site, together with the observed inorganic and hydrocarbon impact, soakaway drainage will not be a suitable method of surface water disposal for the subject site.
Sulphate Assessment	Concrete classification will be DS1 AC1s.
CBR Design %	Granular soils can be re-engineered to ensure 5% within the subgrade during favourable climatic conditions. Natural clay soils will provide a CBR in the order of 3–5% during drier climatic periods. However, if water is allowed to shed onto the formation, the CBR will reduce to < 2%, which will require specialist engineering of the subgrade.
Cut/Fill	Development levels unknown at this time; however, significant cut-and-fill works will be required to prepare the development platform. This will include excavation of peat from beneath roads, driveways and drainage infrastructure as a minimum.
Civil Engineering Excavations	The E3P Intrusive Ground Investigation has identified loose/collapsible deep Made Ground. Allowances should be made for battering back excavations and provisions of supports for open trenches.



Development Platform	Historical relict vegetation and organic matter identified as a peat material has been encountered beneath the Made Ground across much of the development area. This material is identified as potentially degradable which may represent a risk associated with future consolidation induced by earthworks surcharge loading, temporary works and infrastructure loading. Peat and compressible materials will require removal from beneath areas of adopted highway, infrastructure and external hard standing.
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>. Based on concentrations of TPH identified to date, the material is likely to comprise a mixture of Non-Hazardous and Hazardous waste. Allowances for disposal of Hazardous waste should be made. A well designed and managed Materials Management Plan should ensure the retention of materials is a safe and legislatively compliant manner.

RECOMMENDATIONS

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

- ✳ Additional investigation required adjacent the live railway along southern boundary subject to agreement and permit from Network Rail.
- ✳ Further investigation / delineation of soils impacted with volatiles (WS110) or with obvious olfactory / visual evidence of potential hydrocarbon or volatile impact (including, but not limited to WS104, W105, and TP211).
- ✳ Further assessment of mercury in soils is also recommended on a site wise basis. This testing should be supplemented by speciation to determine the spread and level of elemental (volatile) mercury present in the soils to fully appraise the risk to end users and potentially zone the site into discrete areas requiring further assessment/delineation.
- ✳ Remediation and enabling works strategy.
- ✳ Plot-specific foundation schedule (upon receipt of the final development levels).
- ✳ Arboricultural survey.
- ✳ Geotechnical earthworks strategy (infrastructure).



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DRAWING LIST

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14-768-002 - Proposed Development Plan
14-768-003 - Historical Features Plan
14-768-004 - Site Features Plan
14-768-005 - Exploratory Hole Location Plan
14-768-006 - Depth of Made Ground Plan
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14-768-010 - Conceptual Site Model
14-768-016 - Depth to Peat Plan
14-768-017 - Thickness of Peat Plan
14-768-018 - Contamination Issues Plan
14-768-019 – Vapour Monitoring Location Plan



1. INTRODUCTION

1.1. BACKGROUND

E3P has been commissioned by Kellen Homes to undertake a detailed Phase I and II Geoenvironmental Site Assessment for a parcel of land to the south of Heywood Road, Rochdale also known as Castleton Sidings.

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

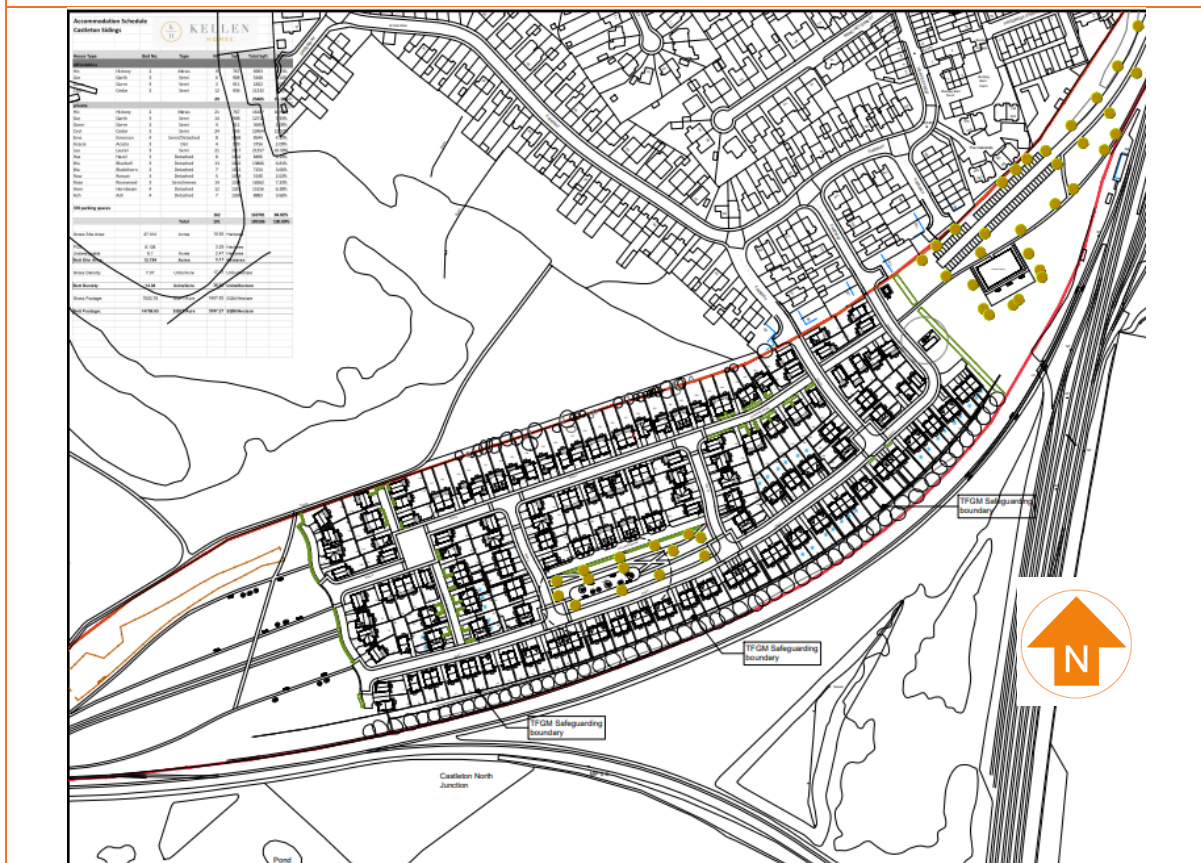
1.2. PROPOSED DEVELOPMENT

Kellen Homes are considering the proposed acquisition and future redevelopment of the site for a hybrid planning application comprising the following:

- ✿ Full planning application for residential development, including access, car parking, landscaping, open space and associated engineering and infrastructure including an electric substation and foul water pump station.
- ✿ Outline planning permission with all matters reserved for the principle of development to facilitate the East Lancashire Railway (ELR) extension.

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:

- ✦ Undertake a preliminary stage of sampling and analysis to provide an overview of environmental issues identified.
- ✦ Assess the implications of any potential environmental risks, liabilities and development constraints associated with the site in relation to the future use of the site and in relation to off-site receptors.
- ✦ Assess the geotechnical information and provide preliminary recommendations in relation to foundations, pavement construction and floor slabs.
- ✦ Provide recommendations regarding future works required.

1.4. SCOPE OF WORKS

The scope of work includes the following elements:

- ✦ Detailed desk study;
- ✦ Design of suitable intrusive ground investigation;
- ✦ 14 no. Window sample probeholes with, and construction of, environmental monitoring installations;
- ✦ 2 no. Deep cable percussive boreholes with groundwater monitoring installations;
- ✦ 2 no. Deep rotary boreholes;
- ✦ 37 no. Mechanically excavated trial pits;
- ✦ 32 no. Shallow rotary probe holes with dynamic sampling;
- ✦ 10 no. Hand dug pits (in heavily wooded area of proposed POS);
- ✦ Tier 2 Human Health and Vapour Risk Assessment;
- ✦ 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. SITE SETTING

2.1. SITE DETAILS

Site Address	Land south of Heywood Road, Castleton, Rochdale, OL11 3AU
National Grid Reference	E 387930 N 410140.
Site Area	95.27 Ha.

All acronyms used within this report are defined in the Glossary presented in Appendix II.

A site location map is presented in Appendix III as Drawing 14-768-001.

2.2. CURRENT SITE USE

E3P has undertaken a site walkover of the entire site and a description of the key findings is summarised in Table 2.1.

TABLE 2.1 SITE DESCRIPTION

Occupancy/Use	The site is a roughly semi-circular shaped parcel of land to the south of Heywood Road in Rochdale and to the west of Castleton railway station. Live railway lines are present along the eastern site boundary and the site itself forms derelict railway sidings open to the adjacent active railway. The southwestern quarter of the site falls within a designated area of greenbelt and the north eastern quarter falls within an area of Network Rail operated land. All former structures except for an active signal box have now been removed; however, track sidings, ballast, and relict hardstanding and concrete slabs remain.	
Surface Cover (%)	Buildings	0%
	Hardstand	40%
	Soft Cover	60%
Structures	There are several historical train platform structures present across the site. All historical building structures have been removed. There are also several areas of concrete hardstanding in the western sector of the site. A raised area of concrete hardstanding is present in the southern sector, with demolition rubble stockpiled creating a steep ramp. A void is evident beneath this raised area on the very southern boundary, which appears to be associated with a large, voided area just off the south-western boundary.	
Access	Vehicular access can be gained via a double gate from Heywood Road in the northern sector of the site. Pedestrian access is restricted due to the active railway lines to the north of the site.	
Slope	The site is split across a plateau in the centre of the site, with the north and eastern sector of the site being the highest elevation.	
Retaining Structures	There are no retaining wall structures identified within the site boundary.	



Vegetation/Ecology	Rough scrub vegetation is present throughout the site with significant vegetation present on the site boundary. The northern boundary of the site is comprised of mature trees. There are also numerous areas of semi-mature and mature trees within the site boundary. A habitat survey will be required to support planning applications.
Hazardous Material Storage	No above-ground storage tanks (ASTs) or underground storage tanks (USTs) were observed at the site during the preliminary site walkover. However, historical mapping has identified tanks on-site and due to the previously developed railway sidings nature of the site, it is likely that unrecorded hazardous materials storage will have occurred on the site.
Asbestos-Containing Material (ACM)	ACM was identified within stockpiles of rubble materials in the centre of the site.
Polychlorinated Biphenyls (PCBs)	There is no equipment identified that may contain PCBs within the site boundary. However, historically equipment containing PCBs may have been present.
Waste Storage	Potentially hazardous waste streams are likely to be generated at the site, however, none were observed during the preliminary site inspection.
Drainage / Utilities	A formal drainage survey has not been completed; however, a review of online records held by United Utilities does not indicate the presence of any drainage infrastructure within the site boundary. Other services identified on-site include: • A 6 kV electricity cable enters the site from the north and runs along the northern boundary and loops back in the centre of the site. • Overhead pylons electricity cables are located off-site to the south, in close proximity of the far south western extent of the site. • Overhead BT cables also enter from the housing estate to the north and follow the northern boundary, diverting south in the approximate centre of the site. A second loop is also present in the north eastern third of the site.

2.3. SURROUNDING AREA

The surrounding area land uses are summarised in Table 2.2.

TABLE 2.2 SURROUNDING LAND USES

DIRECTION	LAND USE
North	Residential dwellings and farmland.
East	Active railway line and farmland beyond.
South	Open farmland.
West	Open farmland.

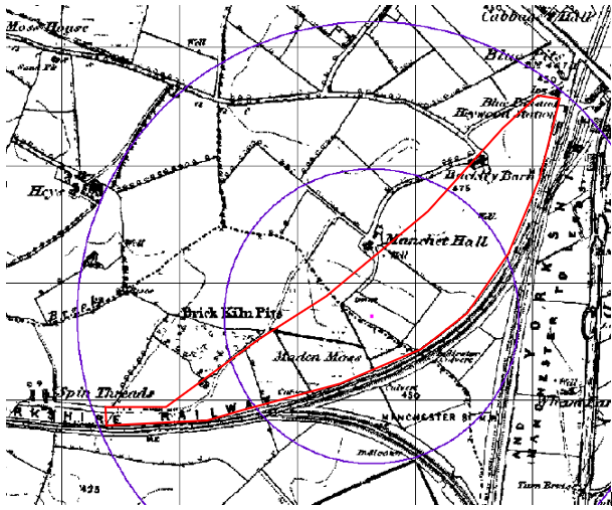
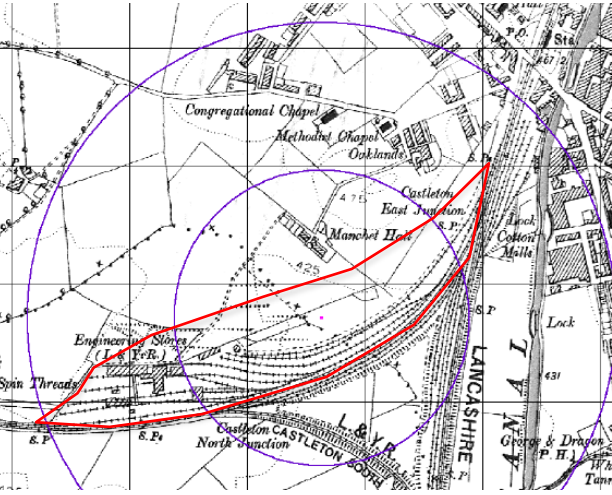


3. SITE HISTORY

3.1. ON-SITE HISTORICAL DEVELOPMENT

A review of historical mapping and historical aerial imagery pertinent to the site is summarised in Table 3.1. In addition, historical site features are presented on Drawing No. 14-768-003 in Appendix III.

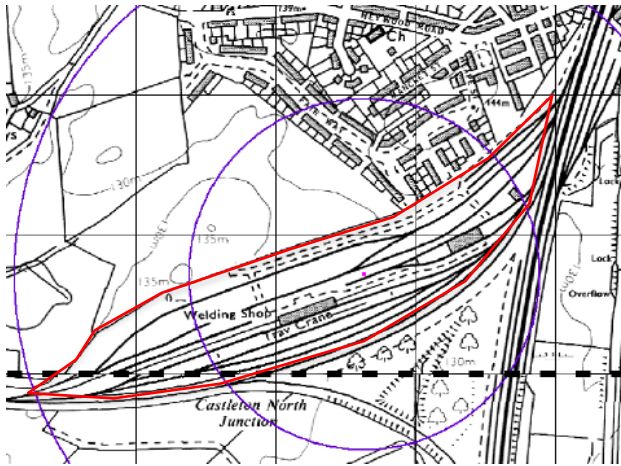
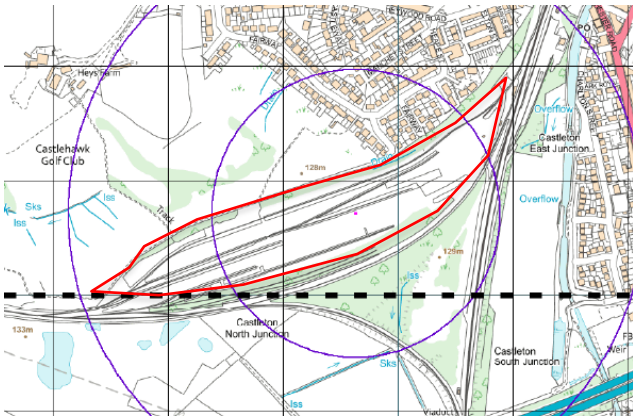
TABLE 3.1 HISTORICAL DEVELOPMENT

MAP EDITION	HISTORICAL LAND USE	HISTORICAL MAP EXCERPT
1851 1:10,560	Heywood Station is located in the northern sector of the site, with a barn located in the north western sector. A Brick Kiln Works is also present in the south western sector of the site.	
1898 1:10,560	The barn in the north western sector of the site is no longer recorded. The brick works is also no longer recorded. However, the pits associated with the brickworks were still present. Engineering Stores and a Saw Mill and associated structures are present in the west of the site. Two chimneys are shown on the 1:2500 mapping, associated with the saw mill. Train tracks are now present covering the southern and west of the site.	



MAP EDITION	HISTORICAL LAND USE	HISTORICAL MAP EXCERPT
1932 1:10,560	Tanks are recorded in the centre-north of the site. These tanks could possibly be re-watering tanks for steam engines. A gasometer/reservoir is present in the centre east of the site. An earthworking / level change is indicated across the northern half of the site, potentially indicating the construction of a level development platform.	
1938 1:10,560	The tanks in the centre north are no longer recorded. The edge of the earthworking / level change has moved further north.	
1965-1968 1:10,000	The engineering stores are no longer recorded and the majority of structures have been removed. The site is now almost entirely occupied by tracks (sidings).	



MAP EDITION	HISTORICAL LAND USE	HISTORICAL MAP EXCERPT
1973-1977 1:10,000	Two tanks are indicated in the centre-west and centre south of the site on 1:2500 mapping. An electrical substation is also shown in the centre of the site. A welding shop and travelling crane are now recorded in the central sector of the site. A railway platform is present in the east of the site.	
2020 1:10,000	The travelling crane is no longer recorded and previous structures now appear to have been removed. The track coverage has also been reduced.	
2021 Google Earth	The sidings now appear disused and becoming overgrown with self-seeded vegetation.	



3.2. OFF-SITE HISTORICAL DEVELOPMENT

A review of potentially contaminative uses identified on historical Ordnance Survey maps within a 250 m radius of the site is summarised in Table 3.2.

TABLE 3.2 SURROUNDING HISTORICAL DEVELOPMENT

SURROUNDING FEATURE	DISTANCE	DATES	DIRECTION
Lancashire and Yorkshire Railway	5 m	Pre 1851 – Present	East
Lock Cotton Mills Then... named as Mill. Then...named as Works. Then...no longer recorded	100 m	Pre 1894 – Pre 1910 Pre 1910 – Pre 1965 Pre 1965 – Pre 2020 Pre 2020 – Present	East
Heywood Station Then...no longer recorded	250 m	Pre 1851 – Pre 1894 Pre 1984 – Present	North East

3.3. PLANNING HISTORY

E3P has undertaken a review of online planning records held by Rochdale Metropolitan Borough Council and the following applications have been reviewed:

- 85/D17701 March 1985 – Alteration and Extension of Rail Welding Depot – Grant subject to conditions. No further details provided.
- 94/D30267 January 1994 – Construction of Concrete Hardstanding for Railway Crossing Assembly and Two Mobile Cranes – Grant subject to conditions. No further details provided.
- 16/00209/SO Feb 2016 – Screening opinion in respect of proposed residential development for up to 150 dwellings, means of access, on-site infrastructure, potential to deliver a rail platform for East Lancashire Railway and landscaping - EIA Not Required. No further details provided.

3.4. PREVIOUS REPORTS

There are no previous reports available to E3P relating to the subject site.

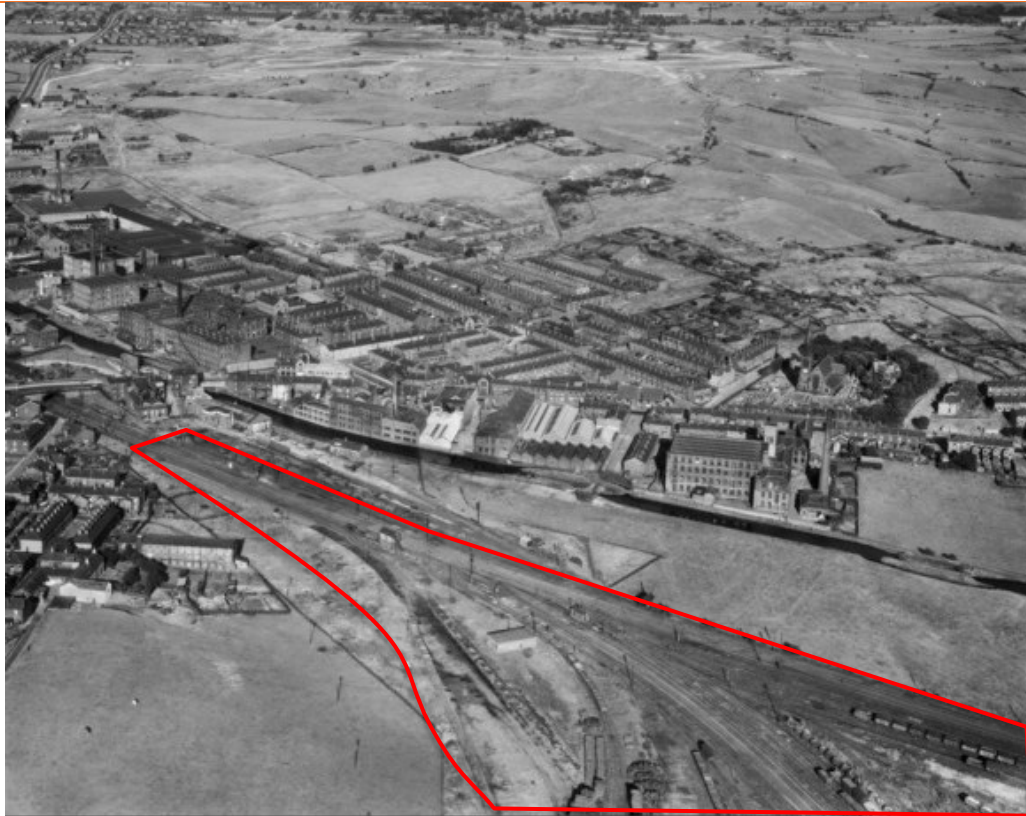
3.5. ANECDOTAL INFORMATION

Available online information details that the site forms part of the Greater Manchester Spatial Framework and the site is allocated for circa 125 new homes, alongside improvements to open space around Castleton railway station. The western half of site will be redeveloped as an area of open space or a nature conservation area and kept within the green belt. Land has also been earmarked as part of this scheme to enable the extension of the East Lancs Railway into Castleton.

Historical aerial photography for the site is also available from <https://www.britainfromabove.org.uk/> as shown in Figure 1.2. Goods sheds and signal boxes are visible, together with areas of storage.



FIGURE 1.2 SNAPSHOT OF THE NORTHERN SECTOR OF THE RAILWAY SIDINGS (1947)



www.britainfromabove.org.uk/image/EAW010792

© Historic England



4. ENVIRONMENTAL SETTING

4.1. GEOLOGY AND HYDROGEOLOGY

The British Geological Survey (BGS) map (Sheet 85) for the site, (1:50,000, Solid and Drift editions) and online records indicate the site is underlain by the geological sequence presented in Table 4.1.

TABLE 4.1 SUMMARY OF UNDERLYING GEOLOGY

GEOLOGICAL UNIT	CLASSIFICATION	DESCRIPTION	AQUIFER CLASSIFICATION
Drift (North)	Glaciofluvial Deposits	SAND and GRAVEL	Secondary A Aquifer
Drift (South)	Glacial Till – Diamicton	SAND, CLAY and GRAVEL	Secondary Undifferentiated Aquifer
Solid	Pennine Lower Coal Measures Formation	MUDSTONE, SILTSTONE, SANDSTONE	Secondary A Aquifer

TABLE 4.2 SUMMARY OF BGS BOREHOLE RECORDS

LOCATION	DEPTH	MADE GROUND	DRIFT	SOLID
180 m E (Ref: SD81SE9)	150 m	-	SAND and MARL 0.0 – 81.38 m	SHALE 81.38 - > 150.27 M
280 m S (Ref: SD80NE300)	2.10 m	0.30 m	SAND 0.30 - > 2.10 m	Not encountered
290 m N (Ref: SD81SE573)	20.00 m	0.30 m	SAND and CLAY 0.30 - > 20.0 m	Not encountered
295 m SE (Ref: SD80NE120)	4.30 m	0.60 m	SAND 0.30 - > 4.30 m	Not encountered

A geological fault is located through the northern sector of the site, orientated north west to south east.

4.2. NATURAL LANDFORM AND GEOMORPHOLOGY

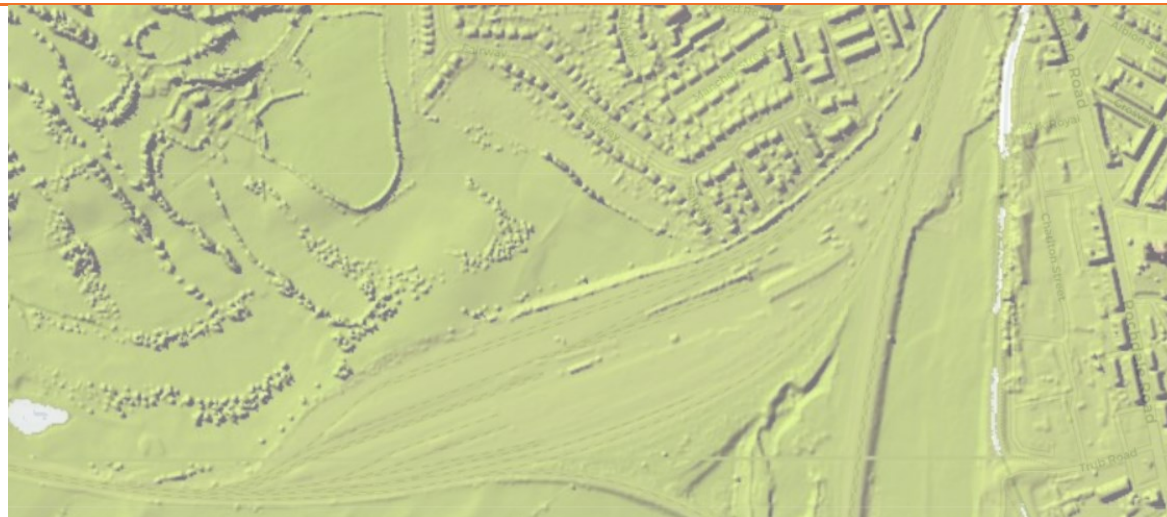
Based on the initial geological assessment, a review of available topographic data and pertinent mapping, E3P has undertaken a preliminary geomorphological assessment of the landform and its possible mechanism for formation.

Lidar data indicates the site to be at a slightly higher elevation and more evenly level in comparison to the land directly north and south, suggesting artificial raising/levelling of the site to accommodate former structures and railway sidings.

The canal to the east of the site is evident by an incision, however, this will also have been artificially constructed and as such the surrounding levels may not be reflective of the natural geomorphology.



FIGURE 4.1 SURFACE LIDAR DATA OF THE SITE AND SURROUNDING AREA



4.3. GEOTECHNICAL DATA

Geotechnical data presented within a commercially available environmental database is summarised in Table 4.3.

TABLE 4.3 SUMMARY OF GEOTECHNICAL DATA

HAZARD	DESIGNATION
Shrink-Swell Clay	Very low risk
Landslides	Very low risk
Ground Dissolution	No hazard
Compressible Ground	Moderate risk (South)
Collapsible Deposits	Very low risk
Running Sand	Very low risk

4.4. COAL MINING

The Envirocheck report states the site is in an area that may be affected by coal mining.

A CA mining report was obtained (Ref: 51002404759001) dated 16th March 2021.

The CA operates a risk-based approach to the assessment of potential instability issues associated with future development of land located within the predefined CA consultation areas. This risk-based approach subdivides the potential risk into “low” and “high” risk categories.

The risk categories can be defined as:

Low-Risk Sites – Deemed to be land where coal mining has taken place, however it was at such depth not to pose a risk to new development, and it therefore contains no known recorded risks and as such no further assessment is required.

For low-risk sites, the CA categorically states:



If your proposed development is within the Development Low Risk Area, there is no need for you to submit any coal mining information with your planning application and The Coal Authority will not be consulted by the LPA. The LPA will include our Standing Advice as an informative note within the decision notice.

High-Risk Sites – Deemed to be landholdings located within an area known to contain legacy risks that include:

- ✦ Mine entries (shaft or adit);
- ✦ Shallow coal workings (recorded and probable);
- ✦ Workable coal seam outcrops;
- ✦ Mine gas sites and areas;
- ✦ Recorded coal-mining-related hazards;
- ✦ Geological features (fissures and break lines); and
- ✦ Former surface mining sites (sometimes using historic opencast extraction methods).

4.4.1. COAL MINING INFORMATION

Prior to the enactment of the Coal Mines Regulation Act (1872), which came into force on the 1st January 1883, there was no statutory requirement to record the extent of abandoned mine workings and as such the CA has no knowledge of extensive workings throughout the UK Coal Fields where shallow workings are present at a depth that could result in a subsidence event in the future (through successive cavitation) associated with failure of support mechanism.

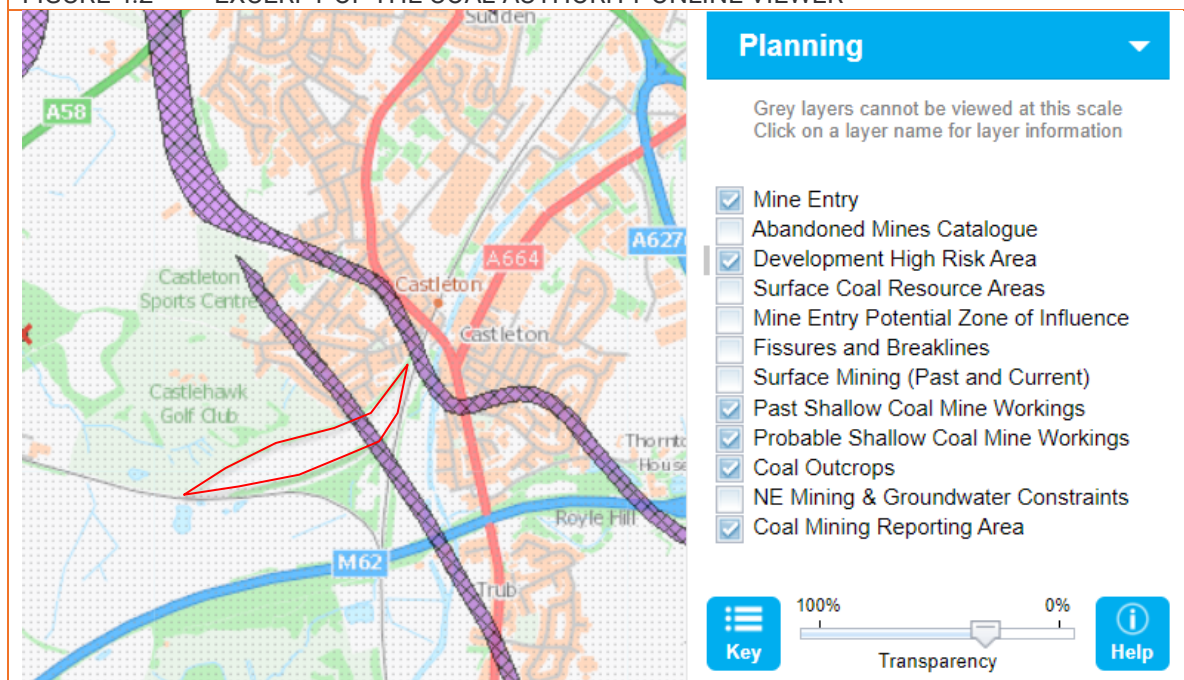
To determine if a site may have unrecorded or recorded coal mine workings requires the consideration of a wide range of information and E3P has completed a review of relevant information in relation to potential coal mining activities.

In the first instance, E3P has reviewed the Coal Authority Online Viewer and an excerpt of this is presented as Figure 4.2.

This map shows that a section of the site lies within a development high risk area, which corresponds with the conjectures subcrop of a coal seam.



FIGURE 4.2 EXCERPT OF THE COAL AUTHORITY ONLINE VIEWER



As the site is within an area affected by Coal Mining E3P have consulted with the Coal Authority who have provided a Consultant Coal Mining Report for the site (ref: 51002404759001).

Table 4.4 provides a summary of pertinent coal mining information with this report.

TABLE 4.4 COAL MINING INFORMATION

SOURCES OF INFORMATION	SUMMARY
Known Past Underground Mining	No past mining recorded.
Probable Unrecorded workings	None.
Spine Roadways at Shallow Depth	No spine roadway recorded at shallow depth.
Mine Entries within 100m of the site	None recorded within 100 metres of the site boundary.
Mine Abandonment plans	16820 – intersects with some, or all of the site boundary.
Known outcrops	Arley – Workable: Yes.
Faults / Fissures	A geological fault is located through the northern sector of the site, orientated north west to south east.
Opencast mines	None recorded within 500 metres of the site boundary.
Coal Authority Managed Tips	None recorded within 500 metres of the site boundary.
Remediated Sites	None recorded within 50 metres of the site boundary.

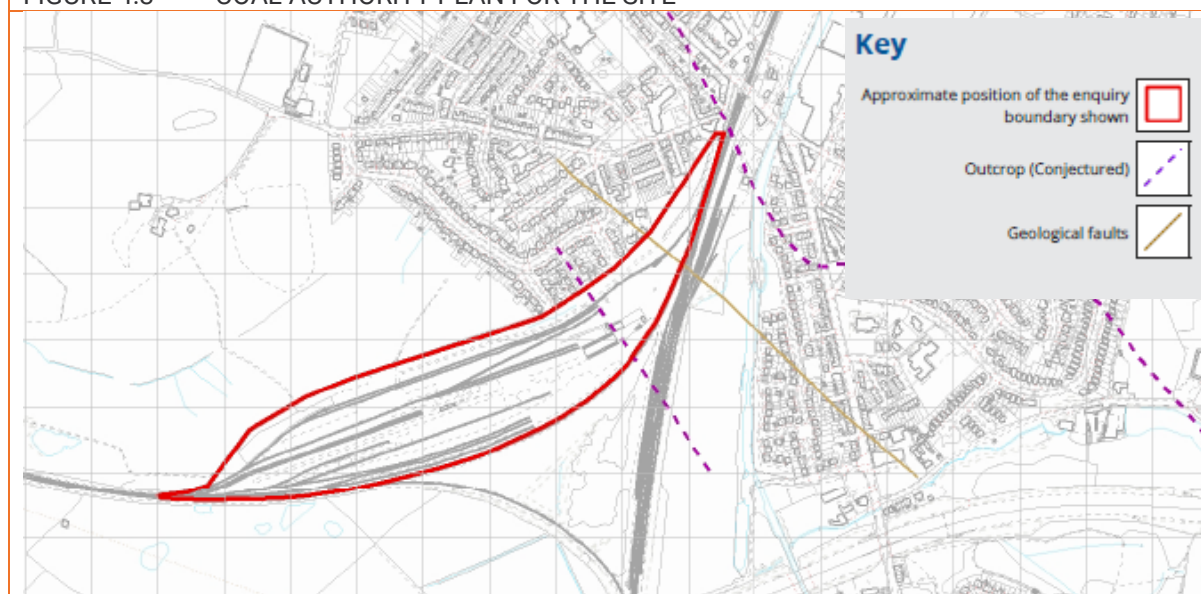


SOURCES OF INFORMATION	SUMMARY
Coal Mining Subsidence	The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994. There is no current Stop Notice delaying the start of remedial works or repairs to the property. The Coal Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.
Mine Gas	None recorded within 500 metres of the site boundary.
Mine Water	None recorded within 500 metres of the site boundary.
Future Underground Mining	None recorded.
Coal Authority Development Advice	None recorded.
British Geological Survey Mapping	The 1:10,000 geological mapping for the area does not indicate any coal outcrops or mine shafts are located within the site boundary.
Historical Ordnance Survey Mapping	A review of the 1:10,000 Ordnance Survey mapping from circa 1850, does not have any records of mine workings that predate the Mining & Regulation Act of 1872.
Historical Site Investigations	E3P has not been provided with any historic site investigation reports.

4.4.2. COAL AUTHORITY PLAN

The Coal Authority plan referenced: MR-LARGE-PLOT-510024047559001-1615909131879 shows the conjectured coal seams beneath the site along within the fault through the site.

FIGURE 4.3 COAL AUTHORITY PLAN FOR THE SITE

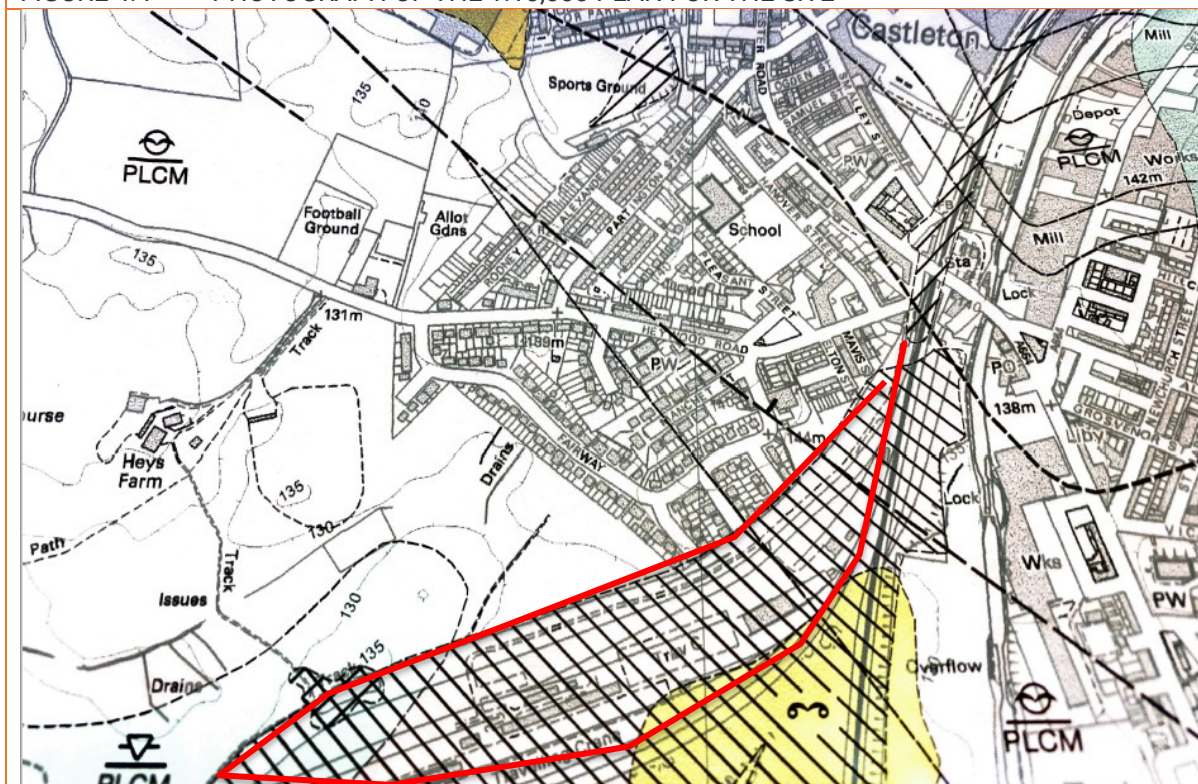


4.4.3. COAL MINING GEOLOGY

Figure 4.4 is a photograph of the 1:10,000 plan for the site which shows a fault trending north west to south east through the north of the site, with the downthrow to the north east. The site is also shown to be covered by artificial ground.

The coal seam is also indicated crossing the north eastern sector, concurring with the CA mining report mapped position.

FIGURE 4.4 PHOTOGRAPH OF THE 1:10,000 PLAN FOR THE SITE



4.4.4. COAL MINING RISK ASSESSMENT

This risk assessment comprises a desk-based review of all available information on coal mining issues that are relevant to the application site deemed to be located within a high-risk area. This includes:

- Interpretation of information to identify and assess the risks to the proposed development from coal mining legacy, including the cumulative impact of issues;
- Setting out appropriate mitigation measures to address the coal mining legacy issues affecting the site, including any necessary remedial works and/or demonstrate how coal mining issues have influenced the proposed development; and
- Demonstrating to the local planning authority that the application site is, or can be made, safe and stable to meet the requirements of national planning policy with regard to development on unstable land.

The coal mining risk assessment is summarised in Table 4.5.



TABLE 4.5 SUMMARY OF COAL MINING RISK ASSESSMENT

COAL MINING RISK ASSESSMENT	YES/NO	RISK ASSESSMENT
Recorded Underground Coal Mining at Shallow Depth (< 30 m)	No	Low
Recorded Underground Coal Mining at Shallow Depth (> 30 m)	No	Low
Evidence of Unrecorded Surface Extraction of Coal Outcrop	No	Low
Unrecorded Underground Coal Mining at Shallow Depth (< 30 m)	No	Low
Mine Entries (Shaft/Adits)	No	Low
Coal Mining Geology – Fractures/Fissures	Yes (Fault)	Moderate
Recorded Gas Emissions	No	Low
Recorded Mining Surface Hazard	No	Low
Surface Mining (Opencast)	No	Low

The site is located within a coal mining reporting area, and the Arley Coal seam is indicated to subcrop beneath the north eastern sector. A narrow development high risk zone associated with this seam is mapped on the western side of the conjectured crop.

Surrounding BGS boreholes indicate the thickness of overlying drift deposits to be in excess of 80 m bgl, thus significantly reducing the risk of any workings/void propagating upwards and resulting in subsidence at the surface.

Verbal consultation with the Coal Authority indicated that, due to the depth of the seam, they do not consider it likely that the seam has been worked.

The risk from coal mining related hazards is therefore considered low.

However, it would be considered prudent to undertake precautionary drilling in the location of the seam and development high risk zone to confirm the anticipated ground condition and conclusions of this assessment.

4.5. BRINE WORKINGS

The site is not situated within the Cheshire Salt Field; therefore, a brine workings risk assessment is not required.

4.6. RADON RISK POTENTIAL

The Envirocheck report indicates the site is situated in an area where less than 1% of homes are above the "Action Level" and that the BGS reports that full radon protective measures are not necessary in the construction of new dwellings or extensions.

4.7. PRELIMINARY GEOTECHNICAL ASSESSMENT

Based on the desk-study information, the following geotechnical assessment has been made:



- ✦ Given the extensive development history of the site, it is likely there will be significant Made Ground fill deposits and obstructions across the site. Existing structures will require demolition, with all relict foundations grubbing out, prior to the construction of the proposed development.
- ✦ In addition to potential depths of Made Ground, peat/organic deposits may be present beneath the site, in infilled areas (brick pit/reservoir) or those historically indicated to be marshland. Investigation will be required in order to assess these and undertake in-situ geotechnical testing to determine the likely foundation solution for plots in these areas.
- ✦ The site is undulating with a split plateau across the centre of the site. In order to construct low-rise residential development, significant earthworks will be required to create a level developable platform.

4.8. HYDROLOGY

The Envirocheck report indicates that the site is not located within a groundwater source protection zone. Furthermore, there are no groundwater/potable abstractions within 500 m of the site boundary. The closest groundwater abstraction point is located 593 m north east of the site, operated by Sonoco Industrial Packaging for cooling, however the license was revoked.

A second abstraction point is located 656m south of the site, operated by the Manchester Golf Club Ltd for spray irrigation.

Surface water features within 250 m of the subject site are summarised in Table 4.6.

TABLE 4.6 SURFACE WATER FEATURES

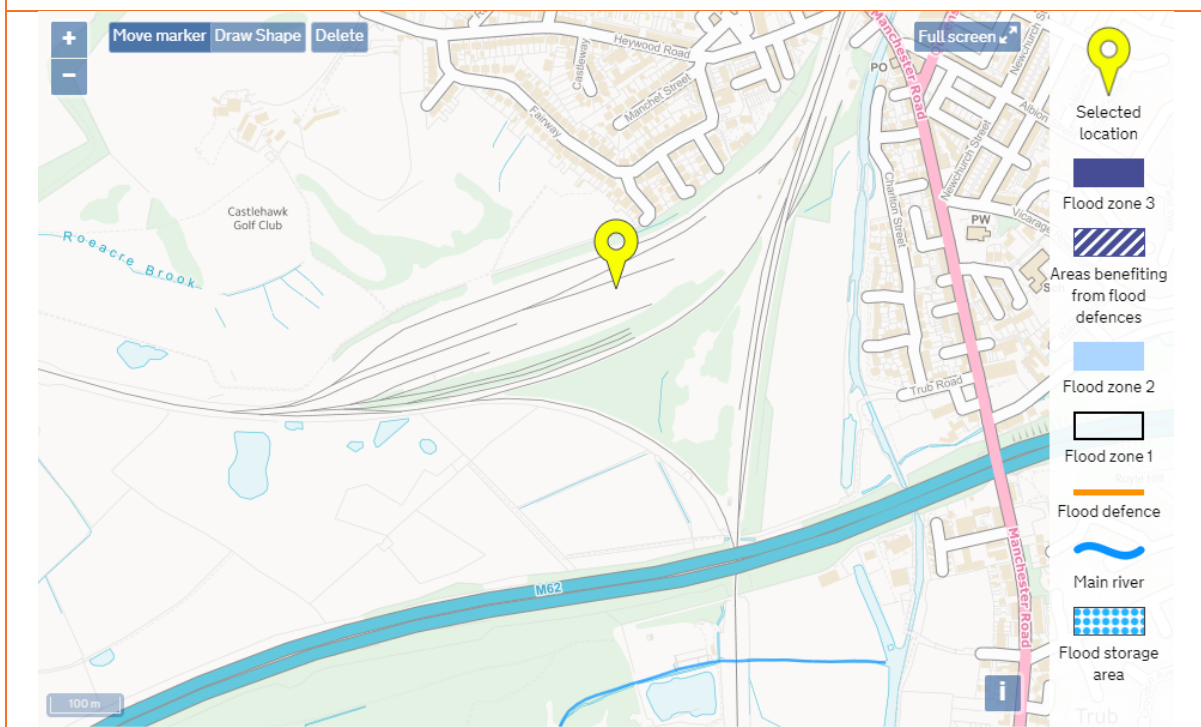
SURFACE WATER FEATURE	QUALITY	DISTANCE (m)	DIRECTION
Inland River	–	10 m	North
Roeacre Brook	–	150 m	North West
Rochdale Canal	B – Good	100 m	East

The Rochdale Canal and adjacent unnamed inland river are at a similar elevation to the site itself, however, the Roeacre Brook appears to be at a lower elevation and therefore down perceived hydraulic gradient of the site.

The site is predominantly located within a currently defined “Flood Risk Zone 1”; defined as land assessed as having less than 1 in 1,000 annual probability of river or sea flooding (< 0.1%), and as such is considered to be unaffected by river flooding. In addition, the Envirocheck report states there is a limited potential for groundwater flooding to occur at the site. The Environment Agency (EA) Flood Risk Map for the site is presented as Figure 4.5.



FIGURE 4.5 EA FLOOD RISK MAP



Source - <https://flood-map-for-planning.service.gov.uk/>

4.9. INDUSTRIAL LAND USES

There are no active entries within the trade directory for industrial land uses within 250 m of the site.

4.10. SENSITIVE LAND USES

The closest residential properties are located adjacent to the northern boundary of the site. The site is also situated within a nitrate vulnerable zone of the River Irk. An area of adopted green belt land is also present in the western sector of the site.

No other environmentally sensitive land uses have been identified within close proximity to the site.

4.11. SITE SENSITIVITY ASSESSMENT

The site is assessed to be located within a "Moderate" sensitivity setting as discussed within Table 4.7.



TABLE 4.7 SITE SENSITIVITY ASSESSMENT

SENSITIVITY PROFILE	DISCUSSION	RATING
Groundwater Source Protection Zone or Drinking Water Safeguard Zone	The site is not situated within a Groundwater Source Protection Zone.	Low
Distance to the Closest Groundwater Abstraction Point	The closest groundwater abstraction point is located roughly 260 m north east of the site, operated by Sonoco Industrial Packaging for cooling, however the license was revoked. A second abstraction point is located circa 600 m south of the site, operated by the Manchester Golf Club Ltd for spray irrigation.	Low
Aquifer Classification in Superficial Drift Deposits	The glaciofluvial drift deposits in the north comprise a Secondary A Aquifer. The underlying deposits in the north of the site may comprise of moderate/high permeability sands and gravels, thus allowing downward and lateral migration.	High
Aquifer Classification in Bedrock	Secondary A Aquifer.	High
Is the Site Underlain by Low-Permeability Drift to Depths in Excess of 10 m?	The underlying superficial deposits are likely to comprise gravelly sands in the north of the site and low-permeability clay soils in the south of the site. A nearby BGS borehole indicates drift deposits extending to c. 81 m bgl. Given the anticipated granular nature of the drift, there is therefore a potential for mobile phase contaminants to migrate downwards and laterally to surrounding watercourses.	High
Is the Site Located Within 50 m of a Surface Watercourse?	An inland river is present along the northern site boundary, together with the Roeacre Brook 150 m to the north of the site. the Roeacre Brook appears to be at a lower elevation and therefore down perceived hydraulic gradient of the site. The Rochdale Canal is located 100 m east is at a similar elevation to the site and likely to be lined and therefore not in hydraulic continuity with the site.	Moderate
Sensitive Land Uses	The closest residential properties are located adjacent to the northern boundary of the site. The site is also situated within a nitrate vulnerable zone of the River Irk. An area of adopted green belt land is also present to the west of the site.	Moderate
OVERALL SITE ENVIRONMENTAL SENSITIVITY		Moderate



5. CONSULTATIONS

5.1. LANDFILL SITES AND WASTE TREATMENT SITES

A historical landfill site is located circa 550 m west of the site, at land south of Chadwick Lane, which received inert, industrial, commercial, household and special waste from December 1984 until December 1986. The licence was held by Wilderness Quarries Limited. Given the distance from the site, this landfill is not considered to be within influencing distance of the site.

5.2. REGULATORY DATABASE

The information summarised in Table 5.1 has been obtained from a commercially available environmental database. The summary table only includes records from within 250 m of the subject site and not otherwise detailed in the report.

TABLE 5.1 SUMMARY OF ENVIRONMENTAL DATA

RECORD	ENTRIES WITHIN 250 m	DETAILS
Contaminated Land Register Entries and Notices	0	None Identified (N/A).
Authorised Industrial Processes (IPC/IPPC/LAPPC)	0	None Identified (N/A).
Fuel Stations Entries	0	None Identified (N/A).
Licensed Radioactive Substances	0	None Identified (N/A).
Enforcements, Prohibitions or Prosecutions	0	None Identified (N/A).
Discharge Consents	0	None Identified (N/A).
Pollution Incidents	0	None Identified (N/A).
Consents Issued Under the Planning (Hazardous Substances) Act 1990	0	None Identified (N/A).
Control of Major Accident Hazard (COMAH) Sites	0	None Identified (N/A).

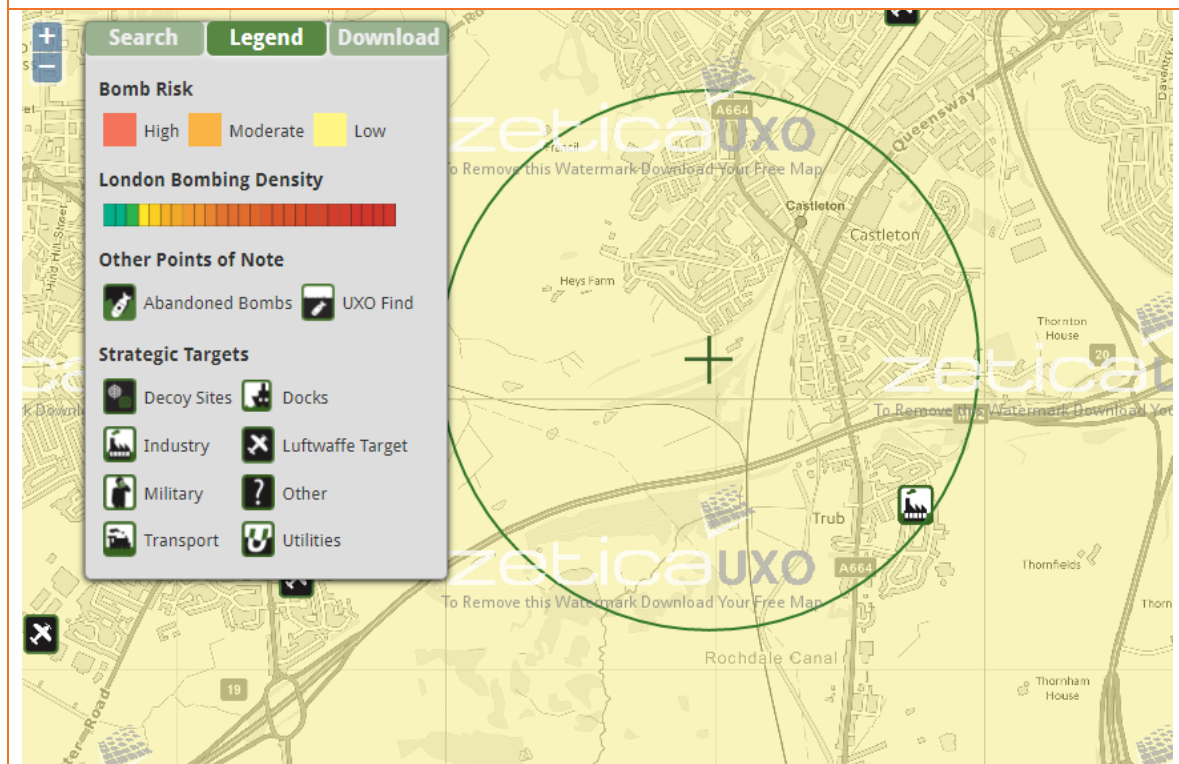


5.3. UNEXPLODED ORDNANCE

The regional unexploded bomb risk map from Zetica (2014) indicates that the site is in an area at low risk from possible unexploded ordnance (UXO) resulting from the Second World War.

The Zetica UXO Risk Map is presented as Figure 5.1.

FIGURE 5.1 ZETICA UXO RISK MAP



Source - <https://zeticauxo.com/downloads-and-resources/risk-maps/>



6. INITIAL CONCEPTUAL SITE MODEL

In accordance with EA LCRM (2019) and BSI 10175 (Code of Practice for Investigation of Potentially Contaminated Land), E3P has developed an initial conceptual site model (CSM) to identify potential contamination sources, migration pathways and receptors within the study area. This is summarised within Table 6.1.

ON-SITE SOURCES OF CONTAMINATION

The following potential on-site sources of contamination have been identified:

Made Ground potentially containing PAHs, TPHs, SVOCs, VOCs, heavy metals and asbestos due to the historical presence of the following:

- ✦ Railway Sidings;
- ✦ Brick Kiln Works with pits;
- ✦ L&YR Engineering Works;
- ✦ Tanks;
- ✦ Welding Shop;
- ✦ Travelling Crane; and
- ✦ Leather Works.

PCBs may also be present within the associated Railway Sidings present on site.

OFF-SITE SOURCES OF CONTAMINATION

The following potential off-site sources of contamination have been identified:

- ✦ Lancashire and Yorkshire Railway – Made Ground may be present containing SVOCs, VOCs, TPHs and PCBs.
- ✦ Lock Cotton Mills – reservoirs and infilled ground are likely to be present within the vicinity of the Mill.



TABLE 6.1 INITIAL CONCEPTUAL SITE MODEL

SOURCE	PATHWAY	RECEPTOR
Human Health		
Heavy Metals, PAHs and PCBs Associated with Made Ground and Historical Site Use as Railway Sidings and Industrial Uses	Dermal Contact and Ingestion. Consumption of Homegrown Produce.	Construction Workers. Residential End Users.
Discussion: Made Ground is likely to be present on site, derived from the previous site uses as Railway Sidings, Brick Kiln Works, Engineering Works, Leather Works and a Travelling Crane. Made Ground may contain anthropogenic material and as such may be impacted by heavy metals, hydrocarbons and polycyclic aromatic hydrocarbons (PAH) derived from fuel and coal storage and combustion processes. PCBs may also be present within the vicinity of the railway sidings in the centre of the site and former substations associated with transformer oils utilised pre 2000. If present, heavy metals and non-volatile PAHs may pose a short-term risk to construction workers who may come into contact with impacted soils during earthworks. However, this risk can be mitigated through the use of appropriate Personal Protective Equipment (PPE) and the provision of adequate welfare facilities.		
Volatile Hydrocarbon Compounds Associated with Historical Site Use of Railway Sidings	Volatilisation/Accumulation. Vapour Inhalation.	Construction Workers. Residential End Users.
Discussion: Historical developments on site including railway sidings and engineering works and underlying Made Ground on site may be a source of volatile contaminants such as PAHs, TPH and BTEX compounds (common fuel derivatives). There is potential for spillages and leakages to have occurred over time and the presence of railway sidings also increases the risk of diesel spillages. Multiple tanks have been identified within the site which may have leaked and have been mobilised beneath the site. Volatile compounds may pose a risk to construction workers if they come into contact with impacted soils during further earthworks, however appropriate PPE/ Respiratory Protective Equipment (RPE) will ensure they are at no unacceptable risk. Future end users may come into contact with impacted soils in garden and landscaped areas, though the main pathway of volatile compounds is considered to be vapour inhalation indoors. If identified, it is likely that additional remediation of impacted soils and/or perched groundwater will be required to mitigate the risk to future residential end users.		
Asbestos-Containing Materials (ACMs) within Made Ground	Fibre/Dust Inhalation.	Construction Workers. Residential End Users. Third-Party Property.
Discussion: The presence of ACM being present within Made Ground underlying the site from former structures and activities on the site is considered likely given its insulating and fire resistant properties. Asbestos may be present in the Made Ground associated with historic developments, earth mounds, infilling and demolition activities. ACM poses a risk through fibre and dust inhalation and if present may pose a risk to construction workers during any future earthworks / demolition and to adjacent third-party property should dust be generated during those works.		



Hazardous Ground Gases		
Methane and Carbon Dioxide Associated with Possible On-Site Fill Material, Organic Soils	Inhalation. Accumulation.	Construction Workers. Residential End Users.
Discussion: Potentially infilled features (brick pits) and deep Made Ground on site and within 250 m of the site present a moderate ground gas risk. Dependent on the materials used to infilling, there is a possibility for the generation of hazardous ground gases within any of these features which may migrate along preferential pathways to the proposed building. This poses a risk of inhalation of gas to future site users and explosion in confined spaces.		
Controlled Waters		
Hydrocarbon Compounds Associated Within Vehicle Repair Facilities	Vertical/Lateral Migration.	Secondary A Aquifers. Roeacre Brook.
Discussion: Potentially mobile sources of contamination have been identified with the historic uses on site. It is likely that chemicals will have been stored/present on site in the past and spillages of mobile contamination are considered possible. The underlying granular drift, particularly in the north of the site, is unlikely to reduce downward or lateral migration, however where any low-permeability clay deposits are encountered in the south of the site, will afford some protection to the underlying aquifer. The closest groundwater abstraction is located 593 m to the north east of the site, thus reducing the sensitivity of the receptor.		
Buildings and Infrastructure		
pH and Sulphate	Corrosion of Concrete.	Foundations/Concrete.
Discussion: Presence of high pH and sulphate within Made Ground deposits may result in corrosion of buried concrete within the proposed development. Assessment must be undertaken to confirm the levels of pH and sulphate within the underlying strata and in particular any Made Ground deposits so that a concrete classification can be determine.		
Ecology		
Phytotoxic Contaminants	Plant Uptake	On-site flora and fauna.
Discussion: Made Ground on site is likely to contain levels of contamination which may inhibit plant growth. Further investigation is required to confirm the presence/absence of phytotoxic contaminants on site will be required.		



7. GROUND INVESTIGATION

7.1. GENERAL OVERVIEW

A ground investigation has been designed based on the findings of the desk study, with exploratory holes advanced to target specific potential contaminant sources summarised in Table 6.1. 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 in three phases as follows:

- ✳ Preliminary site investigation – between 4th and 18th March 2021
- ✳ Additional trial pitting to target / delineate peat identified in preliminary site investigation – 16th June 2021
- ✳ Further rotary probing on 40 m grid to bottom out peat and shallow soil sampling of southwestern POS area – between 19th and 28th July 2021

7.2. LIMITATIONS

The following limitations constrained the extent and coverage of intrusive investigation:

- ✳ The north eastern third of the site is currently Network Rail retained land. Access to the area for intrusive work was therefore not permitted. Passage through the land was agreed prior to the works commencing (Figure 7.1).
- ✳ The south western third of the site is designated greenbelt land currently heavily vegetated/wooded. Clearance works were not permitted (Figure 7.1) but access for hand pitting was permitted. It is understood that the land will be retained as POS.
- ✳ A live railway forms the southern boundary of the site. A 15 m easement was applied to prevent any disturbance/vibration to infrastructure.
- ✳ Ponds are located off-site in the wider area. Ecological constraints (potential for Great Crested Newts) dictated that no intrusive works could be undertaken within 50 m of the ponds, and any works within 250 m were to be supervised by an ecologist. (Refer to Figure 7.2).
- ✳ A number of exploratory holes were terminated or refused on obstructions. Access in the south of the site was limited with the drilling rig due to dense vegetation.



FIGURE 7.1 GREENBELT LAND (GREEN) AND NETWORK RAIL RETAINED LAND (BLUE)

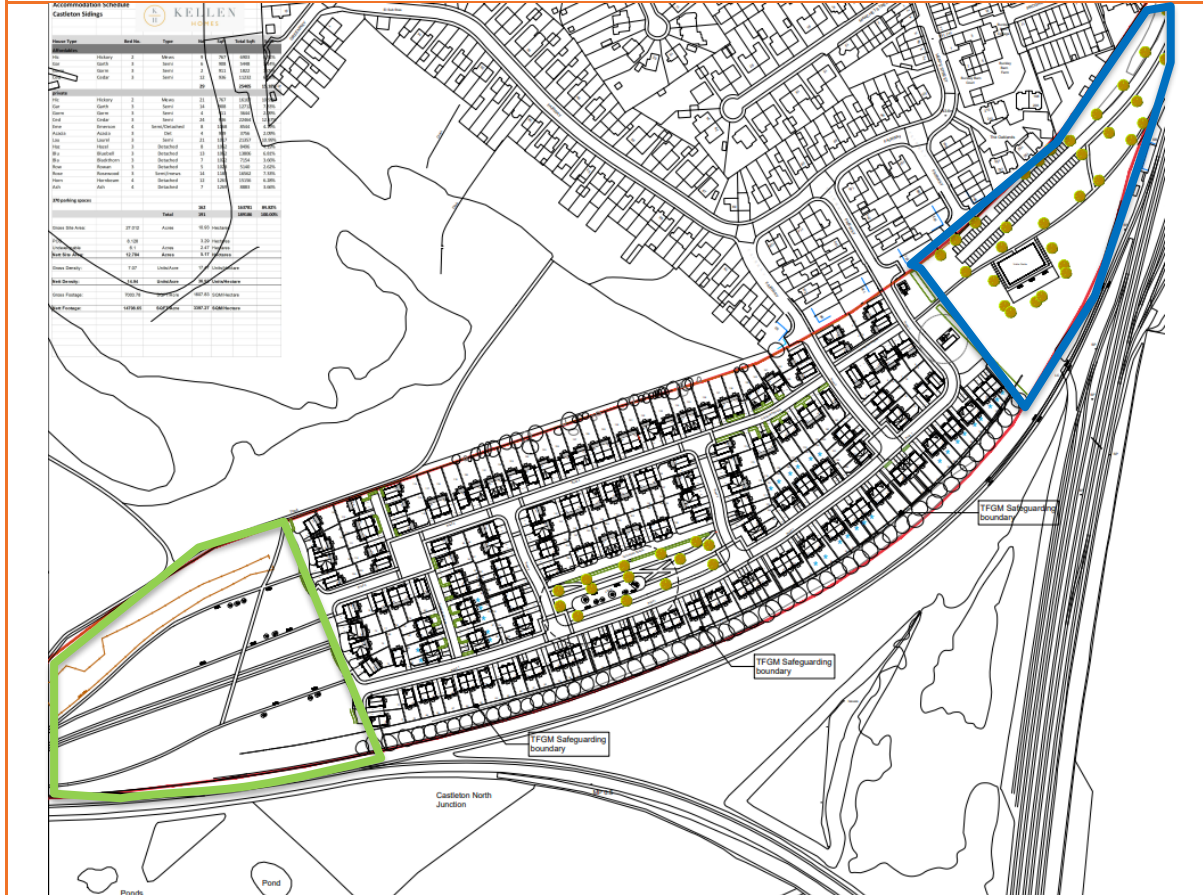


FIGURE 7.2 ECOLOGICAL CONSTRAINTS PLAN



7.3. SCOPE OF INVESTIGATION

TABLE 7.1 SUMMARY OF FIELDWORK

PHASE	POTENTIAL SOURCE/RATIONALE	LOCATION HOLE	TYPE	MAXIMUM DEPTH (m bgl)	MONITORING WELLS RESPONSE ZONE (m bgl)
Preliminary Investigation – March 2021	Investigation of the Old Brick/Clay Pit	WS101	Window Sample Probehole	4.45	1.00–3.50
	General Ground Conditions Including the Presence/Nature of Obstructions within the Railway Sidings	WS102		3.45	N/A
		WS103		5.45	1.00–3.00
		WS104		5.45	1.00–3.00
		WS105		5.45	1.00–3.00
		WS106a		0.50	N/A
		WS106b		5.45	1.00–3.20
	Investigation Beneath the Former Travelling Crane	WS107		5.45	1.00–4.50
		WS108		5.45	1.00–4.50
	General Ground Conditions Including the Presence/Nature of Obstructions within the Railway Sidings	WS109		5.00	1.00–4.00
		WS110		5.45	2.00–5.00
		WS111		5.45	2.00–5.00
		WS112		5.45	2.00–5.00
	Investigation Beneath the Former Travelling Crane	WS113		5.45	2.00–3.00
		WS114a		0.70	N/A
		WS114b		5.45	1.00–4.00
	General Ground Conditions Including the Presence/Nature of Obstructions within the Railway Sidings	TP101–TP124	Mechanically Excavated Trial Pit	2.80	N/A
	Investigation of Deeper Soil Horizons	CP101–CP102	Cable Percussive Borehole	15.00	N/A
	Investigation of Conjectured Coal Outcrop	RB101–RB102	Rotary Borehole	60.50	N/A
June 2021	Targeted Investigation in Locations Where Peat was Identified in Preliminary Investigation	TP201–TP213	Mechanically Excavated Trial Pit	5.50	N/A
July 2021	Investigation of Vertical and Lateral Extent of Peat Deposits	RO201–RO232	Rotary Borehole	10.00	1.00–7.00
	Sampling of Existing Soils in Greenbelt (Proposed POS)	HP101–HP107	Hand Dug Pit	0.80	N/A
	Sampling of On-Site Stockpile (for Re-Use)	SP101–SP103	Hand Dug Pit	N/A	N/A



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

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

The deep cable percussive boreholes were advanced to investigate the deeper soil horizons and to undertake in-situ detailed geotechnical testing.

The series of rotary boreholes were advanced to investigate the potential presence of a conjectured coal outcrop in the north of the site. These boreholes were drilled in accordance with the CA permissions process and industry best practice.

Additional shallow rotary boreholes with dynamic sampling were drilled on a 30 – 40 m spaced grid to assess the vertical and lateral extent of deep peat / organic deposits beneath the development area.

A series of shallow hand dug pits were also dug in accessible locations across the south west of the site (current greenbelt zone and proposed area of POS) to collect samples for chemical analysis

The sampling locations are illustrated in Drawing 14-768-005 (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. Vapour (volatile gases) monitoring has also been undertaken at a number of locations. In addition, selected wells were purged, and samples of groundwater recovered for chemical analysis.

7.4. IN-SITU STANDARD PENETRATION TESTING (SPT)

In-situ geotechnical testing was conducted using the standard penetration test (SPT) and, where the ground is granular, a 60° cone (SPT(C)) was used instead of the sampling tube. The results are shown in the probehole logs in Appendix V and presented in Table 8.7 and discussed in Section 11.

7.5. LABORATORY ANALYSIS

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

- ✳ Metals.
- ✳ pH, total sulphate, water-soluble sulphate (2:1 extract).
- ✳ Sulphide.
- ✳ Cyanide.
- ✳ Phenols.
- ✳ Total and speciated polycyclic aromatic hydrocarbons (PAHs).
- ✳ Semi Volatile Organic Compounds (SVOC).



- ✳ Volatile Organic Compounds (VOC).
- ✳ Speciated and banded total petroleum hydrocarbon (TPH).
- ✳ BTEX Compounds.
- ✳ Asbestos identification and quantification.

I2 Analytical undertook the analytical work and the testing results are included in Appendix VI and discussed in Section 9.

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

- ✳ Atterberg limits determinations;
- ✳ Particle Size Distribution Tests;
- ✳ Dry Density / Optimum Moisture Content Testing;
- ✳ One Dimensional Consolidation Test; and
- ✳ Single stage triaxial tests.

Laboratory analysis sheets are included in Appendix VIII and are summarised in Section 8.



8. GROUND AND GROUNDWATER CONDITIONS

8.1. SUMMARY OF GROUND CONDITIONS

The ground investigation identified the strata set out in Table 8.1.

TABLE 8.1 SUMMARY OF STRATA

HOLE	DEPTH TO STRATUM (m bgl)					
	MADE GROUND	SOFT CLAY	PEAT	STIFF CLAY	SAND	GRAVEL
TP101	0.00–2.70*	–	–	–	–	–
TP102	0.00–3.00*	–	–	–	–	–
TP103	0.00–0.70*	–	–	–	–	–
TP104	0.00–1.50	–	–	–	–	1.50–2.40
TP105	0.00–2.50*	–	–	–	–	–
TP106	0.00–2.20*	–	–	–	–	–
TP107	0.00–2.20	–	–	–	–	2.20–2.80
TP108	0.00–2.60*	–	–	–	–	–
TP109	0.00–0.70	–	–	–	0.70–2.80	–
TP110	0.00–1.80*	–	–	–	–	–
TP111	0.00–2.30*	–	–	–	–	–
TP112	0.00–2.70*	–	–	–	–	–
TP113	0.00–2.60*	–	–	–	–	–
TP114	0.00–2.20*	–	–	–	–	–
TP115	0.00–2.00*	–	–	–	–	–
TP116	0.00–2.40*	–	–	–	–	–
TP117	0.00–2.00*	–	–	–	–	–
TP118	0.00–2.10*	–	–	–	–	–
TP119	0.00–2.10*	–	–	–	–	–
TP120	0.00–2.30*	–	–	–	–	–
TP121	0.00–2.40*	–	–	–	–	–
TP122	0.00–2.60*	–	–	–	–	–
TP123	0.00–2.80*	–	–	–	–	–
TP124	0.00–2.40*	–	–	–	–	–
WS101	0.00–1.40	–	–	1.40–4.45	–	–
WS102	0.00–3.45*	–	–	–	–	–
WS103	0.00–4.50	–	–	–	4.50–5.45	–
WS104	0.00–4.20	–	–	–	4.20–5.45	–
WS105	0.00–4.80	–	–	–	4.80–5.45	–
WS106a	0.00–0.50*	–	–	–	–	–



HOLE	DEPTH TO STRATUM (m bgl)					
	MADE GROUND	SOFT CLAY	PEAT	STIFF CLAY	SAND	GRAVEL
WS106b	0.00–4.50	–	4.50–5.45	–	–	–
WS107	0.00–5.45*	–	–	–	–	–
WS108	0.00–4.40	–	4.40–5.45	–	–	–
WS109	0.00–3.30	–	–	3.30–5.00	–	–
WS110	0.00–2.60	–	–	–	2.60–5.45	–
WS111	0.00–5.45*	–	–	–	–	–
WS112	0.00–5.45*	–	–	–	–	–
WS113	0.00–3.00*	–	–	–	–	–
WS114a	0.00–0.70*	–	–	–	–	–
WS114b	0.00–4.60	–	4.60–5.45	–	–	–
CP101	0.00–4.20	4.20–6.30	–	11.70–14.95	6.30–11.70	–
CP102	0.00–3.10	–	3.10–5.70	9.00–15.00	5.70–9.00	–
RB101	0.00–3.90	–	–	12.20–31.20 33.20–35.60 40.80–60.50	3.90–12.20 31.20–33.20 35.60–40.80	–
RB102	0.00–4.10	–	–	10.20–24.10 28.20–32.10 39.60–59.00	4.10–10.20 24.10–28.20 32.10–39.60	–
TP201	0.00–4.50*	–	–	–	–	–
TP202	0.00–4.00 *	–	–	–	–	–
TP203	0.00–4.20*	–	–	–	–	–
TP204	0.00–1.50*	–	–	–	–	–
TP205	0.00–4.30*	–	–	–	–	–
TP206	0.00–5.50*	–	–	–	–	–
TP207	0.00–1.10	–	–	–	1.10–4.00	–
TP208	0.00–2.70	–	2.70–4.10**	–	–	–
TP209	0.00–1.40*	–	–	–	–	–
TP210	0.00–1.00*	–	–	–	–	–
TP211	0.00–3.50	–	3.50–4.50**	–	–	–
TP212	0.00–3.80	–	3.80–4.20	–	4.20–4.80	–
TP213	0.00–3.60	–	3.60–4.60**	–	–	–
RO201	0.00–5.80	–	5.80–6.00	6.00–6.60	–	6.60–10.00
RO202	0.00–5.60	–	5.60–5.80	5.80–6.70	6.70–10.00	–
RO203	0.00–6.00	–	–	–	6.00–10.00	–
RO204	0.00–5.80	–	–	–	5.80–10.00	–
RO205	0.00–3.60	–	3.60–4.20	–	4.20–10.00	–
RO206	0.00–3.20	–	3.20–3.40	–	3.40–10.00	–



HOLE	DEPTH TO STRATUM (m bgl)					
	MADE GROUND	SOFT CLAY	PEAT	STIFF CLAY	SAND	GRAVEL
RO207	0.00–4.70	–	4.70–5.00	–	–	5.00–10.00
RO208	0.00–3.20	–	3.20–3.50	7.80–10.00	–	3.50–7.80
RO209	0.00–1.20	–	–	8.20–10.00	–	1.20–8.20
RO210	0.00–6.10	–	6.10–7.80	7.80–8.30	8.30–10.00	–
RO211	Unable to complete due to access limitations					
RO212	0.00–6.30	–	–	–	6.30–10.00	–
RO213	Unable to complete due to access limitations					
RO214	0.00–0.30*	–	–	–	–	–
RO215	Unable to complete due to access limitations					
RO216						
RO217						
RO218						
RO219	0.00–0.30*	–	–	–	–	–
RO220	0.00–0.30*	–	–	–	–	–
RO221	0.00–1.20	–	–	–	1.20–10.00	–
RO222	0.00–1.60	–	–	–	1.60–10.00	–
RO223	0.00–5.60	–	–	–	–	5.60–10.00
RO224	0.00–0.70	–	–	–	–	–
RO225	0.00–4.20	–	4.20–4.30	–	4.30–10.00	–
RO226	0.00–4.20	–	4.20–5.80	5.80–10.00	–	–
RO227	0.00–6.60	–	–	6.60–8.60	–	8.60–10.00
RO228	0.00–6.20	–	6.20–7.80	7.80–8.30	–	8.30–10.00
RO229	0.00–5.90	–	5.90–6.30	6.30–8.60	–	8.60–10.00
RO230	0.00–5.70	–	5.70–6.40	6.40–8.90	–	8.90–10.00
RO231	0.00–5.30	–	5.30–6.00	6.00–8.20	–	8.20–10.00
RO232	0.00–5.50	–	5.50–6.10	6.10–7.90	–	7.90–10.00
HP101	0.00–0.60*	–	–	–	–	–
HP102	0.00–0.70*	–	–	–	–	–
HP103	0.00–0.80*	–	–	–	–	–
HP104	0.00–0.50*	–	–	–	–	–
HP105	0.00–0.70*	–	–	–	–	–
HP106	0.00–0.50*	–	–	–	–	–
HP107	0.00–0.70*	–	–	–	–	–

Notes:

*Full extent of Made Ground not proven.

**Full extent of Peat not proven.



8.2. MADE GROUND

Made Ground deposits have been encountered within all of the exploratory hole locations from ground level to a maximum proven depth of 6.60 m bgl (RO227).

The full depth of Made Ground remained unproven in c. 50% of exploratory hole locations and was generally only proven in the deeper rotary boreholes and a select number of trial pits and window sampler probeholes.

The material generally comprises a black slightly clayey gravelly medium sand / sandy gravel. Gravel constituents predominantly include mudstone, brick, clinker, coal, and ceramic with less frequent inclusions of metal, shale, glass and timber/wood.

Obstructions were encountered at three locations during the first phase of investigation: TP103 (Concrete slab with probable services beneath at 0.70 m bgl), WS106a (double concrete slab at 0.50 m bgl and WS114a (ballast/cobble obstruction at 0.70 m bgl), and a further four locations during the third phase of investigation: RO214, RO219, RO220 and RO224 at depths between 0.30 m – 0.70 m bgl, described as reinforced concrete / railway obstructions.

Redundant services were also encountered at a number of locations within the Made Ground including electrical cabling, polyethylene pipes, drainage infrastructure etc.

A Depth of Made Ground Plan is presented as Drawing 14-768-006 in Appendix III.

8.3. PEAT

During the first phase of site investigation blackish brown pseudo fibrous PEAT was encountered at four locations in the centre/east of the site. The peat was encountered at the base of WS106b, WS108 and WS114b, and the full depth was not proven due to reaching the limit of the drilling rig. Where proven, in CP102, the full thickness was recorded to be 2.60 m.

A second phase of investigation comprising a series of trial pits (TP201-TP213) was carried out to determine the vertical and lateral extent of the peat in these locations. Brown pseudo fibrous PEAT was encountered in four locations TP208, TP211, TP212 and T213 at top depths of between 2.70 m and 3.80 m bgl. The full extent of the peat was proven in TP212 at 4.20 m bgl (0.40 m thick). The peat in the remaining locations remained unproven at depths of between 4.10 and 4.60 m bgl.

Given peat had been encountered beneath the Made Ground in a number of locations, but the Made Ground remained unproven in a large proportion of the holes, it was inferred that the peat may be present as a consistent horizon beneath the site.

A third phase of investigation was therefore conducted, comprising rotary probing and dynamic sampling on a c. 40 m grid across the site (RO201-RO232). The investigation confirmed the presence of brown pseudo fibrous PEAT in 14 locations (in addition to those noted previously) at top depths of between 3.20 m and 6.20 m bgl, extending to a maximum proven depth of 7.80 m bgl (RO210 and RO228).

The peat encountered beneath the site was found to range in thickness from 0.20 to 2.60 m thick (CP102), although was predominantly 1.0 m thick or less, and noted to be generally thicker towards the south and west of the site. A summary of the depth and thickness of peat is presented in Table 8.2 and the Depth to Peat Plan (Drawing no. 14-768-016) and Thickness of Peat Plan (Drawing no. 14-768-017) presented in Appendix III.



TABLE 8.2 DEPTH AND THICKNESS OF PEAT

LOCATION	DEPTH (m)	THICKNESS (mm)
WS106b	4.50 – >5.45	950
WS108	4.40 – >5.45	1050
WS114b	4.60 – >5.45	850
CP102	3.10 – 5.70	2600
TP208	2.70 – >4.10	1400
TP211	3.50 – >4.50	1000
TP212	3.80 – 4.20	400
TP213	3.60 – >4.60	1000
RO201	5.80–6.00	200
RO202	5.60–5.80	200
RO205	3.60–4.20	600
RO206	3.20–3.40	200
RO207	4.70–5.00	300
RO208	3.20–3.50	300
RO210	6.10–7.80	1700
RO225	4.20–4.30	100
RO226	4.20–5.80	1600
RO228	6.20–7.80	1600
RO229	5.90–6.30	400
RO230	5.70–6.40	700
RO231	5.30–6.00	700
RO232	5.50–6.10	600

The peat in CP102 (2.60 m thick) may be indicative of the location of an infilled reservoir identified in this area on historical mapping, as it was found to 'thin out' towards surrounding boreholes.

In each location the peat was encountered at the base of the Made Ground, it is therefore likely to be associated with relict vegetation/organic material that was overfilled to create the sidings plateau.

The presence of PEAT beneath the site can result in high concentrations of natural ground gas such as carbon dioxide and methane within monitoring wells, posing a potential gas risk to future residents.

Furthermore, the geotechnical properties of PEAT often consist of low bulk density, bearing capacity and shear strength, along with high permeability and compressibility.

8.4. DRIFT DEPOSITS

Drift deposits were encountered beneath the Made Ground and Peat where proven (predominantly in the deeper boreholes and during the third phase of investigation).



The drift deposits are varied beneath the site, comprising of alternating SAND/GRAVEL and sandy CLAY and extending to depths in excess of 60.50 m bgl (RB101). Although where encountered, shallowest drift deposits were predominantly granular.

Drift deposits were generally described as follows:

- ✦ Medium dense light brown variably slightly clayey SAND with occasional gravel of fine to coarse angular to rounded of sandstone. Loose silty sand was encountered in WS103 from 4.50 m bgl. The granular soils were also noted to be loose and collapsing in TP207 and TP212
- ✦ Light brown sandy GRAVEL of medium subangular to rounded mudstone and sandstone.
- ✦ Stiff to very stiff medium to high strength sandy CLAY with occasional gravel of fine to coarse angular to rounded mudstone. At one location (CP101), directly beneath the Made Ground, a soft very low strength brown sandy CLAY was encountered between 4.20 m and 5.00 m bgl.

8.5. SOLID GEOLOGY

The solid geology was not encountered within the deeper cable holes or rotary open holes across the site. A nearby BGS borehole indicates rockhead at circa 81.00 m bgl.

8.6. GROUNDWATER

Groundwater strikes were encountered as seepages. The depth of the seepages are shown on the exploratory hole records in Appendix V and are summarised in Table 8.3.

TABLE 8.3 SUMMARY GROUNDWATER STRIKES

LOCATION	DEPTH TO STRIKE (m)	NOTES
TP104	1.50	Water strike in sand
TP105	1.20	Perched in Made Ground
TP109	2.70	Water strike in sand
TP110	1.60	Perched in Made Ground
TP113	2.20	Perched in Made Ground
WS110	4.80	Water strike in sand
CP102	1.50	Perched in Made Ground
TP205	4.00	Perched in Made Ground
TP208	1.20	Perched in Made Ground
TP211	3.20	Perched in Made Ground
TP212	3.40	Perched in Made Ground

Water strikes were natural SAND in a handful of locations, together strikes in the Made Ground, indicating the water to be perched.

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 9.19.



8.7. VISUAL AND OLFACTORY EVIDENCE OF CONTAMINATION

Visual and olfactory evidence of potential contamination has been identified during the site investigation and these are summarised in Table 8.4.

TABLE 8.4 SUMMARY VISUAL AND OLFACTORY EVIDENCE OF CONTAMINATION

LOCATION	DEPTH (m)	STRATUM	NOTES
TP105	0.50–2.50	Made Ground	Hydrocarbon impact
TP106	1.40–2.20	Made Ground	Strong hydrocarbon odour
TP107	1.40–2.20	Made Ground	Strong hydrocarbon odour
TP113	2.00	Made Ground	Hydrocarbon odour
WS104	3.20–4.20	Made Ground	Hydrocarbon impact and strong odour
WS105	2.00–5.45	Made Ground	Hydrocarbon impact and strong odour
WS106b	4.00–4.45	Made Ground	Hydrocarbon impact and strong odour
WS108	4.00–4.45	Made Ground	Hydrocarbon impact and strong odour
CP102	0.60–3.10	Made Ground	Hydrocarbon impact and strong odour
TP201	0.00–4.50	Made Ground	Slight hydrocarbon odour
TP203	2.80–4.20	Made Ground	Slight hydrocarbon odour
TP206	0.70–5.50	Made Ground	Slight hydrocarbon odour
TP208	4.00	Peat	Strong organic odour
TP211	2.10–4.50	Made Ground	Strong hydrocarbon odour
TP212	2.80–3.80	Made Ground	Strong hydrocarbon odour
TP213	2.90–3.40	Made Ground	Strong hydrocarbon odour

8.8. SOIL CONSISTENCY

Undrained shear strength values were measured using both field hand shear vane tests and laboratory undrained triaxial tests. Results of the tests are presented in Table 8.5 and Table 8.6, which indicate the clay soils to be stiff. Strength test data is generally consistent with the field descriptions of the aforementioned soils.

TABLE 8.5 SUMMARY OF HAND SHEAR VANE TESTS

LOCATION	DEPTH	SHEAR STRENGTH (kPA)	CALCULATED ALLOWABLE BEARING PRESSURE (kN/m ²)
TP106	1.60	90	212

Notes

ABP Calculated using Stroud and Butler et al 1974.



TABLE 8.6 SUMMARY OF UNDRAINED SHEAR STRENGTH TEST RESULTS

LOCATION	SAMPLE DEPTH (m)	LAB DESCRIPTION	UNDRAINED SHEAR STRENGTH (kN/m ²)	CONSISTENCY
WS101	1.50–2.00	Stiff brown slightly gravelly slightly sandy CLAY	133	Stiff

Results of the standard penetration tests, including undrained shear strengths derived from SPTs are included in Table 8.7.



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TABLE 8.7 STANDARD/CONE PENETRATION TEST RESULTS

BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE (N ₁) ₆₀	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m ²)	ALLOWABLE BEARING PRESSURE (kN/m ²)*
WS101	1.00	MG: Gravelly sand	20	20.16	Medium Dense	N/A	N/A	N/A	201.63
WS101	2.00	Sandy CLAY	15	13.70	N/A	Medium strength	Stiff	68.52	140.87
WS101	3.00	Sandy CLAY	9	7.83	N/A	Low strength	Firm	39.13	80.46
WS101	4.00	Sandy CLAY	14	11.83	N/A	Medium strength	Stiff	59.14	121.59
WS102	1.00	MG: Sandy gravel	22	22.18	Medium Dense	N/A	N/A	N/A	221.79
WS102	2.00	MG: Sandy gravel	13	11.88	Medium Dense	N/A	N/A	N/A	118.76
WS103	1.00	MG: Sandy gravel	16	16.13	Medium Dense	N/A	N/A	N/A	161.30
WS103	2.00	MG: Sandy gravel	17	15.53	Medium Dense	N/A	N/A	N/A	155.30
WS103	3.00	MG: Sandy gravel	21	18.26	Medium Dense	N/A	N/A	N/A	182.63
WS103	4.00	MG: Sandy gravel	13	10.98	Medium Dense	N/A	N/A	N/A	109.83
WS103	5.00	MG: Sandy gravel	12	9.96	Loose	N/A	N/A	N/A	99.55



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BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE (N ₁) ₆₀	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m ²)	ALLOWABLE BEARING PRESSURE (kN/m ²)*
WS104	1.00	MG: Sandy gravel	21	21.17	Medium Dense	N/A	N/A	N/A	211.71
WS104	2.00	MG: Sandy gravel	11	10.05	Medium Dense	N/A	N/A	N/A	100.49
WS104	3.00	MG: Sandy gravel	7	6.09	Loose	N/A	N/A	N/A	60.88
WS104	4.00	MG: Sandy gravel	15	12.67	Medium Dense	N/A	N/A	N/A	126.73
WS104	5.00	MG: Sandy gravel	6	4.98	Loose	N/A	N/A	N/A	49.78
WS105	1.00	MG: Sandy gravel	23	23.19	Medium Dense	N/A	N/A	N/A	231.87
WS105	2.00	MG: Sandy gravel	15	13.70	Medium Dense	N/A	N/A	N/A	137.03
WS105	3.00	MG: Sandy gravel	10	8.70	Loose	N/A	N/A	N/A	86.97
WS105	4.00	MG: Sandy gravel	17	14.36	Medium Dense	N/A	N/A	N/A	143.62
WS105	5.00	MG: Sandy gravel	26	21.57	Medium Dense	N/A	N/A	N/A	215.70
WS106b	1.00	MG: Sandy gravel	20	20.16	Medium Dense	N/A	N/A	N/A	201.63
WS106b	2.00	MG: Sandy gravel	12	10.96	Medium Dense	N/A	N/A	N/A	109.62
WS106b	3.00	MG: Sandy gravel	10	8.70	Loose	N/A	N/A	N/A	86.97



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WS106b	4.00	MG: Sandy gravel	8	6.76	Loose	N/A	N/A	N/A	67.59
WS106b	5.00	PEAT	16	13.27	N/A	Medium strength	Stiff	66.37	136.46
WS107	1.00	MG: Sandy gravel	11	11.09	Medium Dense	N/A	N/A	N/A	110.90
WS107	2.00	MG: Sandy gravel	11	10.05	Medium Dense	N/A	N/A	N/A	100.49
WS107	3.00	MG: Sandy gravel	7	6.09	Loose	N/A	N/A	N/A	60.88
WS107	4.00	MG: Sandy gravel	14	11.83	Medium Dense	N/A	N/A	N/A	118.28
WS107	5.00	MG: Sandy gravel	21	17.42	Medium Dense	N/A	N/A	N/A	174.22
WS108	1.00	MG: Sandy gravel	17	17.14	Medium Dense	N/A	N/A	N/A	171.39
WS108	2.00	MG: Sandy gravel	10	9.14	Loose	N/A	N/A	N/A	91.35
WS108	3.00	MG: Sandy gravel	6	5.22	Loose	N/A	N/A	N/A	52.18
WS108	4.00	MG: Sandy gravel	4	3.38	Very Loose	N/A	N/A	N/A	33.79
WS108	5.00	PEAT	15	12.44	N/A	Medium strength	Stiff	62.22	127.93
WS109	1.00	MG: Gravelly sand	7	7.06	Loose	N/A	N/A	N/A	70.57
WS109	2.00	MG: Gravelly sand	1	0.91	Very Loose	N/A	N/A	N/A	9.13



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WS109	3.00	MG: Gravelly sand	1	0.87	Very Loose	N/A	N/A	N/A	8.70
WS109	4.00	Gravelly CLAY	10	8.45	N/A	Medium strength	Stiff	42.24	86.85
WS109	5.00	Gravelly CLAY	10	8.30	N/A	Medium strength	Stiff	41.48	85.29
WS110	1.00	MG: Gravelly sand	5	5.04	Loose	N/A	N/A	N/A	50.41
WS110	2.00	MG: Gravelly sand	3	2.74	Very Loose	N/A	N/A	N/A	27.41
WS110	3.00	Clayey SAND	13	11.31	Medium Dense	N/A	N/A	N/A	113.05
WS110	4.00	Clayey SAND	11	9.29	Loose	N/A	N/A	N/A	92.93
WS110	5.00	Clayey SAND	9	7.47	Loose	N/A	N/A	N/A	74.67
WS111	1.00	MG: Gravelly sand	13	13.11	Medium Dense	N/A	N/A	N/A	131.06
WS111	2.00	MG: Gravelly sand	2	1.83	Very Loose	N/A	N/A	N/A	18.27
WS111	3.00	MG: Gravelly sand	3	2.61	Very Loose	N/A	N/A	N/A	26.09
WS111	4.00	MG: Gravelly sand	2	1.69	Very Loose	N/A	N/A	N/A	16.90
WS111	5.00	MG: Gravelly sand	3	2.49	Very Loose	N/A	N/A	N/A	24.89
WS112	1.00	MG: Gravelly sand	16	16.13	Medium Dense	N/A	N/A	N/A	161.30
WS112	2.00	MG: Gravelly sand	5	4.57	Loose	N/A	N/A	N/A	45.68



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WS112	3.00	MG: Gravelly sand	4	3.48	Very Loose	N/A	N/A	N/A	34.79
WS112	4.00	MG: Gravelly sand	4	3.38	Very Loose	N/A	N/A	N/A	33.79
WS112	5.00	MG: Gravelly sand	4	3.32	Very Loose	N/A	N/A	N/A	33.18
WS113	1.00	MG: Gravelly sand	15	15.12	Medium Dense	N/A	N/A	N/A	151.22
WS113	2.00	MG: Gravelly sand	4	3.65	Very Loose	N/A	N/A	N/A	36.54
WS113	3.00	No return	1	0.87	Very Loose	N/A	N/A	N/A	8.70
WS113	4.00	No return	1	0.84	Very Loose	N/A	N/A	N/A	8.45
WS113	5.00	No return	4	3.32	Very Loose	N/A	N/A	N/A	33.18
WS114b	1.00	MG: Gravelly sand	5	5.04	Loose	N/A	N/A	N/A	50.41
WS114b	2.00	MG: Gravelly sand	0	0.00	Very Loose	N/A	N/A	N/A	0
WS114b	3.00	MG: Gravelly sand	0	0.00	Very Loose	N/A	N/A	N/A	0
WS114b	4.00	MG: Gravelly sand	2	1.69	Very Loose	N/A	N/A	N/A	16.90
WS114b	5.00	MG: Gravelly sand	10	8.30	Loose	N/A	N/A	N/A	82.96
CP101	1.00	MG: Sandy gravel	7	7.06	Loose	N/A	N/A	N/A	70.57
CP101	2.00	MG: Sandy gravel	4	3.65	Very Loose	N/A	N/A	N/A	36.54
CP101	3.00	MG: Sandy gravel	3	2.61	Very Loose	N/A	N/A	N/A	26.09
CP101	4.00	Sandy CLAY	3	2.53	N/A	Very low strength	Soft	12.67	26.06



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CP101	5.00	Sandy CLAY	15	12.44	N/A	Medium strength	Stiff	62.22	127.93
CP101	6.50	SAND	17	13.88	Medium Dense	N/A	N/A	N/A	138.79
CP101	8.00	SAND	16	12.95	Medium Dense	N/A	N/A	N/A	129.51
CP101	9.50	SAND	18	14.51	Medium Dense	N/A	N/A	N/A	145.07
CP101	11.00	SAND	19	14.69	Medium Dense	N/A	N/A	N/A	146.94
CP101	12.5	Sandy CLAY	23	16.80	N/A	High strength	Very Stiff	84.02	172.75
CP101	14.5	Sandy CLAY	28	19.07	N/A	High strength	Very Stiff	95.34	196.01
CP102	1.00	MG: Gravelly sand	5	5.04	Loose	N/A	N/A	N/A	50.41
CP102	2.00	MG: Gravelly sand	4	3.65	Very Loose	N/A	N/A	N/A	36.54
CP102	3.00	PEAT	3	2.61	N/A	Very low strength	Soft	13.04	26.82
CP102	4.00	PEAT	4	3.38	N/A	Very low strength	Soft	16.90	34.74
CP102	5.00	PEAT	5	4.15	N/A	Low strength	Firm	20.74	42.64
CP102	6.50	Gravelly SAND	36	29.39	Medium Dense	N/A	N/A	N/A	293.90



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CP102	8.00	Gravelly SAND	39	31.57	Dense	N/A	N/A	N/A	315.69
CP102	9.50	Sandy CLAY	27	21.76	N/A	High strength	Very Stiff	108.80	223.70
CP102	11.00	Sandy CLAY	26	20.11	N/A	High strength	Very Stiff	100.54	206.70
CP102	12.50	Sandy CLAY	26	19.00	N/A	High strength	Very Stiff	94.98	195.28
CP102	14.00	Sandy CLAY	36	24.94	N/A	High strength	Very Stiff	124.69	256.36

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.



8.9. SIDE STABILITY AND EASE OF EXCAVATION

The sides of the trial pit excavations were generally unstable within the Made Ground during excavation, with frequent sidewall collapse observed.

The presence of brick and concrete cobbles within the Made Ground deposits meant that in certain places, excavation was slow through the Made Ground and in many locations could not be fully penetrated.

The natural strata was excavated with relative ease.

8.10. CONSOLIDATION

An undisturbed sample of Glacial Till was submitted for oedometer analysis. The results are provided in Table 8.8.

TABLE 8.8 OEDOMETER CONSOLIDATION RESULTS

LOCATION	DEPTH (m)	SAMPLE TYPE	MOISTURE CONTENT (%)	OEDOMETER CONSOLIDATION		
				PRESSURE RANGE (kPa)	M _v (m ² /MN)	C _v (m ² /year)
WS101	1.50-2.00	U100	19	0-35	0.254	14.760
				35-70	0.190	12.498
				70-140	0.155	10.218
				140-280	0.113	10.133
				280-35	0.040	10.861

When considered at over-burden pressure with an additional load of 110 kPa the coefficient of volume compressibility (M_v) was 0.155 m²/MN. The material is considered to be very low to medium compressibility.

The rate at which settlement is likely to occur is determined by the coefficient of consolidation (C_v). As shown in Table 8.8, the coefficient ranges from 10.133 m²/yr to 14.760 m²/yr. The rate at which settlement will occur is increased by the presence of sand within the Glacial Till and it is likely that settlement will occur over a period of months to years.

8.11. SOIL DENSITY/MOISTURE CONTENT RELATIONSHIP

Dry density / moisture content relationship analysis has been conducted on Made Ground soils using via utilising proctor compaction tests utilising a 2.5 kg rammer, in order to show the reengineering properties of the material.

The results of the tests have been summarised in Table 8.9. The full test results can be found in Appendix VIII.



TABLE 8.9 SUMMARY DRY DENSITY AND MOISTURE CONTENT

LOCATION	LABORATORY DESCRIPTION	TOP DEPTH (m)	METHOD OF COMPACTION	INITIAL MOISTURE CONTENT (%)	OPTIMUM MOISTURE CONTENT (%)	MATERIAL RETAINED ON 37.5 mm SIEVE (%)	MAX DRY DENSITY (mg/m ³)	MATERIAL RETAINED ON 20.0 mm TEST SIEVE (%)
TP105	Class 1A (MADE GROUND)	1.00	2.5 kg	19	19	0	1.60	33
TP111	Class 1A (MADE GROUND)	1.00	2.5 kg	20	20	7	1.54	24

The compaction tests have indicated that the as dug materials on site are at the optimum moisture content. Should the materials be re-used, the moisture content will need to be carefully managed to ensure the material can be suitably reengineered.

8.12. SOIL PLASTICITY

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

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

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

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

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

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

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

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

The Atterberg limits determinations, summarised in Table 8.10, show the clay drift to be of low plasticity.

TABLE 8.10 SUMMARY OF PLASTICITY INDEX TEST RESULTS

LOCATION	DEPTH (m)	NATURAL MOISTURE CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	PASSING 425 µm SIEVE (%)	MODIFIED PLASTICITY INDEX	NHBC VOLUME CHANGE POTENTIAL
WS101	3.00	19	15	27	12	96	11.52	Low
WS109	4.00	21	NP	–	–	–	–	–



LOCATION	DEPTH (m)	NATURAL MOISTURE CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	PASSING 425 µm SIEVE (%)	MODIFIED PLASTICITY INDEX	NHBC VOLUME CHANGE POTENTIAL
WS110	3.00	11	NP	–	–	–	–	–
CP101	4.00	19	15	26	11	97	10.67	Low
CP102 (PEAT)	3.00	198	73	303	230	88	202.4	Very High
CP102	9.50	18	19	38	19	96	18.24	Low

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

The sample of peat analysed was confirmed to have a high liquid limit and plasticity index, resulting in a very high volume change potential due to the highly compressible nature of the material.

8.13. pH AND SULPHATE

Chemical analyses for pH and soluble sulphate content contained in Appendix VI (summarised in Table 8.11).

TABLE 8.11 SUMMARY OF pH AND SULPHATE DATA

LOCATION	DEPTH (m)	SO ₄ IN 2:1 WATER/SOIL (g/l)	pH VALUE	CLASSIFICATION
TP108	1.00	0.081	7.1	DS-1, AC-1s
TP112	1.30	0.240	7.6	DS-1, AC-1s
TP115	1.00	0.088	7.6	DS-1, AC-1s
TP117	1.00	0.150	7.1	DS-1, AC-1s
WS104	3.20	0.320	7.5	DS-1, AC-1s
WS104	4.30	0.029	7.6	DS-1, AC-1s
WS109	2.20	0.110	7.9	DS-1, AC-1s
WS110	2.80	0.021	8.5	DS-1, AC-1s
WS111	1.60	0.066	6.7	DS-1, AC-1s
WS112	1.00	0.027	7.3	DS-1, AC-1s
WS113	2.20	0.082	7.9	DS-1, AC-1s
WS114b	1.70	0.170	7.9	DS-1, AC-1s
TP201	0.60	0.019	7.5	DS-1, AC-1S
TP205	0.70	0.052	8.3	DS-1, AC-1S
TP207	0.60	0.760	7.2	DS-2, AC-1S
TP211	0.70	0.090	8.2	DS-1, AC-1S



LOCATION	DEPTH (m)	SO ₄ IN 2:1 WATER/SOIL (g/l)	pH VALUE	CLASSIFICATION
TP211	1.90	0.460	7.0	DS-1, AC-1S
R0201	7.00	0.024	7.1	DS-1, AC-1S
R0203	6.00	0.014	6.6	DS-1, AC-1S
R0206	6.00	0.051	7.0	DS-1, AC-1S
R0210	7.00	0.110	4.8	DS-1, AC-1S
R0228	7.00	0.053	U/S	DS-1, AC-1S
HP101	0.60	0.024	8.0	DS-1, AC-1S
HP102	0.70	0.077	7.0	DS-1, AC-1S
HP103	0.80	0.031	8.5	DS-1, AC-1S
HP104	0.50	0.062	11.3	DS-1, AC-1S
HP105	0.70	0.050	8.0	DS-1, AC-1S
HP106	0.50	0.049	7.3	DS-1, AC-1S
HP107	0.70	0.033	8.5	DS-1, AC-1S
SP101	N/A	0.360	9.8	DS-1, AC-1S
SP102	N/A	0.100	10.8	DS-1, AC-1S
SP103	N/A	0.800	8.0	DS-2, AC-1S

The results show that the soils at the site generally meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with BRE *Special Digest 1* (2005).

However, the Made Ground in at 0.60 m bgl in TP207 and sample SP103 taken from stockpiled materials on site have been classified as DS-2, AC-1s.

When a large dataset is available, characteristic sulphate and pH values should be adopted to characterise the site. For a dataset of ten or more samples, the characteristic value is calculated from the mean of the highest 20% of sulphate results and lowest 20% of pH results. Based on the data available the characteristic sulphate value would be 0.49 g/l, and the characteristic pH value would be 6.6, thus resulting in an overall classification of DS-1, AC-1s (based on static groundwater).



9. TIER I QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT

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

9.1. DEVIATING SAMPLES

There were no deviating samples identified within any of the samples submitted for chemical analysis.

9.2. HUMAN HEALTH RISK ASSESSMENT

At Tier 1 stage, the long term (chronic) human health toxicity of the soil has been assessed by comparing the on-site concentrations of organic and inorganic compounds with reference values published in LQM/CIEH S4UL (S4UL3267) relevant to Residential End Use with Plant Uptake based on 1% Soil Organic Matter (SOM).

The results of this comparison have been summarised within Table 9.1.

Where Tier 1 screening values are not provided by LQM, other screening values have been used (ATRISK and US EPA) as referenced in Table 9.1.



TABLE 9.1 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	20	290	TP106 1.60m TP108 1.00m TP112 1.30m TP115 1.00m TP116 1.20m TP121 1.00m WS104 3.20m WS109 2.20m WS111 1.60m WS112 1.00m WS114b 1.70m TP201 0.60m TP207 0.60m TP211 0.70m TP211 1.90m TP213 0.60m HP102 0.70m	1	Further Action
Cadmium	mg/kg	17	20	2.5	N/A	1	No Further Action
Chromium (VI)	mg/kg	6.1	19	<4.0	N/A	1	No Further Action
Lead	mg/kg	200	20	2500	TP106 1.60m TP108 1.00m TP112 1.30m TP115 1.00m TP116 1.20m TP121 1.00m WS104 3.20m WS109 2.20m WS112 1.00m WS113 2.20m WS114b 1.70m TP201 0.60m TP205 0.70m TP207 0.60m TP211 0.70m TP211 1.90m TP213 0.60m HP101 0.70m HP102 0.70m HP104 0.50m SP103	1	Further Action
Total Mercury	mg/kg	1.2	20	17	TP115 1.00m TP116 1.20m TP121 1.00m WS112 1.00m WS113 2.20m WS114b 1.70m TP201 0.60m TP207 0.60m TP211 1.90m TP213 0.60m	3	Further Action



DETERMINANT	UNIT	GAC	N	MC	LOC. OF EX	PATH -WAY	ASSESSMENT
					HP102 0.70m HP104 0.50m SP103		
Nickel	mg/kg	180	20	79	N/A	1	No Further Action
Selenium	mg/kg	250	20	<1.0	N/A	1	No Further Action
Copper	mg/kg	2400	20	1300	N/A	1	No Further Action
Zinc	mg/kg	3700	20	2000	N/A	1	No Further Action
Cyanide – Total	mg/kg	791	19	270	N/A	1	No Further Action
Phenols – Total	mg/kg	210	12	15	N/A	1	No Further Action
Asbestos	Fibres	NFD	17	<0.001	TP112 1.30m	3	Further Action
Naphthalene	mg/kg	2.3	20	10000	TP115 1.00m TP116 1.20m WS101 0.50m WS104 3.20m WS105 4.90m WS106a 4.60m WS107 2.10m WS109 2.20m TP201 0.60m TP207 0.60m TP211 0.70m TP211 1.90m TP213 0.60m SP103	4	Further Action
Acenaphthylene	mg/kg	170	20	1400	TP211 1.90m	2	Further Action
Acenaphthene	mg/kg	210	20	4300	WS104 3.20m WS105 4.90m TP211 1.90m	1	Further Action
Fluorene	mg/kg	170	20	830	WS104 3.20m WS105 4.90m	1	Further Action
Phenanthrene	mg/kg	95	20	8700	WS104 3.20m WS105 4.90m WS106a 4.60m TP211 1.90m	2	Further Action
Anthracene	mg/kg	2400	20	2700	TP211 1.90m	2	Further Action
Fluoranthene	mg/kg	280	20	2200	WS104 3.20m TP211 1.90m	2	Further Action
Pyrene	mg/kg	620	20	1500	TP211 1.90m	2	Further Action
Benzo(a)Anthracene	mg/kg	7.2	20	210	TP115 1.00m TP116 1.20m TP121 1.00m WS104 3.20m WS105 4.90m WS107 2.10m WS113 2.20m TP201 0.60m	2	Further Action



DETERMINANT	UNIT	GAC	N	MC	LOC. OF EX	PATH -WAY	ASSESSMENT
					TP211 1.90m TP213 0.6m		
Chrysene	mg/kg	15	20	190	TP115 1.00m TP116 1.20m WS104 3.20m WS105 4.90m WS107 2.10m WS113 2.20m TP201 0.60m TP211 1.90m TP213 0.60m	2	Further Action
Benzo(b)Fluoranthene	mg/kg	2.6	20	54	TP108 1.00m TP115 1.00m TP116 1.20m TP121 1.00m WS101 0.50m WS104 3.20m WS105 4.90m WS106a 4.60m WS107 2.10m WS109 2.20m WS112 1.00m WS113 2.20m WS114b 1.70m TP201 0.60m TP205 0.70m TP207 0.60m TP211 0.70m TP211 1.90m TP213 0.6m HP102 0.70m HP104 0.50m SP101 SP103	2	Further Action
Benzo(k)Fluoranthene	mg/kg	77	20	20	N/A	2	No Further Action
Benzo(a)Pyrene	mg/kg	2.2	20	48	TP108 1.00m TP115 1.00m TP116 1.20m TP117 1.00m TP121 1.00m WS101 0.50m WS104 3.20m WS105 4.90m WS107 2.10m WS109 2.20m WS112 1.00m WS113 2.20m TP201 0.60m TP207 0.60m TP211 0.70m TP211 1.90m TP213 0.6m	2	Further Action



DETERMINANT	UNIT	GAC	N	MC	LOC. OF EX	PATH -WAY	ASSESSMENT
					HP102 0.70m HP104 0.50m SP101 SP103		
Indeno(123-cd)Pyrene	mg/kg	27	20	14	N/A	2	No Further Action
Dibenzo(a,h)Anthracene	mg/kg	0.24	20	3.9	TP115 1.00m TP116 1.20m TP121 1.00m WS101 0.50m WS107 2.10m WS109 2.20m WS112 1.00m WS113 2.20m WS114b 1.70m TP201 0.6m TP213 0.6m HP102 0.70m HP104 0.50m SP101 SP103	2	Further Action
Benzo(ghi)Perylene	mg/kg	320	20	17	N/A	2	No Further Action
TPH C5-C6 (aliphatic)*	mg/kg	42	19	<1.0	N/A	4	No Further Action
TPH C6-C8 (aliphatic)*	mg/kg	100	19	5.7	N/A	4	No Further Action
TPH C8-C10 (aliphatic)*	mg/kg	27	19	80	TP211 1.90m	4	Further Action
TPH C10-C12 (aromatic)*	mg/kg	74	19	11000	WS104 3.20m WS105 4.90m TP211 0.70m TP211 1.90m	4	Further Action
TPH C12-C16 (aromatic)*	mg/kg	140	19	7800	WS104 3.20m WS105 4.90m TP210 0.60m TP211 1.90m	4	Further Action
TPH C16-C21 (aromatic)*	mg/kg	260	19	20000	WS104 3.20m WS105 4.90m WS106a 4.60m TP201 0.60m TP211 1.90m TP213 0.60m	1	Further Action
TPH C21-C35 (aromatic)*	mg/kg	1100	19	3300	TP201 0.60m TP211 1.90m	1	Further Action
Benzene	ug/kg	0.087	3	<0.1	N/A	4	No Further Action
Toluene	ug/kg	130	3	11	WS104 3.20m	4	Further Action
Ethylbenzene	ug/kg	47	3	39	N/A	4	No Further Action
p & m-Xylene	ug/kg	56	3	55	N/A	4	No Further Action
o-Xylene	ug/kg	60	3	49	N/A	4	No Further Action
Isopropylbenzene**	ug/kg	46900	3	10	N/A	4	No Further Action



DETERMINANT	UNIT	GAC	N	MC	LOC. OF EX	PATH -WAY	ASSESSMENT
1,3,5-Trimethylbenzene***	ug/kg	810	3	120	N/A	4	No Further Action
1,2,4-Trimethylbenzene**	ug/kg	1170	3	160	N/A	4	No Further Action
2-Methylnaphthalene***	ug/kg	720	3	2.4	N/A	4	No Further Action

Notes

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

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

* The Tier 1 GAC for the hydrocarbon fraction is derived from the CIEH assessment for petroleum hydrocarbons Criteria Working Group (CWG) for both aliphatic and aromatic compounds. E3P has utilised the Tier 1 values for aliphatic compounds for the volatile and semi volatile fractions (C5-C12) and the Tier 1 values for aromatic compound for the non-volatile fractions (C12-C35). The comparison of a total (aliphatic/aromatic) compounds to an individual fraction is considered to be a conservative approach and satisfactory for the protection of human health.

** Atkins ATRISK

*** USEPA Risk Management Levels

Referring to Table 9.1, the result of this direct comparison indicates that the data exceeds the screening criteria for a residential end use for the following contaminants:



✿ Heavy Metals:

- Arsenic;
- Lead; and,
- Mercury (potentially volatile).

✿ Non-Volatile PAH:

- Acenaphthene;
- Acenaphthylene;
- Fluorene;
- Phenanthrene;
- Fluoranthene;
- Benzo(a)Anthracene;
- Chrysene;
- Benzo(b)Fluoranthene;
- Benzo(a)Pyrene;
- Dibenzo(a,h)Anthracene;

✿ Petroleum Hydrocarbon Fractions C8-C35 (potentially volatile in C5-C16 range)

✿ S/VOC – Naphthalene & Toluene

✿ Asbestos – Loose chrysotile <0.001% wt/wt.

The locations of contaminant exceedances are shown on Drawing no. 14-768-018 in Appendix III.

Three samples taken from TP101, TP113 and TP124 were tested for PCBs due to the historical presence of railway sidings and substations on the site. Concentrations were found to be below the limit of detection (LOD) in each of the samples.

Concentrations of Isopropylbenzene, p-isopropyltoluene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene, and 2-Methylnaphthalene (VOCs) were found above the LOD in the Made Ground in WS104 at 1.40 m and 3.20 m bgl. No screening criteria is available for p-isopropyltoluene, however, comparison of the other identified VOCs to available GAC values indicates no exceedances in respect of human health. The identified VOCs are typical derivatives of oil and petroleum products. WS104 is located in the centre west of the site, in the location of a former tank and gasometer and it is thus inferred that localised spillage / leakage has occurred here.

Other potentially volatile contaminants have also been detected at concentrations in exceedance of GAC values at numerous locations, including Toluene (WS104 at 3.20 m bgl), Naphthalene (with a maximum concentration 10000 mg/kg in TP211 at 1.90 m bgl) and TPH C8-16 (with a maximum concentration also detected in TP211 at 1.90 m bgl). It is noted that TP211 is located in the area of a former travelling crane and in close proximity to WS105, and southwest of WS104; in both locations Naphthalene and volatile TPH were also recorded, together with visual and olfactory evidence of contamination.



Elevated Mercury has also been frequently encountered. Mercury comes in three different forms; elemental mercury, inorganic mercury and organic mercury (or methyl mercury), each with a specific GAV value. Elemental mercury is volatile (vapour inhalation risk) and therefore has the most conservative GAC value of 1.2 mg/kg. Where the total mercury concentration exceeds 1.2 mg/kg, speciation should be undertaken to determine the volatile risk.

Across the three phases of investigation, thirteen samples were found to contain concentrations of total mercury in exceedance of 1.2 mg/kg. Speciation was therefore carried out on an initial two samples TP115 at 1.00 m located in the centre-west of the site, and TP121 at 1.00 m located in the north east, to determine the volatile risk.

This speciation indicated that both samples were predominantly inorganic, with elevated elemental Mercury in TP121. The results are summarised in Table 9.2.

TABLE 9.2 MERCURY SPECIATION

LOCATION	DEPTH (m)	INORGANIC MERCURY (mg/kg)	ORGANO-MERCURY SPECIES (mg/kg)	ELEMENTAL MERCURY (mg/kg)
TP115	1.00	1.283	0.042	0.398
TP121	1.00	1.693	0.168	1.608

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

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

- Soil ingestion;
- Vapour inhalation (indoor);
- Dermal contact and ingestion;
- Consumption of homegrown vegetables; and,
- Fibre/dust inhalation.

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 on inorganic heavy metals and non-volatile PAH compounds can be mitigated through the installation of a suitable cover system. Given the widespread distribution of the contamination, the cover system would be required in all proposed private gardens, landscaping, and public open space to remove any potential for direct exposure to impacted soils.

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



FIGURE 9.1 ASBESTOS RISK MITIGATION CONCEPTUAL SITE MODEL



ND None Detected

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

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

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

SVOC contamination (elemental mercury, naphthalene, toluene and aromatic hydrocarbon fractions C8-C16) has been encountered across the site in Made Ground at depths of between 0.50 m and 4.90 m bgl. It is noted that only two samples containing elevated concentrations of total mercury have been speciated, however, given the spread and depth of encounter of other identified SVOCs, it is considered that the contamination is widespread, and it would be impractical and costly to delineate and excavate.

In order to assess the risks from the identified volatile contaminants a Tier 2 DQRA has been undertaken to model the actual vapour emission risk from residue within the anthropogenic material in order to determine whether specialist hydrocarbon resistant membranes will be required to the dwellings.

The full Tier 2 assessment to assess the vapour risk from hydrocarbon, naphthalene, toluene and mercury is presented in the Section 9.2.

It is considered that chemical analysis of the natural clay drift deposits will identify these soils to be acceptable for use as subsoil within the proposed garden areas subject to further chemical validation; however, given the depth of Made Ground on-site, it is unlikely that subsoils will be excavated.

There are no suitable sources of topsoil available on the site.



9.3. TIER 2 VAPOUR RISK ASSESSMENT

To assist in determining the potential vapour risk, E3P has completed a soil vapour survey to quantify hydrocarbon, naphthalene, toluene and mercury vapour concentrations present in the subsurface soils and assess whether these will present a long term human health risk to the future site users through indoor volatilisation and inhalation.

9.3.1. NAPHTHALENE AND TPH COMPOUND ANALYSIS METHODOLOGY

Analytical Thermal Desorption (ATD) tubes have been installed within pre-existing wells and sampling was completed via active pump sampling using a pump and rotometer to collect the required 10 litre volume of air.

Each ATD tube in each location has been tested for the following set of compounds:

- ✳ Naphthalene
- ✳ Aliphatic / Aromatic Banding TPH Compounds
- ✳ BTEX Compounds

ATD tubes have been supplied by i2 Analytical Laboratory (UKAS Accredited), who also completed the laboratory analysis.

E3P attended site on the 9th November 2021 to install ATD tubes into five monitoring wells widely spaced across the site and targeting particular locations where previously elevated concentrations of the volatile compounds had been encountered.

Due to time constraints, the active pump sampling was carried out across the 16th and 19th November 2021.

ATD tubes have been installed within the locations detailed within Table 9.3 and shown on Drawing no. . A summary of the associated strata and monitoring wells response zone are also included.

TABLE 9.3 VAPOUR MONITORING LOCATION RATIONALE

LOCATION	RATIONAL / STRATA	DEPTH OF MONITORING WELL (m)
WS107	Made Ground / General Coverage.	1.00 – 4.50
WS106b	Made Ground with hydrocarbon impact.	1.00 – 3.00
WS105	Made Ground with hydrocarbon impact. Closest available location to TP211.	1.00 – 3.00
RO225	To target WS104 which could not be located. Closest available location to TP211.	1.00 – 4.00
WS110	Made Ground. Closest available location to TP116 with elevated Naphthalene.	1.00 – 5.00

On completion of the active pump sampling, the tubes were removed and sealed in strict accordance with the laboratory sampling procedures and shipped for analysis. Once the compounds have absorbed onto the carbon sorption tubes, the sample is stable and is not subject to degradation.



It is noted that significant odours and concentrations of volatile TPH fractions and Naphthalene were recorded in TP211 at 1.90 m bgl. The closest monitoring installations to this location are WS105, WS104 and RO225. It was attempted to drill RO217 in the vicinity of TP211 to facilitate the installation of a monitoring well, however, the location could not be accessed due to uneven ground and vegetation.

9.3.2. MERCURY ANALYSIS METHODOLOGY

During the Geoenvironmental Site Assessment undertaken by E3P, 13 samples returned elevated concentrations of total mercury when compared with the most conservative screening value of 1.2 mg/kg for elemental (volatile) mercury.

Given the prevalence of elevated total mercury in the soils, it was considered that a volatile risk assessment as opposed to widespread speciation would be a more effective assessment.

However, due to the low limit of detection for vaporific mercury, the time required to actively pump an adequate volume of air under the appropriate flow rate (12-13 hours) was considered unviable. Passive sampling was also considered likely to be unsuccessful due to the increased potential of water damage to semi-permanent tubes installed within the monitoring wells over long periods during the winter months.

The assessment was therefore carried out using SKC 520 Series elemental mercury passive samplers obtained from and analysed by SKC Ltd.

The passive samplers measure exposure levels as a Time-Weighted Average (TWA) and only samples elementary mercury (Hg) in the vapour phase; it does not sample elemental Hg in the particulate phase or organic mercury compounds. Mercury vapour enters the sampler by positive, controlled diffusion so that a known sample volume is taken for a given period of time.

For the required volume of air to be sampled, a minimum sampling time of 130 hours was required.

E3P attended site on the 12th January to install the passive samplers into five monitoring wells widely spaced across the site and targeting particular locations where previously elevated concentrations of total mercury had been encountered.

Passive samplers have been installed within the locations detailed within Table 9.4. A summary of the associated strata and monitoring wells response zone are also included.

TABLE 9.4 MERCURY MONITORING LOCATION RATIONALE

LOCATION	RATIONAL / STRATA	DEPTH OF MONITORING WELL (m)
WS114b	Made Ground / Elevated Mercury	1.00 – 4.00
WS112	Made Ground / Elevated Mercury	1.00 – 5.00
WS105	Made Ground / General Coverage	1.00 – 3.00
RO225	Made Ground / General Coverage	1.00 – 4.00
WS107	Made Ground / General Coverage	1.00 – 4.50

On completion of the passive sampling, the samplers were removed and sealed in strict accordance with the laboratory sampling procedures, and shipped for analysis.



9.3.3. NAPHTHALENE AND TPH COMPOUND ANALYSIS RESULTS

The results of the laboratory analysis of the ATD tubes for TPH and naphthalene have been summarised with in Table 9.5 and are presented in full in Appendix VI.

TABLE 9.5 SUMMARY OF TIME WEIGHTED AVERAGES (TPH AND NAPHTHALENE)

TPH COMPOUND	WS107 300038		WS105 300039		WS106 300040		RO225 300041		WS111 300042	
	ng	mg/m ³	ng	mg/m ³	ng	mg/m ³	ng	mg/m ³	ng	mg/m ³
Aliphatic C6-C8	850	0.0178	<10	0.0002	610	0.0128	1200	0.0258	270	0.0056
Aliphatic C8-C10	2000	0.0413	<10	0.0002	2700	0.0573	1500	0.0321	1300	0.0275
Aliphatic C10-C12	1700	0.0348	<10	0.0002	2500	0.0525	410	0.0086	9200	0.1925
Aromatic C6-C8	84	0.0018	<10	0.0002	180	0.0037	300	0.0063	33	0.0020
Aromatic C8-C10	680	0.0141	<10	0.0002	1800	0.0383	1500	0.0313	2900	0.0613
Aromatic C10-C12	970	0.0202	<10	0.0002	1100	0.0235	2000	0.0086	3500	0.0740
Naphthalene	11.5	0.0002	<10	0.0000	14.6	0.0003	26.9	0.0006	32.5	0.0007
Toluene	84.4	0.0018	<10	0.0000	58.5	0.0012	300.7	0.0063	97.8	0.0020

9.3.4. DQRA ASSESSMENT OF NAPHTHALENE AND BANDED TPH COMPOUNDS

In order to determine if the vapour concentrations detected would generate a risk to human health, the results in µg/m³ have to be assessed against the Tolerable Daily Intake values (TDIs) for the relevant compound or group which are shown in Table 9.6 and Table 9.7 (ID).

The proposed residential end use means that the critical receptor in this instance for any vapour inhalation is a 0-6 year old child of approximately 12.70 kg who breathes circa 11.85 m³ of air per day.

TABLE 9.6 CHEMICAL PARAMETERS (TDI)

COMPOUND	TDI _{inhal} ug kg ⁻¹ BW day ⁻¹	SOURCE
Naphthalene	60 0.86	TPH CWG USEPA (1998a)
Toluene	1400	TPH CWG
C5-C6 aliphatic	5000	TPH CWG
C6-C8 aliphatic		
C8-C10 aliphatic	290	
C10-C12 aliphatic		
C12-C16 aliphatic		
C5-C7 aromatic	1400	Environment Agency (2009) Contaminates in Soil: updated collation of toxicological data and intake values for humans. Toluene
C7-C8 aromatic		
C8-C10 aromatic	60	TPH CWG
C10-C12 aromatic		
C12-C16 aromatic		



TABLE 9.7 PHYSIOLOGICAL PARAMETERS AND JUSTIFICATION

PARAMETER	VALUE	SOURCE	JUSTIFICATION
Average body weight	12.70 kg	Table 4.6 SR3	Based on a 3 year old female child
Daily Inhalation Rate (long term exposure)	11.85 m ³ /day	Table 4.14 SR3	Based on a 0-6 year old female child

E3P has used the above data to devise Site Specific Screening Values (SSSVs) for each individual compounds or group using the below formula:

$$\text{Site Specific Screening Value} = \frac{\text{TDI (inhal)} \times \text{Body Weight}}{\text{Daily Inhalation Rate}}$$

The result is recorded in µg/m³ which is then divided by 1000 to give a result expressed in mg/m³, which is the unit that the analysis results are recorded in.

Table 9.8 outlines the SSSVs for the individual compounds and groups for naphthalene and banded TPH.

TABLE 9.8 SITE SPECIFIC SCREENING VALUES RESIDENTIAL EXPOSURE - mg/m³

COMPOUND	TDI _{inhal} ug kg ⁻¹ BW day ⁻¹	SITE SPECIFIC SCREENING VALUES mg/m ³
Naphthalene	60	0.0643
Toluene	1400	1.5004
C5-C6 aliphatic	5000	5.3586
C6-C8 aliphatic		5.3586
C8-C10 aliphatic	290	0.3108
C10-C12 aliphatic		0.3108
C12-C16 aliphatic		0.3108
C5-C7 aromatic	1400	1.5004
C7-C8 aromatic		1.5004
C8-C10 aromatic	60	0.0643
C10-C12 aromatic		0.0643
C12-C16 aromatic		0.0643

* Value based on ID_{inhal} ug kg⁻¹ BW day⁻¹

E3P has directly compared the SSSVs to the concentrations identified during the vapour monitoring as shown in Table 9.9.

TABLE 9.9 DQRA RESULTS (NAPHTHALENE, BTEX, BANDED TPH)

COMPOUND	SITE SPECIFIC SCREENING VALUES (mg/m ³)	MAX MONITORING RESULT (mg/m ³)	LOCATION OF EXCEEDANCE
Naphthalene	0.0643	0.0000 – 0.0007	N/A
Toluene	1.5004	0.0000 – 0.0063	N/A
C6-C8 aliphatic	5.3586	0.0002 – 0.0258	N/A
C8-C10 aliphatic	0.3108	0.0002 – 0.0413	N/A
C10-C12 aliphatic	0.3108	0.0002 – 0.1925	N/A
C6-C8 aromatic	1.5004	0.0002 – 0.0063	N/A
C8-C10 aromatic	0.0643	0.0002 – 0.0613	N/A
C10-C12 aromatic	0.0643	0.0002 – 0.0740	WS110 (0.0740)

TPH C10-C12 aromatic has been found marginally in exceedances of the SSSV within WS110 in the east of the site.

Given that the ATD tubes were installed within the ground to measure soil gas/vapour, the data is considered to capture the very worst case vapour emissions and are therefore highly conservative. It is considered that the indoor TDI concentrations will be reduced when considering an ambient environment accounting for significant dispersion of the vapours within a residential unit and when considering the residential properties will be installed with a ventilated sub-floor void.



To avoid the requirement for specialist VOC resistant membranes, in the vicinity of WS110, a process of delineation and subsequent excavation of the soils is recommended. The resulting void will then require validation (base and sides). Excavated soils may be suitable for retention in an area of no future sensitivity or removal from site.

Given the high concentrations of volatile TPH fractions and Naphthalene recorded in TP211 at 1.90 m bgl (south west of site) and absence of direct targeted monitoring at this location, further investigation to confirm the source and nature of the contamination is highly recommended and full delineation and excavation may be required to ensure no future vapour risk to residential end users.

9.3.5. ELEMENTAL MERCURY RESULTS

The results of the mercury vapour analysis are presented in Appendix IV.

The concentration of mercury was below the limit of detection in each location.

9.3.6. ELEMENTAL MERCURY ASSESSMENT

The limit of detection of the samplers was 0.2 µg and the site specific screening guideline value (SSSGV) for mercury based on TDI of 0.06 ug kg⁻¹ BW day⁻¹ x Body Weight of 12.7 kg / Daily Inhalation Rate of 11.85 m³ = 0.0643038 µg/m³.

It is noted that the LOD is 0.2 µg, which is higher than the SSSGV. It must therefore it must be assumed that the true concentrations may be up to 0.19 µg. Again, it is considered that the indoor TDI concentrations will be reduced when considering dispersion factors, as the residential properties will be installed with a sub-floor void.

It is recommended that further assessment of mercury in soils is undertaken on a site wise basis, particularly in areas where the highest total concentrations have been encountered. This testing should be supplemented by speciation to determine the spread and level of elemental (volatile) mercury present in the soils to fully appraise the risk to sensitive residential end users and potentially zone the site into discrete areas requiring further assessment/delineation.

9.3.7. CONCLUSIONS

- ✦ Vaporific TPH C10-C12 aromatic has been found marginally in exceedances of the SSSGV within WS110 in the east of the site.
- ✦ To avoid the requirement for specialist VOC resistant membranes in the vicinity of WS110, a process of delineation and subsequent excavation of the soils is recommended. The resulting void will then require validation and excavated soils may be suitable for retention in an area of no future sensitivity (proposed POS in the west of the site – subject to concentrations) or removal from site.
- ✦ With respect to mercury, due to the very low SSSGV (0.0643038 µg/m³), vapour sampling options were limited at the time of assessment due to external factors such as seasonal changes to water levels and moisture in the monitoring wells affecting the data. Passive samplers confirmed the concentration of elemental mercury to be below the limit of detection (0.2 µg) in each location. A worst case concentration of 0.19 µg/m³ must therefore be assumed.
- ✦ It is recommended that further assessment of mercury in soils is undertaken on a site wise basis, particularly in areas where the highest total concentrations have been encountered. This testing should be supplemented by speciation to determine the spread and level of elemental (volatile) mercury present in the soils to fully appraise the risk to end users and potentially zone the site into discrete areas requiring further assessment/delineation.



- ✳ Given the high concentrations of volatile TPH fractions and Naphthalene recorded in TP211 at 1.90 m bgl (southwest of site) and absence of direct targeted monitoring at this location, further investigation to confirm the source and nature of the contamination will be necessary, and full delineation and excavation may be required to ensure no future vapour risk to residential end users.
- ✳ In addition, allowances should be made for removal of contaminated soils where volatile impact is encountered in the groundwater, to thus remove the point source e.g. WS104 / WS105.

9.4. CONTROLLED WATERS RISK ASSESSMENT

E3P has undertaken a controlled waters risk assessment for the site based on the consideration of the conceptual site model and the sensitive receptors which are summarised in Table 9.10.

TABLE 9.10 CONTROLLED WATERS CONCEPTUAL MODEL AND SENSITIVITY PROFILE

DISCUSSION		SENSITIVITY RATING
Contaminant Source		
Made Ground Potentially leachable heavy metal, PAH and VOC contamination has been identified in the Made Ground.		High
Pathway		
Vertical Migration The site is underlain by Secondary A superficial and bedrock aquifers. Due to the site being underlain by moderate/high permeability granular drift deposits, vertical migration of contaminants may be facilitated. However, thick banks of glacial clay deposits have been identified at depths beyond circa 10.0 m bgl in RB101 and RB102, thus likely inhibiting downward and lateral flow.		Medium
Lateral migration Lateral migration of contaminants is considered possible due to the presence of granular drift deposits across the site.		Medium
Receptor		
Aquifer Classification in Superficial Drift Deposits	Secondary Undifferentiated / Secondary A Aquifer	Medium
Aquifer Classification in Bedrock	Secondary A Aquifer – overlain by circa 80 m of drift, thus reducing the sensitivity.	Low/Medium
Groundwater Source Protection Zone or Drinking Water Safeguard Zone	The site is not situated with a Groundwater Source Protection Zone.	Low
Distance to the Closest Groundwater Abstraction Point	None identified within a 1 km radius.	Low
Is the Site Located Within 50 m of a Surface Watercourse?	The Rochdale Canal is located east of the site. However, it is not within influencing distance or in hydraulic continuity of the site.	Medium
The ICSM developed within the context of the site setting has viable pollutant pathway, which would be the lateral migration of potentially mobile phase-soluble contaminants towards nearby surface water courses including the adjacent inland river (northern boundary) and Roeacre Brook.		



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 9.11.

TABLE 9.11 QUALITATIVE RISK TO CONTROLLED WATERS FROM SOIL ANALYTICAL RESULTS

CONTAMINANT	ASSESSMENT RATING	DISCUSSION
BTEX > 1 mg/kg	The soil data analysis has not identified detectable concentrations of VOCs above 1 mg/kg, however, further testing is recommended to confirm this.	None
Total VOC > 1 mg/kg		
Total SVOC > 1 mg/kg	SVOC analysis recorded concentrations below the laboratory LOD, however, PAH analysis has identified levels above 1 mg/kg LOD throughout the site.	Further discussion
C5-C10 > 5 mg/kg	All concentrations are below or slightly exceeding the laboratory LOD with the exception of WS105 at 4.90 m bgl of 12 mg/kg and TP211 at 1.90 m bgl with a concentration 80 mg/kg.	Further discussion
C10-C12 > 10 mg/kg	Concentrations of C10-C12 have been recorded above 10 mg/kg throughout the site and the maximum concentration was recorded in TP211 at 1.90 m bgl with a concentration 11000 mg/kg.	Further discussion
C12-C16 > 50 mg/kg	Concentrations of C12-C16 have been recorded throughout the site and the maximum concentration was recorded within TP212 at 1.90 m bgl with a concentration 7800 mg/kg.	Further discussion
Phenols > 2 mg/kg	All concentrations are below the laboratory LOD with the exception of WS104 at 3.20 m bgl of 4.1 mg/kg, and TP211 at 1.90 m bgl of 15 mg/kg.	Further discussion
Naphthalene > 2 mg/kg	Concentrations of naphthalene above 2 mg/kg have been recorded in several locations at depths between 0.50 m and 4.90 m bgl. The maximum concentration was encountered in TP211 at 1.90 m bgl (10000 mg/kg)	Further discussion
Total PAH > 10 mg/kg	Total concentrations of low-solubility PAH compounds greater than 10 mg/kg have been detected throughout the site, with a maximum concentration recorded in TP211 at 1.90 m bgl of 31400 mg/kg.	Further discussion
PCB > 1 mg/kg	PCB testing undertaken at three locations has not identified any concentrations exceeding the laboratory LOD.	None
Heavy metals > 500 mg/kg	Concentrations of heavy metals above 500 mg/kg have been recorded in several locations across the site.	Further discussion

The Tier I assessment has included a comparison of leachate analysis from samples of the Made Ground and groundwater samples to Environmental Quality Standards (EQS) in the first instance and Drinking Water Standards (DWS).

Two phased of water sampling have been conducted (March 2021 and November 2021). The results are presented in Table 9.12.

During the first visit, water samples were obtained from WS105(-1), WS101 and WS110. During the second visit, water sampleS were obtained from WS105(-2), RO221 and RO223.



TABLE 9.12 COMPARISON OF GROUNDWATER AND LEACHATE ANALYSIS WITH TIER 1 SCREENING LEVELS

DETERMINAND	UNIT	EQS ^{1,2,3}	DWS ^{3,4,5}	NO. OF GW SAMPLES	MAX CONC. IN GROUNDWATER	LOCATION OF EXCEEDANCE	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE	ASSESSMENT
		AA								
Arsenic	µg/l	50	10	6	19.2 13.2	WS105-1 (DWS) WS105-2 (DWS)	3	82	WS105 4.90 (EQS/ DWS)	Further Action
Cadmium	µg/l	0.08-0.25	5	6	0.07	N/A	3	<0.08	N/A	No Further Action
Chromium (VI)	µg/l	3.4	–	6	<5.0	N/A	3	<5.0	N/A	No Further Action
Chromium (III)	µg/l	4.7	50	6	4.7	N/A	3	1.7	N/A	No Further Action
Copper	µg/l	1	2000	6	3.0 5.9 2.0 5.2 1.6	WS101 (EQS) WS110 (EQS) RO223 (EQS) RO221 (EQS) WS105-2 (EQS)	3	11 6.9 11	TP105 1.00 (EQS) TP123 1.00 (EQS) WS105 4.90 (EQS)	Further Action
Total Cyanide	µg/l	1	50	6	6.3 6.1 1.9	WS105-1 (EQS) WS110 (EQS) WS105-2 (EQS)	3	2.8 2.3 20	TP105 1.00 (EQS) TP123 1.00 (EQS) WS105 4.90 (EQS)	Further Action
Lead	µg/l	1.2	10	6	1.0	N/A	3	<1.0	N/A	No Further Action
Mercury	µg/l	–	1.0	6	0.23	N/A	3	<0.5	N/A	No Further Action
Nickel	µg/l	4	20	6	4.2 7.0 7.6	WS110 (EQS) WS105-1 (EQS) WS105-2 (EQS)	3	3.8	N/A	Further Action
Selenium	µg/l	–	10	6	1.7	N/A	3	<4.0	N/A	No Further Action
Zinc	µg/l	10.9	–	6	13 13 13 19	WS101 (EQS) WS110 (EQS) WS105-1 (EQS) WS105-2 (EQS)	3	34	WS105 4.90 (EQS)	Further Action
pH	6–9	–	–	6	6.6-7.4	N/A	3	7.8	N/A	No Further Action
Naphthalene	µg/l	2	10*	6	3300 5200	WS105-1 (EQS/DWS) WS105-2 (EQS/ DWS)	3	980	WS105 4.90 (EQS/ DWS)	Further Action
Anthracene	µg/l	0.1	10*	6	8.2	WS105-1 (EQS)	3	1.8	N/A	Further Action



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DETERMINAND	UNIT	EQS ^{1,2,3}	DWS ^{3,4,5}	NO. OF GW SAMPLES	MAX CONC. IN GROUNDWATER	LOCATION OF EXCEEDANCE	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE	ASSESSMENT
		AA								
					32	WS105-2 (EQS/ DWS)				
Benzo[b]fluoranthene	µg/l	0.00017*	10*	6	0.68	WS105-2 (EQS)	3	<0.01	N/A	No Further Action
Benzo[k]fluoranthene	µg/l	0.00017*	10*	6	0.38	WS105-2 (EQS)	3	<0.01	N/A	No Further Action
Benzo(a)pyrene	µg/l	0.00017*	10*	6	0.40	WS105-2 (EQS)	3	<0.01	N/A	No Further Action
Indeno(123-cd)pyrene	µg/l	0.00017*	10*	6	<0.01	N/A	3	<0.01	N/A	No Further Action
Fluoranthene	µg/l	0.0063	10*	6	0.95 11	WS101 (EQS) WS105-1 (EQS/DWS)	3	1.6	WS105 4.90 (EQS)	Further Action
Benzo(ghi)perylene	µg/l	1.7–4	10*	6	<0.01	N/A	3	<0.01	N/A	No Further Action
TPH C5-C6 Aromatic (benzene)	µg/l	10	1	6	11	WS105-1 (EQS/DWS)	3	<1.0	N/A	Further Action
TPH C6-C8 Aromatic (toluene)	µg/l	74	700	6	44	N/A	3	<1.0	N/A	No Further Action
TPH C8-C10 Aromatic (ethyl benzene)	µg/l	20	300	6	370 380	WS105-1 (EQS/DWS) WS105-2 (EQS/DWS)	3	<1.0	N/A	Further Action
TPH C10-C12 Aromatic (xylene)	µg/l	30	500	6	5800 6000	WS105-1 (EQS/DWS) WS105-2 (EQS/DWS)	3	2500	WS105 4.90 (EQS/ DWS)	Further Action
TPH C12-C16 Aromatic	µg/l	2	90 ⁵	6	4300 6600	WS105-1 (EQS/DWS) WS105-2 (EQS/DWS)	3	1500	WS105 4.90 (EQS/ DWS)	Further Action
TPH C16-C35 Aromatic	µg/l	50#	90 ⁵	6	2500 27000	WS105-1 (EQS/DWS) WS105-2 (EQS/DWS)	3	900	WS105 4.90 (EQS/ DWS)	Further Action
TPH C5-C6 Aliphatic	µg/l	–	15000	6	<1.0	N/A	3	<1.0	N/A	No Further Action
TPH C6-C8 Aliphatic	µg/l	–	15000	6	<1.0	N/A	3	<1.0	N/A	No Further Action
TPH C8-C10 Aliphatic	µg/l	–	300	6	<1.0	N/A	3	<1.0	N/A	No Further Action
TPH C10-C12 Aliphatic	µg/l	–	300	6	<10	N/A	3	<10	N/A	No Further Action
TPH C12-C16 Aliphatic	µg/l	–	300	6	<10	N/A	3	<10	N/A	No Further Action



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DETERMINAND	UNIT	EQS ^{1, 2, 3}	DWS _{3,4,5}	NO. OF GW SAMPLES	MAX CONC. IN GROUNDWATER	LOCATION OF EXCEEDANCE	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE	ASSESSMENT
		AA								
TPH C16-C21 Aliphatic	µg/l	–	300**	6	<10	N/A	3	<10	N/A	No Further Action
TPH C21-C35 Aliphatic	µg/l	–	300**	6	<10	N/A	3	<10	N/A	No Further Action
Trichlorobenzene	µg/l	0.4	–	6	<1.0	N/A	–	–	–	No Further Action
Trichloromethane	µg/l	2.5	–	6	<1.0	N/A	–	–	–	No Further Action
Vinyl Chloride	µg/l	–	0.3	6	<1.0	N/A	–	–	–	No Further Action

Notes

Solubility <0.01µg/l

AA – Annual Average

MAC- Maximum Admissible Concentration

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

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

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



9.4.1. CONTROLLED WATER RISK ASSESSMENT AND MITIGATION

This comparison indicates that the data exceeds the EQS / DWS values for the following in the groundwater samples taken from across the site.

- ✿ Arsenic;
- ✿ Copper
- ✿ Total Cyanide
- ✿ Nickel
- ✿ Zinc (also in exceedance in WS101 and WS110);
- ✿ Naphthalene;
- ✿ Anthracene;
- ✿ Benzo[b]fluoranthene;
- ✿ Benzo[k]fluoranthene;
- ✿ Benzo(a)pyrene;
- ✿ Fluoranthene;
- ✿ TPH C5–C6 Aromatic (Benzene);
- ✿ TPH C8-C10 Aromatic (ethyl benzene);
- ✿ TPH C10-C12 Aromatic (xylene);
- ✿ TPH C12-C16 Aromatic; and,
- ✿ TPH C16-C35 Aromatic

In relation to the above listed exceedances, Table 9.13 provides a summary.

TABLE 9.13 SUMMARY OF ELEVATED CONTAMINANTS IN GROUNDWATER

CONTAMINANT	WS101 (µg/l)	WS105-1 (µg/l)	WS110 (µg/l)	R0221 (µg/l)	R0223 (µg/l)	WS105-2 (µg/l)
	MADE GROUND	MADE GROUND	MADE GROUND	MADE GROUND	MADE GROUND	MADE GROUND
Arsenic	–	19.2	–	–	–	13.2
Copper	3.0	–	5.9	5.2	2.0	1.6
Total Cyanide	–	6.3	6.1	–	–	1.9
Nickel	–	7.0	4.2	–	–	7.6
Zinc	13.0	13.0	13.0	–	–	19.0
Naphthalene	–	3300	–	–	–	5200
Anthracene	–	8.2	–	–	–	32.0
Benzo[b]fluoranthene	–	–	–	–	–	7.6
Benzo[k]fluoranthene	–	–	–	–	–	0.68



CONTAMINANT	WS101 (µg/l) MADE GROUND	WS105-1 (µg/l) MADE GROUND	WS110 (µg/l) MADE GROUND	RO221 (µg/l) MADE GROUND	RO223 (µg/l) MADE GROUND	WS105-2 (µg/l) MADE GROUND
Benzo(a)pyrene	–	–	–	–	–	0.38
Fluoranthene	0.38	11	–	–	–	–
TPH C5–C6	–	11	–	–	–	0.40
TPH C8–C10	–	370	–	–	–	380
TPH C10–C12 (xylene);	–	5800	–	–	–	6000
TPH C12–C16; and	–	4300	–	–	–	6000
TPH C16–C35	–	2500	–	–	–	27000

The majority of exceedances in the groundwater samples were encountered within the samples taken from WS105 (WS105-1 and WS105-2).

Exceedances of heavy metals, fluoranthene, naphthalene and aromatic hydrocarbon fractions were also encountered in the soil leachate samples at a number of locations, including WS105. Heavy metal concentrations in the leachate sample from WS105 were generally higher than in the water samples, however, naphthalene and aromatic hydrocarbon concentrations were noted to be higher in the water samples.

9.4.2. DISCUSSION OF CONTROLLED WATERS RISK ASSESSMENT

Historically, the site has been subjected to extensive industrial uses including railway sidings and, engineering stores/sheds. Widespread leachable heavy metal, PAH, TPH and SVOC contamination has been identified in the soils across the site, thus posing a risk to controlled waters.

The site is underlain by a mixed geology, generally cohesive clay in the northeast of the site and generally granular sand and gravel in the southwest, with thick bands of clay beyond 10.0 m bgl. The clay deposits will afford for the protection of the underlying bedrock aquifer. Given the extensive thickness of drift (>60.0 m) and absence of a nearby water abstraction borehole, the risk to the underlying bedrock aquifer is considered to be significantly reduced and therefore deemed to be at a low risk from on-site contamination.

However, high concentrations of naphthalene and aromatic hydrocarbon fractions were recorded in the initial groundwater sample taken from WS105 (sample-1, March 2021) in the centre west of the site, potentially representative of a plume.

The site sits at an approximate elevation of 130-135 m AOD and is inferred to slope very gently down to the southwest. The land to the north west and Roeacre Brook (circa 150 m to the north west) is noted to be at a lower elevation (~125 m AOD) and thus down hydraulic gradient of the site. Although this is considered outside of typical influencing distance, a surface water drain is present along the northern boundary, which may act as a conduit for site derived contamination to enter nearby watercourses. It is noted that at the ditch was dry at the time of the initial phase of works but has been assumed to be ephemeral.

Further sampling of WS105(sample-2) was therefore undertaken in November 2021 to determine whether the identified elevated concentrations were persistent within the shallow/perched groundwater. The results again showed high concentrations of volatile compounds at this location, including naphthalene and aromatic hydrocarbon fractions, together with heavy metals and non-volatile PAHs.



Water samples taken from surrounding boreholes to the north west (WS101 and RO223) and west (RO221) of WS105 contained elevated heavy metal concentrations, but did not identify elevated volatile compounds, thus indicating no significant migration of volatile contamination towards the west or north west i.e. down-gradient and in the direction of the Roeacre Brook / peripheral drainage channels.

Further sampling of surrounding monitoring wells to the west and south would be considered prudent to confirm the extent of the volatile impact in the vicinity of WS105 to ascertain whether the identified impact is an isolated occurrence or a plume.

It should be noted that in the longer term, the proposed development will create increased hardstanding cover across the site, thus containing the Made Ground beneath the impermeable surface and reducing the amount of infiltration generated. This will in turn, reduce the amount of subsurface lateral flow and therefore the risk to adjacent surface water course.

However, the risk to surface water courses is considered to remain moderate in the absence of further water analysis to the south and west, and due to the presence of heavy metals in the water samples obtained from locations (WS101, RO223 and WS110) and leachate samples (TP105 and TP123) adjacent the northern boundary. These locations are in closest proximity to peripheral drainage networks. An M-BAT assessment has therefore been completed using the data to date to assess the risk to surface water networks and aquatic life.

9.4.3. M-BAT ASSESSMENT

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

Where the Risk Characterisation Ratio (RCR) is greater than 1, this indicates the bioavailable concentration is above the EQS and the receptor is therefore at risk.

The RCR value for Manganese in WS105-1 was calculated to be 1.51. All other determinants were calculated to have an RCR value of less than 1.

Due to the very conservative screening value for manganese, this is widely found in exceedance and therefore not considered to pose a major risk and would not require remediation.

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

However, further analysis of the surface water in the peripheral (accessible) drainage ditches should be undertaken as groundworks progress, to ensure no future mobilisation of contaminants is caused, which may pose a risk to the nearby Roeacre Brook.



9.5. GROUND GAS

9.5.1. INVESTIGATION RATIONALE

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

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

The initial CSM and ground investigation identified the following potential sources of ground gas:

- ✚ Made Ground containing PAHs, TPHs, SVOCs, VOCs derived historical land uses (railway sidings and associated processes, leatherworks, hydrocarbon impacted soils etc)
- ✚ Infilled features (reservoir on-site, brick works)
- ✚ Extensive organic/peat deposits

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

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

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

TABLE 9.14 GROUND GAS MONITORING LOCATION RATIONALE

LOCATION	GROUND GAS SOURCE	DEPTH OF MONITORING RESPONSE ZONE (m)
WS101	Former Clay Pit – Natural Strata	1.00–3.50
WS103	Railway Sidings – Made Ground	1.00–3.00
WS104	Former Engineering Works / Travelling Crane – Made Ground with Hydrocarbon Odour	1.00–3.00
WS105	Railway Sidings – Made Ground with Hydrocarbon Odour and Groundwater Impact	1.00–3.00
WS106b	Former Engineering Works – Made Ground with Hydrocarbon Odour	1.00–3.20
WS107	Travelling Crane – Made Ground	1.00–4.50
WS108	Travelling Crane – Made Ground with Hydrocarbon Odour	1.00–4.30
WS09	Railway Sidings – Made Ground	1.00–4.00



LOCATION	GROUND GAS SOURCE	DEPTH OF MONITORING RESPONSE ZONE (m)
WS110	Railway Sidings – Natural Strata	2.00–5.00
WS111	Railway Sidings /Former Structures – Made Ground	2.00–5.00
WS112	Railway Sidings – Made Ground	2.00–5.00
WS113	Travelling Crane – Made Ground	2.00–3.00
WS114b	Travelling Crane – Made Ground	1.00–4.00

9.5.2. 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 9.15.



TABLE 9.15 SITE CHARACTERISATION BY GSV (BS8485:2015)

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

Notes

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

NHBC guidance (Report No 10627R01) can also be considered, if appropriate, which is based on standard residential houses with precast concrete floors (block and beam) / suspended cast in situ concrete floor slabs.

The thresholds for GSVs based upon NHBC guidance are provided within Table 9.16.

TABLE 9.16 RESIDENTIAL THRESHOLDS FOR GAS SCREENING VALUES (GSV) IN ACCORDANCE WITH CIRIA C665 AND NHBS REPORT NO 10627-R01 – RESIDENTIAL END USE

CIRIA – NO SUBFLOOR VOID		NHBC – SUBFLOOR VOID		
CLASSIFICATION	GSV (METHANE AND CARBON DIOXIDE)	CLASSIFICATION	GSV (METHANE)	GSV (CARBON DIOXIDE)
CS1	< 0.07	Green	< 0.13	< 0.76
CS2	< 0.70	Amber 1	< 0.63	< 1.60
CS3	< 3.5	Amber 2	< 1.60	< 3.10
CS4	< 15	Red	> 1.60	> 3.10
CS5	< 70	N/A	N/A	N/A
CS6	> 70	N/A	N/A	N/A

9.5.3. MONITORING METHODOLOGY

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



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

The results of the ground gas monitoring are presented in Table 9.17.

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



TABLE 9.17 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 Strata	23/3/21	0.10	0.10	0.00052	0.30	0.30	0.00156	20.00	1003	Falling	0.52	0.52	1.00-3.00	3.24	1.71
		6/4/21	0.10	0.10	0.00013	0.40	0.40	0.00052	19.80	1009	Steady	0.13	0.13		3.25	1.80
		22/4/21	0.10	0.10	0.00026	0.50	0.50	0.00130	19.90	1013	Rising	0.26	0.26		3.24	1.89
		19/5/21	0.10	0.10	0.00013	0.20	0.20	0.00026	20.20	1001	Rising	0.13	0.13		2.31	1.44
		7/6/21	0.10	0.10	0.00052	0.30	0.30	0.00156	19.90	1015	Steady	0.52	0.52		2.30	1.50
		18/6/21	0.10	0.10	0.00010	0.10	0.10	0.00010	20.40	1005	Steady	0.10	0.10		3.30	1.90
		9/7/21	0.10	0.10	0.00010	0.10	0.10	0.00010	20.30	1003	Falling	0.10	0.10		3.29	1.95
		26/7/21	0.10	0.10	0.00013	0.20	0.20	0.00026	19.90	990	Low	0.13	0.13		3.30	1.95
		10/8/21	0.10	0.10	0.00052	0.30	0.30	0.00156	20.00	997	Low	0.52	0.52		3.24	1.71
WS103	Made Ground	23/3/21	0.10	0.10	0.00052	0.30	0.30	0.00156	20.10	1003	Falling	0.52	0.52	1.00-3.00	2.35	Dry
		6/4/21	0.10	0.10	0.00026	0.30	0.30	0.00078	20.00	1009	Steady	0.26	0.26		2.35	Dry
		22/4/21	0.10	0.10	0.00088	0.50	0.50	0.00440	19.70	1013	Rising	0.88	0.88		2.35	Dry
		19/5/21	0.10	0.10	0.00288	1.40	1.40	0.04032	18.25	1001	Rising	2.88	2.88		2.44	Dry
		7/6/21	0.10	0.10	0.00130	1.20	1.20	0.01560	18.80	1015	Steady	1.30	1.30		2.40	Dry
		18/6/21	0.10	0.10	0.00039	3.40	3.40	0.01326	13.10	1005	Steady	0.39	0.39		2.44	Dry
		9/7/21	0.10	0.10	0.00010	2.90	2.00	0.00290	12.30	1003	Falling	0.10	0.10		2.50	Dry
		26/7/21	0.10	0.10	0.00013	1.60	1.60	0.00208	17.80	990	Low	0.13	0.13		2.49	Dry
		10/8/21	0.10	0.10	0.00052	1.70	1.70	0.00884	17.30	997	Low	0.52	0.52		2.50	Dry
WS107	Made Ground	23/3/21	0.10	0.10	-0.00013	0.20	0.20	-0.00026	20.10	1003	Falling	-0.13	-0.13	1.00-4.50	4.36	4.32
		6/4/21	0.10	0.10	0.00013	0.40	0.40	0.00052	19.90	1009	Steady	0.13	0.13		4.35	4.33
		22/4/21	0.10	0.10	0.00052	0.30	0.30	0.00156	20.00	1013	Rising	0.52	0.52		4.35	Dry
		19/5/21	0.10	0.10	0.00010	0.10	0.10	0.00010	20.30	1001	Rising	0.10	0.10		4.60	4.60



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		7/6/21	0.10	0.10	0.00013	0.20	0.20	0.00026	20.10	1015	Steady	0.13	0.13		4.41	4.41
		18/6/21	0.10	0.10	0.00013	1.50	1.50	0.00195	18.00	1005	Steady	0.13	0.13		4.45	4.37
		9/7/21	0.10	0.10	0.00010	1.70	1.70	0.00170	15.20	1003	Falling	0.10	0.10		4.61	Dry
		26/7/21	0.10	0.10	0.00013	2.90	2.90	0.00377	15.80	990	Low	0.13	0.13		4.48	Dry
		10/8/21	0.10	0.10	0.00026	2.70	2.70	0.00702	16.00	997	Low	0.26	0.26		4.49	Dry
WS104	Made Ground with Hydrocarbon Odour	23/3/21	Monitoring Well Damaged – Repaired											1.00-3.00	2.63	2.33
		6/4/21	0.10	0.10	0.00026	2.40	0.20	0.00052	20.20	1009	Steady	0.26	0.26		4.57	Dry
		22/4/21	0.10	0.10	0.00052	2.45	0.60	0.00312	19.70	1013	Rising	0.52	0.52		4.54	Dry
		19/5/21	Monitoring Well Destroyed													
		7/6/21														
		18/6/21														
		9/7/21														
		26/7/21														
10/8/21																
WS105	Made Ground with Hydrocarbon Odour	23/3/21	0.10	0.10	0.00013	3.90	3.90	0.00507	16.20	1003	Falling	0.13	0.13	1.00-3.00	2.75	1.94
		6/4/21	0.10	0.10	0.00052	3.20	3.20	0.01664	17.30	1009	Steady	0.52	0.52		2.75	1.99
		22/4/21	0.10	0.10	0.00013	2.70	2.70	0.00351	18.70	1013	Rising	0.13	0.13		2.75	2.06
		19/5/21	0.10	0.10	0.00010	0.10	0.10	0.00010	20.40	1001	Rising	0.10	0.10		2.76	1.93
		7/6/21	0.10	0.10	0.00013	0.30	0.30	0.00039	19.90	1015	Steady	0.13	0.13		2.75	1.99
		18/6/21	Monitoring Well Destroyed													
		9/7/21														
		26/7/21														
		10/8/21														



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WS106b	Made Ground with Hydrocarbon Odour	23/3/21	0.10	0.10	0.00079	0.70	0.70	0.00553	19.30	1003	Falling	0.79	0.79	1.00–3.20	3.18	Dry
		6/4/21	0.10	0.10	0.00088	0.80	0.80	0.00704	19.10	1009	Steady	0.88	0.88		3.17	Dry
		22/4/21	0.10	0.10	0.00052	0.60	0.60	0.00312	19.40	1013	Rising	0.52	0.52		3.18	Dry
		19/5/21	0.10	0.10	0.00052	0.10	0.10	0.00052	20.50	1001	Rising	0.52	0.52		3.25	Dry
		7/6/21	0.10	0.10	0.00026	0.50	0.50	0.00130	19.80	1015	Steady	0.26	0.26		3.20	Dry
		18/6/21	0.10	0.10	0.00039	3.00	3.00	0.01170	15.20	1005	Steady	0.39	0.39		3.26	Dry
		9/7/21	0.10	0.10	0.00010	4.30	4.30	0.00430	11.10	1003	Falling	0.10	0.10		3.21	Dry
		26/7/21	0.10	0.10	0.00013	5.00	5.00	0.00650	14.20	990	Low	0.13	0.13		3.22	Dry
		10/8/21	0.10	0.10	0.00026	4.80	4.80	0.01248	14.90	997	Low	0.26	0.26		3.21	Dry
WS108	Made Ground with Hydrocarbon Odour	23/3/21	0.10	0.10	0.00013	0.80	0.80	0.00104	19.40	1003	Falling	0.13	0.13	1.00–4.30	4.24	4.18
		6/4/21	0.10	0.10	0.00052	0.70	0.70	0.00364	19.60	1009	Steady	0.52	0.52		4.23	4.20
		22/4/21	0.10	0.10	0.00026	0.90	0.90	0.00234	19.30	1013	Rising	0.26	0.26		4.23	4.22
		19/5/21	0.10	0.10	0.00206	1.50	1.50	0.03090	18.40	1001	Rising	2.06	2.06		4.34	4.12
		7/6/21	0.10	0.10	0.00134	1.40	1.40	0.01876	18.70	1015	Steady	1.34	1.34		4.30	4.10
		18/6/21	0.10	0.10	0.00010	2.80	2.80	0.00280	17.30	1005	Steady	0.10	0.10		4.32	4.29
		9/7/21	0.10	0.10	0.00010	3.70	3.70	0.00370	13.00	1003	Falling	0.10	0.10		4.38	4.27
		26/7/21	0.10	0.10	0.00010	0.10	0.10	0.00010	20.60	990	Low	0.10	0.10		4.35	4.30
		10/8/21	0.10	0.10	0.00013	0.90	0.90	0.00117	19.10	997	Low	0.13	0.13		4.35	4.31
WS109	Made Ground	23/3/21	Monitoring Well Could Not be Accessed											1.00–4.00		
		6/4/21	0.10	0.10	0.00013	0.40	0.40	0.00052	20.10	1009	Steady	0.13	0.13		4.00	3.44
		22/4/21	0.10	0.10	0.00124	0.60	0.60	0.00744	19.90	1013	Rising	1.24	1.24		4.00	3.70
		19/5/21	0.10	0.10	0.00010	0.10	0.10	0.00010	20.60	1001	Rising	0.10	0.10		4.04	3.26
		7/6/21	0.10	0.10	0.00060	0.40	0.40	0.00240	20.10	1015	Steady	0.60	0.60		4.02	3.30



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		18/6/21	0.10	0.10	0.00013	1.30	1.30	0.00169	18.60	1005	Steady	0.13	0.13		Bung Jammed	
		9/7/21	Monitoring Well Damaged – Repaired													
		26/7/21	0.10	0.10	0.00013	0.20	0.20	0.00026	20.40	990	Low	0.13	0.13			
		10/8/21	0.10	0.10	0.00079	0.40	0.40	0.00316	19.90	997	Low	0.79	0.79			
WS110	Natural Strata	23/3/21	0.10	0.10	0.00026	1.60	1.60	0.00416	18.70	1003	Falling	0.26	0.26	2.00-5.00	3.54	3.19
		6/4/21	0.10	0.10	0.00052	1.20	1.20	0.00624	19.20	1009	Steady	0.52	0.52		3.53	3.24
		22/4/21	0.10	0.10	0.00026	1.10	1.10	0.00286	19.50	1013	Rising	0.26	0.26		3.53	3.30
		19/5/21	Monitoring Well Destroyed													
		7/6/21														
		18/6/21														
		9/7/21														
		26/7/21														
		10/8/21														
WS111	Made Ground	23/3/21	0.10	0.10	0.000525	0.70	0.70	0.003675	18.70	1003	Falling	0.53	0.53	2.00-5.00	5.07	Dry
		6/4/21	0.10	0.10	0.00124	0.80	0.80	0.00992	18.40	1009	Steady	1.24	1.24		5.06	Dry
		22/4/21	0.10	0.10	0.00079	0.60	0.60	0.00474	18.70	1013	Rising	0.79	0.79		5.05	Dry
		19/5/21	0.10	0.10	0.0001	0.10	0.10	0.0001	20.30	1001	Rising	0.10	0.10		5.22	Dry
		7/6/21	0.10	0.10	0.00052	0.20	0.20	0.00104	20.10	1015	Steady	0.52	0.52		5.20	Dry
		18/6/21	0.10	0.10	0.0001	2.40	2.40	0.0024	16.80	1005	Steady	0.10	0.10		5.12	Dry
		9/7/21	0.10	0.10	0.0001	1.50	1.50	0.0015	15.80	1003	Falling	0.10	0.10		4.95	Dry
		26/7/21	0.10	0.10	0.0001	0.40	0.40	0.0001	20.10	990	Low	0.10	0.10		4.95	Dry
		10/8/21	0.10	0.10	0.0001	0.70	0.70	0.0007	19.80	997	Low	0.10	0.10		4.96	Dry
WS112	Made Ground	23/3/21	0.10	0.10	0.00026	0.90	0.90	0.00234	18.60	1003	Falling	0.26	0.26	2.00-5.00	4.84	Dry



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		6/4/21	0.10	0.10	0.00012	1.20	1.20	0.00144	18.40	1009	Steady	0.12	0.12		4.83	Dry
		22/4/21	0.10	0.10	0.00052	0.70	0.70	0.00364	19.2	1013	Rising	0.52	0.52		4.83	Dry
		19/5/21	0.10	0.10	0.0001	0.10	0.10	0.0001	20.4	1001	Rising	0.10	0.10		4.96	4.76
		7/6/21	0.10	0.10	0.00026	0.50	0.50	0.0013	19.8	1015	Steady	0.26	0.26		4.90	Dry
		18/6/21	0.10	0.10	0.0001	6.60	6.60	0.0066	10.4	1005	Steady	0.10	0.10		4.93	4.92
		9/7/21	0.10	0.10	0.0001	0.10	0.10	0.0001	18.4	1003	Falling	0.10	0.10		5.04	Dry
		26/7/21	0.10	0.10	0.0001	0.10	0.10	0.0001	20.7	990	Low	0.00	0.00		5.03	Dry
		10/8/21	0.10	0.10	0.001	1.90	1.90	0.019	19.2	997	Low	1.00	1.00		5.01	Dry
WS113	Made Ground	23/3/21	0.10	0.10	0.00079	3.50	3.50	0.02765	15.40	1003	Falling	0.79	0.79	2.00-5.00	2.96	Dry
		6/4/21	0.10	0.10	0.00129	3.10	3.10	0.03999	16.20	1009	Steady	1.29	1.29		2.95	Dry
		22/4/21	0.10	0.10	0.00088	2.70	2.70	0.02376	17.2	1013	Rising	0.88	0.88		2.95	Dry
		19/5/21	0.10	0.10	0.0001	0.10	0.10	0.0001	20.3	1001	Rising	0.10	0.10		3.05	Dry
		7/6/21	0.10	0.10	0.00052	0.90	0.90	0.00468	18.2	1015	Steady	0.52	0.52		3.00	Dry
		18/6/21	0.10	0.10	0.0001	1.40	1.40	0.0014	18.3	1005	Steady	0.10	0.10		3.05	Dry
		9/7/21	0.10	0.10	0.0001	2.50	2.50	0.0025	14.6	1003	Falling	0.10	0.10		3.32	Dry
		26/7/21	0.10	0.10	-0.00052	5.90	5.90	-0.03068	12.5	990	Low	-0.52	-0.52		3.31	Dry
		10/8/21	0.10	0.10	0.00013	5.60	5.60	0.00728	12.9	997	Low	0.13	0.13		3.30	Dry
WS114b	Made Ground	23/3/21	0.10	0.10	0.00052	0.10	0.10	0.00052	20.30	1003	Falling	0.52	0.52	1.00-4.00	3.38	Dry
		6/4/21	0.10	0.10	0.00013	0.10	0.10	0.00013	20.10	1009	Steady	0.13	0.13		3.39	Dry
		22/4/21	0.10	0.10	0.00026	0.10	0.10	0.00026	20.1	1013	Rising	0.26	0.26		3.37	Dry
		19/5/21	0.10	0.10	0.00479	0.20	0.20	0.00958	20.2	1001	Rising	4.79	4.79		1.96	Dry
		7/6/21	0.10	0.10	0.0024	0.20	0.20	0.0048	20.1	1015	Steady	2.40	2.40		2.00	Dry
		18/6/21	0.10	0.10	0.0001	0.10	0.10	0.0001	20.5	1005	Steady	0.10	0.10		3.47	Dry



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		9/7/21	0.10	0.10	0.0001	0.70	0.70	0.0007	17.2	1003	Falling	0.10	0.10		3.82	Dry
		26/7/21	0.10	0.10	0.0001	2.30	2.30	0.0001	16.9	990	Low	0.00	0.00		3.40	Dry
		10/8/21	0.10	0.10	0.0001	1.90	1.90	0.0019	17.3	997	Low	0.10	0.10		3.40	Dry

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



9.5.4. SUMMARY OF MONITORING RESULTS

GROUNDWATER

No wells were flooded during the nine monitoring visits. The monitoring wells were predominantly found to be dry or containing only small volumes of water.

BAROMETRIC PRESSURE

Visits were undertaken over a range of barometric pressures, with the first visit and seventh visits undertaken during falling pressure, and the eighth and ninth visit undertaken during periods of steady low pressure (below 1000 mbar).

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

GAS FLOW

Throughout the monitoring period, flow rates were recorded to range between 0.1 l/hr (limit of detection of the analyser) and 4.79 l/hr (WS114b).

Flows were generally below 1.0 l/hr, however, flow rates greater than 1.0 l/hr were recorded in wells WS103, WS108, WS109, WS111, WS113 and WS114b on sporadic occasions that do not appear to be linked with falling or low pressure weather events.

Negative flows were recorded in WS107 and WS113 on one occasion respectively. Negative flows are indicative of back pressure from wind being greater than the active flow from the wells.

GAS CONCENTRATIONS

No elevated concentrations of methane above 0.10% v/v have been recorded.

Carbon dioxide concentrations were recorded at concentrations ranging from 0.10% v/v to 6.60% v/v (WS112). Concentrations greater than 5% were recorded in WS106b (26/7/21 – low pressure), WS112 (18/6/21 – steady pressure) and WS113 (26/7/21 and 10/8/21 – low pressure).

9.5.5. CONCLUSIONS

The worst case determined Characteristic Situation for each monitoring well location is presented in Table 9.18. This is based on the peak flow rates and maximum gas concentrations.



TABLE 9.18 WORST CASE GAS RISK PROFILE AND LOCATION

LOCATION	MAX FLOW (l/hr)	MAX CH ₄ (% v/v)	MAX CH ₄ Q _{hg} / GSV (l/hr)	MAX CO ₂ (% v/v)	MAX CO ₂ Q _{hg} / GSV (l/hr)	CHARACTERISTIC SITUATION	NHBC TRAFFIC LIGHT
WS101	0.52	0.10	0.00052	0.50	0.00260	CS1	Green
WS103	2.88	0.10	0.00288	3.40	0.09792	CS2	Green
WS104	0.52	0.10	0.00052	0.60	0.00312	CS1	Green
WS105	0.52	0.10	0.00052	3.90	0.02028	CS1	Green
WS106b	0.88	0.10	0.00088	5.00	0.04400	CS1	Green
WS107	0.52	0.10	0.00052	2.90	0.01508	CS1	Green
WS108	2.06	0.10	0.00206	3.70	0.07622	CS2	Green
WS109	1.24	0.10	0.00124	1.30	0.01612	CS1	Green
WS110	0.52	0.10	0.00052	1.60	0.00832	CS1	Green
WS111	1.24	0.10	0.00124	2.40	0.02976	CS1	Green
WS112	1.00	0.10	0.00100	6.60	0.0660	CS2*	Green
WS113	1.29	0.10	0.00129	5.90	0.07611	CS2	Green
WS114b	4.79	0.10	0.00479	2.30	0.11017	CS2	Green

Notes:

Values in **BOLD** exceed thresholds for CS1 classification.

*Consideration for CS2 based on CO₂ concentration >5%. Further discussion required.

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

- ✳ The data for 8 of the monitoring wells suggests these locations can be classified as Characteristic Situation (CS)1 – Very Low Gas Risk. However, in 5 locations, the worst-case conditions indicate a CS2 classification is most appropriate.
- ✳ It is noted that 4 of these 5 locations are clustered in the east of the site, in the location of a former travelling crane, underlain by Made Ground generally in excess of 5.0 m thick and subsequently underlain by organic peat deposits. The fifth location, WS103, is located in the centre north of the site, close to a former gasometer/reservoir, although WS104 (located in closer proximity to this feature) did not record elevated gas concentrations.
- ✳ It is also noted that in WS112, carbon dioxide has been identified above the 5% v/v threshold on two occasions, however, the calculated GSV is within a CS1 classification. Given the history of the site and its proximity to other wells with a GSV equating to CS2, it is considered that plots constructed in the vicinity of WS112 would also require CS2 gas protection measures.
- ✳ Given the high concentrations of volatile TPH fractions and Naphthalene recorded in TP211 at 1.90 m bgl (southwest of site) and absence of direct targeted monitoring at this location, further investigation to confirm the source and nature of the contamination will be necessary.
- ✳ Due to the nature of the site, historical land uses, and prevalence of S/VOC and mercury impacted soils, **E3P consider that gas protection measures in accordance with a CS2 (NHBC Amber 1) classification should be incorporate in all residential properties constructed at the site.**



CS2 protection measures require a point score of 3.5, which may be achieved with the (example) following combination:

- ✳ Precast suspended segmental subfloor (i.e. beam and block) – Point score = 0
- ✳ 250 mm ventilated subfloor void (good performance) – Point score = 1.5
- ✳ Gas resistant membrane appropriate to CS2 classification – Point score = 2

However, a specialist design by structural engineer will be required, in accordance with BS8485 (2015)+A1 (2019) (Section 9.6).

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

9.6. BUILDING GAS RISK MITIGATION

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

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

- ✳ **Type A Building** – Private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms are present. Probably conventional building construction (rather than civil engineering). Examples include private housing and some retail premises.
- ✳ **Type B Building** – Private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium sized rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels.
- ✳ **Type C Building** – Commercial building with central building management control of any alterations to the building or its uses and central building management control of the maintenance of the building, including the gas protection measures. Single occupancy of ground floor and basement areas. Small to large-size rooms with active ventilation or good passive ventilation of all rooms and other internal spaces throughout ground floor and basement areas. Probably civil engineering construction. Examples include offices, some retail premises, and parts of some public buildings (such as schools, hospitals, leisure centres and parts of hotels).
- ✳ **Type D Building** – Industrial-style building having large-volume internal space(s) that are well ventilated. Corporate ownership with building management controls on alterations to the ground floor and basement areas of the building and on maintenance of ground gas protective measures. Probably civil engineering construction. Examples are retail park sales buildings, factory shop floor areas, warehouses. (Small rooms within these style buildings should be separately categorised as Type B or Type C.)

Based on the ground gas risk assessment and the proposed Type A Building, it is envisaged that a point score of 3.5 will be required for affected properties, as summarised in Table 9.19.



TABLE 9.19 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 9.20 SUMMARY OF GROUND GAS MITIGATION MEASURES – BS8485 (2015)+A1(2019)

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



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



PROTECTION ELEMENT SYSTEM	SCORE	COMMENTS
(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.		

9.6.2. NHBC

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

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

NHBC expectations for verification to satisfy the Traffic Light gas regime classifications are as detailed in Table 9.21.



TABLE 9.21 TYPICAL NHBC EXPECTATION AND VERIFICATION REQUIREMENTS

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

9.7. 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 9.22 PIPELINE SELECTION PE THRESHOLD CONCENTRATIONS

Contaminant Group	PE-threshold (mg/kg)	Concentrations at <u>Current</u> pipeline depth (mg/kg)
Total VOC / Naphthalene	0.5	110
Total BTEX And MTBE	0.1	<0.001
Total SVOCs (Excluding PAH)	2	<1.0
EC5-EC10 Aliphatic and Aromatic Hydrocarbons	2	<1.0
EC10-EC16- Aliphatic and Aromatic Hydrocarbons	10	120
EC16-EC40 Aliphatic and Aromatic Hydrocarbons	500	130
Phenols (From SVOC Analysis)*	2	<1.0
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?	Yes – several locations at a range of depths.	
Is free product present in soil and groundwater?	None identified.	
Could hydrocarbon impact at greater depth than current pipeline depth be mobilised by rising groundwater levels?	Hydrocarbon impact and low solubility PAH has been identified within Made Ground and in perched groundwater. However, groundwater levels are generally significantly deeper than pipeline depth.	
Will soils impacted with above determinands likely be utilised elsewhere on site?	Unknown.	
Will soils be imported to site as part of any future earth works	Unknown but considered likely. The importation of materials may affect the WIR Risk Assessment which should be updated after completion.	

Notes

Pipe line depth normally between 0.75 m–1.35 m

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



9.8. REVISED CONCEPTUAL SITE MODEL

Following the completion of the intrusive site investigation, chemical analysis and risk assessment, the conceptual model shown in Table 9.23 has been prepared for the site.

TABLE 9.2 CONCEPTUAL MODEL

POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
PL1 PL2	Heavy Metals, non-volatile PAH (Made Ground / Railway Sidings)	Dermal contact. Dermal contact and ingestion.	Future site users. Off-site receptors.	Likely	High	LOW
Discussion: Heavy metals (arsenic and lead) have been identified throughout Made Ground between depths of 0.60 m and 3.20 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 Chrysotile fibres have been identified within Made Ground deposits at TP112 at 1.30 m bgl, quantified at <0.001% (trace), however, can still cause harm to site workers and appropriate PPE should be worn.						
Recommendation: Any impacted materials will require placement in accordance with the asbestos CSM (in this case beneath 600 mm clean cover system) to prevent exposure to future site users. Construction works completed with PPE and provision of welfare. If any visual signs of ACM are encountered elsewhere during the enabling works stage, further sampling and risk assessment should be undertaken.						



POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
PL4	Volatile Contaminants such as hydrocarbons and fuel derivatives (Made Ground / Railway Sidings/Tanks)	Inhalation of vapours. Migration through permeable strata and preferential pathways.	Future site users. Off-site receptors.	Likely	High	Low
Assessment: Naphthalene, aliphatic TPH C8-C10, aromatic TPH C10-C12 and mercury have been identified sitewide between 0.50 m bgl and 4.90 m bgl. Visual and olfactory evidence of hydrocarbon impact was also identified at several locations across site. Recommendation: Ordinarily, delineation and removal of volatile impacted material would be recommended. However, give the spread and depth of encounter, it is considered that the contamination is widespread, and it would be impractical and costly to excavate. A vapour risk assessment has therefore been carried out, which has concluded a low overall vapour risk, except in the vicinity of WS111. It is considered the risks at this location can be mitigated through a localised hotspot delineation and excavation of impacted soils. High concentrations of volatile TPH fractions and Naphthalene have also been recorded in TP211 at 1.90 m bgl (southwest of site) but have not been the subject of direct targeted monitoring. Further investigation to confirm the source and nature of the contamination will be necessary and it is likely that delineation and excavation of impacted soils will be required to remove the risk from vapour emission.						
PL4	Methane, carbon dioxide (Made Ground, peat and potentially infilled features on and within 250 m of the site)	Inhalation of gas. Migration through permeable strata and preferential pathways. Explosion in confined spaces.	Future site users. Buildings. Off-site land users.	Likely	Moderate	Low
Assessment: The data for 8 of the monitoring wells suggests a classification of Characteristic Situation (CS)1 – Very Low Gas Risk. However, in 5 locations, the worst-case conditions indicate a CS2 classification is most appropriate.						



POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
It is noted that 4 of these 5 locations are clustered in the east of the site. The fifth location, WS103, is located in the centre north of the site. Olfactory and visual evidence of hydrocarbon impact has been noted at various locations across the site, in particular WS104, W105 and TP211. Recommendation: In consideration of the nature of the site, historical land uses, and prevalence of S/VOC impacted soils (albeit generally low vapour risk), E3P consider that gas protection measures in accordance with a CS2 (NHBC Amber 1) classification should be incorporated in all residential properties constructed at the site. Soils impacted with volatiles (WS110) or with obvious olfactory / visual evidence of potential hydrocarbon or volatile impact (for example, but not limited to, WS104, W105, and TP211) should be further investigated and allowances made for delineation, excavation, and removal.						
PL5	Mobile contaminants such as metals, PAHs, hydrocarbons, volatile compounds (Made Ground/ Railway Sidings/Tanks)	Surface runoff. Migration through permeable strata and preferential pathways. Perched waters migration.	Adjacent inland river/drain, Roeacre Brook	Likely	Moderate	TBC
Assessment: Given the extensive thickness of drift (>60.0 m) and absence of a nearby water abstraction borehole, the risk to the underlying bedrock aquifer is considered to be significantly reduced and therefore deemed to be at a low risk from on-site contamination. The Roeacre Brook to the northwest of the site may be fed by the drainage ditch on the northern boundary, which may be impacted by laterally migrating contamination. Local surface water courses are therefore considered to be the primary receptor. Potentially mobile contamination has been identified in perched groundwater. Leachate and water analysis indicated heavy metal, PAH and TPH concentrations that exceed the EQS values. High concentrations of naphthalene and aromatic hydrocarbon fractions were recorded in the initial groundwater sample taken from WS105 (sample-1, March 2021) in the centre west of the site, potentially representative of a plume. Further sampling of WS105(sample-2) was therefore undertaken in November 2021 to determine whether the identified elevated concentrations were persistent within the shallow/perched groundwater. The results again showed high concentrations of volatile compounds at this location, including naphthalene and aromatic hydrocarbon fractions, together with heavy metals and non-volatile PAHs. However, water samples taken from surrounding boreholes to the north west (WS101 and RO223) and west (RO221) of WS105 contained elevated heavy metal concentrations, but did not identify elevated volatile compounds, thus indicating no significant migration of volatile contamination towards the west or north west i.e. down-gradient and in the direction of the Roeacre Brook / peripheral drainage channels.						



POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
Due to exceedances in both soils and leachate samples for copper, nickel and zinc, an m-BAT assessment has been completed to assess the bioavailability of the metals with respect to surface water receptors (drainage ditches and Roeacre Brook). The assessment concluded a low risk to surface water receptors. Recommendations: Further analysis of the surface water in the peripheral (accessible) drainage ditches should be undertaken as groundworks progress, to ensure no future mobilisation of contaminants is caused, which may pose a risk to the nearby Roeacre Brook.						
PL6	Sulphate (potential ash within Made Ground)	Sulphate attack on concrete.	Building structure.	Low Likelihood	Low	Low
Assessment: Based on the data available the characteristic sulphate value would be 0.49 g/l, and the characteristic pH value would be 6.6, thus resulting in an overall classification of DS-1, AC-1s (based on static groundwater).						
PL7	Organic contaminants such as hydrocarbons, solvents (Made Ground)	Ingestion of tainted water supply.	Future site users. Water pipes.	Likely	Moderate	Low
Assessment: Elevated concentrations of organic contaminants have been detected in the soils at current pipeline depth that might present a risk to water pipelines. Recommendation: Based on existing ground conditions, barrier pipes are likely to be required due to the nature of the site. However, site conditions may differ post remediation and enabling works and as such further testing will be required to confirm the requirements.						
PL8	Phytotoxic contaminants (Made Ground)	Direct Contact (plant uptake).	Flora.	Likely	Low	Low
Assessment: High concentrations of phytotoxic contaminants Zinc, Copper and Nickel which inhibit plant growth have been detected in the Made Ground soils across the site. Recommendation: Provision of a suitable clean cover system to provide a suitable growing medium and promote plant growth will be required in garden and landscaped areas.						



Notes:

Main exposure pathways: PL1 = Soil Ingestion; PL2 = Dermal Contact and Ingestion; PL3 = Dust Inhalation; PL4 = Vapour/Gas Inhalation; PL5 = Vertical/Lateral Migration; PL6 = Corrosion of Concrete; PL7=Tainting of Water Supply; PL8 = Uptake by plants.



10. COAL MINING

10.1. SCOPE OF INTRUSIVE GROUND INVESTIGATION

The Arley Coal Seam is conjectured to subcrop beneath the north east of the site. Surrounding BGS boreholes indicate the thickness of overlying drift deposits to be in excess of 80 m bgl, thus significantly reducing the risk of any workings/void propagating upwards and resulting in subsidence at the surface.

Verbal consultation with the Coal Authority indicated that, due to the depth of the seam, they do not consider it likely that the seam has been worked. The risk from coal mining related hazards was therefore concluded to be low.

However, it was considered prudent to undertake precautionary drilling in the location of the seam and development high risk zone to confirm the anticipated ground condition and conclusions of this assessment.

A series of rotary boreholes have therefore been advanced within the narrow development high risk area associated with this seam, in accordance with Coal Authority Permission ref: 21608, to assess the potential presence of shallow workings and the potential for ground instability to induce a future subsidence event within the proposed development.

10.2. SUMMARY OF GROUND INVESTIGATION WORKS

10.3. ROTARY BOREHOLES TO INVESTIGATE WORKINGS IN COAL

TABLE 10.1 ROTARY BOREHOLES

ROTARY BOREHOLE	DEPTH TO ROCKHEAD (m bgl)	DEPTH TO COAL (m bgl)	EVIDENCE OF MINING ACTIVITY/SEAM	REMARKS
RB101	> 60.50 m	N/A	N/A	Loss of flush in SAND strata between 35.60 m and 40.80 m bgl. Hard drilling in CLAY strata between 40.80 m and 60.50 m bgl.
RB102	> 59.00 m	N/A	N/A	Loss of flush in SAND strata between 32.10m and 39.60 m bgl. Hard drilling in CLAY strata between 39.60m and 59.00 m bgl.



10.4. SUMMARY OF COAL MINING ISSUES

E3P has reviewed the historical BGS geological mapping and CA information, in addition to completing two 60 m rotary boreholes to investigate the presence of a coal outcrop.

- ✿ The intrusive ground investigations comprising two, deep, rotary boreholes did not identify any shallow coal seams or evidence of historic shallow coal workings to the base of the boreholes.
- ✿ Rockhead was not proven due to extensive drift and difficulties drilling at depth leading to termination of the boreholes at circa 60.0 m bgl in granular drift.
- ✿ Based on the confirmed ground conditions, it is likely that any coal seams will be at significant depth and thus highly unlikely to have been worked at this location. Even if the seam has been worked, the overlying thickness of drift would be sufficient to mitigate the risk of subsidence at the surface.



11. GEOTECHNICAL ASSESSMENT

11.1. PROPOSED DEVELOPMENT

Kellen Homes are considering the proposed acquisition and future redevelopment of the site for a hybrid planning application comprising the following:

- ✳ Full planning application for residential development, including access, car parking, landscaping, open space and associated engineering and infrastructure including an electric substation and foul water pump station.
- ✳ Outline planning permission with all matters reserved for the principle of development to facilitate the East Lancashire Railway (ELR) extension.

11.2. SUMMARY OF GROUND CONDITIONS

MADE GROUND

Made Ground deposits have been encountered within all of the exploratory hole locations from ground level to a maximum proven depth of 6.60 m bgl (RO227). The full depth of Made Ground remained unproven in c. 50% of exploratory hole locations and was generally only proven in the deeper rotary boreholes and a select number of trial pits and window sampler probeholes.

The material generally comprises a black slightly clayey gravelly medium sand / sandy gravel. Gravel constituents predominantly include mudstone, brick, clinker, coal, and ceramic with less frequent inclusions of metal, shale, glass and timber/wood.

Obstructions were encountered at three locations during the first phase of investigation: TP103 (Concrete slab with probable services beneath at 0.70 m bgl), WS106a (double concrete slab at 0.50 m bgl and WS114a (ballast/cobble obstruction at 0.70 m bgl), and a further four locations during the third phase of investigation: RO214, RO219, RO220 and RO224 at depths between 0.30 m – 0.70 m bgl, described as reinforced concrete / railway obstructions.

Redundant services were also encountered at a number of locations within the Mage Ground including electrical cabling, polyethylene pipes, drainage infrastructure etc.

A Depth of Made Ground Plan is presented as Drawing 14-768-006 in Appendix III.

PEAT

PEAT has been encountered beneath the Made Ground in the majority of (deep) exploratory hole locations at top depths of between 2.70 m (TP208) and 6.20 m bgl (RO228) and extending to a maximum proven depth of 7.80 m bgl (RO210 and RO228).

The peat encountered beneath the site was found to range in thickness from 0.20 to 2.60 m thick (CP102), although was predominantly 1.0 m thick or less, and noted to be generally thicker towards the south and west of the site.

The geotechnical properties of PEAT often consist of low bulk density, bearing capacity and shear strength, along with high permeability and compressibility.



A summary of the depth and thickness of peat is presented in Table 8.2 and the Depth to Peat Plan (Drawing no. 14-768-016) and Thickness of Peat Plan (Drawing no. 14-768-017) presented in Appendix III.

DRIFT DEPOSITS

Drift deposits were encountered beneath the Made Ground and Peat where proven and were found to comprise of alternating medium dense light brown variably slightly clayey SAND / light brown sandy GRAVEL and stiff to very stiff medium to high strength sandy CLAY, extending to depths in excess of 60.50 m bgl (RB101). Although where encountered, shallowest drift deposits were predominantly granular.

At one location (CP101), directly beneath the Made Ground, a soft very low strength brown sandy CLAY was encountered between 4.20 m and 5.00 m bgl.

SOLID GEOLOGY

The solid geology was not encountered within the deeper cable holes or rotary open holes. A nearby BGS borehole indicates rockhead at circa 81.00 m bgl.

11.3. SITE PREPARATION

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

- ✳ Roots present below the footprint of proposed structures and infrastructure should be grubbed out and the resulting void infilled with suitable compacted engineered fill.
- ✳ Removal of all relict structures, concrete hardstanding and historical railway sidings.
- ✳ Redundant services should be sealed off and grubbed out and replaced with suitable compacted engineered fill.
- ✳ Buried structures and old foundations have been encountered on site. These should be excavated from below the proposed development footprint with the resulting void backfilled.
- ✳ A reservoir was identified on historical mapping (in the location of a former gasometer), the location and extent of this feature has not been confirmed and further investigation/delineation will be required.
- ✳ Excavation or treatment of peat beneath roads, driveways and drainage infrastructure.

11.4. FOUNDATION CONDITIONS AND ASSESSMENT OF POTENTIAL BEARING CAPACITIES

Deep Made Ground deposits have been encountered across much of the development area, as such, the potential for adoption of traditional shallow foundations in natural strata will be limited.



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 11.1.

TABLE 11.1 SUMMARY OF ABP

GRANULAR SOILS			
Description	Depth (Range m bgl)	Relative Density	Allowable Bearing Pressure (kN/m ²)
Clayey SAND	3.00–5.00	Loose–Medium Dense	75–113
SAND	6.50–11.00	Medium Dense	130–294
COHESIVE SOILS			
Description	Depth (range m bgl)	Undrained Shear Strength (Cu) (kN/m ²)	Allowable Bearing Pressure (kN/m ²)
Soft sandy CLAY (CP101)	4.00	13	26
Firm to stiff sandy CLAY	1.50–5.00	41–133	85–313
Stiff to very stiff sandy CLAY	9.50–14.50	84–125	173–256

Made Ground deposits extend to proven depths of up to 6.60 m bgl (RO227). PEAT has been encountered beneath the Made Ground in the majority of (deep) exploratory hole locations extending to a maximum proven depth of 7.80 m bgl (RO210 and RO228). The peat encountered beneath the site was found to range in thickness from 0.20 to 2.60 m thick (CP102), although was predominantly 1.0 m thick or less, and noted to be generally thicker towards the south and west of the site.

Made Ground and Peat are not considered to be suitable founding strata due to their variable and compressible nature respectively.

Adoptable foundation solutions are therefore as follows:

- ✳ The natural deposits have generally been assessed has firm/stiff or medium dense with anticipated ABP >100 kN/m². Natural deposits were encountered at shallow depth (<2.50 m bgl) in WS101, TP104, TP109 TP207, RO209, RO221 and RO222; all located in the north west of the development area. In this part of the site, ground conditions may allow the adoption of deep trench foundations.
- ✳ Driven piled foundations will be required for plots across the remainder of the site. However, detailed consideration must be given to working in proximity to the live rail infrastructure.
- ✳ Alternative solutions may include Controlled Modulus Columns (CMC) or rigid inclusion ground improvement. It should be noted that these systems are not currently accepted by NHBC but may be accepted by other warranty providers. The preferred Building Control and warranty provider must accept the use of such a solution if it is to be adopted.

Where piled foundations are adopted, controlled waters and associated generation of pollutant pathways will need to be adequately assessed.



Consideration must be given to the settlement characteristic of the recently deposited Made Ground and will require modelling when a detailed layout with levels becomes available.

Trees are present in the west of the site (retained greenbelt) and along the site periphery. Their influence will need to be modelled to assess the implications to foundations in respect of heave.

A summary of anticipated shallow foundations is presented in Table 11.3. At all other locations, an engineered (piled) foundation solution will be required.

A concept foundation zoning plan is included as Drawing 14-768-010 in Appendix III.

TABLE 11.3 ANTICIPATED SHALLOW FOUNDATIONS

LOCATION	ANTICIPATED FOUNDING STRATA DEPTH (m bgl)	GROUND WATER (m bgl)	TARGET STRATUM	TREES	COAL	FOUNDATION TYPE	TYPE OF CONCRETE
WS101	1.85	N	Stiff CLAY	Y	N	MT	DS-1, AC-1s
TP104	1.85	1.50	GRAVEL	Y	N	MT	DS-1, AC-1s
TP109	1.05	2.70	SAND	Y	N	MT	DS-1, AC-1s
TP207	1.45*	N	SAND	Y	N	MT	DS-1, AC-1s
RO209	1.55*	N	SAND	Y	N	MT	DS-1, AC-1s
RO221	1.55*	N	SAND	Y	N	MT	DS-1, AC-1s
RO222	1.95*	N	SAND	Y	N	MT	DS-1, AC-1s

Notes:

Subject to confirmation of medium dense strata.

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

11.5. GROUND FLOOR SLABS

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

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

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

11.6. HEAVE PRECAUTIONS

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



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

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

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

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

A summary of heave precautions is presented in Table 11.4.

TABLE 11.4 SUMMARY OF HEAVE PRECAUTIONS

TABLE 11.4 SUMMARY OF SPECIAL PRECAUTIONS				
		MINIMUM VOID DIMENSION FOR FOUNDATIONS, GROUND BEAMS AND SUSPENDED IN-SITU CONCRETE GROUND FLOORS		MINIMUM VOID DIMENSIONS UNDER PRECAST CONCRETE AND SUSPENDED TIMBER FLOORS
Plasticity Index of Soil	Required Foundation Depth (m)	Thickness of Void Former Against Side of Foundation or Ground Beam (mm)	Thickness of Void Former on Underside of Edge Beam and Floor Slab (mm)	Void Dimension (mm)
High Plasticity (> 40)	> 2.5	Engineer Design		Engineer Design
	2.0–2.5	35	150	300
	1.5–2.0	25	75	
Moderate Plasticity (20–40)	> 2.5	Engineer Design		Engineer Design
	2.0–2.5	25	100	250
	1.5–2.0	25	50	
Low Plasticity (< 20)	2.0–2.5	N/A	50	200
	> 2.0	No Special Precautions		

11.7. HIGHWAYS CONSTRUCTION

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

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

Complete excavation of compressible peat deposits from beneath roadways, driveways and drainage will be required.



11.8. DEVELOPMENT PLATFORM STABILITY

Deep Made Ground had been found overlying what is presumed to be historical relict vegetation that is identified as a 'peat material' across the site. The peat encountered beneath the site was found to range in thickness from 0.20 to 2.60 m thick (CP102), although was predominantly 1.0 m thick or less, and noted to be generally thicker towards the south and west of the site.

This material is identified as potentially degradable, which may represent a risk associated with future consolidation induced by earthworks surcharge loading, temporary works and infrastructure loading.

Excavation of the peat from beneath roadways, driveways and drainage infrastructure will be required.

Development of a suitably robust settlement model is recommended to ensure design stability for the development platform.

11.9. DRAINAGE

Due to the lateral and vertical extent of Made Ground across the site, together with the observed inorganic and hydrocarbon impact, soakaway drainage will not be a suitable method of surface water disposal for the subject site.

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

Allowances for flexible joints in service infrastructure should be made to allow for differential settlement associated with consolidation of organic peat deposits where still in-situ.

11.10. CONCRETE DURABILITY

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

11.11. EXCAVATIONS

Trial pits were unstable in the granular Made Ground and loose natural sand deposits, resulting in termination.

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

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



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

TABLE 11.5 CIVIL ENGINEERING EXCAVATION RISK MATRIX

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

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



11.13. GEOTECHNICAL RISK REGISTER

POTENTIAL CONSTRAINT	ABNORMAL	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Remediation of contaminated soils		On site	100	Made Ground soils impacted by heavy metals, non-volatile PAH, and volatiles (TPH, naphthalene and mercury) has been encountered sitewide. A clean cover system will be required in all garden areas to mitigate the risk to end users. Further investigation / delineation of soils impacted with volatiles (WS110) or with obvious olfactory / visual evidence of potential hydrocarbon or volatile impact is recommended, including, but not limited to, WS104, W105, and TP211. Further assessment of mercury in soils is also recommended on a site wise basis. This testing should be supplemented by speciation to determine the spread and level of elemental (volatile) mercury present in the soils to fully appraise the risk to end users and potentially zone the site into discrete areas requiring further assessment/delineation.
Obstructions		All	100	Obstructions were encountered at three locations during the first phase of investigation: TP103 (Concrete slab with probable services beneath at 0.70 m bgl), WS106a (double concrete slab at 0.50 m bgl and WS114a (ballast/cobble obstruction at 0.70 m bgl), and a further four locations during the third phase of investigation: RO214, RO219, RO220 and RO224 at depths between 0.30 m – 0.70 m bgl, described as reinforced concrete / railway obstructions. Redundant services were also encountered at a number of locations within the Mage Ground including electrical cabling, polyethylene pipes, drainage infrastructure etc. Other obstructions should be anticipated at intervening locations.
Artificially levelled and filled platforms		All	100	The site appears to have been levelled and artificially backfilled.
Trench collapse		All	100	Made Ground and natural granular strata beneath the site is prone to collapse.



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POTENTIAL CONSTRAINT	ABNORMAL	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Infilled reservoir		North	5	A reservoir is noted on mapping in the location of a former gasometer will need to be clearly identified and investigated to assess the nature of materials and extent of any organic or deleterious elements. Organic / peat deposits here are anticipated to be deeper.
Mature trees		On site	100	Arboriculture survey required to determine areas of potential tree influence.
Volume change potential clay		On site	80	Cohesive soils where present are deemed to be low volume change potential. Peat is of very high plasticity/compressibility.
Peat		On site	100	Peat has been encountered beneath the Made Ground in the majority of (deep) exploratory hole locations at top depths of between 2.70 m (TP208) and 6.20 m bgl (RO228) and extending to a maximum proven depth of 7.80 m bgl (RO210 and RO228). The peat encountered beneath the site was found to range in thickness from 0.20 to 2.60 m thick (CP102), although was predominantly 1.0 m thick or less, and noted to be generally thicker towards the south and west of the site. Peat is a highly compressible stratum that represents a risk in terms of consolidation inducing failure to structures and infrastructure and will require removal from beneath roads drives and drainage infrastructure.
Running sands		N/A	N/A	Data searches indicate low risk.
Ground dissolution		N/A	N/A	Data searches indicate no hazard.
Concrete design		On site	N/A	The soils meet class DS-1, AC-1s.
Low-permeability ground		On site	100	Soakaways not viable where extensive Made Ground deposits are present or where areas of contaminated soil and groundwater are present.
Services/sensitive structures		On site	25	A review of online services has identified a number of services within the site boundary. A live railway is also present along the southern site boundary. Plots adjacent the railway wall may require bored piles due to the potential to cause vibration and disturbance.



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POTENTIAL CONSTRAINT	ABNORMAL	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Abnormal foundation solutions		On site	95	Due to sitewide presence of deep Made Ground and peat extending to depths of up to 7.80 m bgl, an engineered foundation solution (pile) will be required in plots across the site majority of the site. There may be potential to adopt a mass trench foundation solution where suitable shallow natural strata have been encountered in the northwest of the site.
Areas not investigated		On site	25	Additional investigation required adjacent the live railway along southern boundary subject to agreement and permit from Network Rail.



11.14. FURTHER WORKS

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

- ✳ Additional investigation required adjacent the live railway along southern boundary subject to agreement and permit from Network Rail.
- ✳ Further investigation / delineation of soils impacted with volatiles (WS110) or with obvious olfactory / visual evidence of potential hydrocarbon or volatile impact (including, but not limited to WS104, W105, and TP211).
- ✳ Further assessment of mercury in soils is also recommended on a site wise basis. This testing should be supplemented by speciation to determine the spread and level of elemental (volatile) mercury present in the soils to fully appraise the risk to end users and potentially zone the site into discrete areas requiring further assessment/delineation.
- ✳ Remediation and enabling works strategy.
- ✳ Plot-specific foundation schedule (upon receipt of the final development levels).
- ✳ Arboricultural survey.
- ✳ Geotechnical earthworks strategy (infrastructure).



12. CONCLUSIONS AND RECOMMENDATIONS

12.1. CONTAMINATED LAND ASSESSMENT

Human Health	Exceedances of heavy metals, non-volatile PAH, naphthalene, toluene, I TPH C8-C35 and mercury have been identified at various locations across the site (including in the POS area and stockpile in the Network Rail retained land) between 0.50 m bgl and 4.90 m bgl. Asbestos in the form of chrysotile (<0.001%wt/wt) has also been identified in TP112. Visual and olfactory evidence of hydrocarbon impact was also identified at several locations across site. The risk to chronic human health associated with the elevated concentrations of inorganic heavy metals, non-volatile PAH compounds and trace asbestos can be mitigated through the installation of a suitable cover system. Given the widespread distribution of the contamination, the cover system would be required in all proposed private gardens, landscaping, and public open space to remove any potential for direct exposure to impacted soils. The specific design and installation process for the appropriate cover systems will be clearly defined within the site remediation and enabling works strategy. In relation to the exceedances of S/VOCs mercury and visual and olfactory evidence of hydrocarbon impact identified at several locations across site, ordinarily, delineation and removal of volatile impacted material would be recommended. However, given the spread and depth of encounter, it is considered that the contamination is widespread, and it would be impractical and costly to excavate. A vapour risk assessment has therefore been carried out, which has concluded a low overall risk from hydrocarbons and S/VOCs, except in the vicinity of WS110. It is considered the risks at this location can be mitigated through a localised hotspot delineation and excavation of impacted soils. High concentrations of volatile TPH fractions and Naphthalene have also been recorded in TP211 at 1.90 m bgl (southwest of site) but have not been the subject of direct targeted monitoring due to lack of installations within the immediate vicinity. Further investigation to confirm the source and nature of the contamination will be necessary and it is likely that delineation and excavation of impacted soils will be required to remove the risk from vapour emission. Further investigation in other locations of observed significant odours / contamination impact (including WS104 and WS105) is also required. Further assessment of mercury in soils is also recommended on a site wise basis. This testing should be supplemented by speciation to determine the spread and level of elemental (volatile) mercury present in the soils to fully appraise the risk to end users and potentially zone the site into discrete areas requiring further assessment/delineation.
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	It is considered that chemical analysis of the natural clay drift deposits will identify these soils to be acceptable for use as subsoil within the proposed garden areas subject to further chemical validation; however, given the depth of Made Ground on-site, it is unlikely that subsoils will be excavated. There are no suitable sources of topsoil available on the site.
Tier 2 Vapour Risk Assessment	Analytical Thermal Desorption (ATD) tubes have been installed within five pre-existing wells and sampling was completed via active pump sampling using a pump and rotometer to collect the required 10 litre volume of air. Each ATD tube in each location has been tested for the following set of compounds: ✿ Naphthalene ✿ Aliphatic / Aromatic Banding TPH Compounds ✿ BTEX Compounds In order to determine if the vapour concentrations detected would generate a risk to human health, the results have been assessed against the Tolerable Daily Intake values (TDIs) for the relevant compound or group. TPH C10-C12 aromatic has been found marginally in exceedances of the SSSV within WS110 in the east of the site. To avoid the requirement for specialist VOC resistant membranes in the vicinity of WS110, a process of delineation and subsequent excavation of the soils is recommended. The resulting void will then require validation and excavated soils may be suitable for retention in an area of no future sensitivity (proposed POS in the west of the site) or removal from site. Mercury vapour analysis was conducted using SKC 520 Series elemental mercury passive samplers installed at five locations. The limit of detection of the samplers was 0.2 µg and the site specific screening guideline value (SSSGV) has been calculated to be 0.0643038 µg/m3. It is noted that the LOD is 0.2 µg, which is higher than the SSSGV. It must therefore it must be assumed that the true concentrations may be up to 0.19 µg. Further assessment of mercury in soils is recommended on a site wise basis. This testing should be supplemented by speciation to determine the spread and level of elemental (volatile) mercury present in the soils to fully appraise the risk to end users and potentially zone the site into discrete areas requiring further assessment/delineation.



Controlled Waters	The site sits at an approximate elevation of 130-135 m AOD and is inferred to slope very gently down to the southwest. The land to the north west and Roeacre Brook (circa 150 m to the north west) is noted to be at a lower elevation (~125 m AOD) and thus down hydraulic gradient of the site. Although this is considered outside of typical influencing distance, a surface water drain is present along the northern boundary, which may act as a conduit for site derived contamination to enter nearby watercourses. It is noted that at the ditch was dry at the time of the initial phase of works but has been assumed to be ephemeral. Surface water courses are therefore considered to be the primary receptor given the extensive thickness of drift (>60.0 m) and absence of a nearby water abstraction borehole. High concentrations of naphthalene and aromatic hydrocarbon fractions were recorded in the initial groundwater sample taken from WS105 (sample-1, March 2021) in the centre west of the site. Further sampling of WS105(sample-2) was therefore undertaken in November 2021. The results again showed high concentrations of naphthalene and aromatic hydrocarbon fractions, together with heavy metals and non-volatile PAHs. Water samples taken from surrounding boreholes to the north west (WS101 and RO223) and west (RO221) of WS105 contained elevated heavy metal concentrations (copper, nickel and zinc), but did not identify elevated volatile compounds, thus indicating no significant migration of volatile contamination towards the west or north west i.e. down-hydraulic gradient and in the direction of the Roeacre Brook / peripheral drainage channels. An M-BAT assessment has been completed to assess the risk to surface water networks and aquatic life from heavy metals, which calculated a Risk Characterisation Ratio (RCR) less than 1 for all except Manganese. Due to the very conservative screening value for manganese, this is widely found in exceedance and therefore not considered to pose a major risk and would not require remediation. In light of this assessment, E3P do not consider the site to pose an unacceptable level of risk to surface waters for copper, zinc and nickel. However, further analysis of the surface water in the peripheral (accessible) drainage ditches should be undertaken as groundworks progress, to ensure no future mobilisation of contaminants is caused, which may pose a risk to the nearby Roeacre Brook. Further sampling of surrounding monitoring wells to the west and south of WS105 is also recommended to confirm the extent of the volatile impact in the vicinity of WS105 to ascertain whether the identified impact is an isolated occurrence or a plume.
Ground Gas	In consideration of the nature of the site, historical land uses, and prevalence of S/VOC impacted soils (albeit generally low vapour risk), E3P consider that gas protection measures in accordance with a CS2 (NHBC Amber 1) classification should be incorporated in all residential properties constructed at the site.



	Soils impacted with volatiles (WS111) or with obvious olfactory / visual evidence of potential hydrocarbon or volatile impact (for example, but not limited to, WS104, W105, and TP211) should be further investigated and allowances made for delineation, excavation, and removal.
Potable Water	Based on the assessment of current site conditions it is likely that barrier pipe will be required at the proposed development. This will need to be confirmed following the completion of a UKWIR risk assessment. Post-remediation and enabling works ground conditions may be different from those identified during this site investigation.

12.2. COAL MINING

Coal Mining	The Arley Coal seam is conjectured to subcrop beneath the north east of the site. However, a nearby BGS borehole indicates drift deposits to extend to circa 80 m bgl. Verbal consultation with the Coal Authority indicated that, due to the depth of the seam, they do not consider it likely that the seam has been worked. The risk from coal mining related hazards was therefore concluded to be low but it was considered prudent to carry out intrusive investigation to confirm the assessment. Two ~60.0 m deep rotary boreholes have therefore been advanced within the narrow development high risk area associated with the Arley Coal seam, in accordance with Coal Authority Permission ref: 21608. Ground conditions were found to comprise alternating bands of cohesive and granular drift to depths in excess of 60.5 m bgl. Rockhead was not proven due to extensive drift and difficulties drilling at depth leading to termination of the boreholes at circa 60.0 m bgl in granular drift. No evidence of shallow coal seams or historic shallow coal workings was recorded. Based on the confirmed ground conditions, it is likely that any coal seams will be at significant depth and thus highly unlikely to have been worked at this location. Even if the seam has been worked, it is considered that the overlying thickness of drift would be sufficient to mitigate the risk of subsidence at the surface.
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12.3. GEOTECHNICAL ASSESSMENT

Obstructions were encountered at three locations during the first phase of investigation: TP103 (Concrete slab with probable services beneath at 0.70 m bgl), WS106a (double concrete slab at 0.50 m bgl) and WS114a (ballast/cobble obstruction at 0.70 m bgl), and a further four locations during the third phase of investigation: R0214, R0219, R0220 and R0224 at depths between 0.30 m – 0.70 m bgl, described as reinforced concrete / railway obstructions.

Redundant services were also encountered at a number of locations within the Mage Ground including electrical cabling, polyethylene pipes, drainage infrastructure etc.



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

Made Ground deposits extend to proven depths of up to 6.60 m bgl (RO227). PEAT has been encountered beneath the Made Ground in the majority of (deep) exploratory hole locations extending to a maximum proven depth of 7.80 m bgl (RO210 and RO228). The peat encountered beneath the site was found to range in thickness from 0.20 to 2.60 m thick (CP102), although was predominantly 1.0 m thick or less, and noted to be generally thicker towards the south and west of the site.

Excavation of peat from beneath roads, driveways and drainage infrastructure will be required as a minimum.

Adoptable foundation solutions are likely to be as follows:

- ✳ Traditional strip / deep mass trench foundations bearing onto suitable firm/stiff CLAY or medium dense SAND – limited to north west of the development area where natural strata was encountered at shallow depth (<2.50 m bgl).
- ✳ Driven piled foundations will be required for plots across the remainder of the site. However, detailed consideration must be given to working in proximity to the live rail infrastructure.
- ✳ Alternative solutions may include Controlled Modulus Columns (CMC) or rigid inclusion ground improvement. It should be noted that these systems are not currently accepted by NHBC but may be accepted by other warranty providers. The preferred Building Control and warranty provider must accept the use of such a solution if it is to be adopted.

Where piled foundations are adopted, controlled waters and associated generation of pollutant pathways will need to be adequately assessed.

Consideration must be given to the settlement characteristic of the recently deposited Made Ground and will require modelling when a detailed layout with levels becomes available.

Given the presence of extensive (contaminated) Made Ground, soakaway drainage will not be suitable for adoption at the site.

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



Castleton Sidings, Heywood

Phase I & II Geoenvironmental Site Assessment

March 2023

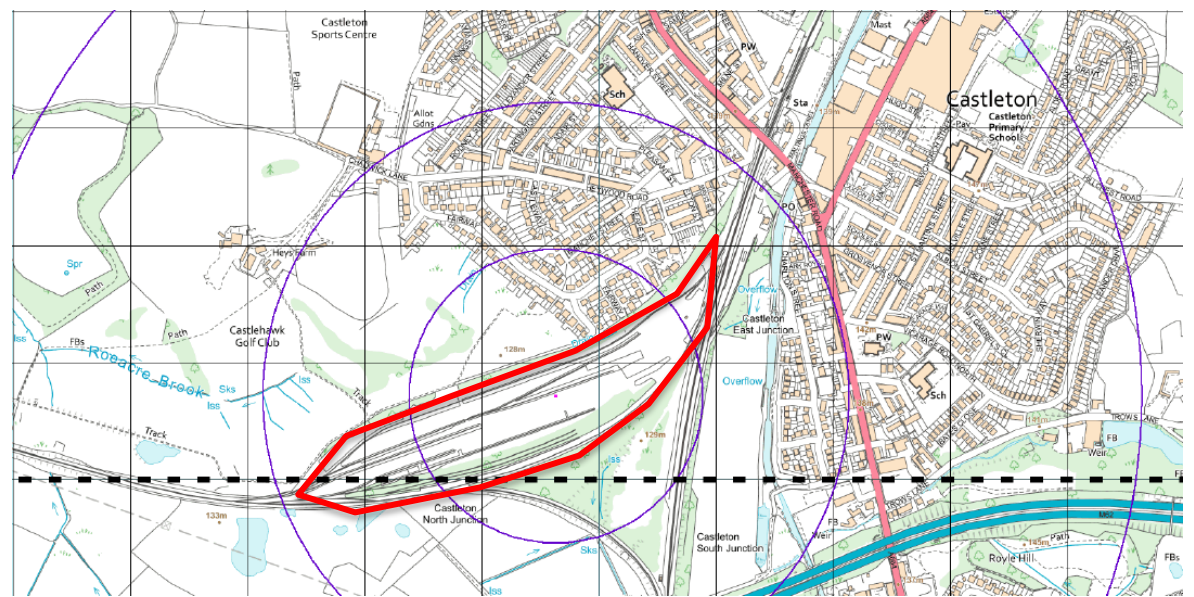
MIBK	Methyl isobutyl ketone	WTE	Water table elevation
m	Metres	ppm	Parts per million
km	Kilometres	mg/m³	Milligram per metre cubed
% v/v	Percent volume in air	m bgl	Metres below ground level
mb	Millibars (atmospheric pressure)	m bcl	Metre below cover level
l/hr	Litres per hour	mAOD	Metres above ordnance 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 14-768-001 – SITE LOCATION PLAN



KELLEN
HOMES

Accommodation Schedule
Castleton Sidings

House Type		Bed No.	Type	No.	Sqft	Total Sqft	Split
Affordables							
Hic	Hickory	2	Mews	9	767	6903	4.71%
Gar	Garth	3	Semi	6	908	5448	3.54%
Gorm	Gorm	3	Semi	2	911	1822	1.05%
Ced	Cedar	3	Semi	12	936	11232	6.98%
				29		25405	15.18%
Private							
Hic	Hickory	2	Mews	21	767	16107	10.99%
Gar	Garth	3	Semi	14	908	12712	7.83%
Gorm	Gorm	3	Semi	4	911	3644	2.09%
Ced	Cedar	3	Semi	24	936	22464	12.57%
Eme	Emerson	4	Semi/Detached	8	1068	8544	4.19%
Acacia	Acacia	3	Det	4	999	3756	2.09%
Lau	Laurel	3	Semi	21	1017	21357	10.99%
Haz	Hazel	3	Detached	8	1062	8496	4.19%
Blu	Bluebell	3	Detached	13	1062	13806	6.81%
Bla	Blackthorn	3	Detached	7	1022	7154	3.66%
Row	Rowan	3	Detached	5	1028	5140	2.62%
Rose	Rosewood	3	Semi/mews	14	1183	16562	7.33%
Horn	Hornbeam	4	Detached	12	1263	15156	6.28%
Ash	Ash	4	Detached	7	1269	8883	3.66%
370 parking spaces							
				162		163781	84.82%
			Total	191		189186	100.00%
Gross Site Area: 27.012 Acres 10.93 Hectares							
POS: 8.128 Acres 3.29 Hectares							
Undevelopable: 6.1 Acres 2.47 Hectares							
Net Site Area: 12.784 Acres 5.17 Hectares							
Gross Density: 7.07 Units/Acre 17.47 Units/Hectare							
Net Density: 14.94 Units/Acre 36.92 Units/Hectare							
Gross Footage: 7003.78 SQFT/Acre 1607.83 SQM/Hectare							
Net Footage: 14798.65 SQFT/Acre 3397.27 SQM/Hectare							

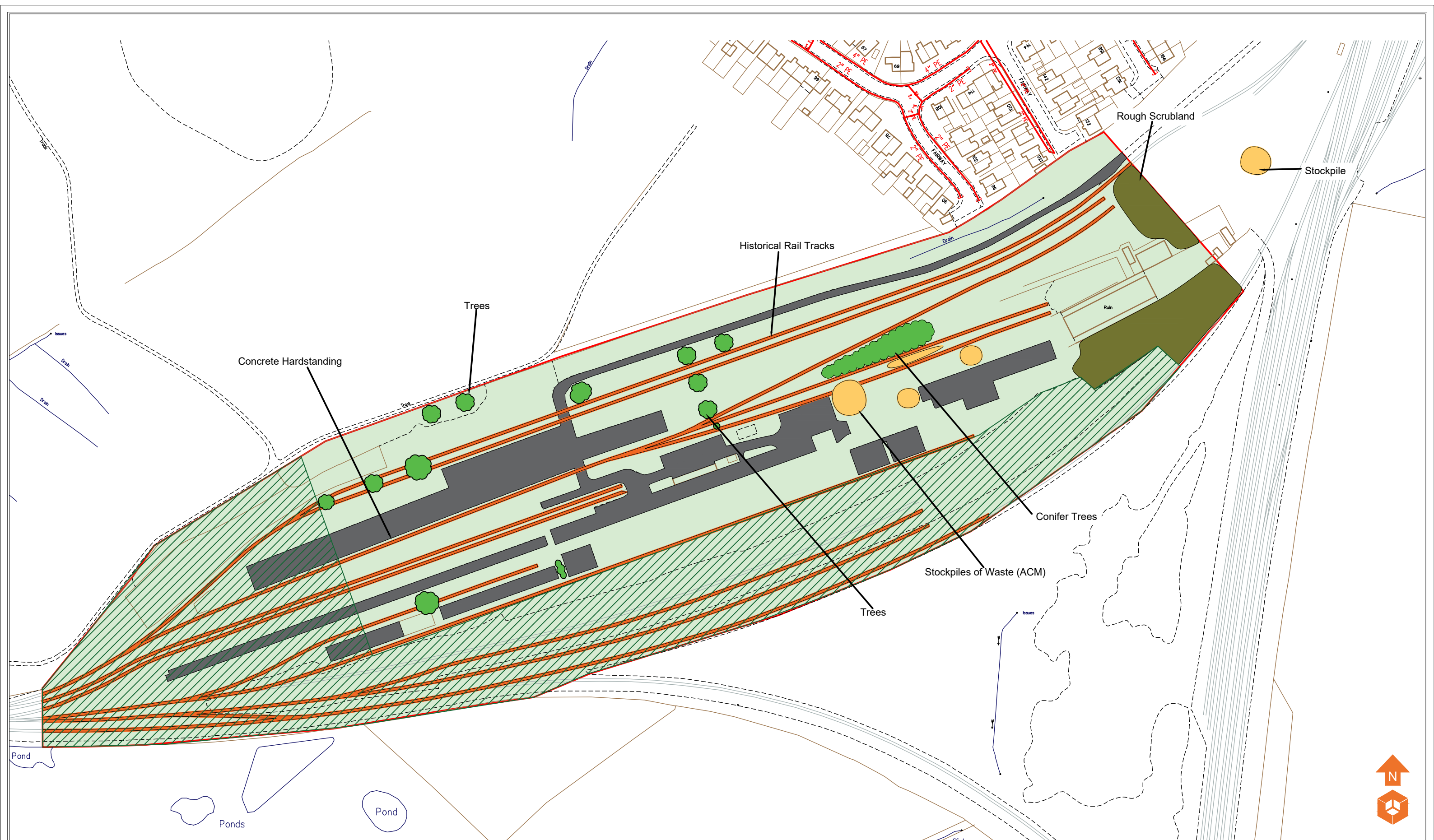
	Indicates 1.8m high brick wall with piers
	Indicates 1.8m high plot divisional screen fence.
	Indicates 1.8m high closed boarded fence.
	Indicates proposed tree planting subject to a landscape design and specification.
	Indicates bin collection points.
	Indicates principle entrance door to dwelling.
	Indicates secondary entrance door to dwelling.
	Indicates application site boundary.
	Indicates parcel of land allocated to East Lancashire Railway.
	Indicates affordable units

Rev	Date	Amend	Initials
-----	------	-------	----------

—



KELLEN
HOMES



Site Features

- Overgrown Trees
- Concrete Hardstanding
- Rough Scrubland
- Trees
- Stockpiles of Waste (Possible ACM)
- Historical Rail Tracks

Notes:

P1	REVB	11.03.2022	HM	JS
P1	REVA	15.04.2021	EB	EF
Phase	Issue	Date	Drawn	Checked

Client:

Kellen Homes

Job Title:

Heywood Road,
Castleton

Job No:

14-768

Drawing No:

004

Date:

11.03.2022

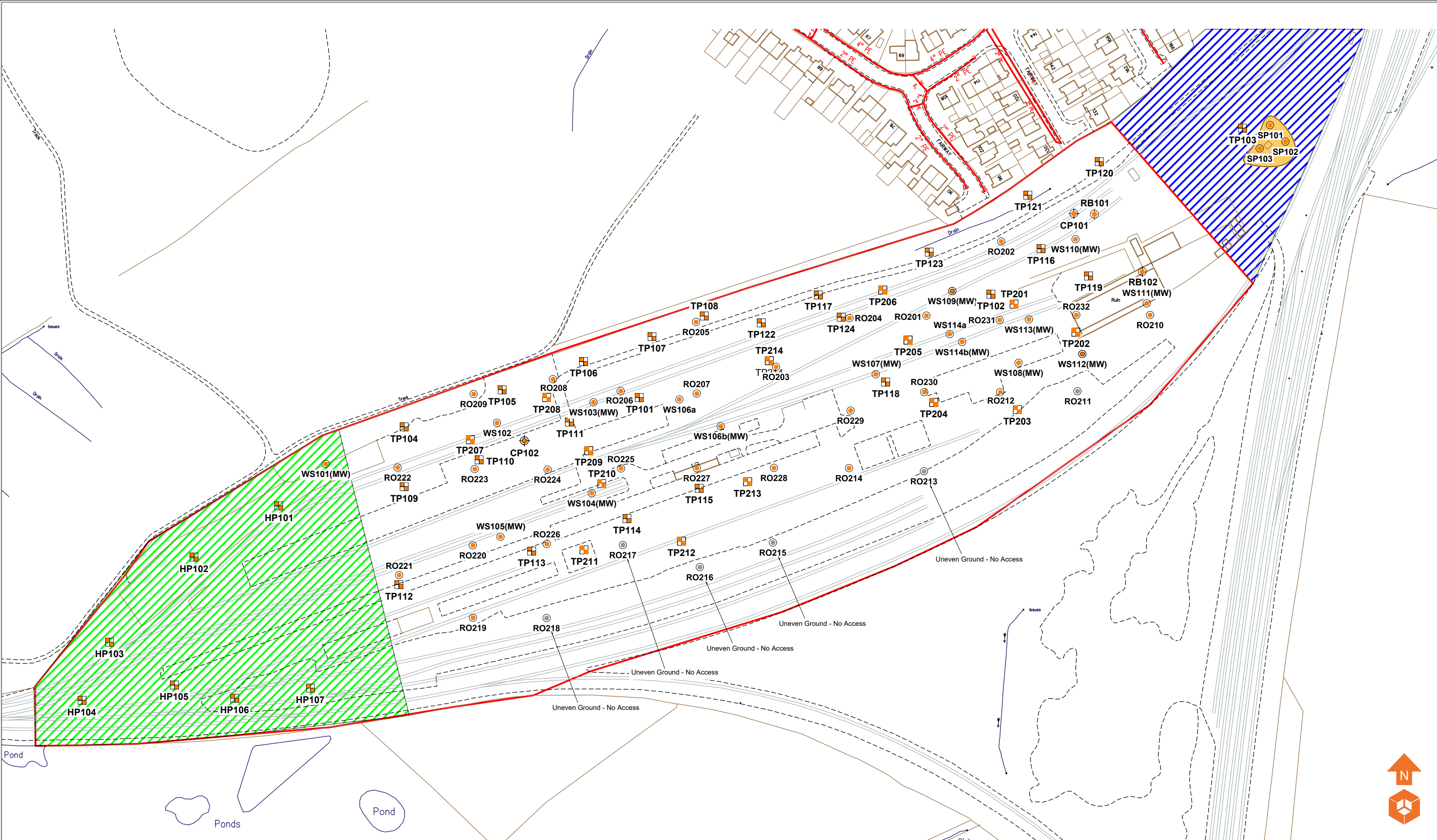
Scale:

NTS @ A3



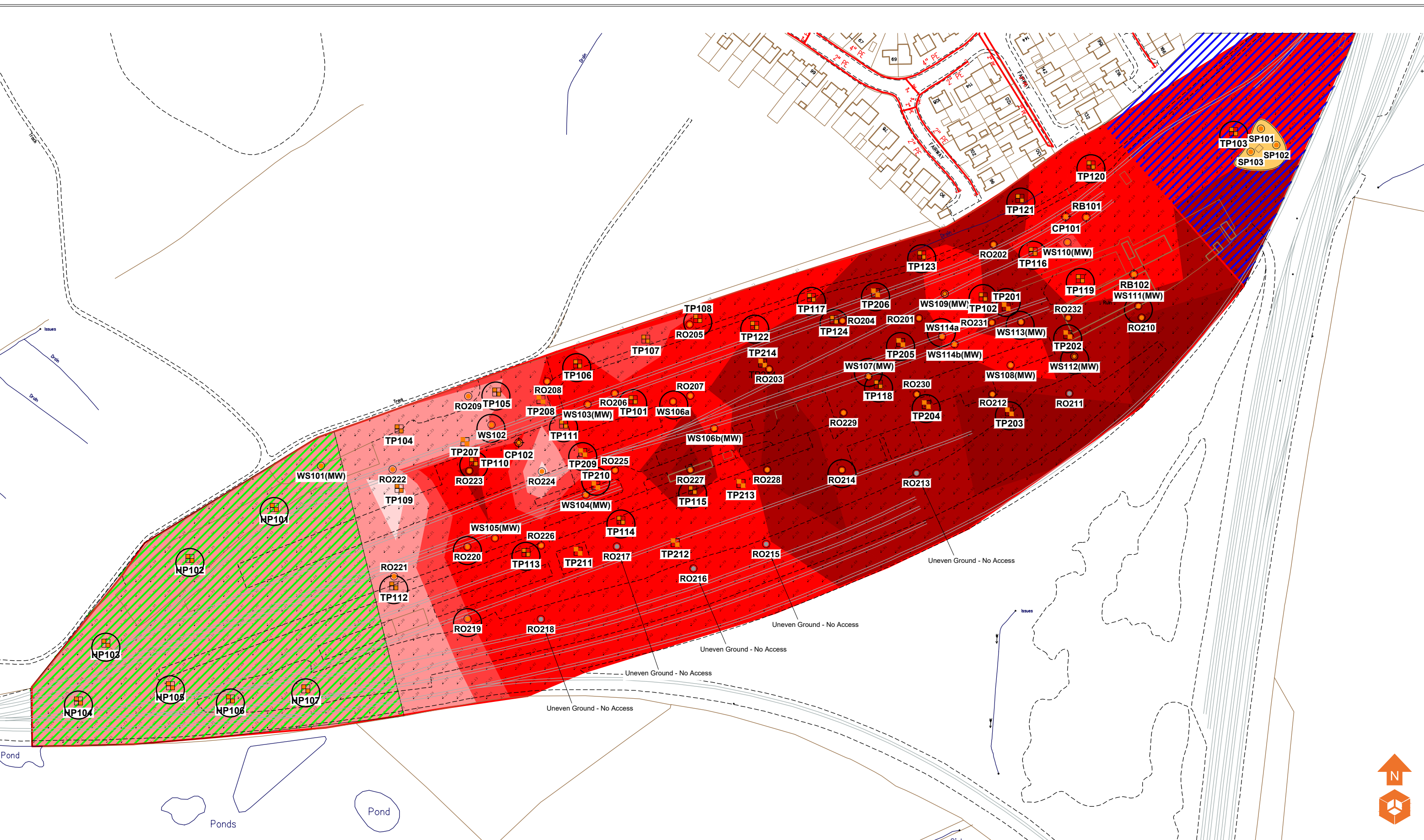
Environmental Engineering
Partnership Ltd
Taylor Road, Trafford Park
Urmston, Manchester, M41 7JQ
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
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Location Symbols WS101 Approximate Window Sample Probehole Location (March 2021) WS101(Inst) Approximate Window Sample Probehole Location with Install (March 2021) TP101 Approximate Trial Pit Location (March 2021) RB101 Approximate Rotary Borehole Location (March 2021) TP101 Approximate Trial Pit Location (June 2021) RB101 Approximate Rotary Borehole Location (July 2021) HP101 Approximate Hand Dug Pit Location (July 2021) SP101 Approximate Stockpile Sample Location (July 2021) RB101 Approximate Location of Attempted Rotary Borehole (July 2021 - Not Completed Due to Access Limitations)
--

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Location Symbols

- WS101: Approximate Window Sample Probehole Location (March 2021)
- WS101(INST): Approximate Window Sample Probehole Location with Install (March 2021)
- TP101: Approximate Trial Pit Location (March 2021)
- RO101: Approximate Rotary Borehole Location (March 2021)
- TP201: Approximate Trial Pit Location (June 2021)
- RO201: Approximate Rotary Borehole Location (July 2021)
- NP101: Approximate Hand Dug Pit Location (July 2021)
- SP101: Approximate Stockpile Sample Location (July 2021)
- RO101(AT): Approximate Location of Attempted Rotary Borehole (July 2021 - Not Completed Due to Access Limitations)

Made Ground Depth (m)

- Depth of Made Ground 0.00 - 0.09m
- Depth of Made Ground 0.10 - 0.19m
- Depth of Made Ground 0.20 - 0.29m
- Depth of Made Ground 0.30 - 0.39m
- Depth of Made Ground 0.40 - 0.49m
- Depth of Made Ground 0.50 - 0.59m

○ Base of Made Ground Not Proven

Notes:

P1	REVD	30.03.2022	EB	JS
P1	REVC	11.03.2022	HM	JS
P1	REVB	07.05.2021	EB	JS
P1	REVA	31.03.2021	EB	EF
Phase	Issue	Date	Drawn	Checked

Client:

Kellen Homes

Job Title:

Heywood Road, Castleton

Job No:

14-768

Drawing No:

006

Job Title:

Depth Of Made Ground Plan

Date:

30.03.2021

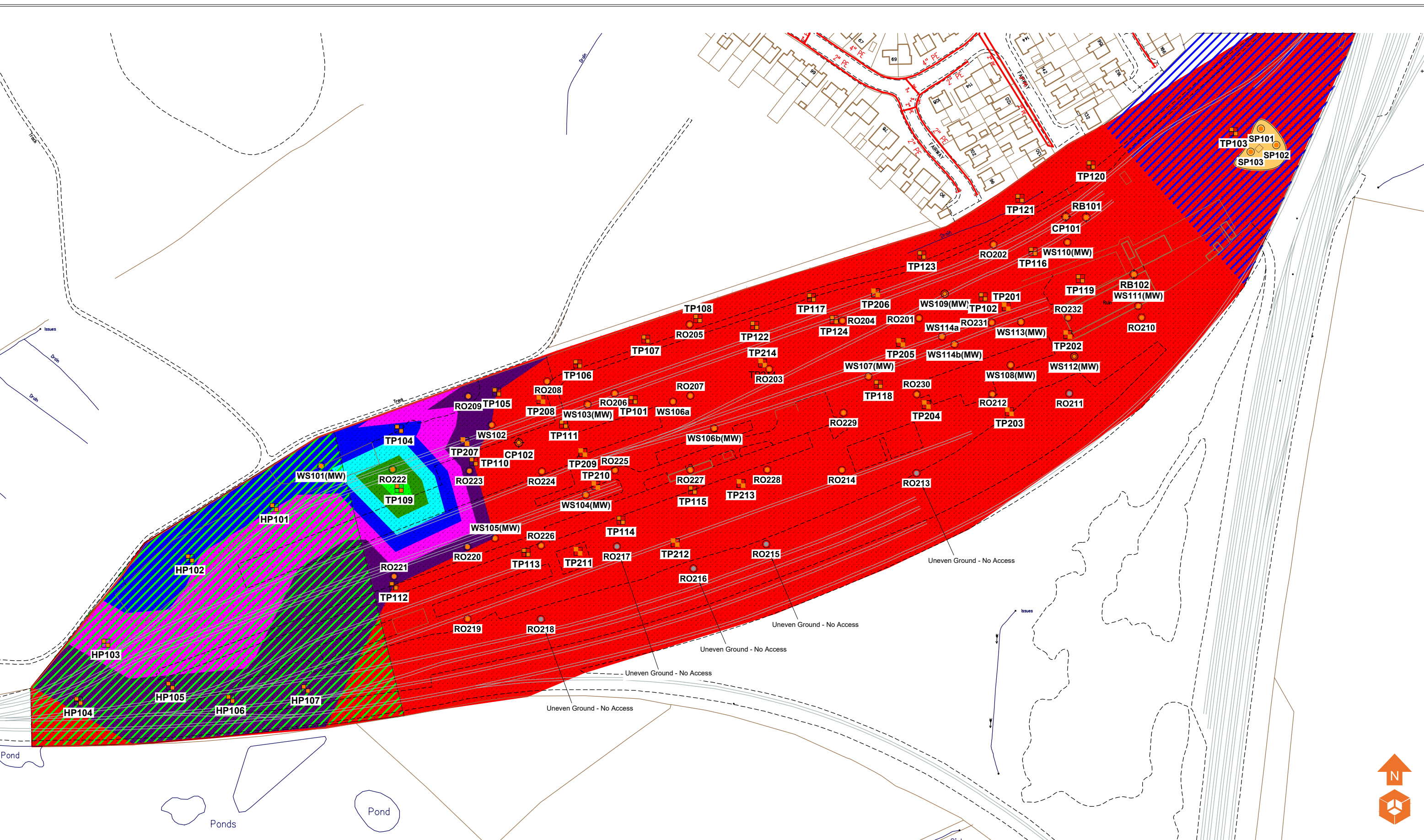
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NTS @ A3

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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Location Symbols

WS101

Approximate Window Sample Probehole Location (March 2021)

WS101(Inst)

Approximate Window Sample Probehole Location with Install (March 2021)

TP101

Approximate Trial Pit Location (March 2021)

RO101

Approximate Rotary Borehole Location (March 2021)

TP201

Approximate Trial Pit Location (June 2021)

RO201

Approximate Rotary Borehole Location (July 2021)

HP101

Approximate Hand Dug Pit Location (July 2021)

SP101

Approximate Stockpile Sample Location (July 2021)

RO201

Approximate Location of Attempted Rotary Borehole (July 2021 - Not Completed Due to Access Limitations)

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	30.03.2022	EB	EF
P1	REVA	15.04.2021	EB	EF
Phase	Issue	Date	Drawn	Checked

Client:

Kellen Homes

Job Title:

Heywood Road, Castleton

Job No:

14-768

Drawing No:

005

Drawing Title:

Depth Of Founding Strata Plan

Date:

30.03.2022

Scale:

NTS @ A3

e3p

Environmental Engineering Partnership Ltd

Taylor Road, Trafford Park

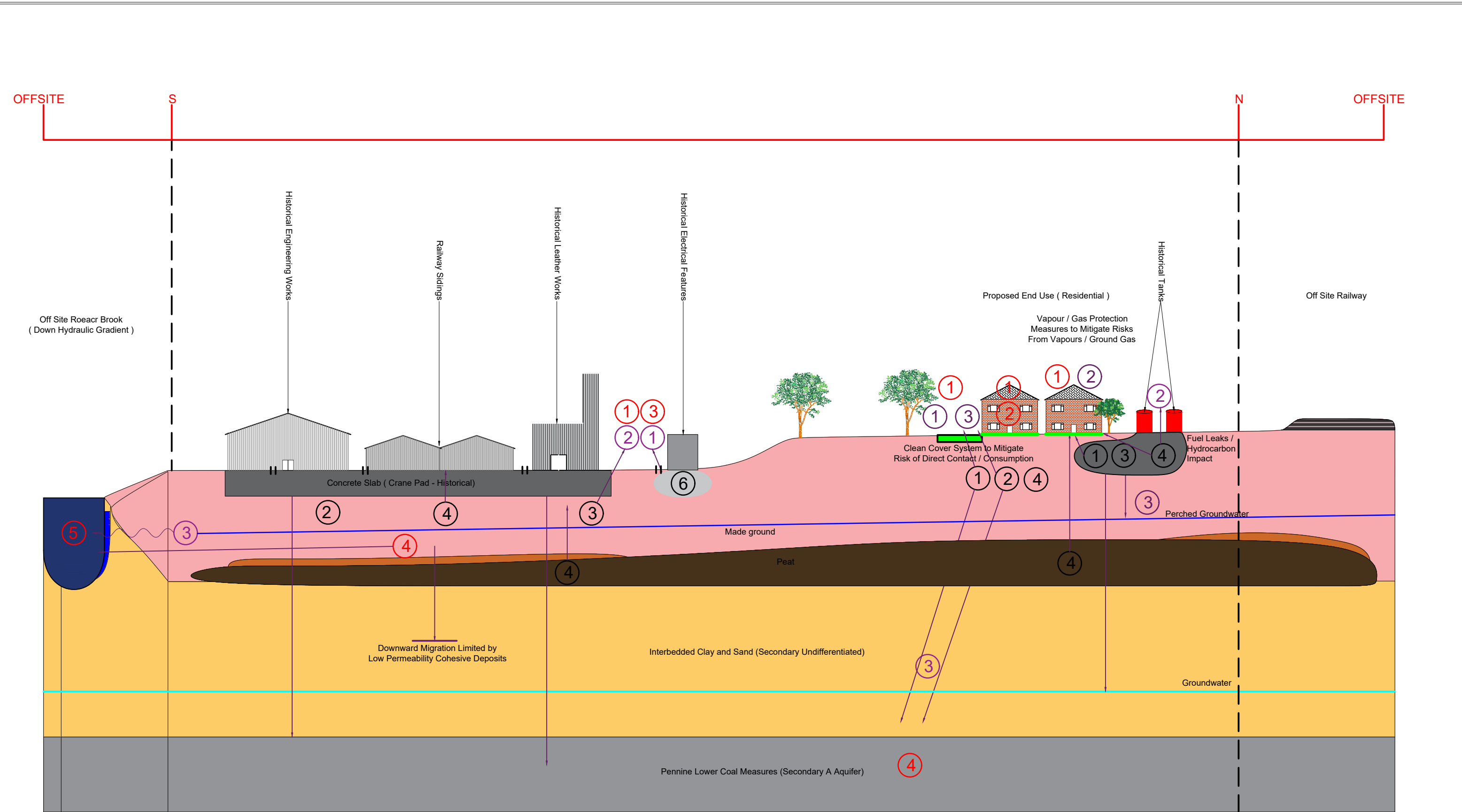
Urmston, Manchester, M41 7JQ

Tel: 0161 707 9612

E-mail: info@e3p.co.uk

Website: www.e3p.co.uk

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Geology Key

- Made Ground
- Interbedded Clay and Sand
- Pennine Lower Coal Measures
- Peat
- Railway Sidings

Sources

- ① Historical Land Uses - Heavy Metals / Non Volatile PAH
- ② Historical Structures - ACM
- ③ Historical Land Uses - Railway Sidings - Volatile Contaminant - Fuel Storage Etc
- ④ Made Ground, Peat - Methane / CO2
- ⑤ Made Ground - Sulphate's
- ⑥ Railway & Electrical Features - PCB's

Receptors

- ① Residential End User
- ② Buildings
- ③ Off-site Receptors
- ④ Ground Water
- ⑤ Surface Water Courses

Pathways

- ① Direct Contact / Ingestion
- ② Inhalation
- ③ Lateral / Vertical Migration

Notes:

P1	REVC	11.03.2022	HM	JS
P1	REVB	07.05.2021	EB	JS
P1	REVA	16.04.2021	EB	EF
Phase	Issue	Date	Drawn	Checked

Client:

Kellen Homes

Job Title:

Heywood Road, Castleton

Job No:

14-768

Drawing No:

010

Date:

11.03.2022

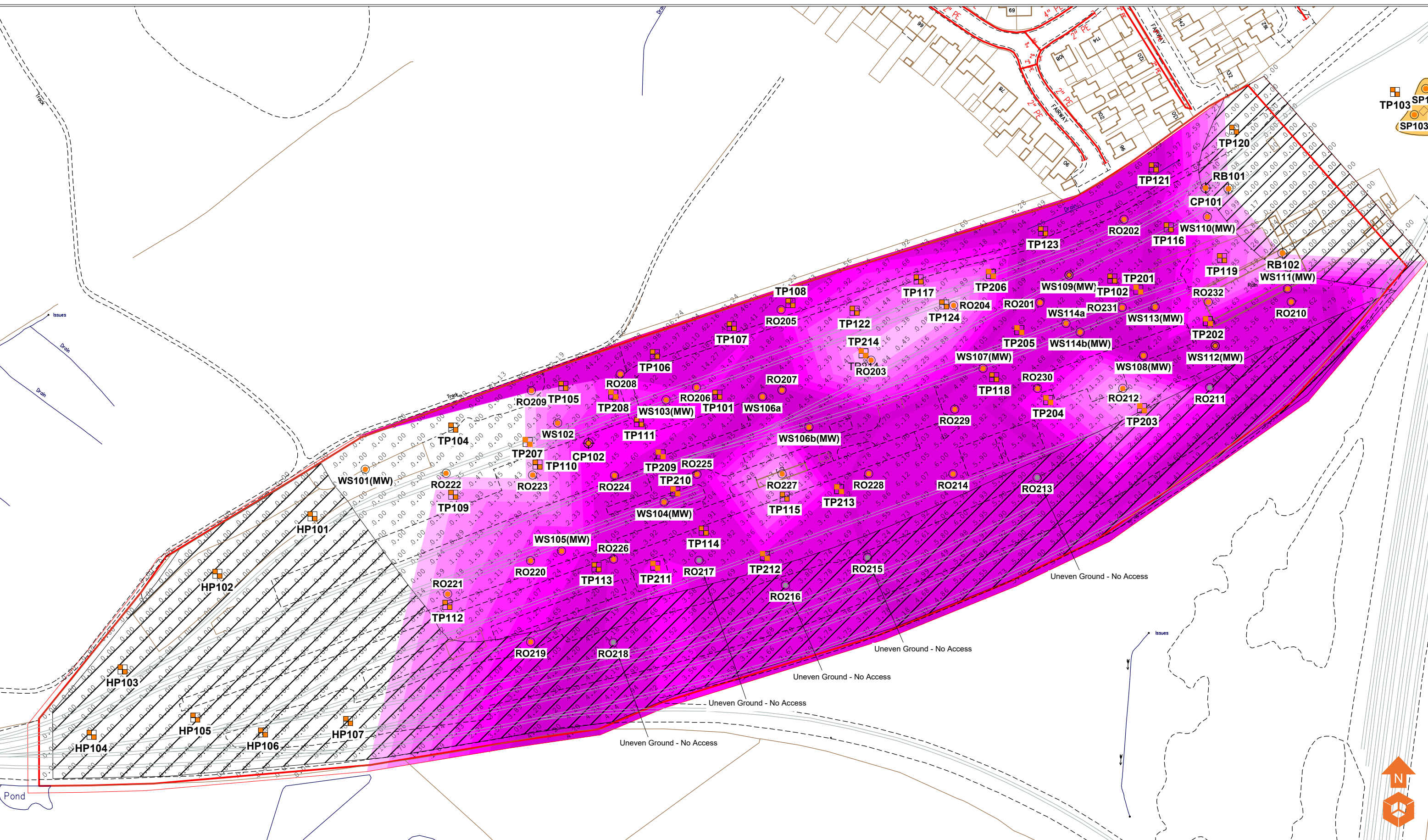
Scale:

NTS@ A3

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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Location Symbols

- Approximate Window Sample Probehole Location (March 2021)
- Approximate Window Sample Probehole Location with Install (March 2021)
- Approximate Trial Pit Location (March 2021)
- Approximate Rotary Borehole Location (March 2021)
- Approximate Trial Pit Location (June 2021)
- Approximate Rotary Borehole Location (July 2021)
- Approximate Hand Dug Pit Location (July 2021)
- Approximate Stockpile Sample Location (July 2021)
- Approximate Location of Attempted Rotary Borehole (July 2021 - Not Completed Due to Access Limitations)

Depth to Peat (m)

- Depth to Peat 0.00 - 0.59m
- Depth to Peat 0.60 - 1.19m
- Depth to Peat 1.20 - 1.59m
- Depth to Peat 1.80 - 2.39m
- Depth to Peat 2.40 - 2.99m
- Depth to Peat 3.00 - 3.59m
- Depth to Peat 3.60 - 4.19m
- Depth to Peat 4.20 - 4.79m
- Depth to Peat >4.80m

Obstructions

Area Not Investigated

Notes:				
P1	REVF	30.03.2022	EB	JS
P1	REVE	29.11.2021	EB	JS
P1	REVD	04.08.2021	HM	JS
P1	REVC	03.08.2021	HM	JS
P1	REVB	28.08.2021	HM	JS
P1	REVA	27.07.2021	HM	JS
Phase	Issue	Date	Drawn	Checked

Client:

Kellen Homes

Job Title:

Heywood Road,
Castleton

Job No:

14-768

Drawing No:

016

Date:

30.03.2022

Scale:

NTS @ A3

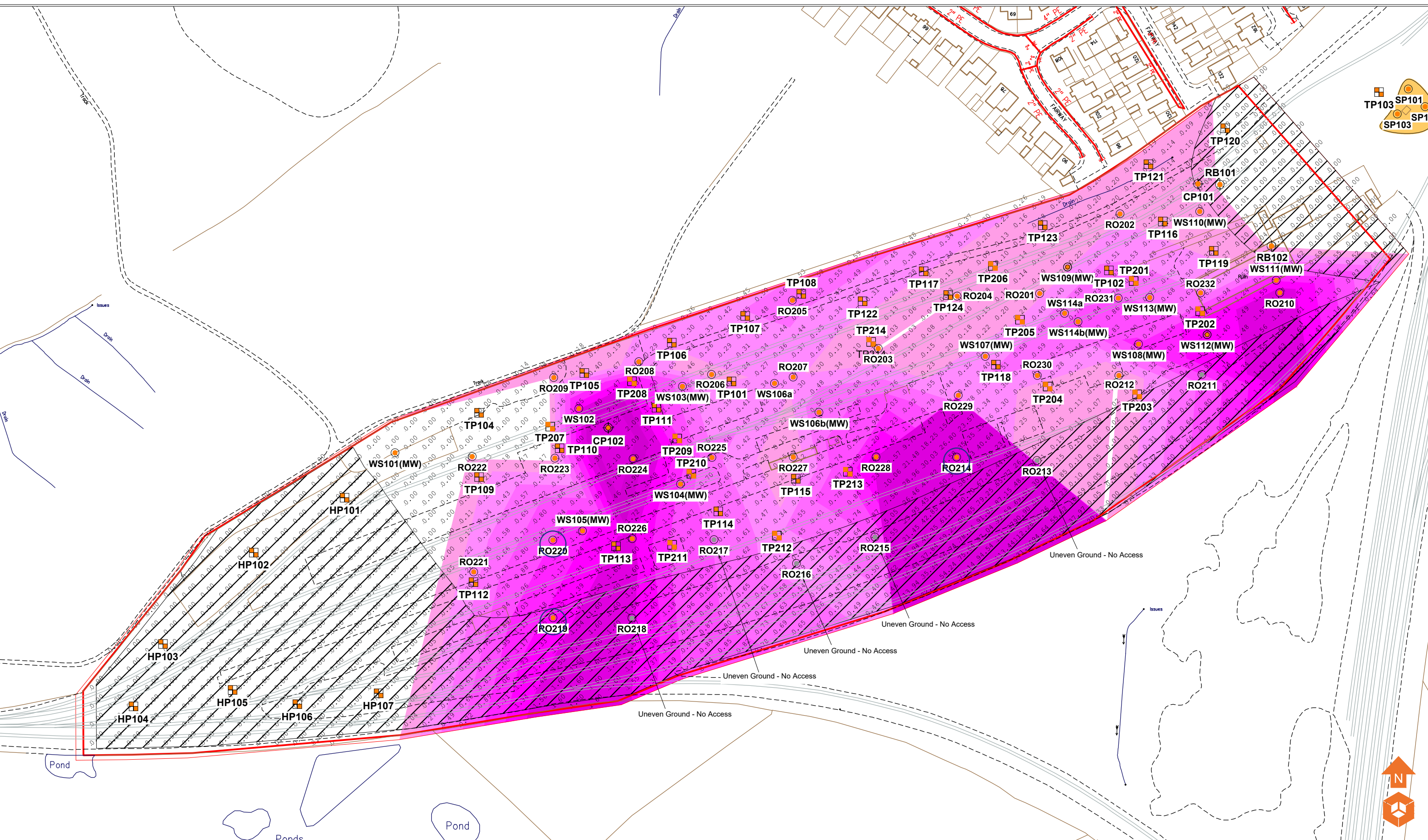
Drawing Title:

Depth to Peat Plan

Environmental Engineering
Partnership Ltd
Taylor Road, Trafford Park
Urmston, Manchester, M41 7JQ
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
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TP103 SP101
SP103 SP10



Location Symbols

- Approximate Window Sample Probehole Location (March 2021)
- Approximate Window Sample Probehole Location with Install (March 2021)
- Approximate Trial Pit Location (March 2021)
- Approximate Rotary Borehole Location (March 2021)
- Approximate Trial Pit Location (June 2021)
- Approximate Rotary Borehole Location (July 2021)
- Approximate Hand Dug Pit Location (July 2021)
- Approximate Stockpile Sample Location (July 2021)
- Approximate Location of Attempted Rotary Borehole (July 2021 - Not Completed Due to Access Limitations)

Thickness of Peat (m)

- Thickness of Peat 0.00 - 0.24m
- Thickness of Peat 0.25 - 0.49m
- Thickness of Peat 0.50 - 0.74m
- Thickness of Peat 0.75 - 0.99m
- Thickness of Peat 1.00 - 1.24m
- Thickness of Peat 1.25 - 1.49m
- Thickness of Peat 1.50 - 1.74m
- Thickness of Peat 1.75 - 1.99m
- Thickness of Peat >2.00m

Obstructions

Area Not Investigated

Notes:				
Thickness of Peat is Inferred.				
P1	REVG	30.03.2022	EB	JS
P1	REVF	29.11.2021	EB	JS
P1	REVE	04.08.2021	HM	JS
P1	REVD	03.08.2021	HM	JS
P1	REVC	30.07.2021	HM	JS
P1	REVB	28.07.2021	HM	JS
P1	REVA	27.07.2021	HM	JS
Phase	Issue	Date	Drawn	Checked

Client:

Kellen Homes

Job Title:

Heywood Road,
Castleton

Job No:

14-768

Drawing No:

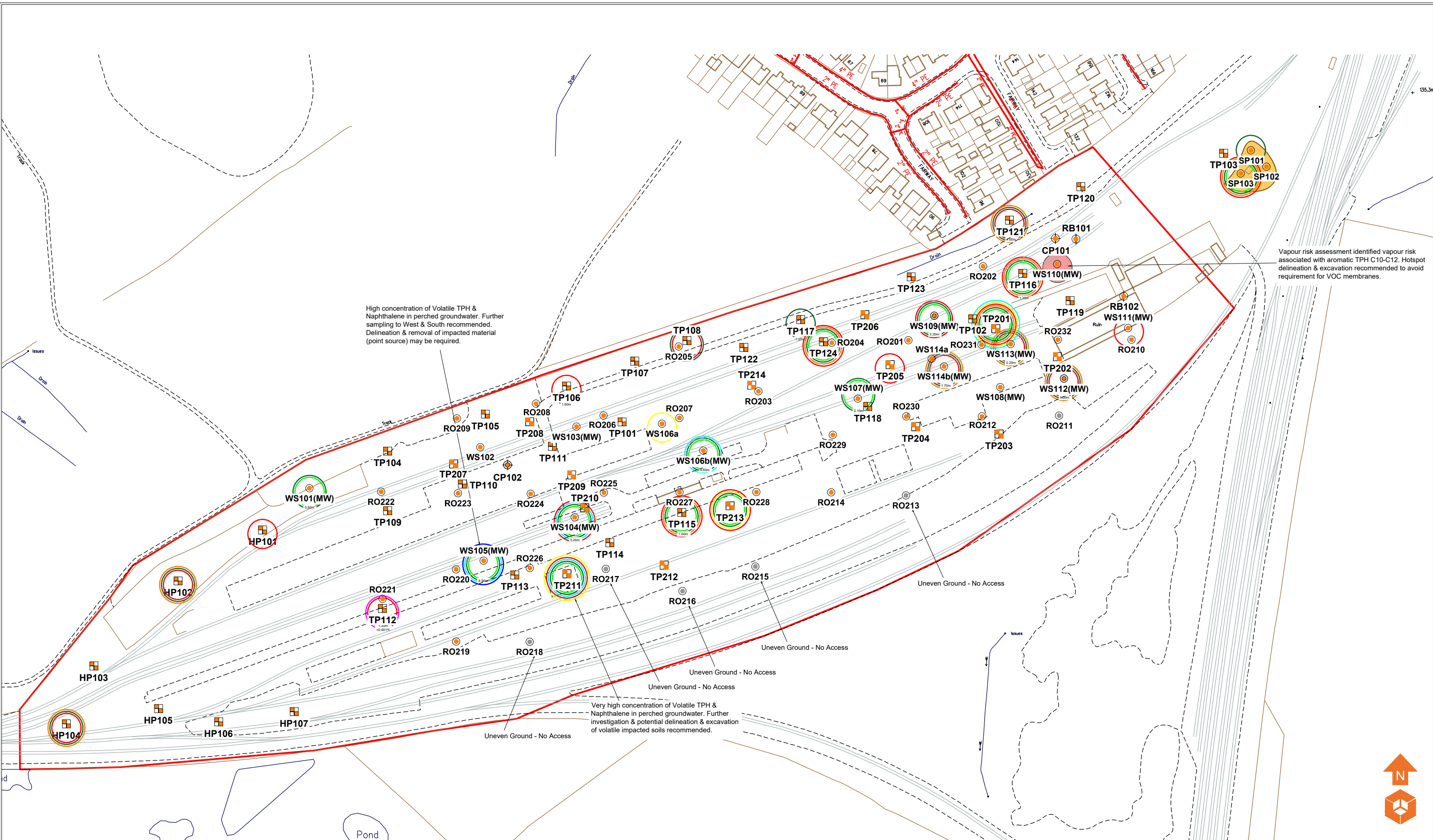
017

Drawing Title:

Thickness of Peat Plan

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

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Location Symbols		Soil Contaminants		Groundwater Contaminants		Notes:		Client:		Job No:		Date:		 Environmental Engineering Partnership Ltd Taylor Road, Trafford Park Urmston, Manchester, M41 7JQ Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk																										
WS001 WS1000W TP101 RO101 TP102 RO102 HP101 SP101 RO103 Approximate Window Sample Probehole Location (March 2021) Approximate Window Sample Probehole Location with Install (March 2021) Approximate Trial Pit Location (March 2021) Approximate Rotary Borehole Location (March 2021) Approximate Trial Pit Location (June 2021) Approximate Rotary Borehole Location (July 2021) Approximate Hand Dug Pit Location (July 2021) Approximate Stockpile Sample Location (July 2021) Approximate Location of Attempted Rotary Borehole (July 2021 - Not Completed Due to Access Limitations)		Heavy metals Mercury (volatile) Asbestos (chryrotile <0.001% wt/wt) Napathalene (volatile) Non-volatile PAH TPH C10-C16 (volatile) TPH C16-C21 (non-volatile)		Volatile TPH & Naphthalene in Groundwater Sample. Vapour Risk (TPH C10-C12 Aromatic)				Kellen Homes		14-768		30.03.2022																												
								Job Title: Heywood Road, Castleton		Drawing No: 018		Scale: NTS @ A3		The client must not amend any drawing, design or other intellectual property produced by E3P Ltd without permission in writing from E3P Ltd in advance of any amendments being made. In the event that such written permission is not obtained in advance of the amendments being made, E3P Ltd shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.																										
						<table><tr><td>P1</td><td>REVD</td><td>30.03.2022</td><td>EB</td><td>JS</td></tr><tr><td>P1</td><td>REVC</td><td>24.02.2022</td><td>LM</td><td>JS</td></tr><tr><td>P1</td><td>REVB</td><td>30.04.2021</td><td>EB</td><td>EF</td></tr><tr><td>P1</td><td>REVA</td><td>15.04.2021</td><td>EB</td><td>EF</td></tr><tr><td>Phase</td><td>Issue</td><td>Date</td><td>Drawn</td><td>Checked</td></tr></table>		P1	REVD	30.03.2022	EB	JS	P1	REVC	24.02.2022	LM	JS	P1	REVB	30.04.2021	EB	EF	P1	REVA	15.04.2021	EB	EF	Phase	Issue	Date	Drawn	Checked								
P1	REVD	30.03.2022	EB	JS																																				
P1	REVC	24.02.2022	LM	JS																																				
P1	REVB	30.04.2021	EB	EF																																				
P1	REVA	15.04.2021	EB	EF																																				
Phase	Issue	Date	Drawn	Checked																																				

APPENDIX IV PHOTOGRAPHS

PLATE 1 ACTIVE RAILWAY ON EASTERN BOUNDARY –FACING SOUTH



PLATE 2 VIEW OF SITE FACING NORTH THROUGH CENTRE OF SITE



PLATE 3 VIEW OF SITE FACING NORTH ALONG EASTERN BOUNDARY



PLATE 4 AREA OF ROUGH SCRUBLAND IN NORTHERN CENTRAL AREA OF SITE



PLATE 5 AREA OF TIPPED WASTE IN CENTRE OF SITE – POSSIBLE ACM



PLATE 6 AREA OF HARD STANDING IN SOUTH OF SITE



PLATE 7

AREA OF HARD STANDING THROUGH CENTRE OF SITE – FACING SOUTH



APPENDIX V

E3P EXPLORATORY HOLE LOGS

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387825.00 - 410127.00 Level:	Date 04/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): 2.20	Scale 1:30
Client: Kellen Homes		Depth 2.70	Logged E. Fearn

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	1.00	ES		0.20			MADE GROUND: Black brown slightly clayey gravelly medium sand with rootlets. Gravel is fine to coarse angular to sub-rounded of mudstone. MADE GROUND: Black slightly clayey gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of mudstone, brick and wood.	1
				2.70			End of Pit at 2.70m	3
								4

Trial Pit Photographs



Trial Pit 101 Spoil

Trial Pit 101

Remarks: 1. Terminated due to side wall collapse within Made Ground.

Stability: Unstable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387980.00 - 410161.00 Level:	Date 04/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): 2.30 Depth 3.00	Scale 1:30
Client: Kellen Homes			Logged E. Fearn

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.30			MADE GROUND: Black brown slightly clayey gravelly medium sand with rootlets. Gravel is fine to coarse angular to sub-rounded of mudstone and limestone.	
	1.20 1.20	B ES					MADE GROUND: Black slightly clayey gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of mudstone, brick, ash and slate.	1
								2
				3.00			End of Pit at 3.00m	3
								4

Trial Pit Photographs



Trial Pit 102



Trial Pit 102 Spoil

Remarks: 1. Terminated due to side wall collapse within Made Ground.

Stability: Unstable.

Stability: Stable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387709.00 - 410123.00 Level:	Date 04/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): 2.40 Depth 2.40	Scale 1:30
Client: Kellen Homes			Logged E. Fearn

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
 1.50	0.30	ES		0.40			MADE GROUND: Black slightly clayey gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of mudstone, brick and ash.	
							MADE GROUND: Yellow brown clayey medium sand.	1
	1.30	ES		1.50			Light brown sandy GRAVEL. Gravel is fine to coarse angular to rounded of mudstone and sandstone.	2
				2.40			End of Pit at 2.40m	3
								4

Trial Pit Photographs

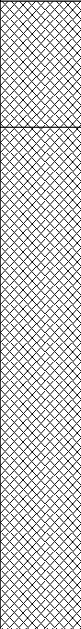


Trial Pit 104

Remarks: 1. Terminated due to side wall collapse within Made Ground. 2. Water strike encountered at 1.50m bgl.

Stability: Unstable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387758.00 - 410142.00 Level:	Date 04/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): 2.20 Depth 2.50	Scale 1:30
Client: Kellen Homes			Logged E. Fearn

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
 1.20	1.00	B ES		0.50			MADE GROUND: Black slightly clayey gravelly medium sand with rootlets. Gravel is fine to coarse angular to sub-rounded of mudstone, brick and ash.	
	1.00						MADE GROUND: Black gravelly medium sand with cobbles. Gravel is fine to coarse angular to sub-rounded of mudstone and brick. Cobbles are angular of brick.	1
				2.50			End of Pit at 2.50m	2 3 4

Trial Pit Photographs



Trial Pit 105



Trial Pit 105 Spoil

Remarks: 1. Terminated due to side wall collapse within Made Ground at 2.00m bgl. 2. Water strike encountered at 1.20m bgl. 3. Hydrocarbon impact identified in Made Ground encountered between 0.50m and 2.50m bgl.

Stability: Unstable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387803.00 - 410157.00 Level:	Date 04/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): 2.50 Depth 2.20	Scale 1:30
Client: Kellen Homes			Logged E. Fearn

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	1.00	ES					MADE GROUND: Black brown slightly clayey gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of mudstone, limestone and brick.	1
	1.60 1.60	ES HVP	90	1.40 2.20			MADE GROUND: Light brown grey slightly sandy clay.	2
							End of Pit at 2.20m	3
								4

Trial Pit Photographs



Trial Pit 106



Trial Pit 106 Spoil

Remarks: 1. Complete. 2. Hydrocarbon odour encountered in Made Ground between 1.40m and 2.20m bgl.

Stability: Stable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387825.00 - 410159.00 Level:	Date 04/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): 2.20 Depth 2.80	Scale 1:30
Client: Kellen Homes			Logged E. Fearn

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	1.80 1.80	B ES					MADE GROUND: Black very gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of mudstone, brick and ash.	1
				2.20				2
				2.80			Light brown grey sandy GRAVEL. Gravel is fine to coarse angular to sub-rounded of mudstone and sandstone.	
							End of Pit at 2.80m	3
								4

Trial Pit Photographs



Trial Pit 107

Trial Pit 107 Spoil

Remarks: 1. Complete. 2. Hydrocarbon odour encountered in Made Ground between 1.40m and 2.20m bgl.

Stability: Stable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387855.00 - 410171.00 Level:	Date 04/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): 2.00 Depth 2.60	Scale 1:30
Client: Kellen Homes			Logged E. Fearn

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	1.00	ES		1.20			MADE GROUND: Black slightly clayey gravelly medium sand with rootlets. Gravel is fine to coarse angular to rounded of mudstone and brick.	1
				2.60			MADE GROUND: Dark grey slightly clayey gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of mudstone, brick and ash.	2
							End of Pit at 2.60m	3
								4

Trial Pit Photographs



Trial Pit 108

Trial Pit 108 Spoil

Remarks: 1. Terminated due to side wall collapse within Made Ground.

Stability: Unstable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387723.00 - 410087.00 Level:	Date 04/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): 2.00 Depth 2.80	Scale 1:30 Logged E. Fearn
Client: Kellen Homes			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.30	ES		0.40			MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to sub-rounded of mudstone, brick and ash.	
				0.70			MADE GROUND: Light grey brown clayey medium sand.	
	0.80	ES					Yellow brown slightly clayey medium SAND.	1
				2.80			End of Pit at 2.80m	2
 2.70								3
								4

Trial Pit Photographs



Trial Pit 109



Trial Pit 109 Spoil

Remarks: 1. Terminated due to side wall collapse within Made Ground. 2. Water strike encountered at 2.70m bgl.

Stability: Unstable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387752.00 - 410101.00 Level:	Date 04/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): 2.20 Depth 1.80	Scale 1:30
Client: Kellen Homes			Logged E. Fearn

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.10			MADE GROUND: Light grey concrete.	
							MADE GROUND: Black clayey slightly gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of mudstone, brick and ash.	
	1.00	ES						1
▼ 1.60				1.80			End of Pit at 1.80m	2
								3
								4

Trial Pit Photographs



Trial Pit 110



Trial Pit 110 Spoil

Remarks: 1. Terminated due to significant water strike encountered at 1.60m bgl, causing side wall collapse.

Stability: Unstable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387805.00 - 410121.00 Level:	Date 04/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): 2.40 Depth 2.30	Scale 1:30
Client: Kellen Homes			Logged E. Fearn

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.10			MADE GROUND: Asphalt.	
							MADE GROUND: Dark grey brown slightly clayey gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of mudstone, brick, ash and slate.	
	1.20 1.20	B ES						1
				2.30			End of Pit at 2.30m	2
								3
								4

Trial Pit Photographs



Trial Pit 111



Trial Pit 111 Spoil

Remarks: 1. Terminated due to side wall collapse within Made Ground.

Stability: Unstable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387727.00 - 410030.00 Level:	Date 04/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): 2.20 Depth 2.70	Scale 1:30
Client: Kellen Homes			Logged E. Fearn

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	1.30	ES		0.10			MADE GROUND: Light grey concrete. MADE GROUND: Dark grey slightly clayey gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of mudstone, brick, timber and ash.	1
				2.70			End of Pit at 2.70m	2
								3
								4

Trial Pit Photographs



Trial Pit 112

Trial Pit 112 Spoil

Remarks: 1. Complete.

Stability: Stable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387801.00 - 410063.00 Level:	Date 04/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): 2.10 Depth 2.60	Scale 1:30
Client: Kellen Homes			Logged E. Fearn

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.10			MADE GROUND: Dark brown slightly clayey medium sand with rootlets (Topsoil) and occasional fragments of brick.
				0.60			MADE GROUND: Grey gravel. Gravel is fine to coarse angular of mudstone.
	0.80	ES					
	2.10	ES					MADE GROUND: Dark grey clayey gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of mudstone, brick and timber.
▼ 2.20				2.60			End of Pit at 2.60m

Trial Pit Photographs



Trial Pit 113



Trial Pit 113

Remarks: 1. Terminated due to side wall collapse at water strike. 2. Water strike encountered at 2.20m bgl. 3. Hydrocarbon odour encountered in Made Ground at 2.00m bgl.

Stability: Unstable.

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387842.00 - 410061.00
Level:

Date
04/03/2021

Location: Heywood Road, Rochdale

Dimensions (m): 2.00

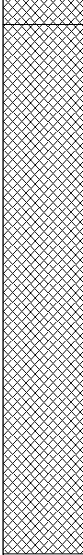
Scale
1:30

Client: Kellen Homes

Depth
2.20

0.60

Logged
E. Fearn

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	1.00 1.00	B ES		0.10			MADE GROUND: Black slightly clayey medium sand with rootlets. MADE GROUND: Black slightly clayey gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of mudstone, brick, ash and glass.
				2.20			End of Pit at 2.20m

Trial Pit Photographs



Trial Pit 114



Trial Pit 114 Spoil

Remarks: 1. Terminated due to side wall collapse in Made Ground at 1.80m bgl.

Stability: Unstable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387866.00 - 410069.00 Level:	Date 04/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): 2.40 Depth 2.00	Scale 1:30
Client: Kellen Homes			Logged E. Fearn

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	1.00	ES		0.20			MADE GROUND: Black grey slightly clayey medium sand with rootlets.	
				2.00			MADE GROUND: Black slightly clayey gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of mudstone, brick and timber.	
							End of Pit at 2.00m	

Trial Pit Photographs



Trial Pit 115

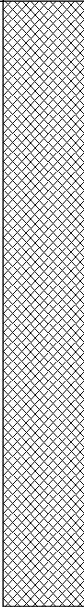


Trial Pit 115 Spoil

Remarks: 1. Complete.

Stability: Stable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: - Level:	Date 05/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): 2.00	Scale 1:30
Client: Kellen Homes		Depth 2.40	Logged J. Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	1.20	ES		2.40			MADE GROUND: Black slightly sandy gravel. Gravel is fine to coarse angular to sub-angular of mudstone, brick and ash.	1
							End of Pit at 2.40m	2
								3
								4

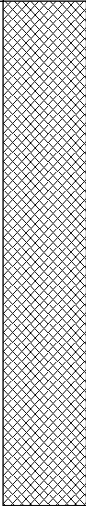
Trial Pit Photographs



Remarks: 1. Terminated due to side wall collapse in Made Ground.

Stability: Unstable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: - Level:	Date 05/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): Depth 2.00	Scale 1:30
Client: Kellen Homes		0.60	Logged J. Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	1.00	ES		2.00			MADE GROUND: Black slightly sandy gravel. Gravel is fine to coarse angular to sub-angular of mudstone, brick and ash.	1
							End of Pit at 2.00m	2
								3
								4

Trial Pit Photographs



Trial Pit 117



Trial Pit 117 Spoil

Remarks: 1. Terminated due to side wall collapse in Made Ground at 1.80m bgl.

Stability: Unstable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: - Level:	Date 05/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): 2.10	Scale 1:30
Client: Kellen Homes		Depth 2.10	Logged J. Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	1.00	ES		0.40			MADE GROUND: Light grey concrete.	1
				2.10			MADE GROUND: Black slightly sandy gravel. Gravel is fine to coarse angular to sub-angular of mudstone, brick and ash.	2
							End of Pit at 2.10m	3
								4

Trial Pit Photographs



Trial Pit 118

Trial Pit 118 Spoil

Remarks: 1. Terminated due to side wall collapse in Made Ground.

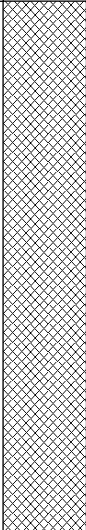
Stability: Unstable.



Trial Pit Log

TrialPit No
TP119
Sheet 1 of 1

Project Name: Castleton Sidings	Project No. 14768	Co-ords: - Level:	Date 05/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): Depth 2.10	Scale 1:30 Logged J. Craig
Client: Kellen Homes		0.60	

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	1.00	ES		2.10			MADE GROUND: Black slightly sandy gravel. Gravel is fine to coarse angular to sub-angular of mudstone, brick and ash.	1
							End of Pit at 2.10m	2
								3
								4

Remarks: 1. Terminated due to side wall collapse in Made Ground.

Stability: Unstable.



Project Name: Castleton Sidings	Project No. 14768	Co-ords: - Level:	Date 05/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): 2.10	Scale 1:30
Client: Kellen Homes		Depth 2.30	Logged J. Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.80	ES					MADE GROUND: Black slightly sandy gravel with occasional boulders. Gravel is fine to coarse angular to sub-angular of mudstone, brick and ash. Boulders are sub-angular of brick.	
	1.10	ES		1.00			MADE GROUND: Yellow brown gravelly clay. Gravel is fine to coarse angular to rounded of sandstone and mudstone.	1
				1.20			MADE GROUND: Black slightly sandy gravel with occasional boulders. Gravel is fine to coarse angular to sub-angular of mudstone, brick and ash. Boulders are sub-angular of brick.	2
				2.30			End of Pit at 2.30m	3
								4

Trial Pit Photographs



Trial Pit 120

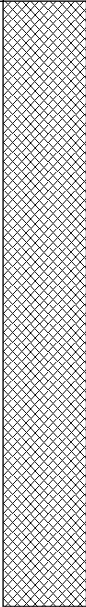


Trial Pit 120 Spoil

Remarks: 1. Terminated due to side wall collapse in Made Ground at 2.00m bgl.

Stability: Unstable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: - Level:	Date 05/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): Depth 2.40	Scale 1:30
Client: Kellen Homes		0.60	Logged J. Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	1.00	ES		2.40			MADE GROUND: Black slightly sandy gravel. Gravel is fine to coarse angular to sub-angular of mudstone, brick and ash.	1
							End of Pit at 2.40m	2
								3
								4

Trial Pit Photographs



Trial Pit 121



Trial Pit 121 Spoil

Remarks: 1. Terminated due to side wall collapse in Made Ground.

Stability: Unstable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: - Level:	Date 05/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): Depth 2.60	Scale 1:30
Client: Kellen Homes		0.60	Logged J. Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	1.00	ES					MADE GROUND: Black slightly sandy gravel. Gravel is fine to coarse angular to sub-angular of mudstone, brick and ash.	1
				2.60			End of Pit at 2.60m	2
								3
								4

Trial Pit Photographs



Trial Pit 122



Trial Pit 122

Remarks: 1. Terminated due to collapse in Made Ground.

Stability: Unstable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: - Level:	Date 05/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): Depth 2.80	Scale 1:30 Logged J. Craig
Client: Kellen Homes			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	1.00	ES		2.80			MADE GROUND: Black slightly sandy gravel. Gravel is fine to coarse angular to sub-angular of mudstone, brick and ash.	1
							End of Pit at 2.80m	2
								3
								4

Trial Pit Photographs



Trial Pit 123



Trial Pit 123 Spoil

Remarks: 1. Terminated due to collapse in Made Ground.

Stability: Unstable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: - Level:	Date 05/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): 2.20	Scale 1:30
Client: Kellen Homes		Depth 2.40	Logged J. Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	1.00	ES					MADE GROUND: Black slightly sandy gravel. Gravel is fine to coarse angular to sub-angular of mudstone, brick and ash.	1
				2.40			End of Pit at 2.40m	2
								3
								4

Trial Pit Photographs



Trial Pit 124



Trial Pit 124 Spoil

Remarks: 1. Terminated due to side wall collapse in Made Ground at 2.00m bgl.

Stability: Unstable.

Borehole Log

Borehole No.

WS101

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords:

Hole Type
WS

Location: Heywood Road, Rochdale

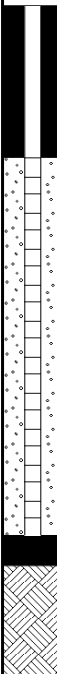
Level:

Scale
1:50

Client: Kellen Homes

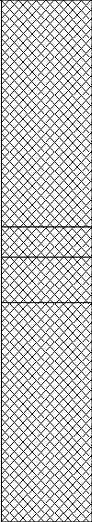
Dates: 04/03/2021

Logged By
J. Craig

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.50	ES		0.50			MADE GROUND: Black slightly sandy gravel. Gravel is fine to coarse angular to sub-angular of mudstone, brick and ash.	
		0.70	ES						
		1.00	SPT	N=20 (5,6/6,6,4,4)				MADE GROUND: Medium dense brown grey gravelly medium sand. Gravel is fine to coarse sub-angular to rounded of mudstone and sandstone.	1
		1.50 - 2.00	U		1.40				
		1.60	PP	25.00					
		1.90	PP	49.00					
		2.00	SPT	N=15 (3,2/3,3,4,5)					2
		2.10	PP	25.00					
		2.90	PP	25.00					3
		3.00	SPT	N=9 (1,2/2,2,2,3)					
		3.10	PP	25.00					
		3.70	PP	25.00					4
		4.00	SPT	N=14 (3,3/3,4,3,4)					
					4.45				
								End of Borehole at 4.45m	5
									6
									7
									8
									9
									10

Remarks

1. Terminated due to collapse from 4.00m bgl. 2. Monitoring well installed.

				Borehole Log				Borehole No. WS102 Sheet 1 of 1	
Project Name: Castleton Sidings				Project No. 14768		Co-ords:		Hole Type WS	
Location: Heywood Road, Rochdale				Level:		Scale 1:50			
Client: Kellen Homes				Dates: 04/03/2021		Logged By J. Craig			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		1.00 1.00	ES SPT	N=22 (4,5/4,6,6,6)				MADE GROUND: Medium dense black slightly sandy gravel. Gravel is fine to coarse angular to sub-angular of mudstone, concrete, brick and ash.	1
		1.60	ES		1.50 1.70			MADE GROUND: Dark brown slightly gravelly clay. Gravel is fine to coarse angular to rounded of mudstone and sandstone.	2
		2.00	SPT	N=13 (4,4/4,3,3,3)	2.00			MADE GROUND: Brown gravelly clay. Gravel is fine to coarse sub-angular to rounded of mudstone and sandstone.	
		3.20	ES		3.45			MADE GROUND: Medium dense black sandy clayey gravel. Gravel is fine to coarse angular to sub-rounded of mudstone and brick.	3
							End of Borehole at 3.45m		4
									5
									6
									7
									8
									9
									10
Remarks 1. Terminated due to collapse to 2.30m bgl.									

Project Name: Castleton Sidings

Project No.
14768

Co-ords:

Hole Type
WS

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

Dates: 04/03/2021

Logged By
J. Craig

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		1.00	SPT	N=16 (4,4/5,3,4,4)				MADE GROUND: Medium dense black slightly sandy gravel. Gravel is fine to coarse angular to sub-angular of mudstone, concrete, brick and ash.	1
		2.00	SPT	N=17 (4,2/3,4,4,6)					2
		3.00 3.00	ES SPT	N=21 (5,5/5,6,5,5)					3
		4.00	SPT	N=13 (4,5/3,2,4,4)					4
		4.90 5.00	ES SPT	N=12 (3,3/4,3,3,2)	4.50			Medium dense grey slightly silty SAND.	5
					5.45			End of Borehole at 5.45m	6
									7
									8
									9
									10

Remarks

1. Complete. 2. Monitoring well installed.



Borehole Log

Borehole No.

WS104

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords:

Hole Type
WS

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

Dates: 04/03/2021

Logged By
J. Craig

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.15			MADE GROUND: Light grey concrete. MADE GROUND: Medium dense black slightly sandy gravel. Gravel is fine to coarse angular to sub-angular of mudstone, brick and ash.	
		1.00 1.20	SPT ES	N=21 (3,4/5,5,5,6)					1
		2.00	SPT	N=11 (5,5/3,3,3,2)					2
		3.00 3.20	SPT ES	N=7 (2,2/1,2,2,2)					3
		4.00 4.30	SPT ES	N=15 (2,2/3,3,4,5)	4.20			Medium dense grey slightly clayey SAND.	4
		5.00	SPT	N=6 (4,3/2,1,1,2)					5
					5.45			End of Borehole at 5.45m	6
									7
									8
									9
									10

Remarks

1. Complete. 2. Significant hydrocarbon odour and impact encountered 3.20m to 4.20m bgl. 3. Monitoring well installed.





Borehole Log

Borehole No.

WS105

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords:

Hole Type
WS

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

Dates: 04/03/2021

Logged By
J. Craig

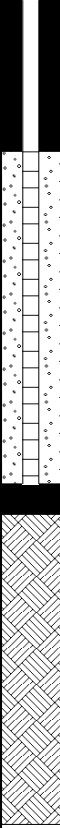
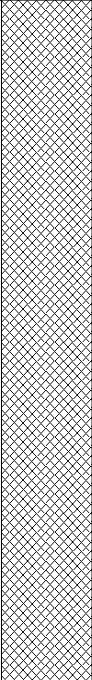
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		1.00	SPT	N=23 (3,5/7,6,5,5)				MADE GROUND: Medium dense black slightly sandy gravel. Gravel is fine to coarse angular to sub-angular of mudstone, brick and ash.	1
		1.30	ES		1.40				
		1.90	ES					MADE GROUND: Grey clayey gravel. Gravel is fine to coarse angular to sub-angular of mudstone.	
		2.00	SPT	N=15 (2,2/3,4,5,3)	2.00			MADE GROUND: Medium dense black slightly clayey gravel. Gravel is fine to coarse angular to sub-angular of mudstone, brick and ash.	2
		3.00	ES						3
		3.00	SPT	N=10 (1,2/3,3,2,2)					
		4.00	SPT	N=17 (4,4/5,4,4,4)					4
		4.90	ES		4.80				
		5.00	SPT	N=26 (5,5/6,8,6,6)				Grey slightly clayey SAND.	5
					5.45			End of Borehole at 5.45m	6
									7
									8
									9
									10

Remarks

1. Complete. 2. Significant hydrocarbon odour and impact encountered 2.00m to 5.45m bgl. 3. Monitoring well installed.



					Borehole Log			Borehole No. WS106a Sheet 1 of 1	
Project Name: Castleton Sidings					Project No. 14768		Co-ords:		Hole Type WS
Location: Heywood Road, Rochdale					Level:		Scale 1:50		
Client: Kellen Homes					Dates: 05/03/2021		Logged By J. Craig		
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.50			MADE GROUND: Light grey concrete.	
								End of Borehole at 0.50m	
									1
									2
									3
									4
									5
									6
									7
									8
									9
									10
Remarks 1. Terminated and location moved due to double concrete slab.									

				Borehole Log			Borehole No. WS106b Sheet 1 of 1		
Project Name: Castleton Sidings				Project No. 14768		Co-ords:		Hole Type WS	
Location: Heywood Road, Rochdale						Level:		Scale 1:50	
Client: Kellen Homes						Dates: 05/03/2021		Logged By J. Craig	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		1.00	ES	N=20 (2,2/4,5,6,5)	4.50			MADE GROUND: Medium dense black slightly clayey gravel. Gravel is fine to coarse angular to sub-angular of mudstone, brick and ash. Becoming loose from circa. 3.00m bgl.	1
		1.00	SPT						
		2.00	SPT	N=12 (4,4/3,4,3,2)					3
		3.00	SPT	N=10 (2,2/2,2,3,3)					4
		4.00	SPT	N=8 (2,1/1,2,2,3)					5
		4.60	ES						6
	5.00	SPT	N=16 (2,3/3,4,4,5)	5.45		Stiff medium strength black brown PEAT.	7		
	5.20	ES					8		
End of Borehole at 5.45m									9
									10
Remarks 1. Complete. 2. Significant hydrocarbon odour and impact encountered between 4.00m and 4.45m bgl. 3. Monitoring well installed.									

Project Name: Castleton Sidings

Project No.
14768

Co-ords:

Hole Type
WS

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

Dates: 05/03/2021

Logged By
J. Craig

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.90 1.00	ES SPT	N=11 (3,3/4,3,2,2)				MADE GROUND: Medium dense black slightly clayey gravel. Gravel is fine to coarse angular to sub-angular of mudstone, brick and ash.	1
		2.00 2.10	SPT ES	N=11 (2,4/4,3,2,2)					2
		3.00	SPT	N=7 (3,2/2,1,2,2)					3
		4.00	SPT	N=14 (2,2/3,4,4,3)					4
		5.00	SPT	N=21 (4,4/5,5,6,5)					5
					5.45			End of Borehole at 5.45m	6
									7
									8
									9
									10

Remarks

1. Complete. 2. Monitoring well installed.



Borehole Log

Borehole No.

WS108

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords:

Hole Type
WS

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

Dates: 05/03/2021

Logged By
J. Craig

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		1.00	SPT	N=17 (3,4/4,6,4,3)				MADE GROUND: Medium dense black slightly clayey gravel. Gravel is fine to coarse angular to sub-angular of mudstone, brick and ash. Becoming loose from circa. 2.00m bgl.	1
		2.00 2.10	SPT ES	N=10 (2,2/2,3,2,3)					2
		3.00	SPT	N=6 (2,1/1,1,2,2)					3
		4.00	SPT	N=4 (1,2/1,1,1,1)					4
		4.60	ES		4.40			Stiff medium strength black brown PEAT.	5
		5.00	SPT	N=15 (2,3/5,4,3,3)	5.45			End of Borehole at 5.45m	6
									7
									8
									9
									10

Remarks

1. Complete. 2. Significant hydrocarbon odour and impact encountered at 4.00m to 4.45m bgl. 3. Monitoring well installed.



Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387963E - 410193N

Hole Type
WS

Location: Heywood Road, Rochdale

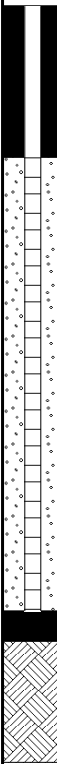
Level:

Scale
1:50

Client: Kellen Homes

Dates: 18/03/2021

Logged By
E. Fearn

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Brown slightly clayey gravelly medium sand with rootlets. Gravel is fine to coarse angular to sub-rounded of mudstone and brick.	
		0.80	ES					MADE GROUND: Loose black brown clayey very gravelly medium sand. Gravel is fine to coarse angular to sub-angular of mudstone, brick and ash.	1
		1.00	SPT	N=7 (2,1/2,2,2,1)					
					1.80				
		2.00	SPT	1 (,1,,)				MADE GROUND: Red gravel. Gravel is coarse angular of brick.	2
		2.20	ES		2.10			MADE GROUND: Very loose black clayey gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of brick and ash.	
		3.00	SPT	N=7 (1,1/2,1,2,2)					3
					3.30				
		4.00 - 4.45	D					Stiff medium strength brown grey sandy gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of mudstone.	4
		4.00	SPT	N=10 (3,3/2,2,3,3)					
		5.00	SPT	N=10 (3,3/3,2,2,3)	5.00			End of Borehole at 5.00m	5
									6
									7
									8
									9
									10

Remarks

1. Collapsed before 5.00m to 5.45m SPT could be completed. 2. Redrilled due to collapse. 3. Monitoring well installed.

Borehole Log

Borehole No.

WS110

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 388046E - 410225N

Hole Type
WS

Location: Heywood Road, Rochdale

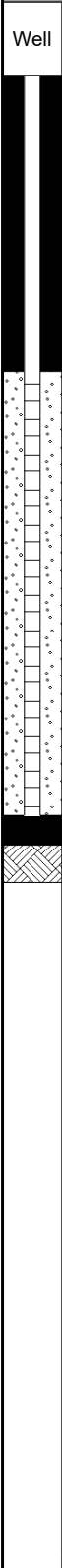
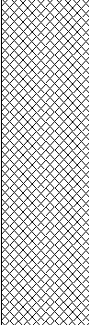
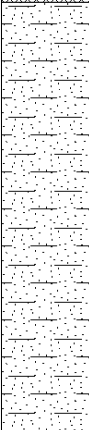
Level:

Scale
1:50

Client: Kellen Homes

Dates: 18/03/2021

Logged By
E. Fearn

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		1.00 1.20	SPT ES	N=5 (2,2/1,1,1,2)	2.20 2.60 5.45			MADE GROUND: Very loose black brown slightly clayey gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of mudstone, brick and ash.	1
		2.00	SPT	3 (2,1/1,,1,1)				MADE GROUND: Brown grey sandy gravelly clay. Gravel is fine to coarse angular to sub-rounded of mudstone and brick.	2
		2.80 3.00 - 3.45 3.00	ES D SPT	N=13 (2,2/3,4,3,3)				Medium dense light yellow brown clayey medium SAND. Becoming loose from circa. 4.00m bgl.	3
		4.00 - 4.45 4.00	D SPT	N=11 (3,3/2,2,4,3)				4	
		5.00 - 5.45 5.00	D SPT	N=9 (3,3/2,2,2,3)				5	
		End of Borehole at 5.45m						6	
								7	
								8	
								9	
								10	

Remarks

1. Water strike encountered at 4.80m bgl. 2. Complete. 3. Monitoring well installed.



Borehole Log

Borehole No.

WS111

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 388071E - 410168N

Hole Type
WS

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

Dates: 18/03/2021

Logged By
E. Fearn

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Brown slightly clayey gravelly medium sand with rootlets. Gravel is fine to coarse angular to sub-rounded of mudstone and brick.	
		1.00	SPT	N=13 (2,2/3,3,3,4)				MADE GROUND: Medium dense black slightly clayey gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of mudstone, brick and ash. Becoming very loose from circa. 2.00m bgl.	1
		1.60	ES						
		2.00	SPT	2 (2,1/1,,1)					2
		3.00	SPT	3 (2,/1,1,1,)					3
		4.00	SPT	2 (1,1/,1,1)					4
		5.00	SPT	3 (1,1/,1,1,1)					5
					5.45			End of Borehole at 5.45m	6
									7
									8
									9
									10

Remarks

1. Complete. 2. Monitoring well installed.



Project Name: Castleton Sidings

Project No.
14768

Co-ords: 388027E - 410145N

Hole Type
WS

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

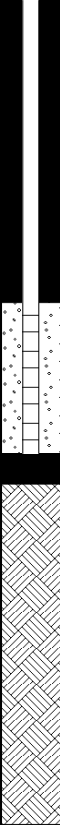
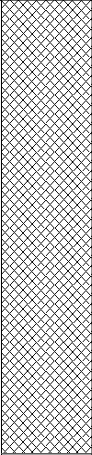
Dates: 18/03/2021

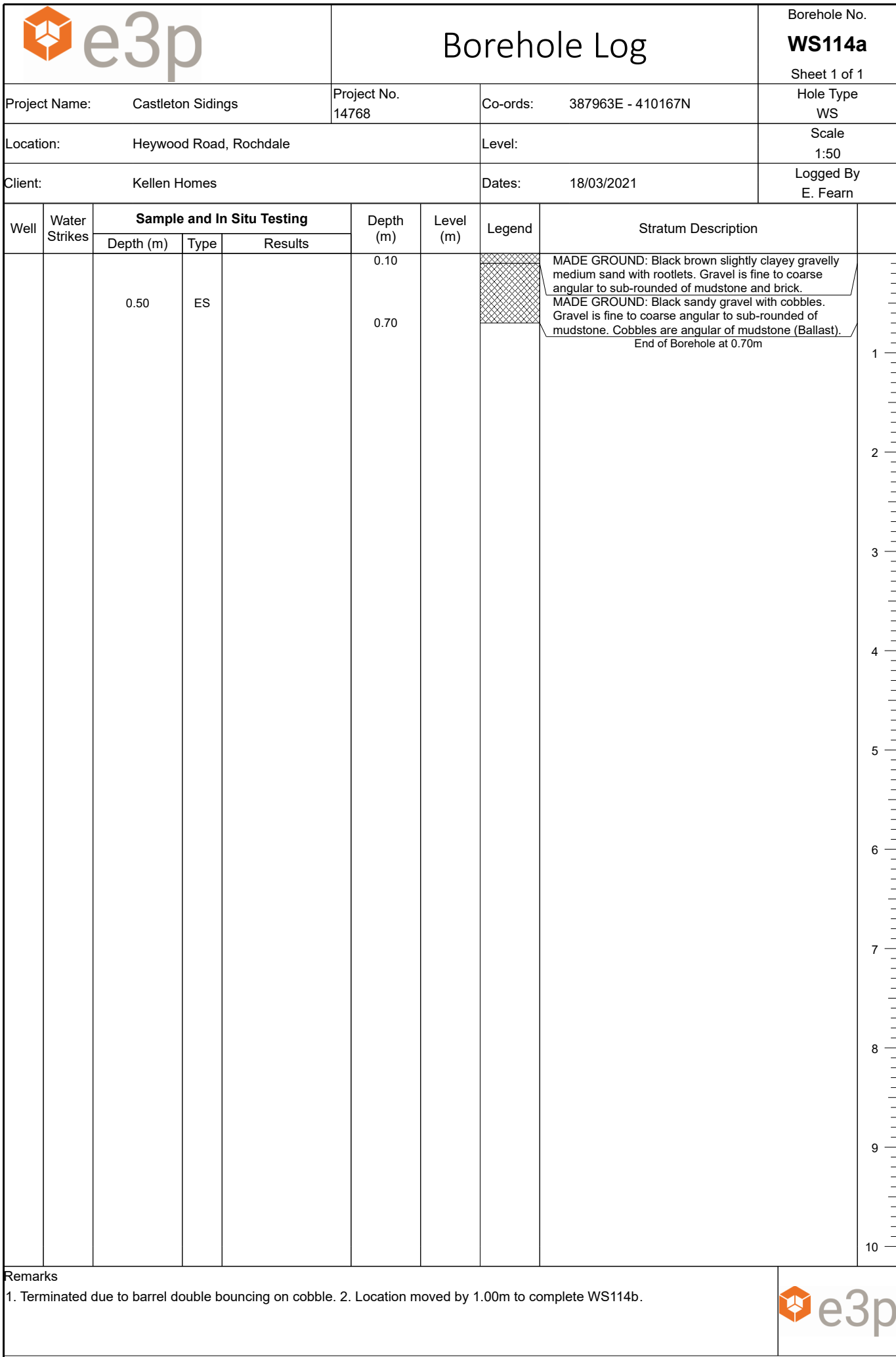
Logged By
E. Fearn

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20			MADE GROUND: Brown slightly clayey gravelly medium sand with rootlets. Gravel is fine to coarse angular to sub-rounded of mudstone and brick.	
		1.00	ES					MADE GROUND: Medium dense black slightly clayey gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of mudstone, brick and ash. Becoming loose from circa. 2.00m bgl. Then becoming very loose from circa. 3.00m bgl.	1
		1.00	SPT	N=16 (3,3/4,3,5,4)					
		2.00	SPT	5 (3,3/2,2,1,)					2
		3.00	SPT	N=4 (./1,1,1,1)					3
		4.00	SPT	4 (1,1/1,2,1)					4
		5.00	SPT	N=4 (1,1/1,1,1,1)					5
					5.45			End of Borehole at 5.45m	6
									7
									8
									9
									10

Remarks

1. Complete. 2. Monitoring well installed.

				Borehole Log				Borehole No. WS113 Sheet 1 of 1	
Project Name: Castleton Sidings				Project No. 14768		Co-ords: 388018E - 410170N		Hole Type WS	
Location: Heywood Road, Rochdale						Level:		Scale 1:50	
Client: Kellen Homes						Dates: 18/03/2021		Logged By E. Fearn	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.80	ES	N=15 (3,5/4,6,3,2)	3.00			MADE GROUND: Medium dense black slightly clayey gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of mudstone, brick and ash. Becoming very loose from circa. 2.00m bgl.	1
	1.00	SPT							
	2.00	SPT	4 (3,2/2,1,,1)					2	
	2.20	ES							
	3.00	SPT	1 (,1/1,,)					3	
							No return.		4
		4.00	SPT	1 (1,1/1,,)					5
		5.00	SPT	N=4 (1,/1,1,1,1)	5.45			End of Borehole at 5.45m	6
									7
									8
									9
									10
Remarks 1. Complete. 2. Monitoring well installed.									



Borehole Log

Borehole No.

WS114b

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387964E - 410166N

Hole Type
WS

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

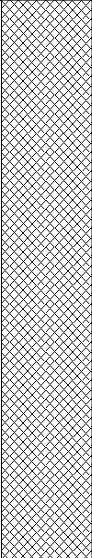
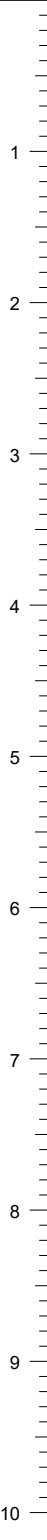
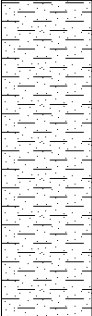
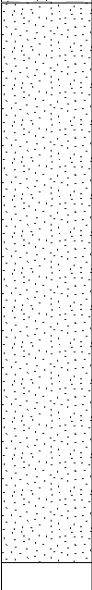
Dates: 18/03/2021

Logged By
E. Fearn

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10			MADE GROUND: Black brown slightly clayey gravelly medium sand with rootlets. Gravel is fine to coarse angular to sub-rounded of mudstone and brick.	
					0.40			MADE GROUND: Black sandy gravel with cobbles. Gravel is fine to coarse angular to sub-rounded of mudstone. Cobbles are angular of mudstone (Ballast).	
		1.00	SPT	N=5 (1,1/2,1,1,1)				MADE GROUND: Loose black slightly clayey gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of mudstone, brick and ash.	1
		1.70	ES						
		2.00	SPT	0 (1,/,,,)					2
		3.00	SPT	0 (/,,,)					3
		4.00	SPT	2 (2,2/,1,1)					4
					4.60			Stiff medium strength black brown PEAT.	5
		5.00	SPT	N=10 (3,2/2,2,3,3)					
					5.45			End of Borehole at 5.45m	6
									7
									8
									9
									10

Remarks

1. Complete. 2. Redrilled due to collapse. 3. Monitoring well installed.

				Borehole Log				Borehole No. CP101 Sheet 1 of 2	
Project Name: Castleton Sidings				Project No. 14768		Co-ords: 388022E - 410219N		Hole Type CP	
Location: Heywood Road, Rochdale						Level:		Scale 1:50	
Client: Kellen Homes						Dates: 04/03/2021		Logged By E. Fearn	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	D					MADE GROUND: Loose black sandy gravel. Gravel is fine to coarse angular to sub-rounded of mudstone, brick and ash.	
		1.00 - 1.45 1.00	D SPT	N=7 (1,1/2,2,1,2)					
		2.00 - 2.45 2.00	D SPT	N=4 (1,1/1,1,1,1)					
		3.00 - 3.45 3.00	D SPT	3 (1 for 75mm/3 for 225mm)					
		3.70	D		3.70			MADE GROUND: Yellow brown clayey medium sand.	
		4.00 - 4.45 4.00	D SPT	3 (1 for 75mm/3 for 225mm)	4.20				
		5.00 - 5.45 5.00	D SPT	N=15 (1,2/3,3,4,5)				Soft very low strength light brown sandy CLAY. Becoming stiff medium strength from circa. 5.00m bgl.	
		6.50 - 6.95 6.50	D SPT	N=17 (2,3/3,4,5,5)	6.30				
		8.00 - 8.45 8.00	D SPT	N=16 (2,2/3,4,4,5)					
		9.50 - 9.95 9.50	D SPT	N=18 (2,3/3,4,5,6)				Medium dense brown SAND with clay bands and occasional gravel. Gravel is fine to coarse angular to rounded of sandstone.	
Remarks 1. Complete. 2. Water strikes encountered at 5.30m bgl and 14.10m bgl.									



Borehole Log

Borehole No.

CP101

Sheet 2 of 2

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 388022E - 410219N

Hole Type
CP

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

Dates: 04/03/2021

Logged By
E. Fearn

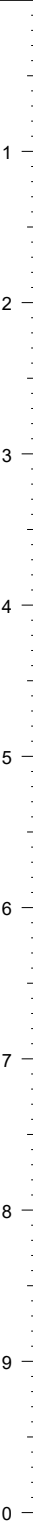
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		11.00 - 11.45 11.00	D SPT	N=19 (2,3/4,4,5,6)				Medium dense brown SAND with clay bands and occasional gravel. Gravel is fine to coarse angular to rounded of sandstone.	11
		11.70	D		11.70				
		12.50 - 12.95 12.50	D SPT	N=23 (3,4/4,6,6,7)				Very stiff high strength light brown sandy CLAY.	12
									13
									14
		14.50 - 14.95 14.50	D SPT	N=28 (4,5/6,6,7,9)					
					14.95				
								End of Borehole at 14.95m	15
									16
									17
									18
									19
									20

Remarks

1. Complete. 2. Water strikes encountered at 5.30m bgl and 14.10m bgl.



					Borehole Log			Borehole No. CP102 Sheet 1 of 2	
Project Name: Castleton Sidings					Project No. 14768		Co-ords: 387766E - 410115N		Hole Type CP
Location: Heywood Road, Rochdale					Level:		Scale 1:50		
Client: Kellen Homes					Dates: 19/03/2021		Logged By E. Fearn		

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
	 1.50				0.10			MADE GROUND: Black asphalt.	
					0.60			MADE GROUND: Light grey sandy gravel. Gravel is fine to coarse angular of limestone and concrete.	
		1.00 - 1.45 1.00	D SPT	2 (2,1,,1,1)			MADE GROUND: Black slightly clayey gravelly medium sand. Gravel is fine to coarse angular to sub-angular of mudstone, brick and ash.		
		2.00 - 2.45 2.00	D SPT	3 (1,/1,,1,1)					
		3.00 - 3.45 3.00	D SPT	2 (1,/1,,1,1)	3.10		Soft very low strength brown PEAT. Becoming firm low strength from circa. 5.00m bgl.		
		4.00 - 4.45 4.00	D SPT	3 (1,/1,1,1,1)					
		5.00 - 5.45 5.00	D SPT	3 (1,1/1,,1,1)					
		6.50 - 6.95 6.50	D SPT	N=24 (6,6/7,6,5,6)	5.70		Medium dense light brown very gravelly medium to coarse SAND. Gravel is fine to coarse angular to sub-rounded of mudstone and sandstone. Becoming dense from circa. 8.00m bgl.		
		8.00 - 8.45 8.00	D SPT	N=26 (6,7/7,6,7,6)					
		9.50 - 9.95 9.50	D SPT	N=18 (5,4/4,5,5,4)	9.00		Very stiff high strength brown slightly sandy CLAY.		

Remarks
 1. Water strike encountered at 1.50m bgl. 2. Significant hydrocarbon impact, odour and impact identified between 0.60m and 3.10m bgl. 3. Complete.



Borehole Log

Borehole No.

CP102

Sheet 2 of 2

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387766E - 410115N

Hole Type
CP

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

Dates: 19/03/2021

Logged By
E. Fearn

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		11.00 - 11.45 11.00	D SPT	N=17 (5,4/4,4,4,5)				Very stiff high strength brown slightly sandy CLAY.	11
		12.50 - 12.95 12.50	D SPT	N=17 (4,5/5,4,4,4)					12
		14.00 - 14.45 14.00	D SPT	N=25 (5,6/6,7,6,6)					13
					15.00				14
								End of Borehole at 15.00m	15
									16
									17
									18
									19
									20

Remarks

1. Water strike encountered at 1.50m bgl. 2. Significant hydrocarbon impact, odour and impact identified between 0.60m and 3.10m bgl. 3. Complete.



Borehole Log

Borehole No.

RB101

Sheet 1 of 7

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 388055E - 410220N

Hole Type
BH

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

Dates: 19/03/2021

Logged By
E. Fearn

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.60			MADE GROUND: Light grey gravel. Gravel is fine to coarse angular to rounded of mudstone (Ballast).	1
								MADE GROUND: Black slightly silty gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of mudstone, ash and brick.	2
									3
					3.90			Brown medium SAND.	4
									5
									6
									7
									8
									9
									10

Remarks

1. Loss of flush between 35.60m and 40.80m bgl. 2. Hard drilling between 40.80m and 60.50m bgl. 3. Complete.



					Borehole Log			Borehole No. RB101 Sheet 2 of 7		
Project Name: Castleton Sidings					Project No. 14768		Co-ords: 388055E - 410220N		Hole Type BH	
Location: Heywood Road, Rochdale					Level:			Scale 1:50		
Client: Kellen Homes					Dates: 19/03/2021			Logged By E. Fearn		
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
					11.10			Brown medium SAND.	11	
								Brown gravelly SAND. Gravel is fine to coarse angular of sandstone.	12	
								Brown CLAY with sand bands.	13	
					12.20				14	
									15	
									16	
									17	
									18	
									19	
									20	
Remarks 1. Loss of flush between 35.60m and 40.80m bgl. 2. Hard drilling between 40.80m and 60.50m bgl. 3. Complete.										



Borehole Log

Borehole No.

RB101

Sheet 3 of 7

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 388055E - 410220N

Hole Type
BH

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

Dates: 19/03/2021

Logged By
E. Fearn

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								Brown CLAY with sand bands.	21
									22
									23
									24
									25
					26.00			Grey brown boulder. Boulder is angular of mudstone.	26
					26.30			Brown CLAY.	27
									28
									29
									30

Remarks

1. Loss of flush between 35.60m and 40.80m bgl. 2. Hard drilling between 40.80m and 60.50m bgl. 3. Complete.



Borehole Log

Borehole No.

RB101

Sheet 4 of 7

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 388055E - 410220N

Hole Type
BH

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

Dates: 19/03/2021

Logged By
E. Fearn

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					31.20			Brown CLAY.	31
					33.20			Brown medium SAND.	32
					35.60			Brown grey sandy CLAY.	33
								Brown gravelly SAND. Gravel is fine to coarse angular of sandstone. Loss of flush.	34
									35
									36
									37
									38
									39
									40

Remarks

1. Loss of flush between 35.60m and 40.80m bgl. 2. Hard drilling between 40.80m and 60.50m bgl. 3. Complete.

Borehole Log

Borehole No.

RB101

Sheet 5 of 7

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 388055E - 410220N

Hole Type
BH

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

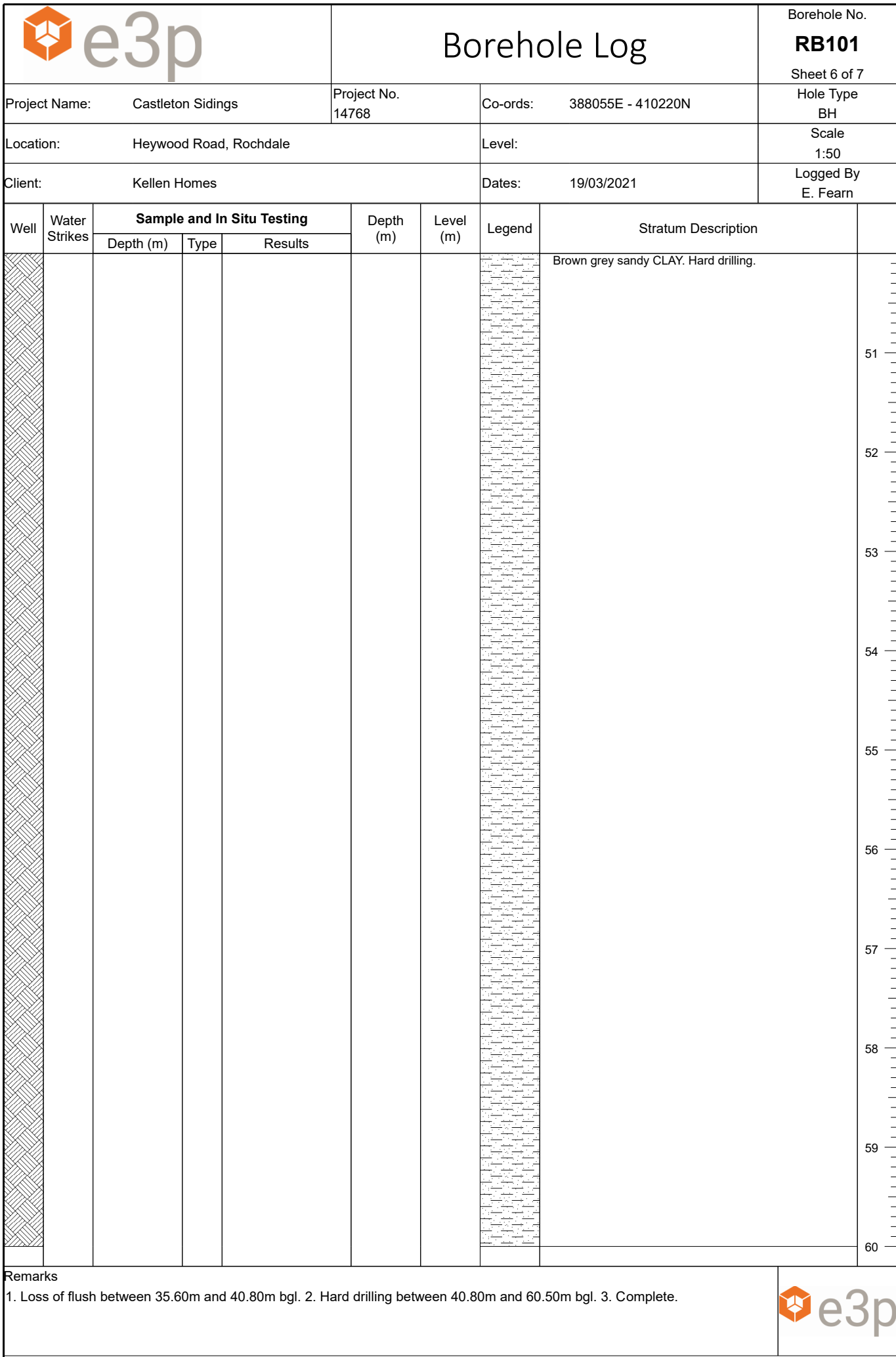
Dates: 19/03/2021

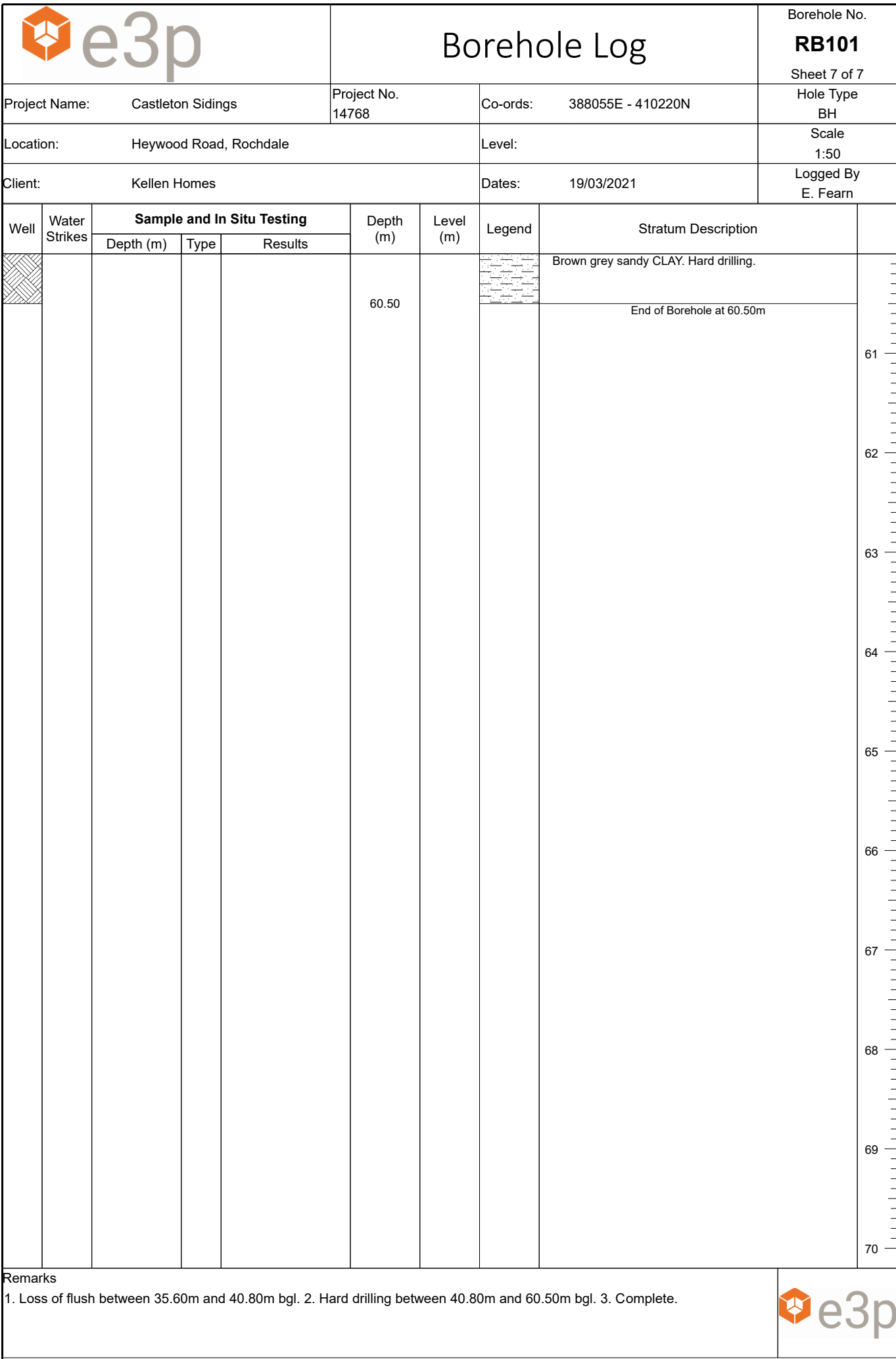
Logged By
E. Fearn

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					40.80			Brown gravelly SAND. Gravel is fine to coarse angular of sandstone. Loss of flush.	
								Brown grey sandy CLAY. Hard drilling.	41
									42
									43
									44
									45
									46
									47
									48
									49
									50

Remarks

1. Loss of flush between 35.60m and 40.80m bgl. 2. Hard drilling between 40.80m and 60.50m bgl. 3. Complete.





Borehole Log

Borehole No.

RB102

Sheet 1 of 6

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 388055E - 410168N

Hole Type
BH

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

Dates: 19/03/2021

Logged By
E. Fearn

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.50			MADE GROUND: Light grey gravel. Gravel is fine to coarse angular to rounded of mudstone (Ballast).	1
								MADE GROUND: Black slightly clayey gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of mudstone, ash and brick.	2
									3
					4.10			Brown medium SAND.	4
									5
									6
									7
									8
									9
									10

Remarks

1. Loss of flush between 32.10m and 39.60m bgl. 2. Hard drilling between 39.60m and 52.80m bgl. 3. Complete.



Borehole Log

Borehole No.

RB102

Sheet 2 of 6

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 388055E - 410168N

Hole Type
BH

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

Dates: 19/03/2021

Logged By
E. Fearn

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					10.20			Brown medium SAND.	
								Brown CLAY with sand bands.	
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

1. Loss of flush between 32.10m and 39.60m bgl. 2. Hard drilling between 39.60m and 52.80m bgl. 3. Complete.



Borehole Log

Borehole No.

RB102

Sheet 3 of 6

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 388055E - 410168N

Hole Type
BH

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

Dates: 19/03/2021

Logged By
E. Fearn

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								Brown CLAY with sand bands.	21
									22
									23
					24.10				24
								Brown gravelly SAND. Gravel is fine to coarse angular of sandstone.	25
									26
									27
					28.20				28
								Brown sandy CLAY.	29
									30

Remarks

1. Loss of flush between 32.10m and 39.60m bgl. 2. Hard drilling between 39.60m and 52.80m bgl. 3. Complete.

Borehole Log

Borehole No.

RB102

Sheet 4 of 6

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 388055E - 410168N

Hole Type
BH

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

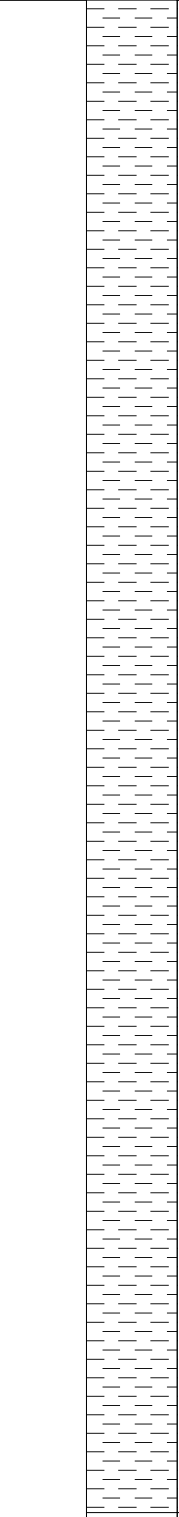
Dates: 19/03/2021

Logged By
E. Fearn

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					32.10			Brown sandy CLAY.	31
								Brown gravelly SAND. Gravel is fine to coarse angular of sandstone. Loss of flush.	32
									33
									34
									35
									36
									37
									38
									39
					39.60			Brown CLAY. Hard drilling.	40

Remarks

1. Loss of flush between 32.10m and 39.60m bgl. 2. Hard drilling between 39.60m and 52.80m bgl. 3. Complete.

					Borehole Log			Borehole No. RB102 Sheet 5 of 6		
Project Name: Castleton Sidings					Project No. 14768		Co-ords: 388055E - 410168N		Hole Type BH	
Location: Heywood Road, Rochdale					Level:			Scale 1:50		
Client: Kellen Homes					Dates: 19/03/2021			Logged By E. Fearn		
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
							Brown CLAY. Hard drilling.		41	
									42	
									43	
									44	
									45	
									46	
									47	
									48	
									49	
									50	
									Remarks 1. Loss of flush between 32.10m and 39.60m bgl. 2. Hard drilling between 39.60m and 52.80m bgl. 3. Complete.	



Borehole Log

Borehole No.

RB102

Sheet 6 of 6

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 388055E - 410168N

Hole Type
BH

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

Dates: 19/03/2021

Logged By
E. Fearn

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								Brown CLAY. Hard drilling.	
									51
									52
									53
									54
									55
									56
									57
									58
					59.00			End of Borehole at 59.00m	59
									60

Remarks

1. Loss of flush between 32.10m and 39.60m bgl. 2. Hard drilling between 39.60m and 52.80m bgl. 3. Complete.



Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387997.00 - 410193.00 Level:	Date 15/06/2021
Location: Heywood Road, Rochdale		Dimensions (m): 3.60 Depth 4.50	Scale 1:45 Logged H.Morgan
Client: Kellen Homes			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.60	ES		1.10			MADE GROUND: Sandy gravel. Gravel is fine to coarse angular to subrounded of brick, mudstone and clinker.	1
				2.80			MADE GROUND: Clayey sandy gravel. Gravel is fine to coarse angular to subrounded of brick, mudstone and sandstone.	2
				4.50			MADE GROUND: Loose dark brown sandy clayey gravel. Gravel is fine to coarse angular to subrounded of clinker, brick, mudstone and metal. Pockets of organic materials.	3
							End of Pit at 4.50m	4
								5
								6

Trial Pit Photographs



TP201

TP201 spoil

Remarks: 1. Slight hydrocarbon odour throughout.

Stability: Unstable from 3.5m bgl.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 388033.00 - 410176.00 Level:	Date 15/06/2021
Location: Heywood Road, Rochdale		Dimensions (m): Depth 4.00	Scale 1:45 Logged H.Morgan
Client: Kellen Homes			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				2.50			MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to rounded of brick, mudstone, clinker, glass and ceramic.	1
				4.00			MADE GROUND: Black sandy slightly clayey gravel. Gravel is fine to coarse angular to subrounded of clinker, brick and laminated mudstone.	3
							End of Pit at 4.00m	4
								5
								6

Trial Pit Photographs



TP202



TP202 spoil

Remarks: 1. Redundant cable encountered approx 1.0m bgl.

Stability: Unstable from 3.0m bgl.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387991.00 - 410126.00 Level:	Date 15/06/2021
Location: Heywood Road, Rochdale		Dimensions (m): 3.60 1.00	Scale 1:45
Client: Kellen Homes		Depth 4.20	Logged H.Morgan

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				2.80			MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to subrounded of brick, mudstone, glass, ceramic and clinker.	1
				3.20			MADE GROUND: Dark brown sandy gravel. Gravel is fine to coarse angular to subrounded of brick, clinker, glass and wood.	3
				4.20			MADE GROUND: Black slightly clayey sandy gravel. Gravel is fine to coarse angular to subrounded of mudstone, brick, ceramic and coal.	4
							End of Pit at 4.20m	5
								6

Trial Pit Photographs



TP203

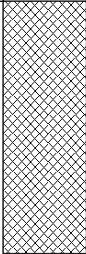


TP203 spoils

Remarks: 1.Slight hydrocarbon odour.

Stability: Unstable from 3.0m bgl.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387928.00 - 410113.00 Level:	Date 15/06/2021
Location: Heywood Road, Rochdale		Dimensions (m): Depth 1.50	Scale 1:45 Logged H.Morgan
Client: Kellen Homes			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				1.50			MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to subrounded of mudstone, brick, ceramic and coal.	1
							End of Pit at 1.50m	2
								3
								4
								5
								6

Trial Pit Photographs



Remarks: 1. Terminated at 1.5m bgl on encountering redundant service.

Stability: Unstable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387913.00 - 410144.00 Level:	Date 15/06/2021
Location: Heywood Road, Rochdale		Dimensions (m): 3.60 Depth 4.30	Scale 1:45 Logged H.Morgan
Client: Kellen Homes			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.70	ES					MADE GROUND: Brown gravelly fine to medium sand. Gravel is fine to coarse angular to subrounded of brick, concrete, ceramic, glass and litter.	1
				1.60			MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to subrounded of brick and mudstone.	2
				2.20			MADE GROUND: Brown gravelly sand. Gravel is fine to coarse of brick with intact brick and cobbles.	3
				3.00			MADE GROUND: Black sandy gravel. Gravel is fine to medium angular to rounded of sandstone and mudstone.	4
				4.30			End of Pit at 4.30m	5
								6

Trial Pit Photographs



TP205



TP205 spoil

Remarks: 1. Water strike at 4.0 mbgl.

Stability: Unstable from 2.0m bgl.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387896.00 - 410178.00 Level:	Date 15/06/2021
Location: Heywood Road, Rochdale		Dimensions (m): 3.60 1.00	Scale 1:45
Client: Kellen Homes		Depth 5.50	Logged H.Morgan

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.70			MADE GROUND: Grey medium gravel. Gravel is fine to coarse angular to subrounded of brick, concrete, ceramic, glass and litter.	1
				1.60			MADE GROUND: Dark grey sandy gravel. Gravel is fine to coarse angular to subrounded of mudstone and brick.	2
				2.00			MADE GROUND: Brown sandy gravel. Gravel is fine to coarse angular to subrounded of brick, ceramic, clinker and glass.	3
				3.80			MADE GROUND: Firm blackish brown sandy gravelly clay. Gravel is fine to coarse angular to rounded of brick, mudstone and ceramic.	4
				4.50			MADE GROUND: Black very gravelly sandy clay.	5
				5.50			MADE GROUND: Black sandy clayey gravel. Gravel is fine to coarse angular to rounded of mudstone brick with slight organic material.	6
							End of Pit at 5.50m	

Trial Pit Photographs



TP206

Remarks: 1. Water strike at 4.5m bgl. 2. Slight hydrocarbon odour throughout.

Stability:

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387639.00 - 410074.00 Level:	Date 15/06/2021
Location: Heywood Road, Rochdale		Dimensions (m): 3.60 Depth 4.00	Scale 1:45 Logged H.Morgan
Client: Kellen Homes			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.60	ES		0.30			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to subrounded f concrete, sandstone and brick.	
				1.10			MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to rounded of brick, mudstone and clinker.	1
							Loose brown medium SAND.	2
				4.00			End of Pit at 4.00m	4
								5
								6

Trial Pit Photographs



TP207 spoil

Remarks: 1. Termination due to instability.

Stability: Unstable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387748.00 - 410129.00 Level:	Date 15/06/2021
Location: Heywood Road, Rochdale		Dimensions (m): 3.60 1.00 Depth 4.10	Scale 1:45 Logged H.Morgan
Client: Kellen Homes			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
 1.20				1.20			MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to subangular of brick.	1
							MADE GROUND: Firm brown silty sandy gravelly clay. Gravel is fine to coarse angular to rounded of mudstone and ceramic.	2
				2.70			Brown pseudo-fibrous PEAT with visible plant remains and organic odour. (soft and wet).	3
				4.10			End of Pit at 4.10m	4
								5
								6

Trial Pit Photographs



TP208

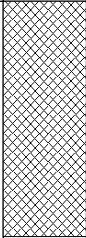


TP208 spoil

Remarks: 1. Strong organic odour at 4.00m bgl.

Stability: Unstable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387738.00 - 410089.00 Level:	Date 15/06/2021
Location: Heywood Road, Rochdale		Dimensions (m): 3.60 Depth 1.40	Scale 1:45 Logged H.Morgan
Client: Kellen Homes			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				1.40			MADE GROUND Blackish grey sandy gravel. Gravel is fine to coarse angular to subrounded of brick, sandstone and ceramic.	1
							End of Pit at 1.40m	2
								3
								4
								5
								6

Trial Pit Photographs

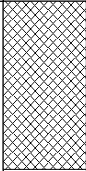


TP209

Remarks: 1. Terminated at 4.10m bgl on encountering plastic pipe/redundant service.

Stability: Stable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387817.00 - 410118.00 Level:	Date 15/06/2021
Location: Heywood Road, Rochdale		Dimensions (m): 3.60 Depth 1.00	Scale 1:45 Logged H.Morgan
Client: Kellen Homes			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				1.00			MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to subrounded of brick, sandstone and ceramic. End of Pit at 1.00m	1
								2
								3
								4
								5
								6

Trial Pit Photographs

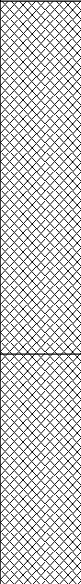


TP210

Remarks: 1. Terminated at 1.0m bgl on encountering plastic pipe/redundant service.

Stability: Stable.

				Trial Pit Log			TrialPit No TP211 Sheet 1 of 1		
Project Name: Castleton Sidings				Project No. 14768		Co-ords: 387729.00 - 410047.00 Level:		Date 15/06/2021	
Location: Heywood Road, Rochdale						Dimensions (m): 3.60		Scale 1:45	
Client: Kellen Homes						Depth 4.50		Logged H.Morgan	

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
 3.20	0.70	ES		2.10			MADE GROUND: Black very sandy gravel. Gravel is fine to coarse angular to rounded of mudstone, brick and sandstone.	1
	1.90	ES					MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to subrounded of mudstone. Very strong hydrocarbon/possible creosote odour. PID reading: 386.4 ppm.	2
							Brown fibrous PEAT with visible plant remains. Organic odour. (soft and wet).	3
							End of Pit at 4.50m	4
				4.50				5
								6

Trial Pit Photographs



TP211



TP211 spoil

Remarks: 1. Very strong hydrocarbon/creosote odour. 2. Water strike at 3.2m bgl. 3. Oily sheen on surface of water.

Stability: **Unstable.**



Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387789.00 - 410057.00 Level:	Date 15/06/2021
Location: Heywood Road, Rochdale		Dimensions (m): 3.60 1.00 Depth 4.80	Scale 1:45 Logged H.Morgan
Client: Kellen Homes			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
 3.40				0.30			MADE GROUND: Grass over black gravelly sand. Gravel is fine to coarse angular to rounded of brick and mudstone. (Topsoil). MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to rounded of brick and mudstone.	1
				2.80			MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to rounded of mudstone slate with frequent cobbles.	2
				3.80			Brown pseudo-fibrous PEAT with visible plant remains and organic odour. (Very wet/saturated).	3
				4.20			Loose brown SAND.	4
				4.80			End of Pit at 4.80m	5
								6

Trial Pit Photographs



TP212



TP212 spoil

Remarks: 1. Strong hydrocarbon odour. 2.8-3.8m bgl. 2. Oily sheen on surface of water.

Stability: Unstable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387841.00 - 410087.00 Level:	Date 15/06/2021
Location: Heywood Road, Rochdale		Dimensions (m): 3.60 1.00	Scale 1:45
Client: Kellen Homes		Depth 4.60	Logged

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.60	ES		0.30			MADE GROUND: Grass over dark grey gravelly sand. (Topsoil).	
							MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to subrounded of mudstone, brick and clinker.	1
				2.90			MADE GROUND: Black sandy gravel. Gravel is fine to medium angular to subangular of mudstone. Very strong hydrocarbon odour.	2
				3.40			MADE GROUND: Soft brown gravelly clay. Gravel is fine to coarse angular to rounded of brick, mudstone and ceramic.	3
				3.60			Brown pseudo-fibrous PEAT with and organic odour. Easily moulded (plastic).	4
				4.60			End of Pit at 4.60m	5
								6

Trial Pit Photographs



TP213

Remarks: 1. Strong hydrocarbon odour 2.9-3.4m bgl. 3. Oil.

Stability: Stable.

Borehole Log

Borehole No.

RO201

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387947E - 410179N

Hole Type
RO

Location: Heywood Road, Rochdale

Level:

Scale
1:100

Client: Kellen Homes

Dates: 19/07/2021

Logged By
DP Drilling

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Black slightly clayey gravelly sand. Gravel is fine to medium angular to rounded of mudstone brick and concrete (Topsoil). MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick clinker and concrete.	1
									2
									3
									4
									5
					5.80				6
					6.00			Brown pseudo-fibrous PEAT with visible plant remains and organic odour. (Soft and wet).	6
					6.60			Brown slightly gravelly slightly sandy CLAY. Gravel is fine to coarse subangular to rounded of mudstone and sandstone.	7
		7.00	ES					Brown very sandy GRAVEL. Gravel is fine subangular to rounded of mudstone and sandstone.	8
									9
									10
					10.00			End of Borehole at 10.00m	10
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

1. Complete. 2. Peat encountered 5.8-6.0 m bgl

Borehole Log

Borehole No.

RO202

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387987E - 410218N

Hole Type
RO

Location: Heywood Road, Rochdale

Level:

Scale
1:100

Client: Kellen Homes

Dates: 19/07/2021

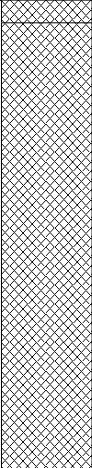
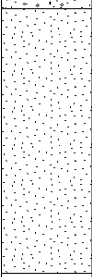
Logged By
DP Drilling

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Black slightly clayey gravelly sand. Gravel is fine to medium angular to rounded of mudstone brick and concrete (Topsoil). MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick clinker and concrete.	1
									2
									3
									4
									5
					5.60			Brown pseudo-fibrous PEAT with visible plant remains and organic odour. (Soft and wet).	6
					5.80			Brown slightly gravelly slightly sandy CLAY. Gravel is fine to coarse subangular to rounded of mudstone and sandstone.	7
					6.70			Brown gravelly SAND. Gravel is fine to coarse subangular to rounded of mudstone and sandstone.	8
					6.90			Brown SAND.	9
									10
					10.00			End of Borehole at 10.00m	11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

1. Complete. 2. Peat encountered 5.6-5.8 m bgl

				Borehole Log				Borehole No. RO203 Sheet 1 of 1	
Project Name: Castleton Sidings				Project No. 14768		Co-ords: 387868E - 410152N		Hole Type RO	
Location: Heywood Road, Rochdale						Level:		Scale 1:100	
Client: Kellen Homes						Dates: 19/07/2021		Logged By DP Drilling	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		6.00	ES		0.30		 MADE GROUND: Black slightly clayey gravelly sand. Gravel is fine to medium angular to rounded of mudstone brick and concrete (Topsoil). MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick clinker and concrete. MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick clinker and concrete.	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	
					6.00 6.20 6.50				 Brown gravelly SAND. Gravel is fine to coarse subangular to rounded of mudstone and sandstone. Brown SAND.
					10.00		End of Borehole at 10.00m		

Remarks 1. Complete. 2. No peat encountered.									
---	--	--	--	--	--	--	--	---	--



Borehole Log

Borehole No.

RO204

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387907E - 410177N

Hole Type
RO

Location: Heywood Road, Rochdale

Level:

Scale
1:100

Client: Kellen Homes

Dates: 20/07/2021

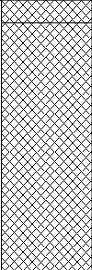
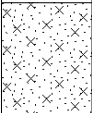
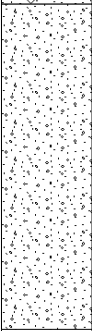
Logged By
DP Drilling

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Black slightly clayey gravelly sand. Gravel is fine to medium angular to rounded of mudstone brick and concrete (Topsoil). MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick clinker and concrete.	1
									2
									3
									4
									5
					5.80			Brown gravelly SAND. Gravel is fine to coarse subangular to rounded of mudstone and sandstone.	6
					6.70			Brown SAND.	7
									8
									9
									10
					10.00			End of Borehole at 10.00m	11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

1. Complete. 2. No peat encountered.



				Borehole Log				Borehole No. RO205 Sheet 1 of 1	
Project Name: Castleton Sidings				Project No. 14768		Co-ords: 387826E - 410175N		Hole Type RO	
Location: Heywood Road, Rochdale				Level:		Scale 1:100			
Client: Kellen Homes				Dates: 20/07/2021		Logged By DP Drilling			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to subrounded of concrete and brick. MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick clinker and concrete.	1
					3.60			Brown pseudo-fibrous PEAT with visible plant remains and organic odour. (Soft and wet).	4
					4.20			Grey silty SAND.	5
					5.70			Brown gravelly SAND. Gravel is fine to coarse subangular to rounded of mudstone and sandstone.	6
					10.00		End of Borehole at 10.00m		10
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20
Remarks 1. Complete. 2. Peat encountered 3.6-4.2 m bgl									

Borehole Log

Borehole No.

RO206

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387787E - 410139N

Hole Type
RO

Location: Heywood Road, Rochdale

Level:

Scale
1:100

Client: Kellen Homes

Dates: 20/07/2021

Logged By
DP Drilling

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.40			MADE GROUND: Black slightly clayey gravelly sand. Gravel is fine to medium angular to rounded of mudstone brick and concrete (Topsoil). MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick clinker and concrete.	1
					3.20				2
					3.40			Brown pseudo-fibrous PEAT with visible plant remains and organic odour. (Soft and wet). Grey silty SAND.	3
					4.10			Brown gravelly SAND. Gravel is fine to coarse subangular to rounded of mudstone and sandstone.	4
		6.00	ES						5
					10.00			End of Borehole at 10.00m	6
									7
									8
									9
									10
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

1. Complete. 2. Peat encountered 3.2-3.4 m bgl

Borehole Log

Borehole No.

RO207

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387827E - 410138N

Hole Type
RO

Location: Heywood Road, Rochdale

Level:

Scale
1:100

Client: Kellen Homes

Dates: 20/07/2021

Logged By
DP Drilling

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Black slightly clayey gravelly sand. Gravel is fine to medium angular to rounded of mudstone brick and concrete (Topsoil). MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick clinker and concrete.	1
									2
									3
									4
					4.70			Brown pseudo-fibrous PEAT with visible plant remains and organic odour.	5
					5.00			Grey silty sandy GRAVEL. Gravel is fine to medium subangular to rounded of mudstone.	6
					5.30			Light brown sandy GRAVEL. Gravel is fine to medium subangular to rounded of mudstone and sandstone.	7
									8
									9
					10.00			End of Borehole at 10.00m	10
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

1. Complete. 2. Peat encountered 4.7-5.0 m bgl

Borehole Log

Borehole No.

RO208

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387751E - 410145N

Hole Type
RO

Location: Heywood Road, Rochdale

Level:

Scale
1:100

Client: Kellen Homes

Dates: 20/07/2021

Logged By
DP Drilling

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to subrounded of concrete and brick. MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick clinker and concrete.	1
									2
					3.20			Brown pseudo-fibrous PEAT with visible plant remains and organic odour. (Soft and wet).	3
					3.50			Grey silty sandy GRAVEL. Gravel is fine to medium subangular to rounded of mudstone.	4
					3.90			Light brown sandy GRAVEL. Gravel is fine to medium subangular to rounded of mudstone and sandstone.	5
									6
									7
					7.80			Light brown very sandy CLAY.	8
									9
					10.00			End of Borehole at 10.00m	10
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

1. Complete. 2. Peat encountered 3.2-3.5 m bgl

Borehole Log

Borehole No.

RO209

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387709E - 410137N

Hole Type
RO

Location: Heywood Road, Rochdale

Level:

Scale
1:100

Client: Kellen Homes

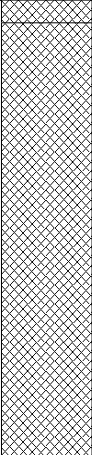
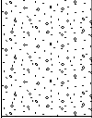
Dates: 22/07/2021

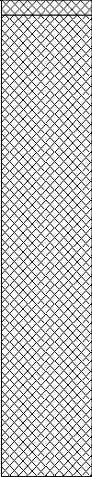
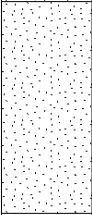
Logged By
DP Drilling

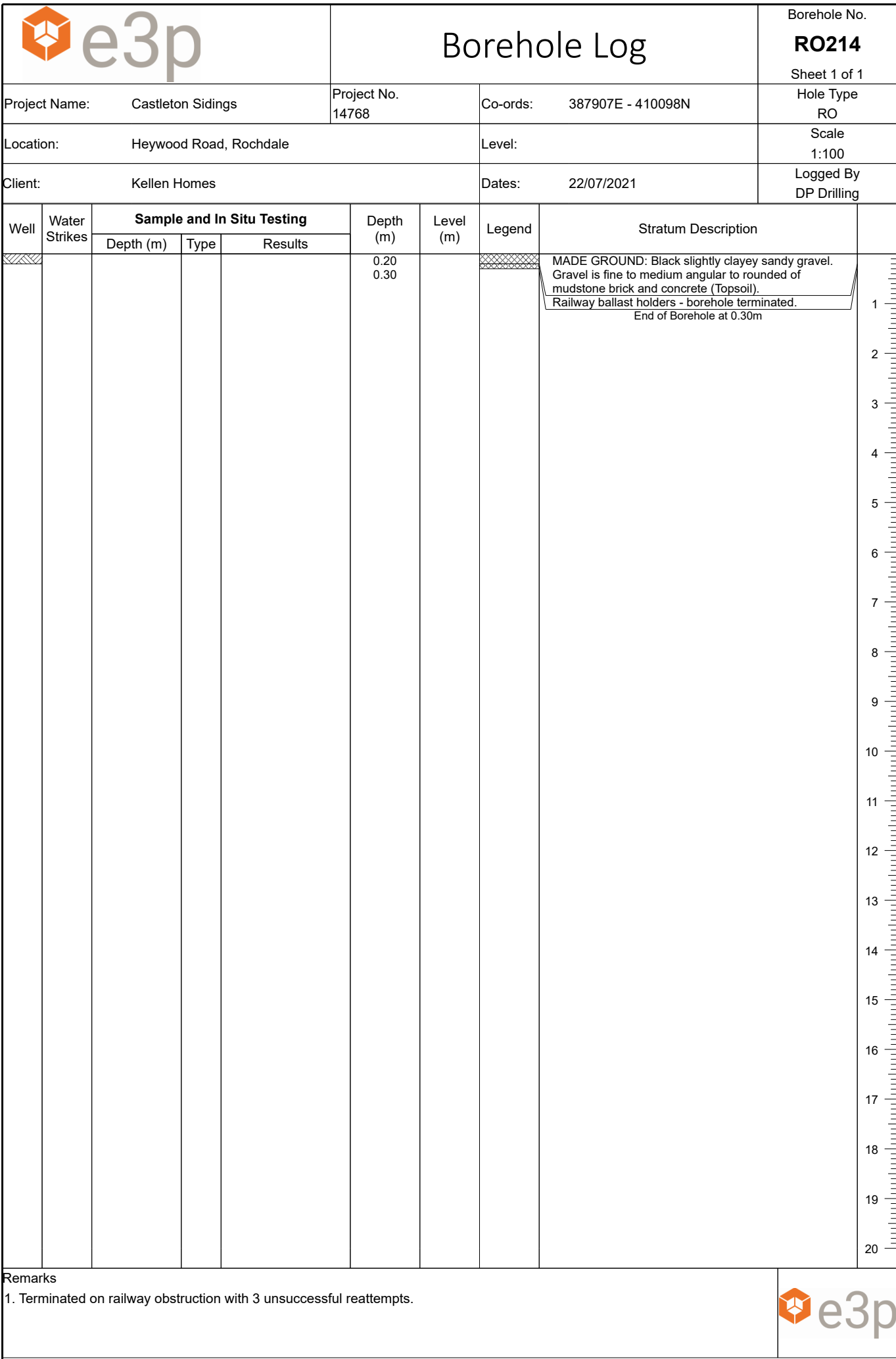
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to subrounded of concrete and brick.	1
					1.20			MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick clinker and concrete.	2
								Brown sandy GRAVEL. Gravel is fine to coarse subangular to subrounded of mudstone and sandstone.	3
									4
									5
									6
									7
					8.20			Light brown very sandy CLAY.	8
									9
					10.00			End of Borehole at 10.00m	10
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

1. Complete. 2. No peat encountered.

				Borehole Log				Borehole No. RO210 Sheet 1 of 1	
Project Name: Castleton Sidings				Project No. 14768		Co-ords: 388065E - 410179N		Hole Type RO	
Location: Heywood Road, Rochdale						Level:		Scale 1:100	
Client: Kellen Homes						Dates: 19/07/2021		Logged By DP Drilling	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		7.00	ES		0.30			MADE GROUND: Black slightly clayey gravelly sand. Gravel is fine to medium angular to rounded of mudstone brick and concrete (Topsoil). MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick clinker and concrete.	1
					2				
					3				
					4				
					5				
					6.10			Brown pseudo-fibrous PEAT with visible plant remains and organic odour. (Soft and wet).	6
					7.80			Brown slightly gravelly slightly sandy CLAY. Gravel is fine to coarse subangular to rounded of mudstone and sandstone.	7
				8.30			Light brown gravelly SAND. Gravel is fine to medium subangular to rounded of mudstone and sandstone.		8
					10.00			End of Borehole at 10.00m	9
									10
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20
Remarks 1. Complete. 2. Peat encountered 6.1-7.8 m bgl									

				Borehole Log				Borehole No. RO212 Sheet 1 of 1	
Project Name: Castleton Sidings				Project No. 14768		Co-ords: 388030E - 410158N		Hole Type RO	
Location: Heywood Road, Rochdale						Level:		Scale 1:100	
Client: Kellen Homes						Dates: 19/07/2021		Logged By DP Drilling	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20			MADE GROUND: Black slightly clayey gravelly sand. Gravel is fine to medium angular to rounded of mudstone brick and concrete (Topsoil). MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick clinker and concrete.	1
					6.30			Light brown gravelly SAND. Gravel is fine to medium subangular to rounded of mudstone and sandstone.	2
					7.20			Light brown SAND.	3
					10.00			End of Borehole at 10.00m	4
Remarks 1. Complete. 2. No peat encountered. 3. Monitoring standpipe installed. Response Zone 2.0-5.0 m bgl.									





Borehole Log

Borehole No.

RO219

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387709E - 410020N

Hole Type
RO

Location: Heywood Road, Rochdale

Level:

Scale
1:100

Client: Kellen Homes

Dates: 19/07/2021

Logged By
DP Drilling

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20 0.30			MADE GROUND: Black slightly clayey sandy gravel. Gravel is fine to medium angular to rounded of mudstone brick and concrete (Topsoil). Railway ballast holders - borehole terminated. End of Borehole at 0.30m	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Remarks

1. Terminated on railway obstruction with 3 unsuccessful reattempts.





Borehole Log

Borehole No.

RO220

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387709E - 410058N

Hole Type
RO

Location: Heywood Road, Rochdale

Level:

Scale
1:100

Client: Kellen Homes

Dates: 19/07/2021

Logged By
DP Drilling

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20 0.30			MADE GROUND: Black slightly clayey sandy gravel. Gravel is fine to medium angular to rounded of mudstone brick and concrete (Topsoil). Railway ballast holders - borehole terminated. End of Borehole at 0.30m	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Remarks

1. Terminated on railway obstruction with 3 unsuccessful reattempts.



Borehole Log

Borehole No.

R0221

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387670E - 410042N

Hole Type
RO

Location: Heywood Road, Rochdale

Level:

Scale
1:100

Client: Kellen Homes

Dates: 22/07/2021

Logged By
DP Drilling

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Black slightly clayey gravelly sand. Gravel is fine to medium angular to rounded of mudstone brick and concrete (Topsoil).	1
					1.20			MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick clinker and concrete. Brown fine to medium SAND.	2
									3
									4
									5
									6
									7
									8
									9
					10.00			End of Borehole at 10.00m	10
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

1. Complete. 2. Peat encountered 6.4-7.5 m bgl

Borehole Log

Borehole No.

RO222

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387669E - 410099N

Hole Type
RO

Location: Heywood Road, Rochdale

Level:

Scale
1:100

Client: Kellen Homes

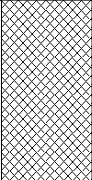
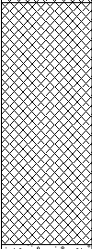
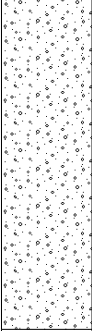
Dates: 23/07/2021

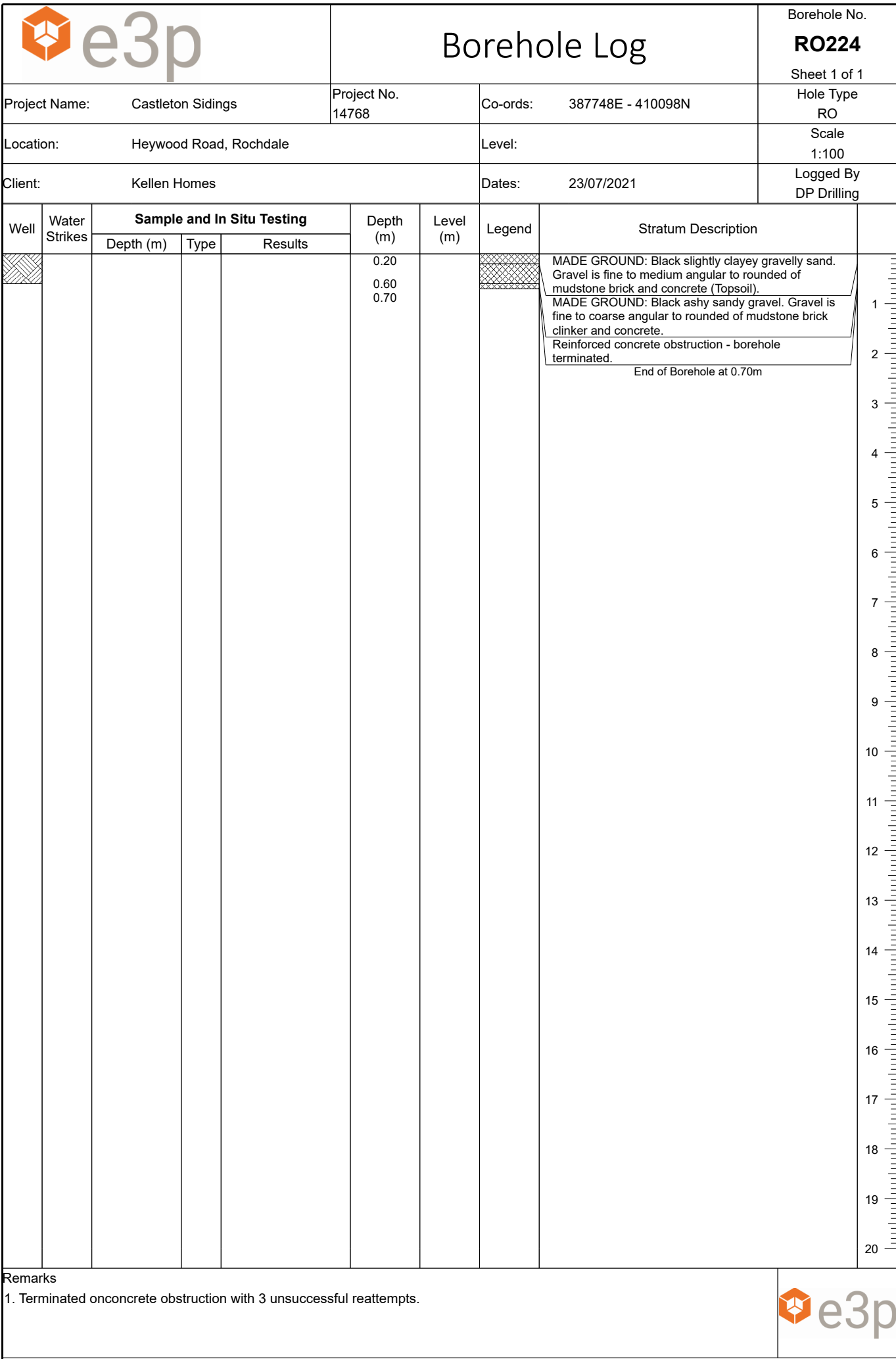
Logged By
DP Drilling

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20			MADE GROUND: Black slightly clayey gravelly sand. Gravel is fine to medium angular to rounded of mudstone brick and concrete (Topsoil).	1
					1.60			MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick clinker and concrete.	2
								Light brown gravelly fine to medium SAND. Gravel is fine to coarse subangular to rounded of mudstone and sandstone.	3
									4
									5
									6
									7
									8
									9
					10.00			End of Borehole at 10.00m	10
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

1. Complete. 2. No peat encountered.

				Borehole Log				Borehole No. RO223 Sheet 1 of 1		
Project Name: Castleton Sidings				Project No. 14768		Co-ords: 387710E - 410098N		Hole Type RO		
Location: Heywood Road, Rochdale						Level:		Scale 1:100		
Client: Kellen Homes						Dates: 23/07/2021		Logged By DP Drilling		
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
					2.40			MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick clinker and concrete.	1	
								MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick clinker and concrete. With hydrocarbon sheen.	2	
							5.60			Light brown sandy GRAVEL. Gravel is fine to medium subangular to rounded of mudstone and sandstone.
					10.00		End of Borehole at 10.00m			4
									5	
									6	
									7	
									8	
									9	
									10	
									11	
									12	
									13	
									14	
									15	
									16	
									17	
									18	
									19	
									20	
Remarks 1. Complete. 2. No peat encountered. 3. Monitoring standpipe installed. Response Zone 2.0-5.0 m bgl.										



Borehole Log

Borehole No.

RO225

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387787E - 410098N

Hole Type
RO

Location: Heywood Road, Rochdale

Level:

Scale
1:100

Client: Kellen Homes

Dates: 23/07/2021

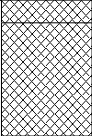
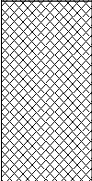
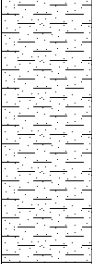
Logged By
DP Drilling

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Black slightly clayey gravelly sand. Gravel is fine to medium angular to rounded of mudstone brick and concrete (Topsoil). MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick.	1
									2
									3
					4.20				4
					4.30			Brown pseudo-fibrous PEAT with visible plant remains and organic odour. Grey silty fine to medium SAND.	5
					5.30			Light brown fine to medium SAND.	6
									7
									8
									9
					10.00			End of Borehole at 10.00m	10
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

1. Complete. 2. Peat encountered 4.2-4.8 m bgl

				Borehole Log				Borehole No. RO226 Sheet 1 of 1	
Project Name: Castleton Sidings				Project No. 14768		Co-ords: 387748E - 410058N		Hole Type RO	
Location: Heywood Road, Rochdale				Level:		Scale 1:100			
Client: Kellen Homes				Dates: 19/07/2021		Logged By DP Drilling			

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Black slightly clayey gravelly sand. Gravel is fine to medium angular to rounded of mudstone brick and concrete (Topsoil). MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick.	1
					1.80			MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick clinker and concrete. With hydrocarbon sheen.	2
					4.20			Brown pseudo-fibrous PEAT with visible plant remains and organic odour. (Soft and wet with hydrocarbon sheen).	3
					5.80			Brown sandy silty CLAY.	4
					6.20			Brown sandy CLAY.	5
					10.00			End of Borehole at 10.00m	6
									7
									8
									9
									10
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks 1. Complete. 2. Peat encountered 4.2-5.8 m bgl									
---	--	--	--	--	--	--	--	---	--

Borehole Log

Borehole No.

RO227

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387827E - 410098N

Hole Type
RO

Location: Heywood Road, Rochdale

Level:

Scale
1:100

Client: Kellen Homes

Dates: 19/07/2021

Logged By
DP Drilling

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Black slightly clayey gravelly sand. Gravel is fine to medium angular to rounded of mudstone brick and concrete (Topsoil). MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick.	1
									2
									3
									4
									5
									6
					6.60			Light brown slightly sandy CLAY.	7
									8
					8.60			Light brown sandy GRAVEL. Gravel is fine to medium subangular to rounded of mudstone and sandstone.	9
									10
					10.00			End of Borehole at 10.00m	10
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

1. Complete. 2. No peat encountered.

Borehole Log

Borehole No.

RO228

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387867E - 410098N

Hole Type
RO

Location: Heywood Road, Rochdale

Level:

Scale
1:100

Client: Kellen Homes

Dates: 19/07/2021

Logged By
DP Drilling

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Black slightly clayey gravelly sand. Gravel is fine to medium angular to rounded of mudstone brick and concrete (Topsoil). MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick.	1
									2
									3
									4
									5
					6.20			Brown pseudo-fibrous PEAT with visible plant remains and organic odour. (Soft and wet).	6
									7
					7.80			Brown slightly sandy CLAY.	8
					8.30			Light brown sandy gravel. Gravel is fine to medium subangular to rounded of mudstone and sandstone.	9
									10
					10.00			End of Borehole at 10.00m	10
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

1. Complete. 2. Peat encountered 6.2-7.8 m bgl

Borehole Log

Borehole No.

RO229

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387907E - 410129N

Hole Type
RO

Location: Heywood Road, Rochdale

Level:

Scale
1:100

Client: Kellen Homes

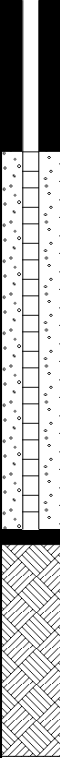
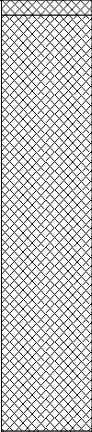
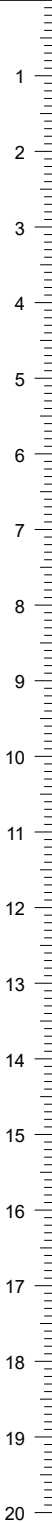
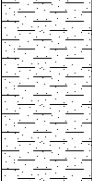
Dates: 28/07/2021

Logged By
DP Drilling

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20			MADE GROUND: Black slightly clayey gravelly sand. Gravel is fine to medium angular to rounded of mudstone brick and concrete (Topsoil). MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick.	1
									2
									3
									4
									5
					5.90				6
					6.30			Brown pseudo-fibrous PEAT with visible plant remains and organic odour. (Soft and wet with hydrocarbon sheen). Grey sandy silty CLAY.	7
									8
					8.60			Light brown sandy GRAVEL. Gravel is fine to medium subangular to rounded of mudstone and sandstone.	9
					10.00			End of Borehole at 10.00m	10
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

1. Complete. 2. Peat encountered 5.9-6.3 m bgl

				Borehole Log				Borehole No. RO230 Sheet 1 of 1	
Project Name: Castleton Sidings				Project No. 14768		Co-ords: 387946E - 410138N		Hole Type RO	
Location: Heywood Road, Rochdale						Level:		Scale 1:100	
Client: Kellen Homes						Dates: 28/07/2021		Logged By DP Drilling	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to subrounded of concrete and brick. MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick.	
					5.70				
					6.40			Light grey sandy CLAY.	
					8.90				
					10.00		End of Borehole at 10.00m		
Remarks 1. Complete. 2. Peat encountered 5.9-6.4 m bgl. 3. Monitoring standpipe installed. Response Zone 5.0-7.0 m bgl.									



Borehole Log

Borehole No.

R0231

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387986E - 410176N

Hole Type
RO

Location: Heywood Road, Rochdale

Level:

Scale
1:100

Client: Kellen Homes

Dates: 28/07/2021

Logged By
DP Drilling

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to subrounded of concrete and brick. MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick.	1
									2
									3
									4
					5.30				5
					6.00			Brown pseudo-fibrous PEAT with visible plant remains and organic odour with constituents of gravel. Gravel is fine to coarse angular to subrounded of mudstone. Light grey sandy silty CLAY.	6
									7
									8
					8.20			Light brown sandy GRAVEL. Gravel is fine to medium subangular to rounded of mudstone and sandstone.	9
									10
					10.00			End of Borehole at 10.00m	10
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

1. Complete. 2. Peat encountered 5.3-6.0 m bgl



Borehole Log

Borehole No.

RO232

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 388026E - 410179N

Hole Type
RO

Location: Heywood Road, Rochdale

Level:

Scale
1:100

Client: Kellen Homes

Dates: 28/07/2021

Logged By
DP Drilling

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Black slightly clayey gravelly sand. Gravel is fine to medium angular to rounded of mudstone brick and concrete (Topsoil). MADE GROUND: Black ashy sandy gravel. Gravel is fine to coarse angular to rounded of mudstone brick.	1
									2
									3
									4
									5
					5.50			Brown pseudo-fibrous PEAT with visible plant remains and organic odour with constituents of gravel. Gravel is fine to coarse angular to subrounded of mudstone. Light grey sandy silty CLAY.	6
					6.10				7
									8
					7.90			Light brown sandy GRAVEL. Gravel is fine to medium subangular to rounded of mudstone and sandstone.	9
									10
					10.00			End of Borehole at 10.00m	11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

1. Complete. 2. Peat encountered 5.5-6.1 m bgl



Trial Pit Log

TrialPit No
HP102
Sheet 1 of 1

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387596.00 - 409985.00 Level:	Date 20/07/2021
Location: Heywood Road, Rochdale		Dimensions (m): 0.40 Depth 0.70	Scale 1:45 Logged J.James
Client: Kellen Homes			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10			0.10			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to subrounded of brick mudstone and sandstone.	
	0.70	ES		0.70			MADE GROUND: Black gravelly SAND. Gravel is fine to corase angular to subangular of brick clinker ash. End of Pit at 0.70m	1 2 3 4 5 6

Remarks:	
Stability: Stable.	



Trial Pit Log

TrialPit No
HP103
Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387548.00 - 409977.00
Level:

Date
20/07/2021

Location: Heywood Road, Rochdale

Dimensions (m):

0.40

Scale
1:45

Client: Kellen Homes

Depth
0.80

0.40

Logged
J.James

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.80	ES		0.25			MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to subrounded of brick mudstone and clinker.	
				0.80			Soft brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse angular to subrounded of mudstone sandstone brick and coal	
							End of Pit at 0.80m	1
								2
								3
								4
								5
								6

Remarks:

Stability: Stable.





Trial Pit Log

TrialPit No
HP104
Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387494.00 - 409975.00
Level:

Date
20/07/2021

Location: Heywood Road, Rochdale

Dimensions (m): 0.40

Depth
0.50

0.40

Scale
1:45

Logged
J.James

Client: Kellen Homes

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.50	ES		0.20 0.50			MADE GROUND: Black gravelly SAND. Gravel is fine to coarse angular to subangular of brick mudstone ceramic and glass (TOPSOIL). MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to subrounded of brick mudstone and sandstone. End of Pit at 0.50m	1 2 3 4 5 6

Remarks:

Stability: Stable.





Trial Pit Log

TrialPit No
HP105
Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387539.00 - 409989.00
Level:

Date
20/07/2021

Location: Heywood Road, Rochdale

Dimensions (m): 0.40

Scale
1:45

Client: Kellen Homes

Depth
0.70

0.40

Logged
J.James

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.60	ES		0.20			MADE GROUND: Black gravelly SAND. Gravel is fine to coarse angular to subangular of brick mudstone ceramic and glass (TOPSOIL).	
				0.70			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to subrounded of brick mudstone and sandstone.	
							End of Pit at 0.70m	1
								2
								3
								4
								5
								6

Remarks:

Stability: Stable.





Trial Pit Log

TrialPit No
HP106
Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387576.00 - 409999.00
Level:

Date
20/07/2021

Location: Heywood Road, Rochdale

Dimensions (m): 0.40

Depth
0.50

Scale
1:45

Logged
J.James

Client: Kellen Homes

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.70	ES		0.20 0.50			MADE GROUND: Black gravelly SAND. Gravel is fine to coarse angular to subangular of brick mudstone ceramic and glass (TOPSOIL). MADE GROUND: Black gravelly SAND. Gravel is fine to coarse angular to subangular of brick clinker ash. End of Pit at 0.50m	1 2 3 4 5 6

Remarks:

Stability: Stable.





Trial Pit Log

TrialPit No
HP107
Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387594.00 - 410016.00
Level:

Date
20/07/2021

Location: Heywood Road, Rochdale

Dimensions (m): 0.40

Depth
0.70

Scale
1:45

Logged
J.James

Client: Kellen Homes

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20			0.20			MADE GROUND: Black gravelly SAND. Gravel is fine to coarse angular to subangular of brick mudstone ceramic and glass (TOPSOIL).	
	0.70	ES		0.70			MADE GROUND: Black gravelly SAND. Gravel is fine to coarse angular to subangular of brick clinker ash.	
							End of Pit at 0.70m	
								1
								2
								3
								4
								5
								6

Remarks:

Stability: Stable.



APPENDIX VI

CHEMICAL TESTING

RESULTS

Jessica Sheridan

e3p
Taylor Road
Urmston
Manchester
M41 7JQ

e: jsheridan@e3p.co.uk

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

t: 01923 225404

f: 01923 237404

e: reception@i2analytical.com

Analytical Report Number : 21-64760

Project / Site name:	Castleton Sidings	Samples received on:	08/03/2021
Your job number:	14-268	Samples instructed on/ Analysis started on:	25/03/2021
Your order number:	14768-EF-M	Analysis completed by:	31/03/2021
Report Issue Number:	1	Report issued on:	31/03/2021
Samples Analysed:	2 soil samples		

Signed: *A. Czerwińska*

Agnieszka Czerwińska
Technical Reviewer (Reporting Team)
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

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

Analytical Report Number: 21-64760
 Project / Site name: Castleton Sidings
 Your Order No: 14768-EF-M

Lab Sample Number				1815248	1815249
Sample Reference				TP101	TP113
Sample Number				None Supplied	None Supplied
Depth (m)				1.00	0.80
Date Sampled				04/02/2021	04/02/2021
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Stone Content	%	0.1	NONE	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	95	21
Total mass of sample received	kg	0.001	NONE	0.90	0.40

PCBs by GC-MS

PCB Congener 28	mg/kg	0.001	MCERTS	< 0.001	< 0.001
PCB Congener 52	mg/kg	0.001	MCERTS	< 0.001	< 0.001
PCB Congener 101	mg/kg	0.001	MCERTS	< 0.001	< 0.001
PCB Congener 118	mg/kg	0.001	MCERTS	< 0.001	< 0.001
PCB Congener 138	mg/kg	0.001	MCERTS	< 0.001	< 0.001
PCB Congener 153	mg/kg	0.001	MCERTS	< 0.001	< 0.001
PCB Congener 180	mg/kg	0.001	MCERTS	< 0.001	< 0.001

Total PCBs by GC-MS

Total PCBs	mg/kg	0.007	MCERTS	< 0.007	< 0.007
------------	-------	-------	--------	---------	---------

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



Analytical Report Number : 21-64760
Project / Site name: Castleton Sidings

* 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 *
1815248	TP101	None Supplied	1	Brown sandy clay with gravel.
1815249	TP113	None Supplied	0.8	Brown sandy clay with gravel.

Analytical Report Number : 21-64760
Project / Site name: Castleton Sidings

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
PCB's By GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE

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

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

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

Sample Deviation Report



Analytical Report Number : 21-64760
Project / Site name: Castleton Sidings

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
TP101	None Supplied	S	1815248	c	PCB's By GC-MS in soil	L027-PL	c
TP113	None Supplied	S	1815249	c	PCB's By GC-MS in soil	L027-PL	c



Jessica Sheridan

e3p
Taylor Road
Urmston
Manchester
M41 7JQ

e: jsheridan@e3p.co.uk

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

t: 01923 225404

f: 01923 237404

e: reception@i2analytical.com

Analytical Report Number : 21-63848

Project / Site name:	Castleton Sidings	Samples received on:	19/03/2021
Your job number:	14-768	Samples instructed on/ Analysis started on:	19/03/2021
Your order number:	14768-EF-J	Analysis completed by:	26/03/2021
Report Issue Number:	1	Report issued on:	26/03/2021
Samples Analysed:	6 soil samples		

Signed:

Rachel Bradley
Deputy Quality Manager
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

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

Analytical Report Number: 21-63848
Project / Site name: Castleton Sidings
Your Order No: 14768-EF-J

Lab Sample Number				1810045	1810046	1810047	1810048	1810049
Sample Reference				WS109	WS110	WS111	WS112	WS113
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				2.20	2.80	1.60	1.00	2.20
Date Sampled				18/03/2021	18/03/2021	18/03/2021	18/03/2021	18/03/2021
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	22	15	21	19	23
Total mass of sample received	kg	0.001	NONE	0.40	0.40	0.40	0.40	0.40

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

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.9	8.5	6.7	7.3	7.9
Total Cyanide	mg/kg	1	MCERTS	270	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	5100	130	3300	1400	970
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.11	0.021	0.066	0.027	0.082
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	220	42	130	53	160
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	108	21.1	65.5	26.5	81.7
Sulphide	mg/kg	1	MCERTS	16	< 1.0	9.5	5.7	15
Total Sulphur	mg/kg	50	MCERTS	3000	90	13000	1200	1200

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	3.2	< 0.05	1.9	1.1	2.0
Acenaphthylene	mg/kg	0.05	MCERTS	0.29	< 0.05	< 0.05	0.21	0.35
Acenaphthene	mg/kg	0.05	MCERTS	1.7	< 0.05	1.4	0.85	10
Fluorene	mg/kg	0.05	MCERTS	1.2	< 0.05	0.83	0.67	6.8
Phenanthrene	mg/kg	0.05	MCERTS	11	< 0.05	8.8	7.5	53
Anthracene	mg/kg	0.05	MCERTS	2.4	< 0.05	1.3	1.2	7.6
Fluoranthene	mg/kg	0.05	MCERTS	13	< 0.05	6.6	9.8	46
Pyrene	mg/kg	0.05	MCERTS	12	< 0.05	6.8	9.6	44
Benzo(a)anthracene	mg/kg	0.05	MCERTS	6.8	< 0.05	3.2	6.4	21
Chrysene	mg/kg	0.05	MCERTS	5.8	< 0.05	3.1	4.5	19
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	6.6	< 0.05	2.2	6.1	18
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	2.5	< 0.05	1.3	2.0	8.4
Benzo(a)pyrene	mg/kg	0.05	MCERTS	4.4	< 0.05	1.8	4.1	16
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	2.3	< 0.05	0.90	2.1	7.0
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.63	< 0.05	< 0.05	0.56	2.1
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	2.7	< 0.05	1.5	2.6	9.5

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	77.2	< 0.80	41.6	59.3	273
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Analytical Report Number: 21-63848
 Project / Site name: Castleton Sidings
 Your Order No: 14768-EF-J

Lab Sample Number	1810045	1810046	1810047	1810048	1810049
Sample Reference	WS109	WS110	WS111	WS112	WS113
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	2.20	2.80	1.60	1.00	2.20
Date Sampled	18/03/2021	18/03/2021	18/03/2021	18/03/2021	18/03/2021
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	44	2.2	75	56	26
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	26	9.1	7.4	27	20
Copper (aqua regia extractable)	mg/kg	1	MCERTS	200	8.5	91	300	180
Lead (aqua regia extractable)	mg/kg	1	MCERTS	320	5.5	130	690	360
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	2.3	2.4
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	32	7.9	27	67	46
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	110	21	64	210	140

Petroleum Hydrocarbons

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	11	< 2.0	20	14	35
TPH (C12 - C16)	mg/kg	4	MCERTS	27	< 4.0	23	15	74
TPH (C16 - C21)	mg/kg	1	MCERTS	63	< 1.0	31	35	170
TPH (C21 - C35)	mg/kg	1	MCERTS	200	< 1.0	56	93	250
TPH (C35 - C40)	mg/kg	10	MCERTS	39	< 10	< 10	< 10	54
TPH Total C5 - C40	mg/kg	10	MCERTS	350	< 10	150	170	610

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

Analytical Report Number: 21-63848
 Project / Site name: Castleton Sidings
 Your Order No: 14768-EF-J

Lab Sample Number				1810050
Sample Reference				WS114b
Sample Number				None Supplied
Depth (m)				1.70
Date Sampled				18/03/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	
Stone Content	%	0.1	NONE	< 0.1
Moisture Content	%	0.01	NONE	17
Total mass of sample received	kg	0.001	NONE	0.40

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.9
Total Cyanide	mg/kg	1	MCERTS	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	2200
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.17
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	340
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	170
Sulphide	mg/kg	1	MCERTS	9.3
Total Sulphur	mg/kg	50	MCERTS	1500

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	1.9
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	0.62
Fluorene	mg/kg	0.05	MCERTS	0.41
Phenanthrene	mg/kg	0.05	MCERTS	7.6
Anthracene	mg/kg	0.05	MCERTS	1.1
Fluoranthene	mg/kg	0.05	MCERTS	9.3
Pyrene	mg/kg	0.05	MCERTS	9.0
Benzo(a)anthracene	mg/kg	0.05	MCERTS	4.5
Chrysene	mg/kg	0.05	MCERTS	4.0
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	4.1
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	1.6
Benzo(a)pyrene	mg/kg	0.05	MCERTS	3.0
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	1.4
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.38
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	1.8

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	50.5
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Analytical Report Number: 21-63848
 Project / Site name: Castleton Sidings
 Your Order No: 14768-EF-J

Lab Sample Number				1810050
Sample Reference				WS114b
Sample Number				None Supplied
Depth (m)				1.70
Date Sampled				18/03/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	
Heavy Metals / Metalloids				
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	48
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	20
Copper (aqua regia extractable)	mg/kg	1	MCERTS	1300
Lead (aqua regia extractable)	mg/kg	1	MCERTS	1900
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	2.6
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	35
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	310

Petroleum Hydrocarbons

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	9.6
TPH (C12 - C16)	mg/kg	4	MCERTS	13
TPH (C16 - C21)	mg/kg	1	MCERTS	34
TPH (C21 - C35)	mg/kg	1	MCERTS	200
TPH (C35 - C40)	mg/kg	10	MCERTS	17
TPH Total C5 - C40	mg/kg	10	MCERTS	290

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

Analytical Report Number : 21-63848
Project / Site name: Castleton Sidings

* 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 *
1810045	WS109	None Supplied	2.2	Brown loam and clay with brick and vegetation.
1810046	WS110	None Supplied	2.8	Light brown sand.
1810047	WS111	None Supplied	1.6	Brown loam and sand with gravel.
1810048	WS112	None Supplied	1	Brown loam and sand with gravel.
1810049	WS113	None Supplied	2.2	Brown loam and sand with gravel.
1810050	WS114b	None Supplied	1.7	Brown loam and sand with gravel.

Analytical Report Number : 21-63848
Project / Site name: Castleton Sidings

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
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 soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-PL	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
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
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
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



Analytical Report Number : 21-63848
Project / Site name: Castleton Sidings

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

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

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



Jessica Sheridan

e3p
Taylor Road
Urmston
Manchester
M41 7JQ

e: jsheridan@e3p.co.uk

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

t: 01923 225404

f: 01923 237404

e: reception@i2analytical.com

Analytical Report Number : 21-61519

Project / Site name:	Castleton Sidings	Samples received on:	08/03/2021
Your job number:	14-768	Samples instructed on/ Analysis started on:	08/03/2021
Your order number:	14768-EF-F	Analysis completed by:	24/03/2021
Report Issue Number:	1	Report issued on:	25/03/2021
Samples Analysed:	3 leachate samples - 12 soil samples		

Signed:

Joanna Wawrzeczko
Technical Reviewer (Reporting Team)
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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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: 21-61519
Project / Site name: Castleton Sidings
Your Order No: 14768-EF-F

Lab Sample Number				1797155	1797156	1797157	1797158	1797159
Sample Reference				TP105	TP106	TP112	TP115	TP117
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	1.60	1.30	1.00	1.00
Date Sampled				04/02/2021	04/02/2021	04/02/2021	04/02/2021	04/02/2021
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	9.5	11	13	14	15
Total mass of sample received	kg	0.001	NONE	0.50	0.40	0.50	1.0	0.50

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

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	-	-	7.6	7.6	7.1
Total Cyanide	mg/kg	1	MCERTS	-	< 1.0	< 1.0	1.4	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-	-	2500	2500	1200
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	-	-	0.24	0.088	0.15
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	-	-	470	180	310
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	-	-	237	88.0	153
Sulphide	mg/kg	1	MCERTS	-	-	3.3	30	1.4
Total Sulphur	mg/kg	50	MCERTS	-	-	2800	2400	1000

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	1.5	15	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	-	< 0.05	< 0.05	0.54	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	-	0.54	0.24	5.2	0.23
Fluorene	mg/kg	0.05	MCERTS	-	0.47	0.29	4.0	0.17
Phenanthrene	mg/kg	0.05	MCERTS	-	2.9	2.1	32	2.2
Anthracene	mg/kg	0.05	MCERTS	-	0.78	0.32	6.5	0.49
Fluoranthene	mg/kg	0.05	MCERTS	-	4.5	1.9	36	3.8
Pyrene	mg/kg	0.05	MCERTS	-	3.9	1.9	33	3.4
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	2.4	1.4	18	2.7
Chrysene	mg/kg	0.05	MCERTS	-	1.9	0.97	16	2.5
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	2.1	1.0	11	2.5
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	1.0	0.65	6.0	1.2
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	2.1	1.1	9.5	2.7
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	0.74	0.45	4.5	1.3
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	< 0.05	< 0.05	1.7	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	0.92	0.61	5.4	1.7

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	-	24.2	14.4	204	24.7
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Analytical Report Number: 21-61519
Project / Site name: Castleton Sidings
Your Order No: 14768-EF-F

Lab Sample Number				1797155	1797156	1797157	1797158	1797159
Sample Reference				TP105	TP106	TP112	TP115	TP117
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	1.60	1.30	1.00	1.00
Date Sampled				04/02/2021	04/02/2021	04/02/2021	04/02/2021	04/02/2021
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	-	50	51	54	36
Barium (aqua regia extractable)	mg/kg	1	MCERTS	-	230	-	-	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-	1.7	-	-	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-	1.1	-	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	-	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	43	22	19
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-	230	250	240	190
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-	320	220	370	130
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-	0.7	0.7	1.8	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-	38	42	45	59
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	49	-	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-	280	140	250	130

Speciated Mercury (Dry Weight)

Inorganic Mercury	mg/kg	0.005	NONE	-	-	-	1.283	-
Organo-Mercury Species (including Methyl Hg)	mg/kg	0.005	NONE	-	-	-	0.042	-
Elemental Mercury	mg/kg	0.005	NONE	-	-	-	0.398	-

Speciated Mercury (Dry Weight)

F1 - Water soluble	mg/kg	0.005	NONE	-	-	-	0.010	-
F2 - Weak acid	mg/kg	0.005	NONE	-	-	-	0.006	-
F3 - Organo- complexed	mg/kg	0.005	NONE	-	-	-	0.042	-
F4 - Strongly complexed	mg/kg	0.005	NONE	-	-	-	0.398	-
F5 - Mineral bound	mg/kg	0.005	NONE	-	-	-	1.266	-

Petroleum Hydrocarbons

TPH (C5 - C6)	mg/kg	1	NONE	-	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	-	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	-	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	-	< 2.0	< 2.0	27	< 2.0
TPH (C12 - C16)	mg/kg	4	MCERTS	-	< 4.0	< 4.0	33	< 4.0
TPH (C16 - C21)	mg/kg	1	MCERTS	-	10	8.0	120	11
TPH (C21 - C35)	mg/kg	1	MCERTS	-	21	15	120	63
TPH (C35 - C40)	mg/kg	10	MCERTS	-	< 10	< 10	< 10	18
TPH Total C5 - C40	mg/kg	10	MCERTS	-	33	25	330	94

VOCs

Chloromethane	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
Chloroethane	µg/kg	1	NONE	< 1.0	-	-	-	-
Bromomethane	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
Vinyl Chloride	µg/kg	1	NONE	< 1.0	-	-	-	-
Trichlorofluoromethane	µg/kg	1	NONE	< 1.0	-	-	-	-
1,1-Dichloroethene	µg/kg	1	NONE	< 1.0	-	-	-	-
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
Cis-1,2-dichloroethene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,1-Dichloroethane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
2,2-Dichloropropane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Trichloromethane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,1,1-Trichloroethane	µg/kg	1	MCERTS	< 1.0	-	-	-	-

Analytical Report Number: 21-61519
Project / Site name: Castleton Sidings
Your Order No: 14768-EF-F

Lab Sample Number				1797155	1797156	1797157	1797158	1797159
Sample Reference				TP105	TP106	TP112	TP115	TP117
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	1.60	1.30	1.00	1.00
Date Sampled				04/02/2021	04/02/2021	04/02/2021	04/02/2021	04/02/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
1,2-Dichloroethane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,1-Dichloropropene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Trans-1,2-dichloroethene	µg/kg	1	NONE	< 1.0	-	-	-	-
Benzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Tetrachloromethane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,2-Dichloropropane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Trichloroethene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Dibromomethane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Bromodichloromethane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Cis-1,3-dichloropropene	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
Trans-1,3-dichloropropene	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
Toluene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,1,2-Trichloroethane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,3-Dichloropropane	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
Dibromochloromethane	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
Tetrachloroethene	µg/kg	1	NONE	< 1.0	-	-	-	-
1,2-Dibromoethane	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
Chlorobenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,1,1,2-Tetrachloroethane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
p & m-Xylene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Styrene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Tribromomethane	µg/kg	1	NONE	< 1.0	-	-	-	-
o-Xylene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,1,1,2,2-Tetrachloroethane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Isopropylbenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Bromobenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
n-Propylbenzene	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
2-Chlorotoluene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
4-Chlorotoluene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,3,5-Trimethylbenzene	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
tert-Butylbenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,2,4-Trimethylbenzene	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
sec-Butylbenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,3-Dichlorobenzene	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
p-Isopropyltoluene	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
1,2-Dichlorobenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,4-Dichlorobenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Butylbenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,2-Dibromo-3-chloropropane	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
1,2,4-Trichlorobenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Hexachlorobutadiene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,2,3-Trichlorobenzene	µg/kg	1	ISO 17025	< 1.0	-	-	-	-

SVOCs

Aniline	mg/kg	0.1	NONE	< 0.1	-	-	-	-
Phenol	mg/kg	0.2	ISO 17025	< 0.2	-	-	-	-
2-Chlorophenol	mg/kg	0.1	MCERTS	< 0.1	-	-	-	-
Bis(2-chloroethyl)ether	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
1,3-Dichlorobenzene	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
1,2-Dichlorobenzene	mg/kg	0.1	MCERTS	< 0.1	-	-	-	-
1,4-Dichlorobenzene	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
Bis(2-chloroisopropyl)ether	mg/kg	0.1	MCERTS	< 0.1	-	-	-	-

Analytical Report Number: 21-61519
 Project / Site name: Castleton Sidings
 Your Order No: 14768-EF-F

Lab Sample Number				1797155	1797156	1797157	1797158	1797159
Sample Reference				TP105	TP106	TP112	TP115	TP117
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	1.60	1.30	1.00	1.00
Date Sampled				04/02/2021	04/02/2021	04/02/2021	04/02/2021	04/02/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
2-Methylphenol	mg/kg	0.3	MCERTS	< 0.3	-	-	-	-
Hexachloroethane	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Nitrobenzene	mg/kg	0.3	MCERTS	< 0.3	-	-	-	-
4-Methylphenol	mg/kg	0.2	NONE	< 0.2	-	-	-	-
Isophorone	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
2-Nitrophenol	mg/kg	0.3	MCERTS	< 0.3	-	-	-	-
2,4-Dimethylphenol	mg/kg	0.3	MCERTS	< 0.3	-	-	-	-
Bis(2-chloroethoxy)methane	mg/kg	0.3	MCERTS	< 0.3	-	-	-	-
1,2,4-Trichlorobenzene	mg/kg	0.3	MCERTS	< 0.3	-	-	-	-
Naphthalene	mg/kg	0.05	MCERTS	2.9	-	-	-	-
2,4-Dichlorophenol	mg/kg	0.3	MCERTS	< 0.3	-	-	-	-
4-Chloroaniline	mg/kg	0.1	NONE	< 0.1	-	-	-	-
Hexachlorobutadiene	mg/kg	0.1	MCERTS	< 0.1	-	-	-	-
4-Chloro-3-methylphenol	mg/kg	0.1	NONE	< 0.1	-	-	-	-
2,4,6-Trichlorophenol	mg/kg	0.1	MCERTS	< 0.1	-	-	-	-
2,4,5-Trichlorophenol	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
2-Methylnaphthalene	mg/kg	0.1	NONE	2.0	-	-	-	-
2-Chloronaphthalene	mg/kg	0.1	MCERTS	< 0.1	-	-	-	-
Dimethylphthalate	mg/kg	0.1	MCERTS	< 0.1	-	-	-	-
2,6-Dinitrotoluene	mg/kg	0.1	MCERTS	< 0.1	-	-	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Acenaphthene	mg/kg	0.05	MCERTS	1.2	-	-	-	-
2,4-Dinitrotoluene	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
Dibenzofuran	mg/kg	0.2	MCERTS	0.9	-	-	-	-
4-Chlorophenyl phenyl ether	mg/kg	0.3	ISO 17025	< 0.3	-	-	-	-
Diethyl phthalate	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
4-Nitroaniline	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
Fluorene	mg/kg	0.05	MCERTS	1.1	-	-	-	-
Azobenzene	mg/kg	0.3	MCERTS	< 0.3	-	-	-	-
Bromophenyl phenyl ether	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
Hexachlorobenzene	mg/kg	0.3	MCERTS	< 0.3	-	-	-	-
Phenanthrene	mg/kg	0.05	MCERTS	7.8	-	-	-	-
Anthracene	mg/kg	0.05	MCERTS	2.2	-	-	-	-
Carbazole	mg/kg	0.3	MCERTS	0.8	-	-	-	-
Dibutyl phthalate	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
Anthraquinone	mg/kg	0.3	MCERTS	0.5	-	-	-	-
Fluoranthene	mg/kg	0.05	MCERTS	8.2	-	-	-	-
Pyrene	mg/kg	0.05	MCERTS	7.0	-	-	-	-
Butyl benzyl phthalate	mg/kg	0.3	ISO 17025	< 0.3	-	-	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	3.6	-	-	-	-
Chrysene	mg/kg	0.05	MCERTS	2.8	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	2.2	-	-	-	-
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.87	-	-	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	1.5	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.72	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.87	-	-	-	-

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

Analytical Report Number: 21-61519
Project / Site name: Castleton Sidings
Your Order No: 14768-EF-F

Lab Sample Number				1797160	1797161	1797162	1797163	1797164
Sample Reference				TP121	WS101	WS103	WS104	WS105
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	0.50	4.90	3.20	4.90
Date Sampled				04/02/2021	04/02/2021	04/02/2021	04/02/2021	04/02/2021
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	10	18	25	14
Total mass of sample received	kg	0.001	NONE	0.50	1.0	0.50	1.0	0.50

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	-
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	-	-	-	-
Asbestos Quantification Total	%	0.001	ISO 17025	-	-	-	-	-

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	-	-	-	7.5	-
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	13	3.6
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-	-	-	6300	-
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	-	-	-	0.32	-
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	-	-	-	630	-
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	-	-	-	317	-
Sulphide	mg/kg	1	MCERTS	-	-	-	630	-
Total Sulphur	mg/kg	50	MCERTS	-	-	-	28000	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-	-	-	4.1	-
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	1.2	6.5	0.77	220	130
Acenaphthylene	mg/kg	0.05	MCERTS	0.21	0.29	< 0.05	14	3.5
Acenaphthene	mg/kg	0.05	MCERTS	3.1	2.8	1.8	530	250
Fluorene	mg/kg	0.05	MCERTS	2.2	1.9	2.2	830	210
Phenanthrene	mg/kg	0.05	MCERTS	20	8.2	7.2	1600	640
Anthracene	mg/kg	0.05	MCERTS	5.2	2.9	1.7	310	120
Fluoranthene	mg/kg	0.05	MCERTS	30	7.4	2.1	490	170
Pyrene	mg/kg	0.05	MCERTS	27	6.8	1.5	350	120
Benzo(a)anthracene	mg/kg	0.05	MCERTS	19	4.5	0.32	69	23
Chrysene	mg/kg	0.05	MCERTS	14	4.0	0.26	35	16
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	17	3.9	< 0.05	18	4.7
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	9.1	1.6	< 0.05	13	3.9
Benzo(a)pyrene	mg/kg	0.05	MCERTS	18	2.6	< 0.05	20	4.5
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	7.4	1.7	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	1.9	0.62	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	9.3	< 0.05	< 0.05	< 0.05	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	184	55.6	17.7	4510	1690
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Analytical Report Number: 21-61519
Project / Site name: Castleton Sidings
Your Order No: 14768-EF-F

Lab Sample Number				1797160	1797161	1797162	1797163	1797164
Sample Reference				TP121	WS101	WS103	WS104	WS105
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	0.50	4.90	3.20	4.90
Date Sampled				04/02/2021	04/02/2021	04/02/2021	04/02/2021	04/02/2021
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	53	34	1.4	290	5.9
Barium (aqua regia extractable)	mg/kg	1	MCERTS	470	180	9.5	-	15
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	2.4	1.6	0.13	-	0.26
Boron (water soluble)	mg/kg	0.2	MCERTS	0.5	0.3	< 0.2	-	< 0.2
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	2.5	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	21	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	340	170	15	91	18
Lead (aqua regia extractable)	mg/kg	1	MCERTS	720	100	4.2	900	8.6
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	3.6	< 0.3	< 0.3	0.7	0.5
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	79	42	3.0	53	6.9
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	66	38	4.5	-	6.7
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	310	230	22	2000	37

Speciated Mercury (Dry Weight)

Inorganic Mercury	mg/kg	0.005	NONE	1.693	-	-	-	-
Organo-Mercury Species (including Methyl Hg)	mg/kg	0.005	NONE	0.168	-	-	-	-
Elemental Mercury	mg/kg	0.005	NONE	1.608	-	-	-	-

Speciated Mercury (Dry Weight)

F1 - Water soluble	mg/kg	0.005	NONE	0.117	-	-	-	-
F2 - Weak acid	mg/kg	0.005	NONE	0.545	-	-	-	-
F3 - Organo- complexed	mg/kg	0.005	NONE	0.168	-	-	-	-
F4 - Strongly complexed	mg/kg	0.005	NONE	1.608	-	-	-	-
F5 - Mineral bound	mg/kg	0.005	NONE	1.031	-	-	-	-

Petroleum Hydrocarbons

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	0.2	5.7
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	0.3	12
TPH (C10 - C12)	mg/kg	2	MCERTS	4.8	11	22	250	480
TPH (C12 - C16)	mg/kg	4	MCERTS	11	18	30	1700	1200
TPH (C16 - C21)	mg/kg	1	MCERTS	100	37	27	2700	1200
TPH (C21 - C35)	mg/kg	1	MCERTS	180	80	11	360	260
TPH (C35 - C40)	mg/kg	10	MCERTS	30	< 10	< 10	19	35
TPH Total C5 - C40	mg/kg	10	MCERTS	330	160	110	5200	3700

VOCs

Chloromethane	µg/kg	1	ISO 17025	-	-	-	< 1.0	-
Chloroethane	µg/kg	1	NONE	-	-	-	< 1.0	-
Bromomethane	µg/kg	1	ISO 17025	-	-	-	< 1.0	-
Vinyl Chloride	µg/kg	1	NONE	-	-	-	< 1.0	-
Trichlorofluoromethane	µg/kg	1	NONE	-	-	-	< 1.0	-
1,1-Dichloroethene	µg/kg	1	NONE	-	-	-	< 1.0	-
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	1	ISO 17025	-	-	-	< 1.0	-
Cis-1,2-dichloroethene	µg/kg	1	MCERTS	-	-	-	< 1.0	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	-	-	< 1.0	-
1,1-Dichloroethane	µg/kg	1	MCERTS	-	-	-	< 1.0	-
2,2-Dichloropropane	µg/kg	1	MCERTS	-	-	-	< 1.0	-
Trichloromethane	µg/kg	1	MCERTS	-	-	-	< 1.0	-
1,1,1-Trichloroethane	µg/kg	1	MCERTS	-	-	-	< 1.0	-

Analytical Report Number: 21-61519
Project / Site name: Castleton Sidings
Your Order No: 14768-EF-F

Lab Sample Number				1797160	1797161	1797162	1797163	1797164
Sample Reference				TP121	WS101	WS103	WS104	WS105
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	0.50	4.90	3.20	4.90
Date Sampled				04/02/2021	04/02/2021	04/02/2021	04/02/2021	04/02/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
1,2-Dichloroethane	µg/kg	1	MCERTS	-	-	-	< 1.0	-
1,1-Dichloropropene	µg/kg	1	MCERTS	-	-	-	< 1.0	-
Trans-1,2-dichloroethene	µg/kg	1	NONE	-	-	-	< 1.0	-
Benzene	µg/kg	1	MCERTS	-	-	-	< 1.0	-
Tetrachloromethane	µg/kg	1	MCERTS	-	-	-	< 1.0	-
1,2-Dichloropropane	µg/kg	1	MCERTS	-	-	-	< 1.0	-
Trichloroethene	µg/kg	1	MCERTS	-	-	-	< 1.0	-
Dibromomethane	µg/kg	1	MCERTS	-	-	-	< 1.0	-
Bromodichloromethane	µg/kg	1	MCERTS	-	-	-	< 1.0	-
Cis-1,3-dichloropropene	µg/kg	1	ISO 17025	-	-	-	< 1.0	-
Trans-1,3-dichloropropene	µg/kg	1	ISO 17025	-	-	-	< 1.0	-
Toluene	µg/kg	1	MCERTS	-	-	-	11	-
1,1,2-Trichloroethane	µg/kg	1	MCERTS	-	-	-	< 1.0	-
1,3-Dichloropropane	µg/kg	1	ISO 17025	-	-	-	< 1.0	-
Dibromochloromethane	µg/kg	1	ISO 17025	-	-	-	< 1.0	-
Tetrachloroethene	µg/kg	1	NONE	-	-	-	< 1.0	-
1,2-Dibromoethane	µg/kg	1	ISO 17025	-	-	-	< 1.0	-
Chlorobenzene	µg/kg	1	MCERTS	-	-	-	< 1.0	-
1,1,1,2-Tetrachloroethane	µg/kg	1	MCERTS	-	-	-	< 1.0	-
Ethylbenzene	µg/kg	1	MCERTS	-	-	-	39	-
p & m-Xylene	µg/kg	1	MCERTS	-	-	-	55	-
Styrene	µg/kg	1	MCERTS	-	-	-	< 1.0	-
Tribromomethane	µg/kg	1	NONE	-	-	-	< 1.0	-
o-Xylene	µg/kg	1	MCERTS	-	-	-	49	-
1,1,1,2,2-Tetrachloroethane	µg/kg	1	MCERTS	-	-	-	< 1.0	-
Isopropylbenzene	µg/kg	1	MCERTS	-	-	-	10	-
Bromobenzene	µg/kg	1	MCERTS	-	-	-	< 1.0	-
n-Propylbenzene	µg/kg	1	ISO 17025	-	-	-	< 1.0	-
2-Chlorotoluene	µg/kg	1	MCERTS	-	-	-	< 1.0	-
4-Chlorotoluene	µg/kg	1	MCERTS	-	-	-	< 1.0	-
1,3,5-Trimethylbenzene	µg/kg	1	ISO 17025	-	-	-	120	-
tert-Butylbenzene	µg/kg	1	MCERTS	-	-	-	< 1.0	-
1,2,4-Trimethylbenzene	µg/kg	1	ISO 17025	-	-	-	160	-
sec-Butylbenzene	µg/kg	1	MCERTS	-	-	-	< 1.0	-
1,3-Dichlorobenzene	µg/kg	1	ISO 17025	-	-	-	< 1.0	-
p-Isopropyltoluene	µg/kg	1	ISO 17025	-	-	-	41	-
1,2-Dichlorobenzene	µg/kg	1	MCERTS	-	-	-	< 1.0	-
1,4-Dichlorobenzene	µg/kg	1	MCERTS	-	-	-	< 1.0	-
Butylbenzene	µg/kg	1	MCERTS	-	-	-	< 1.0	-
1,2-Dibromo-3-chloropropane	µg/kg	1	ISO 17025	-	-	-	< 1.0	-
1,2,4-Trichlorobenzene	µg/kg	1	MCERTS	-	-	-	< 1.0	-
Hexachlorobutadiene	µg/kg	1	MCERTS	-	-	-	< 1.0	-
1,2,3-Trichlorobenzene	µg/kg	1	ISO 17025	-	-	-	< 1.0	-

SVOCs

Aniline	mg/kg	0.1	NONE	-	-	-	< 0.1	-
Phenol	mg/kg	0.2	ISO 17025	-	-	-	< 0.2	-
2-Chlorophenol	mg/kg	0.1	MCERTS	-	-	-	< 0.1	-
Bis(2-chloroethyl)ether	mg/kg	0.2	MCERTS	-	-	-	< 0.2	-
1,3-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-	-	< 0.2	-
1,2-Dichlorobenzene	mg/kg	0.1	MCERTS	-	-	-	< 0.1	-
1,4-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-	-	< 0.2	-
Bis(2-chloroisopropyl)ether	mg/kg	0.1	MCERTS	-	-	-	< 0.1	-

Analytical Report Number: 21-61519
Project / Site name: Castleton Sidings
Your Order No: 14768-EF-F

Lab Sample Number				1797160	1797161	1797162	1797163	1797164
Sample Reference				TP121	WS101	WS103	WS104	WS105
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	0.50	4.90	3.20	4.90
Date Sampled				04/02/2021	04/02/2021	04/02/2021	04/02/2021	04/02/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
2-Methylphenol	mg/kg	0.3	MCERTS	-	-	-	< 0.3	-
Hexachloroethane	mg/kg	0.05	MCERTS	-	-	-	< 0.05	-
Nitrobenzene	mg/kg	0.3	MCERTS	-	-	-	< 0.3	-
4-Methylphenol	mg/kg	0.2	NONE	-	-	-	< 0.2	-
Isophorone	mg/kg	0.2	MCERTS	-	-	-	< 0.2	-
2-Nitrophenol	mg/kg	0.3	MCERTS	-	-	-	< 0.3	-
2,4-Dimethylphenol	mg/kg	0.3	MCERTS	-	-	-	< 0.3	-
Bis(2-chloroethoxy)methane	mg/kg	0.3	MCERTS	-	-	-	< 0.3	-
1,2,4-Trichlorobenzene	mg/kg	0.3	MCERTS	-	-	-	< 0.3	-
Naphthalene	mg/kg	0.05	MCERTS	-	-	-	220	-
2,4-Dichlorophenol	mg/kg	0.3	MCERTS	-	-	-	< 0.3	-
4-Chloroaniline	mg/kg	0.1	NONE	-	-	-	< 0.1	-
Hexachlorobutadiene	mg/kg	0.1	MCERTS	-	-	-	< 0.1	-
4-Chloro-3-methylphenol	mg/kg	0.1	NONE	-	-	-	< 0.1	-
2,4,6-Trichlorophenol	mg/kg	0.1	MCERTS	-	-	-	< 0.1	-
2,4,5-Trichlorophenol	mg/kg	0.2	MCERTS	-	-	-	< 0.2	-
2-Methylnaphthalene	mg/kg	0.1	NONE	-	-	-	42	-
2-Chloronaphthalene	mg/kg	0.1	MCERTS	-	-	-	< 0.1	-
Dimethylphthalate	mg/kg	0.1	MCERTS	-	-	-	< 0.1	-
2,6-Dinitrotoluene	mg/kg	0.1	MCERTS	-	-	-	< 0.1	-
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	-	14	-
Acenaphthene	mg/kg	0.05	MCERTS	-	-	-	530	-
2,4-Dinitrotoluene	mg/kg	0.2	MCERTS	-	-	-	< 0.2	-
Dibenzofuran	mg/kg	0.2	MCERTS	-	-	-	480	-
4-Chlorophenyl phenyl ether	mg/kg	0.3	ISO 17025	-	-	-	< 0.3	-
Diethyl phthalate	mg/kg	0.2	MCERTS	-	-	-	< 0.2	-
4-Nitroaniline	mg/kg	0.2	MCERTS	-	-	-	< 0.2	-
Fluorene	mg/kg	0.05	MCERTS	-	-	-	830	-
Azobenzene	mg/kg	0.3	MCERTS	-	-	-	< 0.3	-
Bromophenyl phenyl ether	mg/kg	0.2	MCERTS	-	-	-	< 0.2	-
Hexachlorobenzene	mg/kg	0.3	MCERTS	-	-	-	< 0.3	-
Phenanthrene	mg/kg	0.05	MCERTS	-	-	-	1600	-
Anthracene	mg/kg	0.05	MCERTS	-	-	-	310	-
Carbazole	mg/kg	0.3	MCERTS	-	-	-	290	-
Dibutyl phthalate	mg/kg	0.2	MCERTS	-	-	-	< 0.2	-
Anthraquinone	mg/kg	0.3	MCERTS	-	-	-	< 0.3	-
Fluoranthene	mg/kg	0.05	MCERTS	-	-	-	490	-
Pyrene	mg/kg	0.05	MCERTS	-	-	-	350	-
Butyl benzyl phthalate	mg/kg	0.3	ISO 17025	-	-	-	< 0.3	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-	-	69	-
Chrysene	mg/kg	0.05	MCERTS	-	-	-	35	-
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	-	-	18	-
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	-	-	13	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-	-	20	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	-	< 0.05	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	-	< 0.05	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	-	< 0.05	-

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

Analytical Report Number: 21-61519
Project / Site name: Castleton Sidings
Your Order No: 14768-EF-F

Lab Sample Number				1797165	1797166
Sample Reference				WS106A	WS107
Sample Number				None Supplied	None Supplied
Depth (m)				4.60	2.10
Date Sampled				04/02/2021	04/02/2021
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Stone Content	%	0.1	NONE	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	13	11
Total mass of sample received	kg	0.001	NONE	1.0	0.30

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

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	-	-
Total Cyanide	mg/kg	1	MCERTS	2.5	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-	-
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	-	-
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	-	-
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	-	-
Sulphide	mg/kg	1	MCERTS	-	-
Total Sulphur	mg/kg	50	MCERTS	-	-

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	46	5.1
Acenaphthylene	mg/kg	0.05	MCERTS	1.4	0.44
Acenaphthene	mg/kg	0.05	MCERTS	50	9.2
Fluorene	mg/kg	0.05	MCERTS	58	6.1
Phenanthrene	mg/kg	0.05	MCERTS	180	60
Anthracene	mg/kg	0.05	MCERTS	39	13
Fluoranthene	mg/kg	0.05	MCERTS	48	74
Pyrene	mg/kg	0.05	MCERTS	35	68
Benzo(a)anthracene	mg/kg	0.05	MCERTS	6.8	36
Chrysene	mg/kg	0.05	MCERTS	6.4	34
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	2.8	31
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	1.4	20
Benzo(a)pyrene	mg/kg	0.05	MCERTS	2.2	34
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	14
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	3.9
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	17

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	474	426
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Analytical Report Number: 21-61519
Project / Site name: Castleton Sidings
Your Order No: 14768-EF-F

Lab Sample Number				1797165	1797166
Sample Reference				WS106A	WS107
Sample Number				None Supplied	None Supplied
Depth (m)				4.60	2.10
Date Sampled				04/02/2021	04/02/2021
Time Taken				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	26	31
Barium (aqua regia extractable)	mg/kg	1	MCERTS	190	310
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	2.2	1.5
Boron (water soluble)	mg/kg	0.2	MCERTS	0.4	0.5
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	160	180
Lead (aqua regia extractable)	mg/kg	1	MCERTS	87	120
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	49	39
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	53	54
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	160	110

Speciated Mercury (Dry Weight)

Inorganic Mercury	mg/kg	0.005	NONE	-	-
Organo-Mercury Species (including Methyl Hg)	mg/kg	0.005	NONE	-	-
Elemental Mercury	mg/kg	0.005	NONE	-	-

Speciated Mercury (Dry Weight)

F1 - Water soluble	mg/kg	0.005	NONE	-	-
F2 - Weak acid	mg/kg	0.005	NONE	-	-
F3 - Organo- complexed	mg/kg	0.005	NONE	-	-
F4 - Strongly complexed	mg/kg	0.005	NONE	-	-
F5 - Mineral bound	mg/kg	0.005	NONE	-	-

Petroleum Hydrocarbons

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	2.1	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	48	5.5
TPH (C12 - C16)	mg/kg	4	MCERTS	130	48
TPH (C16 - C21)	mg/kg	1	MCERTS	310	260
TPH (C21 - C35)	mg/kg	1	MCERTS	61	240
TPH (C35 - C40)	mg/kg	10	MCERTS	< 10	53
TPH Total C5 - C40	mg/kg	10	MCERTS	600	620

VOCs

Chloromethane	µg/kg	1	ISO 17025	-	-
Chloroethane	µg/kg	1	NONE	-	-
Bromomethane	µg/kg	1	ISO 17025	-	-
Vinyl Chloride	µg/kg	1	NONE	-	-
Trichlorofluoromethane	µg/kg	1	NONE	-	-
1,1-Dichloroethene	µg/kg	1	NONE	-	-
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	1	ISO 17025	-	-
Cis-1,2-dichloroethene	µg/kg	1	MCERTS	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	-
1,1-Dichloroethane	µg/kg	1	MCERTS	-	-
2,2-Dichloropropane	µg/kg	1	MCERTS	-	-
Trichloromethane	µg/kg	1	MCERTS	-	-
1,1,1-Trichloroethane	µg/kg	1	MCERTS	-	-

Analytical Report Number: 21-61519
Project / Site name: Castleton Sidings
Your Order No: 14768-EF-F

Lab Sample Number				1797165	1797166
Sample Reference				WS106A	WS107
Sample Number				None Supplied	None Supplied
Depth (m)				4.60	2.10
Date Sampled				04/02/2021	04/02/2021
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
1,2-Dichloroethane	µg/kg	1	MCERTS	-	-
1,1-Dichloropropene	µg/kg	1	MCERTS	-	-
Trans-1,2-dichloroethene	µg/kg	1	NONE	-	-
Benzene	µg/kg	1	MCERTS	-	-
Tetrachloromethane	µg/kg	1	MCERTS	-	-
1,2-Dichloropropane	µg/kg	1	MCERTS	-	-
Trichloroethene	µg/kg	1	MCERTS	-	-
Dibromomethane	µg/kg	1	MCERTS	-	-
Bromodichloromethane	µg/kg	1	MCERTS	-	-
Cis-1,3-dichloropropene	µg/kg	1	ISO 17025	-	-
Trans-1,3-dichloropropene	µg/kg	1	ISO 17025	-	-
Toluene	µg/kg	1	MCERTS	-	-
1,1,2-Trichloroethane	µg/kg	1	MCERTS	-	-
1,3-Dichloropropane	µg/kg	1	ISO 17025	-	-
Dibromochloromethane	µg/kg	1	ISO 17025	-	-
Tetrachloroethene	µg/kg	1	NONE	-	-
1,2-Dibromoethane	µg/kg	1	ISO 17025	-	-
Chlorobenzene	µg/kg	1	MCERTS	-	-
1,1,1,2-Tetrachloroethane	µg/kg	1	MCERTS	-	-
Ethylbenzene	µg/kg	1	MCERTS	-	-
p & m-Xylene	µg/kg	1	MCERTS	-	-
Styrene	µg/kg	1	MCERTS	-	-
Tribromomethane	µg/kg	1	NONE	-	-
o-Xylene	µg/kg	1	MCERTS	-	-
1,1,1,2,2-Tetrachloroethane	µg/kg	1	MCERTS	-	-
Isopropylbenzene	µg/kg	1	MCERTS	-	-
Bromobenzene	µg/kg	1	MCERTS	-	-
n-Propylbenzene	µg/kg	1	ISO 17025	-	-
2-Chlorotoluene	µg/kg	1	MCERTS	-	-
4-Chlorotoluene	µg/kg	1	MCERTS	-	-
1,3,5-Trimethylbenzene	µg/kg	1	ISO 17025	-	-
tert-Butylbenzene	µg/kg	1	MCERTS	-	-
1,2,4-Trimethylbenzene	µg/kg	1	ISO 17025	-	-
sec-Butylbenzene	µg/kg	1	MCERTS	-	-
1,3-Dichlorobenzene	µg/kg	1	ISO 17025	-	-
p-Isopropyltoluene	µg/kg	1	ISO 17025	-	-
1,2-Dichlorobenzene	µg/kg	1	MCERTS	-	-
1,4-Dichlorobenzene	µg/kg	1	MCERTS	-	-
Butylbenzene	µg/kg	1	MCERTS	-	-
1,2-Dibromo-3-chloropropane	µg/kg	1	ISO 17025	-	-
1,2,4-Trichlorobenzene	µg/kg	1	MCERTS	-	-
Hexachlorobutadiene	µg/kg	1	MCERTS	-	-
1,2,3-Trichlorobenzene	µg/kg	1	ISO 17025	-	-

SVOCs

Aniline	mg/kg	0.1	NONE	-	-
Phenol	mg/kg	0.2	ISO 17025	-	-
2-Chlorophenol	mg/kg	0.1	MCERTS	-	-
Bis(2-chloroethyl)ether	mg/kg	0.2	MCERTS	-	-
1,3-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-
1,2-Dichlorobenzene	mg/kg	0.1	MCERTS	-	-
1,4-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-
Bis(2-chloroisopropyl)ether	mg/kg	0.1	MCERTS	-	-

Analytical Report Number: 21-61519
Project / Site name: Castleton Sidings
Your Order No: 14768-EF-F

Lab Sample Number				1797165	1797166
Sample Reference				WS106A	WS107
Sample Number				None Supplied	None Supplied
Depth (m)				4.60	2.10
Date Sampled				04/02/2021	04/02/2021
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
2-Methylphenol	mg/kg	0.3	MCERTS	-	-
Hexachloroethane	mg/kg	0.05	MCERTS	-	-
Nitrobenzene	mg/kg	0.3	MCERTS	-	-
4-Methylphenol	mg/kg	0.2	NONE	-	-
Isophorone	mg/kg	0.2	MCERTS	-	-
2-Nitrophenol	mg/kg	0.3	MCERTS	-	-
2,4-Dimethylphenol	mg/kg	0.3	MCERTS	-	-
Bis(2-chloroethoxy)methane	mg/kg	0.3	MCERTS	-	-
1,2,4-Trichlorobenzene	mg/kg	0.3	MCERTS	-	-
Naphthalene	mg/kg	0.05	MCERTS	-	-
2,4-Dichlorophenol	mg/kg	0.3	MCERTS	-	-
4-Chloroaniline	mg/kg	0.1	NONE	-	-
Hexachlorobutadiene	mg/kg	0.1	MCERTS	-	-
4-Chloro-3-methylphenol	mg/kg	0.1	NONE	-	-
2,4,6-Trichlorophenol	mg/kg	0.1	MCERTS	-	-
2,4,5-Trichlorophenol	mg/kg	0.2	MCERTS	-	-
2-Methylnaphthalene	mg/kg	0.1	NONE	-	-
2-Chloronaphthalene	mg/kg	0.1	MCERTS	-	-
Dimethylphthalate	mg/kg	0.1	MCERTS	-	-
2,6-Dinitrotoluene	mg/kg	0.1	MCERTS	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	-	-
Acenaphthene	mg/kg	0.05	MCERTS	-	-
2,4-Dinitrotoluene	mg/kg	0.2	MCERTS	-	-
Dibenzofuran	mg/kg	0.2	MCERTS	-	-
4-Chlorophenyl phenyl ether	mg/kg	0.3	ISO 17025	-	-
Diethyl phthalate	mg/kg	0.2	MCERTS	-	-
4-Nitroaniline	mg/kg	0.2	MCERTS	-	-
Fluorene	mg/kg	0.05	MCERTS	-	-
Azobenzene	mg/kg	0.3	MCERTS	-	-
Bromophenyl phenyl ether	mg/kg	0.2	MCERTS	-	-
Hexachlorobenzene	mg/kg	0.3	MCERTS	-	-
Phenanthrene	mg/kg	0.05	MCERTS	-	-
Anthracene	mg/kg	0.05	MCERTS	-	-
Carbazole	mg/kg	0.3	MCERTS	-	-
Dibutyl phthalate	mg/kg	0.2	MCERTS	-	-
Anthraquinone	mg/kg	0.3	MCERTS	-	-
Fluoranthene	mg/kg	0.05	MCERTS	-	-
Pyrene	mg/kg	0.05	MCERTS	-	-
Butyl benzyl phthalate	mg/kg	0.3	ISO 17025	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-
Chrysene	mg/kg	0.05	MCERTS	-	-
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	-
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-

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



Analytical Report Number: 21-61519
Project / Site name: Castleton Sidings
Your Order No: 14768-EF-F

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
1797157	TP112	1.30	123	Loose Fibres	Chrysotile	< 0.001	< 0.001

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



Analytical Report Number: 21-61519
Project / Site name: Castleton Sidings

Your Order No: 14768-EF-F

Lab Sample Number				1797167	1797168	1797169
Sample Reference				TP105	TP123	WS105
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				1.00	1.00	4.90
Date Sampled				04/02/2021	04/02/2021	04/02/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	Units	Limit of detection	Accreditation Status			

General Inorganics

pH	pH Units	N/A	ISO 17025	7.8	7.7	7.1
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	2.8	2.3	20

Total Phenols

Total Phenols (monohydric)	µg/l	1	ISO 17025	3.4	4.8	160
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Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	980
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	1.5
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	41
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	15
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	14
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	1.8
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	1.6
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	0.93
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	NONE	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	NONE	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	NONE	< 0.01	< 0.01	< 0.01

Total PAH

Total EPA-16 PAHs	µg/l	0.2	NONE	< 0.2	< 0.2	1100
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Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	1	ISO 17025	3.1	1.5	82
Cadmium (dissolved)	µg/l	0.08	ISO 17025	< 0.08	< 0.08	< 0.08
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0
Chromium (dissolved)	µg/l	0.4	ISO 17025	< 0.4	0.8	1.7
Copper (dissolved)	µg/l	0.7	ISO 17025	11	6.9	11
Lead (dissolved)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5	< 0.5	< 0.5
Nickel (dissolved)	µg/l	0.3	ISO 17025	3.0	3.8	3.0
Selenium (dissolved)	µg/l	4	ISO 17025	< 4.0	< 4.0	< 4.0
Zinc (dissolved)	µg/l	0.4	ISO 17025	5.1	9.2	34

Monoaromatics & Oxygenates

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



Analytical Report Number: 21-61519
Project / Site name: Castleton Sidings

Your Order No: 14768-EF-F

Lab Sample Number				1797167	1797168	1797169
Sample Reference				TP105	TP123	WS105
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				1.00	1.00	4.90
Date Sampled				04/02/2021	04/02/2021	04/02/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	Units	Limit of detection	Accreditation Status			

Petroleum Hydrocarbons

TPH1 (C10 - C40)	µg/l	10	NONE	< 10	< 10	4900
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TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	2500
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	1500
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	900
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	4900

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

Analytical Report Number : 21-61519
Project / Site name: Castleton Sidings

* 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 *
1797155	TP105	None Supplied	1	Brown loam with gravel.
1797156	TP106	None Supplied	1.6	Brown loam and clay with vegetation.
1797157	TP112	None Supplied	1.3	Black loam and sand with gravel and vegetation.
1797158	TP115	None Supplied	1	Black loam and sand with gravel and vegetation.
1797159	TP117	None Supplied	1	Brown gravelly loam.
1797160	TP121	None Supplied	1	Brown gravelly loam.
1797161	WS101	None Supplied	0.5	Brown loam with gravel and vegetation.
1797162	WS103	None Supplied	4.9	Brown sand.
1797163	WS104	None Supplied	3.2	Brown silt.**
1797164	WS105	None Supplied	4.9	Brown sand with vegetation.
1797165	WS106A	None Supplied	4.6	Brown sandy loam with vegetation.
1797166	WS107	None Supplied	2.1	Brown sandy loam.

**Non MCERTS Matrix

Analytical Report Number : 21-61519
Project / Site name: Castleton Sidings

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
BS EN 12457-1 (2:1) Leachate Prep	2:1 (as recieved, moisture adjusted) end over end extraction with water for 24 hours. Eluate filtered prior to analysis.	In-house method based on BSEN12457-1.	L043-PL	W	NONE
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion 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
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
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	NONE
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
pH at 20oC in leachate	Determination of pH in leachate by electrometric measurement.	In house method.	L005-PL	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 : 21-61519
Project / Site name: Castleton Sidings

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

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
Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds in soil by extraction in dichloromethane and hexane followed by GC-MS.	In-house method based on USEPA 8270	L064-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	NONE
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
BTEX and MTBE in leachates (Monoaromatics)	Determination of BTEX and MTBE in leachates by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	MCERTS
Speciated Mercury in soil by Millennium Merlin Ana	Determination of Speciated Mercury in soil by Millennium Merlin Analyzer	In-house method	L085-PL	Dry	NONE
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
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' analysis have been carried out in our laboratory in the United Kingdom.

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

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

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

Sample Deviation Report



Analytical Report Number : 21-61519
Project / Site name: Castleton Sidings

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
TP105	None Supplied	S	1797155	c	Semi-volatile organic compounds in soil	L064-PL	c
TP105	None Supplied	S	1797155	c	Volatile organic compounds in soil	L073B-PL	c
TP106	None Supplied	S	1797156	c	Hexavalent chromium in soil	L080-PL	c
TP106	None Supplied	S	1797156	c	Speciated EPA-16 PAHs in soil	L064-PL	c
TP106	None Supplied	S	1797156	c	TPH in (Soil)	L076-PL	c
TP106	None Supplied	S	1797156	c	Total cyanide in soil	L080-PL	c
TP112	None Supplied	S	1797157	c	Hexavalent chromium in soil	L080-PL	c
TP112	None Supplied	S	1797157	c	Monohydric phenols in soil	L080-PL	c
TP112	None Supplied	S	1797157	c	Speciated EPA-16 PAHs in soil	L064-PL	c
TP112	None Supplied	S	1797157	c	Sulphide in soil	L010-PL	c
TP112	None Supplied	S	1797157	c	TPH in (Soil)	L076-PL	c
TP112	None Supplied	S	1797157	c	Total cyanide in soil	L080-PL	c
TP112	None Supplied	S	1797157	c	pH in soil (automated)	L099-PL	c
TP115	None Supplied	S	1797158	c	Hexavalent chromium in soil	L080-PL	c
TP115	None Supplied	S	1797158	c	Monohydric phenols in soil	L080-PL	c
TP115	None Supplied	S	1797158	c	Speciated EPA-16 PAHs in soil	L064-PL	c
TP115	None Supplied	S	1797158	c	Sulphide in soil	L010-PL	c
TP115	None Supplied	S	1797158	c	TPH in (Soil)	L076-PL	c
TP115	None Supplied	S	1797158	c	Total cyanide in soil	L080-PL	c
TP115	None Supplied	S	1797158	c	pH in soil (automated)	L099-PL	c
TP117	None Supplied	S	1797159	c	Hexavalent chromium in soil	L080-PL	c
TP117	None Supplied	S	1797159	c	Monohydric phenols in soil	L080-PL	c
TP117	None Supplied	S	1797159	c	Speciated EPA-16 PAHs in soil	L064-PL	c
TP117	None Supplied	S	1797159	c	Sulphide in soil	L010-PL	c
TP117	None Supplied	S	1797159	c	TPH in (Soil)	L076-PL	c
TP117	None Supplied	S	1797159	c	Total cyanide in soil	L080-PL	c
TP117	None Supplied	S	1797159	c	pH in soil (automated)	L099-PL	c
TP121	None Supplied	S	1797160	c	Hexavalent chromium in soil	L080-PL	c
TP121	None Supplied	S	1797160	c	Speciated EPA-16 PAHs in soil	L064-PL	c
TP121	None Supplied	S	1797160	c	TPH in (Soil)	L076-PL	c
TP121	None Supplied	S	1797160	c	Total cyanide in soil	L080-PL	c
WS101	None Supplied	S	1797161	c	Hexavalent chromium in soil	L080-PL	c
WS101	None Supplied	S	1797161	c	Speciated EPA-16 PAHs in soil	L064-PL	c
WS101	None Supplied	S	1797161	c	TPH in (Soil)	L076-PL	c
WS101	None Supplied	S	1797161	c	Total cyanide in soil	L080-PL	c
WS103	None Supplied	S	1797162	c	Hexavalent chromium in soil	L080-PL	c
WS103	None Supplied	S	1797162	c	Speciated EPA-16 PAHs in soil	L064-PL	c
WS103	None Supplied	S	1797162	c	TPH in (Soil)	L076-PL	c
WS103	None Supplied	S	1797162	c	Total cyanide in soil	L080-PL	c
WS104	None Supplied	S	1797163	c	Hexavalent chromium in soil	L080-PL	c
WS104	None Supplied	S	1797163	c	Monohydric phenols in soil	L080-PL	c
WS104	None Supplied	S	1797163	c	Semi-volatile organic compounds in soil	L064-PL	c
WS104	None Supplied	S	1797163	c	Speciated EPA-16 PAHs in soil	L064-PL	c
WS104	None Supplied	S	1797163	c	Sulphide in soil	L010-PL	c
WS104	None Supplied	S	1797163	c	TPH in (Soil)	L076-PL	c
WS104	None Supplied	S	1797163	c	Total cyanide in soil	L080-PL	c
WS104	None Supplied	S	1797163	c	Volatile organic compounds in soil	L073B-PL	c
WS104	None Supplied	S	1797163	c	pH in soil (automated)	L099-PL	c
WS105	None Supplied	S	1797164	c	Hexavalent chromium in soil	L080-PL	c
WS105	None Supplied	S	1797164	c	Speciated EPA-16 PAHs in soil	L064-PL	c
WS105	None Supplied	S	1797164	c	TPH in (Soil)	L076-PL	c
WS105	None Supplied	S	1797164	c	Total cyanide in soil	L080-PL	c
WS106A	None Supplied	S	1797165	c	Hexavalent chromium in soil	L080-PL	c
WS106A	None Supplied	S	1797165	c	Speciated EPA-16 PAHs in soil	L064-PL	c
WS106A	None Supplied	S	1797165	c	TPH in (Soil)	L076-PL	c
WS106A	None Supplied	S	1797165	c	Total cyanide in soil	L080-PL	c
WS107	None Supplied	S	1797166	c	Hexavalent chromium in soil	L080-PL	c
WS107	None Supplied	S	1797166	c	Speciated EPA-16 PAHs in soil	L064-PL	c
WS107	None Supplied	S	1797166	c	TPH in (Soil)	L076-PL	c

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

Sample Deviation Report



Analytical Report Number : 21-61519
Project / Site name: Castleton Sidings

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
TP105	None Supplied	S	1797155	c	Semi-volatile organic compounds in soil	L064-PL	c
WS107	None Supplied	S	1797166	c	Total cyanide in soil	L080-PL	c



Jessica Sheridan

e3p
Taylor Road
Urmston
Manchester
M41 7JQ

e: jsheridan@e3p.co.uk

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

t: 01923 225404

f: 01923 237404

e: reception@i2analytical.com

Analytical Report Number : 21-61756

Project / Site name:	Castleton Sidings	Samples received on:	08/03/2021
Your job number:	14-768	Samples instructed on/ Analysis started on:	11/03/2021
Your order number:	14768-EF-F	Analysis completed by:	18/03/2021
Report Issue Number:	1	Report issued on:	18/03/2021
Samples Analysed:	3 soil samples		

Signed: *A. Czerwińska*

Agnieszka Czerwińska
Technical Reviewer (Reporting Team)
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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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: 21-61756
Project / Site name: Castleton Sidings
Your Order No: 14768-EF-F

Lab Sample Number				1798422	1798423	1798424
Sample Reference				TP108	TP116	WS104
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				1.00	1.20	4.30
Date Sampled				04/02/2021	05/02/2021	05/02/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status			
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	14	20	15
Total mass of sample received	kg	0.001	NONE	0.50	0.50	0.50

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.1	-	7.6
Total Cyanide	mg/kg	1	MCERTS	< 1.0	-	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	1300	-	190
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.081	-	0.029
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	160	-	58
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	81.4	-	28.8
Sulphide	mg/kg	1	MCERTS	18	-	12
Total Sulphur	mg/kg	50	MCERTS	890	-	490

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	1.2	13	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	0.30	0.49	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	0.57	14	0.45
Fluorene	mg/kg	0.05	MCERTS	0.42	9.8	0.70
Phenanthrene	mg/kg	0.05	MCERTS	4.6	85	0.98
Anthracene	mg/kg	0.05	MCERTS	1.3	13	0.13
Fluoranthene	mg/kg	0.05	MCERTS	8.0	75	0.41
Pyrene	mg/kg	0.05	MCERTS	7.7	77	0.33
Benzo(a)anthracene	mg/kg	0.05	MCERTS	4.9	32	< 0.05
Chrysene	mg/kg	0.05	MCERTS	4.0	32	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	5.4	32	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	2.3	11	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	4.4	27	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	2.3	11	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	2.8	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	3.6	15	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	50.8	451	3.00
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Analytical Report Number: 21-61756
Project / Site name: Castleton Sidings
Your Order No: 14768-EF-F

Lab Sample Number	1798422	1798423	1798424
Sample Reference	TP108	TP116	WS104
Sample Number	None Supplied	None Supplied	None Supplied
Depth (m)	1.00	1.20	4.30
Date Sampled	04/02/2021	05/02/2021	05/02/2021
Time Taken	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	52	42	3.8
Barium (aqua regia extractable)	mg/kg	1	MCERTS	-	220	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-	2.1	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-	0.4	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	-	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	35	29	10
Copper (aqua regia extractable)	mg/kg	1	MCERTS	500	280	17
Lead (aqua regia extractable)	mg/kg	1	MCERTS	340	730	6.6
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	2.8	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	66	51	12
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	94	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	610	310	38

Petroleum Hydrocarbons

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	6.3	25	< 2.0
TPH (C12 - C16)	mg/kg	4	MCERTS	18	100	< 4.0
TPH (C16 - C21)	mg/kg	1	MCERTS	51	230	< 1.0
TPH (C21 - C35)	mg/kg	1	MCERTS	280	270	< 1.0
TPH (C35 - C40)	mg/kg	10	MCERTS	84	33	< 10
TPH Total C5 - C40	mg/kg	10	MCERTS	450	690	< 10

VOCs

Chloromethane	µg/kg	1	ISO 17025	-	-	< 1.0
Chloroethane	µg/kg	1	NONE	-	-	< 1.0
Bromomethane	µg/kg	1	ISO 17025	-	-	< 1.0
Vinyl Chloride	µg/kg	1	NONE	-	-	< 1.0
Trichlorofluoromethane	µg/kg	1	NONE	-	-	< 1.0
1,1-Dichloroethene	µg/kg	1	NONE	-	-	< 1.0
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	1	ISO 17025	-	-	< 1.0
Cis-1,2-dichloroethene	µg/kg	1	MCERTS	-	-	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	-	< 1.0
1,1-Dichloroethane	µg/kg	1	MCERTS	-	-	< 1.0
2,2-Dichloropropane	µg/kg	1	MCERTS	-	-	< 1.0
Trichloromethane	µg/kg	1	MCERTS	-	-	< 1.0
1,1,1-Trichloroethane	µg/kg	1	MCERTS	-	-	< 1.0
1,2-Dichloroethane	µg/kg	1	MCERTS	-	-	< 1.0
1,1-Dichloropropene	µg/kg	1	MCERTS	-	-	< 1.0
Trans-1,2-dichloroethene	µg/kg	1	NONE	-	-	< 1.0
Benzene	µg/kg	1	MCERTS	-	-	< 1.0
Tetrachloromethane	µg/kg	1	MCERTS	-	-	< 1.0
1,2-Dichloropropane	µg/kg	1	MCERTS	-	-	< 1.0
Trichloroethene	µg/kg	1	MCERTS	-	-	< 1.0
Dibromomethane	µg/kg	1	MCERTS	-	-	< 1.0
Bromodichloromethane	µg/kg	1	MCERTS	-	-	< 1.0
Cis-1,3-dichloropropene	µg/kg	1	ISO 17025	-	-	< 1.0
Trans-1,3-dichloropropene	µg/kg	1	ISO 17025	-	-	< 1.0
Toluene	µg/kg	1	MCERTS	-	-	< 1.0

Analytical Report Number: 21-61756
Project / Site name: Castleton Sidings
Your Order No: 14768-EF-F

Lab Sample Number				1798422	1798423	1798424
Sample Reference				TP108	TP116	WS104
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				1.00	1.20	4.30
Date Sampled				04/02/2021	05/02/2021	05/02/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status			
1,1,2-Trichloroethane	µg/kg	1	MCERTS	-	-	< 1.0
1,3-Dichloropropane	µg/kg	1	ISO 17025	-	-	< 1.0
Dibromochloromethane	µg/kg	1	ISO 17025	-	-	< 1.0
Tetrachloroethene	µg/kg	1	NONE	-	-	< 1.0
1,2-Dibromoethane	µg/kg	1	ISO 17025	-	-	< 1.0
Chlorobenzene	µg/kg	1	MCERTS	-	-	< 1.0
1,1,1,2-Tetrachloroethane	µg/kg	1	MCERTS	-	-	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	-	-	< 1.0
p & m-Xylene	µg/kg	1	MCERTS	-	-	< 1.0
Styrene	µg/kg	1	MCERTS	-	-	< 1.0
Tribromomethane	µg/kg	1	NONE	-	-	< 1.0
o-Xylene	µg/kg	1	MCERTS	-	-	< 1.0
1,1,2,2-Tetrachloroethane	µg/kg	1	MCERTS	-	-	< 1.0
Isopropylbenzene	µg/kg	1	MCERTS	-	-	< 1.0
Bromobenzene	µg/kg	1	MCERTS	-	-	< 1.0
n-Propylbenzene	µg/kg	1	ISO 17025	-	-	< 1.0
2-Chlorotoluene	µg/kg	1	MCERTS	-	-	< 1.0
4-Chlorotoluene	µg/kg	1	MCERTS	-	-	< 1.0
1,3,5-Trimethylbenzene	µg/kg	1	ISO 17025	-	-	< 1.0
tert-Butylbenzene	µg/kg	1	MCERTS	-	-	< 1.0
1,2,4-Trimethylbenzene	µg/kg	1	ISO 17025	-	-	< 1.0
sec-Butylbenzene	µg/kg	1	MCERTS	-	-	< 1.0
1,3-Dichlorobenzene	µg/kg	1	ISO 17025	-	-	< 1.0
p-Isopropyltoluene	µg/kg	1	ISO 17025	-	-	< 1.0
1,2-Dichlorobenzene	µg/kg	1	MCERTS	-	-	< 1.0
1,4-Dichlorobenzene	µg/kg	1	MCERTS	-	-	< 1.0
Butylbenzene	µg/kg	1	MCERTS	-	-	< 1.0
1,2-Dibromo-3-chloropropane	µg/kg	1	ISO 17025	-	-	< 1.0
1,2,4-Trichlorobenzene	µg/kg	1	MCERTS	-	-	< 1.0
Hexachlorobutadiene	µg/kg	1	MCERTS	-	-	< 1.0
1,2,3-Trichlorobenzene	µg/kg	1	ISO 17025	-	-	< 1.0

SVOCs

Aniline	mg/kg	0.1	NONE	-	-	< 0.1
Phenol	mg/kg	0.2	ISO 17025	-	-	< 0.2
2-Chlorophenol	mg/kg	0.1	MCERTS	-	-	< 0.1
Bis(2-chloroethyl)ether	mg/kg	0.2	MCERTS	-	-	< 0.2
1,3-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-	< 0.2
1,2-Dichlorobenzene	mg/kg	0.1	MCERTS	-	-	< 0.1
1,4-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-	< 0.2
Bis(2-chloroisopropyl)ether	mg/kg	0.1	MCERTS	-	-	< 0.1
2-Methylphenol	mg/kg	0.3	MCERTS	-	-	< 0.3
Hexachloroethane	mg/kg	0.05	MCERTS	-	-	< 0.05
Nitrobenzene	mg/kg	0.3	MCERTS	-	-	< 0.3
4-Methylphenol	mg/kg	0.2	NONE	-	-	< 0.2
Isophorone	mg/kg	0.2	MCERTS	-	-	< 0.2
2-Nitrophenol	mg/kg	0.3	MCERTS	-	-	< 0.3
2,4-Dimethylphenol	mg/kg	0.3	MCERTS	-	-	< 0.3
Bis(2-chloroethoxy)methane	mg/kg	0.3	MCERTS	-	-	< 0.3
1,2,4-Trichlorobenzene	mg/kg	0.3	MCERTS	-	-	< 0.3
Naphthalene	mg/kg	0.05	MCERTS	-	-	< 0.05
2,4-Dichlorophenol	mg/kg	0.3	MCERTS	-	-	< 0.3
4-Chloroaniline	mg/kg	0.1	NONE	-	-	< 0.1

Analytical Report Number: 21-61756
Project / Site name: Castleton Sidings
Your Order No: 14768-EF-F

Lab Sample Number				1798422	1798423	1798424
Sample Reference				TP108	TP116	WS104
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				1.00	1.20	4.30
Date Sampled				04/02/2021	05/02/2021	05/02/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status			
Hexachlorobutadiene	mg/kg	0.1	MCERTS	-	-	< 0.1
4-Chloro-3-methylphenol	mg/kg	0.1	NONE	-	-	< 0.1
2,4,6-Trichlorophenol	mg/kg	0.1	MCERTS	-	-	< 0.1
2,4,5-Trichlorophenol	mg/kg	0.2	MCERTS	-	-	< 0.2
2-Methylnaphthalene	mg/kg	0.1	NONE	-	-	2.4
2-Chloronaphthalene	mg/kg	0.1	MCERTS	-	-	< 0.1
Dimethylphthalate	mg/kg	0.1	MCERTS	-	-	< 0.1
2,6-Dinitrotoluene	mg/kg	0.1	MCERTS	-	-	< 0.1
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	-	-	0.45
2,4-Dinitrotoluene	mg/kg	0.2	MCERTS	-	-	< 0.2
Dibenzofuran	mg/kg	0.2	MCERTS	-	-	< 0.2
4-Chlorophenyl phenyl ether	mg/kg	0.3	ISO 17025	-	-	< 0.3
Diethyl phthalate	mg/kg	0.2	MCERTS	-	-	< 0.2
4-Nitroaniline	mg/kg	0.2	MCERTS	-	-	< 0.2
Fluorene	mg/kg	0.05	MCERTS	-	-	0.70
Azobenzene	mg/kg	0.3	MCERTS	-	-	< 0.3
Bromophenyl phenyl ether	mg/kg	0.2	MCERTS	-	-	< 0.2
Hexachlorobenzene	mg/kg	0.3	MCERTS	-	-	< 0.3
Phenanthrene	mg/kg	0.05	MCERTS	-	-	0.98
Anthracene	mg/kg	0.05	MCERTS	-	-	0.13
Carbazole	mg/kg	0.3	MCERTS	-	-	< 0.3
Dibutyl phthalate	mg/kg	0.2	MCERTS	-	-	< 0.2
Anthraquinone	mg/kg	0.3	MCERTS	-	-	< 0.3
Fluoranthene	mg/kg	0.05	MCERTS	-	-	0.41
Pyrene	mg/kg	0.05	MCERTS	-	-	0.33
Butyl benzyl phthalate	mg/kg	0.3	ISO 17025	-	-	< 0.3
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-	< 0.05
Chrysene	mg/kg	0.05	MCERTS	-	-	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	-	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	-	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	< 0.05

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

Analytical Report Number : 21-61756
Project / Site name: Castleton Sidings

* 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 *
1798422	TP108	None Supplied	1	Brown loam and clay with gravel.
1798423	TP116	None Supplied	1.2	Brown loam and clay with gravel.
1798424	WS104	None Supplied	4.3	Brown sandy loam with gravel.

Analytical Report Number : 21-61756
Project / Site name: Castleton Sidings

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

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
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	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 soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazine followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
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 soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
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 SO ₄ in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds in soil by extraction in dichloromethane and hexane followed by GC-MS.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
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
Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
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

Analytical Report Number : 21-61756
Project / Site name: Castleton Sidings

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

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

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

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

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

Sample Deviation Report



Analytical Report Number : 21-61756
Project / Site name: Castleton Sidings

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
TP108	None Supplied	S	1798422	c	Hexavalent chromium in soil	L080-PL	c
TP108	None Supplied	S	1798422	c	Monohydric phenols in soil	L080-PL	c
TP108	None Supplied	S	1798422	c	Speciated EPA-16 PAHs in soil	L064-PL	c
TP108	None Supplied	S	1798422	c	Sulphide in soil	L010-PL	c
TP108	None Supplied	S	1798422	c	TPH in (Soil)	L076-PL	c
TP108	None Supplied	S	1798422	c	Total cyanide in soil	L080-PL	c
TP108	None Supplied	S	1798422	c	pH in soil (automated)	L099-PL	c
TP116	None Supplied	S	1798423	c	Speciated EPA-16 PAHs in soil	L064-PL	c
TP116	None Supplied	S	1798423	c	TPH in (Soil)	L076-PL	c
WS104	None Supplied	S	1798424	c	Hexavalent chromium in soil	L080-PL	c
WS104	None Supplied	S	1798424	c	Monohydric phenols in soil	L080-PL	c
WS104	None Supplied	S	1798424	c	Semi-volatile organic compounds in soil	L064-PL	c
WS104	None Supplied	S	1798424	c	Speciated EPA-16 PAHs in soil	L064-PL	c
WS104	None Supplied	S	1798424	c	Sulphide in soil	L010-PL	c
WS104	None Supplied	S	1798424	c	TPH in (Soil)	L076-PL	c
WS104	None Supplied	S	1798424	c	Total cyanide in soil	L080-PL	c
WS104	None Supplied	S	1798424	c	Volatile organic compounds in soil	L073B-PL	c
WS104	None Supplied	S	1798424	c	pH in soil (automated)	L099-PL	c



Jessica Sheridan

e3p
Taylor Road
Urmston
Manchester
M41 7JQ

e: jsheridan@e3p.co.uk

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

t: 01923 225404

f: 01923 237404

e: reception@i2analytical.com

Analytical Report Number : 21-65250

Project / Site name:	Castleton Sidings	Samples received on:	26/03/2021
Your job number:	14-268	Samples instructed on/ Analysis started on:	26/03/2021
Your order number:	14768-EF-M	Analysis completed by:	01/04/2021
Report Issue Number:	1	Report issued on:	01/04/2021
Samples Analysed:	1 soil sample		

Signed: *A. Czerwińska*

Agnieszka Czerwińska
Technical Reviewer (Reporting Team)
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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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: 21-65250
Project / Site name: Castleton Sidings
Your Order No: 14768-EF-M

Lab Sample Number				1818055
Sample Reference				TP124
Sample Number				None Supplied
Depth (m)				1.00
Date Sampled				05/02/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	
Stone Content	%	0.1	NONE	< 0.1
Moisture Content	%	0.01	NONE	11
Total mass of sample received	kg	0.001	NONE	0.40

PCBs by GC-MS

PCB Congener 28	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 52	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 101	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 118	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 138	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 153	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 180	mg/kg	0.001	MCERTS	< 0.001

Total PCBs by GC-MS

Total PCBs	mg/kg	0.007	MCERTS	< 0.007
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U/S = Unsuitable Sample I/S = Insufficient Sample



Analytical Report Number : 21-65250
Project / Site name: Castleton Sidings

* 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 *
1818055	TP124	None Supplied	1	Brown loam and sand with gravel and vegetation.

Analytical Report Number : 21-65250
Project / Site name: Castleton Sidings

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
PCB's By GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE

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

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

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

Sample Deviation Report



Analytical Report Number : 21-65250
Project / Site name: Castleton Sidings

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
TP124	None Supplied	S	1818055	c	PCB's By GC-MS in soil	L027-PL	c



Jessica Sheridan

e3p
Taylor Road
Urmston
Manchester
M41 7JQ

e: jsheridan@e3p.co.uk

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

t: 01923 225404

f: 01923 237404

e: reception@i2analytical.com

Analytical Report Number : 21-89221

Project / Site name:	Castleton Sidings	Samples received on:	26/07/2021
Your job number:	14 760	Samples instructed on/ Analysis started on:	26/07/2021
Your order number:		Analysis completed by:	02/08/2021
Report Issue Number:	1	Report issued on:	02/08/2021
Samples Analysed:	5 soil samples		

Signed:

Joanna Wawrzeczko
Technical Reviewer (Reporting Team)
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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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: 21-89221
Project / Site name: Castleton Sidings

Lab Sample Number				1951814	1951815	1951816	1951817	1951818
Sample Reference				RO203	RO206	RO201	RO210	RO228
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				6.00	6.00	7.00	7.00	7.00
Date Sampled				23/07/2021	23/07/2021	23/07/2021	23/07/2021	23/07/2021
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	4.4	10	9.5	69	79
Total mass of sample received	kg	0.001	NONE	0.40	0.50	0.20	0.80	0.70

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
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General Inorganics

pH - Manual	pH Units	N/A	MCERTS	-	-	-	4.8	-
pH - Automated	pH Units	N/A	MCERTS	6.6	7.0	7.1	-	U/S*
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	190	330	160	1400	860
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.014	0.051	0.024	0.11	0.053
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	28	100	48	210	110
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	13.8	50.9	24.1	106	52.8
Sulphide	mg/kg	1	MCERTS	< 1.0	1.4	< 1.0	5.7	< 1.0
Total Sulphur	mg/kg	50	MCERTS	150	340	69	2600	3500

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	1.2	1.3
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	1.0	0.66
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	0.26	0.27
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.22	0.27
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	0.45	< 0.05	< 0.05	0.56
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.28
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.44	< 0.05	0.33	0.39
Pyrene	mg/kg	0.05	MCERTS	< 0.05	0.46	< 0.05	0.30	0.40
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	1.35	< 0.80	2.11	2.83
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	3.3	10	3.5	5.0	5.0
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	0.3	< 0.2	0.7	0.3
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	16	11	9.4	12	5.0
Copper (aqua regia extractable)	mg/kg	1	MCERTS	16	46	11	25	13
Lead (aqua regia extractable)	mg/kg	1	MCERTS	10	39	5.2	22	10
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	18	15	9.4	12	6.6
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	51	52	37	64	28

Analytical Report Number: 21-89221
Project / Site name: Castleton Sidings

Lab Sample Number				1951814	1951815	1951816	1951817	1951818
Sample Reference				RO203	RO206	RO201	RO210	RO228
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				6.00	6.00	7.00	7.00	7.00
Date Sampled				23/07/2021	23/07/2021	23/07/2021	23/07/2021	23/07/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					

Petroleum Hydrocarbons

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	20	< 4.0
TPH (C16 - C21)	mg/kg	1	MCERTS	6.5	10	< 1.0	36	29
TPH (C21 - C35)	mg/kg	1	MCERTS	45	140	< 1.0	420	440
TPH (C35 - C40)	mg/kg	10	MCERTS	15	18	< 10	66	66
TPH Total C5 - C40	mg/kg	10	MCERTS	66	160	< 10	540	540

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

*U/S - Unsuitable for analysis, samples absorbed all water used for extraction.

Analytical Report Number : 21-89221
Project / Site name: Castleton Sidings

* 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 *
1951814	RO203	None Supplied	6	Brown loam and clay with gravel.
1951815	RO206	None Supplied	6	Brown sand with gravel.
1951816	RO201	None Supplied	7	Brown sand with gravel.
1951817	RO210	None Supplied	7	3.21.3.19
1951818	RO228	None Supplied	7	3.21.3.19

Analytical Report Number : 21-89221
Project / Site name: Castleton Sidings

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazine followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
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 soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
pH at 20oC in soil	Determination of pH in soil by addition of water followed by electrometric measurement.	In house method.	L005-PL	W	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-PL	D	MCERTS
Total sulphate (as SO ₄ in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
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
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
Sulphate, water soluble, in soil (1hr extraction)	Sulphate, water soluble, in soil (1hr extraction)	In-house method	L038-PL	D	MCERTS



Analytical Report Number : 21-89221
Project / Site name: Castleton Sidings

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

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

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

Jessica Sheridan

e3p
Taylor Road
Urmston
Manchester
M41 7JQ

e: jsheridan@e3p.co.uk

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

t: 01923 225404

f: 01923 237404

e: reception@i2analytical.com

Analytical Report Number : 21-88541

Project / Site name:	Castleton 14 768	Samples received on:	21/07/2021
Your job number:	14 768	Samples instructed on/ Analysis started on:	22/07/2021
Your order number:	14768 JS Q	Analysis completed by:	29/07/2021
Report Issue Number:	1	Report issued on:	29/07/2021
Samples Analysed:	10 soil samples		

Signed:



Joanna Wawrzeczko
Technical Reviewer (Reporting Team)
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

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

Analytical Report Number: 21-88541
 Project / Site name: Castleton 14 768
 Your Order No: 14768 JS Q

Lab Sample Number				1947515	1947516	1947517	1947518	1947519
Sample Reference				HP101	HP102	HP103	HP104	HP105
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.60	0.70	0.80	0.50	0.70
Date Sampled				20/07/2021	20/07/2021	20/07/2021	20/07/2021	20/07/2021
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	13	17	11	6.8	20
Total mass of sample received	kg	0.001	NONE	0.40	0.40	0.40	0.40	0.30

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.0	7.0	8.5	11.3	8.0
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO4	mg/kg	50	MCERTS	530	2800	210	3600	1200
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.024	0.077	0.031	0.062	0.050
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	49	150	62	120	99
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	24.4	77.4	31.2	62.2	49.6
Sulphide	mg/kg	1	MCERTS	1.9	4.7	3.6	200	9.3
Total Sulphur	mg/kg	50	MCERTS	450	1300	110	1800	910

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	0.36	0.59	< 0.05	1.6	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	0.31	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	0.38	< 0.05	0.37	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	0.26	< 0.05	0.31	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	1.4	3.4	< 0.05	3.5	0.46
Anthracene	mg/kg	0.05	MCERTS	0.37	0.99	< 0.05	0.73	0.11
Fluoranthene	mg/kg	0.05	MCERTS	2.4	6.6	< 0.05	3.7	0.38
Pyrene	mg/kg	0.05	MCERTS	2.3	6.9	< 0.05	3.8	0.43
Benzo(a)anthracene	mg/kg	0.05	MCERTS	1.7	4.8	< 0.05	2.5	0.33
Chrysene	mg/kg	0.05	MCERTS	1.4	4.2	< 0.05	2.1	0.29
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	1.9	4.8	< 0.05	2.6	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.66	3.1	< 0.05	0.79	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	1.5	4.3	< 0.05	2.2	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.76	2.3	< 0.05	1.1	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.21	0.76	< 0.05	0.37	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.96	3.0	< 0.05	1.5	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	16.0	46.6	< 0.80	27.2	2.00
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	28	74	9.3	31	21
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	0.4	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	30	55	25	26	10
Copper (aqua regia extractable)	mg/kg	1	MCERTS	120	340	26	270	69
Lead (aqua regia extractable)	mg/kg	1	MCERTS	310	860	36	810	99
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	4.7	< 0.3	1.9	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	39	73	29	29	34
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	230	470	69	310	68

Analytical Report Number: 21-88541
 Project / Site name: Castleton 14 768
 Your Order No: 14768 JS Q

Lab Sample Number				1947515	1947516	1947517	1947518	1947519
Sample Reference				HP101	HP102	HP103	HP104	HP105
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.60	0.70	0.80	0.50	0.70
Date Sampled				20/07/2021	20/07/2021	20/07/2021	20/07/2021	20/07/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					

Petroleum Hydrocarbons

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0	20	< 4.0	8.5	< 4.0
TPH (C16 - C21)	mg/kg	1	MCERTS	44	93	< 1.0	38	< 1.0
TPH (C21 - C35)	mg/kg	1	MCERTS	150	280	< 1.0	260	< 1.0
TPH (C35 - C40)	mg/kg	10	MCERTS	< 10	42	< 10	34	< 10
TPH Total C5 - C40	mg/kg	10	MCERTS	190	440	< 10	340	< 10

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

Analytical Report Number: 21-88541
 Project / Site name: Castleton 14 768
 Your Order No: 14768 JS Q

Lab Sample Number				1947520	1947521	1947522	1947523	1947524
Sample Reference				HP106	HP107	SP101	SP102	SP103
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.50	0.70	None Supplied	None Supplied	None Supplied
Date Sampled				20/07/2021	20/07/2021	20/07/2021	20/07/2021	20/07/2021
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	56
Moisture Content	%	0.01	NONE	11	1.7	5.3	1.6	4.3
Total mass of sample received	kg	0.001	NONE	0.40	0.40	0.40	0.40	0.40

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.3	8.5	9.8	10.8	8.0
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO4	mg/kg	50	MCERTS	990	430	3100	3000	2800
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.049	0.033	0.36	0.10	0.80
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	99	65	710	200	1600
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	49.4	32.5	357	100	801
Sulphide	mg/kg	1	MCERTS	25	52	2300	61	16
Total Sulphur	mg/kg	50	MCERTS	820	320	5300	1400	1200

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	0.38	0.34	0.65	< 0.05	2.3
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	0.58	< 0.05	0.67
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.42	< 0.05	0.58
Phenanthrene	mg/kg	0.05	MCERTS	1.1	0.80	3.8	0.97	5.5
Anthracene	mg/kg	0.05	MCERTS	0.29	0.28	0.91	0.25	1.6
Fluoranthene	mg/kg	0.05	MCERTS	1.7	1.1	5.3	1.8	7.7
Pyrene	mg/kg	0.05	MCERTS	1.6	1.2	5.0	1.8	7.6
Benzo(a)anthracene	mg/kg	0.05	MCERTS	1.2	0.80	3.2	1.4	6.0
Chrysene	mg/kg	0.05	MCERTS	1.0	0.64	2.6	1.1	5.1
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	1.1	0.95	3.5	1.4	6.2
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.34	0.35	1.1	1.0	2.0
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.65	0.66	2.8	1.5	5.1
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.34	0.38	1.4	0.74	2.6
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.39	0.23	0.76
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.41	0.44	1.7	0.97	3.2

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	10.0	7.91	33.3	13.2	56.9
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	20	12	15	5.5	16
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	0.5	< 0.2	0.5	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	31	24	37	20	27
Copper (aqua regia extractable)	mg/kg	1	MCERTS	170	77	75	22	260
Lead (aqua regia extractable)	mg/kg	1	MCERTS	93	62	85	37	390
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	4.4
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	77	20	20	16	26
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	140	86	130	62	240

Analytical Report Number: 21-88541
 Project / Site name: Castleton 14 768
 Your Order No: 14768 JS Q

Lab Sample Number				1947520	1947521	1947522	1947523	1947524
Sample Reference				HP106	HP107	SP101	SP102	SP103
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.50	0.70	None Supplied	None Supplied	None Supplied
Date Sampled				20/07/2021	20/07/2021	20/07/2021	20/07/2021	20/07/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Petroleum Hydrocarbons								
TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	5.0
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0	< 4.0	8.0	< 4.0	8.7
TPH (C16 - C21)	mg/kg	1	MCERTS	< 1.0	19	38	11	18
TPH (C21 - C35)	mg/kg	1	MCERTS	< 1.0	53	92	140	41
TPH (C35 - C40)	mg/kg	10	MCERTS	< 10	< 10	14	70	12
TPH Total C5 - C40	mg/kg	10	MCERTS	< 10	72	150	220	85

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

Analytical Report Number : 21-88541
Project / Site name: Castleton 14 768

* 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 *
1947515	HP101	None Supplied	0.6	Brown loam and sand with vegetation and gravel.
1947516	HP102	None Supplied	0.7	Brown loam and sand with vegetation and gravel.
1947517	HP103	None Supplied	0.8	Brown clay and sand.
1947518	HP104	None Supplied	0.5	Brown loam and sand with vegetation and gravel.
1947519	HP105	None Supplied	0.7	Grey sand with clinker.
1947520	HP106	None Supplied	0.5	Brown sand with clinker.
1947521	HP107	None Supplied	0.7	Brown sand with glass and gravel
1947522	SP101	None Supplied	None Supplied	Brown loam and sand with vegetation and gravel.
1947523	SP102	None Supplied	None Supplied	Light brown sand with vegetation and rubble.
1947524	SP103	None Supplied	None Supplied	Brown loam and sand with vegetation and stones.

Analytical Report Number : 21-88541
Project / Site name: Castleton 14 768

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

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
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
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 soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
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 SO ₄ in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
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
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
Sulphate, water soluble, in soil (1hr extraction)	Sulphate, water soluble, in soil (1hr extraction)	In-house method	L038-PL	D	MCERTS

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

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

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



Analytical Report Number : 21-88541
Project / Site name: Castleton 14 768

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

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



Jessica Sheridan

e3p
Taylor Road
Urmston
Manchester
M41 7JQ

e: jsheridan@e3p.co.uk

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

t: 01923 225404

f: 01923 237404

e: reception@i2analytical.com

Analytical Report Number : 21-81884

Project / Site name:	Castleton Sidings	Samples received on:	16/06/2021
Your job number:	14-268	Samples instructed on/ Analysis started on:	18/06/2021
Your order number:	14768-J5-O	Analysis completed by:	28/06/2021
Report Issue Number:	1	Report issued on:	28/06/2021
Samples Analysed:	6 soil samples		

Signed:

Joanna Wawrzeczko
Technical Reviewer (Reporting Team)
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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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: 21-81884
 Project / Site name: Castleton Sidings
 Your Order No: 14768-J5-O

Lab Sample Number				1907681	1907682	1907683	1907684	1907685
Sample Reference				TP201	TP205	TP207	TP211	TP211
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.60	0.70	0.60	0.70	1.90
Date Sampled				15/06/2021	15/06/2021	15/06/2021	15/06/2021	15/06/2021
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	6.9	8.7	12	4.6	19
Total mass of sample received	kg	0.001	NONE	0.40	0.40	0.40	0.40	0.40

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.5	8.3	7.2	8.2	7.0
Total Cyanide	mg/kg	1	MCERTS	2.6	< 1.0	< 1.0	< 1.0	75
Total Sulphate as SO ₄	mg/kg	50	MCERTS	2400	770	2500	1300	1800
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.019	0.052	0.76	0.090	0.46
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	39	100	1500	180	920
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	19.3	51.8	758	90.1	460
Sulphide	mg/kg	1	MCERTS	22	26	39	21	190
Total Sulphur	mg/kg	50	MCERTS	1400	610	2800	900	6000

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	15
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	13	< 0.05	2.9	110	10000*
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	1400
Acenaphthene	mg/kg	0.05	MCERTS	2.0	0.48	1.5	31	4300
Fluorene	mg/kg	0.05	MCERTS	1.2	< 0.05	1.2	28	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	32	2.4	5.5	76	8700*
Anthracene	mg/kg	0.05	MCERTS	4.4	0.88	2.0	25	2700
Fluoranthene	mg/kg	0.05	MCERTS	41	2.6	6.0	24	2200
Pyrene	mg/kg	0.05	MCERTS	39	2.6	5.9	19	1500
Benzo(a)anthracene	mg/kg	0.05	MCERTS	28	1.4	4.0	6.2	210
Chrysene	mg/kg	0.05	MCERTS	22	1.4	3.4	4.3	190
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	25	1.5	3.8	3.5	54
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	13	0.76	2.5	2.3	38
Benzo(a)pyrene	mg/kg	0.05	MCERTS	24	1.3	4.2	3.1	48
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	9.9	0.59	1.6	1.1	9.8
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	3.3	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	13	0.92	2.1	1.5	10

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	271	16.8	46.5	337	31400
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	72	27	110	54	120
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	21	18	33	80	32
Copper (aqua regia extractable)	mg/kg	1	MCERTS	610	170	520	340	300
Lead (aqua regia extractable)	mg/kg	1	MCERTS	2100	320	510	210	270
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	17	< 0.3	3.3	< 0.3	5.8
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	46	32	52	62	54
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	450	200	310	230	450

Analytical Report Number: 21-81884
Project / Site name: Castleton Sidings
Your Order No: 14768-J5-O

Lab Sample Number				1907681	1907682	1907683	1907684	1907685
Sample Reference				TP201	TP205	TP207	TP211	TP211
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.60	0.70	0.60	0.70	1.90
Date Sampled				15/06/2021	15/06/2021	15/06/2021	15/06/2021	15/06/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					

Petroleum Hydrocarbons

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	15
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	80
TPH (C10 - C12)	mg/kg	2	MCERTS	17	< 2.0	3.0	120	11000
TPH (C12 - C16)	mg/kg	4	MCERTS	290	5.6	9.3	59	7800
TPH (C16 - C21)	mg/kg	1	MCERTS	1600	13	23	130	20000
TPH (C21 - C35)	mg/kg	1	MCERTS	2900	38	52	89	3300
TPH (C35 - C40)	mg/kg	10	MCERTS	470	< 10	< 10	< 10	< 10
TPH Total C5 - C40	mg/kg	10	MCERTS	5300	56	87	400	43000

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

*Over range data, sample was diluted and results are estimated from an extrapolated calibration. Results should be interpreted with care.

Analytical Report Number: 21-81884
 Project / Site name: Castleton Sidings
 Your Order No: 14768-J5-O

Lab Sample Number				1907686
Sample Reference				TP213
Sample Number				None Supplied
Depth (m)				0.60
Date Sampled				15/06/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	
Stone Content	%	0.1	NONE	< 0.1
Moisture Content	%	0.01	NONE	10
Total mass of sample received	kg	0.001	NONE	0.40

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.6
Total Cyanide	mg/kg	1	MCERTS	20
Total Sulphate as SO ₄	mg/kg	50	MCERTS	1900
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.092
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	180
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	92.0
Sulphide	mg/kg	1	MCERTS	8.3
Total Sulphur	mg/kg	50	MCERTS	1200

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	9.3
Acenaphthylene	mg/kg	0.05	MCERTS	1.8
Acenaphthene	mg/kg	0.05	MCERTS	5.2
Fluorene	mg/kg	0.05	MCERTS	4.8
Phenanthrene	mg/kg	0.05	MCERTS	24
Anthracene	mg/kg	0.05	MCERTS	8.5
Fluoranthene	mg/kg	0.05	MCERTS	36
Pyrene	mg/kg	0.05	MCERTS	41
Benzo(a)anthracene	mg/kg	0.05	MCERTS	27
Chrysene	mg/kg	0.05	MCERTS	21
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	24
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	14
Benzo(a)pyrene	mg/kg	0.05	MCERTS	24
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	9.6
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	3.2
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	12

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	265
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	99
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	32
Copper (aqua regia extractable)	mg/kg	1	MCERTS	740
Lead (aqua regia extractable)	mg/kg	1	MCERTS	2500
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	13
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	44
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	580

Analytical Report Number: 21-81884
Project / Site name: Castleton Sidings
Your Order No: 14768-J5-0

Lab Sample Number				1907686
Sample Reference				TP213
Sample Number				None Supplied
Depth (m)				0.60
Date Sampled				15/06/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	
Petroleum Hydrocarbons				
TPH (C5 - C6)	mg/kg	1	NONE	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	11
TPH (C12 - C16)	mg/kg	4	MCERTS	51
TPH (C16 - C21)	mg/kg	1	MCERTS	290
TPH (C21 - C35)	mg/kg	1	MCERTS	520
TPH (C35 - C40)	mg/kg	10	MCERTS	37
TPH Total C5 - C40	mg/kg	10	MCERTS	910

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

*Over range data, sample was diluted and results are estimated from an extrapolated calibration. Results should be interpreted with care.

Analytical Report Number : 21-81884
Project / Site name: Castleton Sidings

* 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 *
1907681	TP201	None Supplied	0.6	Brown sand with gravel.
1907682	TP205	None Supplied	0.7	Brown sand with brick and rubble.
1907683	TP207	None Supplied	0.6	Brown sand with glass and gravel
1907684	TP211	None Supplied	0.7	Brown sand with gravel and vegetation.
1907685	TP211	None Supplied	1.9	Black clay and sand with gravel and oil / petroleum.
1907686	TP213	None Supplied	0.6	Brown sand with gravel and vegetation.

Analytical Report Number : 21-81884
Project / Site name: Castleton Sidings

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazine followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
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 soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
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 SO ₄ in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
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
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
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



Analytical Report Number : 21-81884
Project / Site name: Castleton Sidings

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

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

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

**Info**

e3p
Taylor Road
Urmston
Manchester
M41 7JQ

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

t: 01923 225404

f: 01923 237404

e: reception@i2analytical.com

e: info@e3p.co.uk

Analytical Report Number : 21-64864

Project / Site name:	Castleton	Samples received on:	24/03/2021
Your job number:	14768	Samples instructed on/ Analysis started on:	24/03/2021
Your order number:	14768 55 L	Analysis completed by:	31/03/2021
Report Issue Number:	1	Report issued on:	31/03/2021
Samples Analysed:	3 water samples		

Signed:

Rachel Bradley
Deputy Quality Manager
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

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



Analytical Report Number: 21-64864

Project / Site name: Castleton

Your Order No: 14768 55 L

Lab Sample Number				1815818	1815819	1815820
Sample Reference				WS101	WS105	WS110
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied
Date Sampled				Deviating	Deviating	Deviating
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status			

General Inorganics

pH	pH Units	N/A	ISO 17025	7.4	6.6	7.0
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	< 1.0	6.3	6.1
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	2.42	13.4	4.84

Total Phenols

Total Phenols (monohydric)	µg/l	1	ISO 17025	< 1.0	160	< 1.0
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Heavy Metals / Metalloids

Calcium (dissolved)	mg/l	0.012	ISO 17025	73	130	170
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0

Arsenic (dissolved)	µg/l	0.15	ISO 17025	0.62	19.2	0.55
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.04	< 0.02	0.07
Chromium (dissolved)	µg/l	0.2	ISO 17025	4.7	2.7	2.7
Copper (dissolved)	µg/l	0.5	ISO 17025	3.0	1.0	5.9
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2	1.0
Manganese (dissolved)	µg/l	0.05	ISO 17025	410	1700	230
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	3.0	7.0	4.2
Selenium (dissolved)	µg/l	0.6	ISO 17025	< 0.6	< 0.6	1.7
Zinc (dissolved)	µg/l	0.5	ISO 17025	13	13	13

Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	11.3	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	43.7	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	73.3	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	143	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	53.8	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0



Analytical Report Number: 21-64864

Project / Site name: Castleton

Your Order No: 14768 55 L

Lab Sample Number				1815818	1815819	1815820
Sample Reference				WS101	WS105	WS110
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied
Date Sampled				Deviating	Deviating	Deviating
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status			

Petroleum Hydrocarbons

TPH1 (C10 - C40)	µg/l	10	NONE	< 10	13000	< 10
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TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	11	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	44	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	370	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	5800	< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	4300	< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	2500	< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	13000	< 10

VOCs

Chloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Chloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Bromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Vinyl Chloride	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Trichlorofluoromethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
1,1-Dichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Cis-1,2-dichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
2,2-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Trichloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Trans-1,2-dichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Benzene	µg/l	1	ISO 17025	< 1.0	11.3	< 1.0
Tetrachloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Trichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Dibromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Bromodichloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Cis-1,3-dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Trans-1,3-dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	43.7	< 1.0
1,1,2-Trichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Dibromochloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Tetrachloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2-Dibromoethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Chlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0



Analytical Report Number: 21-64864

Project / Site name: Castleton

Your Order No: 14768 55 L

Lab Sample Number				1815818	1815819	1815820
Sample Reference				WS101	WS105	WS110
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied
Date Sampled				Deviating	Deviating	Deviating
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status			
1,1,1,2-Tetrachloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	73.3	< 1.0
p & m-Xylene	µg/l	1	ISO 17025	< 1.0	143	< 1.0
Styrene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Tribromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
o-Xylene	µg/l	1	ISO 17025	< 1.0	53.8	< 1.0
1,1,2,2-Tetrachloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Isopropylbenzene	µg/l	1	ISO 17025	< 1.0	4.8	< 1.0
Bromobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
n-Propylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
2-Chlorotoluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
4-Chlorotoluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	µg/l	1	ISO 17025	< 1.0	32.9	< 1.0
tert-Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	µg/l	1	ISO 17025	< 1.0	59.1	< 1.0
sec-Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
p-Isopropyltoluene	µg/l	1	ISO 17025	< 1.0	2.4	< 1.0
1,2-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-chloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2,4-Trichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0

SVOCs

Aniline	µg/l	0.05	NONE	< 0.05	14	< 0.05
Phenol	µg/l	0.05	NONE	< 0.05	2.8	< 0.05
2-Chlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Bis(2-chloroethyl)ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
1,3-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
1,2-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
1,4-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Bis(2-chloroisopropyl)ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
2-Methylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Hexachloroethane	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Nitrobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
4-Methylphenol	µg/l	0.05	NONE	< 0.05	20	< 0.05
Isophorone	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
2-Nitrophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
2,4-Dimethylphenol	µg/l	0.05	NONE	< 0.05	39	< 0.05
Bis(2-chloroethoxy)methane	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
1,2,4-Trichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Naphthalene	µg/l	0.01	ISO 17025	1.5	3300*	< 0.01
2,4-Dichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
4-Chloroaniline	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Hexachlorobutadiene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
4-Chloro-3-methylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
2,4,6-Trichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
2,4,5-Trichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
2-Methylnaphthalene	µg/l	0.05	NONE	< 0.05	500	< 0.05
2-Chloronaphthalene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05



Analytical Report Number: 21-64864

Project / Site name: Castleton

Your Order No: 14768 55 L

Lab Sample Number				1815818	1815819	1815820
Sample Reference				WS101	WS105	WS110
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied
Date Sampled				Deviating	Deviating	Deviating
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status			
Dimethylphthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
2,6-Dinitrotoluene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	2.7	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	0.26	280	< 0.01
2,4-Dinitrotoluene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Dibenzofuran	µg/l	0.05	NONE	< 0.05	78	< 0.05
4-Chlorophenyl phenyl ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Diethyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
4-Nitroaniline	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Fluorene	µg/l	0.01	ISO 17025	< 0.01	130	< 0.01
Azobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Bromophenyl phenyl ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Hexachlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	130	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	8.2	< 0.01
Carbazole	µg/l	0.05	NONE	< 0.05	52	< 0.05
Dibutyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Anthraquinone	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Fluoranthene	µg/l	0.01	ISO 17025	0.95	11	< 0.01
Pyrene	µg/l	0.01	ISO 17025	0.89	7.1	< 0.01
Butyl benzyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	0.82	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	0.61	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
3&4-Methylphenol	µg/l	0.1	NONE	< 0.10	20	< 0.10

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

*Over range data, sample was diluted and results are estimated from an extrapolated calibration. Results should be interpreted with care



Analytical Report Number : 21-64864
Project / Site name: Castleton

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW.	L080-PL	W	ISO 17025
Monohydric phenols in water - LOW LEVEL 1 ug/l	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Semi-volatile organic compounds in water	Determination of semi-volatile organic compounds in leachate by extraction in dichloromethane followed by GC-MS.	In-house method based on USEPA 8270	L102B-PL	W	NONE
TPH1 (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS.	In-house method	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE
Volatile organic compounds in water	Determination of volatile organic compounds in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Low level total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In house method.	L099-PL	W	ISO 17025

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

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

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

Sample Deviation Report



Analytical Report Number : 21-64864

Project / Site name: Castleton

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
WS101	None Supplied	W	1815818	a	None Supplied	None Supplied	None Supplied
WS105	None Supplied	W	1815819	a	None Supplied	None Supplied	None Supplied
WS110	None Supplied	W	1815820	a	None Supplied	None Supplied	None Supplied



Jessica Sheridan

e3p
Taylor Road
Urmston
Manchester
M41 7JQ

e: jsheridan@e3p.co.uk

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

t: 01923 225404

f: 01923 237404

e: reception@i2analytical.com

Analytical Report Number : 21-22083

Project / Site name:	Castleton Sidings	Samples received on:	10/11/2021
Your job number:	14768	Samples instructed on/ Analysis started on:	10/11/2021
Your order number:	14768-JS	Analysis completed by:	18/11/2021
Report Issue Number:	1	Report issued on:	18/11/2021
Samples Analysed:	3 water samples		

Signed: *A. Czerwińska*

Agnieszka Czerwińska
Technical Reviewer (Reporting Team)
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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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: 21-22083
Project / Site name: Castleton Sidings

Your Order No: 14768-JS

Lab Sample Number	2078517	2078518	2078519
Sample Reference	RO223	RO221	WS105
Sample Number	None Supplied	None Supplied	None Supplied
Depth (m)	None Supplied	None Supplied	None Supplied
Date Sampled	08/11/2021	08/11/2021	08/11/2021
Time Taken	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status

General Inorganics

pH	pH Units	N/A	ISO 17025	7.3	7.2	6.6
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	< 1.0	< 1.0	1.9
Dissolved Organic Carbon (DOC)	mg/l	0.1	ISO 17025	2.46	1.46	14.0

Total Phenols

Total Phenols (monohydric)	µg/l	1	ISO 17025	< 1.0	< 1.0	280
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Heavy Metals / Metalloids

Calcium (dissolved)	mg/l	0.012	ISO 17025	80	83	110
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0

Arsenic (dissolved)	µg/l	0.15	ISO 17025	0.69	0.55	13.3
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.03	0.03	< 0.02
Chromium (dissolved)	µg/l	0.2	ISO 17025	1.3	2.2	3.7
Copper (dissolved)	µg/l	0.5	ISO 17025	2.0	5.2	1.6
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2	0.2
Manganese (dissolved)	µg/l	0.05	ISO 17025	40	30	1600
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	0.23	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	2.1	3.3	7.6
Selenium (dissolved)	µg/l	0.6	ISO 17025	1.4	1.0	0.6
Zinc (dissolved)	µg/l	0.5	ISO 17025	10	5.0	19

Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	9.5
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	31.1
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	77.5
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	119
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	60.5
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0

Petroleum Hydrocarbons

TPH1 (C10 - C40)	µg/l	10	NONE	< 10	< 10	27000
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TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	9.5
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	31
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	380
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	6000
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	6600
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	11000
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	2700
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	27000



Analytical Report Number: 21-22083
Project / Site name: Castleton Sidings

Your Order No: 14768-JS

Lab Sample Number				2078517	2078518	2078519
Sample Reference				RO223	RO221	WS105
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied
Date Sampled				08/11/2021	08/11/2021	08/11/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status			

VOCs

Chloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Chloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Bromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Vinyl Chloride	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Trichlorofluoromethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
1,1-Dichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Cis-1,2-dichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
2,2-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Trichloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Trans-1,2-dichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	9.5
Tetrachloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Trichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Dibromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Bromodichloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Cis-1,3-dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Trans-1,3-dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	31.1
1,1,2-Trichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Dibromochloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Tetrachloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2-Dibromoethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Chlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1,1,2-Tetrachloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	77.5
p & m-Xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	119
Styrene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Tribromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
o-Xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	60.5
1,1,2,2-Tetrachloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Isopropylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	7.2
Bromobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
n-Propylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	1.9
2-Chlorotoluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
4-Chlorotoluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	29.5
tert-Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	80.0
sec-Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
p-Isopropyltoluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-chloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2,4-Trichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0



Analytical Report Number: 21-22083
Project / Site name: Castleton Sidings

Your Order No: 14768-JS

Lab Sample Number				2078517	2078518	2078519
Sample Reference				RO223	RO221	WS105
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied
Date Sampled				08/11/2021	08/11/2021	08/11/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status			
1,2,3-Trichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0

SVOCs

Aniline	µg/l	0.05	NONE	< 0.05	< 0.05	25
Phenol	µg/l	0.05	NONE	< 0.05	< 0.05	16
2-Chlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Bis(2-chloroethyl)ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
1,3-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
1,2-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
1,4-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Bis(2-chloroisopropyl)ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
2-Methylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	36
Hexachloroethane	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Nitrobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
4-Methylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	70
Isophorone	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
2-Nitrophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
2,4-Dimethylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	150
Bis(2-chloroethoxy)methane	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
1,2,4-Trichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	5200
2,4-Dichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
4-Chloroaniline	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Hexachlorobutadiene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
4-Chloro-3-methylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
2,4,6-Trichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
2,4,5-Trichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
2-Methylnaphthalene	µg/l	0.05	NONE	< 0.05	< 0.05	850
2-Chloronaphthalene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Dimethylphthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
2,6-Dinitrotoluene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	12
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	500
2,4-Dinitrotoluene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Dibenzofuran	µg/l	0.05	NONE	< 0.05	< 0.05	340
4-Chlorophenyl phenyl ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Diethyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
4-Nitroaniline	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	260
Azobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Bromophenyl phenyl ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Hexachlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	250
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	32
Carbazole	µg/l	0.05	NONE	< 0.05	< 0.05	240
Dibutyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Anthraquinone	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	30
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	20
Butyl benzyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	3.1
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	2.1
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	0.68
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	0.38
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	0.40
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01



Analytical Report Number: 21-22083
Project / Site name: Castleton Sidings

Your Order No: 14768-JS

Lab Sample Number				2078517	2078518	2078519
Sample Reference				RO223	RO221	WS105
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied
Date Sampled				08/11/2021	08/11/2021	08/11/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status			
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
3&4-Methylphenol	µg/l	0.1	NONE	< 0.10	< 0.10	70

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



Analytical Report Number : 21-22083
Project / Site name: Castleton Sidings

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 *for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW.	L080-PL	W	ISO 17025
Monohydric phenols in water - LOW LEVEL 1 ug/l	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
pH at 20oC in water	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In house method.	L005-PL	W	ISO 17025
Semi-volatile organic compounds in water	Determination of semi-volatile organic compounds in leachate by extraction in dichloromethane followed by GC-MS.	In-house method based on USEPA 8270	L102B-PL	W	NONE
TPH1 (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS.	In-house method	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE
Volatile organic compounds in water	Determination of volatile organic compounds in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Low level total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025

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

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

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

CERTIFICATE OF ANALYSIS



Environmental Science

MULTI-SAMPLE
REPORT REFERENCE

2022-08-31-15:31:46

REGISTERED
DATE

06/01/2022

RECEIVED
DATE

24/01/2022

ANALYSIS
STARTED

24/01/2022

ANALYSIS
COMPLETE

08/03/2022

LABORATORY

i2 Analytical
Croxley Green Business Park
7 Woodshots Meadow
Watford
WD18 8YS

CUSTOMER

E3P
Taylor Road
Urmston
Manchester
M41 7JQ

SAMPLING TIME (MIN)	15600	DATE SAMPLED (DD/MM/YY)	20/01/2022
CLIENT CODE	14-768	PO NUMBER	000374-JS
CLIENT SITE	Castleton Sidings, Rochdale		

Matrix: 520-03A

Determinand	Technique	LOD	Accreditation	i2 Sample Number	328452	328454	328453	328451
				Sample Reference	RO225	WS105	WS107	WS112
				Pre Printed Barcode	PP7E233	PP7E237	PP7E234	PP7E235
Media Charge	T425	0.0	None	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Mercury	T425	0.2 ug	None	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Mercury mg/m3	T425	0.00064 mg/m3	None	< 0.00064	< 0.00064	< 0.00064	< 0.00064	< 0.00064
Mercury ppm	T425	0.00008 ppm	None	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008

Determinand	Technique	LOD	Accreditation	i2 Sample Number	328450
				Sample Reference	WS114B
				Pre Printed Barcode	PP7E236
Media Charge	T425	0.0	None	Not Applicable	
Mercury	T425	0.2 ug	None	< 0.2	
Mercury mg/m3	T425	0.00064 mg/m3	None	< 0.00064	
Mercury ppm	T425	0.00008 ppm	None	< 0.00008	

Technical Reviewer Role

Mrs Jeanette Abbott	Customer Service Manager
Mrs Kathryn Gleaves	Customer Services

Extra Testing Information

Technique Code	Technique Name	Samples
T425	AIR20-2-CVAFS	328450, 328451, 328452, 328453, 328454

Testing Location	Samples
All analysis was carried out at i2 Analytical (Poland), i2 Analytical Limited Sp z o.o, Oddział w Polsce, ul.Pionierow 39, 41-711 Ruda Slaska, Poland	328450, 328451, 328452, 328453, 328454

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Tests covered by this certificate were conducted in accordance with i2 Analytical's SOPs.

Note: All 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 of uncertainty can be provided on request.

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LOD = Limit of Determination. This is the lowest reportable limit of the test.



CERTIFICATE OF ANALYSIS



Environmental Science

MULTI-SAMPLE REPORT REFERENCE	REGISTERED DATE	RECEIVED DATE	ANALYSIS STARTED	ANALYSIS COMPLETE
2021-30-30-10:30:15	08/11/2021	24/11/2021	24/11/2021	30/11/2021

LABORATORY

i2 Analytical
Croxley Green Business Park
7 Woodshots Meadow
Watford
WD18 8YS

CUSTOMER

E3P
Taylor Road
Urmston
Manchester
M41 7JQ

AIR VOLUME (L)	10	CLIENT SITE	Castleton Sidings, Rochdale
CLIENT CODE	14-768	PO NUMBER	14768-JS-R

Matrix: Tenax TD Tube

Determinand	Technique	LOD	Accreditation	i2 Sample Number	
				300041	300042
				Pre Printed Barcode	792100 749739
				Sample Reference	RO225 WS111
Benzene	T352	1.0 ng	None	312.1	32.6
Benzene mg/m3	T352	0.0 mg/m3	None	0.0312	0.0033
Benzene ppb	T352	0.0 ppb	None	9.77	1.02
Ethyl Benzene	T352	1.0 ng	None	46.3	33.1
Ethyl Benzene mg/m3	T352	0.0 mg/m3	None	0.0046	0.0033
Ethyl Benzene ppb	T352	0.0 ppb	None	1.07	0.763
Naphthalene	T352	1.0 ng	None	26.9	32.5
Naphthalene mg/m3	T352	0.0 mg/m3	None	0.0027	0.0033
Naphthalene ppb	T352	0.0 ppb	None	0.513	0.620
TPH CWG - Aliphatic (C5 - C6)	T376	10.0 ng	None	< 10.0	< 10.0
TPH CWG - Aliphatic (C5 - C6) mg/m3	T376	0.001 mg/m3	None	< 0.001	< 0.001
TPH CWG - Aliphatic (C6 - C8)	T376	10.0 ng	None	1200	270
TPH CWG - Aliphatic (C6 - C8) mg/m3	T376	0.0 mg/m3	None	0.124	0.0267
TPH CWG - Aliphatic (C8 - C10)	T376	10.0 ng	None	1500	1300
TPH CWG - Aliphatic (C8 - C10) mg/m3	T376	0.0 mg/m3	None	0.154	0.132
TPH CWG - Aliphatic (EC10 - EC12)	T376	10.0 ng	None	410	9200
TPH CWG - Aliphatic (EC10 - EC12) mg/m3	T376	0.0 mg/m3	None	0.0411	0.924
TPH CWG - Aliphatic (EC12 - EC16)	T376	10.0 ng	None	250	4300
TPH CWG - Aliphatic (EC12 - EC16) mg/m3	T376	0.0 mg/m3	None	0.0246	0.427
TPH CWG - Aromatic (EC10 - EC12)	T376	10.0 ng	None	2000	3500
TPH CWG - Aromatic (EC10 - EC12) mg/m3	T376	0.0 mg/m3	None	0.197	0.355
TPH CWG - Aromatic (EC12 - EC16)	T376	10.0 ng	None	250	33
TPH CWG - Aromatic (EC12 - EC16) mg/m3	T376	0.0 mg/m3	None	0.0252	0.0033
TPH CWG - Aromatic (EC5 - EC7)	T376	10.0 ng	None	310	33
TPH CWG - Aromatic (EC5 - EC7) mg/m3	T376	0.0 mg/m3	None	0.0312	0.0033
TPH CWG - Aromatic (EC7 - EC8)	T376	10.0 ng	None	300	98
TPH CWG - Aromatic (EC7 - EC8) mg/m3	T376	0.0 mg/m3	None	0.0301	0.0098
TPH CWG - Aromatic (EC8 - EC10)	T376	10.0 ng	None	1500	2900
TPH CWG - Aromatic (EC8 - EC10) mg/m3	T376	0.0 mg/m3	None	0.150	0.294
Toluene	T352	1.0 ng	None	300.7	97.8
Toluene mg/m3	T352	0.0 mg/m3	None	0.0301	0.0098
Toluene ppb	T352	0.0 ppb	None	7.98	2.59
m/p-Xylene	T352	1.0 ng	None	126.6	96.4
m/p-Xylene mg/m3	T352	0.0 mg/m3	None	0.0127	0.0096
m/p-Xylene ppb	T352	0.0 ppb	None	1.46	1.11
o-Xylene	T352	1.0 ng	None	56.4	53.5
o-Xylene mg/m3	T352	0.0 mg/m3	None	0.0056	0.0053
o-Xylene ppb	T352	0.0 ppb	None	1.30	1.23

Technical Reviewer	Role
Mrs Jeanette Abbott	Customer Service Manager

Extra Testing Information

Technique Code	Technique Name	Samples
T352	AIR02-1-GCMS-TD	300041, 300042
T376	AIR23-1-GCMS-TD	300041, 300042

Testing Location	Samples
All analysis was carried out at i2 Analytical (Poland), i2 Analytical Limited Sp z.o.o, Oddział w Polsce, ul.Pionierow 39, 41-711 Ruda Slaska, Poland	300041, 300042

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.
Tests covered by this certificate were conducted in accordance with i2 Analytical's SOPs.
Note: All 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 of uncertainty can be provided on request.
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Results in black are positive/detected results. Results in gray are below the LOD or have not been found.
LOD = Limit of Determination. This is the lowest reportable limit of the test.



CERTIFICATE OF ANALYSIS



Environmental Science

MULTI-SAMPLE
REPORT REFERENCE

2021-26-34-15:34:27

REGISTERED
DATE

08/11/2021

RECEIVED
DATE

19/11/2021

ANALYSIS
STARTED

19/11/2021

ANALYSIS
COMPLETE

25/11/2021

LABORATORY

i2 Analytical
Croxley Green Business Park
7 Woodshots Meadow
Watford
WD18 8YS

CUSTOMER

E3P
Taylor Road
Urmston
Manchester
M41 7JQ

AIR VOLUME (L)	10	CLIENT SITE	Castleton Sidlings, Rochdale
CLIENT CODE	14-768	PO NUMBER	14768-JS-R

Matrix: Tenax TD Tube

				i2 Sample Number	300038	300039	300040
				Sample Reference	WS107	WS105	WS106B
				Pre Printed Barcode	749727	749726	736849
Determinand	Technique	LOD	Accreditation				
Benzene	T352	1.0 ng	None	7.0	< 1.0	9.7	
Benzene mg/m3	T352	0.0 mg/m3	None	0.0007	-	0.0010	
Benzene mg/m3	T352	0.0001 mg/m3	None	-	< 0.0001	-	
Benzene ppb	T352	0.0 ppb	None	0.219	-	0.304	
Benzene ppb	T352	0.0313 ppb	None	-	< 0.0313	-	
Ethyl Benzene	T352	1.0 ng	None	58.2	< 1.0	56.9	
Ethyl Benzene mg/m3	T352	0.0 mg/m3	None	0.0058	-	0.0057	
Ethyl Benzene mg/m3	T352	0.0001 mg/m3	None	-	< 0.0001	-	
Ethyl Benzene ppb	T352	0.0 ppb	None	1.34	-	1.31	
Ethyl Benzene ppb	T352	0.023 ppb	None	-	< 0.023	-	
Naphthalene	T352	1.0 ng	None	11.5	< 1.0	14.6	
Naphthalene mg/m3	T352	0.0 mg/m3	None	0.0011	-	0.0015	
Naphthalene mg/m3	T352	0.0001 mg/m3	None	-	< 0.0001	-	
Naphthalene ppb	T352	0.0 ppb	None	0.219	-	0.279	
Naphthalene ppb	T352	0.0191 ppb	None	-	< 0.0191	-	
TPH CWG - Aliphatic (C5 - C6)	T376	10.0 ng	None	< 10.0	< 10.0	< 10.0	
TPH CWG - Aliphatic (C5 - C6) mg/m3	T376	0.001 mg/m3	None	< 0.001	< 0.001	< 0.001	
TPH CWG - Aliphatic (C6 - C8)	T376	10.0 ng	None	850	< 10.0	610	
TPH CWG - Aliphatic (C6 - C8) mg/m3	T376	0.0 mg/m3	None	0.0852	-	0.0614	
TPH CWG - Aliphatic (C6 - C8) mg/m3	T376	0.001 mg/m3	None	-	< 0.001	-	
TPH CWG - Aliphatic (C8 - C10)	T376	10.0 ng	None	2000	< 10.0	2700	
TPH CWG - Aliphatic (C8 - C10) mg/m3	T376	0.0 mg/m3	None	0.198	-	0.275	
TPH CWG - Aliphatic (C8 - C10) mg/m3	T376	0.001 mg/m3	None	-	< 0.001	-	
TPH CWG - Aliphatic (EC10 - EC12)	T376	10.0 ng	None	1700	< 10.0	2500	
TPH CWG - Aliphatic (EC10 - EC12) mg/m3	T376	0.0 mg/m3	None	0.167	-	0.252	
TPH CWG - Aliphatic (EC10 - EC12) mg/m3	T376	0.001 mg/m3	None	-	< 0.001	-	
TPH CWG - Aliphatic (EC12 - EC16)	T376	10.0 ng	None	93	< 10.0	64	
TPH CWG - Aliphatic (EC12 - EC16) mg/m3	T376	0.0 mg/m3	None	0.0093	-	0.0064	
TPH CWG - Aliphatic (EC12 - EC16) mg/m3	T376	0.001 mg/m3	None	-	< 0.001	-	
TPH CWG - Aromatic (EC10 - EC12)	T376	10.0 ng	None	970	< 10.0	1100	
TPH CWG - Aromatic (EC10 - EC12) mg/m3	T376	0.0 mg/m3	None	0.0968	-	0.113	
TPH CWG - Aromatic (EC10 - EC12) mg/m3	T376	0.001 mg/m3	None	-	< 0.001	-	
TPH CWG - Aromatic (EC12 - EC16)	T376	10.0 ng	None	11	< 10.0	15	
TPH CWG - Aromatic (EC12 - EC16) mg/m3	T376	0.0 mg/m3	None	0.0011	-	0.0015	
TPH CWG - Aromatic (EC12 - EC16) mg/m3	T376	0.001 mg/m3	None	-	< 0.001	-	
TPH CWG - Aromatic (EC5 - EC7)	T376	10.0 ng	None	< 10.0	< 10.0	< 10.0	
TPH CWG - Aromatic (EC5 - EC7) mg/m3	T376	0.001 mg/m3	None	< 0.001	< 0.001	< 0.001	
TPH CWG - Aromatic (EC7 - EC8)	T376	10.0 ng	None	84	< 10.0	180	
TPH CWG - Aromatic (EC7 - EC8) mg/m3	T376	0.0 mg/m3	None	0.0084	-	0.0176	
TPH CWG - Aromatic (EC7 - EC8) mg/m3	T376	0.001 mg/m3	None	-	< 0.001	-	
TPH CWG - Aromatic (EC8 - EC10)	T376	10.0 ng	None	680	< 10.0	1800	
TPH CWG - Aromatic (EC8 - EC10) mg/m3	T376	0.0 mg/m3	None	0.0676	-	0.184	

				i2 Sample Number	300038	300039	300040
				Sample Reference	WS107	WS105	WS106B
				Pre Printed Barcode	749727	749726	736849
Determinand	Technique	LOD	Accreditation				
TPH CWG - Aromatic (EC8 - EC10) mg/m3	T376	0.001 mg/m3	None	-	< 0.001	-	
Toluene	T352	1.0 ng	None	84.4	< 1.0	58.5	
Toluene mg/m3	T352	0.0 mg/m3	None	0.0084	-	0.0059	
Toluene mg/m3	T352	0.0001 mg/m3	None	-	< 0.0001	-	
Toluene ppb	T352	0.0 ppb	None	2.24	-	1.55	
Toluene ppb	T352	0.0265 ppb	None	-	< 0.0265	-	
m/p-Xylene	T352	1.0 ng	None	191.1	< 1.0	187.5	
m/p-Xylene mg/m3	T352	0.0 mg/m3	None	0.0191	-	0.0187	
m/p-Xylene mg/m3	T352	0.0001 mg/m3	None	-	< 0.0001	-	
m/p-Xylene ppb	T352	0.0 ppb	None	2.20	-	2.16	
m/p-Xylene ppb	T352	0.0115 ppb	None	-	< 0.0115	-	
o-Xylene	T352	1.0 ng	None	72.8	< 1.0	81.5	
o-Xylene mg/m3	T352	0.0 mg/m3	None	0.0073	-	0.0081	
o-Xylene mg/m3	T352	0.0001 mg/m3	None	-	< 0.0001	-	
o-Xylene ppb	T352	0.0 ppb	None	1.68	-	1.88	
o-Xylene ppb	T352	0.023 ppb	None	-	< 0.023	-	

Technical Reviewer	Role
Mrs Kathryn Gleaves	Customer Services

Extra Testing Information

Technique Code	Technique Name	Samples
T352	AIR02-1-GCMS-TD	300038, 300039, 300040
T376	AIR23-1-GCMS-TD	300038, 300039, 300040

Testing Location	Samples
All analysis was carried out at i2 Analytical (Poland), i2 Analytical Limited Sp z.o.o, Oddział w Polsce, ul.Pionierow 39, 41-711 Ruda Slaska, Poland	300038, 300039, 300040

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LOD = Limit of Determination. This is the lowest reportable limit of the test.

Job 2949

Result calculated using LOD as
mg/m3 is <LOD

	Benzene		Ethyl Benzene		Naphthalene		TPH Ali 5-6		TPH Ali 6-8		TPH Ali 8-10		TPH Ali 10-12		TPH ARO 5-7		TPH ARO 7-8		TPH ARO 8-10		TPH ARO 10-12		TPH ARO 12-16		Toluene		m/p-xylene		o-xylene	
Sample No	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm
300038	0.0001	#####	0.0012	279.1667	0.0002	#####	0.0002		0.0178		0.0413		0.0348		0.0002		0.0018		0.0141		0.0202		0.0019		0.0018	466.6667	0.0040	458.3333	0.0015	350.0000
300039	0.0000	6.5208	0.0000	4.7917	0.0000	3.9792	0.0002		0.0002		0.0002		0.0002		0.0002		0.0002		0.0002		0.0002		0.0002		0.0000	5.5208	0.0000	2.3958	0.0000	4.7917
300040	0.0002	#####	0.0012	272.9167	0.0003	#####	0.0002		0.0128		0.0573		0.0525		0.0002		0.0037		0.0383		0.0235		0.0003		0.0012	322.9167	0.0039	450.0000	0.0017	391.6667

Job 2983

Result calculated using LOD
as mg/m3 is <LOD

	Benzene		Ethyl Benzene		Naphthalene		TPH Ali 5-6		TPH Ali 6-8		TPH Ali 8-10		TPH Ali 10-12		TPH ARO 5-7		TPH ARO 7-8		TPH ARO 8-10		TPH ARO 10-12		TPH ARO 12-16		Toluene		m/p-xylene		o-xylene	
Sample No	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm	mg/m3	ppm
300041	0.0065	2035.4167	0.0010	222.9167	0.0006	106.8750	0.0002		0.0258		0.0321		0.0086		0.0065		0.0063		0.0313		0.0086		0.0051		0.0063	1662.5000	0.0026	304.1667	0.0012	270.8333
300042	0.0006	212.5000	0.0007	158.9583	0.0007	129.1667	0.0002		0.0056		0.0275		0.1925		0.0007		0.0020		0.0613		0.0740		0.0890		0.0020	539.5833	0.0020	231.2500	0.0011	256.2500

Job 3277

Result calculated using LOD
as mg/m3 is <LOD

Sample No	Mercury	
	mg/m3	ppm
328450	0.0208	0.0026
328451	0.0208	0.0026
328452	0.0208	0.0026
328453	0.021	0.003
328454	0.021	0.003

APPENDIX VII

ORIGIN OF TIER I GENERIC ASSESSMENT CRITERIA

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



APPENDIX VIII

GEOTECHNICAL TESTING

CERTIFICATES



LABORATORY REPORT



4043

Contract Number: PSL21/1969

Report Date: 20 April 2021

Client's Reference: 14-768

Client Name: E3P
Taylor Road
Urmston
Manchester
M41 7JQ

For the attention of: Elizabeth Fearn/Jamie Craig

Contract Title: Castleton Sidings/Rochdale

Date Received: 10/3/2021

Date Commenced: 10/3/2021

Date Completed: 20/4/2021

Notes: Opinions and Interpretations are outside the UKAS Accreditation

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

Checked and Approved Signatories:

A Watkins
(Director)

R Berriman
(Quality Manager)

S Royle
(Laboratory Manager)

L Knight
(Senior Technician)


S Eyre
(Senior Technician)

H Daniels
(Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
tel: +44 (0)844 815 6641
fax: +44 (0)844 815 6642
e-mail: rberriman@prosoils.co.uk
awatkins@prosoils.co.uk

Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

[illegible]

4043

PSL
Professional Soils Laboratory

Castleton Sidings/Rochdale

Contract No:

PSL21/1969

Client Ref:

14-768

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

[illegible]

SYMBOLS : NP : Non Plastic

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



4043

PSL
Professional Soils Laboratory

Castleton Sidings/Rochdale

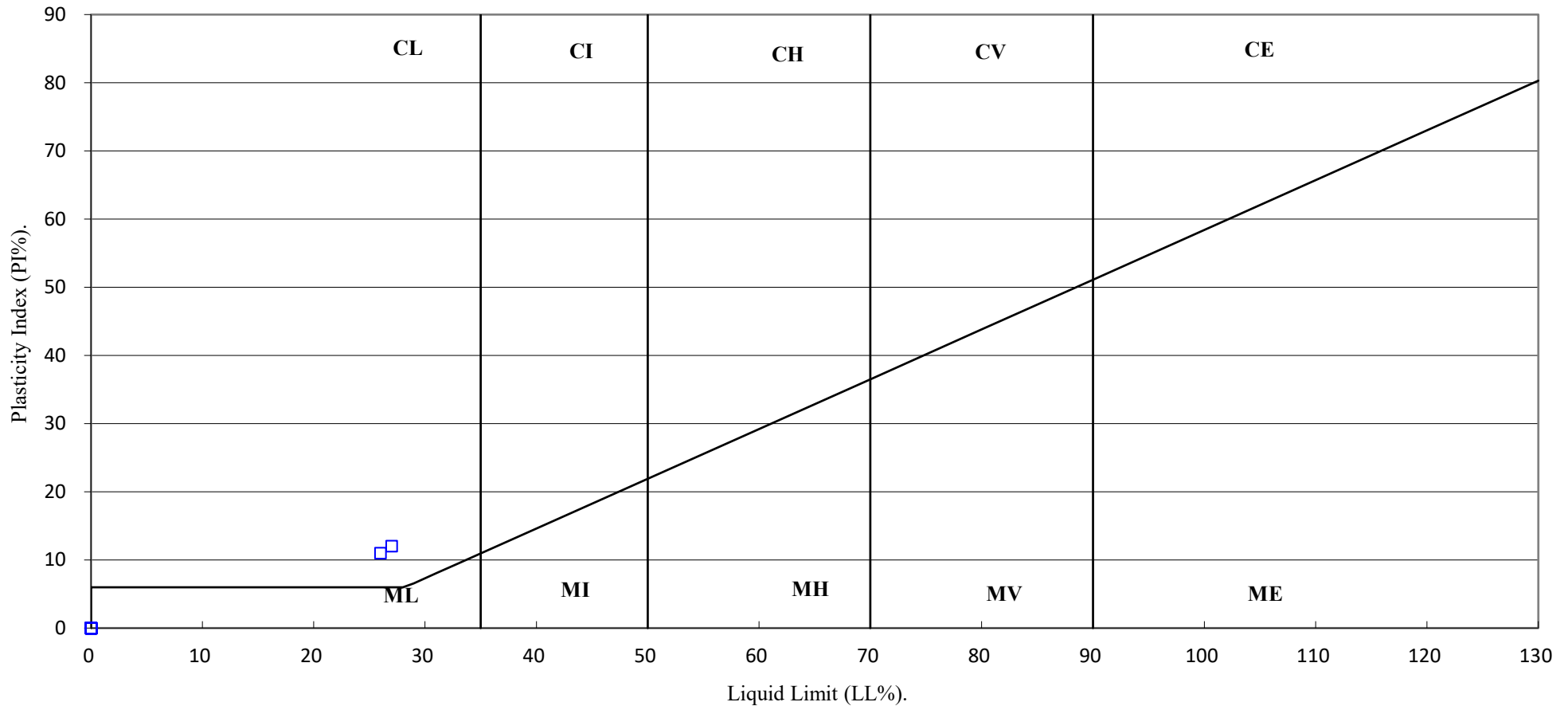
Contract No:

PSL21/1969

Client Ref:

14-768

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



4043

PSL

Professional Soils Laboratory

Castleton Sidings/Rochdale

Contract No:

PSL21/1969

Client Ref:

14-768

PARTICLE SIZE DISTRIBUTION TEST

BS1377:Part 2:1990

Wet Sieve: Clause 9.2

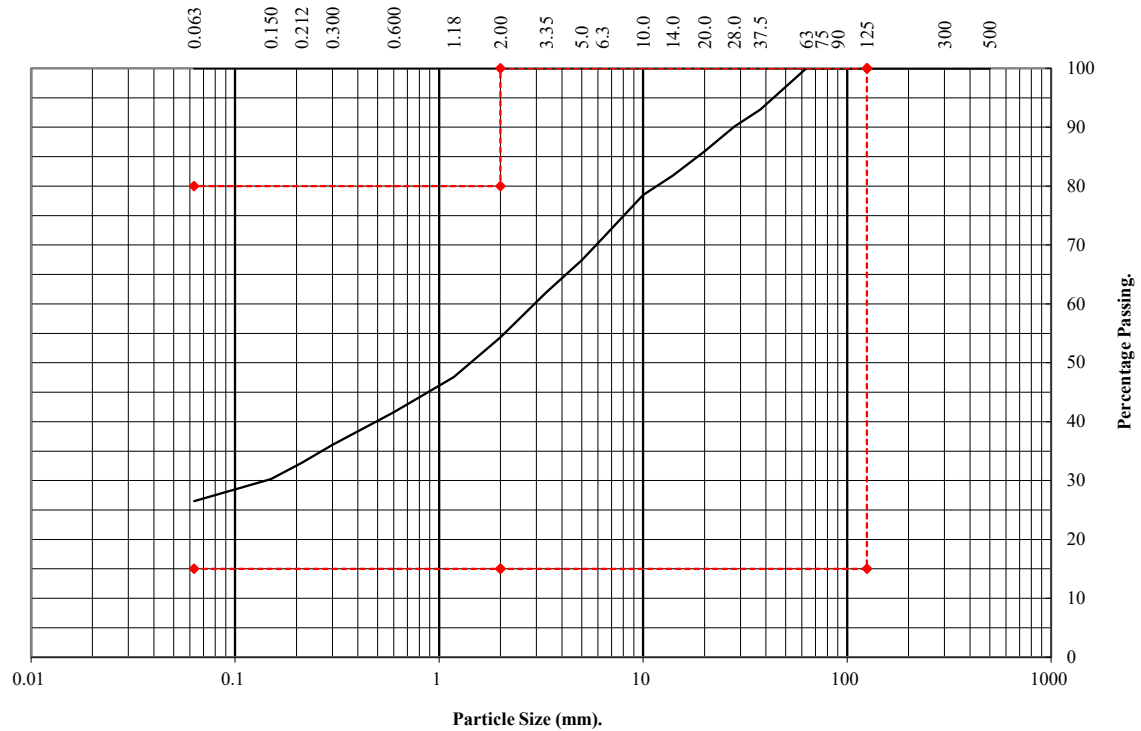
Classification for Acceptable Earthworks Materials

Sample Number:

TP102

Classification Type:

2C



BS Test Sieve mm	Percentage Passing %	Table 6/2 Grading Requirements	
		Lower	Upper
500	100	100	100
300	100		
125	100		
90	100		
75	100		
63	100		
37.5	93		
28	90		
20	86		
14	82		
10	78	15	80
6.3	71		
5	67		
3.35	62		
2	54		
1.18	48		
0.6	42		
0.3	36		
0.212	33		
0.15	30		
0.063	27	15	80

Remarks:

SHW Series 600 Table 6/2 :
Class 2C



PSL
Professional Soils Laboratory

Castleton Sidings/Rochdale

Contract No.:

PSL21/1969

Client Ref:

14-768

PARTICLE SIZE DISTRIBUTION TEST

BS1377:Part 2:1990

Wet Sieve: Clause 9.2

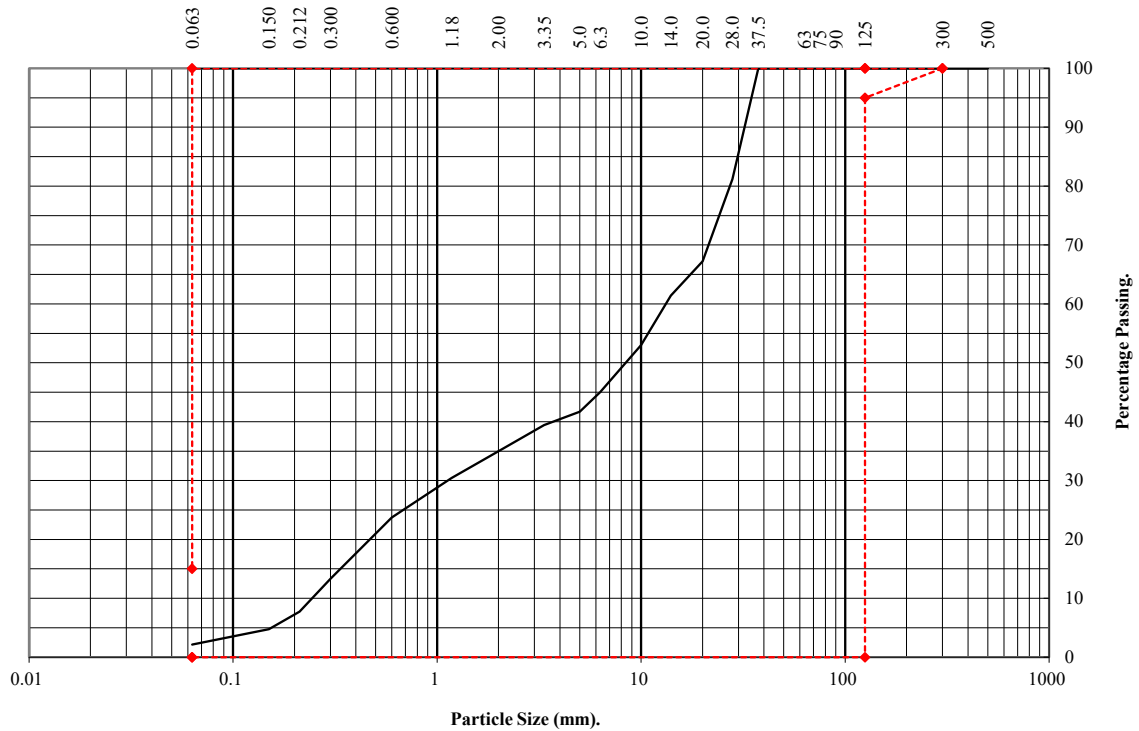
Classification for Acceptable Earthworks Materials

Sample Number:

TP105

Classification Type:

1A



BS Test Sieve mm	Percentage Passing %	Table 6/2 Grading Requirements	
		Lower	Upper
500	100		
300	100	100	100
125	100	95	100
90	100		
75	100		
63	100		
37.5	100		
28	81		
20	67		
14	61		
10	53		
6.3	45		
5	42		
3.35	39		
2	35		
1.18	30		
0.6	24		
0.3	13		
0.212	8		
0.15	5		
0.063	2	0	15

Remarks:

SHW Series 600 Table 6/2 :
Class 1A



PSL
Professional Soils Laboratory

Castleton Sidings/Rochdale

Contract No.:

PSL21/1969

Client Ref:

14-768

PARTICLE SIZE DISTRIBUTION TEST

BS1377:Part 2:1990

Wet Sieve: Clause 9.2

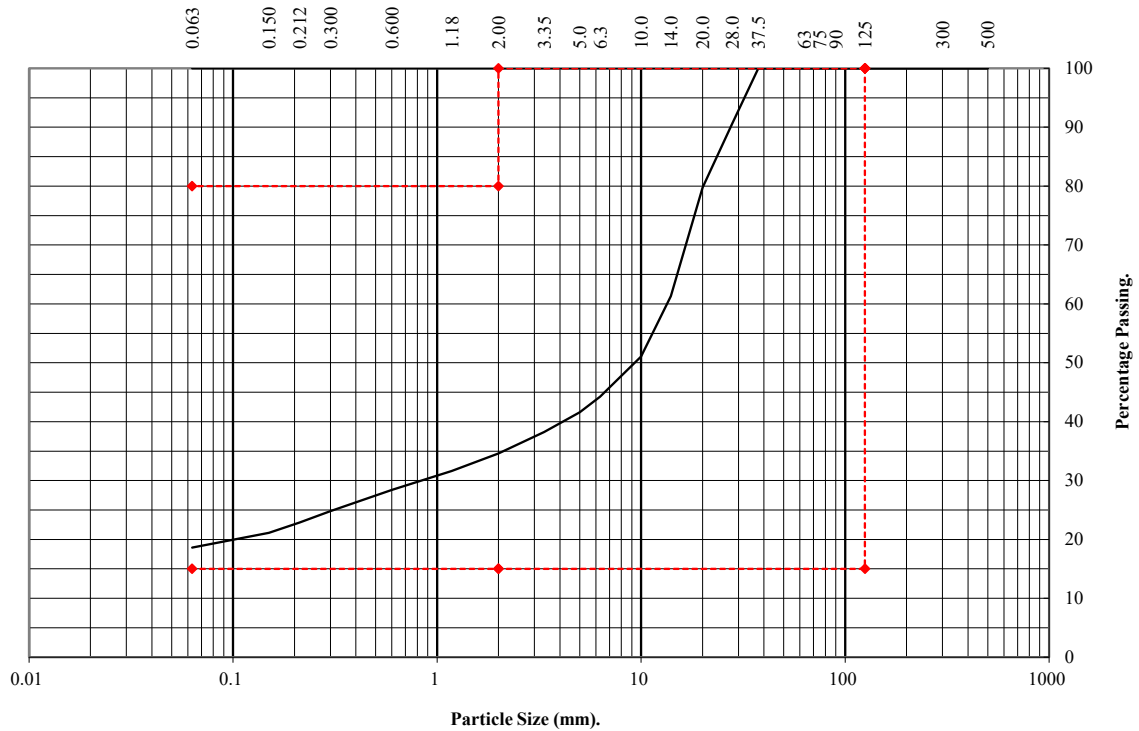
Classification for Acceptable Earthworks Materials

Sample Number:

TP107

Classification Type:

2C



BS Test Sieve mm	Percentage Passing %	Table 6/2 Grading Requirements	
		Lower	Upper
500	100		
300	100		
125	100	100	100
90	100		
75	100		
63	100		
37.5	100		
28	91		
20	80		
14	61		
10	51		
6.3	44		
5	42		
3.35	38		
2	35	15	80
1.18	32		
0.6	28		
0.3	25		
0.212	23		
0.15	21		
0.063	19	15	80

Remarks:

SHW Series 600 Table 6/2 :
Class 2C



Castleton Sidings/Rochdale

Contract No.:

PSL21/1969

Client Ref:

14-768

PARTICLE SIZE DISTRIBUTION TEST

BS1377:Part 2:1990

Wet Sieve: Clause 9.2

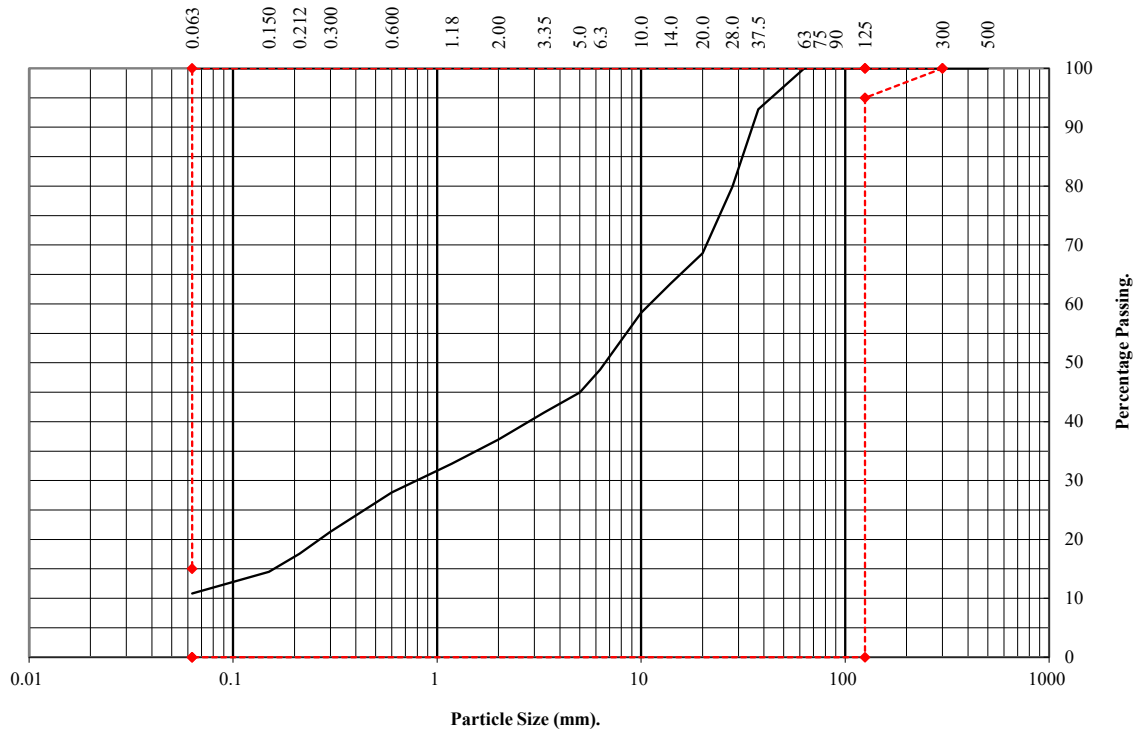
Classification for Acceptable Earthworks Materials

Sample Number:

TP111

Classification Type:

1A



BS Test Sieve mm	Percentage Passing %	Table 6/2 Grading Requirements	
		Lower	Upper
500	100		
300	100	100	100
125	100	95	100
90	100		
75	100		
63	100		
37.5	93		
28	80		
20	69		
14	64		
10	58		
6.3	49		
5	45		
3.35	42		
2	37		
1.18	33		
0.6	28		
0.3	21		
0.212	18		
0.15	15		
0.063	11	0	15

Remarks:

SHW Series 600 Table 6/2 :
Class 1A



PSL
Professional Soils Laboratory

Castleton Sidings/Rochdale

Contract No.:

PSL21/1969

Client Ref:

14-768

PARTICLE SIZE DISTRIBUTION TEST

BS1377:Part 2:1990

Wet Sieve: Clause 9.2

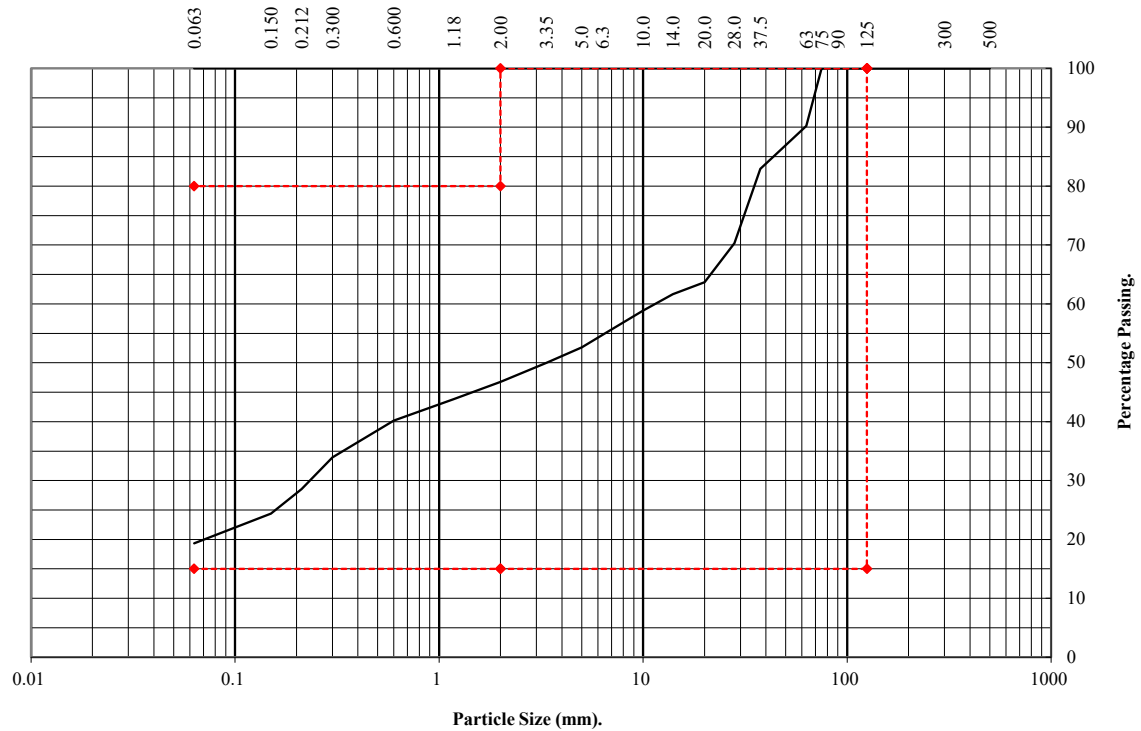
Classification for Acceptable Earthworks Materials

Sample Number:

TP114

Classification Type:

2C



BS Test Sieve mm	Percentage Passing %	Table 6/2 Grading Requirements	
		Lower	Upper
500	100	100	100
300	100		
125	100		
90	100		
75	100		
63	90		
37.5	83		
28	70		
20	64		
14	62		
10	59	15	80
6.3	55		
5	53		
3.35	50		
2	47		
1.18	44	15	80
0.6	40		
0.3	34		
0.212	29		
0.15	24		
0.063	19		

Remarks:

SHW Series 600 Table 6/2 :
Class 2C



Castleton Sidings/Rochdale

Contract No.:

PSL21/1969

Client Ref:

14-768

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

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

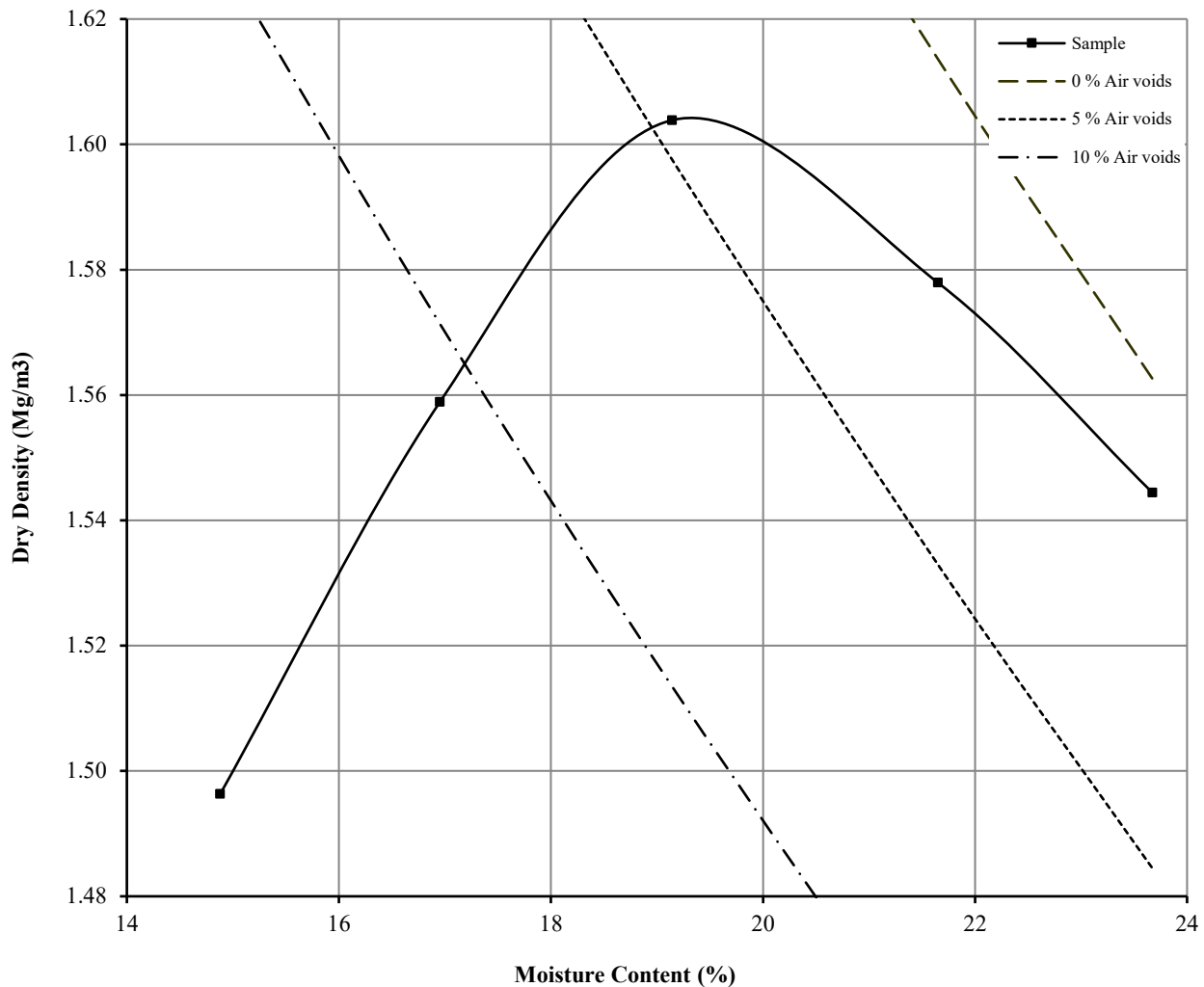
Hole Number: TP105

Top Depth (m) : 1.00

Sample Number:

Base Depth (m) :

Sample Type: BULK



Initial Moisture Content:	19	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m ³):	2.48	Assumed	Material Retained on 37.5 mm Test Sieve (%):	0
Maximum Dry Density (Mg/m ³):	1.60		Material Retained on 20.0 mm Test Sieve (%):	33
Optimum Moisture Content (%):	19			
Remarks See summary of soil descriptions				



PSL
Professional Soils Laboratory

Castleton Sidings/Rochdale

Contract
PSL21/1969
Client Ref
14-768

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

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

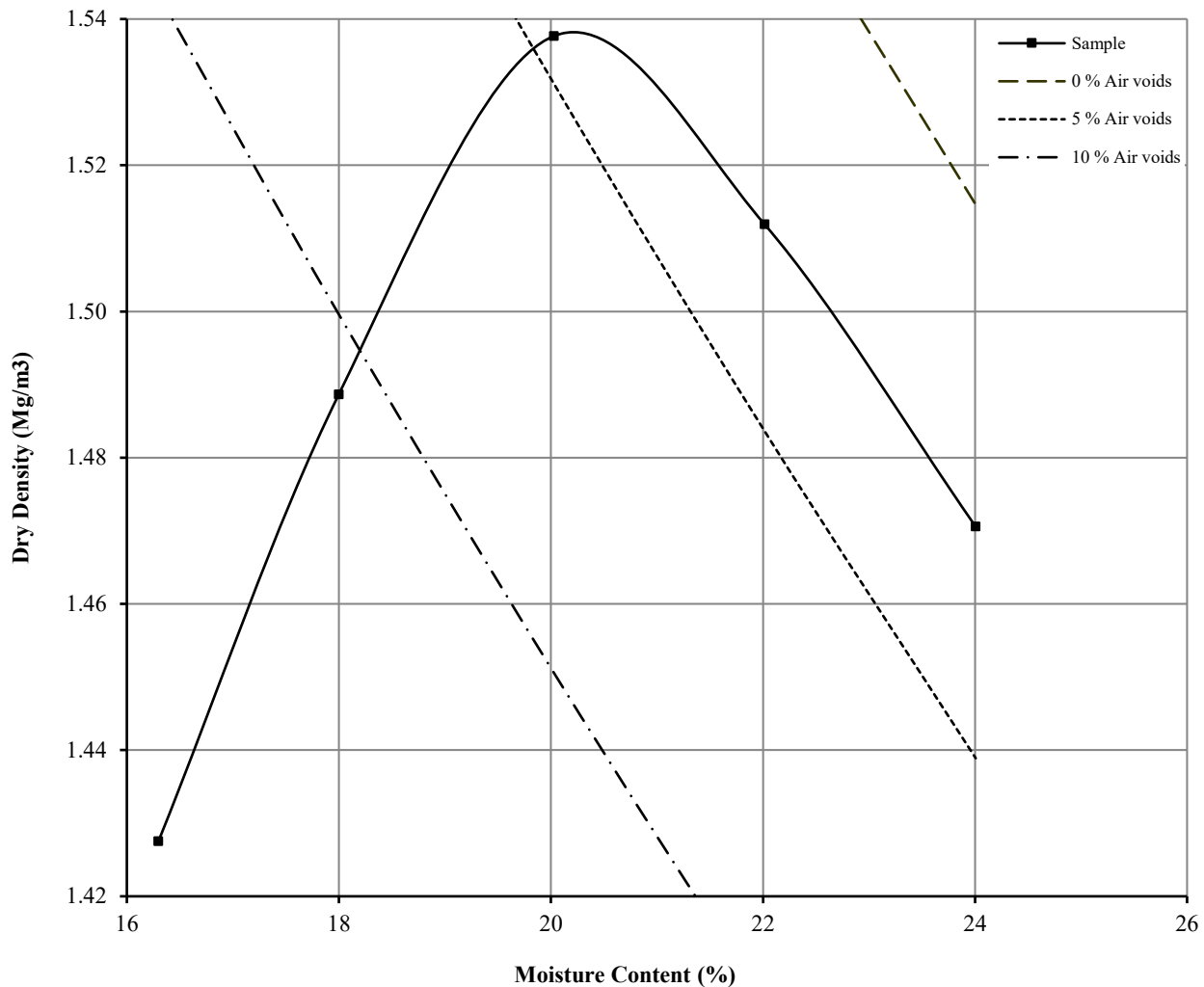
Hole Number: TP111

Top Depth (m) : 1.00

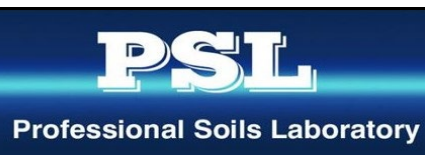
Sample Number:

Base Depth (m) :

Sample Type: BULK



Initial Moisture Content:	20	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m3):	2.38	Assumed	Material Retained on 37.5 mm Test Sieve (%):	7
Maximum Dry Density (Mg/m3):	1.54		Material Retained on 20.0 mm Test Sieve (%):	24
Optimum Moisture Content (%):	20			
Remarks See summary of soil descriptions				



Castleton Sidings/Rochdale

Contract
PSL21/1969
Client Ref
14-768

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

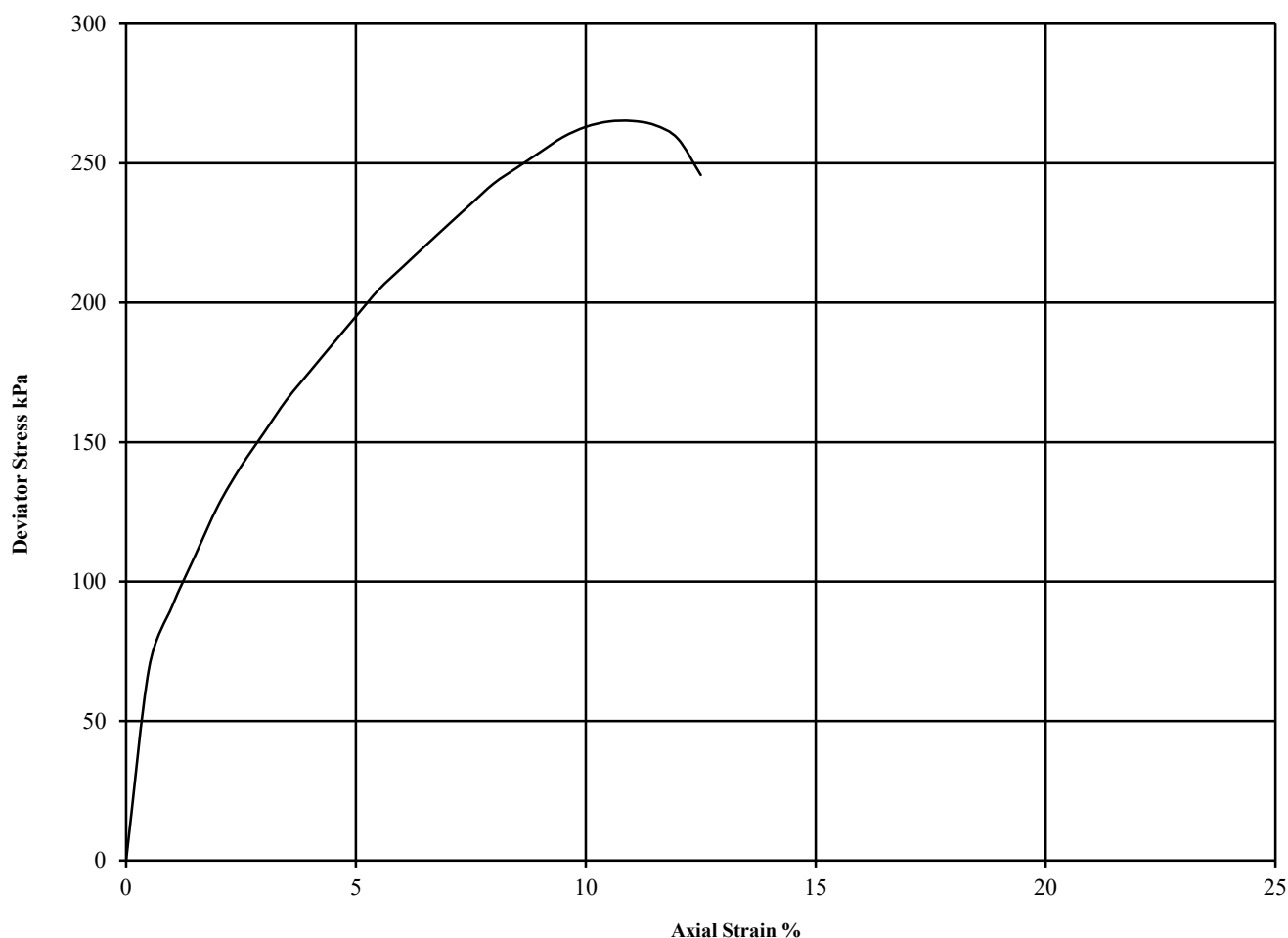
WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

Hole Number: LINER Top Depth (m): 1.50

Sample Number: Base Depth (m): 2.00

Sample Type U



Diameter (mm):		75	Height (mm):		150	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.47 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	19	2.08	1.75	30	265	133	11.0	Brittle	



4043

PSL

Professional Soils Laboratory

Castleton Sidings/Rochdale

Contract No:

PSL21/1969

Client Ref:

14-768

ONE DIMENSIONAL CONSOLIDATION TEST

BS 1377: Part 5: 1990: Clause 3

Hole Number: WS101

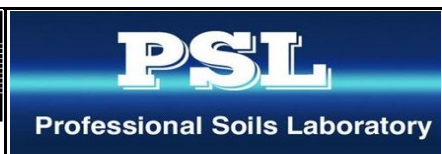
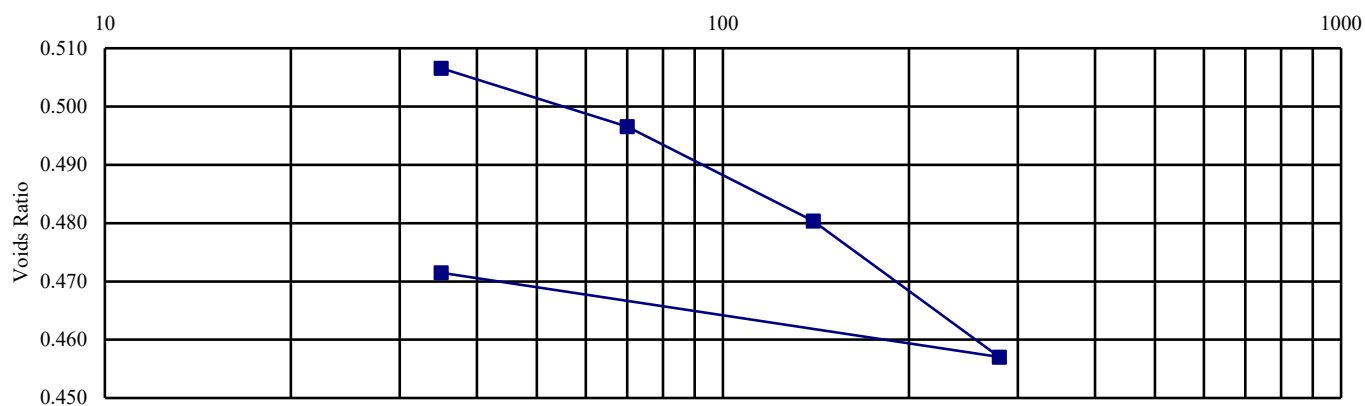
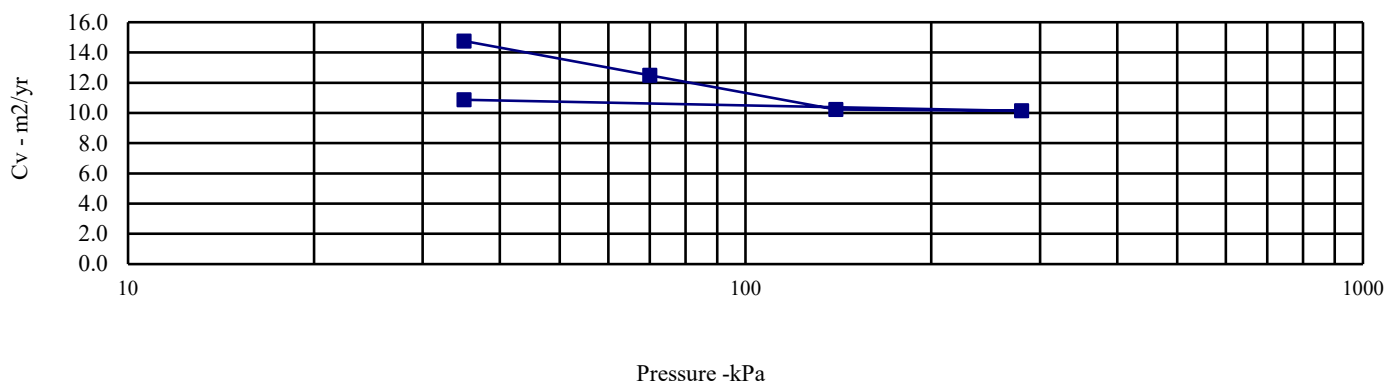
Top Depth (m): 1.50

Sample Number:

Base Depth (m) : 2.00

Sample Type: LINER

Initial Conditions		Pressure Range		Mv	Cv	Specimen location	
Moisture Content (%):	19	kPa		m2/MN	m2/yr	within tube:	Top
Bulk Density (Mg/m3):	2.08	0	35	0.254	14.760	Method used to	
Dry Density (Mg/m3):	1.74	35	70	0.190	12.498	determine CV:	T90
Voids Ratio:	0.520	70	140	0.155	10.218	Nominal temperature	
Degree of saturation:	97.4	140	280	0.113	10.133	during test ' C:	20
Height (mm):	20.002	280	35	0.040	10.861	Remarks:	
Diameter (mm)	50.013	See summary of soil descriptions					
Particle Density (Mg/m3):	2.65						
Assumed							



Castleton Sidings/Rochdale

Contract No:
PSL21/1969
Client Ref:
14-768



LABORATORY REPORT



4043

Contract Number: PSL21/2522

Report Date: 16 April 2021

Client's Reference: 14-768

Client Name: E3P
Taylor Road
Urmston
Manchester
M41 7JQ

For the attention of: Elizabeth Fearn

Contract Title: Castleton Sidings/Rochdale

Date Received: 25/3/2021

Date Commenced: 25/3/2021

Date Completed: 16/4/2021

Notes: Opinions and Interpretations are outside the UKAS Accreditation

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Checked and Approved Signatories:

A Watkins
(Director)

R Berriman
(Quality Manager)

S Royle
(Laboratory Manager)

L Knight
(Senior Technician)

S Eyre
(Senior Technician)


T Watkins
(Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
tel: +44 (0)844 815 6641
fax: +44 (0)844 815 6642
e-mail: awatkins@prosoils.co.uk
rberriman@prosoils.co.uk

Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

[illegible]

4043

PSL
Professional Soils Laboratory

Castleton Sidings/Rochdale

Contract No:

PSL21/2522

Client Ref:

14-768

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

[illegible]

SYMBOLS : NP : Non Plastic

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



4043

PSL
Professional Soils Laboratory

Castleton Sidings/Rochdale

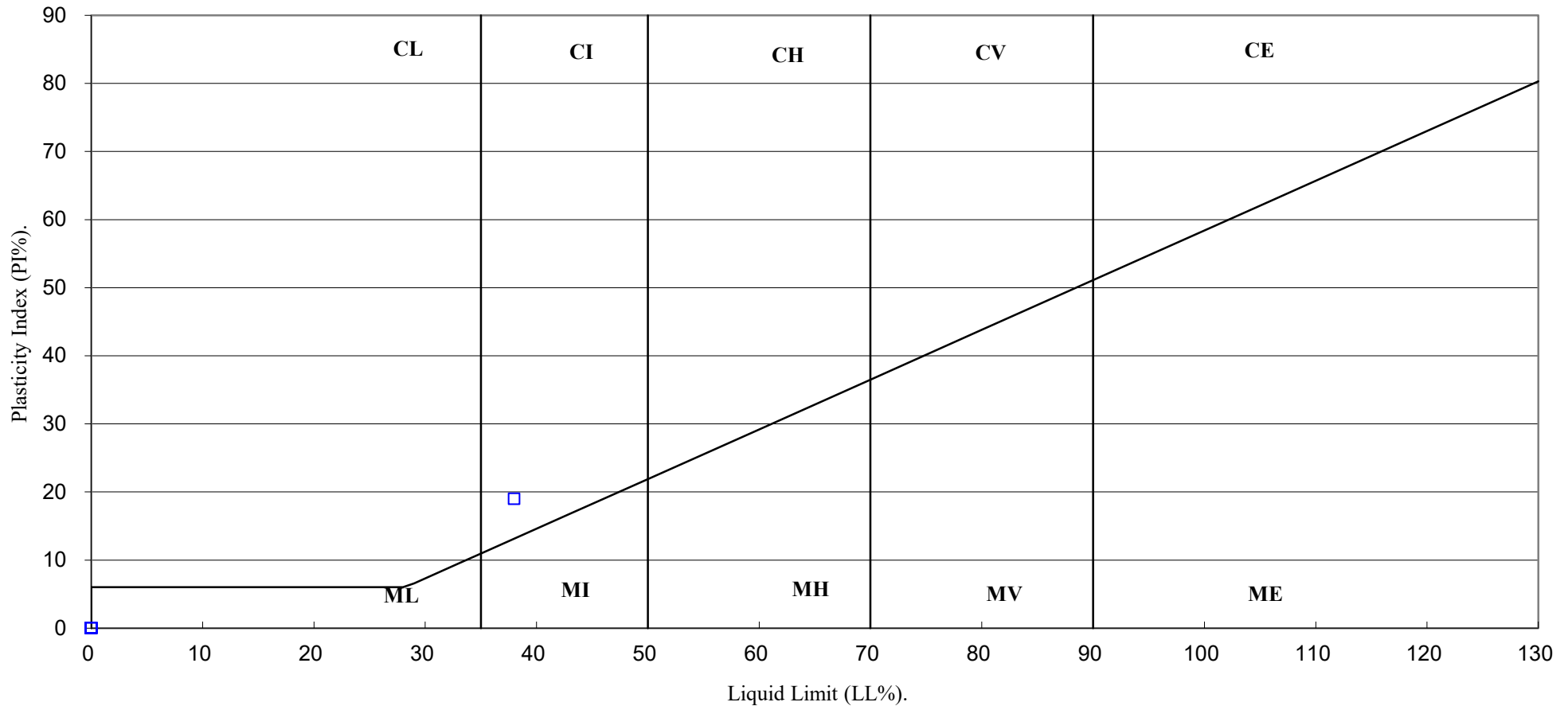
Contract No:

PSL21/2522

Client Ref:

14-768

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



4043

PSL
Professional Soils Laboratory

Castleton Sidings/Rochdale

Contract No:

PSL21/2522

Client Ref:

14-768

APPENDIX IX COAL AUTHORITY REPORT & PERMIT



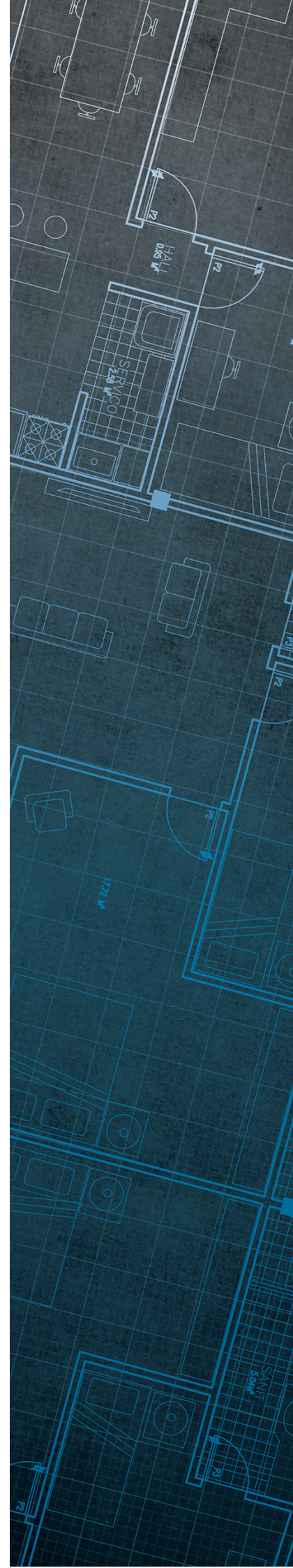
The Coal
Authority

Consultants Coal Mining Report

2 Heywood Road
Rochdale
OL11 3AU

Date of enquiry:	16 March 2021
Date enquiry received:	16 March 2021
Issue date:	16 March 2021

Our reference:	51002404759001
Your reference:	14768-js-h



Consultants

Coal Mining Report

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

Client name

E3P

Enquiry address

2 Heywood Road
Rochdale
OL11 3AU

How to contact us

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

200 Lichfield Lane
Mansfield
Nottinghamshire
NG18 4RG

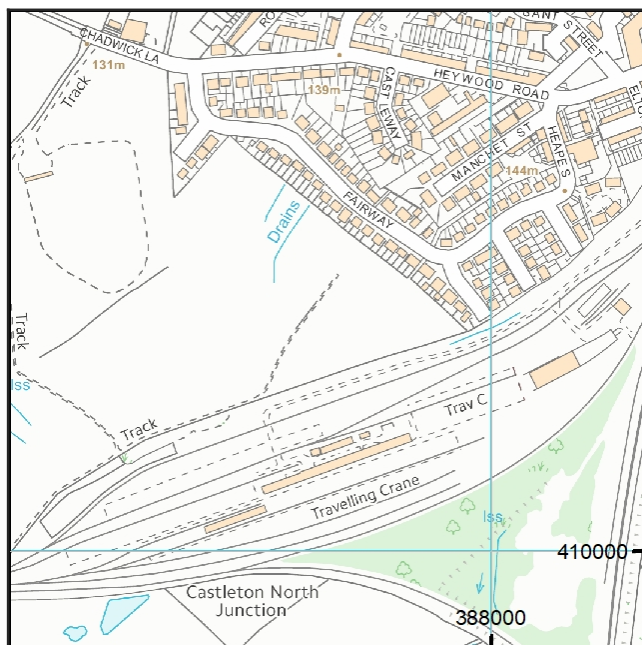
www.groundstability.com

 @coalauthority

 /company/the-coal-authority

 /thecoalauthority

 /thecoalauthority



Approximate position of property



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Section 1 – Mining activity and geology

Past underground mining

No past mining recorded.

Probable unrecorded shallow workings

None.

Spine roadways at shallow depth

No spine roadway recorded at shallow depth.

Mine entries

None recorded within 100 metres of the enquiry boundary.

Abandoned mine plan catalogue numbers

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

16820		
-------	--	--

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

Outcrops

Seam name	Mineral	Seam workable	Distance to outcrop (m)	Direction to outcrop	Bearing of outcrop
ARLEY	Coal	Yes	Within	N/A	324
ARLEY	Coal	Yes	10.4	North-East	337

Geological faults, fissures and breaklines

Please refer to the 'Summary of findings' map (on separate sheet) for details of any geological faults, fissures or breaklines either within or intersecting the enquiry boundary.

Fault under or close to the property recorded.

Opencast mines

None recorded within 500 metres of the enquiry boundary.

Coal Authority managed tips

None recorded within 500 metres of the enquiry boundary.

Section 2 – Investigative or remedial activity

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

Site investigations

None recorded within 50 metres of the enquiry boundary.

Remediated sites

None recorded within 50 metres of the enquiry boundary.

Coal mining subsidence

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

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

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

Mine gas

None recorded within 500 metres of the enquiry boundary.

Mine water treatment schemes

None recorded within 500 metres of the enquiry boundary.

Section 3 – Licensing and future mining activity

Future underground mining

None recorded.

Coal mining licensing

None recorded within 200 metres of the enquiry boundary.

Court orders

None recorded.

Section 46 notices

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

Withdrawal of support notices

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

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

Payments to owners of former copyhold land

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

Section 4 – Further information

Based on the responses in this report, no further information has been highlighted.

Section 5 – Data definitions

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

Past underground coal mining

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

Probable unrecorded shallow workings

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

Spine roadways at shallow depth

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

Mine entries

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

Abandoned mine plan catalogue numbers

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

Outcrops

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

Geological faults, fissures and breaklines

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

Opencast mines

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

Coal Authority managed tips

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

Site investigations

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

Remediated sites

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

Coal mining subsidence

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

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

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

Mine gas

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

Mine water treatment schemes

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

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

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

Future underground mining

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

Coal mining licensing

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

Court orders

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

Section 46 notices

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

Withdrawal of support notices

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

Payment to owners of former copyhold land

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

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

Key

Approximate position of the enquiry boundary shown 

Outcrop (Conjectured) 

Geological faults 

How to contact us
0345 762 6848 (UK)
+44 (0)1623 637 000 (International)
www.groundstability.com





The Coal
Authority

Permit to Enter or Disturb Coal Authority Interests

Permit 21608

Name and Address of Permit Holder:

*Kellen Homes
103 Dalton Avenue
Birchwood Park
Warrington
WA3 6YE*

Site Location:

*Castleton Sidings
Heywood
Rochdale
OL11 3AU*

This certificate hereby grants the above named Permit Holder a Permit to carry out:-

Ground investigation by four boreholes to 40m to determine presence of shallow mine workings within the Authority's interests at the identified site location above as shown on the Grant Permit Boundary (overleaf) for the period of 12 months from the granted date shown below. *The granting of this Permit does not constitute advice given by the Authority in relation to the proposed operations. It is the Permit Holder's responsibility to obtain appropriate health, safety, environmental, technical and legal advice.*

Conditions:

- *Water flush*
- *Gas Monitoring CO, CH₄, CO₂, O₂, H₂S at borehole and rig*
- *Operators undertaking the work must be in possession of this certificate and the Permit boundary plan at the time of works*
- *Appropriate borehole sealing without delay and to withstand site level changes*

Signed: Kevin Waite Granted Date: 11th March 2021

For and on behalf of The Coal Authority

Nominated Representative: Kevin Waite, Permitting Manager;

The Coal Authority, Permitting Office, 200 Lichfield Lane, Mansfield, Notts, NG18 4RG

Tel: 01623 637450; E-Mail: permissions@coal.gov.uk

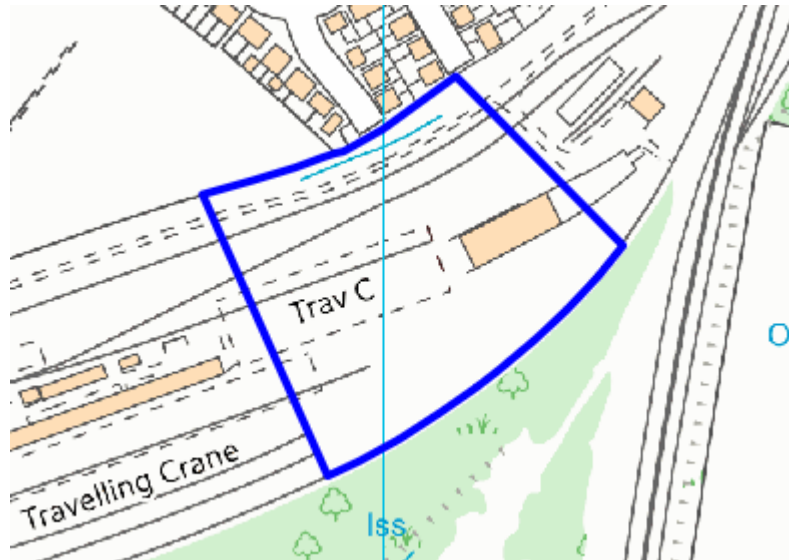


The Coal
Authority

Granted Permit Boundary

Permit Ref: 21608

Permit Boundary:



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