

Geo-Environmental Investigation & Assessment

For a site at

Ferrous – Phoenix II

Undertaken on behalf of

Capital & Centric (Nineteen) Ltd

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Executive Summary

Site Location	The site comprises land off Chapeltown Street, Manchester. It is centred on approximate Ordnance Survey National Grid Reference 385219E, 398060N with an indicative postcode of M1 2BJ.
Development Proposals	The project involves construction of a new 14 and 15-storey residential apartment building. It is assumed that the new building will not have a basement but will have plant at roof level and will include very localised external soft landscaping. It is also anticipated that a substation and kiosk are to be located within the north-eastern apex of the site.
Ground Conditions	Ground conditions encountered during the intrusive investigation generally comprised made ground to depths of between 0.95m and 2.00mbgl. The made ground was underlain by cohesive Glacial Till to depths of between 9.50m and 11.00mbgl, interbedded with granular Glacial Deposits to between 11.00m and 15.50mbgl. The superficial deposits were in turn underlain by sandstone of the Chester Pebble Beds Formation to a maximum proven depth of 28.50mbgl.
Site Preparation	Prior to enabling works commencing detailed discussions with the Metrolink operators will need to be undertaken to establish any restrictions set by them in respect of the adjacent tram lines and the associated retaining wall. Historical/existing foundations, ground floor slabs and other buried concrete/brick obstructions associated with the sites former use may need to be broken out to suitable depths below formation levels where they are to impinge on any proposed structures. Such materials removed as part of the clearance work, subject to appropriate screening and crushing, will be suitable for re-use as bulk fill beneath hard cover areas. Site enabling works and subsequent excavations should take account of the need to maintain the integrity of adjacent infrastructure this may need to include support measures in this respect. No significant earthworks are anticipated to facilitate redevelopment of the site with the exception of localised re-grading.
Foundations	The substation and small kiosk within the north-eastern section of the site could be supported by a reinforced raft designed on a net allowable bearing pressure not exceeding 50kN/m² to limit total differential settlements to tolerable limits. The new multi-storey structure should be supported on piles. Pile type, selection and design should be undertaken in conjunction with a reputable, specialist piling contractor, ideally with experience of the local ground conditions. However, for preliminary considerations, a pre-cast driven concrete pile would minimise waste soil arisings but potential noise and vibration effects may render this option unsuitable. Therefore, a bored pile solution could be the most appropriate solution for the site. Floor slabs for the new structures should be suspended unless underlain by fill which has been compacted to an appropriate specification.
Concrete Classification	The typical design sulfate (DS) class and "Aggressive Chemical Environment for Concrete" (ACEC) class for the natural glacial soils are DS-2 and AC-2 respectively
External Pavements	It is recommended that new road pavement design should be based on a California Bearing Ratio (CBR) value of no more than 2.5% in untreated made ground and natural cohesive strata.
Drainage	In consideration of the predominantly cohesive nature of the natural soils soakaways are not considered a feasible drainage option for the site.
Ground Contamination	The test results indicate that significant /widespread contamination was not encountered across the site. However, more localised elevated concentrations of arsenic and PAH compounds were recorded within 4no samples of made ground. In addition, asbestos in the form of chrysotile fibres was recorded in a 1no samples of made ground. Although the asbestos appears to be localised and at low concentrations it cannot be wholly discounted that further made ground beneath the site could contain ACM and/or free fibres.

	A direct contact pollution linkage will exist in new landscaped areas and it is recommended that made ground exposed at the surface in such areas is removed or is covered by clean sub-soil and topsoil anticipated to be 600mm in thickness removing the pollution linkage. It is recommended that all groundworks should be undertaken under a watching brief with any visible ACM so encountered being segregated for removal to landfill. Such operations may also need to incorporate specific control measures such as dust suppression, perimeter air monitoring and appropriate Personal Protective Equipment (PPE). Due to the low mobile contamination status of the site, the risk to the Principal Aquifer is considered low, even where a potential pathway could be provided by piled foundations for contaminants to migrate downwards towards it. However, it is anticipated that a piling risk assessment may need to be undertaken. Notwithstanding the above, due to the past industrial nature of the site, it cannot be discounted that further unidentified ground contamination could be exposed during groundworks operations. In this respect, it is recommended that a 'watching brief' is undertaken with any suspected ground contamination encountered being segregated for further assessed by an environmental consultant.
Ground Gas	The initial results give a maximum composite Qhg value of 0.0036l/hr and indicate the site to classify as Characteristic Situation (CS) 1 – Very Low Gas Risk' with no specific gas protection measures required. However, the Characteristic Situation will need to be confirmed on completion of the ground gas monitoring and risk assessment in due course
Waste Soils	For guidance and based on the current information, it is likely that the majority of made ground would be classified as Non-Hazardous and natural strata Inert, for landfill disposal. This would need to be confirmed with the landfill operator. However, any soils containing ACM or significant asbestos fibres may classify as 'Hazardous' following further quantification analysis. It will be the responsibility of the waste producer to undertake further testing and classification of any waste soils for disposal to an appropriately licenced landfill in accordance with current guidelines and Duty of Care requirements.

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1.0 INTRODUCTION

Appointment

- 1.1 WML Consulting has been commissioned by Capital & Centric (Nineteen) Ltd to undertake a Geo-environmental Investigation and Assessment of a site located off Chapeltown Street in Manchester.

Proposed Development

- 1.2 The project involves construction of a new 14 and 15-storey residential apartment building. It is assumed that the new building will not have a basement but will have plant at roof level and will include very localised external soft landscaping. It is also anticipated that a substation and kiosk are to be located within the north-eastern apex of the site.
- 1.3 The current proposed development plan is presented within Appendix 01.

Objective

- 1.4 The objective of the ground investigation and assessment was to provide geotechnical recommendations for construction design purposes together with a geo-environmental risk assessment in terms of possible ground contamination.
- 1.5 To achieve the objective, the following tasks were undertaken:
- Review the existing desk study report for the site and design a Phase 2 Ground Investigation.
 - Characterise the ground conditions in terms of geology, soil geotechnical parameters and ground contamination from information provided by the ground investigation.
 - Provide recommendations regarding suitable foundations together with any other geotechnical considerations that could affect possible future development.
 - Determine a ground conceptual model for the site so as to undertake a ground contamination Generic Quantitative Risk Assessment (GQRA).

Scope

- 1.6 A Phase 1 Desk Study for the site area has been undertaken by WML and is presented in the following report:
- Phase 1 Desk Study and Preliminary Geoenvironmental Assessment Report, Reference 9861G-WML-XX-ZZ-RP-G-0001, dated October 2021.
- 1.7 This report includes the findings of a Phase 2 Ground Investigation, undertaken by Groundtech, designed on conclusions and recommendations within the Phase 1 Desk Study. For ease of reference, the findings of the Desk Study are summarised in the following sections. However, the two reports are not exclusive and should be read in conjunction.
- 1.8 The ground investigation comprised the formation of window sample probeholes and cable percussive boreholes extended into bedrock using rotary core methods, undertaken with reference to BS5930:2015 + A1:2020 Code of Practice for Ground Investigation and BS10175:2011 together with A1:2013, "Investigation of Potentially Contaminated Sites - Code of Practice" except where superseded by EN ISO 22475-1 "Geotechnical Investigation and Assessment – Sampling by Drilling and Excavation and Groundwater Measurements".
- 1.9 Geotechnical soil testing was undertaken in general accordance with guidelines provided in BS1377:1990 – Parts 1-9, "Method of Test for Soils for Civil Engineering Purposes". Samples for chemical analysis were obtained and handled generally in accordance with the current guidelines (BS10175: 2011 and A1:2013).

2.0 SITE LOCATION AND DESCRIPTION

Site Location

- 2.1 The site comprises land off Chapeltown Street, Manchester. It is centred on approximate Ordnance Survey National Grid Reference 385219E, 398060N with an indicative postcode of M1 2BJ.
- 2.2 The site is bounded to the North by Chapeltown Street with residential properties beyond; to the north-east by an area of hardstanding and electricity sub-station; to the south by a Metrolink Line with Longacre Street beyond and to the west by existing 10-storey Phoenix residential development.

Site Description

- 2.3 The site comprises an area of maintained grass landscaping.
- 2.4 A CCTV service box is located close to the southwestern part of the site and a row of lamp-posts are located on the northern site boundary.
- 2.5 The southern and south-eastern site boundaries are formed by a Metrolink line which is located in a cutting in the north-eastern part, formed by a brick retaining wall with a line of electricity cables extending along its route, close to the site boundary.
- 2.6 Manholes located in the north-western and southern corners of the site together with a rodding-eye close to the south-western site boundary, indicate the presence of a sewer, although its extent is unknown at this time.
- 2.7 The north-eastern boundary of the site is demarcated by a billboard and is otherwise surrounded by timber knee-rail fencing restricting vehicular access from the north. The southern and south-eastern boundaries access is restricted due to the tramline.

Topography

- 2.8 The topographical survey by Survey and Engineering Projects, referenced S21645-T, provided within Appendix 01 indicates that the site slopes very gently west/south-west from approximately 47.40m Above Ordnance Datum (AOD) in the north-eastern corner to around 46.10m AOD at the western corner of the site.
- 2.9 The surrounding area is generally level with the exception of the south-eastern site boundary where the neighbouring Metrolink line extends into a cutting accommodated by a brick retaining wall. The tramline elevation is roughly 46.35m AOD to the south-west of the site, reducing to around 43.20m AOD immediately before it extends beneath the road bridge.

3.0 SUMMARY OF ENVIRONMENTAL AND HISTORICAL SETTING

3.1 The following paragraphs summarise the most relevant findings of the Phase 1 desk study report.

Geology

3.2 The BGS plans indicate that the site is underlain by cohesive Devensian Glacial Till comprising mainly clay but possibly with interbedded sand and gravel horizons. The drift deposits are underlain by the Triassic Chester Pebble Beds Formation indicated to comprise sandstone.

Radon

3.3 The site is not in Radon Affected Area as defined by the UK Health Security Agency as less than 1% of properties are above the Action Level of exposure. Therefore, no radon protection measures are necessary for new structures as described in publication BR211 by the Building Research Establishment.

Mining and Subsidence

3.4 In consideration of the indicated geology, risks to the development from subsidence relating to shallow, unrecorded abandoned mine workings are considered low and can be discounted.

3.5 The risk from non-coal mining activity at the site is also considered very low.

Environmental Setting

3.6 The bedrock underlying the site is classified as a 'Principal Aquifer'. The superficial strata is classified as a Secondary (Undifferentiated) Aquifer'.

3.7 There are no source protection zones within 500m of the site and no active groundwater abstraction licences are listed within the 1km of the site boundary. One surface water feature is located within 250m of the site, the Ashton Canal 47m north-west.

3.8 There are no active landfills located within 500m of the site or historic landfills located within 250m of the site.

Site History

3.9 The earliest map dated 1848 indicates the site to comprise mixed residential terraced structures, together with back-to-back housing described as Whitaker's building and an Iron Foundry, later with a chimney. Chapel Street formed the north-western site boundary with Fair Street extending north to south-west in the extreme west of the site.

3.10 The site remained relatively unchanged until reconfiguration of the Dolphin Foundry (Iron) in 1932. By this time, the back-to-back houses had been cleared with the terrace structures remaining along Chapel Street.

3.11 By 1948, the remaining residential structures had been cleared with the Iron Foundry remaining in the south and western sections although modified in the central section.

3.12 By 1978, the Iron Foundry had been cleared and the central and western sections of the site redeveloped as a warehouse which extended southwards outside of the current site boundary. This remained until sometime in the 2010s when the site was cleared.

3.13 Between 2017 and 2020 the adjacent residential tower block and the tramline were constructed to the west and south respectively. Anecdotal information indicates that the western section of the site was used as a construction laydown area during the adjacent development before being landscaped into its 2021 configuration.

- 3.14 The area surrounding the site has historically comprised mixed residential and industrial development, including Phoenix (Brass, Iron & Machinery) Works immediately to the west and Chapel Street (Cotton) Mill and Victoria Iron Works both 10m north.
- 3.15 Many of the surrounding residential properties were cleared between 1932 and 1948 prior to industrial redevelopment, including an Engineering Works immediately north-east and a Box Factory immediately south-west on the site of the recently constructed Ferrous I building, with the Crusader Stationary Works to the north and south of Chapel Street further to the west.
- 3.16 More recently, the wider area has been cleared of industrial structures and redeveloped with multi-storey residential structures including those on the land immediately north and west of the site.

Preliminary Contamination Risk Assessment

- 3.17 The approach at the Phase 1 Desk Study stage was precautionary until such time as uncertainties in the conceptual model can be verified by appropriate site investigation.
- 3.18 However, based on the site history and the proposed development scenario, potential pollution linkages were considered low or unlikely with associated preliminary risks being assessed as moderate/low at worst.
- 3.19 Such uncertainties relate, in the main, to the level of historical contamination as a result of the site's brownfield status and the potential for ACM to be present as a result of previous building demolition.

4.0 SITE INVESTIGATION

Rationale

- 4.1 Intrusive investigations were undertaken to provide geotechnical parameters for structural design purposes and to verify the preliminary site conceptual model and clarify the environmental risk.
- 4.2 Due to the risks from World War II ordnance, the investigations were undertaken under supervision and Magnetometer surveying by a UXO Specialist.
- 4.3 Window sample probeholes have been undertaken to provide information on near surface deposits and to obtain samples for chemical analysis. Due to the small diameter of the probing equipment, the depth of penetration achieved is dependent on favourable ground conditions. As such, ground penetration may be restricted in circumstances where the ground is particularly strong or contains relatively large obstructions such as cobbles and/or boulders.
- 4.4 Cable tool percussion boreholes and rotary core boreholes were also undertaken to provide information on deeper ground for pile design.
- 4.5 The investigation locations were chosen so as not to impact on the presence of known/suspected services beneath the site. The locations were also chosen so as not to impact upon either the southern retaining walls or the adjacent Metrolink.

Intrusive Works

- 4.6 Ground Investigation works were undertaken by Groundtech Limited between the 12th and 23rd September 2022. This comprised 4no cable tool percussive boreholes (CP01 to CP04) advanced into bedrock by rotary core techniques to depths of between 24.00m and 28.50 metres below ground level (mbgl) and 6no windowless sample probeholes (WS01 to WS06) advanced to depths of between 1.45m and 2.45mbgl.
- 4.7 The exploratory hole records and locations are presented in the Groundtech Factual information in Appendix 02 of this report.

Monitoring Standpipes

- 4.8 Monitoring wells for gas and groundwater measurements were installed in 3 No. probeholes, namely WS02, WS03 and WS06 as indicated on the logs presented in Appendix 02.

Geotechnical and Chemical Testing

- 4.9 In-situ geotechnical testing was undertaken at regular intervals during the formation of the window samples and boreholes in the form of Standard Penetration Tests (SPT's). The results for this testing are presented on the descriptive logs in Appendix 02.
- 4.10 Geotechnical soils testing was undertaken on selected samples for the following:
 - Natural moisture content
 - Liquid and Plastic limits.
 - Single stage triaxial tests.
 - Dry density/moisture content relationship (compaction).
 - Undrained Shear Strength in triaxial compression.
- 4.11 Geotechnical rock testing was undertaken on selected samples as follows:
 - Unconfined Compressive Strength (UCS).
 - Point Load Index (axial / diametral).

- 4.12 The results of the geotechnical testing are presented with the Groundtech information in Appendix 02.
- 4.13 Chemical analysis was undertaken on selected soil samples for the following contaminants of concern:
- Total arsenic, boron, cadmium, chromium VI, copper, lead, mercury, nickel, selenium, vanadium, zinc.
 - Total cyanide, phenols, sulphur, sulphate.
 - Speciated USEPA polycyclic aromatic hydrocarbons (PAH).
 - Total petroleum hydrocarbons (TPHCWG).
 - BTEX & MTBE.
 - Asbestos screen and identification.
 - 2:1 water/soil sulphate extract, pH.
- 4.14 In order to assess the potential risk to controlled waters, selected samples of shallow soils from the site underwent leachate preparation for the following suite of contaminants:
- Total arsenic, boron, cadmium, chromium VI, copper, lead, mercury, nickel, selenium, vanadium, zinc.
 - Cyanide.
 - Speciated (16) hydrocarbons (PAH).
 - Total phenols, sulphur, sulphate.
 - Sulphate extract, pH.
- 4.15 The results of the chemical testing are presented with the Groundtech information in Appendix 02.

Groundwater and Ground Gas Monitoring

- 4.16 Monitoring of standpipes for groundwater levels and ground gas has been undertaken on 2no occasions to date on 6th and 24th October 2022. The results are presented with the Groundtech information in Appendix 02.

5.0 GROUND CONDITIONS

General

- 5.1 Ground conditions encountered during the intrusive investigation generally comprised made ground to depths of between 0.95m and 2.00mbgl. The made ground was underlain by cohesive Glacial Till to depths of between 9.50m and 11.00mbgl, interbedded with granular Glacial Deposits to between 11.00m and 15.50mbgl. The superficial deposits were in turn underlain by sandstone of the Chester Pebble Beds Formation to a maximum proven depth of 28.50mbgl.

Made Ground

- 5.2 Made ground was encountered within all exploratory holes from ground level to a depths of between 0.95m and in 2.00mbgl.
- 5.3 The made ground generally comprised a surface horizon of dark brown topsoil extending to between 0.10m and 0.30mbgl, underlain by black to brown, variably clayey, gravelly sand and locally sandy gravel and gravelly clay. Gravel sized fragments included brick, sandstone, concrete, ceramic, metal, ironstone, plastic and clinker.
- 5.4 Within WS01 a suspected concrete obstruction was encountered at 1.45mbgl and considered to possibly represent a remnant floor slab from historic construction.

Glacial Deposits

- 5.5 Within all of the exploratory holes penetrating the made ground, soil considered to represent Glacial Deposits were encountered beneath the made ground at depths of between 0.95m and 2.00mbgl. Within the deeper boreholes these were found to extend to depths of between 11.00m and 15.50mbgl.
- 5.6 The upper horizons generally comprised brown, slightly gravelly, silty clay to depths of between 9.50m and 11.00mbgl. Gravels included sandstone and coal.
- 5.7 The lower horizons graded into variably clayey, silty and gravelly sand and locally variably clayey and sandy gravel. However, within CP03 and CP04 these were interbedded with sandy, gravelly clay.
- 5.8 SPT 'N' values within the cohesive Glacial Deposits ranged between 7 to in excess of 50 indicating a initially soft to firm, becoming stiff to very stiff consistency.
- 5.9 SPT 'N' values within the granular Glacial Deposits ranged between 17 and in excess of 50 indicating a initially medium dense, becoming dense to very dense state of compaction.

Chester Pebble Beds Formation

- 5.10 Within the deeper cable percussive boreholes with rotary follow-on, namely CP01 to CP04, strata considered to represent the Chester Pebble Beds Formation were encountered beneath the Glacial Deposits at depths of between 11.00m and 15.50mbgl, extending to a maximum proven depth of 28.50mbgl.
- 5.11 These deposits generally comprised variably weathered, extremely weak to weak, red sandstone.
- 5.12 Areas of no recovery were noted within the majority of the cable holes formed within the sandstone and generally areas described as weak and extremely weak roughly corresponding with area where the strata was recovered as a gravelly sand. Therefore, it is considered that these areas of no recovery most likely relate to areas of sandstone weathered to near the consistency of a soil and the drilling technique was unable to sufficiently recover them.
- 5.13 Core index data indicate Total Core Recovery (TCR) generally between 40% and 100% with Solid Core Recovery generally between 38% and 85%. A Rock Quality Designation (RQD) generally of between

0% and 65% indicates the rock to be locally of poor quality. Fracture Indices also indicate that areas of no recovery and non-intact are locally indicative of the very weak rock with the areas of no recovery highlighted in the rock core descriptions.

- 5.14 SPT 'N' values within the upper parts of the Chester Pebble Beds formation exceeded 50, indicating the equivalent of a very dense state of compaction.

Geotechnical Testing

- 5.15 Geotechnical testing undertaken on selected samples are summarised in the following table:

Test			Made Ground	Glacial Deposits
Natural Content	Moisture	Cohesive	-	14 - 20%
		Granular	-	8.5%
Liquid Limit (cohesive)			-	32 - 48%
Plasticity Index (cohesive)			-	16 - 26%
Atterberg Classification (cohesive)			-	Low - Intermediate Plasticity
Dry Density			1.74 – 1.91Mg/m ³	1.71 – 1.87 Mg/m ³
Bulk Density			-	2.02 – 2.13 Mg/m ³
Optimum Moisture Content			12 - 16%	-
Undrained Triaxial Strength Testing			-	111 - 131kN/m ²

- 5.16 The results of the rock core laboratory testing are summarised as follows:

Depth Range (mbgl)	Point Load I _{s(50)} (Approximate Equivalent UCS) MPa		Unconfined Compressive Strength (UCS) MPa	Relative Strength
	Axial	Diametral		
16.00 – 20.00	0.17 – 0.62 (2.38 – 8.68)	0.03 (0.42)	*29.60	Very weak locally moderately strong
20.00 - 27.00	0.12 – 0.36 (1.68 -5.04)	0.03 (0.42)	*25.20 – 27.90	Very weak locally moderately strong

- 5.17 It should be noted that some of the core samples issued for UCS testing were unsuitable so point loads were carried out instead.

Visual/Olfactory Evidence of Contamination

- 5.18 Visual evidence of ash and clinker was noted within the made ground at locations WS02 and WS03. Otherwise no visual and/or olfactory evidence of significant ground contamination was identified within the exploratory holes during the investigation.

Groundwater

- 5.19 Groundwater was not encountered during the formation of the exploratory holes.

- 5.20 Initial groundwater monitoring has recorded perched water levels in standpipes ranging between 0.86m and 1.98mbgl.
- 5.21 It should be appreciated that the groundwater observations described above have been undertaken during a very short period of time. Significant variations in the long-term groundwater regime may occur at other times, particularly with prolonged, extreme weather conditions, and that no account can be taken of such in this report.

General

- 5.22 It should also be appreciated that ground conditions may vary between and away from the exploratory hole positions, and that no account can be taken in this report of such variations.

6.0 GEOTECHNICAL APPRAISAL

Site Preparation

- 6.1 Prior to enabling works commencing detailed discussions with the Metrolink operators will need to be undertaken to establish any restrictions set by them in respect of the adjacent tram lines and the associated retaining wall.
- 6.2 Historical/existing foundations, ground floor slabs and other buried concrete/brick obstructions associated with the sites former use may need to be broken out to suitable depths below formation levels where they are to impinge on any proposed structures. Such materials removed as part of the clearance work, subject to appropriate screening and crushing, will be suitable for re-use as bulk fill beneath hard cover areas.
- 6.3 In addition the former crane base and any that impinge on the proposed development would need to be removed. A plan identifying the coordinates of the crane base is included on drawing referenced BDP-FRS-XX-00-DR-A-200201, by BDP in Appendix 01.
- 6.4 No significant quantities of suitable topsoil have been encountered at the site, so it is anticipated that any topsoil required for capping to landscaped areas will need to be imported to site, subject to suitability testing.
- 6.5 Site enabling works and subsequent excavations should take account of the need to maintain the integrity of adjacent infrastructure such as the adjacent tram line, roads and adjacent property. It is anticipated that this may need to include support measures in this respect.
- 6.6 No significant earthworks are anticipated to facilitate redevelopment of the site with the exception of localised re-grading.

Retaining Walls

- 6.7 The surrounding area is generally level with the exception of the south-eastern site boundary where the neighbouring Metrolink line extends into a cutting accommodated by a brick retaining wall. The tramline elevation is roughly 46.35m AOD to the south-west of the site, reducing to around 43.20m AOD immediately before it extends beneath the road bridge.
- 6.8 Therefore although new retaining walls are not anticipated to be required based on the existing and proposed elevation, the structural integrity of the existing retaining wall will need to be maintained during and after the construction works and consultation with a structural engineer is recommended in this respect.

Foundations

- 6.9 Made ground and any soft / loose natural deposits should be considered unsuitable for the direct support of structural loads as they will be weak and compressible, leading to possibly unacceptable total and differential settlements.
- 6.10 The substation and small kiosk within the north-eastern section of the site could be supported by a reinforced raft designed on a net allowable bearing pressure not exceeding 50kN/m² to limit total differential settlements to tolerable limits. Foundations should be suitably reinforced and constructed on a suitable thickness of selected and imported granular fill which should be compacted to a n agreed engineering specification on proof-rolled ground and where underlain by made ground incorporating geo-grid reinforcement. Any loose, soft or otherwise unsuitable material identified at proof-rolling stage should be removed and replaced with well compacted granular fill.
- 6.11 The new multi-storey structure should be supported on piles. Pile design should assume no side support (skin friction) for the pile sections surrounded by made ground and may need to be designed to withstand potentially negative skin friction effects within the cohesive strata.

- 6.12 Pile type, selection and design should to be undertaken in conjunction with a reputable, specialist piling contractor, ideally with experience of the local ground conditions.
- 6.13 However, for preliminary considerations, a pre-cast driven concrete pile would minimise waste soil arisings but potential noise and vibration effects may render this option unsuitable. Therefore, a bored pile solution could be the most appropriate solution for the site.
- 6.14 Foundation construction will also need to take account of any remaining and/or new services and the adjacent road and metrolink infrastructure, where they are in close proximity, may need to be taken down to beneath the lowest level of the service trench so that their structural integrity is maintained.

Floor Slabs

- 6.15 Floor slabs for the new structures should be suspended unless underlain by fill which has been compacted to an appropriate specification.

Excavations and Groundwater

- 6.16 Excavations at the site will be feasible using conventional hydraulic plant. All excavations at the site and specifically requiring man-entry, will need adequate lateral support, or will need to be battering back to a safe angle to ensure their stability.
- 6.17 Conventional 'sump and pump' dewatering measures are likely to be adequate to keep excavations dry, although it cannot be discounted that groundwater exclusion measures such as interlocking sheet piles would be required to prevent excessive ingress of water during periods of prolonged rainfall.
- 6.18 Such support measures will also reduce the risk of conditions that could lead to loss of ground beneath any nearby adjacent structures or infrastructure.

External Pavements

- 6.19 In consideration of the near surface ground conditions, it is recommended that new road pavement design should be based on a California Bearing Ratio (CBR) value of no more than 2.5% in untreated made ground and natural cohesive strata.
- 6.20 The CBR will need to be reviewed and confirmed by site inspection and possibly suitable in-situ testing at formation levels following any earthwork operations and prior to pavement construction.
- 6.21 In any event, all formations should be proof-rolled with any soft, loose or otherwise unsuitable material being removed and replaced with compacted granular fill.

Concrete Design

- 6.22 Design/mix of buried concrete should be undertaken in accordance with the "Aggressive Chemical Environment for Concrete" (ACEC) classification, of BRE Special Digest 1:2005 (Concrete in Aggressive Ground). With reference to the site history, it is deemed appropriate to classify the site as "Brownfield", with respect to BRE Special Digest, assuming mobile groundwater conditions.
- 6.23 Values of 2:1 water/soil extract for sulphate range between 13 and 1500mg/l with values of pH ranging between 8.2 and 10.5 indicating alkaline conditions.
- 6.24 On the basis of these results, the typical design sulfate (DS) class and "Aggressive Chemical Environment for Concrete" (ACEC) class for the natural glacial soils are DS-2 and AC-2 respectively.

Drainage and Soakaways

- 6.25 In consideration of the predominantly cohesive nature of the natural soils soakaways are not considered a feasible drainage option for the site.

7.0 GENERIC QUANTITATIVE RISK ASSESSMENT (GQRA)

General

- 7.1 A review of the readily available information has concluded that the potential for exposure to ground contamination is low or unlikely with associated preliminary risks being assessed as moderate/low at worst.
- 7.2 However, it has been considered prudent to undertake chemical analysis of the sub-surface soils to confirm the low human health risk status of the site.

Human Health

- 7.3 Selected samples have been analysed for a general suite of contaminants of concern and compared against Screening Levels (SL's) for human health to determine the significance of the measured concentrations in relation to the site conceptual model. Thus, a Generic Quantitative Risk Assessment has been undertaken in line with guidelines provided in Land Contamination Risk Management, October 2020.
- 7.4 The criteria for a limited number of contaminants have been derived by DEFRA in their document entitled SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, April 2014.
- 7.5 Within the document, Category 4 Screening Levels (C4SL's) are described as being more pragmatic than previous screening criteria and represent concentrations in soil that present an 'acceptable' level of risk within the context of Part 2A.
- 7.6 The National Planning Policy Framework states that 'after development, as a minimum, land should not be capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990'. Therefore, by inference, the C4SL's are appropriate for use in the planning context.
- 7.7 Although the SP1010 document states that C4SL only apply for a 'sandy loam soil with 6% soil organic matter', it is generally accepted that assessment criteria for metals are not sensitive to changes in soil organic content (SOM). The C4SL's have therefore been adopted as assessment criteria in this report for the listed metals within the SP1010.
- 7.8 Subsequent to SP1010, LQM/CIEH have published a document entitled 'The LQM/CIEH S4ULs for Human Health Risk Assessment' 2015. In brief, the document provides updated assessment criteria which have been derived in accordance with UK legislation, national as well as EA policy and using a modified version of the CLEA software and available guidance. The new screening criteria, or Suitable 4 Use Levels (S4ULs), are intended to provide a complete and updated replacement to the previous LQM/CIEH GAC of 2009. As such they are considered appropriate for use in this assessment for other contaminants not covered by C4SL's and/or for organic contaminants assuming a worst-case Soil Organic Matter (SOM) of 1% as an initial conservative assessment.
- 7.9 For each contaminant, S4UL's and C4SL's have been calculated for six land use scenarios, namely:
- Residential with homegrown produce.
 - Residential without homegrown produce.
 - Allotments.
 - Commercial.
 - Public Open Space, near residential housing.
 - Public Parks, remote from residential housing.
- 7.10 In light of the proposed development, the SL's for a "Residential without homegrown produce" end-use are considered appropriate for the assessment at this stage. A table of relevant SL's are provided in Appendix 03.

Controlled Waters

- 7.11 Generic criteria for the assessment of potential groundwater contamination have been derived from very conservative guidelines protective of drinking water and environmental quality, namely:
- UK Drinking Water Standards (DWS) as defined by The Water Supply (Water Quality) Regulations, 2016;
 - UK Environmental Quality Standards (EQS) for Freshwater, based on the United Utilities Hardness based on the postcode (M1 2BJ) of soft; 0 – 50mg/l CaCO₃.
 - Petroleum Products in Drinking-water, Background document for development of WHO Guidelines for Drinking-water Quality, 2011.
- 7.12 A table of relevant SL's are provided in Appendix 03.

Soil Test Results

- 7.13 14no soil samples were analysed for a suite of Contaminants of Concern (CoC). The majority of the concentrations were measured below the SL's for a "Residential without homegrown produce" end-use with the following exceptions.

Contaminant	Number of Exceedances	SL (mg/kg)	Recorded Concentrations (mg/kg)	Samples
Arsenic	2	40	41 - 86	WS02 – 1.00m WS03 – 0.50m
Naphthalene	1	2.3	9.3	WS04 – 0.50m
Benzo[a]anthracene	1	11	26	WS04 – 0.50m
Benzo[b]fluoranthene	3	3.9	5.8 - 27	WS02 – 0.15m WS04 – 0.50m WS06 – 0.30m
Benzo[a]pyrene	3	3.2	5.2 - 24	WS02 – 0.15m WS04 – 0.50m WS06 – 0.30m
Dibenz[a,h]anthracene	4	0.31	0.33 - 2.8	WS01 – 0.10m WS01 – 0.50m WS02 – 0.15m WS04 – 0.50m

- 7.14 2no samples submitted for TPH compound analysis recorded all of concentrations below the relevant reference values for the proposed end-use.
- 7.15 Asbestos was also detected in 1no of the samples analysed (WS01 – 0.50m) in the form of Chrysotile fibres. Quantification testing of this sample has recorded an asbestos concentrations of 0.001% by gravimetry.

Leachate Testing

- 7.16 4no samples of made ground were submitted for leachate preparation and tested for a range of contaminants of concern.
- 7.17 The majority of results were below the assessment criteria when compared to stringent drinking water and environmental standards (EQS with a water hardness of 0-50mg/l) with the following exceptions.

Contaminant	Ref Value ug/l		Concentration Exceedances ug/l		Samples
	EQS	UKDWS	EQS	UKDWS	
Chromium	2	50	2.4	-	CP03 – 0.50m
Copper	0.5	2000	6.7 - 12	-	CP02 – 0.50m CP03 – 0.50m CP04 – 0.50m CP04 – 1.00m
Lead	4	10	6.9 - 12	12	CP02 – 0.50m CP03 – 0.50m CP04 – 0.50m
Zinc	8	5000	8.8 - 14	-	CP03 – 0.50m CP04 – 1.00m

Discussion and Conclusions

Human Health

- 7.18 The test results indicate that localised sections of made ground beneath the site contain levels of certain CoC's that are slightly elevated above their respective SL's. This relates to elevated concentrations of arsenic and PAH compounds recorded within 4no samples of made ground.
- 7.19 In addition, asbestos in the form of chrysotile fibres was recorded in a 1no samples of made ground. Although these appear to be localised and at low concentrations it cannot be wholly discounted that further made ground beneath the site could contain ACM and/or free fibres.
- 7.20 Notwithstanding this, where surfaced with hardstanding, there will be no mechanism for a long-term direct contact contamination linkage or for any asbestos fibres to become airborne. Therefore the risk to end-users and to the general public will be negligible in the long-term.
- 7.21 However, a direct contact pollution linkage will still exist in new landscaped areas and it is recommended that made ground exposed at the surface in such areas is removed or is covered by clean sub-soil and topsoil thus removing the pollution linkage. This will normally comprise a 600mm clean cover, with a minimum 150mm thickness of topsoil and 450mm thickness of sub-soil, over the existing made ground.
- 7.22 Furthermore, as asbestos fibres could become airborne during site enabling and ground works, there is a perceived risk to construction workers and the general public, particularly during dry weather conditions.
- 7.23 Therefore, it is recommended that all groundworks should be undertaken under a watching brief with any visible ACM so encountered being segregated for removal to landfill. Such operations may also need to incorporate specific control measures such as dust suppression, perimeter air monitoring and appropriate Personal Protective Equipment (PPE).
- 7.24 The re-use of any site-won materials as engineered fill, where considered appropriate, would be subject to further testing.

Controlled Waters

- 7.25 No indications of hydrocarbon contamination were noted in any of the exploratory holes.
- 7.26 Although the bedrock underlying the site is classified as a 'Principal Aquifer' the overlying superficial deposits are predominantly cohesive and therefore relatively impermeable in nature, limiting the potential for downward migration of any localised mobile contamination sources.

- 7.27 There are no source protection zones within 500m of the site and no active groundwater abstraction licences are listed within the 1km of the site boundary. One surface water feature is located within 250m of the site, the Ashton Canal 47m north-west.
- 7.28 Taking into consideration the low sensitivity of the underlying superficial aquifer the concentrations recorded are not considered to represent a significant ongoing source of contamination.
- 7.29 Due to the low mobile contamination status of the site, the risk to the Principal Aquifer is considered low, even where a potential pathway could be provided by piled foundations for contaminants to migrate downwards towards it. However, it is anticipated that a piling risk assessment may need to be undertaken.
- 7.30 Notwithstanding the above, due to the past industrial nature of the site, it cannot be discounted that further unidentified ground contamination could be exposed during groundworks operations. In this respect, it is recommended that a 'watching brief' is undertaken with any suspected ground contamination encountered being segregated for further assessed by an environmental consultant.

8.0 GROUND GAS RISK ASSESSMENT

Methodology

- 8.1 Current guidance for the assessment of risk associated with the presence of hazardous ground gases (principally methane and carbon dioxide) is provided in two key documents, namely:
- Code of practice for the Characterisation and remediation from Ground Gas in Affected Developments. British Standard Institution (BS 8485: 2015 & A1:2019); and
 - Assessing Risks posed by Hazardous Ground Gases to Buildings CIRIA (C665, 2007).
- 8.2 The assessment presented herein is primarily based on the BS8485 document.
- 8.3 Hazardous ground gas qualitative risk assessment is based on a conceptual model similar to that used for soil and groundwater contamination sources (i.e., source-pathway-receptor pollutant linkages). A semi-quantitative estimate of risk can be assessed based on knowledge of the conceptual model and a measure of hazardous gas concentration and gas flow at the site within monitoring standpipes.
- 8.4 Based on the measured flow rates and hazardous gas concentrations, individual "hazardous gas flow rates" (Q_{hg}) can 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.
- 8.5 BS8485 provides guidance on the level of gas protection requirements based upon the characteristic situation and the proposed development based on building type as outlined in Table 3.

Table 3 - Building Types

	Type A	Type B	Type C	Type D
Ownership	Private	Private or commercial/ Public, possible multiple	Commercial / Public	Commercial / Industrial
Control (Change of use)	None	Some but not all	Full	Full
Room Sizes	Small	Small/ medium	Small to Large	Large Industrial/ Retail Park

- 8.6 The proposed development therefore is indicated to comprise the construction of Type B buildings which include private or commercial structures with small to medium room sizes.

Ground Gas Conceptual Model

- 8.7 The site is not in Radon Affected Area, defined by the UK Health Security Agency as less than 1% of properties are above the Action Level of exposure. Therefore, no radon protection measures are necessary for new structures as described in publication BR211 by the Building Research Establishment.
- 8.8 There are no active landfills located within 500m of the site or historic landfills located within 250m of the site.
- 8.9 The presence of ground gas resulting from shallow unrecorded mine workings is considered unlikely.
- 8.10 No appreciable thickness of made ground or other soil with significant organic content have been encountered beneath the site.
- 8.11 However, it has been considered prudent to undertake ground gas monitoring, primarily for methane and carbon dioxide, with associated flow rates on 2no occasions to date, the 6th and 24th October 2022.

Results and Recommendations

- 8.12 The results to date indicate concentrations of peak and steady state methane not exceeding 0.1% by volume in air (v/v) and peak and steady state carbon dioxide concentrations ranging between 1.6% and 3.6% v/v. No detectable steady state ground gas flows were recorded.
- 8.13 The initial results give a maximum composite Q_{hg} value of 0.0036l/hr and indicate the site to classify as Characteristic Situation (CS) 1 – Very Low Gas Risk' with no specific gas protection measures required.
- 8.14 However, the Characteristic Situation will need to be confirmed on completion of the ground gas monitoring and risk assessment in due course and should also be confirmed with the local authority Environmental Health / Building Control Officer prior to any building design being finalised.

9.0 OTHER POTENTIAL DEVELOPMENT CONSIDERATIONS

Excavated Soils

- 9.1 Excavation works undertaken during the development are likely to produce waste soils for which appropriate waste management will be required. In line with current sustainability principals, any waste soils should firstly be considered for re-use where possible by incorporation into the development.
- 9.2 However, due to the extent of the proposed redevelopment, it is envisaged that such excavated soil will, in the main, need to be removed from site under appropriate duty of care.
- 9.3 It should be noted that the chemical analysis results for disposal classification are assessed against different assessment criteria to those relating to contamination risk assessment. Soils that are deemed suitable for use in terms of risk to human health and the environment may not necessary be uncontaminated and could be classified as Non-Hazardous or even Hazardous for disposal purposes.
- 9.4 It will be the responsibility of the waste producer to undertake additional testing and classification of any waste soils for disposal to an appropriately licenced landfill in accordance with current guidelines.
- 9.5 For guidance and based on the current information, it is likely that the majority of made ground would be classified as Non-Hazardous and natural strata Inert, for landfill disposal. This would need to be confirmed with the landfill operator.
- 9.6 However, any soils containing ACM or significant asbestos fibres may classify as 'Hazardous' following further quantification analysis.
- 9.7 It will be the responsibility of the waste producer to undertake further testing and classification of any waste soils for disposal to an appropriately licenced landfill in accordance with current guidelines and Duty of Care requirements.

Imported Fill

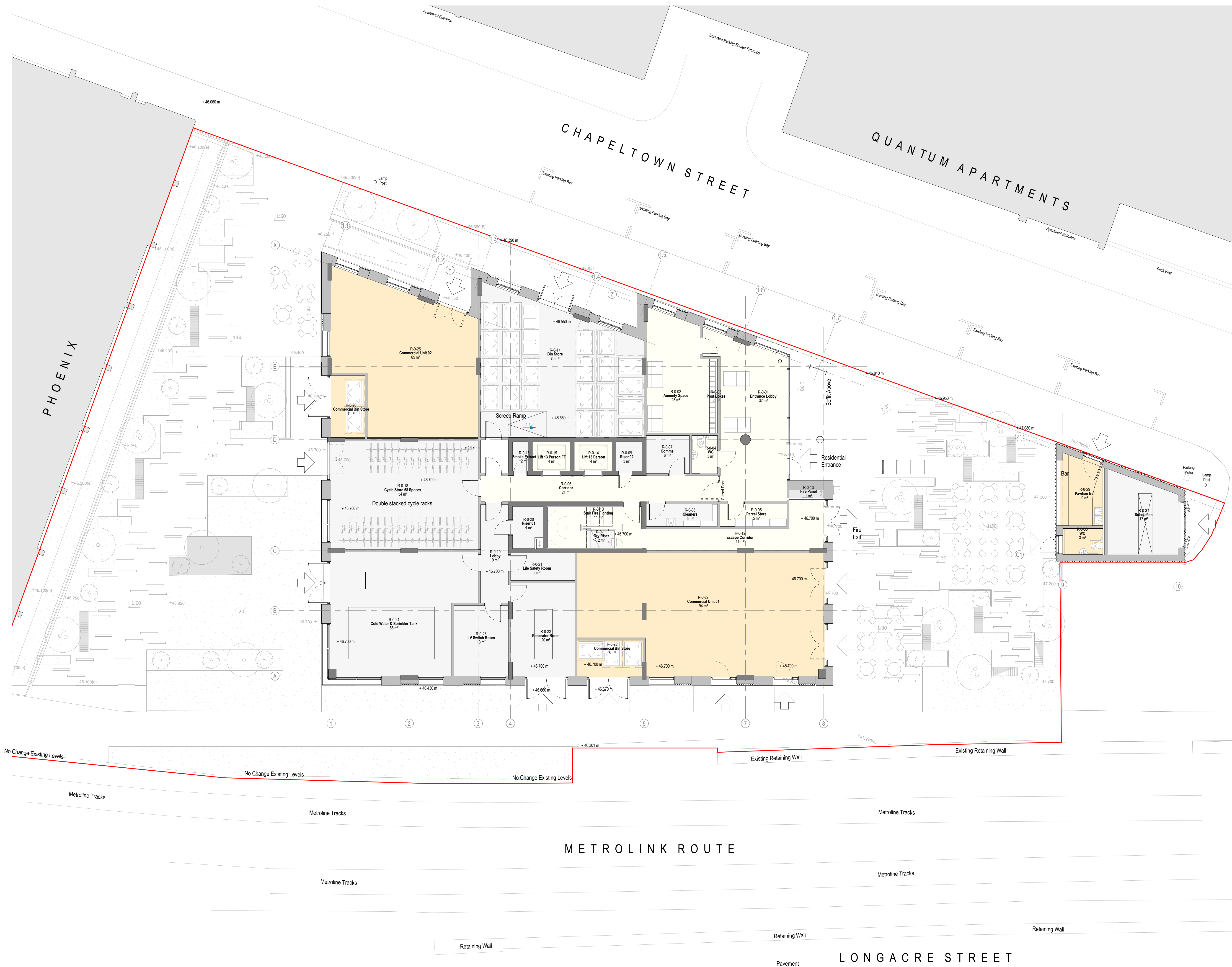
- 9.8 Imported fill will be subject to specific quality requirements and should be accompanied by appropriate certification to confirm its suitability. Allowance should also be made for testing imported fill materials prior to placement to ensure suitability.

Water Supply Pipes

- 9.9 The relevant water supply provider will need to be consulted with regards the selection of suitable water supply pipe materials for the development, should these be required. In light of the ground conditions encountered, the requirement for specific materials and measures to protect the water supply from ground contamination are not anticipated.

APPENDIX 01

Drawings



BUILDING DESIGN PARTNERSHIP SHALL HAVE NO RESPONSIBILITY FOR ANY USE MADE OF THIS DOCUMENT OTHER THAN FOR THAT WHICH IT WAS PREPARED AND ISSUED.

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DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE FOLLOWING BEFORE WORK COMMENCES:

- THE CDM DESIGN ISSUES REGISTER
- THE BDP RISK SERIES OF DRAWINGS
- THE PROJECT CDM RISK REGISTER

Notes

P08	Planning Issue	JSMB	01.11.21
P07	Planning Draft Issue	JSMB	25.10.21
REVISION	DESCRIPTION	DRAWN / CHECKED	DATE

REPLAN

CLIENT

CAPITAL&CENTRIC

BDP.

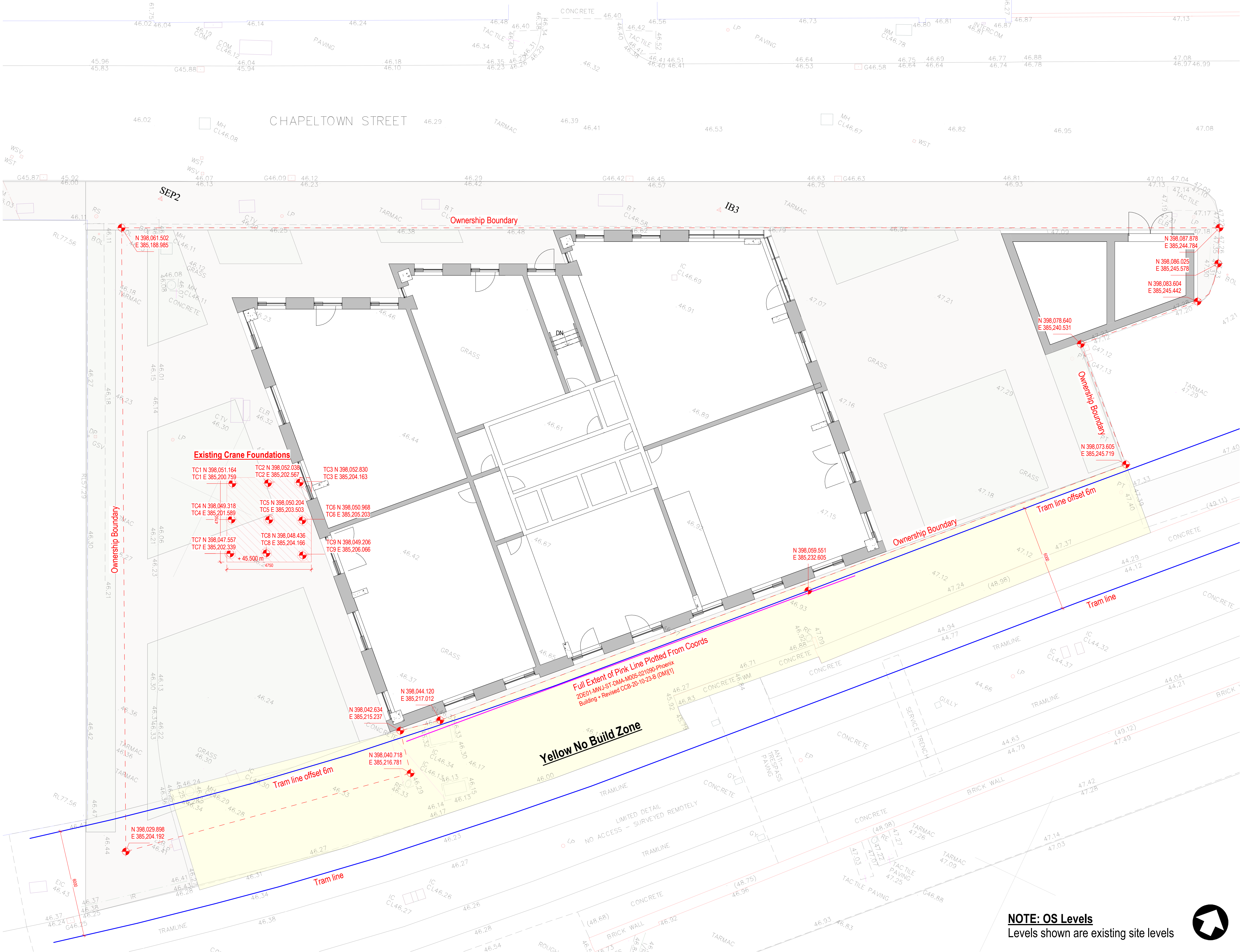
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Ferrous

PROJECT TITLE	P3001911	SCALE	@ A1
DRAWING TITLE	GA Plan - Level 00 Ground Floor	SCALE	1 : 100
DRAWING NO.	BDP-FRS-XX-00-DR-A-200211	DATE FIRST ISSUED	21.04.21
REVISION	P08	DATE	





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- THE CDM DESIGN ISSUES REGISTER
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- THE PROJECT CDM RISK REGISTER

NOTES

Site Constraints Legend

- Ownership Boundary**
 - BDP has traced the Redline Ownership Boundary from the Shed KM pdf drawing "Demise plan(9893473.1) / CW B4 SKM (00) 004b"
 - No CAD / DWG version has been supplied to BDP for verification of boundary coordinates.
 - Redline Coordinates have been plotted by BDP from the traced for verification purposes only.
- No Build TIGM Tramline Servicing Zone**
 - No buildings to be erected within yellow zone, but ground landscaping is allowed.
 - This restriction is to allow TIGM to service the tramline.
 - BDP has traced the Yellow Area from the Shed KM pdf drawing "Demise plan(9893473.1) / CW B4 SKM (00) 004b"
 - No CAD / DWG version has been supplied to BDP for verification of yellow area coordinates.
- HS2 Working Area to re-align Metrolink**
 - HS2 Ltd have advised that both the above ground structure and the below ground foundations cannot crossover the pink line.
 - Works are required to the Metrolink due to the lowering of the alignment to allow for new Metrolink station under the HS2 station.
 - HS2 Ltd need to undertake piling works which will require a working area and the HS2 propose to utilise TWAO area to carry out these works.
 - BDP has plotted the "Pink Line" from the coordinates on pdf drawing "2DE01-MWJ-ST-DMA-M005-021090-Phoenix Building + Revised CCB-20-10-23-B (DM)[1]"
 - No CAD / DWG version has been supplied to BDP for verification of coordinates.
- Metrolink Offset 6m**
 - Metro Tram line has been plotted from SEP Survey dwg drawing "S21645-T"
 - 6m offset from nearest tramline to proposed building shown.
 - NOTE: Required offset distance to be confirmed by client
- Existing Crane Foundation Piles**
 - Existing crane base and piles have been plotted from coordinates supplied via email from Eric Wright Construction 10.08.2020
 - Extent of pile cap to be verified by site survey as pile coordinates do not match design dimension setting out.
- Survey Existing Levels**
 - Existing Levels are shown.
 - Levels plotted from SEP Survey dwg drawing "S21645-T"

P01	First Issue Site Constraints	JSMB	03.06.21
REVISION	DESCRIPTION	DRAWN	CHECKED

REVISION

CURT

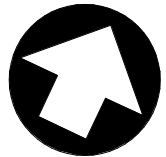


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PROJECT TITLE	Ferrous
BDP JOB NUMBER	P3001911
DRAWING TITLE	Site Constraints Plan
DRAWING NO.	BDP-FRS-XX-00-DR-A-200201
SCALE	@ A1 1 : 100
DATE FIRST ISSUED	06/01/21
REVISION	P01

NOTE: OS Levels
Levels shown are existing site levels



APPENDIX 02

Groundtech Factual Information



GROUNDTECH
CONSULTING

Job title: Ferrous Phase II

Report type: Factual Geo-Environmental
Report

Prepared for: WML Consulting Limited

Date: November 2022

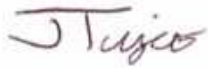
Document Control Form	
PROJECT	FERROUS PHASE II, MANCHESTER
REPORT NAME	FACTUAL GEO-ENVIRONMENTAL REPORT
REPORT REFERENCE	GRO-21454-3981
STATUS	FINAL
ISSUE DATE	11 NOVEMBER 2022
CLIENT	WML CONSULTING LIMITED
CLIENT CONTACT	SAMANTHA SEDDON
For and Behalf of Groundtech Consulting	
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REVIEWED	Richard Wyatt MEng (Hons) FGS

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APPENDIX 8 - LIMITATIONS		

Plans		
<i>Plan Reference</i>	<i>Revision</i>	<i>Title</i>
GRO-21454-P01	-	Project Location Plan
GRO-21454-P02	-	Exploratory Hole Location Plan

1.0 INTRODUCTION

1.1 Project Objectives

Groundtech Consulting Limited have been instructed by WML Consulting to undertake a Ground Investigation for a site located at Chapeltown Street in Manchester known as Ferrous Phase II.

A main investigation was undertaken in accordance with BS 5930:2015, BS 10175:2017, BS 8576:2013, CIRIA C574 and Eurocode 7.

1.2 Proposed Development

The proposed development is anticipated to include the construction of a new 16 storey residential apartment building including external landscaping for residents to use. It is not anticipated this development will have a basement.

1.3 Limitations

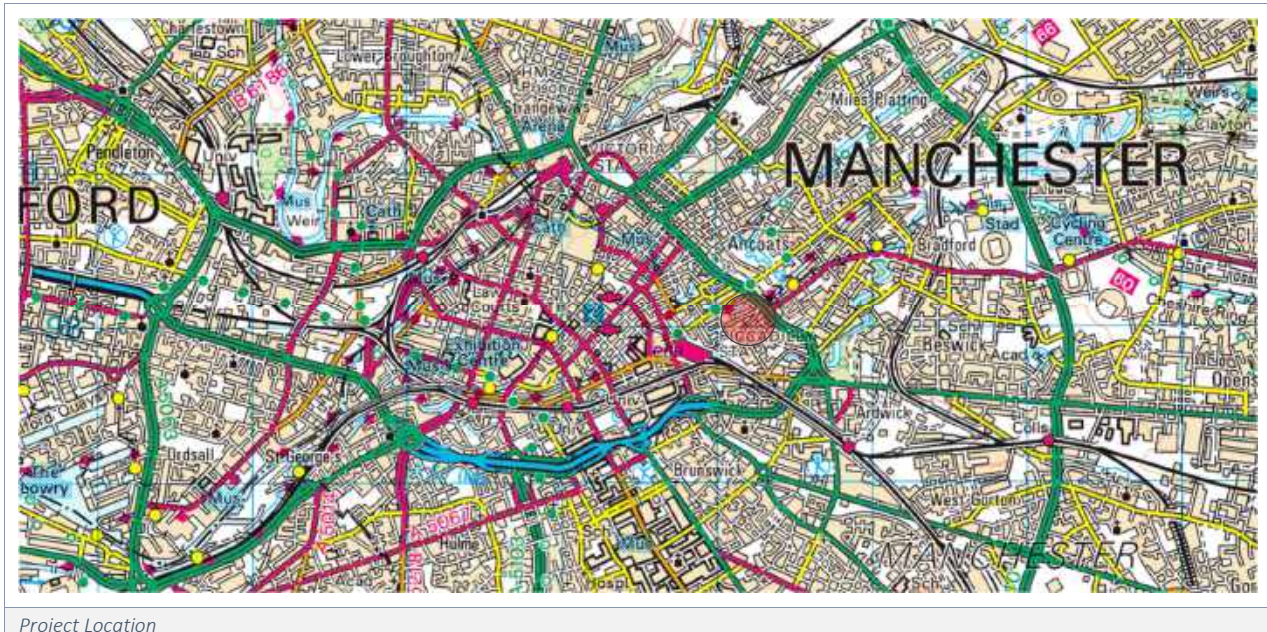
Other conditions may exist on the site that have not been taken into account in this assessment as they are outside the scope of works. Groundtech Consulting are not responsible for these circumstances that are not outlined in the report.

The assessment has been prepared for the exclusive use of the client. No third parties may rely on or reproduce the contents of the report without the written permission of Groundtech Consulting Limited. If any unauthorised third party comes into possession of the report, they rely on it at their own risk and Groundtech Consulting Limited will not be obliged to provide a duty of care.

2.0 SITE SETTING

2.1 Location

The site is located circa 1km east of Manchester City Centre, as shown on the Project Location Plan GRO-21454-P01 and is approximately centred on National Grid Reference 385222, 398065.



Access to the site is gained off Chapeltown Street to the north.

2.2 Site Description

The site, which is irregular in shape, is approximately 0.13 hectares in area and topographically level.

Site Features

The site is currently occupied by disused land surfaced with topsoil and grass with occasional weeds. An advertising billboard supported on steel stanchions is located on the eastern side of the site and a broadband junction box is present along the western edge. There are no other notable site features.

Boundary and Surrounding Features

The boundary of the site consists of a low wooden barrier to the north and a residential apartment building with associated tarmac pathway on the western boundary. The advertising billboard marks the eastern site boundary. A brick-built retaining wall forms approximately half of the southern boundary, separating the site from the tramway that runs parallel to the southern site boundary.

The tramway slopes down in a north easterly direction until it enters a tunnel beneath the junction with Chapeltown Street and Longacre Street. Soils on the site are being retained by the brick wall along the eastern half of the southern site boundary.

The site is surrounded by the following features/land uses:

- North - Chapeltown Street and apartment buildings.

- East - Car park and Great Ancoats Street.
- South - City Centre tramline.
- West - Apartment buildings.

Site photographs are presented in *Appendix 2*.

3.0 SCOPE OF INVESTIGATION AND RATIONALE

3.1 Project Objectives

The aim of the fieldwork was to:

Determine the stratification beneath the site.
Maintain a watching brief for visual and olfactory evidence of contamination.
Obtain samples using methodology in current guidance for contamination and geotechnical testing.
Install monitoring standpipes for gas and groundwater monitoring.

3.2 Scope of Works

The following scope of works was completed between the dates of 12th and 23rd September 2022:

- 4 No. Cable Percussive Boreholes (CP01 to CP04) were drilled to depths between 13.5m and 16.5m bgl using a Dando 2000 rig.
- Rotary coring follow on was undertaken from the base of the Cable Percussive Boreholes to depths between 24.0m and 28.5m bgl using a Beretta T44 Rotary Rig.
- 6 No. Windowless Sample Boreholes (WS01 to WS06) were drilled to depths between 1.45m and 2.45m bgl.
- Monitoring standpipes were installed at three locations.
- Surveying of all exploratory hole locations to National Grid and metres Above Ordnance Datum (mAOD).

The exploratory hole locations are presented on Groundtech Consulting Plan GRO-21454-P02_1.1 and the logs are presented in Appendix 3.

The boreholes were positioned by WML Consultants to establish the stratification beneath the site and target any areas of concern. The exploratory holes were logged by a suitably experienced geo-environmental engineer in general accordance with the following current guidance:

- BS 5930 'Code of Practice for Site Investigations' 2015.
- BS EN 14688-1:2002 'Geotechnical Investigation and Testing – Identification and classification of soil'.
- BS EN ISO 14689:2002 'Geotechnical investigation and testing – Identification and classification of rock'.

3.3 Soil Sampling

During the intrusive investigation, representative samples were taken at regular intervals, changes of strata and where evidence of contamination existed. Laboratory testing was scheduled on the samples obtained.

The samples obtained are summarised in the table below:

Soil Sample	Number
<i>Environmental Sample</i>	12
<i>Disturbed Sample</i>	75
<i>Bulk Sample</i>	13
<i>U100s</i>	16

The samples have been obtained in accordance with current environmental and geotechnical guidance. The sampling plan has been designed to obtain samples from all required strata using the correct methodology.

Disturbed samples of soil for geo-environmental testing were placed in the correct sampling containers as required by the laboratory in accordance with their MCERTS and UKAS Accreditation. Transportation was arranged in a timely manner and the samples were at the correct temperature.

The sample locations and depths are recorded on the exploratory logs.

3.4 Geo-Environmental Testing

All Geo-Environmental analysis was scheduled and received by WML Consultants.

Chain of Contamination	Matrix	Number
<i>Arsenic, Cadmium, Chromium (total and hex), Copper, Nickel, Mercury, Lead, Zinc, Selenium</i>	<i>Soils</i>	14
<i>Phenols</i>	<i>Soils</i>	14
<i>Cyanide</i>	<i>Soils</i>	14
<i>Speciated Polycyclic Aromatic Hydrocarbons</i>	<i>Soils</i>	14
<i>Asbestos Screening</i>	<i>Soils</i>	14
<i>Asbestos Quantification</i>	<i>Soils</i>	1
<i>TPH CWG</i>	<i>Soils</i>	2
<i>BTEX & MTBE</i>	<i>Soils</i>	2
<i>Arsenic, Cadmium, Chromium (total and hex), Copper, Nickel, Mercury, Lead, Zinc, Selenium</i>	<i>Leachate</i>	4
<i>Phenols</i>	<i>Leachate</i>	4
<i>Cyanide</i>	<i>Leachate</i>	4
<i>Speciated Polycyclic Aromatic Hydrocarbons</i>	<i>Leachate</i>	4

The Geo-Environmental Testing results are presented in *Appendix 4*.

Representative disturbed samples were obtained for all soil types encountered. Selected samples were scheduled for testing at an approved laboratory in accordance with BS 1377 'Method of Test for Soils for Civil Engineering Purposes' 1990. The following tests were scheduled by WML Consultants:

BS 1377	Test Method	Number
<i>Part 2</i>	<i>Moisture Content</i>	8
<i>Part 2</i>	<i>Atterberg Limits</i>	8
<i>Part 3</i>	<i>pH Value</i>	6
<i>Part 3</i>	<i>Water Soluble Sulphate Content</i>	6
<i>Part 4</i>	<i>Dry Density / Moisture Content Relationship</i>	2

Part 7	Undrained Shear Strength in Triaxial Compression	3
ISRM	Point Load	10
ISRM	UCS	4

The Geotechnical Laboratory Testing Results are presented in *Appendix 5*.

3.5 Gas and Groundwater Monitoring

Gas monitoring installations were constructed in selected boreholes. The standpipes consisted of high-density polyethylene (HDPE) pipe - a bentonite seal was placed around the plain pipe and a clean gravel pack was placed around the slotted pipe. A summary of the installation construction is presented in the table below:

Location	Depth (m bgl)	Response Zone (m bgl)	Targeted Strata	Reason
WS02	2.0	1.0 – 2.0	Natural Clay	Ground Gas
WS03	2.0	0.5 – 2.0	Made Ground & Natural Clay	Ground Gas
WS06	2.0	1.0 – 2.0	Natural Clay	Ground Gas

Permanent gas and flow rate monitoring was carried out using a GFM 436 infrared gas monitor with integral electronic flow analyser. The measurements taken are listed below:

- Oxygen (O₂), carbon dioxide (CO₂) and methane (CH₄) as the percentage volume in air (%v/v).
- Hydrogen sulphide (H₂S) and carbon monoxide (CO) as the percentage volume in air (%v/v).
- Lower Explosive Limit (%LEL) of methane.
- Atmospheric and borehole pressure, including pressure trend.
- Flow measurements (l/hr).
- Weather and ground surface conditions.

Both peak and steady state conditions were monitored to understand the behaviour of the permanent ground gas, the steady state conditions were recorded by allowing the gas monitor to run for a minimum of 3 minutes.

The interim gas monitoring results are presented in *Appendix 6*.

3.6 UXO

A Preliminary UXO Risk Assessment was commissioned by Groundtech Consulting prior to the intrusive works to assess the risk from potential unexploded ordnance.

No significant risk was identified and further research or UXO mitigation measures were not required.

The Preliminary UXO Risk Assessment is presented in *Appendix 7*.

4.0 GROUND MODEL

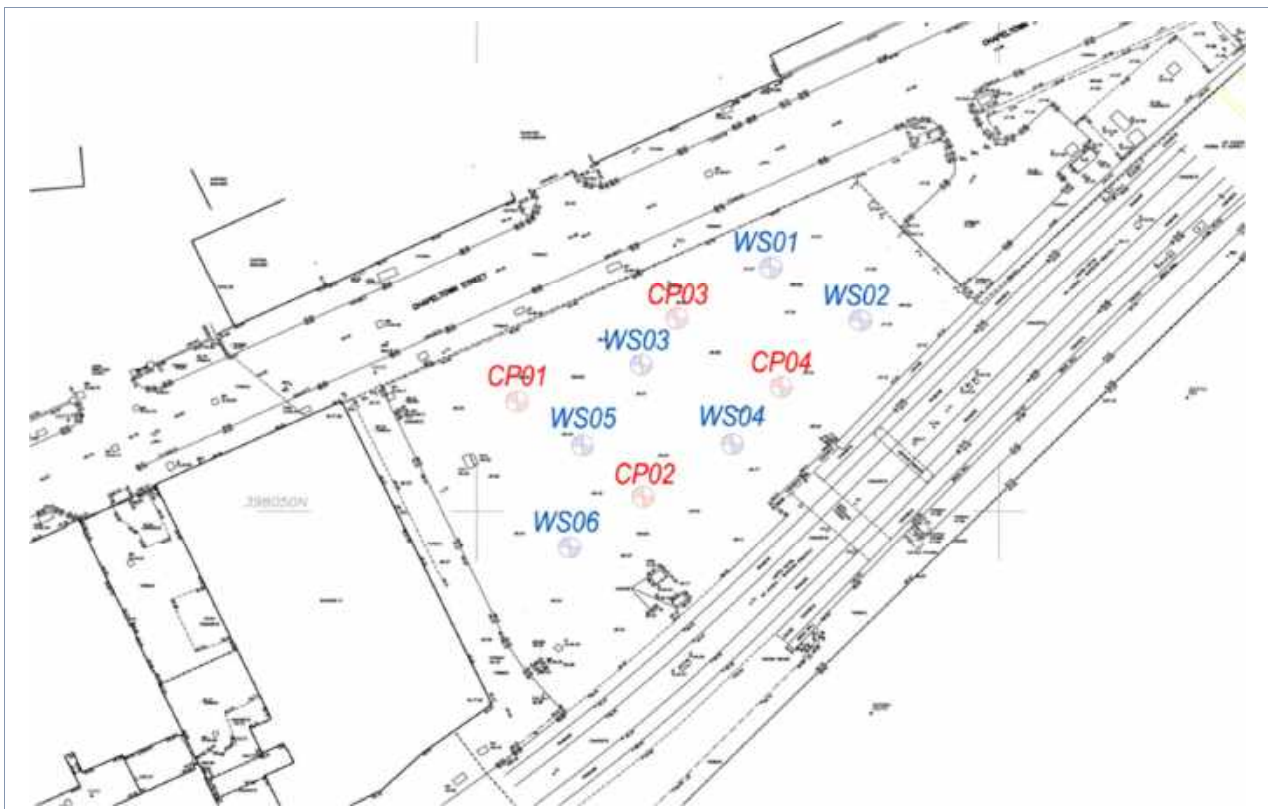
4.1 MADE GROUND

Made Ground was encountered in all exploratory hole locations to depths of between 0.95m and 2.0m bgl.

The surfacing of site comprised grass over dark brown, locally clayey, gravelly topsoil in all of the exploratory holes to depths between 0.1m and 0.3m bgl.

Three main Made Ground populations were encountered beneath the surfacing and consisted of the following:

- *Brown black slightly clayey gravelly sand with gravel of brick, concrete, plastic and rare metal to depths between 0.1m and 1.1m bgl in the majority of locations.*
- *Grey sandy gravel of mixed lithologies including brick and concrete encountered in WS01 to 1.45m bgl.*
- *Soft to firm brown mottled red gravelly clay, with gravel of brick and coal was present to depths between 1.1m and 2.0m bgl at locations WS02, CP01, CP03 and CP04.*



Exploratory Hole Locations

4.2 Natural Ground

The natural strata observed generally confirmed the published geological records. Three main natural strata were encountered during the investigation and are described below:

- *Stiff high strength dark brown mottled grey slightly gravelly Clay was in WS02 to WS06 and CP01 to CP04 generally underlying the Made Ground to proven depths between 9.5m and 15.5m bgl.*
- *Medium dense to very dense Locally clayey, gravelly Sand generally underlying the natural Clay to depths between 11.0m and 13.8m bgl.*
- *Medium dense to very dense Orange, brown Gravel of sandstone and quartzite was present in CP03 and CP04 as bands between 12.5m and 14.5m bgl.*

4.3 Bedrock

Soft, locally highly/locally slightly weathered Red Sandstone bedrock was encountered within CP01 to CP04 from depths between 11.0m and 15.5m bgl and was present to the base of the boreholes to a maximum proven depth of 28.5m bgl.

Rotary Coring was undertaken from depths between 13.5m and 16.5m bgl where the Sandstone became competent.

4.4 Groundwater

Groundwater strikes were not recorded during the investigation.

4.5 Watching Brief

A watching brief was maintained during the Ground Investigation for visual and olfactory evidence of contamination.

Visual evidence of potential contamination was identified where ash and/or clinker was present in the Made Ground soils at locations WS02 and WS03.

No olfactory evidence of contamination was noted.

4.6 Borehole Stability

Instability of the natural ground was observed in the Sand and Gravel deposits beneath the site during the drilling of the boreholes.

4.7 Excavation / Borehole Progress

WS01 was terminated within dense Made Ground deposits at a depth of 1.45m bgl where an SPT refusal was recorded.

WS02 to WS06 were all terminated before their scheduled depths in the natural stiff Clay due to SPT refusals.

5.0 RELEVANT INDUSTRY REFERENCES

British Standards Institution. Investigation of Potentially Contaminated sites - code of practice. BS 10175:2017.

British Standards Institution 'Code of Practice for Site Investigations' BS 5930:2015

British Standards Institution 'Geotechnical investigation and testing – Identification and classification of soil' BS EN ISO 14688:2002.

British Standards Institution 'Geotechnical investigation and testing – Identification and classification of rock' BS EN ISO 14689:2002.

CIRIA C665 "Assessing Risks Posed by Hazardous Ground Gases to Buildings" 2007.

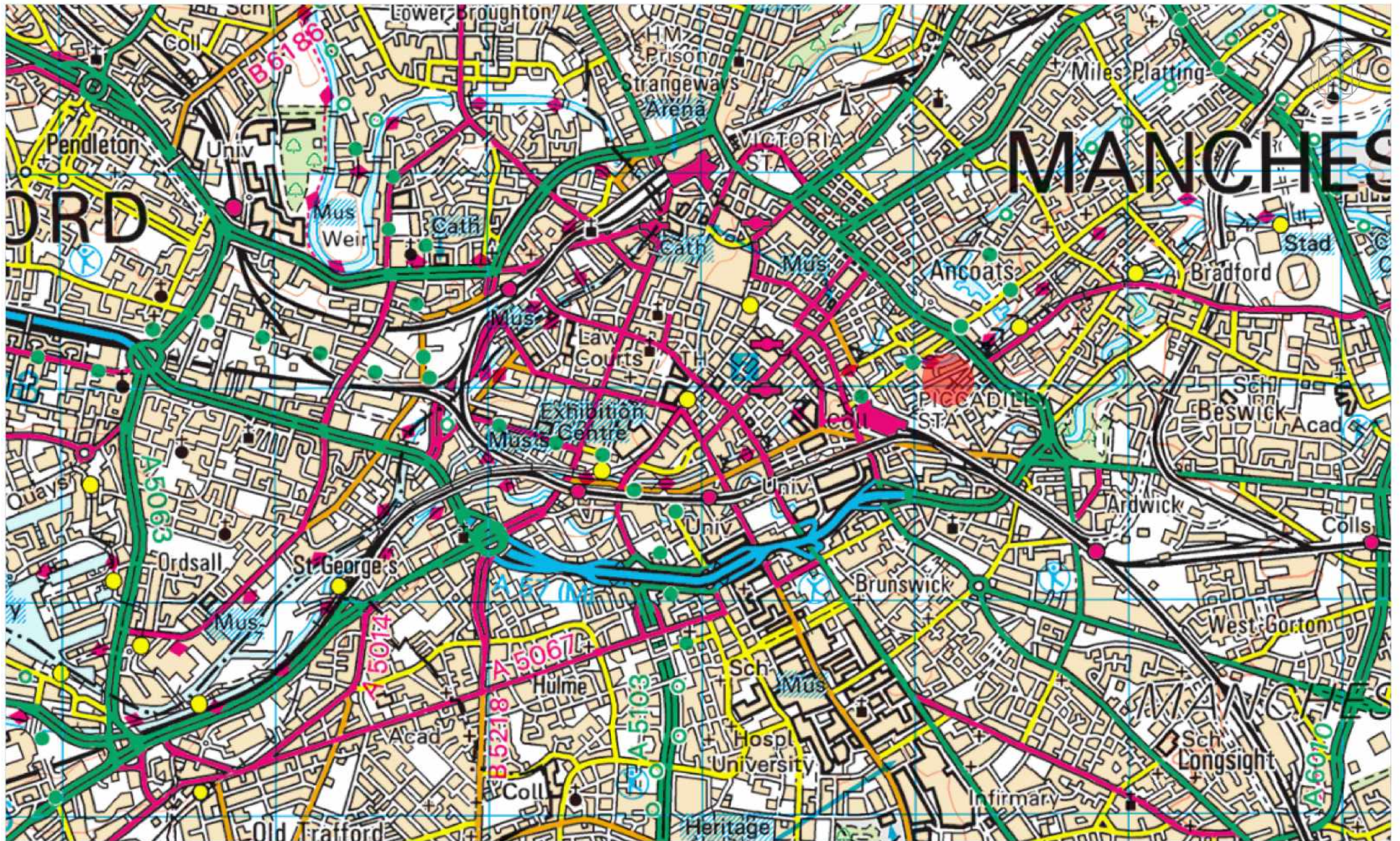
Wilson & Card "Proposed method classifying gassing sites" Ground Engineering 1999.

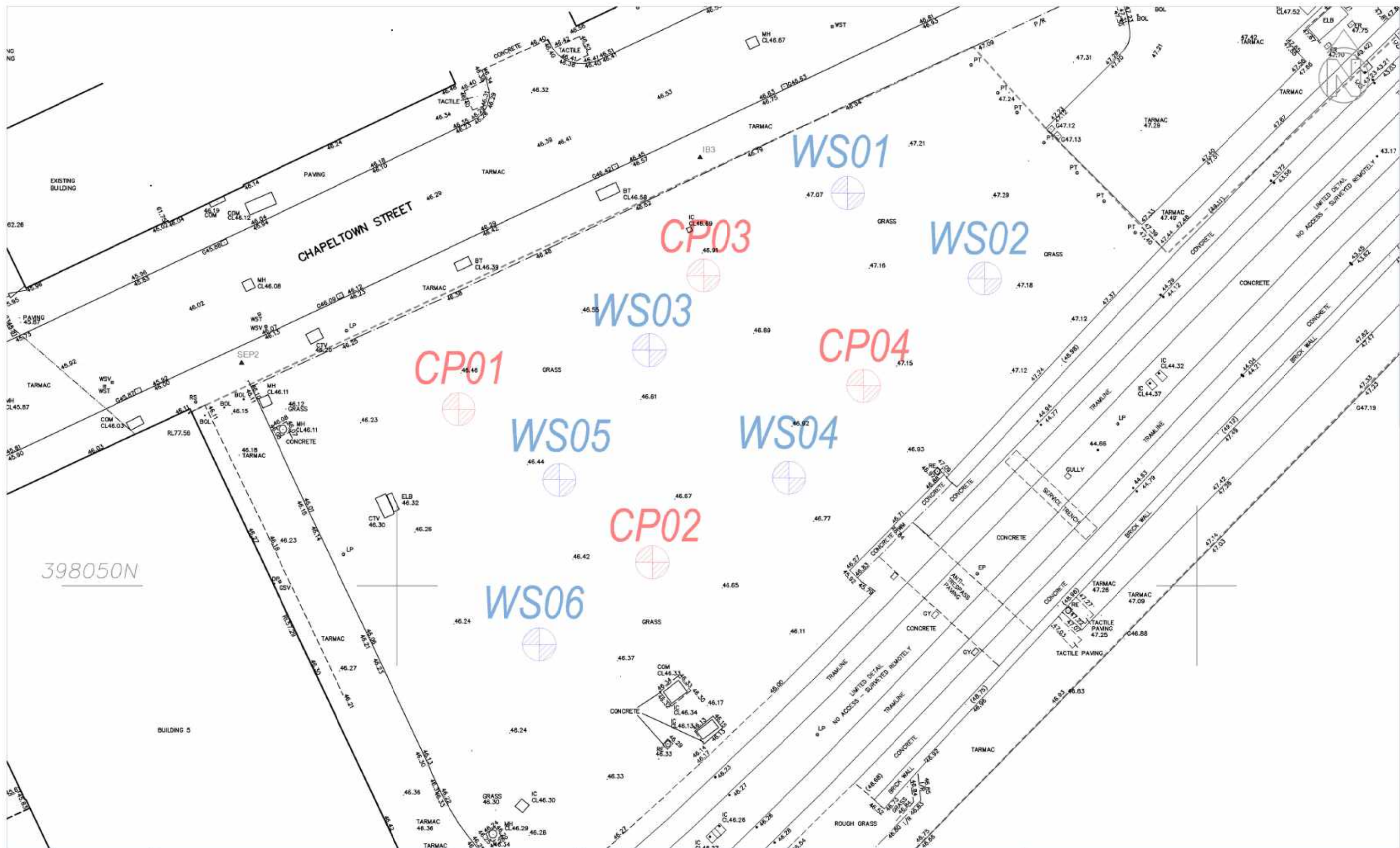
Card & Steve Wilson in "A pragmatic approach to ground gas risk assessment for the 21st Century" - CIRIA/Environmental Protection UK Ground gas seminar 2011

BS 8576:2013 'Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs)'

BS 8485:2015 'Code of practise for the design of protective measures for methane and carbon dioxide ground gases for new buildings'

APPENDIX 1 - Plans





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CLIENT

WML CONSULTING

PROJECT TITLE

FERROUS PHASE II

PLAN TITLE

EXPLORATORY HOLE LOCATION PLAN

DATE

NOVEMBER 2022

SCALE

NTS

PLAN NUMBER

GRO-21454-P02

Rev.	Details	Date

Status

Preliminary

Draft

Issued

For Comment

Approved

Notes

-  Cable Percussion Borehole
-  Windowless Sample Borehole



APPENDIX 2 - Site Photographs



Photograph 1 – Looking onto the billboard and car park on the eastern boundary.



Photograph 2 – Looking along the pathway and apartment building on the western boundary.



Photograph 3 – Taken from the eastern boundary looking across site.



Photograph 4 – Looking across site onto the northern boundary.



Photograph 5 – Broadband junction box located near the western boundary.



Photograph 6 – CP01 rotary core runs 1, 2 and 3.



Photograph 7 – CP01 Rotary core run 4.



Photograph 8 – CP01 Rotary core runs 5 and 6.



Photograph 9 – CP01 Rotary core run 7



Photograph 10 – CP01 Rotary core run 8



Photograph 11 – CP02 Rotary core run 1.



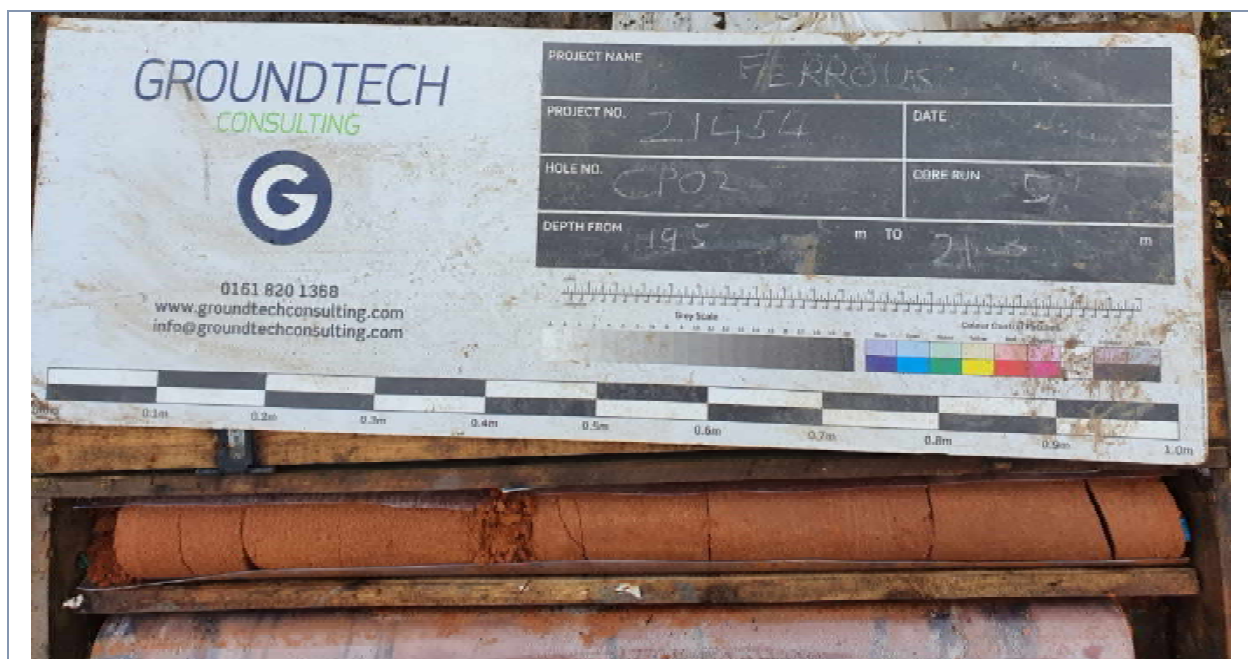
Photograph 12 – CP02 Rotary core run 2.



Photograph 13 – CP02 Rotary core run 3.



Photograph 14 – CP02 Rotary core run 4.



Photograph 15 – CP02 Rotary core run 5.



Photograph 16 – CP02 Rotary core run 6.



Photograph 17 – CP03 Rotary core run 1.



Photograph 18 – CP03 Rotary core run 2



Photograph 19 – CP03 Rotary core run 3.



Photograph 20 – CP03 Rotary core run 4



Photograph 21 – CP03 Rotary core run 5.



Photograph 22 – CP03 Rotary core run 6



Photograph 23 – CP03 Rotary core run 7



Photograph 24 – CP04 Rotary core run 1



Photograph 25 – CP04 Rotary core run 2.



Photograph 26 – CP04 Rotary core run 3.



Photograph 27 – CP04 Rotary core run 4



Photograph 28 – CP04 Rotary core run 5



Photograph 29 – CP04 Rotary core run 6



Photograph 30 – CP04 Rotary core run 7



Photograph 31 – CP04 Rotary core run 8

APPENDIX 3 - Exploratory Hole Logs



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Borehole Log

Borehole No.

WS01

Sheet 1 of 1

Project Name: FERROUS PHASE II

Project No.
GRO-21454

Co-ords: 398073.80 - 385226.40

Hole Type
WS

Location: MANCHESTER

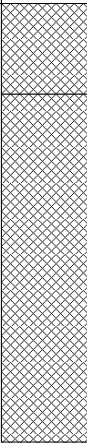
Level: 46.88

Scale
1:25

Client: WML CONSULTING LTD

Dates: 13/09/2022 - 13/09/2022

Logged By
LH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	ES	N=50 (25 for 5mm/50 for 10mm)	0.30	46.58		MADE GROUND: Dark brown slightly clayey slightly gravelly topsoil. Gravel is angular to subangular fine to coarse of mixed lithologies including brick and ceramics.	1
		0.50 0.50	D ES					MADE GROUND: Light grey sandy angular to subangular fine to coarse gravel of mixed lithologies including brick and concrete and low cobble content of concrete. Sand is fine to medium grains.	
		1.00 1.00	D ES		1.45	45.43		End of borehole at 1.45 m	
		1.20							
									2
									3
									4
									5

Remarks

1. Location scanned with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. No groundwater encountered. 4. Hole terminated due to SPT refusal on concrete obstruction. 5. Backfilled with arisings.





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Borehole Log

Borehole No.

WS02

Sheet 1 of 1

Project Name: FERROUS PHASE II

Project No.
GRO-21454

Co-ords: 398070.30 - 385238.30

Hole Type
WS

Location: MANCHESTER

Level: 47.15

Scale
1:25

Client: WML CONSULTING LTD

Dates: 13/09/2022 - 13/09/2022

Logged By
LH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.15	ES		0.10	47.05		MADE GROUND: Dark brown slightly clayey slightly gravelly topsoil. Gravel is angular to subangular fine to coarse of mixed lithologies including brick and ceramics.	
		0.50	ES		0.40	46.75		MADE GROUND: Grey brown gravelly fine to medium sand. Gravel is angular to subangular fine to coarse of mixed lithologies including brick, ceramics and metal.	
		1.00	ES		1.10	46.05		MADE GROUND: Soft to firm brown slightly sandy gravelly clay locally ashy. Gravel is angular to subangular fine to coarse of mixed lithologies including brick, clinker, and ceramics. Sand is fine to medium grains.	
		1.20		N=7 (1,0/1,2,2,2)				Stiff dark brown mottled grey slightly gravelly silty CLAY. Gravel is subangular to subrounded fine to coarse of mixed lithologies including chert.	
		1.40	ES						
		1.50	D						
		2.00	D						
		2.00		N=50 (5,8/50 for 245mm)					
					2.45	44.70		End of borehole at 2.45 m	

Remarks

1. Location scanned with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. No groundwater encountered. 4. Hole terminated due to SPT refusal. 5. Monitoring standpipe installed to 2.0m bgl (1.0m plain, 1.0m slotted).





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Borehole Log

Borehole No.

WS03

Sheet 1 of 1

Project Name: FERROUS PHASE II

Project No.
GRO-21454

Co-ords: -

Hole Type
WS

Location: MANCHESTER

Level:

Scale
1:25

Client: WML CONSULTING LTD

Dates: 13/09/2022 - 13/09/2022

Logged By
LH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	ES		0.20			MADE GROUND: Dark brown slightly clayey slightly gravelly topsoil. Gravel is angular to subangular fine to coarse of mixed lithologies including brick, concrete and ceramics.	1
					0.40			MADE GROUND: Brown slightly clayey gravelly fine to medium sand. Gravel is angular to subangular fine to coarse of mixed lithologies including brick, ceramics, concrete, plastic, slate and rare metal.	
		0.50	ES		0.80			MADE GROUND: Black slightly gravelly ashy fine to medium sand. Gravel is angular to subangular fine to medium of mixed lithologies including clinker, ironstone and ceramics.	
		1.00	D		1.00			MADE GROUND: Brown slightly clayey gravelly fine to medium sand. Gravel is angular to rounded fine to coarse of mixed lithologies including ceramics and concrete.	
		1.00	ES					Stiff dark brown mottled grey slightly gravelly silty CLAY. Gravel is subangular to subrounded fine to coarse of mixed lithologies including chert.	
		1.20		N=30 (7,7/8,9,6,7)					
		1.50	D						
		1.80		N=50 (6,8/50 for 235mm)	2.00				
								End of borehole at 2.00 m	2
									3
									4
									5

Remarks

1. Location scanned with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. No groundwater encountered. 4. Hole terminated due to SPT refusal. 5. Monitoring standpipe installed to 2.0m bgl (0.5m plain, 1.5m slotted).





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Borehole Log

Borehole No.

WS04

Sheet 1 of 1

Project Name: FERROUS PHASE II

Project No.
GRO-21454

Co-ords: 398053.90 - 385224.50

Hole Type
WS

Location: MANCHESTER

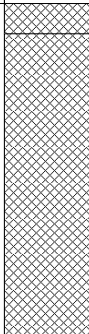
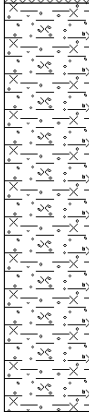
Level: 46.60

Scale
1:25

Client: WML CONSULTING LTD

Dates: 13/09/2022 - 13/09/2022

Logged By
LH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description					
		Depth (m)	Type	Results									
		0.10			0.10	46.50		MADE GROUND: Dark brown slightly clayey slightly gravelly topsoil. Gravel is angular to subangular fine to coarse of mixed lithologies including brick and ceramics.	1				
		0.50	ES					MADE GROUND: Brown slightly clayey gravelly fine to medium sand. Gravel is angular to subangular fine to coarse of mixed lithologies including brick, ceramics, concrete, plastic and rare metal.					
		1.00	ES		1.10	45.50		Stiff dark brown mottled grey slightly gravelly silty CLAY. Gravel is subangular to subrounded fine to coarse of mixed lithologies including chert.					
		1.20		N=18 (3,3/4,4,4,6)									
		1.50	D										
		2.00	D	N=50 (6,8/50 for 240mm)	2.45	44.15							
		2.00											
		End of borehole at 2.45 m											

Remarks

1. Location scanned with CAT prior to breaking ground. 1. Hand dug inspection pit to 1.2m bgl. 2. No groundwater encountered. 3. Hole terminated due to SPT refusal. 4. Backfilled with arisings.





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Borehole Log

Borehole No.

WS05

Sheet 1 of 1

Project Name: FERROUS PHASE II

Project No.
GRO-21454

Co-ords: 398057.60 - 385210.70

Hole Type
WS

Location: MANCHESTER

Level: 46.38

Scale
1:25

Client: WML CONSULTING LTD

Dates: 13/09/2022 - 13/09/2022

Logged By
LH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20	46.18		MADE GROUND: Dark brown slightly clayey slightly gravelly topsoil. Gravel is angular to subangular fine to coarse of mixed lithologies including brick, concrete and ceramics.	1
		0.50	ES					MADE GROUND: Brown slightly clayey gravelly fine to medium sand. Gravel is angular to rounded fine to coarse of mixed lithologies including brick, ceramics, concrete, plastic, slate and rare metal.	
		0.60	ES		0.55	45.83		MADE GROUND: Black fine to medium sand.	
					0.70	45.68		MADE GROUND: Red brown slightly clayey gravelly fine to medium sand. Gravel is angular to rounded fine to coarse of mixed lithologies including brick, ceramics and concrete.	
		1.00	D		0.95	45.43		Stiff dark brown mottled grey slightly gravelly silty CLAY. Gravel is subangular to subrounded fine to coarse of mixed lithologies including chert.	
		1.00	ES						
		1.20		N=33 (3,4/6,7,9,11)					
		1.80		N=50 (6,7/50 for 240mm)					
		2.00	D		2.00	44.38		End of borehole at 2.00 m	
									2
									3
									4
									5

Remarks

1. Location scanned with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. No groundwater encountered. 4. Hole terminated due to SPT refusal. 5. Backfilled with arisings.





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Borehole Log

Borehole No.

WS06

Sheet 1 of 1

Project Name: FERROUS PHASE II

Project No.
GRO-21454

Co-ords: 398046.20 - 385214.60

Hole Type
WS

Location: MANCHESTER

Level: 46.44

Scale
1:25

Client: WML CONSULTING LTD

Dates: 13/09/2022 - 13/09/2022

Logged By
LH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.15			0.15	46.29		MADE GROUND: Dark brown slightly clayey slightly gravelly topsoil. Gravel is angular to subangular fine to coarse of mixed lithologies including brick.	
		0.30	ES					MADE GROUND: Brown slightly clayey gravelly fine to medium sand. Gravel is angular to subangular fine to coarse of mixed lithologies including brick, ceramics, concrete, plastic and rare metal.	
		0.60	ES		0.50	45.94		MADE GROUND: Black fine to medium sand.	
		1.00	D		1.00	45.44		Stiff dark brown mottled grey slightly gravelly silty CLAY. Gravel is subangular to subrounded fine to coarse of mixed lithologies including chert.	
		1.20		N=25 (4,4/5,6,7,7)					
		1.50	D						
		1.80		N=49 (5,8/49 for 240mm)					
		2.00			2.00	44.44		End of borehole at 2.00 m	

Remarks

1. Location scanned with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. No groundwater encountered. 4. Hole terminated due to refusal. 5. Monitoring standpipe installed to 2.0m bgl (1.0m plain, 1.0m slotted).





Rotary Core Log

Project Name: FERROUS PHASE II				Client: WML CONSULTING LTD				Date: 20/09/2022									
Location: MANCHESTER				Contractor:				Co-ords: E398062.60 N385207.50									
Project No. : GRO-21454				Crew Name:				Drilling Equipment:									
Borehole Number CP01		Hole Type CP+RC		Level 46.45m AoD		Logged By JT		Scale 1:25		Page Number Sheet 1 of 6							
Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description						
		0.50	ES					0.60	45.85		MADE GROUND: Brown gravelly fine to coarse sand with low cobble content of brick and concrete. Gravel is angular to subangular fine to coarse of mixed lithologies including mudstone, sandstone and chert.	1					
		1.00	ES								MADE GROUND: Soft brown mottled red gravelly clay. Gravel is angular to subangular fine to coarse of brick and coal.						
		1.20 - 1.65	D				(43)	1.20	45.25		Stiff brown mottled grey slightly gravelly CLAY. Gravel is angular medium of mudstone.						
		1.50	ES														
		2.00	D							Sandstone and coal gravel encountered from 2.0m bgl.							
		2.50	D														
		3.00 - 3.45	D				(27)			High strength at 4.0m bgl.							
		4.00	D														
		4.50	D														
		5.00 - 5.45	D				(40)					5					
Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)
Remarks																	
1. Location cleared with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. Cable percussive drilling undertaken to 14.5m bgl. 4. Rotary core follow-on undertaken to 25.5m bgl. 5 No groundwater encountered. 6. Borehole backfilled.																	

Rotary Core Log

Project Name: FERROUS PHASE II			Client: WML CONSULTING LTD			Date: 20/09/2022		
Location: MANCHESTER			Contractor:			Co-ords: E398062.60 N385207.50		
Project No. : GRO-21454			Crew Name:			Drilling Equipment:		
Borehole Number CP01		Hole Type CP+RC		Level 46.45m AoD		Logged By JT		Page Number Sheet 2 of 6

Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD						
		6.00	D								Stiff brown mottled grey slightly gravelly CLAY. Gravel is angular medium of mudstone.	6
		6.50	D									
		7.00 - 7.45	D				(26)					7
		8.50	D									8
		9.00 - 9.45	D				(25)				Medium dense brown slightly clayey slightly gravelly fine SAND. Gravel is subangular to subrounded fine to medium of mudstone.	9
		9.50	D					9.50	36.95			
			D				(28)	10.00	36.45			10

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Location cleared with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. Cable percussive drilling undertaken to 14.5m bgl. 4. Rotary core follow-on undertaken to 25.5m bgl. 5 No groundwater encountered. 6. Borehole backfilled.



Rotary Core Log

Project Name: FERROUS PHASE II				Client: WML CONSULTING LTD				Date: 20/09/2022			
Location: MANCHESTER				Contractor:				Co-ords: E398062.60 N385207.50			
Project No. : GRO-21454				Crew Name:				Drilling Equipment:			
Borehole Number CP01		Hole Type CP+RC		Level 46.45m AoD		Logged By JT		Scale 1:25		Page Number Sheet 3 of 6	

Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD						
		10.00 - 10.45									Dense brown slightly clayey fine SAND with low cobble content of chert. Gravel is subrounded to rounded medium to coarse of chert.	
		11.00 - 11.45	D				N=50 (25 for 60mm/ 50 for 70mm)				From 11.0m bgl becomes dense.	11
		12.00 - 12.45	D				N=50 (25 for 75mm/ 50 for 20mm)					12
		13.00 - 13.45	D				N=50 (25 for 20mm/ 50 for 20mm)					13
		13.80 - 14.00	D					13.80	32.65		Extremely weak red medium grained SANDSTONE residually weathered recovered as medium to coarse sand.	14
		14.50	D				N=50 (25 for 50mm/ 50 for 20mm)	14.50	31.95		NO RECOVERY	
		14.50 - 15.00	NR					14.57	31.88		Extremely weak red medium SANDSTONE residually weathered recovered as slightly gravelly medium to coarse sand.	
			2					14.67	31.78			
			NI									
			4								Extremely weak red medium SANDSTONE highly weathered with horizontal smooth to	15
							15.00	31.45				

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks														
1. Location cleared with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. Cable percussive drilling undertaken to 14.5m bgl. 4. Rotary core follow-on undertaken to 25.5m bgl. 5 No groundwater encountered. 6. Borehole backfilled.														



Rotary Core Log

Project Name: FERROUS PHASE II			Client: WML CONSULTING LTD			Date: 20/09/2022		
Location: MANCHESTER			Contractor:			Co-ords: E398062.60 N385207.50		
Project No. : GRO-21454			Crew Name:			Drilling Equipment:		
Borehole Number CP01		Hole Type CP+RC		Level 46.45m AoD		Logged By JT		Page Number Sheet 4 of 6

Well	Water	Depth (m)	Type /FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
		15.00 - 16.50	NR	40	32	7	15.90	30.55		Extremely weak red medium SANDSTONE highly weathered with horizontal smooth to rough planar to undulating closely spaced discontinuities. <i>Between 14.73m and 14.80m bgl recovered as slightly gravelly medium to coarse sand.</i> NO RECOVERY	16
			6							Weak red medium SANDSTONE highly weathered with horizontal rough planar very closely to closely spaced discontinuities.	
			NI 2							<i>Between 16.34m and 16.40m bgl recovered as slightly sandy slightly clayey angular to sub angular medium to coarse gravel.</i> NO RECOVERY	
		16.50 - 18.00	NR	62	43	9	17.08 17.24	29.37 29.21			17
			NI 2							Extremely weak red medium SANDSTONE residually weathered recovered as medium sand.	
			NI							Weak red medium SANDSTONE highly weathered with horizontal and vertical smooth planar closely spaced discontinuities. <i>Between 17.31m and 17.43m bgl recovered as medium sand.</i>	
			8								
		18.00 - 19.50	NR	75	74	29	18.69 18.70	27.76 27.75		NO RECOVERY	18
			NI 4							Extremely weak red medium SANDSTONE residually weathered recovered as slightly clayey medium sand.	
			NI							Weak red medium SANDSTONE slightly weathered with horizontal smooth planar to undulating discontinuities.	
			2 NI							<i>Between 18.5m and 18.64m bgl recovered as coarse rounded sandstone gravel and medium red sand.</i>	
			20							Extremely weak red orange SILTSTONE highly weathered recovered as coarse angular gravel.	
										Weak red medium SANDSTONE slightly weathered with horizontal smooth planar to undulating closely spaced discontinuities. NO RECOVERY	

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)
Remarks																	
1. Location cleared with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. Cable percussive drilling undertaken to 14.5m bgl. 4. Rotary core follow-on undertaken to 25.5m bgl. 5 No groundwater encountered. 6. Borehole backfilled.																	



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Rotary Core Log

Project Name: FERROUS PHASE II				Client: WML CONSULTING LTD				Date: 20/09/2022			
Location: MANCHESTER				Contractor:				Co-ords: E398062.60 N385207.50			
Project No. : GRO-21454				Crew Name:				Drilling Equipment:			
Borehole Number CP01		Hole Type CP+RC		Level 46.45m AoD		Logged By JT		Scale 1:25		Page Number Sheet 5 of 6	

Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD						
		19.50 - 21.00	NR	55	45	10		20.32 20.39	26.13 26.06		NO RECOVERY	
			NI									
			2									
			NI									
			1									
			NI									
		21.00 - 22.50	NR	31	21	11		21.00	25.45		Extremely weak red SANDSTONE highly weathered recovered as coarse rounded sandstone gravel. Weak red medium SANDSTONE slightly weathered with horizontal smooth planar closely spaced discontinuities. Between 20.49m and 20.51m bgl recovered as medium to coarse sub rounded sandstone gravel. Between 20.57m and 20.58m bgl very weak sandstone. Between 20.68m and 20.71m bgl very weak sandstone with siltstone gravel. NO RECOVERY	
			NR									
			1									
			NI									
			1									
			NI									
22.50 - 24.00	4	100	84	54	22.50	23.95		Weak red medium SANDSTONE slightly weathered with horizontal smooth planar discontinuities. Between 22.19m and 22.29m bgl extremely weak sandstone recovered as medium sand. Between 22.39m and 22.43m bgl extremely weak sandstone recovered as medium sand. Weak red medium SANDSTONE slightly weathered with horizontal smooth planar discontinuities. Between 22.83m and 22.88m bgl horizontal and vertical smooth planar discontinuity.				
	NI											
	5											
	NI											
	3											
	3											
24.00 - 25.50		31	30	8	24.00	22.45		NO RECOVERY				

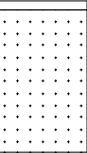
Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Location cleared with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. Cable percussive drilling undertaken to 14.5m bgl. 4. Rotary core follow-on undertaken to 25.5m bgl. 5 No groundwater encountered. 6. Borehole backfilled.

Rotary Core Log

Project Name: FERROUS PHASE II			Client: WML CONSULTING LTD			Date: 20/09/2022		
Location: MANCHESTER			Contractor:			Co-ords: E398062.60 N385207.50		
Project No. : GRO-21454			Crew Name:			Drilling Equipment:		
Borehole Number CP01		Hole Type CP+RC		Level 46.45m AoD		Logged By JT		Page Number Sheet 6 of 6

Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD						
			NR					25.03	21.42		NO RECOVERY	
			3								Weak red medium SANDSTONE slightly weathered with horizontal smooth planar discontinuities.	
			NI								Between 25.2m and 25.23m bgl recovered as rounded sandstone cobbles.	
			3					25.50	20.95		End of Borehole at 25.500m	
												26
												27
												28
												29
												30

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Location cleared with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. Cable percussive drilling undertaken to 14.5m bgl. 4. Rotary core follow-on undertaken to 25.5m bgl. 5 No groundwater encountered. 6. Borehole backfilled.



Rotary Core Log

Project Name: FERROUS PHASE II			Client: WML CONSULTING LTD			Date: 21/09/2022 - 22/09/2022		
Location: MANCHESTER			Contractor:			Co-ords: E398050.80 N385216.70		
Project No. : GRO-21454			Crew Name:			Drilling Equipment:		
Borehole Number CP02		Hole Type CP+RC		Level 46.50m AoD		Logged By JT		Page Number Sheet 1 of 5

Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD						
		0.10	ES								MADE GROUND: Brown gravelly fine to coarse sand. Gravel is angular to subangular fine to coarse of mixed lithologies including brick and concrete.	
		0.50	ES									
		1.20 - 1.65	D				(19)	1.20	45.30		Sandstone gravel encountered from 1.0m bgl.	1
		1.50	ES								Stiff brown mottled grey gravelly CLAY. Gravel is subangular medium sandstone, mudstone and rare coal.	
		2.00	D									2
		2.50	D									
		3.00 - 3.45	D				(25)					3
		4.00	D					4.00	42.50		Stiff brown mottled grey slightly gravelly CLAY. Gravel is subrounded medium of coal and mudstone.	4
		4.50	D									
							(32)					5

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)
Remarks																	
1. Location cleared with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. Cable percussive drilling undertaken to 13.5m bgl. 4. Rotary core follow-on undertaken to 24.0m bgl. 5 No groundwater encountered. 6. Borehole backfilled.																	



Rotary Core Log

Project Name: FERROUS PHASE II			Client: WML CONSULTING LTD			Date: 21/09/2022 - 22/09/2022		
Location: MANCHESTER			Contractor:			Co-ords: E398050.80 N385216.70		
Project No. : GRO-21454			Crew Name:			Drilling Equipment:		
Borehole Number CP02		Hole Type CP+RC		Level 46.50m AoD		Logged By JT		Page Number Sheet 2 of 5

Well	Water	Depth (m)	Type /FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
		6.00	D							Stiff brown mottled grey slightly gravelly CLAY. Gravel is subrounded medium of coal and mudstone.	
		6.50	D				6.50	40.00		High strength at 6.0m bgl.	6
		7.00 - 7.45	D							Stiff brown gravelly CLAY with low cobble content of mudstone. Gravel is angular to subrounded mudstone.	7
		8.00	D								8
		9.00	D				9.00	37.50		Stiff brown slightly sandy slightly gravelly CLAY. Sand is fine. Gravel is sub angular to subrounded medium mudstone.	9
		10.00	D				10.00	36.50			10

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Location cleared with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. Cable percussive drilling undertaken to 13.5m bgl. 4. Rotary core follow-on undertaken to 24.0m bgl. 5 No groundwater encountered. 6. Borehole backfilled.



Rotary Core Log

Project Name: FERROUS PHASE II				Client: WML CONSULTING LTD				Date: 21/09/2022 - 22/09/2022			
Location: MANCHESTER				Contractor:				Co-ords: E398050.80 N385216.70			
Project No. : GRO-21454				Crew Name:				Drilling Equipment:			
Borehole Number CP02		Hole Type CP+RC		Level 46.50m AoD		Logged By JT		Scale 1:25		Page Number Sheet 3 of 5	

Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description			
				TCR	SCR	RQD								
		11.00	D				N=50 (7,9/50 for 220mm)	11.00	35.50		Dense red brown slightly gravelly clayey fine to medium SAND. Gravel is angular to subangular fine to medium sandstone.	11		
		12.00	D				N=50 (25 for 50mm/ 50 for 40mm)	12.00	34.50		Extremely weak red fine to medium grained poorly cemented SANDSTONE residually weathered, recovered as sandy gravelly subangular cobbles. Sand is fine to medium. Gravel is angular to subangular fine to coarse.	12		
		13.50 - 15.00	NR				95	55	16	13.58 13.62	32.92 32.88		NO RECOVERY	13
			NI											
			NI											
			4											
			NI											
			4											
			NI											
			2											
NI				14.66	31.84		Extremely weak red medium grained SANDSTONE residually weathered recovered as slightly gravelly sand. Weak red medium grained SANDSTONE moderately weathered with horizontal smooth planar closely spaced discontinuities. Between 13.69m and 13.79m bgl recovered as sandy gravel. Gravel is coarse sub rounded sandstone. Between 14.07m and 14.14m bgl recovered as sandy medium angular sandstone gravel. Between 14.25m and 14.34m bgl recovered as medium sand. Between 14.46m and 14.66m bgl recovered as medium sand.	14						
4														
							15.00	31.50		Weak red medium grained SANDSTONE	15			

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Location cleared with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. Cable percussive drilling undertaken to 13.5m bgl. 4. Rotary core follow-on undertaken to 24.0m bgl. 5 No groundwater encountered. 6. Borehole backfilled.




Rotary Core Log

Project Name: FERROUS PHASE II				Client: WML CONSULTING LTD				Date: 21/09/2022 - 22/09/2022			
Location: MANCHESTER				Contractor:				Co-ords: E398050.80 N385216.70			
Project No. : GRO-21454				Crew Name:				Drilling Equipment:			
Borehole Number CP02		Hole Type CP+RC		Level 46.50m AoD		Logged By JT		Scale 1:25		Page Number Sheet 5 of 5	

Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description		
				TCR	SCR	RQD							
		19.50 - 21.00	NI				68	61	62		Extremely weak red SANDSTONE highly weathered recovered as medium sand. Weak red fine grained SANDSTONE slightly weathered with horizontal to sub horizontal (15) smooth planar very closely to closely spaced discontinuities. <i>Between 20.37m and 20.42m bgl recovered as red medium sand.</i>		
			5										
			NI										
		21.00 - 22.50	NR				96	80	48		NO RECOVERY	21	
			NI										
			3										
			NI										
			4										
			NI										
			5										
			NI										
			3										
			22.50 - 24.00	NR									
		10											
		NI											
		2											
		NI											
		2											
		24.00											

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks															
1. Location cleared with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. Cable percussive drilling undertaken to 13.5m bgl. 4. Rotary core follow-on undertaken to 24.0m bgl. 5 No groundwater encountered. 6. Borehole backfilled.															







Rotary Core Log

Project Name: FERROUS PHASE II				Client: WML CONSULTING LTD				Date: 22/09/2022									
Location: MANCHESTER				Contractor:				Co-ords: E398069.80 N385219.30									
Project No. : GRO-21454				Crew Name:				Drilling Equipment:									
Borehole Number CP03		Hole Type CP+RC		Level 46.74m AoD		Logged By JT		Scale 1:25		Page Number Sheet 2 of 6							
Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description						
		5.00 - 5.45	D								Stiff brown mottled grey gravelly CLAY. Gravel is subrounded to rounded of mudstone and sandstone.	6					
		6.00	D														
		7.00 7.00 - 7.45	D D				(36)				Stiff brown slightly gravelly slightly sandy CLAY. Gravel is subrounded fine to medium of sandstone and mudstone.	7					
		8.00	D					8.00	38.74								
		8.50	D														
		9.00 - 9.45	D				(32)	9.45	37.29		Stiff brown slightly gravelly CLAY. Gravel is angular to subangular fine to medium of sandstone and mudstone.	8					
												9					
												10					
Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)
Remarks																	
1. Location cleared with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. Cable percussive drilling undertaken to 16.5m bgl. 4. Rotary core follow-on undertaken to 28.5m bgl. 5 No groundwater encountered. 6. Borehole backfilled.																	

Rotary Core Log

Project Name: FERROUS PHASE II			Client: WML CONSULTING LTD			Date: 22/09/2022		
Location: MANCHESTER			Contractor:			Co-ords: E398069.80 N385219.30		
Project No. : GRO-21454			Crew Name:			Drilling Equipment:		
Borehole Number CP03		Hole Type CP+RC		Level 46.74m AoD		Logged By JT		Page Number Sheet 3 of 6

Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD						
		10.50	D								Stiff brown slightly gravelly CLAY. Gravel is angular to subangular fine to medium of sandstone and mudstone.	
		11.00 11.00 - 11.45	D D				(17)	11.00	35.74		Medium density red brown fine SAND. Locally clayey.	11
		12.00 - 12.45	D				N=50 (5.5/50 for 200mm)	12.50	34.24		Very dense brown orange slightly sandy subangular to rounded medium to coarse GRAVEL of chert and quartzite with low cobble content of chert. Sand is fine to coarse.	12
		13.00 13.00 - 13.45	D D				N=50 (25 for 50mm/ 50 for 70mm)	13.00	33.74		Firm brown fine to medium sandy gravelly CLAY. Gravel is angular to subangular fine to coarse of sandstone and mudstone.	13
		14.00 - 14.45	D				N=50 (7.6/50 for 115mm)	13.50	33.24		Very dense brown clayey sandy angular to subangular medium to coarse GRAVEL of chert and quartzite. Sand is fine to coarse.	
		14.50	D					14.00	32.74		Brown subrounded to rounded medium to coarse GRAVEL of sandstone, mudstone and chert.	14
								14.50	32.24		Extremely weak red fine to medium grained poorly cemented SANDSTONE residually weathered recovered as slightly sandy subangular cobbles. Sand is fine to medium.	15

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Location cleared with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. Cable percussive drilling undertaken to 16.5m bgl. 4. Rotary core follow-on undertaken to 28.5m bgl. 5 No groundwater encountered. 6. Borehole backfilled.



Rotary Core Log

Project Name: FERROUS PHASE II				Client: WML CONSULTING LTD				Date: 22/09/2022									
Location: MANCHESTER				Contractor:				Co-ords: E398069.80 N385219.30									
Project No. : GRO-21454				Crew Name:				Drilling Equipment:									
Borehole Number CP03		Hole Type CP+RC		Level 46.74m AoD		Logged By JT		Scale 1:25		Page Number Sheet 4 of 6							
Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description						
				TCR	SCR	RQD											
		15.50	D				N=50 (25 for 50mm/ 50 for 20mm)				Extremely weak red fine to medium grained poorly cemented SANDSTONE residually weathered recovered as slightly sandy subangular cobbles. Sand is fine to medium.	16					
		16.50	NR				N=50 (25 for 30mm/ 50 for 35mm)	16.50	30.24		NO RECOVERY						
			NI					16.59	30.15		Extremely weak red MUDSTONE residually weathered recovered as angular coarse mudstone gravel.						
			7					16.68	30.06		Extremely weak red medium grained SANDSTONE highly weathered recovered as medium red sand.	17					
		16.50 - 18.00	NI	94	67	44		16.85	29.89		Weak red medium grained SANDSTONE moderately weathered with horizontal smooth planar closely spaced discontinuities. <u>Between 17.23m and 17.3m bgl recovered as medium red sand.</u>						
			12														
			NR					18.00	28.74		NO RECOVERY	18					
			NI					18.16	28.58		Weak red SANDSTONE highly weathered recovered as sandy cobbles.						
			3					18.32	28.42		Weak red medium grained SANDSTONE moderately weathered with horizontal smooth planar closely spaced discontinuities. <u>Between 18.55m and 18.57m bgl recovered as sandstone cobble.</u>						
		18.00 - 19.50	5	89	76	56					<u>Between 18.86m and 18.89m bgl recovered as slightly gravelly sand. Gravel is medium angular red mudstone.</u>	19					
			NI														
			10														
			NR					19.50	27.24		NO RECOVERY						
			NI					19.75	26.99		Weak red medium grained SANDSTONE highly weathered recovered as a rounded sandstone cobble.	20					
			5					19.78	26.96								
	Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush				
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)
Remarks																	
1. Location cleared with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. Cable percussive drilling undertaken to 16.5m bgl. 4. Rotary core follow-on undertaken to 28.5m bgl. 5 No groundwater encountered. 6. Borehole backfilled.																	



Rotary Core Log

Project Name: FERROUS PHASE II			Client: WML CONSULTING LTD			Date: 22/09/2022		
Location: MANCHESTER			Contractor:			Co-ords: E398069.80 N385219.30		
Project No. : GRO-21454			Crew Name:			Drilling Equipment:		
Borehole Number CP03		Hole Type CP+RC		Level 46.74m AoD		Logged By JT		Page Number Sheet 5 of 6

Well	Water	Depth (m)	Type /FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
		19.50 - 21.00	NI	83	54	25	21.00	25.74		Weak red SANDSTONE moderately weathered with horizontal rough planar closely spaced discontinuities. <i>Between 20.12m and 20.15m bgl recovered as slightly gravelly sand. Gravel is medium sub angular mudstone.</i> <i>Between 20.15m and 20.49m bgl recovered as sandstone cobbles.</i> <i>Between 20.49m and 20.52m bgl recovered as angular coarse sandstone gravel.</i> <i>Between 20.52m and 20.56m bgl recovered as sandstone cobble.</i>	21
			6								
		21.00 - 22.50	NR	80	80	35	21.30	25.44		NO RECOVERY	22
			22								
		22.50 - 24.00	NR	88	77	46	22.50	24.12		Weak red medium grained SANDSTONE slightly weathered with horizontal smooth planar closely spaced discontinuities and gravel inclusions of fine to medium quartz. NO RECOVERY Weak red medium grained SANDSTONE slightly weathered with horizontal to sub horizontal (15) rough to smooth planar closely spaced discontinuities. <i>Between 23.11m and 23.17m bgl recovered as sandstone cobble.</i> <i>Between 23.28m and 23.31m bgl recovered as a sandstone cobble.</i> <i>Between 23.53m and 23.75m bgl recovered as gravelly red sand. Gravel is coarse rounded sandstone.</i>	23
			7								
			NI								
			3								
			NI								
			3								
		24.00 - 25.50	NI				24.00	22.74		NO RECOVERY	24
			2								
			2								
			NI								
			2								
			2								
		24.00 - 25.50	NI	88	73	23	24.18	22.56		Weak red medium grained SANDSTONE slightly weathered with horizontal rough planar closely spaced discontinuities. <i>Between 24.28m and 24.31m bgl recovered as a sandstone cobble.</i> <i>Between 24.42m and 24.62m bgl recovered as coarse angular sandstone gravel.</i> Weak red medium grained SANDSTONE slightly weathered with horizontal rough	25
			NI								

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)
Remarks																	
1. Location cleared with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. Cable percussive drilling undertaken to 16.5m bgl. 4. Rotary core follow-on undertaken to 28.5m bgl. 5 No groundwater encountered. 6. Borehole backfilled.																	



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Rotary Core Log

Project Name: FERROUS PHASE II				Client: WML CONSULTING LTD				Date: 22/09/2022			
Location: MANCHESTER				Contractor:				Co-ords: E398069.80 N385219.30			
Project No. : GRO-21454				Crew Name:				Drilling Equipment:			
Borehole Number CP03		Hole Type CP+RC		Level 46.74m AoD		Logged By JT		Scale 1:25		Page Number Sheet 6 of 6	

Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description			
				TCR	SCR	RQD								
			17					25.50	21.24		Weak red medium grained SANDSTONE slightly weathered with horizontal rough planar closely spaced discontinuities with inclusions of medium to coarse rounded mudstone. <i>Between 25.24m and 25.5m bgl slightly gravelly. Gravel is medium to coarse rounded mudstone.</i> NO RECOVERY	26		
			NR											
		25.50 - 27.00	NI	45	23	0		26.32	20.42		Weak red medium grained SANDSTONE highly weathered recovered as a medium rounded sandstone cobble. Weak red SANDSTONE slightly weathered with horizontal smooth planar closely spaced discontinuities. <i>Between 26.52m and 26.6m bgl recovered as a sandstone cobble.</i> <i>Between 26.69m and 26.84m bgl recovered as gravelly sand. Gravel is angular coarse sandstone.</i> NO RECOVERY	27		
			5					26.35	20.39					
			NI											
			2											
			NI											
		27.00 - 28.50	4					27.00	19.74		Extremely weak red medium grained SANDSTONE highly weathered recovered as medium red sand. Weak red medium grained SANDSTONE highly weathered recovered as a sandstone cobble. Weak red medium grained SANDSTONE highly weathered with horizontal smooth planar to undulating very closely spaced discontinuities. <i>Between 27.95m and 28.5m bgl recovered as slightly gravelly sand. Gravel is medium to coarse angular sandstone.</i>	28		
			NR					27.05	19.69					
			NI					27.14	19.60					
								27.18	19.56					
			32	97	52	0								
			NI					28.50	18.24		End of Borehole at 28.500m	29		
														30

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Location cleared with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. Cable percussive drilling undertaken to 16.5m bgl. 4. Rotary core follow-on undertaken to 28.5m bgl. 5 No groundwater encountered. 6. Borehole backfilled.



GROUNDTECH
CONSULTING

Rotary Core Log

Project Name: FERROUS PHASE II			Client: WML CONSULTING LTD			Date: 23/09/2022		
Location: MANCHESTER			Contractor:			Co-ords: E398063.80 N385232.50		
Project No. : GRO-21454			Crew Name:			Drilling Equipment:		
Borehole Number CP04		Hole Type CP+RC		Level 46.98m AoD		Logged By JT		Page Number Sheet 2 of 6

Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD						
		5.50	D								Stiff brown mottled grey slightly gravelly CLAY. Gravel is angular to subrounded fine to medium of mudstone and coal.	
		6.00 - 6.45	D				(31)					6
		7.00	D								Becoming slightly sandy between 6.50m and 7.00m bgl.	
		7.50	D								No coal observed from 7.00m bgl.	7
		8.00 8.00 - 8.45	D D				(37)	8.00	38.98		Stiff brown orange slightly gravelly sandy CLAY. Sand is fine to medium. Gravel is angular to subangular fine to coarse of sandstone and mudstone.	8
		9.00	D									9
		9.50	D									
			D									10

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Location cleared with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. Cable percussive drilling undertaken to 16.0m bgl. 4. Rotary core follow-on undertaken to 28.5m bgl. 5 No groundwater encountered. 6. Borehole backfilled.



Rotary Core Log

Project Name: FERROUS PHASE II				Client: WML CONSULTING LTD				Date: 23/09/2022			
Location: MANCHESTER				Contractor:				Co-ords: E398063.80 N385232.50			
Project No. : GRO-21454				Crew Name:				Drilling Equipment:			
Borehole Number CP04		Hole Type CP+RC		Level 46.98m AoD		Logged By JT		Scale 1:25		Page Number Sheet 3 of 6	

Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD						
		10.00 - 10.45					N=50 (5,5/50 for 283mm)	10.50	36.48		Stiff brown orange slightly gravelly sandy CLAY. Sand is fine to medium. Gravel is angular to subangular fine to coarse of sandstone and mudstone.	11
		11.00 - 11.45					D				(28)	
		12.00 - 12.45	D	(18)		11.50	35.48		Dense brown orange subangular to rounded medium to coarse GRAVEL of sandstone and mudstone with moderate cobble content of sandstone and mudstone.	12		
		13.00 - 13.45	D	(33)		12.50	34.48		Medium dense red slightly gravelly clayey fine SAND. Gravel is fine rounded of mudstone.	13		
		14.00 - 14.45	D	(45)		13.50	33.48		Stiff brown sandy gravelly CLAY with moderate cobble content of sandstone and mudstone. Gravel is angular to subangular fine to coarse of sandstone and mudstone. Sand is fine to coarse.	14		
			D									15

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks															
1. Location cleared with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. Cable percussive drilling undertaken to 16.0m bgl. 4. Rotary core follow-on undertaken to 28.5m bgl. 5 No groundwater encountered. 6. Borehole backfilled.															

Rotary Core Log

Project Name: FERROUS PHASE II			Client: WML CONSULTING LTD			Date: 23/09/2022		
Location: MANCHESTER			Contractor:			Co-ords: E398063.80 N385232.50		
Project No. : GRO-21454			Crew Name:			Drilling Equipment:		
Borehole Number CP04		Hole Type CP+RC		Level 46.98m AoD		Logged By JT		Page Number Sheet 4 of 6

Well	Water	Depth (m)	Type /FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
		15.00 - 15.45								Stiff brown sandy gravelly CLAY with moderate cobble content of sandstone and mudstone. Gravel is angular to subangular fine to coarse of sandstone and mudstone. Sand is fine to coarse.	
		16.00	D				15.50	31.48		Extremely weak red medium grained SANDSTONE residually weathered recovered as gravelly fine sand. Gravel is angular to subrounded medium to coarse.	
							16.00	30.98		NO RECOVERY	16
			NR				16.65	30.33			
			NI				16.85	30.13		Weak red medium grained SANDSTONE highly weathered recovered mainly as red medium sand.	
			3							<i>Between 16.82m to 16.85m bgl weak mudstone.</i>	
			NI							Weak red medium grained SANDSTONE slightly weathered with horizontal to sub horizontal smooth to rough planar closely to very closely spaced discontinuities.	17
		16.50 - 18.00		90	73	23				<i>Between 17.01m and 17.05m bgl recovered as medium sand.</i>	
			12							<i>Between 17.13m and 17.15m bgl recovered as medium sand.</i>	
			NI				17.79	29.19			
			3				17.84	29.14		<i>Between 17.79m and 17.84m bgl extremely weak red slightly sandy MUDSTONE residually weathered recovered as coarse angular gravel.</i>	18
			NR				18.00	28.98		Weak red slightly clayey medium grained SANDSTONE slightly weathered with horizontal rough planar closely spaced discontinuities.	
			5				18.28	28.70		NO RECOVERY	
		18.00 - 19.50		82	60	21				Weak red medium grained SANDSTONE slightly weathered with horizontal to sub horizontal (10) smooth planar very closely spaced discontinuities.	
			NI							<i>Between 18.72m and 18.82m bgl recovered as a sandstone cobble.</i>	19
										<i>Between 18.82m and 19.0m bgl recovered mainly as medium red sand.</i>	
										<i>Between 19.0m to 19.16m bgl recovered as gravelly medium sand. Gravel is sandstone.</i>	
			3							<i>Between 19.16m and 19.31m bgl recovered as sandstone cobble.</i>	
			NI				19.50	27.48		<i>Between 19.42m and 19.44m recovered as sandy gravel. Gravel is coarse angular to rounded sandstone and quartz.</i>	
			NR				19.65	27.33		NO RECOVERY	
			NI				19.75	27.23		Weak slightly gravelly red medium grained SANDSTONE highly weathered recovered	20

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)
Remarks																	
1. Location cleared with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. Cable percussive drilling undertaken to 16.0m bgl. 4. Rotary core follow-on undertaken to 28.5m bgl. 5 No groundwater encountered. 6. Borehole backfilled.																	



Rotary Core Log

Project Name: FERROUS PHASE II			Client: WML CONSULTING LTD			Date: 23/09/2022		
Location: MANCHESTER			Contractor:			Co-ords: E398063.80 N385232.50		
Project No. : GRO-21454			Crew Name:			Drilling Equipment:		
Borehole Number CP04		Hole Type CP+RC		Level 46.98m AoD		Logged By JT		Page Number Sheet 5 of 6

Well	Water	Depth (m)	Type /FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
		19.50 - 21.00	17	90	77	28				Weak slightly gravelly red medium grained SANDSTONE highly weathered recovered as sandstone cobbles. <i>Between 19.66m and 19.75m bgl recovered as angular coarse gravel of sandstone and mudstone.</i>	
							21.00	25.98		Weak red medium grained SANDSTONE. Slightly weathered with horizontal smooth planar medium to closely to very closely to medium spaced discontinuities.	21
			NR							NO RECOVERY	
			NI				21.20	25.78			
							21.28	25.70		Weak red medium grained SANDSTONE highly weathered recovered as a sandstone cobble.	
		21.00 - 22.50	18	87	49	30				Weak red medium grained SANDSTONE slightly weathered with sub horizontal (15) to horizontal smooth planar very closely to closely spaced discontinuities.	
										<i>Between 21.88m and 22.3m bgl grain size increase from fine to medium.</i>	22
			NI								
			2							<i>Between 22.3m and 22.37m bgl recovered as a sandstone cobble.</i>	
			NI				22.50	24.48		<i>Between 22.44m and 22.5m bgl recovered as a sandstone cobble.</i>	
			NR							NO RECOVERY	
			NI				22.66	24.32		Weak red medium grained SANDSTONE residually weathered recovered as a sandstone cobble.	
							22.75	24.23		Weak red medium grained SANDSTONE moderately weathered with horizontal to sub horizontal (15) smooth planar closely to very closely spaced discontinuities.	23
		22.50 - 24.00	12	89	81	66					
			NI							<i>Between 23.73m and 23.78m bgl recovered as a sandstone cobble.</i>	
			2							<i>Between 23.77m and 23.81m bgl recovered as gravelly medium sand. Gravel is coarse angular sandstone.</i>	24
			NI				24.00	22.98		NO RECOVERY	
							24.09	22.89			
			NR							Extremely weak red medium grained SANDSTONE residually weathered, recovered as medium red sand and sub angular coarse sandstone gravel.	
		24.00 - 25.50	3	93	59	33	24.40	22.58		Weak red medium grained SANDSTONE slightly to moderately weathered with horizontal to sub horizontal (10) smooth planar closely spaced discontinuities.	
			NI							<i>Between 24.54m and 24.59m bgl recovered as</i>	25
			7								

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)
Remarks																	
1. Location cleared with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. Cable percussive drilling undertaken to 16.0m bgl. 4. Rotary core follow-on undertaken to 28.5m bgl. 5 No groundwater encountered. 6. Borehole backfilled.																	



Rotary Core Log

Project Name: FERROUS PHASE II				Client: WML CONSULTING LTD				Date: 23/09/2022			
Location: MANCHESTER				Contractor:				Co-ords: E398063.80 N385232.50			
Project No. : GRO-21454				Crew Name:				Drilling Equipment:			
Borehole Number CP04		Hole Type CP+RC		Level 46.98m AoD		Logged By JT		Scale 1:25		Page Number Sheet 6 of 6	

Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD						
		25.50 - 27.00	NI				90	84	63		Weak red medium grained SANDSTONE slightly to moderately weathered with horizontal to sub horizontal (10) smooth planar closely spaced discontinuities. <i>Between 24.54m and 24.59m bgl recovered as medium sand.</i> <i>Between 25.09m and 25.21m bgl recovered as sandy sub angular coarse gravel of sandstone.</i> <i>Between 25.45m and 25.5m bgl recovered as a sandstone cobble.</i> NO RECOVERY	26
			3									
			NI									
			NR									
			10									
			NI									
			3									
			NI									
			5									
			NI									
			2									
			27.00 - 28.50	NR								
		NI										
		2										
		NI										
		4										
		NI										
		2										
		NI										
		4										
		NI										
		2										
		28.50		4								Weak red medium grained SANDSTONE. Slightly weathered with horizontal smooth planar closely to medium spaced discontinuities. <i>Between 27.22m and 27.26m bgl recovered as a sandstone cobble.</i> <i>Between 27.26m and 27.29m bgl recovered as medium angular mudstone and sandstone gravel.</i> Weak red medium grained SANDSTONE. Slightly weathered with horizontal smooth planar closely to medium spaced discontinuities. <i>Between 27.38m and 27.46m bgl recovered as a sandstone cobble.</i> <i>Between 27.61m and 27.77m bgl recovered as a sandstone cobble.</i> <i>Between 27.77m and 27.85m bgl recovered as gravelly red medium sand. Gravel is coarse angular sandstone and mudstone.</i> End of Borehole at 28.500m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Location cleared with CAT prior to breaking ground. 2. Hand dug inspection pit to 1.2m bgl. 3. Cable percussive drilling undertaken to 16.0m bgl. 4. Rotary core follow-on undertaken to 28.5m bgl. 5 No groundwater encountered. 6. Borehole backfilled.



APPENDIX 4 – Geo-Environmental Testing Results



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Analytical Report Number : 22-84568

Project / Site name:	Groundtec	Samples received on:	15/09/2022
Your job number:	GRO 21454	Samples instructed on/ Analysis started on:	15/09/2022
Your order number:	ORD 21454 2819	Analysis completed by:	28/09/2022
Report Issue Number:	1	Report issued on:	28/09/2022
Samples Analysed:	14 soil samples		

Signed:

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

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

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

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

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

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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: 22-84568
Project / Site name: Ferrous Phase II
Your Order No: ORD 21454 2819

Lab Sample Number				2427186	2427187	2427188	2427189	2427190
Sample Reference				WS01	WS01	WS02	WS02	WS02
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.10	0.50	0.15	0.50	1.00
Date Sampled				13/09/2022	13/09/2022	13/09/2022	13/09/2022	13/09/2022
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	100	11	9.3	11	19
Total mass of sample received	kg	0.001	NONE	1	1	1	1	1

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	Not-detected
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	0.001	-	-	-
Asbestos Quantification Total	%	0.001	ISO 17025	-	0.001	-	-	-
Asbestos Analyst ID	N/A	N/A	N/A	PDO	PDO	SZS	SZS	SZS

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.3	8.7	10.4	8.2	8.2
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	13	270	870	210	210
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.0066	0.14	0.44	0.11	0.11
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	6.6	137	437	107	106
Organic Matter (automated)	%	0.1	MCERTS	4	3.4	2.7	2.4	4.2

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	< 0.05	< 0.05	0.55	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	0.24	< 0.05	0.8	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	0.33	0.92	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	0.2	0.21	1.4	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	3.2	2.2	12	< 0.05	0.49
Anthracene	mg/kg	0.05	MCERTS	0.86	0.63	2.6	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	5.2	3.5	13	< 0.05	0.43
Pyrene	mg/kg	0.05	MCERTS	4.8	3.5	13	< 0.05	0.48
Benzo(a)anthracene	mg/kg	0.05	MCERTS	2.6	2.1	6.8	< 0.05	0.37
Chrysene	mg/kg	0.05	MCERTS	2.3	2.2	4.7	< 0.05	0.29
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	2.5	2.8	6.1	< 0.05	0.29
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	1.3	0.92	2.1	< 0.05	0.18
Benzo(a)pyrene	mg/kg	0.05	MCERTS	2.4	2.6	5.9	< 0.05	0.32
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	1.3	1.3	2.4	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.33	0.37	0.76	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	1.4	1.5	3.2	< 0.05	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	28.4	24.2	76.5	< 0.80	2.85
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Analytical Report Number: 22-84568
Project / Site name: Ferrous Phase II
Your Order No: ORD 21454 2819

Lab Sample Number				2427186	2427187	2427188	2427189	2427190
Sample Reference				WS01	WS01	WS02	WS02	WS02
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.10	0.50	0.15	0.50	1.00
Date Sampled				13/09/2022	13/09/2022	13/09/2022	13/09/2022	13/09/2022
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	17	19	28	21	41
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	1.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	23	39	29	34	43
Copper (aqua regia extractable)	mg/kg	1	MCERTS	55	120	120	150	130
Lead (aqua regia extractable)	mg/kg	1	MCERTS	120	200	290	130	190
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	0.5	< 0.3	0.7	0.7	0.8
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	19	33	35	45	43
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	120	230	240	80	69

Monoaromatics & Oxygenates

Benzene	µg/kg	1	MCERTS	-	-	-	-	-
Toluene	µg/kg	1	MCERTS	-	-	-	-	-
Ethylbenzene	µg/kg	1	MCERTS	-	-	-	-	-
p & m-xylene	µg/kg	1	MCERTS	-	-	-	-	-
o-xylene	µg/kg	1	MCERTS	-	-	-	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	-	-	-	-

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6 _{HS_1D_AL}	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC6 - EC8 _{HS_1D_AL}	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC8 - EC10 _{HS_1D_AL}	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC10 - EC12 _{EH_CU_1D_AL}	mg/kg	1	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC12 - EC16 _{EH_CU_1D_AL}	mg/kg	2	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC16 - EC21 _{EH_CU_1D_AL}	mg/kg	8	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC21 - EC35 _{EH_CU_1D_AL}	mg/kg	8	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic (EC5 - EC35) _{EH_CU+HS_1D_AL}	mg/kg	10	MCERTS	-	-	-	-	-

TPH-CWG - Aromatic >EC5 - EC7 _{HS_1D_AR}	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC7 - EC8 _{HS_1D_AR}	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC8 - EC10 _{HS_1D_AR}	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC10 - EC12 _{EH_CU_1D_AR}	mg/kg	1	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC12 - EC16 _{EH_CU_1D_AR}	mg/kg	2	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC16 - EC21 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC21 - EC35 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic (EC5 - EC35) _{EH_CU+HS_1D_AR}	mg/kg	10	MCERTS	-	-	-	-	-

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

Analytical Report Number: 22-84568
Project / Site name: Ferrous Phase II
Your Order No: ORD 21454 2819

Lab Sample Number				2427191	2427192	2427193	2427194	2427195
Sample Reference				WS03	WS03	WS03	WS04	WS05
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.10	0.50	1.00	0.50	0.50
Date Sampled				13/09/2022	13/09/2022	13/09/2022	13/09/2022	13/09/2022
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	15	18	13	6.2	12
Total mass of sample received	kg	0.001	NONE	1	1	1	1	1

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

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.2	7	8.5	8.7	9.4
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	20	1500	540	330	1100
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.01	0.75	0.27	0.16	0.56
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	10.2	754	268	163	560
Organic Matter (automated)	%	0.1	MCERTS	3.7	1.8	1.3	2.1	1.5

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	< 0.05	< 0.05	< 0.05	9.3	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.68	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	0.36	< 0.05	< 0.05	5.8	0.42
Fluorene	mg/kg	0.05	MCERTS	0.2	< 0.05	< 0.05	5	0.3
Phenanthrene	mg/kg	0.05	MCERTS	1.6	< 0.05	1.4	37	2.8
Anthracene	mg/kg	0.05	MCERTS	0.3	< 0.05	0.3	8.8	0.62
Fluoranthene	mg/kg	0.05	MCERTS	2.3	< 0.05	1.1	43	3.5
Pyrene	mg/kg	0.05	MCERTS	2.2	< 0.05	1.1	44	3.4
Benzo(a)anthracene	mg/kg	0.05	MCERTS	1.3	< 0.05	0.64	26	2.1
Chrysene	mg/kg	0.05	MCERTS	1.1	< 0.05	0.59	18	1.5
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	1.4	< 0.05	0.59	27	2.1
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.63	< 0.05	0.17	6.3	0.63
Benzo(a)pyrene	mg/kg	0.05	MCERTS	1.4	< 0.05	0.47	24	2
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.66	< 0.05	0.21	8.4	0.89
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	2.8	0.27
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.8	< 0.05	0.31	11	1

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	14.2	< 0.80	6.92	277	21.5
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Analytical Report Number: 22-84568
Project / Site name: Ferrous Phase II
Your Order No: ORD 21454 2819

Lab Sample Number				2427191	2427192	2427193	2427194	2427195
Sample Reference				WS03	WS03	WS03	WS04	WS05
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.10	0.50	1.00	0.50	0.50
Date Sampled				13/09/2022	13/09/2022	13/09/2022	13/09/2022	13/09/2022
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	14	86	8.8	11	7.8
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	0.9	0.3
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	17	160	31	22	66
Copper (aqua regia extractable)	mg/kg	1	MCERTS	51	2500	24	49	28
Lead (aqua regia extractable)	mg/kg	1	MCERTS	110	170	13	130	44
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	0.5	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	17	100	36	22	22
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	99	660	58	79	62

Monoaromatics & Oxygenates

Benzene	µg/kg	1	MCERTS	-	< 1.0	-	-	-
Toluene	µg/kg	1	MCERTS	-	< 1.0	-	-	-
Ethylbenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	-
p & m-xylene	µg/kg	1	MCERTS	-	< 1.0	-	-	-
o-xylene	µg/kg	1	MCERTS	-	< 1.0	-	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	< 1.0	-	-	-

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6 _{HS_1D_AL}	mg/kg	0.001	MCERTS	-	< 0.001	-	-	-
TPH-CWG - Aliphatic >EC6 - EC8 _{HS_1D_AL}	mg/kg	0.001	MCERTS	-	< 0.001	-	-	-
TPH-CWG - Aliphatic >EC8 - EC10 _{HS_1D_AL}	mg/kg	0.001	MCERTS	-	< 0.001	-	-	-
TPH-CWG - Aliphatic >EC10 - EC12 _{EH_CU_1D_AL}	mg/kg	1	MCERTS	-	< 1.0	-	-	-
TPH-CWG - Aliphatic >EC12 - EC16 _{EH_CU_1D_AL}	mg/kg	2	MCERTS	-	10	-	-	-
TPH-CWG - Aliphatic >EC16 - EC21 _{EH_CU_1D_AL}	mg/kg	8	MCERTS	-	32	-	-	-
TPH-CWG - Aliphatic >EC21 - EC35 _{EH_CU_1D_AL}	mg/kg	8	MCERTS	-	100	-	-	-
TPH-CWG - Aliphatic (EC5 - EC35) _{EH_CU+HS_1D_AL}	mg/kg	10	MCERTS	-	140	-	-	-

TPH-CWG - Aromatic >EC5 - EC7 _{HS_1D_AR}	mg/kg	0.001	MCERTS	-	< 0.001	-	-	-
TPH-CWG - Aromatic >EC7 - EC8 _{HS_1D_AR}	mg/kg	0.001	MCERTS	-	< 0.001	-	-	-
TPH-CWG - Aromatic >EC8 - EC10 _{HS_1D_AR}	mg/kg	0.001	MCERTS	-	< 0.001	-	-	-
TPH-CWG - Aromatic >EC10 - EC12 _{EH_CU_1D_AR}	mg/kg	1	MCERTS	-	< 1.0	-	-	-
TPH-CWG - Aromatic >EC12 - EC16 _{EH_CU_1D_AR}	mg/kg	2	MCERTS	-	4.6	-	-	-
TPH-CWG - Aromatic >EC16 - EC21 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	-	13	-	-	-
TPH-CWG - Aromatic >EC21 - EC35 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	-	49	-	-	-
TPH-CWG - Aromatic (EC5 - EC35) _{EH_CU+HS_1D_AR}	mg/kg	10	MCERTS	-	67	-	-	-

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

Analytical Report Number: 22-84568
Project / Site name: Ferrous Phase II
Your Order No: ORD 21454 2819

Lab Sample Number				2427196	2427197	2427198	2427199
Sample Reference				WS05	WS05	WS06	WS06
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.60	1.00	0.30	0.60
Date Sampled				13/09/2022	13/09/2022	13/09/2022	13/09/2022
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status				
Stone Content	%	0.1	NONE	< 0.1	< 0.1	22	12
Moisture Content	%	0.01	NONE	8.3	11	7.9	9
Total mass of sample received	kg	0.001	NONE	1	1	1	1

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

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.6	8.9	10.5	8.2
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	150	410	1300	140
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.075	0.21	0.66	0.07
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	74.9	206	662	69.5
Organic Matter (automated)	%	0.1	MCERTS	2.7	1.1	1.8	3.1

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	1.5	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.95	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	0.28	7.4	0.46
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	1.6	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.32	9.6	0.41
Pyrene	mg/kg	0.05	MCERTS	< 0.05	0.3	8.9	0.39
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	0.19	5.4	0.27
Chrysene	mg/kg	0.05	MCERTS	< 0.05	0.2	3.7	0.29
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	5.8	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	1.6	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	5.2	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	2.4	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.7	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	3.1	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	1.29	57.8	1.82
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Analytical Report Number: 22-84568
Project / Site name: Ferrous Phase II
Your Order No: ORD 21454 2819

Lab Sample Number				2427196	2427197	2427198	2427199
Sample Reference				WS05	WS05	WS06	WS06
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.60	1.00	0.30	0.60
Date Sampled				13/09/2022	13/09/2022	13/09/2022	13/09/2022
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status				
Heavy Metals / Metalloids							
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	14	7.8	10	9
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	0.5	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	16	30	18	13
Copper (aqua regia extractable)	mg/kg	1	MCERTS	30	24	40	15
Lead (aqua regia extractable)	mg/kg	1	MCERTS	61	15	86	39
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	14	36	16	13
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	42	58	89	30

Monoaromatics & Oxygenates

Benzene	µg/kg	1	MCERTS	< 1.0	-	-	-
Toluene	µg/kg	1	MCERTS	< 1.0	-	-	-
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	-	-	-
p & m-xylene	µg/kg	1	MCERTS	< 1.0	-	-	-
o-xylene	µg/kg	1	MCERTS	< 1.0	-	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	-	-	-

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6 _{HS_1D_AL}	mg/kg	0.001	MCERTS	< 0.001	-	-	-
TPH-CWG - Aliphatic >EC6 - EC8 _{HS_1D_AL}	mg/kg	0.001	MCERTS	< 0.001	-	-	-
TPH-CWG - Aliphatic >EC8 - EC10 _{HS_1D_AL}	mg/kg	0.001	MCERTS	< 0.001	-	-	-
TPH-CWG - Aliphatic >EC10 - EC12 _{EH_CU_1D_AL}	mg/kg	1	MCERTS	< 1.0	-	-	-
TPH-CWG - Aliphatic >EC12 - EC16 _{EH_CU_1D_AL}	mg/kg	2	MCERTS	< 2.0	-	-	-
TPH-CWG - Aliphatic >EC16 - EC21 _{EH_CU_1D_AL}	mg/kg	8	MCERTS	< 8.0	-	-	-
TPH-CWG - Aliphatic >EC21 - EC35 _{EH_CU_1D_AL}	mg/kg	8	MCERTS	< 8.0	-	-	-
TPH-CWG - Aliphatic (EC5 - EC35) _{EH_CU+HS_1D_AL}	mg/kg	10	MCERTS	< 10	-	-	-

TPH-CWG - Aromatic >EC5 - EC7 _{HS_1D_AR}	mg/kg	0.001	MCERTS	< 0.001	-	-	-
TPH-CWG - Aromatic >EC7 - EC8 _{HS_1D_AR}	mg/kg	0.001	MCERTS	< 0.001	-	-	-
TPH-CWG - Aromatic >EC8 - EC10 _{HS_1D_AR}	mg/kg	0.001	MCERTS	< 0.001	-	-	-
TPH-CWG - Aromatic >EC10 - EC12 _{EH_CU_1D_AR}	mg/kg	1	MCERTS	< 1.0	-	-	-
TPH-CWG - Aromatic >EC12 - EC16 _{EH_CU_1D_AR}	mg/kg	2	MCERTS	< 2.0	-	-	-
TPH-CWG - Aromatic >EC16 - EC21 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	< 10	-	-	-
TPH-CWG - Aromatic >EC21 - EC35 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	< 10	-	-	-
TPH-CWG - Aromatic (EC5 - EC35) _{EH_CU+HS_1D_AR}	mg/kg	10	MCERTS	< 10	-	-	-

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



Analytical Report Number: 22-84568
Project / Site name: Ferrous Phase II
Your Order No: ORD 21454 2819

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
2427187	WS01	0.50	147	Loose Fibres	Chrysotile	0.001	0.001

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

Analytical Report Number : 22-84568

Project / Site name: Ferrous Phase II

* 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 *
2427186	WS01	None Supplied	0.1	Brown loam and sand with gravel and vegetation.
2427187	WS01	None Supplied	0.5	Brown loam and sand with brick and vegetation.
2427188	WS02	None Supplied	0.15	Brown loam and sand with gravel.
2427189	WS02	None Supplied	0.5	Brown clay and sand with gravel.
2427190	WS02	None Supplied	1	Brown clay and sand with gravel.
2427191	WS03	None Supplied	0.1	Brown clay and loam with vegetation.
2427192	WS03	None Supplied	0.5	Brown clay and sand with gravel.
2427193	WS03	None Supplied	1	Brown clay and sand with vegetation.
2427194	WS04	None Supplied	0.5	Brown clay and sand with gravel.
2427195	WS05	None Supplied	0.5	Brown clay and sand with gravel and brick.
2427196	WS05	None Supplied	0.6	Brown sandy loam with gravel.
2427197	WS05	None Supplied	1	Brown clay and sand with vegetation.
2427198	WS06	None Supplied	0.3	Brown loam and sand with gravel and stones.
2427199	WS06	None Supplied	0.6	Black loam and sand with gravel and stones.

Analytical Report Number : 22-84568

Project / Site name: Ferrous Phase II

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
NRA Leachate Prep	10:1 extract with de-ionised water shaken for 24 hours then filtered.	In-house method based on National Rivers Authority	L020-PL	W	NONE
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
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
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 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
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in house method based on references.	HSE Report No: 83/1996, HSG 248, HSG 264 & SCA Blue Book (draft).	A006-PL	D	ISO 17025
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
D.O. for Gravimetric Quant if Screen/ID positive	Dependent option for Gravimetric Quant if Screen/ID positive scheduled.	In house asbestos methods A001 & A006.	A006-PL	D	NONE

Analytical Report Number : 22-84568

Project / Site name: Ferrous Phase II

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Sulphate, water soluble, in soil	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

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.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

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



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

t: 01923 225404

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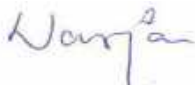
e: reception@i2analytical.com

Analytical Report Number : 22-88719

Replaces Analytical Report Number: 22-88719, issue no. 1
Report format change.

Project / Site name:	Ferrous	Samples received on:	06/10/2022
Your job number:	GRO-21454	Samples instructed on/ Analysis started on:	07/10/2022
Your order number:		Analysis completed by:	17/10/2022
Report Issue Number:	2	Report issued on:	08/11/2022
Samples Analysed:	4 leachate samples		

Signed:


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

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

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

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

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

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

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

Analytical Report Number: 22-88719
Project / Site name: Ferrous

Lab Sample Number				2452430	2452431	2452432	2452433
Sample Reference				CP02	CP03	CP04	CP04
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.50	0.50	0.50	1.00
Date Sampled				27/09/2022	28/09/2022	30/09/2022	30/09/2022
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)				Units	Limit of detection	Accreditation Status	

General Inorganics

pH (automated)	pH Units	N/A	ISO 17025	7.8	7.8	7.9	7.9
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10
Sulphate as SO ₄	mg/l	0.1	ISO 17025	16.1	16.1	13.8	12.6
Total Organic Carbon (TOC)	mg/l	0.1	NONE	4.36	6.2	8.42	5.19

Total Phenols

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

Speciated PAHs

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

Total PAH

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

Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	1	ISO 17025	1.9	4.1	5.4	2.2
Cadmium (dissolved)	µg/l	0.08	ISO 17025	< 0.08	< 0.08	< 0.08	< 0.08
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0	< 5.0
Chromium (dissolved)	µg/l	0.4	ISO 17025	1.3	2.4	1.8	1.7
Copper (dissolved)	µg/l	0.7	ISO 17025	6.7	12	12	7.8
Lead (dissolved)	µg/l	1	ISO 17025	6.9	12	11	2.5
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5	< 0.5	< 0.5	< 0.5
Nickel (dissolved)	µg/l	0.3	ISO 17025	1.1	4.9	2.1	5.4
Selenium (dissolved)	µg/l	4	ISO 17025	< 4.0	< 4.0	< 4.0	< 4.0
Zinc (dissolved)	µg/l	0.4	ISO 17025	6.9	14	3.4	8.8

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

Analytical Report Number : 22-88719

Project / Site name: Ferrous

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
NRA Leachate Prep	10:1 extract with de-ionised water shaken for 24 hours then filtered.	In-house method based on National Rivers Authority	L020-PL	W	NONE
Metals by ICP-OES in leachate	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Hexavalent chromium in leachate	Determination of hexavalent chromium in leachate by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	ISO 17025
Monohydric phenols in leachate	Determination of phenols in leachate by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Speciated EPA-16 PAHs in leachate	Determination of PAH compounds in leachate by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
pH at 20oC in leachate (automated)	Determination of pH in leachate by electrometric measurement.	In house method.	L099B	W	ISO 17025
Total cyanide in leachate	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Total organic carbon in leachate	Determination of dissolved organic carbon in leachate by TOC/DOC NDIR analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
Sulphate in leachates	Determination of sulphate in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil""	L039-PL	W	ISO 17025

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

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

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

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

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

APPENDIX 5 - Geotechnical Testing Results



LABORATORY REPORT



4043

Contract Number: PSL22/6673

Report Date: 31 October 2022
Client's Reference: GRO-21454
Client Name: Groundtech Consulting
First Floor
Lloyd House
Orford Court
Greenfold Way
WN7 3XJ

For the attention of: Luke Harrison

Contract Title: Ferrous Phase II
Date Received: 17/10/2022
Date Commenced: 17/10/2022
Date Completed: 31/10/2022

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

Checked and Approved Signatories:

A Watkins
(Director)

R Berriman
(Quality Manager)

S Royle
(Laboratory Manager)

L Knight
(Assistant Laboratory Manager)

S Eyre
(Senior Technician)

M Fennell
(Senior Technician)

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Page 1 of

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

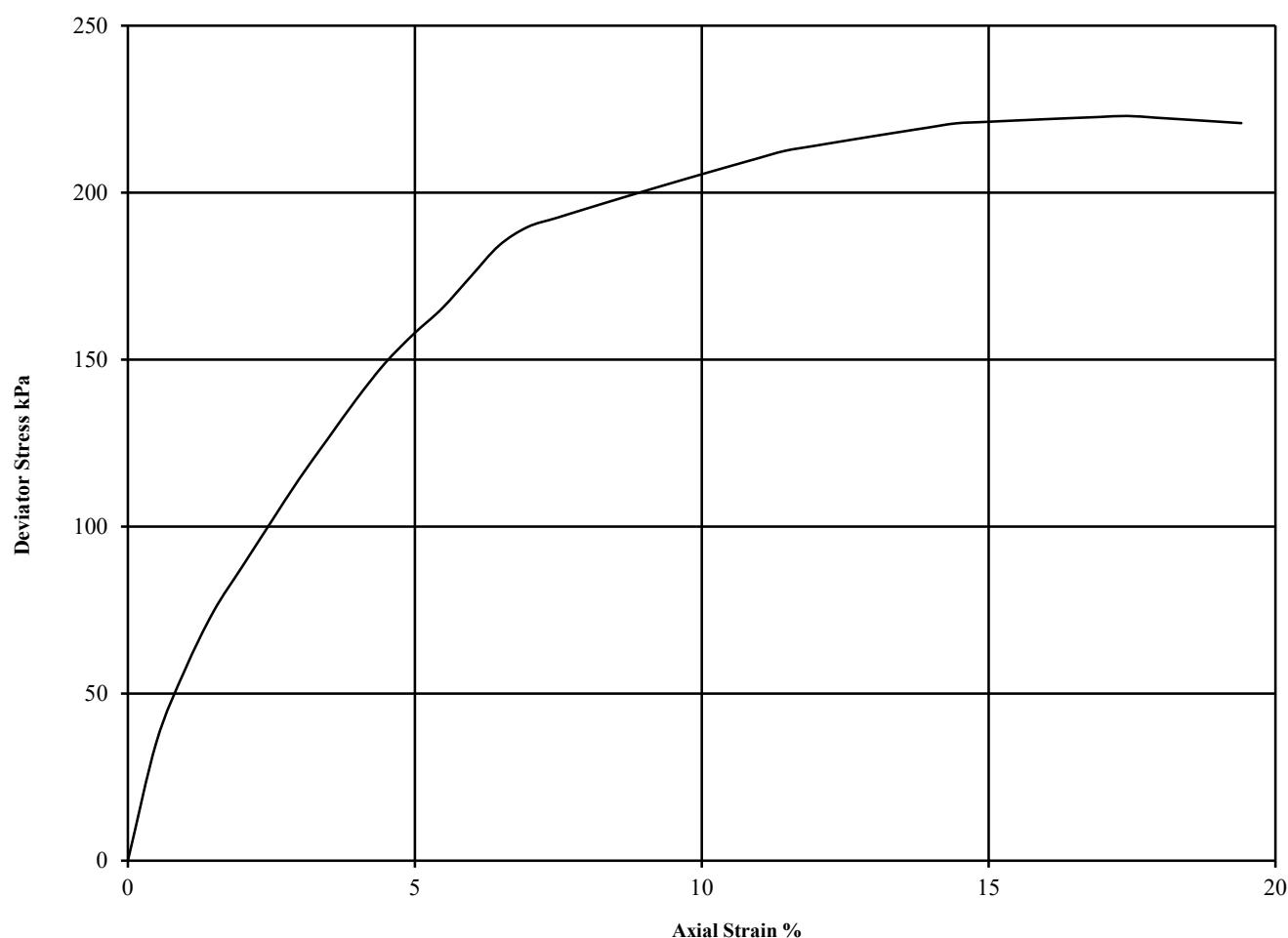
Hole Number: CP01

Top Depth (m): 4.00

Sample Number:

Base Depth (m): 4.45

Sample Type U



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.34 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	17	2.05	1.75	80	223	111	17.4	Plastic	



4043

PSL
Professional Soils Laboratory

Ferrous Phase II

Contract No:

PSL22/6673

Client Ref:

GRO-21454



LABORATORY REPORT



4043

Contract Number: PSL22/6674

Report Date: 26 October 2022
Client's Reference: GRO-21454
Client Name: Groundtech Consulting
First Floor
Lloyd House
Orford Court
Greenfold Way
WN7 3XJ

For the attention of: Luke Harrison

Contract Title: Ferrous Phase II
Date Received: 17/10/2022
Date Commenced: 17/10/2022
Date Completed: 24/10/2022

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.

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Page 1 of

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

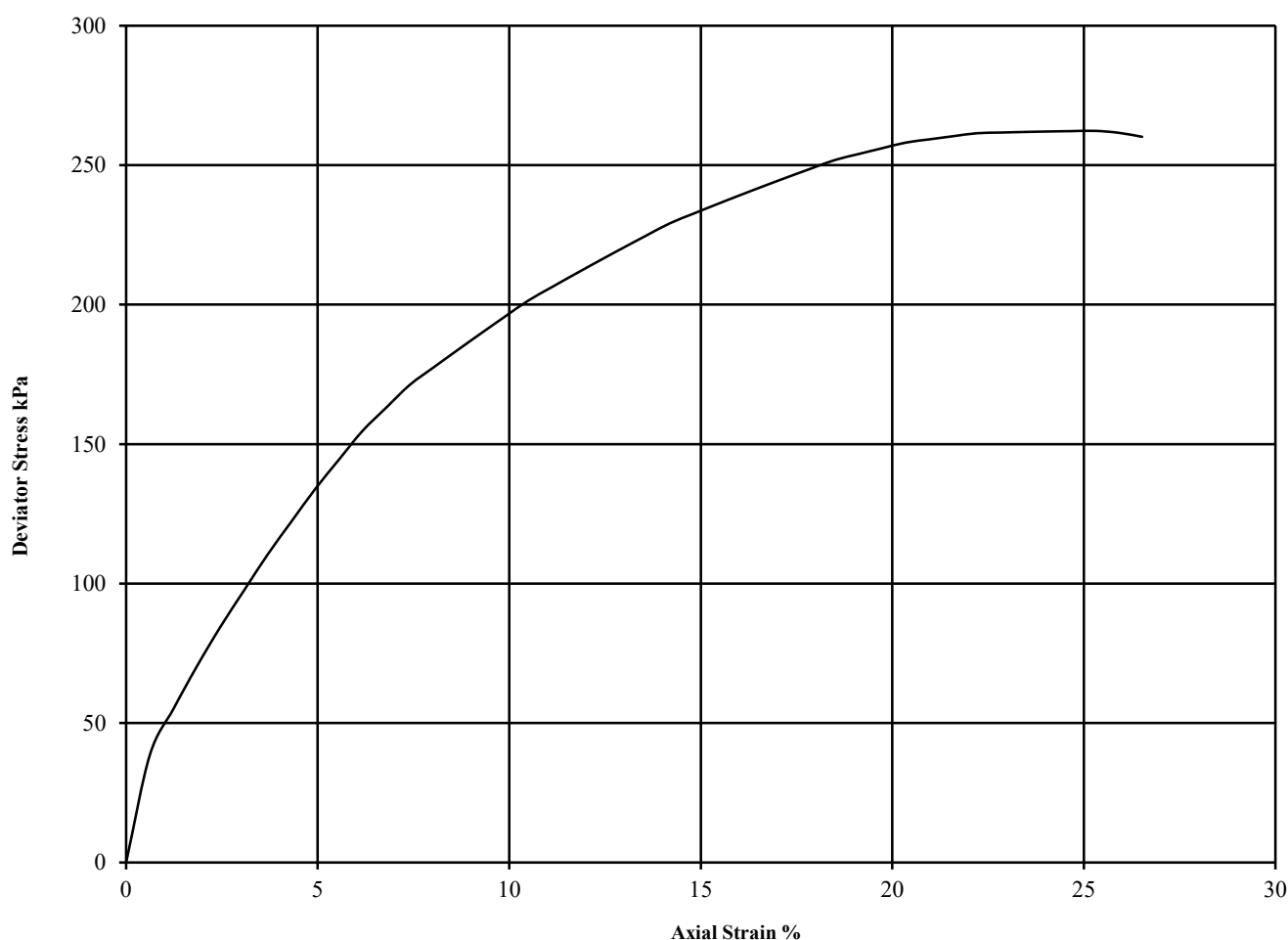
Hole Number: CP02

Top Depth (m): 6.00

Sample Number:

Base Depth (m): 6.45

Sample Type U



Diameter (mm):		103		Height (mm):		167	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.32 See summary of soil descriptions	
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$				
1	18	2.02	1.71	120	262	131	25.3	Plastic		



4043

PSL
Professional Soils Laboratory

Ferrous Phase II

Contract No:

PSL22/6674

Client Ref:

GRO-21454



LABORATORY REPORT



4043

Contract Number: PSL22/6675

Report Date: 31 October 2022
Client's Reference: GRO-21454
Client Name: Groundtech Consulting
First Floor
Lloyd House
Orford Court
Greenfold Way
WN7 3XJ

For the attention of: Luke Harrison

Contract Title: Ferrous Phase II
Date Received: 17/10/2022
Date Commenced: 17/10/2022
Date Completed: 31/10/2022

Notes: Opinions and Interpretations are outside the UKAS Accreditation

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T Watkins
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Page 1 of

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

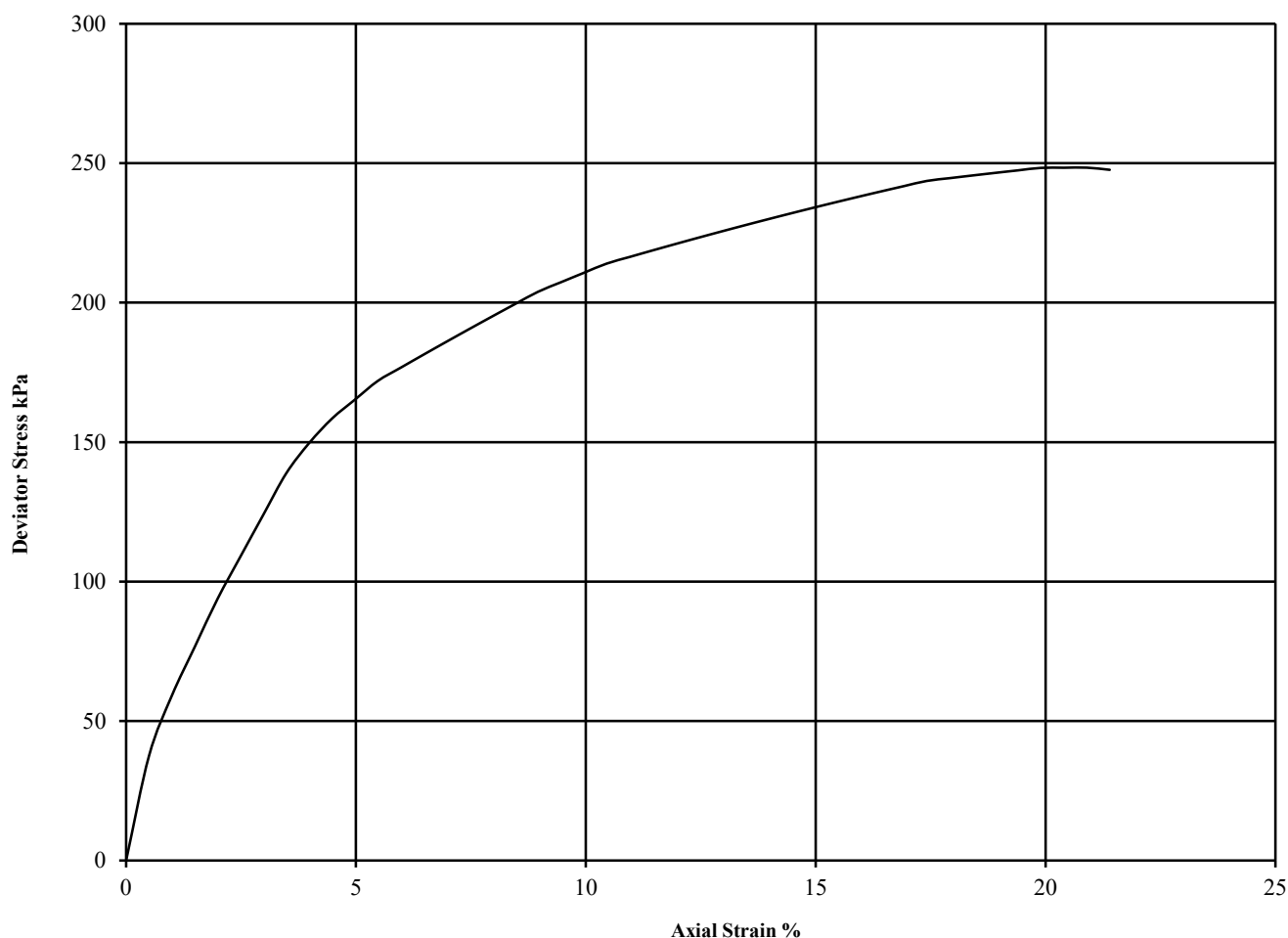
Hole Number: CP03

Top Depth (m): 8.00

Sample Number:

Base Depth (m): 8.45

Sample Type U



Diameter (mm):		103	Height (mm):		207	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 0.33 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	14	2.13	1.87	160	248	124	20.9	Plastic	



4043

PSL
Professional Soils Laboratory

Ferrous Phase II

Contract No:

PSL22/6675

Client Ref:

GRO-21454



LABORATORY REPORT



4043

Contract Number: PSL22/6676

Report Date: 25 October 2022
Client's Reference: GRO-21454
Client Name: Groundtech Consulting
First Floor
Lloyd House
Orford Court
Greenfold Way
WN7 3XJ

For the attention of: Luke Harrison

Contract Title: Ferrous Phase II
Date Received: 17/10/2022
Date Commenced: 17/10/2022
Date Completed: 24/10/2022

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Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

[illegible]

4043

PSL
Professional Soils Laboratory

Ferrous Phase II

Contract No:

PSL22/6676

Client Ref:

GRO-21454

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

Ferrous Phase II

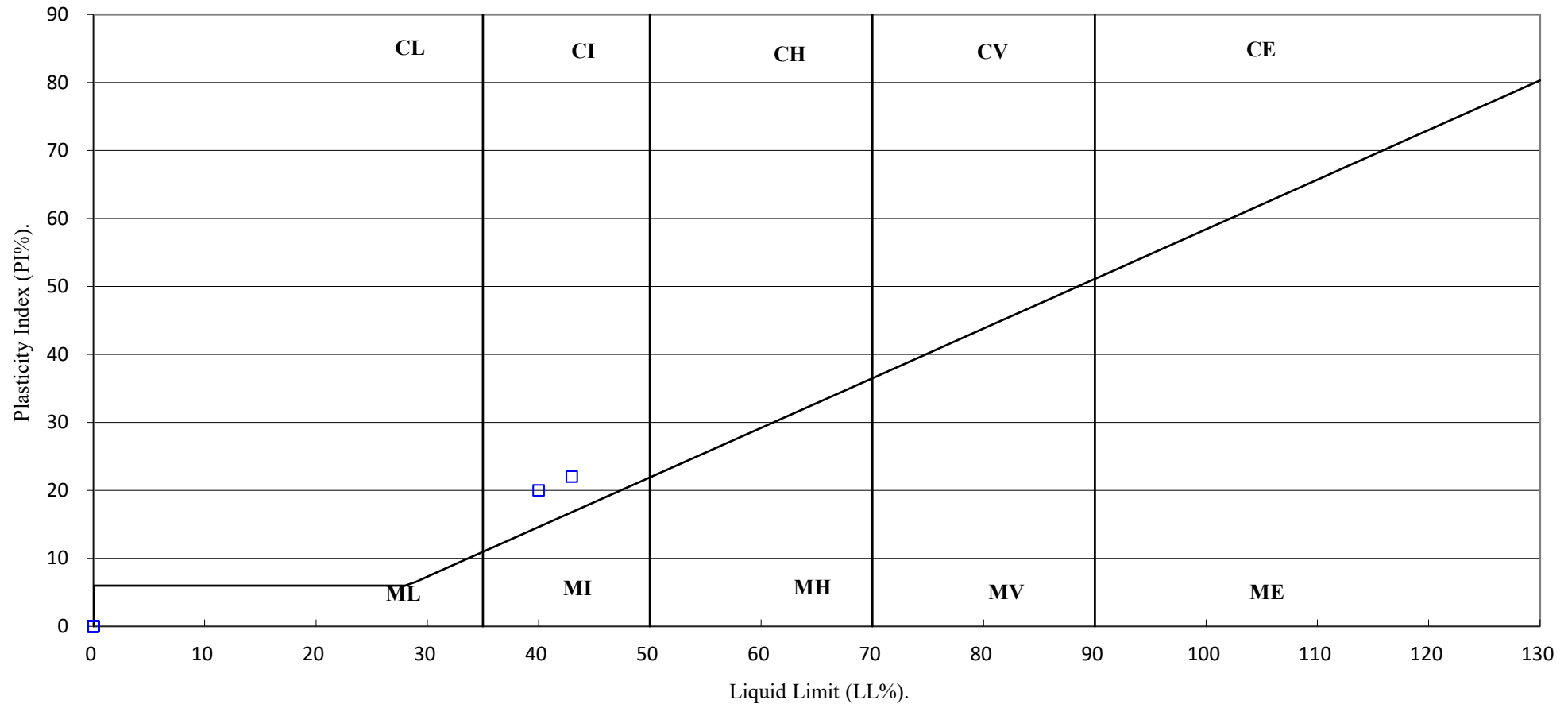
Contract No:

PSL22/6676

Client Ref:

GRO-21454

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



4043

PSL
Professional Soils Laboratory

Ferrous Phase II

Contract No:

PSL22/6676

Client Ref:

GRO-21454



LABORATORY REPORT



4043

Contract Number: PSL22/6677

Report Date: 02 November 2022

Client's Reference: GRO-21454

Client Name: Groundtech Consulting
First Floor
Lloyd House
Orford Court
Greenfold Way
WN7 3XJ

For the attention of: Luke Harrison

Contract Title: Ferrous Phase II

Date Received: 17/10/2022

Date Commenced: 17/10/2022

Date Completed: 2/11/2022

Notes: Opinions and Interpretations are outside the UKAS Accreditation

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Page 1 of

SUMMARY OF POINT LOAD TEST RESULTS

ISRM Suggested Methods : 2007

[illegible]

***Note** All testing carried out on samples at as received water content

Par = parallel, Perp = perpendicular, U = Random

A = Axial, D = Diametral, I = Irregular



Ferrous Phase II

Contract No:

PSL22/6677

Client Ref:

GRO-21454

SUMMARY OF POINT LOAD TEST RESULTS

ISRM Suggested Methods : 2007

Borehole Number	Depth (m)	Sample Ref	Test Type	Orientation	Dimensions (mm)		D_c^2	D_c (mm)	Failure Load		I_s (MPa)	Corr Fac F	I_{s50} (MPa)	Failure Type	Remarks
				Par / Perp	L	D			(Mpa)	(kN)					
CP01	16.60		D	Par	-	80	6400	80.00	-	0.18	0.028	1.236	0.03	Valid	
CP01	18.10		D	Par	-	80	6400	80.00	-	0.17	0.027	1.236	0.03	Valid	
CP02	16.70		D	Par	-	80	6400	80.00	-	0.12	0.019	1.236	0.02	Valid	
CP03	22.00		D	Par	-	80	6400	80.00	-	0.14	0.022	1.236	0.03	Valid	
CP04	17.50		D	Par	-	80	6400	80.00	-	0.14	0.022	1.236	0.03	Valid	
CP04	19.50		D	Par	-	80	6400	80.00	-	0.14	0.022	1.236	0.03	Valid	
CP04	20.60		D	Par	-	80	6400	80.00	-	0.31	0.048	1.236	0.06	Valid	
CP04	23.20		D	Par	-	80	6400	80.00	-	0.13	0.020	1.236	0.03	Valid	
CP04	24.30		D	Par	-	80	6400	80.00	-	0.11	0.017	1.236	0.02	Valid	
CP04	26.40		D	Par	-	80	6400	80.00	-	0.14	0.022	1.236	0.03	Valid	

***Note** All testing carried out on samples at as received water content

Par = parallel, Perp = perpendicular, U = Random



Ferrous Phase II

Contract No:

PSL22/6677

Client Ref:

GRO-21454

DETERMINATION OF UNCONFINED COMPRESSIVE STRENGTH

ISRM Suggested Methods, pp 111 –116, 1981.

[illegible]

Ferrous Phase II

Contract No:

PSL22/6677

Client Ref:

GRO-21454

APPENDIX 6 – Interim Permanent Gas and Groundwater Monitoring Results

SITE NAME:		FERROUS PHASE II				ENGINEER:		Jack Perkins				
CLIENT:		WML CONSULTING				DATE:		06/10/2022				
JOB NO:		GRO-21454										
Pressure Trend:		Rising	Weather:	Overcast			Equipment:		GFM 436			
Ambient:		O ₂ (%v/v)	CH ₄ (%v/v)	CO ₂ (%v/v)	LEL	H ₂ S (ppm)	CO (ppm)					
Start		20.6	0.0	0.0	0.0	0.0	0.0					
Finish		20.6	0.0	0.0	0.0	0.0	0.0					

BH Ref.	Gas Flow Rate (l/hr)		Borehole Pressure (mb)	Methane (%v/v)			Carbon Dioxide (%v/v)		Oxygen (%v/v)		Hydrogen Sulphide (ppm)		Carbon Monoxide (ppm)		Q _{hg} CO ₂ (l/hr)	Q _{hg} CH ₄ (l/hr)	Atmos Press (mb)	PID (ppm)	Sheen (Y/N)	LNAPL (Y/N)	DNAPL (Y/N)	Depth to Water (m bgl)
	Peak	Steady		Peak	Steady	LEL	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady								
WS02	0.0	0.0	0.00	0.0	0.0	0.0	3.6	2.4	7.4	10.6	0.0	0.0	0.0	0.0	0.0036	0.0000	1014	-	N	N/A	N/A	1.98
WS03	0.0	0.0	0.00	0.0	0.0	0.0	2.9	2.1	15.6	17.3	0.0	0.0	0.0	0.0	0.0029	0.0000	1013	-	N	N/A	N/A	0.86
WS06	0.0	0.0	0.00	0.0	0.0	0.0	2.7	1.6	10.1	15.0	0.0	0.0	0.0	0.0	0.0027	0.0000	1013	-	N	N/A	N/A	1.05
Notes:																						

SITE NAME:		FERROUS PHASE II				ENGINEER:		Jack Perkins				
CLIENT:		WML CONSULTING				DATE:		24/10/2022				
JOB NO:		GRO-21454										
Pressure Trend:		Steady	Weather:	Raining			Equipment:		GFM 436			
Ambient:		O ₂ (%v/v)	CH ₄ (%v/v)	CO ₂ (%v/v)	LEL	H ₂ S (ppm)	CO (ppm)					
Start		20.8	0.0	0.0	0.0	0.0	0.0					
Finish		20.8	0.0	0.0	0.0	0.0	0.0					

BH Ref.	Gas Flow Rate (l/hr)		Borehole Pressure (mb)	Methane (%v/v)			Carbon Dioxide (%v/v)		Oxygen (%v/v)		Hydrogen Sulphide (ppm)		Carbon Monoxide (ppm)		Q _{hg} CO ₂ (l/hr)	Q _{hg} CH ₄ (l/hr)	Atmos Press (mb)	PID (ppm)	Sheen (Y/N)	LNAPL (Y/N)	DNAPL (Y/N)	Depth to Water (m bgl)
	Peak	Steady		Peak	Steady	LEL	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady								
WS02	0.0	0.0	0.00	0.0	0.0	0.0	3.4	2.8	7.9	9.7	0.0	0.0	0.0	0.0	0.0034	0.0000	1003	-	N	N/A	N/A	1.94
WS03	0.0	0.0	0.00	0.0	0.0	0.0	2.6	2.6	15.8	16.8	0.0	0.0	0.0	0.0	0.0026	0.0000	1003	-	N	N/A	N/A	0.86
WS06	0.0	0.0	0.00	0.0	0.0	0.0	2.5	2.4	10.4	14.3	0.0	0.0	0.0	0.0	0.0025	0.0000	1003	-	N	N/A	N/A	1.01

Notes:

APPENDIX 7 – Preliminary UXI Risk Assessment



Preliminary UXO Risk Assessment

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Client	Groundtech Consulting Limited
Project	Ferrous Phase II, Chapeltown Street
Site Address	Ferrous Phase II, Chapeltown Street, Manchester M1 2BJ
Report Reference	PA16489-00
Date	07/09/2022
Originator	SB

Assessment Objective

This preliminary risk assessment is a qualitative screening exercise to assess the likely potential of encountering unexploded ordnance (UXO) at the Ferrous Phase II, Chapeltown Street site. The assessment involves the consideration of the basic factors that affect the potential for UXO to be present at a site as outlined in Stage One of the UXO risk management process.

Background

This assessment uses the sources of information available in-house to 1st Line Defence Ltd to enable the placement of a development site in context with events that may have led to the presence of German air-delivered or Allied military UXO. The report will identify any immediate necessity for risk mitigation or additional research in the form of a Detailed UXO Risk Assessment. It makes use of 1st Line Defence's extensive historical archives, library and unique geo-databases, as well as internet resources, and is researched and compiled by UXO specialists and graduate researchers.

The assessment directly follows CIRIA C681 guidelines "Unexploded Ordnance, a Guide for the Construction Industry". The document will therefore assess the following factors:

- Basic Site Data
- Previous Military Use
- Indicators of potential aerial delivered UXO threat
- Consideration of any Mitigating Factors
- Extent of Proposed Intrusive Works
- Any requirement for Further Work

It should be noted that the vast majority of construction sites in the UK will have a low or negligible risk of encountering UXO and should be able to be screened out at this preliminary stage. The report is meant as a common sense 'first step' in the UXO risk management process. The content of the report and conclusions drawn are based on basic, preliminary research using the information available to 1st Line Defence at the time this report was produced. It should be noted that the only way to entirely negate risk from UXO to a project would be to support the works proposed with appropriate UXO risk mitigation measures. It is rarely possible to state that there is absolutely 'no' risk from UXO to a project.





Risk Assessment Considerations	
Site location and description/current use	The site is located in the city of Manchester within the county of Greater Manchester. The site is bordered to the north by multi-storey properties along Chapeltown Street, to the east by structures and roadways, to the south by Longacre Street and to the west by structures along Fair Street. The site is currently occupied by open ground. The site is approximately centred on the OS grid reference: SJ 85221 98064. 
Are there any indicators of current/historical military activity on/close to the site?	In house records do not indicate that the site had any former military use. No features such as WWII defensive positions, encampments or firing ranges are recorded to have been located at or in the immediate vicinity of the site. In addition, no information of ordnance being stored, produced, or disposed of within the site boundary could be found. Although the closest Heavy Anti-Aircraft (HAA) battery was situated approximately 2.3km north of the site, the range of a fired projectile can be up to 15km. The conditions in which unexploded anti-aircraft ordnance may have fallen undetected is analogous to that of aerial delivered German bombs.
What was the pre- and post-WWII history of the site?	Pre-war OS mapping dated 1938, shows the site to consist of structures in the western section, whilst open ground is located in the eastern section. The site is bordered by roadways to the north and west, and open ground and structures to the east and south respectively. Post-war OS mapping dated 1950-1951, shows the site appears to have maintained much of its pre-war composition. The structures in the western section of the site are labelled <i>Iron Factory</i>, whilst an <i>Engine Works</i> is located to the east of the site.
Was the area subject to bombing during WWII?	During WWII the site was located in the County Borough of Manchester. According to Home Office bombing statistics, this area sustained a low bomb density of 27 items per 1,000 acres. This consisted of 712 high explosive (HE) bombs, 18 parachute mines, seven oil bombs, and one V-1 flying bomb, culminating in 738 incidents across 27,255 acres. Available bomb mapping for Manchester does not record any bombing to have affected the site or the surrounding area. The nearest incidents are recorded 180m north and 220m south-west of the site.
Is there any evidence of bomb damage on/close to the site?	Available bomb damage mapping for Manchester does not record any damage to the site. It also does not record any damage to the structures bordering the site. Whilst post-war aerial photography shows there to be a cleared area within the eastern section of the site, pre-war imagery dated 1937 highlights this area of clearance to have already been present pre-war. The closest reference of damage to the site is a structure labelled 'Ruin' located 75m east of the site within post-war OS mapping.





To what degree would the site have been subject to access?	Due to the site consisting of industrial structures adjacent to roadways in an urban area, it is anticipated that the site area would have been subject to a frequent level of access during the war.
To what degree has the site been developed post-WWII?	Historic aerial imagery shows the site has been redeveloped in the post-war era, previously occupied by a large square structure which was later cleared, following this the site was occupied by hardstanding ground, and currently comprises undeveloped soft ground.
What is the nature and extent of the intrusive works proposed?	Proposed works are set to include six boreholes to 6m and four boreholes to 32m.

Summary and Conclusions

During WWII the site was located in the County Borough of Manchester. According to Home Office bombing statistics, this area sustained a low bomb density of 27 items per 1,000 acres. Available bomb and damage mapping for Manchester does not record any bombing incidents on site, the nearest are recorded 180m north and 220m south-west of the site. It also does not record any damage on site, or to the structures bordering the site.

Whilst post-war aerial photography shows there to be a cleared area within the eastern section of the site, pre-war imagery dated 1937 highlights this area of clearance to have already been present pre-war.

Due to the site comprising industrial structures adjacent to roadways in an urban area, it is anticipated that the site area would have been subject to a frequent level of access during the war. As such, no further research is recommended for this site.

Recommendations

Preliminary research for this site has not indicated any significant cause for concern or highlighted any positive evidence of bombing on site, which would indicate that the risk of encountering UXO is elevated above the background level for this area of Manchester.

Whilst it would be possible to conduct a Detailed UXO Risk Assessment for this site, it is not anticipated that any further research would significantly alter the findings of this report. It is therefore recommended that **no further action** is taken for this site.

If the client has any anecdotal or empirical evidence of UXO risk on site, please contact 1st Line Defence.





It should be noted that although the risk from unexploded ordnance on this site has been assessed as low/minimal, this does not mean there is 'no' risk of encountering UXO. This preliminary report has been undertaken with due diligence, and all reasonable care has been taken to access and analyse relevant historical information. By necessity, when dealing with historical evidence, and when making assessments of UXO risk, various assumptions have to be made which we have discussed and justified within this report. Our reports take a common-sense and practical approach to the assessment of UXO risk, and we strive to be reasonable and pragmatic in our conclusions. As referenced, it would be possible to undertake further research into this site, but based on the evidence to hand, this is not deemed strictly necessary, and no reasonably justifiable requirement for proactive on-site mitigation has been identified.

It should however be stressed that if any suspect items are encountered during the proposed works, 1st Line Defence should be contacted for advice/assistance, and to re-assess the risk as necessary. Furthermore, we would recommend that ground personnel are always made aware of the potential for encountering UXO, what to look out for and what to do in the unlikely event that a suspect item is encountered, and that a UXO Risk Management Plan is put together for the proposed works. We would be happy to provide a template and guidance for this – contact us on 01992 245020. Should the scope of works change or additional works be proposed, 1st Line Defence should be contacted to re-evaluate the risk.



APPENDIX 8 - Limitations

Limitations

This report (Report) forms part of the Services and if applicable Additional Services undertaken by Groundtech Consulting Ltd pursuant to a written contract (Agreement) which contains detailed provisions including express limitations of the liability of Groundtech Consulting Ltd.

This Report was prepared using reasonable skill and care as stated in the Agreement for the purpose including intended end use stated by the Client (Purpose) and the liability of Groundtech Consulting Ltd in respect of the form and content of this Report is no greater than its liability under the Agreement. All records, measurements notes, or any other data (Data) obtained by or for the benefit of the Consultant were obtained at a specific point in time and it may not be assumed by the Client or any person relying on this Report that the Data will remain unaffected by the passage of time, the seasons, weather conditions, changes in the water table or the carrying out and completion of works at the Site.

Unless otherwise agreed this Report has been prepared exclusively for the use and reliance of the Client and may not be relied upon, by any other party except as provided for in the Agreement. A third party who relies on this Report, does so at their own and sole risk and Groundtech Consulting Ltd has no liability to such parties.

Groundtech Consulting Ltd that this Report is to be used for the Purpose. The Purpose was instrumental in determining the scope and of the Services provided. If the Purpose should change, the Client may not be able to rely on the Report without the separate agreement of Groundtech Consulting Ltd.

Since the Report was written, later changes in legislation, statutory requirements and industry best practices have not been considered and this should be allowed for. Ground conditions can also change (see below) and should be investigated if there is any significant delay in acting on the findings of this Report. The period of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the Report inaccurate or unreliable. The information and conclusions in this Report should not be relied upon in the future without written confirmation from Groundtech Consulting Ltd that it is safe to do so.

The observations and conclusions outlined in this Report are based exclusively on the services that were provided as set out in the agreement between the client and Groundtech Consulting Ltd.

Groundtech Consulting Ltd is not liable for the existence of any condition, the discovery of which would require additional investigation outside the agreed scope of works or core competency. The Report is based upon Groundtech Consulting Ltd's observations of existing physical conditions at the Site gained from site reconnaissance together with interpretation of information including documentation, obtained from third parties and from the Client on the history and usage of the Site. The findings and recommendations contained in this Report are based in part upon information provided by third parties, and Groundtech Consulting Ltd have relied upon such information assuming it to be correct.

Groundtech Consulting Ltd accepts no responsibility for errors or inaccuracies in third party information presented in this Report. Groundtech Consulting Ltd was not authorised to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services or Additional Services. Groundtech Consulting Ltd is not liable for any inaccurate information, misrepresentation of data or conclusions, which may inform the scope of investigation undertaken by Groundtech Consulting Ltd and forms the contract with the client.

Where field investigations have been carried out these have been restricted to a level of detail required to achieve the stated objectives of the work. Ground conditions may also vary due to the ground's heterogeneous properties and because investigation exploratory locations only allow examination of the ground at discrete locations. The potential exists for ground conditions to be encountered which are different to those considered in this Report, particularly between exploratory holes. The extent of the limited area depends on the soil and groundwater conditions, together with other constraints such as the position of any existing structures and underground utilities. If so stipulated in the Agreement, geo-environmental testing was carried out for a limited number of parameters based on an understanding of the available operational and historical information, and it should not be inferred that other chemical species are not present.

Any groundwater conditions entered on the exploratory hole records are those observed at the time of investigation. The groundwater level often has not had time to reach equilibrium and a monitoring period is required. Furthermore, groundwater levels are subject to seasonal variation or changes in local drainage conditions and groundwater levels may occur at other times of the year which are higher than were recorded during this investigation.

Any site drawings provided in this Report are preliminary and used to present the general relative locations of features on, and surrounding, the Site.



APPENDIX 03

Site Specific Acceptance Criteria

Site Specific Assessment Criteria for Residential (without homegrown produce) assuming a 1% SOM for hydrocarbons

Contaminant	Assessment Criteria for Residential (without homegrown produce) (mg/kg)
Metals	
Arsenic	40
Boron	11,000
Cadmium	85
Chromium III	910
Chromium VI	6
Copper	7,100
Lead*	310
Mercury	1.2
Nickel	180
Selenium	430
Vanadium	1,200
Zinc	40,000
Non – Metals	
Phenol	440 ^{dir} (460)
Polyaromatic Hydrocarbons (PAH)	
Benzo[a]anthracene	11
Benzo[a]pyrene	3.2
Benzo[b]fluoranthene	3.9
Benzo[ghi]perylene	360
Benzo[k]fluoranthene	110
Chrysene	30
Dibenz[ah]anthracene	0.31
Fluoranthene	1,500
Indeno[123-cd]pyrene	45
Naphthalene	2.3
Pyrene	3,700

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* Where not included in the S4UL's criteria for a limited number of contaminants, namely lead, have been derived by DEFRA in their document entitled SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, April 2014.

Contaminant	Criteria (mg/kg)
Volatile Organic Compounds – (VOCs) 1% SOM	
Benzene	0.38
Ethylbenzene	83
Toluene	880 ^{vap} (869)
Xylene	79
1,2-Dichloroethane	0.0092
1,1,1-Trichloroethane	9.0
Tetrachloroethane	3.9
Tetrachloroethene (PCE)	0.18
Tetrachloromethane	0.026
Trichloroethene (TCE)	0.017
Trichloromethane	1.2
Vinyl Chloride	0.00077
Semi-Volatile Organic Compounds (SVOCs) 1% SOM	
1,2-Dichlorobenzene	24
1,4-Dichlorobenzene	61
1,2,4-Trichlorobenzene	2.6
Hexachlorobenzene	4.1(0.2) ^{vap}
Total Petroleum Hydrocarbons – TPH	
Aliphatic C5-6	42
Aliphatic C6-8	100
Aliphatic C8-10	27
Aliphatic C10-12	130(48) ^{vap}
Aliphatic C12-16	1,100(24) ^{sol}
Aliphatic C16-35	65,000(8.48) ^{sol}
Aliphatic C35 - 44	65,000(8.84) ^{sol}
Aromatic C5 – 7 (benzene)	370
Aromatic C7 – 8 (toluene)	860
Aromatic C8-10	47
Aromatic C10-12	250
Aromatic C12-16	1,800
Aromatic C16-21	1,900
Aromatic C21-35	1,900
Aromatic C35 - 44	1,900

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* Where not included in the S4UL's criteria for a limited number of contaminants, namely lead, have been derived by DEFRA in their document entitled SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, April 2014.

The GAC's for the assessment of potential groundwater contamination have been derived from very conservative guidelines protective of drinking water and environmental quality, namely:

- UK Environmental Quality Standards (EQS) for Freshwater, 2000;
- Petroleum Products in Drinking-water, Background document for development of WHO Guidelines for Drinking-water Quality, 2011.

Table 1: Inorganic Tier 1 Water Environment Screening Criteria

Contaminant	Units	Hardness Banding (CaCO ₃ mg/l)	EQS /WFD (Freshwater)	UK DWS
Arsenic	µg/l	-	50	10
Ammonia	mg/l	-	0.2	0.5
Boron	µg/l	-	2000	1000
Cadmium	µg/l	-	5	5
Chromium	µg/l	0-50	2	50
		50-100	10	
		100-150	10	
		150-200	20	
		200-250	20	
Copper	µg/l	0-10	0.5	2000
		10-50	0.5	
		50-200	3	
		200-250	8	
		>250	12	
Cyanide (Free)	µg/l	-	1	-
Cyanide		-	-	50
Iron	µg/l	-	1000	200
Lead	µg/l	0-50	4	10
		50-150	10	
		150-250	20	
		>250	20	
Mercury	µg/l	-	1	1
Nickel	µg/l	0-50	8	20
		50-100	20	
		100-150	20	
		150-250	40	
		>250	40	
Selenium	µg/l	-	-	10
Sulphate (SO ₄)	mg/l	-	400	250
Zinc	µg/l	0-50	8	5000
		50-150	15	
		150-250	50	
		>250	50	
pH	-	-	6-9	-

Table 2: Organic Tier 1 Water Environment Screening Criteria

Contaminant	Units	UK DWS	WHO
PAHs - The sum of • Benzo(b)fluoranthene, • Benzo(ghi)perylene, • Benzo(k)fluoranthene, • indeno(1,2,3-c,d)pyrene)	µg/l	0.1	-
Phenol (total)	µg/l	0.5	-
MTBE	µg/l	-	15
Aliphatic C5-C6	µg/l	-	15,000
Aliphatic C6-C8	µg/l	-	15,000
Aliphatic C8-C10	µg/l	-	300
Aliphatic C10-C12	µg/l	-	300
Aliphatic C12-C16	µg/l	-	300
Aliphatic C16-21	µg/l	-	(300) *
Aliphatic C21-35	µg/l	-	(300)*
Aromatic C6-C7	µg/l	1 (benzene)	10 (benzene)
Aromatic C7-C8	µg/l	-	700 (toluene)
Aromatic C8-C10	µg/l	-	300 (ethylbenzene)
Aromatic C10-12	µg/l	-	100
Aromatic C12-C16	µg/l	-	100
Aromatic C16-C21	µg/l	-	90
Aromatic C21-C35	µg/l	-	90

Notes

The WHO Guideline Values for petroleum products in drinking water have been applied in the absence of current TPH water quality standards. However, for the aromatic TPH bandings of C6-C7, C7-C8 and C8-C10, the more conservative UK specific WQS for benzene, toluene and ethylbenzene have been used.

In the absence of specific WHO Guideline Values for the aliphatic ranges C16-C21 and C21-C35, the guideline values for the aliphatic C8-C10 through to C12-C16 ranges of 300µg/l have been used. This is however considered conservative due to the increased stability and lower volatility of the longer chain aliphatics.