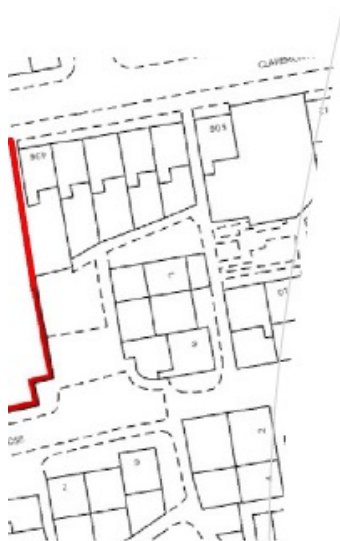




EARTH ENVIRONMENTAL
& GEOTECHNICAL



Remediation Strategy

Claremont Road

Manchester

January 2022

On behalf of

RS Drylining MCR

Earth Environmental & Geotechnical Ltd
Houldsworth Mill Business & Arts Centre
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**CLAREMONT ROAD
MANCHETSER
REMEDICATION STRATEGY
FOR
RS DRYLINING MCR**

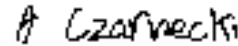
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Report No. A2212/19/RMS

January 2022

Report Title:	Claremont Road, Manchester Remediation Strategy	
Report Reference:	A2212/19/RMS	
Client:	RS Drylining MCR	
Issue Date:	15th January 2022	
Drafted By:	J Sheridan	
Reviewed By:	A Czarnecki	
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CONTENTS

1.0	INTRODUCTION	1
	Appointment	1
	Proposed Development.....	1
	Historical Information.....	1
	Objective	2
	Sources of Information	2
2.0	SITE LOCATION AND DESCRIPTION	3
3.0	PREVIOUS SITE INVESTIGATIONS	4
	Scope of Works	4
	Ground Conditions	4
	Soil Contamination Assessment.....	4
	Asbestos Contamination Assessment.....	5
	Recommendations	5
4.0	LICENCES & APPROVALS	7
5.0	PROPOSED WORKS	8
	Aims	8
	Soil Contamination	8
	<i>Clean Cover Capping System – Specification.....</i>	<i>8</i>
	<i>Clean Cover Capping System – Verification & Validation</i>	<i>8</i>
6.0	SITE WORKS.....	10
	Site Organisation.....	10
	Welfare Facilities/Security	10
	Health & Safety	10
	Site Clearance.....	10
	Excavation of Subsurface Obstructions	10
	Unexpected Contamination.....	11
	Control of Perched Groundwater.....	11
7.0	ENVIRONMENTAL MONITORING & CONTROLS.....	12
	General.....	12
	Noise Control.....	12
	Odour Control.....	12
	Dust Control	13
8.0	OTHER CONSIDERATIONS	14
	Material Management Plan	14
	Waste Soils	14

APPENDICES

Appendix 1	EEG Phase I Geo-Environmental Assessment Report
Appendix 2	EEG Phase II Geo-Environmental Investigation Report
Appendix 3	Assessment Criteria for Clean Cover System
Appendix 4	Report Limitations

FIGURES

Figure 1	Proposed Development Layout Plan
Figure 2	Site Location Plan
Figure 3	Location of Soil Contaminant Exceedances

TABLES

Table 1	Summary of Soil Contamination
Table 2	Summary of Asbestos Contamination

1.0 INTRODUCTION

Appointment

Earth Environmental & Geotechnical Ltd has been commissioned by RS Drylining MCR (the Client) to produce a Remediation Strategy for the site at 492-494 Claremont Road, Manchester, M14 5AB.

Proposed Development

It is understood that the client proposes to construct 7no. two-storey residential houses with associated private gardens, driveways and utility infrastructure.

Figure 1, below, shows extracts from the proposed development plans.

Figure 1 Development Layout Plan



Historical Information

Historically, the site was occupied by residential houses and gardens from the mid-1800s. Later developments on-site included the demolition of the residential housing, followed by the construction of several other structures including a public house in the northern part of the site (1930s), and a works in the centre of the site (1950s).

The works and public house were later demolished in the 1980s and early 2000s respectively. The site is currently vacant and has most recently been used as a storage yard.

Objective

The Remediation Strategy is intended to build on the site characterisation information and provide details on the remediation objectives necessary to protect potential receptors and render the site suitable for the proposed development.

We have included a specification for topsoil quality for gardens, however it is assumed this will lie under the remit of the final developer.

In summary this document presents the technical detail behind the proposed remedial activities at the site and includes:

- Clean Cover System in garden areas.

This report has been prepared for the purpose of satisfying the requirements of the Local Planning Authority (Manchester City Council). Earth Environmental & Geotechnical Ltd reserves the right to amend this remediation strategy in the light of further information which may become available or future changes in contaminated land guidance, prior to site activities.

Sources of Information

The RMS includes a review of the following reports previously produced by Earth Environmental & Geotechnical Ltd;

- Phase I Geo-Environmental Assessment Report, Claremont Road, A2212/17, September 2017
- Phase II Geo-Environmental Investigation Report, Claremont Road, A2212/19/B.0, January 2019

These reports are provided as Appendices 1 and 2 respectively.

2.0 SITE LOCATION AND DESCRIPTION

The site is located at the junction of Claremont Road (north) and Victory Street (west). The approximate National Grid Reference for the centre of the site is SJ 85087 95107 (X: 385087, Y: 395107) with the closest postcode being M14 5AB.

The site is approximately rectangular in shape with maximum dimensions of 50m north-south and 20m east-west, and currently comprises a vacant, completely hard surfaced, storage yard, which is absent of any buildings or permanent structures. The topography of the site appears flat and level.

The site is bound by a combination of brick walls and palisade fencing, and the surrounding area comprises predominantly residential housing with a recreational park to the west.

A location plan is shown below as Figure 2.

Figure 2: Site Location Plan



3.0 PREVIOUS SITE INVESTIGATIONS

A Phase I Desk Study report has been prepared by EEG Ltd. A copy of this report is presented in Appendix 1.

A Phase II Geo-Environmental Site Investigation has also been conducted by EEG Ltd and is presented in Appendix 2.

Scope of Works

The EEG Ltd site investigation was completed on 20th November 2018 and comprised:

- 5no. window sample boreholes (WS1-WS5) to a maximum depth of 3.8m bgl.

Standard Penetration Tests (SPTs) were conducted, and soil samples were retrieved at regular intervals for geotechnical and chemical analysis. Soils were logged by an on-site engineer.

Ground Conditions

The recorded ground conditions are summarised as follows:

- **Asphalt**
- **Made Ground** – variable material encountered in each of the boreholes to a maximum depth of 2.20m bgl (WS1). Typically comprising:
 - Predominantly dark brown/black sandy gravelly clay containing variable proportions of brick, concrete, sandstone, mudstone, wood, tile, coal and clinker fragments. (With relict building materials in WS1).
 - Grey clayey sandy gravel containing variable proportions of brick, concrete, mudstone, coal and clinker fragments.
- **Devensian Till** –
 - Stiff becoming very stiff, brown, silty, slightly sandy, slightly gravelly clay with occasional silty sand bands. The material was noted to become sandier with depth.

Boreholes were terminated at depths of between 3.0m and 3.8m bgl due to SPT refusals (N=50) in the very stiff natural clay (Devensian Till).

Soil Contamination Assessment

As part of the site investigation, 7no. soil samples were retrieved from the site for chemical analysis.

Samples were analysed for the following suite of determinants:

Asbestos Screen, Arsenic, Beryllium, Boron, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc, Cyanide, Thiocyanate, Phenol, Sulphate (SO₄), Sulphide, pH, Sulphur, Soil Organic Matter and speciated Polycyclic Aromatic Hydrocarbons (PAH) and speciated Total Petroleum Hydrocarbons (TPH).

Section 7.2 of the Phase II report states that, based on the results of the chemical analysis, each of the samples tested contained concentrations of contaminants in exceedance of screening criteria relevant to

residential end use with plant uptake. The table below summarises the contaminants found to be in exceedance at each location:

Table 1 Summary of Soil Contamination

Determinant	WS1 0.30m MG	WS1 1.00m MG	WS2 0.60m MG	WS3 0.60m MG	WS4 0.40m MG	WS4 0.90m MG	WS5 0.50m MG	Assessment Criteria (mg/kg)
Lead	323	-	-	-	209	268	218	200
Di-benz (a, h) anthracene	0.34	0.55	0.33	0.32	0.31	-	-	0.24
Naphthalene	-	5.02	-	-	-	-	-	2.3

Asbestos Contamination Assessment

Asbestos (Chrysotile) was also detected in two of the seven soil samples tested. Laboratory quantification was carried out for each sample to determine the percentage of asbestos by mass. The results of the quantification are summarised in Table 2 below.

Table 2 Summary of Asbestos Contamination

Asbestos	WS1 0.30m MG	WS1 1.00m MG	WS2 0.60m MG	WS3 0.60m MG	WS4 0.40m MG	WS4 0.90m MG	WS5 0.50m MG	Guideline Concentration by mass (%)
Chrysotile	0.055	-	-	-	<0.001	-	-	< 0.001

Figure 3, overleaf, shows the exploratory locations and corresponding soil contamination in respect of the proposed development.

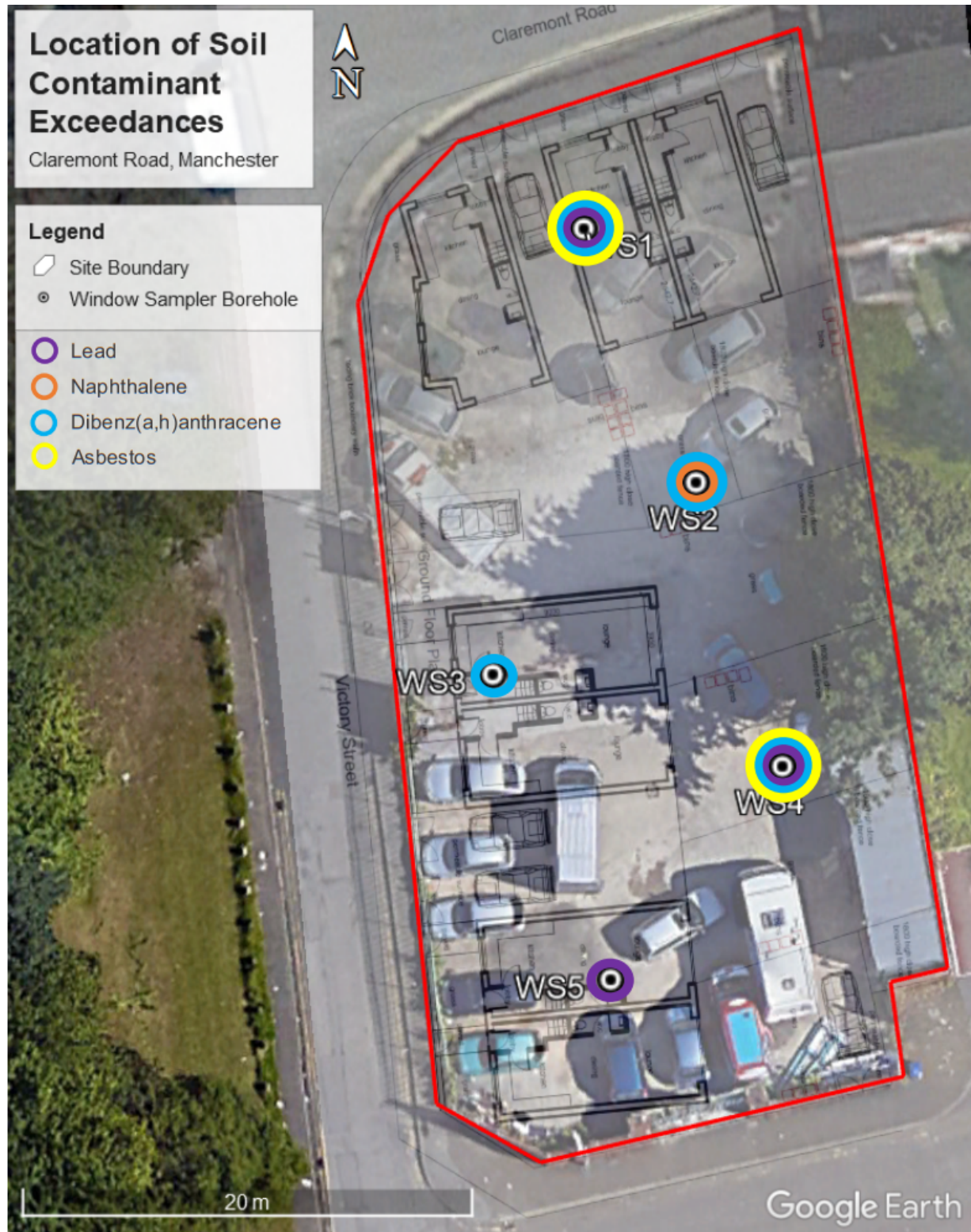
Recommendations

Due to the presence of potential contaminants and asbestos within the Made Ground at the site, it was recommended that all garden and landscaped areas should be capped with a minimum 600mm of validated clean cover soils, incorporating an appropriate physical barrier at the base of the capping layer, to act as a no dig layer for future residents and to prevent potential bioturbation.

Due to the presence of asbestos at concentration greater than 0.001% (0.055% in WS1 at 0.3m bgl), an Asbestos Management Plan (AMP) was also recommended for the site, to outline necessary precautions to be taken during the construction and remediation works.

The Asbestos Management Plan, reference A2212/19/AMP, should be read to in conjunction with this Remediation Strategy.

Figure 3 Location of Soil Contaminant Exceedances



4.0 LICENCES & APPROVALS

Various licences, permits and approvals are required at various stages before certain works can commence. Some activities can start before all such approvals are in place.

- (i) Approval of this Remediation Method Statement;
- (ii) All documentation in accordance with the CDM 2015 Regulations;
- (iii) A signed declaration by qualified person of the Material Management Plan (MMP) in accordance with CL:AIRE Waste Code of Practice, Version 2, March 2011. This would allow for reuse or removal of excavated soils; and,
- (iv) General condition survey of boundary features.

5.0 PROPOSED WORKS

Aims

The remediation aims are to resolve contamination issues in order to protect human and environmental receptors and render the site suitable for the proposed end use and satisfy the requirements of the Local Planning Authority and Insurance bodies (NHBC).

Soil Contamination

Asbestos

Asbestos Containing Materials and any potentially impacted soils should be dealt with following the Asbestos Management Plan (Reference A2212/19/AMP).

Clean Cover Capping System – Specification

All areas of landscaping and private garden areas will need to be capped with a suitable thickness of uncontaminated cover soils to break the potential contamination linkage, as follows:

- A geotextile will be placed at the base of the clean cover within affected garden areas to maintain soil separation between the inert growing medium and the residual underlying soils and to act as a physical marker for future works.
- A minimum total thickness of imported clean cover of 600mm should be placed in rear gardens, with 450mm in front gardens.
- Clean cover may comprise a combination of subsoil and topsoil. Topsoil is to comprise no less than the upper 150mm.

Clean Cover Capping System – Verification & Validation

Soils to be used as capping layers must not contain contaminant concentrations above the assessment criteria for residential end use (with plant uptake) and be free of deleterious components e.g. glass, plastic, wood, ash and metal solids. Soil must have a complete absence of ACMs and asbestos fibres.

Evidence will be required to demonstrate the suitability of the materials to be used and that the capping has been installed in line with the specification outlined above. Validation will require:

- Chemical analysis of clean cover soils will be carried out at source to ensure suitability for use, prior to being imported and placed.
- Relevant source test data for clean cover soils will be provided to confirm all determinants are at concentrations below the relevant assessment criteria. Testing should be carried out at a frequency of one sample per 100m³ batch of soil.
- Imported soils should be stockpiled on receipt and sampled from the stockpile prior to placement and undergo appropriate chemical analysis to confirm it is suitable for use.

- Following confirmation that material is suitable for use, the material is to be placed in line with the above specification.
- Following placement of clean cover system, trial holes will be formed in each garden to confirm the correct implementation. Each pit will be inspected, photographed and the depths/thicknesses of the subsoil and topsoil measured by the consultant engineer.
- A validation report will be provided for approval by the Environmental Health Contaminated Land Officer at the LA.

6.0 SITE WORKS

Outlined below are some of the main task and activities associated with the remediation works. Reference should also be made to the Asbestos Management Plan (Reference A2212/19/AMP).

Site Organisation

Site works will be supervised throughout by a suitably qualified Engineer, who will report to a Project Manager. Supervision may be part-time for certain activities, but will be full-time during the removal of any contaminated soil/fill and any placement of fill to an engineering specification.

Welfare Facilities/Security

Initial mobilisation works will include the establishment of appropriate office and welfare facilities. Such facilities may include but are not restricted to; office accommodation, canteen facilities, washroom/drying room, toilets, wheel wash, car parking, stores and security unit.

The site should be secured by fencing to prevent unauthorised access onto the site during the enabling works.

Health & Safety

All site personnel will undergo a site-specific health and safety induction prior to commencement of work on site.

The Engineer will be informed prior to any proposed entry of a confined space or deep excavation. Entry will be restricted to suitably qualified and equipped personnel.

Works will be carried out with regard to current statutory requirements and guidance by the Health & Safety Executive "Protection of workers and the general public during the redevelopment of contaminated land". Protective clothing, footwear and gloves will be required with hand washing and boot-washing facilities made available. Smoking will be limited to designated areas.

Specific reference should also be made to the Asbestos Management Plan (Reference A2212/19/AMP).

Site Clearance

Any trees currently under a preservation order should be identified and agreed with relevant authorities prior to the commencement of the works. All trees subject to a Tree Preservation Order should be clearly identified and protected by chestnut paling with fluorescent tape.

The site should then be cleared of all residual debris, fly tipped materials, any vegetation, shrubs, bushes and unprotected trees as instructed by the client.

Excavation of Subsurface Obstructions

During the site investigation, obstructions were not identified within the made ground, which could pose obstacles during excavations and construction. However, obstructions may be present in the southwest of the site.

Any material identified as potentially contaminated should be stockpiled on a non-permeable membrane, and tested for suitability for either re-use on site, or offsite disposal.

Should the material be removed from site, waste acceptance criteria testing should be undertaken and the material disposed of in a suitably licensed facility. The development of a Materials Management Plan (MMP) in line with the CL:AIRE Code of Practice may be required to remove or re-use soils.

Unexpected Contamination

If during site clearance works or other excavations, material with visual or olfactory evidence of previously unrecorded contamination is encountered, the principal contractor should contact the environmental consultant.

These soils should be then sampled, and chemical analysis carried out. The environmental consultant shall decide upon the chemical suitability of the material, to either remain on site or if it is likely to present a risk to receptors.

If the soils present a risk, the materials should be removed from site or remediated as per the specification in Section 5.0.

Any excavated material identified as potentially contaminated should be stockpiled on a non-permeable membrane, and tested for suitability for either re-use on site, or disposed offsite.

If prolonged stockpiling is unavoidable, these soils should be covered with a non-permeable membrane at the end of each working day, to prevent the possibility of leachate migrating from the soils due to infiltration.

Should the material be removed from site, waste acceptance criteria testing should be undertaken and the material disposed of in a suitably licensed facility. The development of a Materials Management Plan (MMP) in line with the CL:AIRE Code of Practice may be required to remove or re-use soils.

Backfill of Excavations

All excavations shall, prior to backfilling, be surveyed to ascertain their spatial extent and depth. Excavations (to remove relict structures, contamination etc) should be backfilled with suitable materials as agreed with the Engineer, and subjected to nominal compaction.

However, where an excavation conflicts with the footprint of a proposed highway, compaction in general accordance with the Specification for Highway Works Table 6/1 will be required.

Control of Perched Groundwater

The regional groundwater table is unlikely to be encountered during remediation earthworks; however, discontinuous perched groundwater may be present within Made Ground. If encountered during the excavation works this perched water will be recovered by pumping from open excavations. Dependant on volumes recovered, some form of temporary storage may also be required.

Provision should be made for pumping from sumps and appropriate excavation support for all excavations.

7.0 ENVIRONMENTAL MONITORING & CONTROLS

General

All works should be carried out in a manner that minimises impact on the environment and generates adequate and accurate records to demonstrate remediation works have been carried out to the required standard and in accordance with all applicable legislation. All such records should be collated on contract completion (or sooner as required) and included within the contract completion report. Appropriate progress reports should be provided in a format and at a frequency as agreed with the client and project manager including on-going monitoring/validation information.

Comprehensive records should be maintained throughout the project. These should be collated on contract completion into a completion and validation report, which should be submitted to the appropriate regulators for approval. It will be presented in an appropriate manner so as to allow interested third parties to fully understand the whole remediation process.

The records should include correspondence with the regulators & other third parties, environmental monitoring data, validation testing, comprehensive as-built drawings, photographs, collation of all site investigation reports, operational method statements & risk assessments, construction phase health & safety plan and confirmation of post remediation considerations especially in respect of interaction with initial construction (groundwork's).

Noise Control

Earthworks will only take place during normal working hours 8.00am – 6.00pm Monday to Friday and 8.00am to 13:00pm on Saturdays with no working on Sundays or Bank Holidays. The site manager shall assess noise and its impact upon neighbours through the working day and to ensure the following mitigation measures are being utilised:

All plant and machinery will be fitted with adequate silencers and will not be operated unless in good condition.

Noise levels will be as per normal for a project of this nature. Pneumatic breakers will be used but location and hours of use controlled whenever possible.

Should local residents make any complaints regarding noise associated with the works, the site manager shall investigate. Such investigation may include the use of portable monitoring equipment to record noise levels at the location of the complainant. The nature of the complaint and findings of the investigation shall be discussed with the local EHO. If the complaint is upheld appropriate remedial action shall be taken. Such action may include the adjustment of working hours or the alteration of site practices and working methods.

Odour Control

Works may produce odours but good site practice and associated mitigation measures should ensure fugitive odours are kept to an absolute minimum. Such controls may include:

- Additional covers will be applied to stockpiles, if they are contributing to fugitive odours.

- Areas of excavation i.e. area of exposed contaminated soils, will be kept to a minimum and covered/re-instated as soon as is practicably possible.
- Odour suppressing equipment shall be utilised at appropriate locations at appropriate times.

In the event that a complaint is made regarding odours from nearby residents, the site manager shall respond by attending the complainant's property to assess the nature and level of odour nuisance including monitoring where appropriate. Appropriate mitigation measures as described herein shall then be enforced including if necessary, suspension of excavation works until the prevailing weather conditions become more favourable.

Dust Control

Earthworks may produce dust during prolonged periods of dry weather. The site manager shall assess dust and its impact upon neighbours through the working day and ensure the following mitigation measures are being utilised to control dust:

- The use and maintenance of good quality site roads;
- Enforcing speed limits of site plant and;
- Dust suppression via water applied by towed bowser, particularly in the vicinity of locations where asbestos has been detected in soils.

8.0 OTHER CONSIDERATIONS

Material Management Plan

The development of a Materials Management Plan (MMP) in line with the CL:AIRE Code of Practice may be required to re-use or remove onsite soils.

The development of an MMP will require a Cut and Fill model to identify the sources of and possible destinations for site-won materials. In respect of re-using site won soils, formation levels should be designed to accommodate the required thickness of clean cover soils in garden/landscaped areas, without the requirement for offsite disposal of significant soil quantities.

Waste Soils

Waste Acceptance Criteria testing should be undertaken to ensure the materials to be disposed of offsite are received by a suitably licensed facility. Chemical testing should be completed by a reputable laboratory with MCERTS accreditation prior to making disposal arrangements.

Where excess soils require offsite disposal, the materials need to be managed under the appropriate legislation e.g. MMP.

APPENDIX 1

EEG LTD PHASE I GEOENVIRONMENTAL ASSESSMENT REPORT



Earth Environmental
& Geotechnical

Phase 1 GeoEnvironmental Assessment

Claremont Road

Rusholme

January 2022

On behalf of

RS Drylining MCR

Earth Environmental & Geotechnical Ltd
Houldsworth Mill Business & Arts Centre
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Stockport
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**CLAREMONT ROAD
RUSHOLME
PHASE I
ENVIRONMENTAL DESK STUDY
FOR
RS DRYLINING MCR**

Earth Environmental & Geotechnical Ltd
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Houldsworth Street
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Tel:0161 975 6088

Report No. A2212/17

January 2022

Report Title:	Claremont Road, Rusholme Phase I Environmental Desk Study
Report Reference:	A2212/17
Client:	RS Drylining MCR
Issue Date:	15th January 2022
Drafted By:	N Ramsumair
Reviewed By:	A Czarnecki
Authorised By:	A Czarnecki

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CONTENTS

1.0	INTRODUCTION.....	1
	Appointment	1
	Objective	1
	Scope	2
2.0	SITE LOCATION AND DESCRIPTION	3
	Site Utility Services.....	4
3.0	ENVIRONMENTAL SETTING	5
	Geology	5
	Ground Workings	6
	Mining and Other Underground Workings.....	6
	Radon Potential.....	7
	Hydrogeology and Hydrology	7
	Industrial Land Use Information	9
	Environmental Permits, Incidents and Registers.....	9
	Environmentally Sensitive Sites	10
	Ecology.....	10
	Archaeology	10
	Potential Flood Risks.....	11
	Previous Site Investigations	11
4.0	SITE HISTORY	12
5.0	WALKOVER SURVEY.....	18
6.0	PRELIMINARY CONTAMINATION RISK ASSESSMENT.....	19
	Introduction.....	19
	Preliminary Risk Assessment.....	21
7.0	CONCLUSIONS AND RECOMMENDATIONS	22
	Recommendations	22

APPENDICES

Appendix 1	GroundSure Reports
Appendix 2	Site Photographs
Appendix 3	Site Walkover Notes
Appendix 4	Report Limitations

FIGURES

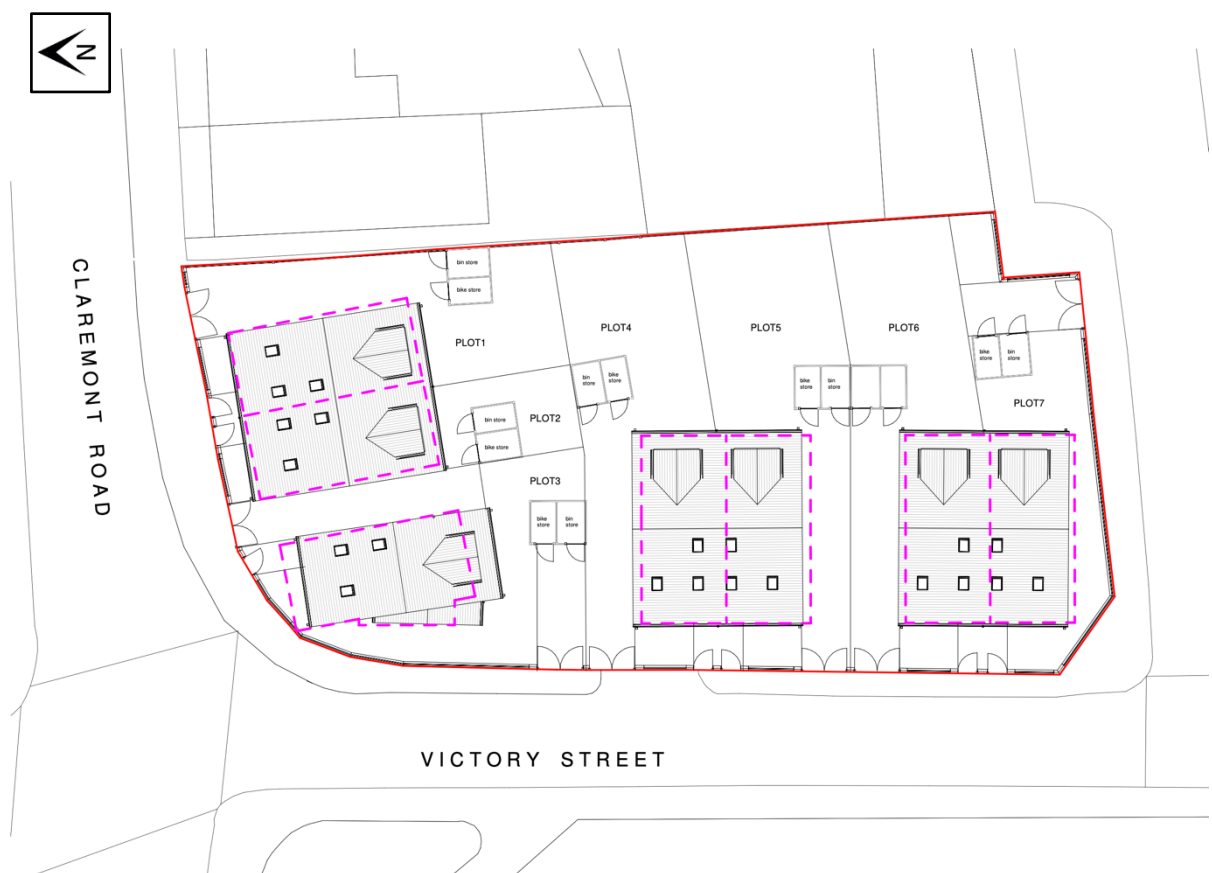
Figure 1	Site Development Plan
Figure 2	Site Location Plan
Figure 3	Artificial Ground Map
Figure 4	Coal Mining Development High Risk Area
Figure 5	OS Map Extract 1849
Figure 6	OS Map Extract 1850
Figure 7	OS Map Extract 1923-1934
Figure 8	OS Map Extract 1988
Figure 9	Google Earth Image 2017

1.0 INTRODUCTION

Appointment

- 1.1 Earth Environmental & Geotechnical was commissioned by PHA Architects on behalf of RS Drylining MCR (the client) to undertake a Phase I Environmental Desk Study at Claremont Road, Rusholme, Manchester.
- 1.2 The proposal includes the development of seven residential dwellings with private garden areas.

Figure 1 Site Development Plan



Objective

- 1.3 The purpose of the Desk Study is to collate available geological and environmental data for the site (and its environment) and provide a preliminary geotechnical and geo-environmental appraisal, with a site specific conceptual model. This enables a preliminary assessment of geo-environmental risks to be undertaken and, if necessary, provides information for the design of a Phase 2 Ground Investigation.

Scope

1.4 The Phase I Environmental Desk Study comprises of a site reconnaissance visit and a review of the following information sources some of which was provided by the client.

- British Geological Survey online maps.
- Google Earth imagery.
- Environment Agency online mapping data.
- Historical Ordnance Survey maps.
- The site and surrounding areas environmental, geological and mining data presented in the site specific GroundSure Reports (Appendix 1).
- Coal Authority Interactive Viewer.
- Manchester City Council Planning Portal.

2.0 SITE LOCATION AND DESCRIPTION

- 2.1 The site is situated between and bounded by Claremont Road to the north, Victory Street to the west with a park further west, Stenbury Close to the south and residential homes and gardens to the east.
- 2.2 The site is located approximately 3.1km south of the centre of Manchester and 1.25km north of Fallowfield. Access to the site is from the east via Victory Street. The approximate National Grid Reference for the centre of the site is SJ 85087 95107 (X: 385087 Y: 395107) with the closest postcode being M14 5AB.
- 2.3 The site occupies approximately 0.10ha across a rectangular shaped, generally level parcel of land, approximately 50m long and 20m wide.
- 2.4 A location plan is shown as Figure 2, below.

Figure 2 Site Location Plan



Site Utility Services

- 2.5 A site service plan has been not provided by the client. The status of all services should be checked with the statutory providers prior to any development (including site investigation) commencing.

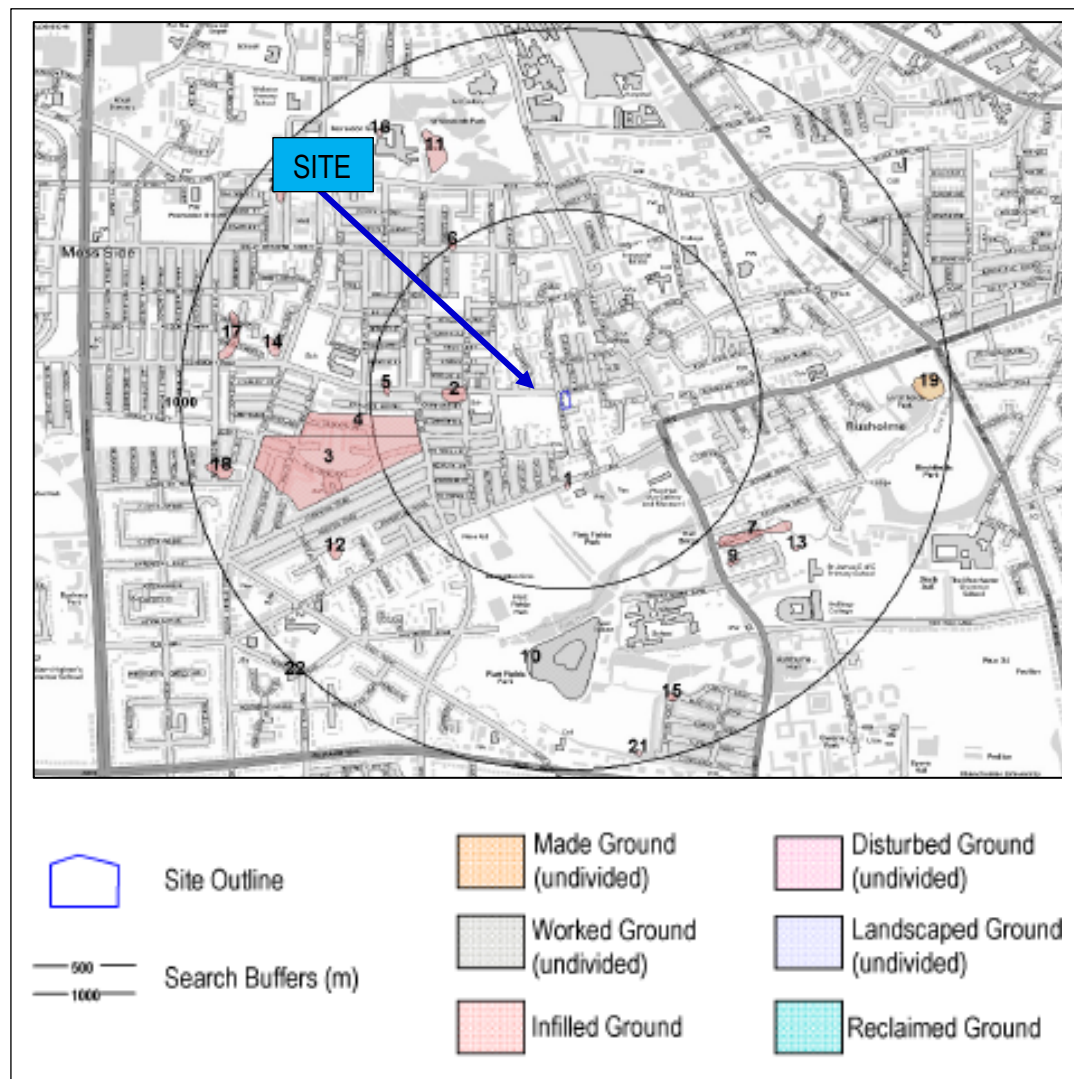
3.0 ENVIRONMENTAL SETTING

- 3.1 The geology of the site is covered by British Geological Survey (BGS) online data and the site specific GroundSure GeoInsight report (Appendix 1).
- 3.2 Environmental conditions are covered by Environment Agency (EA) and British Geological Survey (BGS) online data, and the site specific GroundSure EnviroInsight report (Appendix 1).

Geology

- 3.3 The BGS states that the site is not underlain by any made ground. The nearest record of artificial ground is located 202m south of the site. A copy of the artificial ground map is included below as Figure 3.

Figure 3 Artificial Ground Map



- 3.4 The site is underlain by Devensian Till superficial deposits.
- 3.5 The superficial deposits are underlain by the Chester Pebble Beds Formation consisting of sandstone, fine to coarse grained, commonly pebbly, with conglomerates and sporadic siltstones.
- 3.6 There are no records of geological faults within 500m of the site boundary.
- 3.7 There are no records of landslips within 500m of the site boundary.
- 3.8 There are 10no. borehole records identified within 250m of the site, with the nearest 17m south west of the site. The nearest borehole proved clay to the base of the borehole at 5m.
- 3.9 The site is in an area where the hazard rating is negligible or very low with regards to, landslides, shrink-swell clays, ground dissolution of rocks, natural subsidence, collapsible deposits, compressible deposits and running sands.

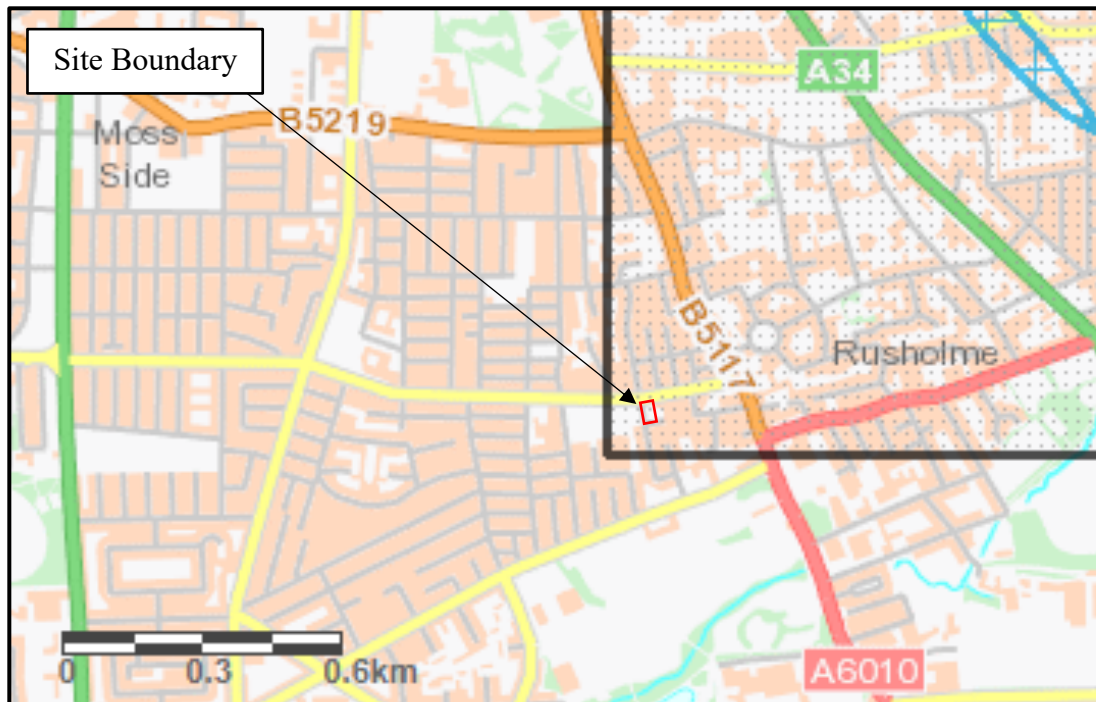
Ground Workings

- 3.10 There are no records of historical surface ground working features identified within 250m of the site boundary.
- 3.11 There are no records of historical underground working features identified within 1km of the site boundary.
- 3.12 There is 1no. current ground working feature identified 539m west of the site with a ceased status.
- 3.13 There are no historical railway features recorded within 250m of the site.
- 3.14 There are no historical railway lines or other tunnels within 250m of the site.
- 3.15 There are no current active railway features within 250m of the site boundary.
- 3.16 The site is not within 5km of the route of the High Speed 2 or Crossrail 1 rail projects.
- 3.17 There are no underground railway lines identified within 250m of the site.

Mining and Other Underground Workings

- 3.18 There are no historical mining records within 1km of the site
- 3.19 There is 1no. record of coal mining onsite although according to the Coal Authority Interactive Viewer, the site is not located within a coal mining development high risk area and there are no mine entries nearby.

Figure 3 Coal Mining Development High Risk Area



- 3.20 There are no non-coal mining areas located within 1km of the site.
- 3.21 There are no areas of gypsum extraction, brine extraction, tin mining or clay mining within 1km of the site.
- 3.22 There are no non-coal cavities or natural cavities identified within 1km of the site.
- 3.23 There are no historical underground working features identified within 1km of the site.

Radon Potential

- 3.24 The site is not in a Radon Affected Area, as less than 1% of properties are above the Action Level and therefore no radon protection measures are necessary.

Hydrogeology and Hydrology

- 3.25 The underlying superficial Devensian Till deposits are classified by the Environment Agency (EA) as a Secondary (undifferentiated) Aquifer with a mixed flow type and high maximum and low minimum permeability. The BGS states the following:

'Assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.'

- 3.26 The underlying Chester Formation (mixed flow type, moderate minimum and high maximum) is classified by the Environment Agency (EA) as a Principal Aquifer. The BGS states the following:

'Geology of high intergranular and/or fracture permeability, usually providing a high level of water storage and may support water supply/river base flow on a strategic scale. Generally principal aquifers were previously major aquifers.'

- 3.27 The EA classifies the groundwater vulnerability and soil leaching potential on site as HU for major aquifer with high leaching potential, where the BGS states:

'Soil information for urban areas and restored mineral workings. These soils are therefore assumed to be highly permeable in the absence of site-specific information'

- 3.28 There are 13no. historical and active groundwater abstraction licence within 2km of the site. The nearest is located 1.4km north west of the site for general cooling.
- 3.29 There is no surface water abstraction license within 2km of the site.
- 3.30 There are no portable water abstraction licences within 2km of the site.
- 3.31 There is one groundwater Source Protection Zone 3 recorded located onsite.
- 3.32 The site is not within 500m of a Source Protection Zone within a confined aquifer.
- 3.33 There are 2no. detailed river network records within 500m of the site. The closest record refers to Platt Brook, a primary river 424m south east of the site.
- 3.34 There are no identified surface water features located within 250m of the site.
- 3.35 There is 1no. biological river quality record located 1.18km south west of the site.
- 3.36 There are no chemical river quality records.

Landfill and Waste Management Activity

- 3.37 There are 9no. records of historical potentially infilled land identified within 500m of the site. The closest record is a pond located 79m south west of the site. Other uses include water bodies, brick works, unspecified pits and depository's.
- 3.38 There are no records of EA landfill sites within 1km of the site.
- 3.39 There are no records of historic EA landfill sites within 1.5km of the site.
- 3.40 There are no records of landfills from Local Authority and Historical Mapping Records within 1.5km of the site.
- 3.41 There are no BGS/DoE non-operational landfill sites within 1.5km of the site.
- 3.42 There are no waste treatment, transfer or disposal site within 500m of the study site.
- 3.43 There are 3no. records of Environment Agency/Natural Resources Wales licensed waste sites within 1.5km of the site, the closest being a clinical waste transfer station 836m north of the site.

Industrial Land Use Information

- 3.44 There are 27no. records of historically potentially contaminative uses identified within 500m of the site. There are 4no. records located within 100m of site comprising of police stations and unspecified works. In the vicinity are records for slaughter houses, fire stations, electrical substations, garages, laundries, unspecified factories, brickworks, unspecified works and a depository.
- 3.45 There are 9no. records of current potentially contaminative uses identified within 250m of the site. The nearest record is ATS Euromaster Ltd for vehicle parts and accessories located 161m east of the site. Other records within the vicinity include electrical features, vehicle repair, testing and servicing, jewellery, baking, airline services, unspecified works or factories and food and beverage industry machinery.
- 3.46 There are 11no. records of historical tanks identified within 250m of the site. There are 3no. records located 122m~ north west of the site comprising of tanks dating to 1950. Other records within the vicinity include unspecified tanks.
- 3.47 There are 14no. records of historical energy features identified within 500m of the site, the closest record refers to an electricity substation 154m north east of the site, dated 1950. Other records include electricity substations.
- 3.48 There are no records of historical petrol or fuel sites within 500m of the site.
- 3.49 There are 3no. records of petrol or fuel sites within 500m of the site. The nearest being an open shell garage 427m north.
- 3.50 There are 32no. historical garages and motor vehicle repair sites identified within 500m of the site. The closest is car body work shop located 257m east. Other uses include garages and coach works.
- 3.51 There are no National Grid high voltage underground electricity transmission cables or high pressure gas transmission pipelines within 500m of the site.

Environmental Permits, Incidents and Registers

- 3.52 The Groundsure Report includes records of environmental permits, incidents and registers within 500m of the site, which are summarised in Table 1, below.

Table 1: Environmental Permits, Incidents and Registers within 500m of the site

Historic IPC Authorisations	None
Part A (1) and IPPC Authorised Activities	None
Red List Discharge Consents	None
List 1 Dangerous Substances Inventory Sites	None
List 2 Dangerous Substances Inventory Sites	None
Part A (2) and Part B Activities and Enforcements	5
Category 3 or 4 Radioactive Substance Authorisations	None
Licensed Discharge Consents	1
Water Industry Referrals	None
Planning Hazardous Substance Consents and Enforcements	None
Dangerous or Hazardous (COMAH and NIHHS) Sites	None
National Incidents Recording System (Pollution Incidents), List 2	None
National Incidents Recording System (Pollution Incidents), List 1	None
Sites Determined as Contaminated Land under Part 2A EPA1990	None

3.53 There are 5no. records for Part A (2) and Part B Activities within 500m of the site. The nearest record refers to a Part B petrol vapour recovery process located 309m east.

3.54 There is 1no. Licensed Discharge Consent recorded 284m north of the site for sewage discharges.

Environmentally Sensitive Sites

3.55 There are no Designated Environmentally Sensitive Sites records within 2km of the study site.

Ecology

3.56 It should be noted that an ecological assessment of the site falls outside the brief of this report and that an ecological specialist should be consulted in this regard.

Archaeology

3.57 An archaeological assessment falls outside the brief of this report. Where considered necessary, advice should be sought from an archaeological specialist in this respect.

Potential Flood Risks

- 3.58 Detailed assessment of flood risks is outside the scope of this report. However, the site does not lie within 250m of an Environment Agency Zone 2 (Fluvial/Tidal Models) or within 250m of a zone 3 Fluvial Models) floodplain.
- 3.59 There are no records of flood defences, areas benefitting from flood defences or areas used for flood storage within 250m of the site.
- 3.60 According to the Environment Agency the highest risk of flooding on site is very low.
- 3.61 According to the BGS there are areas within 50m of the site boundary that may be susceptible to clearwater flooding. The highest susceptibility to groundwater flooding is 'potential at surface' and the BGS confidence rating is low. The BGS states:

'The confidence rating is on a threefold scale - Low, Moderate and High. This provides a relative indication of the BGS confidence in the accuracy of the susceptibility result for groundwater flooding. This is based on the amount and precision of the information used in the assessment. In areas with a relatively lower level of confidence the susceptibility result should be treated with more caution. In other areas with higher levels of confidence the susceptibility result can be used with more confidence.'

Previous Site Investigations

- 3.62 Earth Environmental & Geotechnical Ltd are unaware of any previous site investigations.

4.0 SITE HISTORY

- 4.1 The historical development of the site has been determined by reference historical plans and Google Earth imagery. The reviewed historical plans comprise only readily available records and may be limited; however, the information available to date indicates that additional searches are unlikely to add to our understanding of the site. The earliest available historical mapping covering the site dates back to 1849.
- 4.2 The site history is summarised in Table 2, below, followed by selected extracts from maps and aerial photographs.

Table 2: Summary of Site History

Date	Site	Surrounding Land Use
1849	The site appears to be undeveloped and unoccupied however the current land use is not clear.	Mixed rural and residential setting with mills or factories in the vicinity. Adjacent to the N boundary is Regents Park. Adjacent to the E boundary are residential homes with parks, agricultural land and homes further to the east. Adjacent to the southern boundary is a residential development. This development ends at a church 250m south of the site before continued by agricultural land. A smaller residential development is located to the west of the site followed by agricultural land with small ponds. The nearest pond located approximately 100m south west. Plat Brook located approximately 500m south of the site running northeast- southwest.
1850	Clearer imagery indicates the site is occupied by Kingsthorpe Grove comprising of three residential dwellings with associated gardens. North of the site is open soft verge.	Moor Street Chapel 50m to the east.
1891, 1892, 1905, 1923	The soft verge area now situates six residential homes with small garden areas.	Large scale development of homes and road infrastructure. A police station has been built adjacent to the northern boundary. (1891-1923) A fire station (1891-1905) and Slaughter house (1891-1934) 50m to the west. Followed by a Brick Works with a reservoir. Churches and schools to the south. A public Hall and Library, churches and playing fields to the east. The creation of a Boating lake in Fallowfield 0.75km south of the site. (1932)
1934, 1938, 1950, 1956, 1961, 1966, 1968, 1972, 1976,	Homes still present south of the site with a new public house development.	More development of homes and road infrastructure. The brick works have been replaced by a football ground.

Figure 6 OS Map Extract 1850

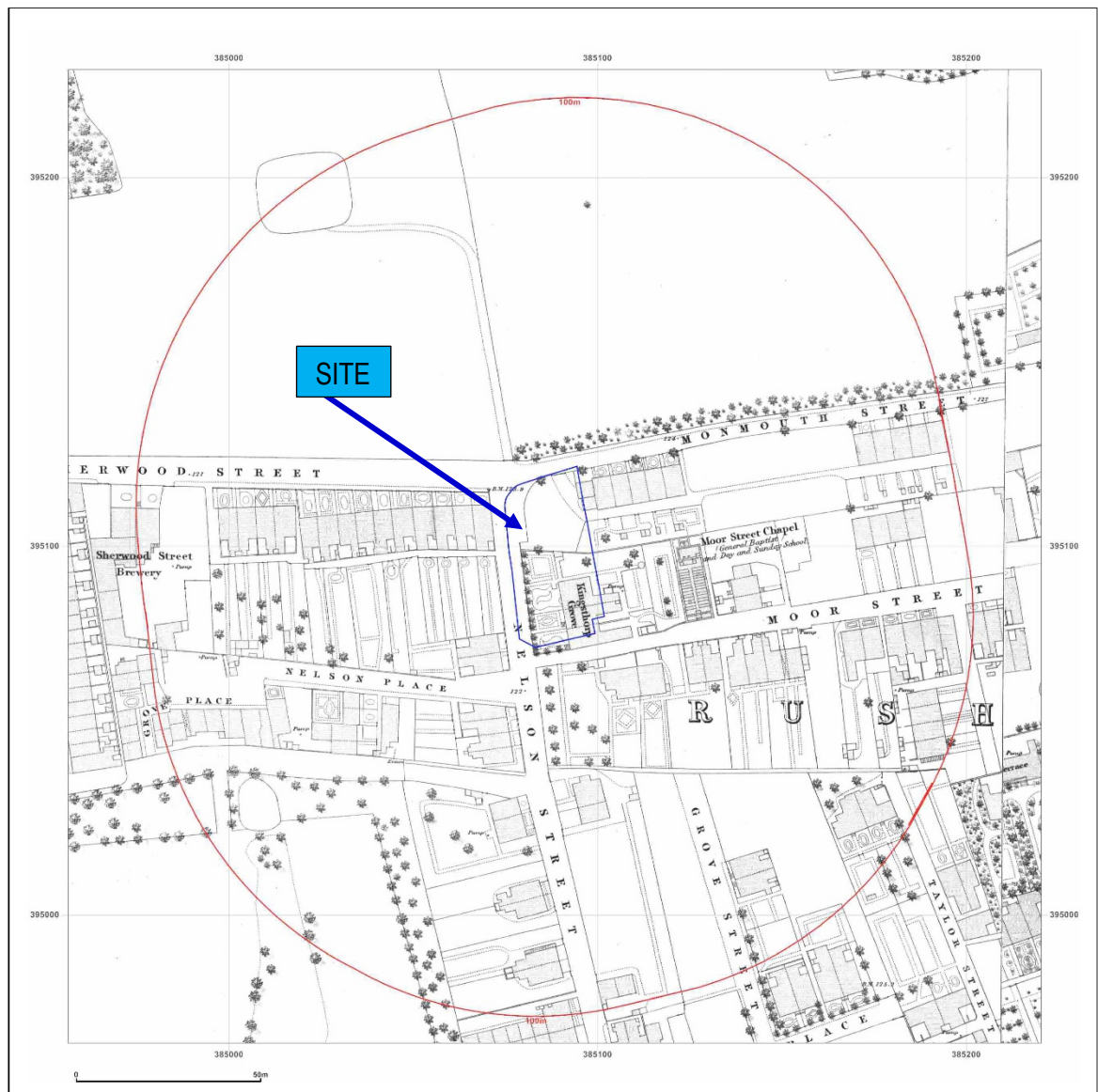


Figure 7 OS Map Extract 1923-1934

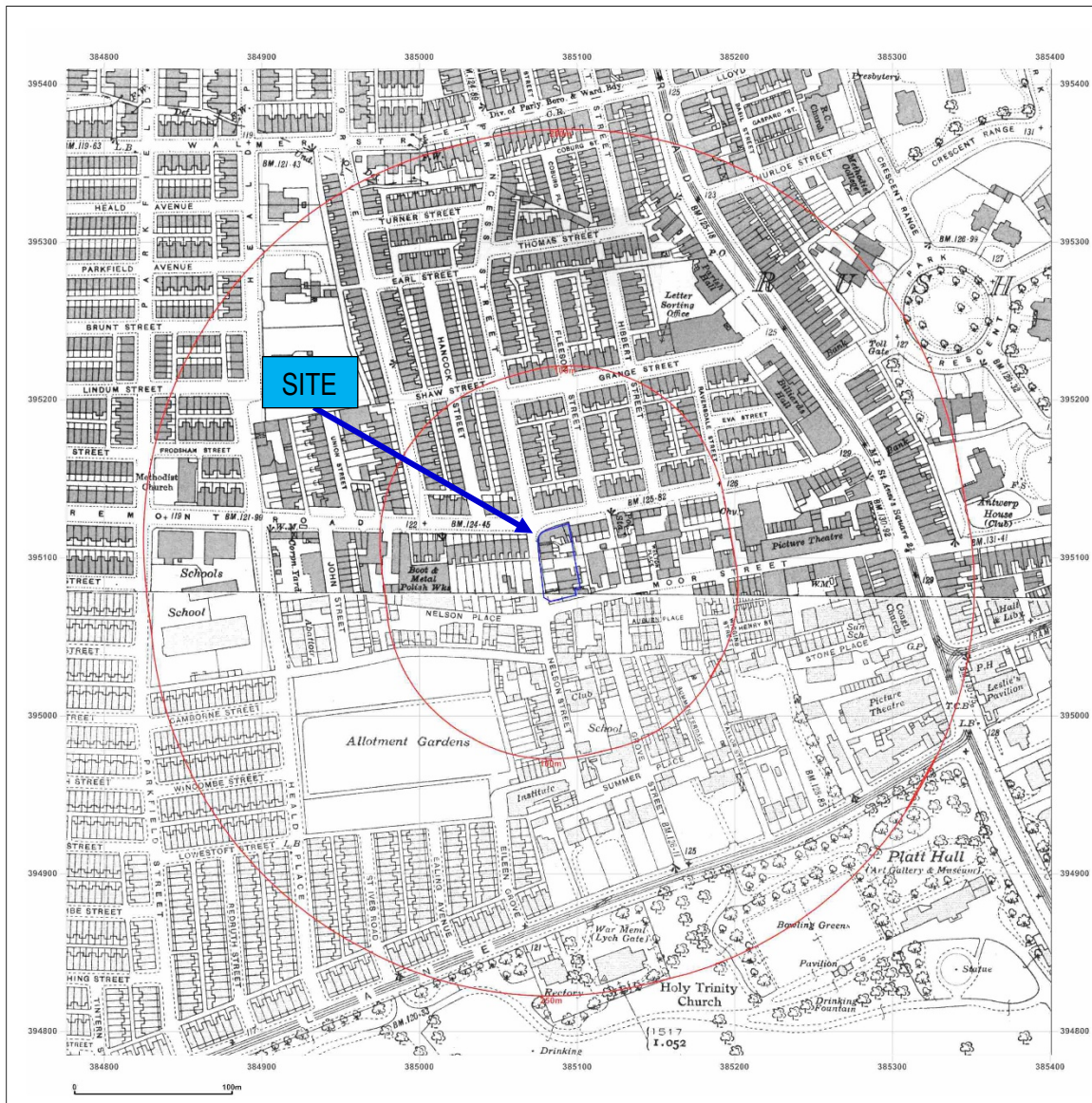


Figure 8 OS Map Extract 1988

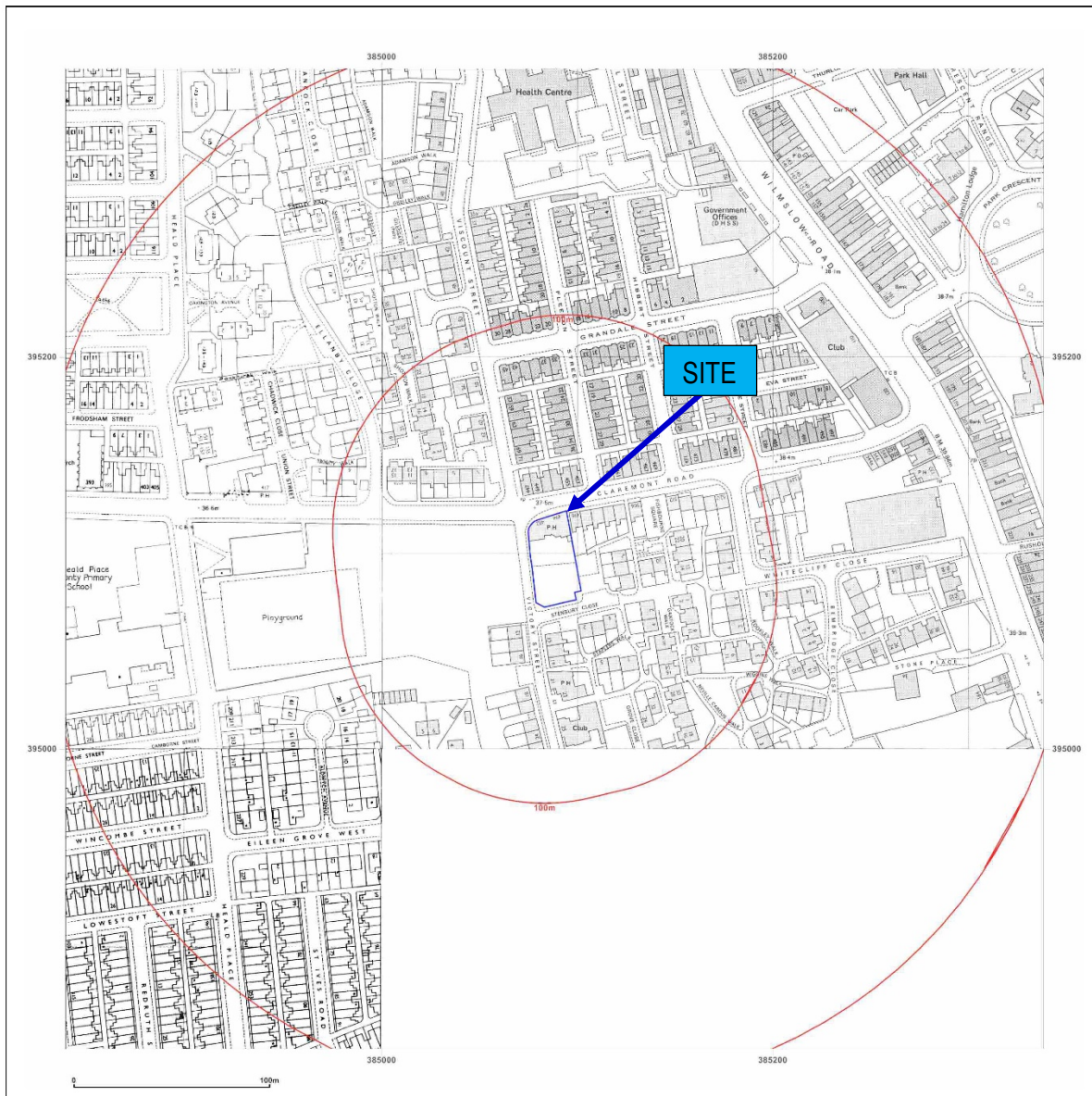
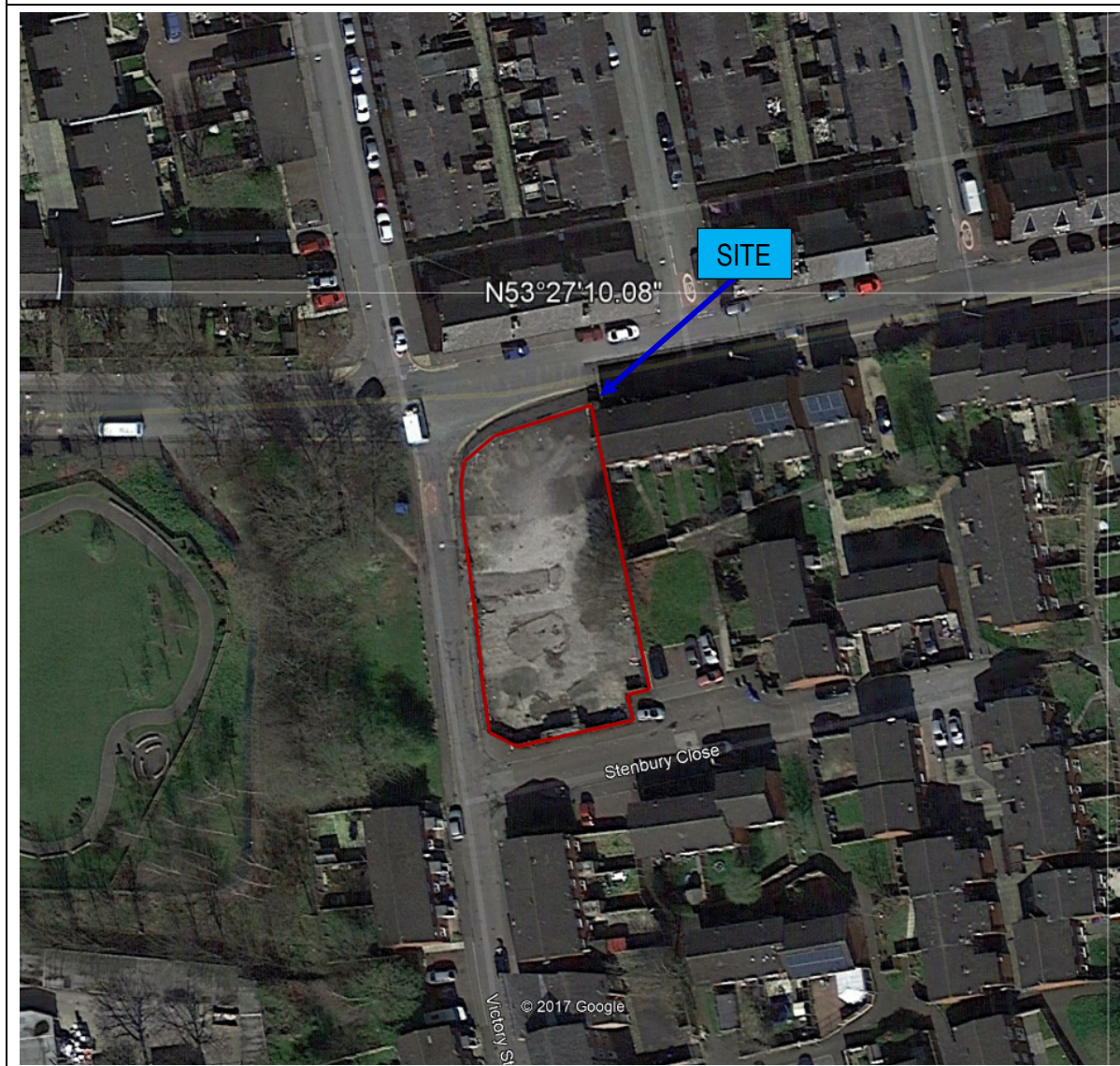


Figure 9 Google Earth Image 2017



5.0 WALKOVER SURVEY

- 5.1 A walkover survey was completed on the 25th August 2017. The photographs and notes from this survey are appended to this report as Appendix 2 and Appendix 3 respectively.
- 5.2 The site is an unoccupied plot with an access gate located along the eastern site boundary (Victory Street).
- 5.3 The site is generally level. There are small amounts of light vegetation on-site comprising of grass and shrubs due to poor maintenance. Mature trees are located along the eastern site boundary.
- 5.1 The site currently has no existing structures.
- 5.2 The site is on hardstanding (asphalt).
- 5.3 The site is bounded by the residential homes to the north, east and south. West of the site is a soft verge followed by a park.
- 5.4 Presence of fly-tipped material includes a stockpile of wood, pallets, plastic and piping. These are generally construction materials located south of the site.
- 5.5 There are two empty Intermediate Bulk Containers (IBCs) located north east of the site.
- 5.6 There are no tankers, electrical substations or transformers located on site.
- 5.7 Materials on site consist of inert waste. In addition, the site is being used for storage of; wood and plastics, two storage containers, two IBCs, scaffolding, plastic piping, vehicles (lorry & caravan), a trailer, fencing and stillages.

6.0 PRELIMINARY CONTAMINATION RISK ASSESSMENT

Introduction

- 6.1 The following paragraphs outline a Preliminary Risk Assessment (PRA) for the site as defined by DEFRA and the EA Model Procedures for the Management of Land Contamination, CLR11 (2004).
- 6.2 Table 3 provides a Preliminary Conceptual Model (PCM) which defines the site in terms of a potential pollution linkage, that is, whether a pathway exists between a contamination source and a sensitive environmental receptor (Source-Pathway-Receptor relationship).
- 6.3 Table 3 considers whether a pollution linkage is potentially present and provides a preliminary qualitative assessment of risk based on the information currently available. Where a possible linkage is identified, it does not necessarily mean that a significant risk exists, but indicates that further information is required through appropriate site investigation to substantiate the conceptual model.

Table 3: Preliminary Conceptual Model

- 6.4 The PCM/PRA is based on a potential residential; end use, representing the most sensitive potential receptors.

Source	Pathway	Receptor	Linkage	Comment
Due to the presence of made ground, on site the likelihood of significant ground contamination sources being present at the site, associated with historical land use, is considered LOW .	Direct contact, ingestion of soil, dermal contact, dust exposure pathways.	Current Site Users	Unlikely	As the site is currently unoccupied, the risk associated with current site users via direct exposure is considered to be LOW .
		Adjacent land users	Unlikely	The neighbouring properties are residential. The current risk is considered LOW .
		Construction Workers	Unlikely	Standard industry working practices for working on sites will be sufficient to manage any potential risks. Therefore, the risk associated with construction workers via direct exposure is considered to be LOW .
		Future land users	Unlikely	If the site is used residential purposes and covered with hardstanding the risk associated with future site users via direct exposure is considered to be LOW .

Due to the presence of made ground on site the likelihood of soluble and/or liquid and therefore mobile contaminants occurring at the site due to its past use is considered LOW .	Direct downward migration through leaching and/or mobile liquids.	Groundwater	Possible	The site lies upon Secondary (Undifferentiated) Aquifer. The perceived risk to groundwater is considered LOW .
	Off-site migration in groundwater or surface water flow.	Surface water	Possible	There are no surface water abstraction licences within 2km of the site. The perceived risk to surface water is considered LOW .
		Groundwater / surface water abstractions	Possible	The nearest active surface groundwater abstraction licence 1.5km from the site. The risk to water abstractions is therefore considered LOW .
		Adjacent Properties	Possible	There is expected to be clay underlying the site. The preliminary risk to adjacent properties is considered LOW .
		Ecology	Unlikely	The site is in a developed area. The risk to ecology is therefore considered LOW .
Due to the current and past land use associated with the site, the likelihood of volatile contaminants at the site due to its this is considered LOW .	Inhalation of harmful vapours (indoor and outdoor airspaces)	Current Site Users	Unlikely	As the site is currently unoccupied, the risk associated with current site users is considered to be LOW .
		Adjacent Properties	Unlikely	The potential risk to adjoining site users is therefore considered LOW .

Due to the nature of the past buildings on site. The likelihood of degradable materials with the potential to generate hazardous ground gas is LOW .	Emissions from the ground collecting in confined spaces and excavations	Construction/ services maintenance workers	Unlikely	The preliminary risk is therefore considered LOW .
	Migration of gases on/off site and collecting in confined spaces on/off site.	Adjoining site users	Unlikely	The potential risk to adjoining site users is therefore considered LOW .
		Current/future site users	Unlikely	The potential of commercial end use represents sensitive receptors. The potential risk is considered LOW .
Chemicals which could prove aggressive to construction materials may be present on site.	Direct contact	Construction concrete, plastic water pipes.	Unlikely	Risks to construction materials can be identified via site investigation prior to the proposed construction works. The perceived risk is considered LOW .

Preliminary Risk Assessment

- 6.5 The site was primarily undeveloped until 1850 after which residential dwellings were built in the southern sector of the site. There was then a public house and works on the site.
- 6.6 The majority of the potential pollution linkages are considered unlikely or possible and the preliminary risks are assessed as **LOW** due to the historic and current land uses.

7.0 CONCLUSIONS AND RECOMMENDATIONS

- 7.1 The likelihood of contamination on the site is overall Low.
- 7.2 The site is underlain by Devensian Till superficial deposits and the Chester Formation.
- 7.3 There are no surface water features within the 250m of the site.

Recommendations

- 7.4 An intrusive investigation should be undertaken to establish geotechnical parameters for the design of foundations, floor slabs and pavement construction for the proposed new structures and surrounding area.
- 7.5 As part of the geotechnical investigation, it is recommended that samples of soil are recovered from proposed garden areas for contamination testing and to confirm whether there are any potential risks.

APPENDIX 1

GROUNDSURE REPORTS

APPENDIX 2

SITE PHOTOGRAPHS

Earth Environmental & Geotechnical Ltd Tel: 0161 975 6088 Email: info@earthenvironmental.co.uk Web: www.earthenvironmental.co.uk	SITE PHOTOGRAPHS 
Job No.: A2212/17	Site: Claremont Road, Rusholme
Plate 1 SE of the site boundary, looking N along the site boundary.	Plate 2 SE of the site boundary, looking W along the site boundary.
	
Date: 25th August 2017	Date: 25th August 2017
Plate 3 SW of the site boundary, looking N along the site boundary.	Plate 4 W of the site boundary, looking E at the site boundary.
	
Date: 25th August 2017	Date: 25th August 2017

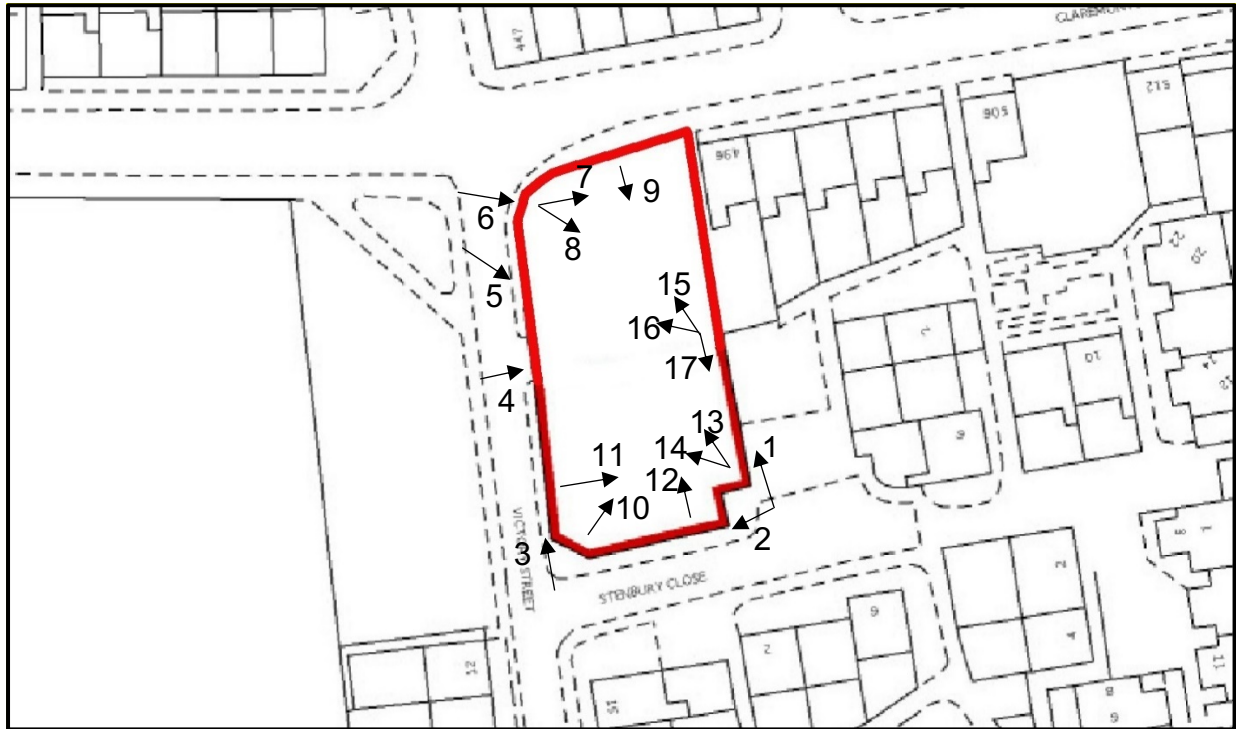
Earth Environmental & Geotechnical Ltd Tel: 0161 975 6088 Email: info@earthenvironmental.co.uk Web: www.earthenvironmental.co.uk	SITE PHOTOGRAPHS 
Job No.: A2212/17	Site: Claremont Road, Rusholme
Plate 5 W of the site boundary, looking SE at the site boundary.	Plate 6 W of the site boundary, looking NE at the site boundary.
	
Date: 25th August 2017	Date: 25th August 2017
Plate 7 NW of the site looking NE of the site. (two IBCs)	Plate 8 NW of the site looking SE of the site (vehicles and storage containers).
	
Date: 25th August 2017	Date: 25th August 2017

Earth Environmental & Geotechnical Ltd Tel: 0161 975 6088 Email: info@earthenvironmental.co.uk Web: www.earthenvironmental.co.uk	SITE PHOTOGRAPHS 
Job No.: A2212/17	Site: Claremont Road, Rusholme
Plate 9 N of the site looking S.	Plate 10 SW of the site looking NE.
	
Date: 25th August 2017	Date: 25th August 2017
Plate 11 SW of the site looking E.	Plate 12 SE of the site looking N.
	
Date: 25th August 2017	Date: 25th August 2017

Earth Environmental & Geotechnical Ltd Tel: 0161 975 6088 Email: info@earthenvironmental.co.uk Web: www.earthenvironmental.co.uk	SITE PHOTOGRAPHS 
Job No.: A2212/17	Site: Claremont Road, Rusholme
Plate 13 SE of the site looking NW.	Plate 14 SE of the site looking W.
	
Date: 25th August 2017	Date: 25th August 2017
Plate 15 W of the site looking NE.	Plate 16 W of the site looking E.
	
Date: 25th August 2017	Date: 25th August 2017

Earth Environmental & Geotechnical Ltd Tel: 0161 975 6088 Email: info@earthenvironmental.co.uk Web: www.earthenvironmental.co.uk	SITE PHOTOGRAPHS 
Job No.: A2212/17	Site: Claremont Road, Rusholme
Plate 17 W of the site looking E.	Plate 18 W of the site looking N.
	
Date: 25th August 2017	Date: 25th August 2017

Figure 10 Site Walkover Photo Locations



APPENDIX 3

SITE WALKOVER NOTES

WALK OVER SURVEY REPORT

Site: Claremont Road, Manchester

Date: 25th August 2017

Job No: A2212

Undertaken By: Nigel Ramsumair

Purpose of Site Walkover:

- 1) Provide further information for the Desk Study Report;
- 2) Identify potential contamination sources, pathways and receptors;
- 3) Identify geotechnical features and potential geohazards;
- 4) Determine locations for exploratory boreholes.

Desk Study features checked during site visit	Feature and Information required	Present	Description / Comments
Site Setting	Description required for: Town/Country/Suburb Setting Industrial/Residential/Retail Usage Current Site use (if undertaking security and access to the site)		Town setting of Rusholme, Manchester. Predominantly residential with the nearest commercial surroundings along the curry mile 200m east. Orientated N-S. A park is located adjacent to the west. Residential homes are located north and south of the site. The site is not currently active and is being used for storage. This includes the following; wood and plastic, two containers, scaffolding, plastic piping, vehicles (lowry & caravan), trailer, fencing and stillages.
Evidence of Past Activities	Are there: Any relevant street names in area? Features or relics which indicate past history?	Yes/No Yes/No	The site is boarder by Stenbury Close in the south, Victory street in the west and Claremont road to the North.
Geographic Setting	Description required for: Low lying flood plain/dry valley/rolling hills etc.		Site is primarily flat lying across the service yard or car park.
Ground Conditions	Is there any evidence of: Mining, Mine entries Subsidence Landslip/slope erosion Former investigation works	Yes/No Yes/No Yes/No	

Desk Study features checked during site visit	Feature and Information required	Present	Description / Comments
Topography	Description required for: Are there apparent differences between site and surrounding area? (If yes describe the presence of retaining walls, and slopes). Is there evidence of Made Ground / Fill on site?	Yes/No Yes/No	The site is located at the end of a housing estate to the east. Soft verge west of the site across Victory Street The site boundary is comprised of a combination of steel fencing and retaining walls. The Brick wall is predominantly along the eastern boundary line. The site is covered in hard standing (asphalt).
Site Boundaries and Neighbours	Description required for: Type of boundary demarcation (if any) on each side of site, usage of adjacent land and name of industrial/commercial occupiers. Note any adjacent features such as water course and other potentially environmentally sensitive uses (residential, school, infirmary, SSSI etc)		The site boundary is comprised of a combination of steel fencing and retaining walls. The Brick wall is predominantly along the eastern boundary line. The nearest commercial surroundings along the curvy mile 200m east. Orientated N-S. A park is located adjacent to the west. Residential homes are located north and south of the site.
Vegetation	Is there any vegetation/trees on or close to side (if yes describe locations, type, maturity, etc) Is there any evidence of poor health / distress?	Yes/No Yes/No	There is light vegetation and shrubs growing on site due to is inactivity. There are mature trees along the eastern boundary along the side on the existing retaining wall.
Ground Surface	Are there areas of hardstanding and estimate the split between hard and soft cover. (If yes describe locations, types and conditions). Is the any evidence of any spillages or staining?	Yes/No Yes/No	The site is completely covered in hardstanding (asphalt).

Desk Study features checked during site visit	Feature and Information required	Present	Description / Comments
Site Drainage	Are there any drain covers / soakaways (if yes describe locations) Are there any outfalls/water courses on site (note the condition of water courses in open water courses. discolouration, odour, eutrophication, oily sheen, gas bubbling water, clear or cloudy) Where a watercourse runs alongside or crosses a site are there any differences in visible water quality upstream and downstream of the site?	Yes/No Yes/No Yes/No	There were no visible manhole covers however the site is currently being using for storage so it is possible that may have been covered at the time of the walkover.
Electrical Equipment	Are there any electricity sub stations on or adjacent to the site? Are there any electrical transformers, capacitors, pylons etc on site?	Yes /No	
Buildings	Is there any evidence of asbestos construction materials e.g. roofing, insulation materials. Do any buildings have basements? Do any buildings have a boiler room (if yes, describe fuel type and storage arrangements)?	Yes/No Yes/No Yes/No	

Desk Study features checked during site visit	Feature and Information required	Present	Description / Comments
Landfilling	Is there any evidence of gas protection measures (gas membrane, gravel-filled trenches, venting pipes, etc)?	Yes /No	N/A
Process Air Emissions	Point Source: Are there any stacks / vents / cooling towers / abatement equipment? Fugitive Source: is there any stockpiled material / windblown dust / vapour process?	Yes /No Yes/ No	The is a stockpile of building materials predominantly along the northern boundary of the site (wood and plastics).
Storage of fuels & Chemicals	Are there any drums / containers (if yes, describe quantity, full /empty, stored on hard standing / soft landscaping, bunding)? Are there any above ground fuel tanks (if yes, describe locations, volumes, how many, bunding, used / disused, condition?) Is there any evidence of underground fuel tanks (fuel pumps, covers, vent pipes, how many and how large, fill point, used / disused, and condition)?	Yes/ No Yes /No Yes /No	There are empty Intermediate bulk containers (IBCs) stored north east of the site.
Accidents	In the event of a large spillage would runoff affect any vulnerable watercourse/culverts? Are emergency procedures / equipment in place?	Yes/ No Yes /No	A spillage could potentially run into road drainage.

Desk Study features checked during site visit	Feature and Information required	Present	Description / Comments
Waste	Are there any waste skips present on site? Are waste storage facilities adequate? Is there any litter/fly tipped material?	Yes/No Yes/No Yes/No	The is a stockpile of building materials predominantly along the southern boundary of the site (wood and plastics).
Atmospheric	Are there any fumes, odours originating from site or affecting site from neighbouring sites?	Yes /No	
Access / Further Investigations	If a Phase 2 Investigation is likely to be required, describe any access problems including headroom where relevant, services, overhead cables, restricted access areas, confined spaces, trafficked areas, etc that are likely to affect investigation scope/techniques. Identify possible site office and storage locations. Identify possible water supply	Yes/ No	There are no issues accessing the inactive site. Difficulties will arise if access is required to an area currently being used as storage. The site is inactive and there is adequate space for storage.
Site Environs	Are there any local features that could have a harmful influence e.g. landfill, industrial processes, railway land? Are there any sensitive water features/courses near to the site?	Yes/No Yes/No	
Local Knowledge / Anecdotal Evidence			
Site Dimensions	Describe shape of Site in plan and measure dimensions.		The site is rectangular approximately 50m x 20m.

APPENDIX 4

REPORT LIMITATIONS

LIMITATIONS

This contract was completed by Earth Environmental & Geotechnical Ltd on the basis of a defined programme and scope of works and terms and conditions agreed with the client. This report was compiled with all reasonable skill, and care, bearing in mind the project objectives, the agreed scope of works, the prevailing site conditions, the budget and staff resources allocated to the project.

Other than that expressly contained in the above paragraph, Earth Environmental & Geotechnical Ltd provides no other representation or warranty whether express or implied, is made in relation to the services. Unless otherwise agreed this report has been prepared exclusively for the use and reliance of the client in accordance with generally accepted consulting practices and for the intended purposes as stated in the agreement under which this work was completed. This report may not be relied upon, or transferred to, by any other party without the written agreement of a Director of Earth Environmental & Geotechnical Ltd.

If a third party relies on this report, it does so wholly at its own and sole risk and Earth Environmental & Geotechnical Ltd disclaims any liability to such parties.

It is Earth Environmental & Geotechnical Ltd understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was an important factor in determining the scope and level of the services. Should the purpose for which the report is used, or the proposed use of the site change, this report will no longer be valid and any further use of, or reliance upon the report in those circumstances by the client without Earth Environmental & Geotechnical Ltd review and advice shall be at the client's sole and own risk.

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The services are based upon Earth Environmental & Geotechnical Ltd observations of existing physical conditions at the site gained from a walkover survey of the site together with Earth Environmental & Geotechnical Ltd 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 whilst Earth Environmental & Geotechnical Ltd have no reason to doubt the accuracy and that it has been provided in full from those it was requested from, the items relied on have not been verified.

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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 can also be variable and as investigation excavations 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. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and Earth Environmental & Geotechnical Ltd] based on an understanding of the available operational and historical information, and it should not be inferred that other chemical species are not present.

The groundwater conditions entered on the exploratory hole records are those observed at the time of investigation. The normal speed of investigation usually does not permit the recording of an equilibrium water level for any one water strike. Moreover, groundwater levels are subject to seasonal variation or changes in local drainage conditions and higher groundwater levels may occur at other times of the year than were recorded during this investigation.

Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.

APPENDIX 2

EEG LTD PHASE II GEOENVIRONMENTAL INVESTIGATION REPORT



EARTH ENVIRONMENTAL
& GEOTECHNICAL

Phase II GeoEnvironmental Investigation

Claremont Road

Manchester

January 2022

On behalf of

RS Drylining MCR



Earth Environmental & Geotechnical Ltd
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**PHASE II GEOENVIRONMENTAL
INVESTIGATION**

CLAREMEONT ROAD

MANCHESTER

Report Ref: A2212/19/B.0/V2

JANUARY 2022

Prepared on Behalf of:

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GEOENVIRONMENTAL INVESTIGATION

CLAREMONT ROAD, MANCHESTER

Report Reference: A2211/19

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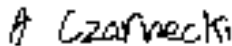
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- B. Applied after the Project Manager has approved the report ready for issue to the client.
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TABLE OF CONTENTS

1.0	INTRODUCTION	1
1.1	BACKGROUND	1
1.2	PREVIOUS INVESTIGATIONS	1
1.2.1	<i>Earth Environmental & Geotechnical Ltd Phase I Desk Study A2212/17, dated September 2017)</i> 1	1
1.3	TERMS OF REFERENCE	1
1.4	LIMITATIONS OF THE STUDY	2
2.0	SITE LOCATION & DESCRIPTION	3
2.2	PROPOSED DEVELOPMENT	7
3.0	SITE INVESTIGATION	8
3.1	EXPLORATORY FIELDWORK	8
3.2	LABORATORY TESTING PROGRAMME	10
3.2.1	<i>Geotechnical Testing</i>	10
3.2.2	<i>Environmental Testing</i>	10
4.0	GROUND CONDITIONS ENCOUNTERED	12
4.1	SOIL PROFILE ENCOUNTERED	12
4.2	OBSERVABLE INDICATIONS OF CONTAMINATION	12
4.3	OBSTRUCTIONS	13
4.4	GROUNDWATER	13
5.0	ENGINEERING PROPERTIES OF SOILS ENCOUNTERED	14
5.1	MADE GROUND	14
5.2	DEVENSIAN TILL	14
5.2.1	Clay	14
6.0	GEOTECHNICAL ASSESSMENT	20
6.1	PROPOSED DEVELOPMENT	20
6.2	GROUND CONDITIONS	20
6.3	FOUNDATION CONSIDERATIONS	20
6.3.1	<i>Shallow Strip Foundations</i>	21
6.4	GROUND FLOOR SLABS	21
6.5	PAVEMENT DESIGN	22
6.6	CHEMICAL ATTACK ON BURIED CONCRETE	22
6.7	SUITABILITY OF EXCAVATED MATERIALS	22
6.8	TEMPORARY WORKS	23
7.0	SOIL CONTAMINATION RISK ASSESSMENT	24
7.1	TIER I HUMAN HEALTH SOIL RISK ASSESSMENT – GROUNDWORKERS DURING DEVELOPMENT	24
7.2	TIER I HUMAN HEALTH SOIL RISK ASSESSMENT – FUTURE SITE USERS	25
7.3	SOIL WASTE ASSESSMENT	27
8.0	REVIEW OF CONCEPTUAL MODEL	28
8.1	SOURCES OF CONTAMINATION	29
8.2	RECEPTORS	29
8.3	POLLUTANT PATHWAYS	29
9.0	CONCLUSIONS AND RECOMMENDATIONS	32
9.1	SOIL CONTAMINATION	32
9.2	ASBESTOS	32
9.3	SOIL WASTE ASSESSMENT	33
9.4	FOUNDATION RECOMMENDATIONS	33
9.5	SITE PERSONNEL	33

LIST OF FIGURES

Figure 1	Site Location Plan
Figure 2	Overview of site, looking N
Figure 3	View of the site entrance from Victory Street, looking SE
Figure 4	Drilling rig in position WS1
Figure 5	Soils encountered in WS1
Figure 6	Oily sheen on water surface in WS4
Figure 7	Development Layout Plans
Figure 8	Exploratory Hole Location Plan (Based on Proposed Layout)
Figure 9	SPT vs Depth Plot
Figure 10	Strength vs Depth Plot
Figure 11	Plasticity Chart

TABLES

Table 1	Summary of Exploratory Holes Undertaken
Table 2	Summary of Ground Conditions Encountered
Table 3	Soil Desiccation Indicators in the Clay
Table 4	Summary of Design Parameters (Clay)
Table 5	Summary of Allowable Bearing Pressures for Strip Foundations
Table 6	Summary of Concrete Classification for Encountered Soils
Table 7	Summary of Guideline Values for Protection of Workers and the General Public During Development of Contaminated Land
Table 8	Assessment of Soil Chemical Data
Table 9	Waste Classification of Soils
Table 10	Consequence, Probability and Risk
Table 11	Estimation of Level of Risk
Table 12	Revised Conceptual Model

APPENDICES

Appendix 1	Exploratory Hole Logs
Appendix 2	Chemical Testing Results
Appendix 3	Geotechnical Testing Results
Appendix 4	Soil Waste Assessment
Appendix 5	Report Limitations

1.0 INTRODUCTION

1.1 Background

A Geo-Environmental Site Investigation has been commissioned by RS Drylining MCR to examine ground conditions and retrieve soil samples for chemical and geotechnical testing, for the proposed housing development on Claremont Road, Manchester.

This report is required to support a planning application to Manchester City Council (Ref: 120891/FO/2018).

1.2 Previous Investigations

1.2.1 *Earth Environmental & Geotechnical Ltd Phase I Desk Study A2212/17, dated September 2017)*

The desk study highlighted that, historically, the site was occupied by residential houses and gardens from the mid-1800s. Later developments on-site included the demolition of the residential housing followed by the construction of several other structures including a public house in the northern part of the site (1930s), and a works in the centre of the site (1950s).

The works and public house were later demolished in the 1980s and early 2000s respectively. The site is currently vacant and has most recently been used as a storage yard.

Over the study period the surrounding area appears to have comprised predominantly residential developments, with occasional small scale industrial and commercial developments.

It was considered possible that potentially contaminated made ground may be present beneath the site, associated with the former on-site structures. However, the risk to end users from potential soil and groundwater contamination on the site was concluded to be **LOW**. Similarly, the risk from ground gas was also considered **LOW**.

An intrusive investigation was recommended to establish geotechnical parameters for proposed development and to provide a contamination assessment of the site to confirm whether or not there are any potential risks.

1.3 Terms of Reference

Earth Environmental and Geotechnical Ltd (EEG) was commissioned by the Client to undertake a Geo-Environmental Investigation of the site in accordance with a proposal A2212/18 dated 26th November 2018.

The objectives of this investigation are as follows:

- *Assess the presence and likely extent of any potential environmental hazards (soil contamination) associated within the areas of the site investigated.*
- *Assess the ground conditions for design of foundations.*
- *Classify the soils for offsite disposal purposes.*

The investigation is required to support a planning application for the site.

1.4 Limitations of the Study

The report is written in the context of an agreed scope of work and budget and should not be used in a different context. New information, improved practices or changes in legislation may require a reinterpretation of the report in whole or in part. EEG reserve the right to amend either conclusions or recommendations in light of any further information that may become available. The report is provided for the sole use by the client and is confidential to them.

Recommendations within this report are also based on exploratory records and examination of samples and, where applicable, laboratory tests. No liability can be accepted for conditions not revealed by the boreholes and trial pits particularly at intervening locations. Whilst every effort is made to ensure accuracy of data supplied, all opinions expressed as to the spatial distribution of strata between sampling locations is for guidance only and no responsibility is accepted as to its accuracy.

2.0 SITE LOCATION & DESCRIPTION

The site is located at the junction of Claremont Road (north) and Victory Street (west) and currently comprises a vacant, completely hard surfaced, storage yard, which is absent of any buildings or permanent structures. The surfacing appears to be in poor condition in places, with emerging vegetation.

The site is accessed from Victory Street, via a gate and is generally used for storage of miscellaneous materials including wooden pallets, cabins, a caravan and other discarded/disused items.

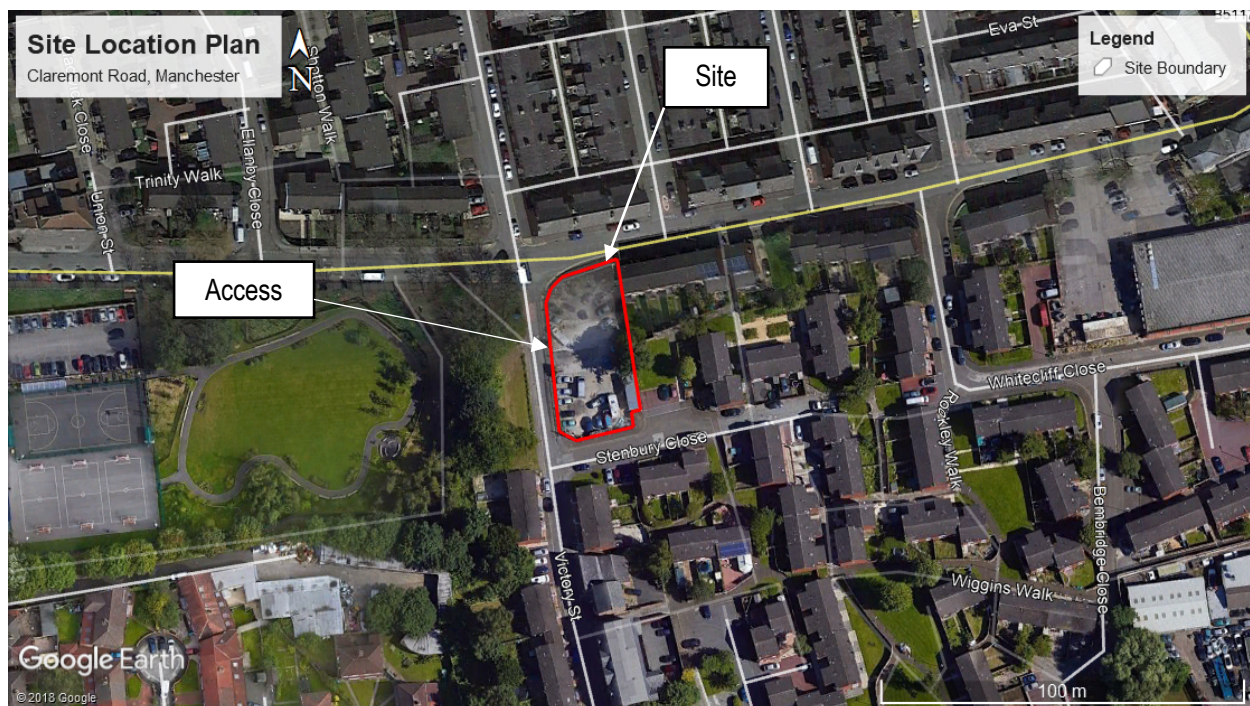
The approximate National Grid Reference for the centre of the site is SJ 85087 95107 (X: 385087 Y: 395107) with the closest postcode being M14 5AB. The site is approximately rectangular in shape with maximum dimensions of 50m north-south and 20m east-west and occupies an area of approximately 0.10ha. The topography of the site appears flat and level.

Two inspection chambers are present on-site, presumed to be drainage. No other services have been observed on-site, although water and gas covers are present in the pavement of Claremont Road and Victory Street and may enter the site.

The site is bound by a combination of brick walls and palisade fencing, and the surrounding area comprises predominantly residential housing with a recreational park to the west. Mature trees are present at the eastern boundary, and in the park to the west, approximately 5m to 12m in height.

The site location is shown in Figure 1, below.

Figure 1 Site Location Plan



Site photographs are presented in Figures 2 to 6 below.

Figure 2 Overview of site, looking N



Figure 3 View of the site entrance from Victory Street, looking SE



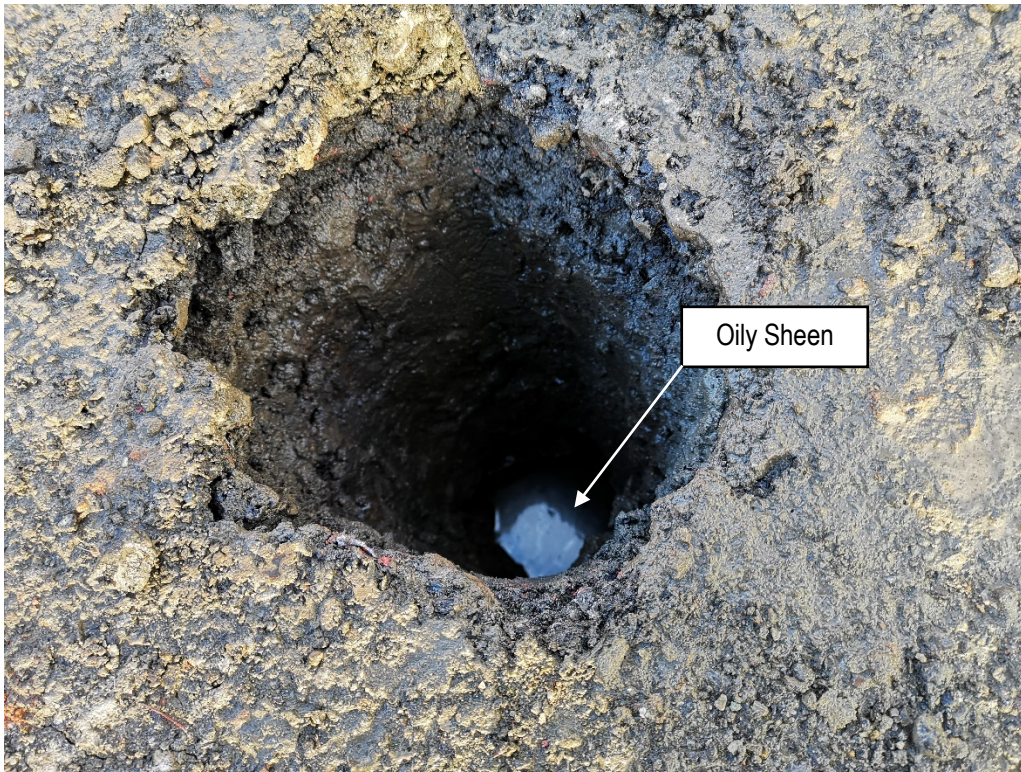
Figure 4 Drilling rig in position WS1



Figure 5 Soils encountered in WS1



Figure 6 Oily sheen on water surface in WS4



2.2 Proposed Development

It is understood that the client intends to construct 7no. residential dwellings.

Figure 7, below, shows extracts from the proposed development plans.

Figure 7 Development Layout Plans



3.0 SITE INVESTIGATION

3.1 Exploratory Fieldwork

The fieldwork was carried out by EEG on the 20th November 2018 and comprised:

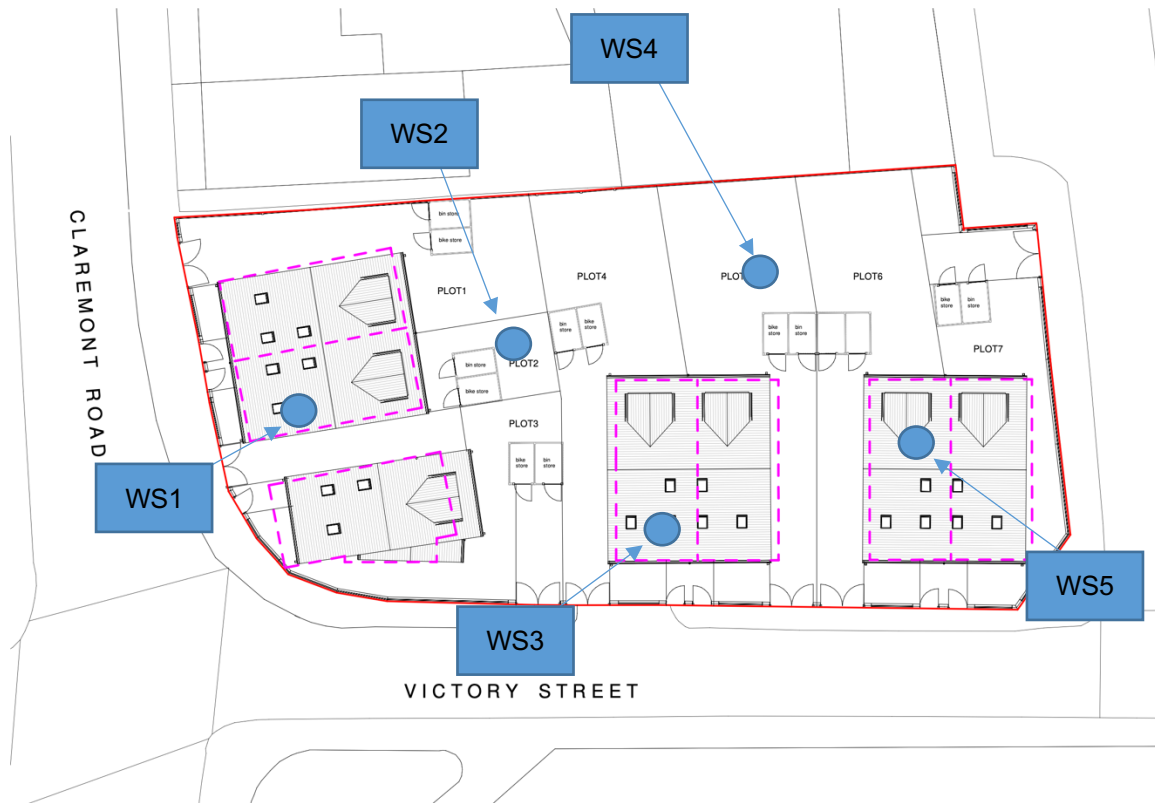
- Five window sample boreholes (designated WS1 to WS5 inclusive) were each sunk to depths of between 3.0m and 3.8m below existing ground level. Window sampler boring is carried out with a small, track-mounted rig, which uses a chain-driven trip hammer to drive sampling tubes or penetrometers into the ground. These tools are coupled to the anvil of the hammer by solid drill rods. Sampling tubes comprise “windowless samplers”, which are plain sampler tubes in which a continuous disturbed sample is recovered within a semi-rigid plastic liner. In order to reduce friction within the borehole, sampling tubes of progressively smaller diameter are used as the borehole depth increases. Sampler diameters generally range from between approximately 90mm to 50mm. Standard Penetration Tests (SPTs) were undertaken in the boreholes in accordance with BS EN ISO 22476-3.

The fieldwork was carried out in accordance with BS5930:2015 Code of Practice for Site Investigations, Eurocode 7, unless otherwise stated.

The exploratory hole locations were determined on site by EEG based on the proposed development plan and to target potential sources of contamination identified in the Phase I Desk Study report (Reference A2212, dated September 2017) and are shown on the Exploratory Hole Location Plan (Figure 8) overleaf.

Exploratory Hole logs are included in Appendix 1.

Figure 8 Exploratory Hole Location Plan (Based on Proposed Layout)



Each exploratory location was scanned using a Cable Avoidance Tool (CAT) in order to locate unrecorded underground services, and the exploratory locations were repositioned if necessary.

On completion, all samples recovered from the site were taken to a specialist laboratory for testing.

All site investigation work was supervised full time by a representative of EEG. The logging of soils and rocks has been carried out in accordance with BS5930⁽²⁰¹⁵⁾ except where superseded by the soil and rock description methodology in BS EN14688-1⁽²⁰⁰²⁾, BS EN 14688-2⁽²⁰⁰⁴⁾ and BS EN 14689-1⁽²⁰⁰³⁾.

All locations and elevations were surveyed by use of a hand-held Trimble GPS with antennae, capable of achieving an accuracy of less than 10cm, depending on the prevailing satellite coverage and obscuring by trees and structures.

A summary of exploratory holes undertaken during the investigation is presented in Table 1, below.

Table 1: Summary of Exploratory Holes Undertaken

Hole	Type	Depth (m)	Date Started	Date Finished	Backfill Details
WS1	WS	3.50*	20/12/2018	20/12/2018	A
WS2	WS	3.80*	20/12/2018	20/12/2018	A
WS3	WS	3.80*	20/12/2018	20/12/2018	A
WS4	WS	3.00*	20/12/2018	20/12/2018	A
WS5	WS	3.00*	20/12/2018	20/12/2018	A
WS=Window Sample Borehole, A=Arising					
*Borehole refused. Proposed drilling depth = 6.00m					

3.2 Laboratory Testing Programme

3.2.1 Geotechnical Testing

A programme of laboratory testing was carried out on samples taken from the various strata to assist in classification and determine the engineering properties of the materials underlying the site. The test procedures used were generally in accordance with the methods described in BS1377:1990. Details of the specific tests used in each case are given overleaf.

TEST	STANDARD (BS1377:1990)	No.
Liquid Limit, Plastic Limit, Plasticity Index	Part 2, Clause 4 / 5	4
Particle Size Distribution	Part 2, Clause 9	2
Single Stage Triaxial Testing	Part 7, Clause 9	3
Sulphate content of 2:1 soil: water extract	Part 3,	4
pH value	Part 3,	4

The results of the laboratory geotechnical tests are discussed in Section 5 and included in Appendix 3.

3.2.2 Environmental Testing

The environmental chemistry of the ground was investigated by specialist chemical analysis of selected samples, scheduled by EEG and carried out by DETS UKAS accredited laboratory.

Chemical analyses were carried out on thirteen soil samples and were submitted for the following suite of determinants:

Asbestos Screen, Arsenic, Beryllium, Boron, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc, Cyanide, Thiocyanate, Phenol, Sulphate (SO₄), Sulphide, pH, Sulphur, Soil Organic Matter and speciated Polyaromatic Hydrocarbons (PAH) and speciated Total Petroleum Hydrocarbons (TPH).

The results of the laboratory contamination tests are discussed in Section 7 and included in Appendix 2.

4.0 GROUND CONDITIONS ENCOUNTERED

4.1 Soil Profile Encountered

The BGS mapping for the area indicates the site to be underlain by superficial deposits of Devensian Till (Diamict) and solid geology of the Chester Pebble Beds.

The sequence of strata encountered beneath the site was:

- **Asphalt**
- **Made Ground** – variable material encountered in each of the boreholes to a maximum depth of 2.20m bgl (WS1). Typically comprising:
 - Predominantly dark brown/black sandy gravelly clay containing variable proportions of brick, concrete, sandstone, mudstone, wood, tile, coal and clinker fragments. (With relict building materials in WS1).
 - Grey clayey sandy gravel containing variable proportions of brick, concrete, mudstone, coal and clinker fragments.
- **Devensian Till** –
 - Stiff becoming very stiff, brown, silty, slightly sandy, slightly gravelly clay with occasional silty sand bands. The material was noted to become sandier with depth.

The depths of the various materials encountered in each of the exploratory holes are summarised in Table 2 overleaf.

Table 2: Summary of Ground Conditions Encountered

Hole	Depth to Stratum (m)				GROUND WATER (m bgl)
	Asphalt	Made Ground		DEVENSIAN TILL	
		Gravelly CLAY	Clayey GRAVEL	Silty Sandy Gravelly CLAY	
WS1	GL-0.05	0.05-1.30	1.30-2.20	2.20-3.50	-
WS2	GL-0.05	0.60-1.00	0.05-0.60	1.00-3.80	-
WS3	GL-0.05	0.40-0.80	0.05-0.40	0.80-3.80	-
WS4	GL-0.05	0.05-1.00	-	1.00-3.00	0.40*
WS5	GL-0.05	-	0.05-1.40	1.40-3.00	0.40*

*Perched water.

4.2 Observable Indications of Contamination

The made ground was observed to contain coal and clinker fragments.

A moderate hydrocarbon odour was detected within the made ground soils encountered in WS4. Significant perched water ingress also occurred in WS4 and an oily sheen was visible on the water surface (refer to Figure 6).

Inclusions of concrete, brick, slate, wood and tile were also noted within the made ground encountered at the site. These particular inclusions are considered generally inert and unlikely to present a risk of contamination.

No other visual or olfactory evidence of contamination was observed.

4.3 Obstructions

Intact brick cobbles were recovered between 1.30m and 2.20m bgl in WS1. Based on the location of this borehole, this material is inferred to be relict building materials used to backfill the former cellar of the public house.

4.4 Groundwater

Perched groundwater was encountered in the made ground of WS4 and WS5 at 0.40m bgl.

5.0 ENGINEERING PROPERTIES OF SOILS ENCOUNTERED

The following sections discuss the engineering properties of the strata encountered, based on results of in situ testing and laboratory testing obtained during this investigation.

5.1 Made Ground

Variable Made Ground was encountered across the site to depths of between 0.80m and 2.20m bgl. Made Ground is not typically considered to be a suitable founding material, and as such, no geotechnical testing was carried out on the material.

Standard Penetration Tests (SPTs) carried out in the Made Ground resulted in **SPT N values** between 10 and 27, as shown on the SPT vs Depth Plot overleaf (Figure 9).

Sulphate content and pH value determination tests were carried out on seven samples of the Made Ground by the chemical laboratory. The **water-soluble sulphate** content of the samples ranged between <32 mg/l SO₄ to 1350 mg/l SO₄ with **pH values** of 7.6 to 8.3.

5.2 Devensian Till

The Till was encountered beneath the Made Ground across the site as a stiff becoming very stiff, Silty, Sandy, Gravelly Clay, with occasional sand bands. The material is referred to as Clay in subsequent sections.

5.2.1 Clay

Two Particle Size Distribution Test was carried out on samples of the Clay at 2.7m and 3.5m bgl, and the lab described the material at 2.7m as stiff, brown, silty, sandy clay with gravel. The clay at 3.5m was described as stiff, brown, silty, very sandy clay with gravel.

SPT tests carried out in the Clay resulted in **SPT N values** of between 11 and 50, as shown on the SPT vs Depth Plot overleaf (Figure 9). The SPT plot shows a clear sharp increase in shear strength with depth.

In situ hand vane (HV) tests were also carried out on the recovered soils, together with undrained shear strength triaxial compression tests at the geotechnical laboratory.

The results of the HV tests range between 24kPa to 140kPa (maximum reading of the hand shear vane). Figure 10, presented on page 16, shows the results of the HV tests plotted alongside equivalent shear strength values derived from SPT N values, based on correlations by Stroud and Butler ⁽¹⁹⁷⁵⁾, together with laboratory derived undrained shear strength values.

There appears to be a good correlation between the results obtained from each method of testing.

Figure 9 SPT vs Depth Plot

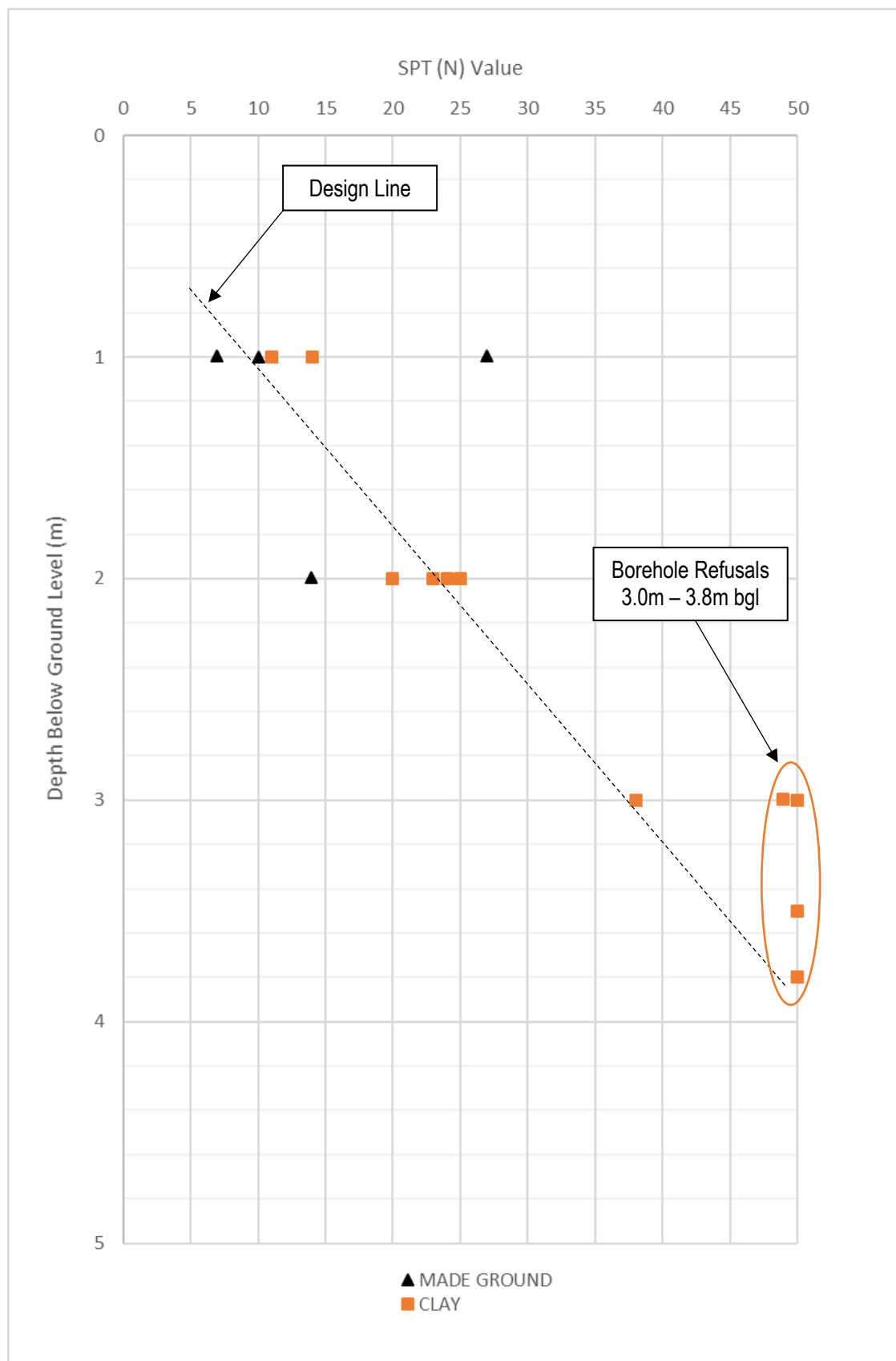
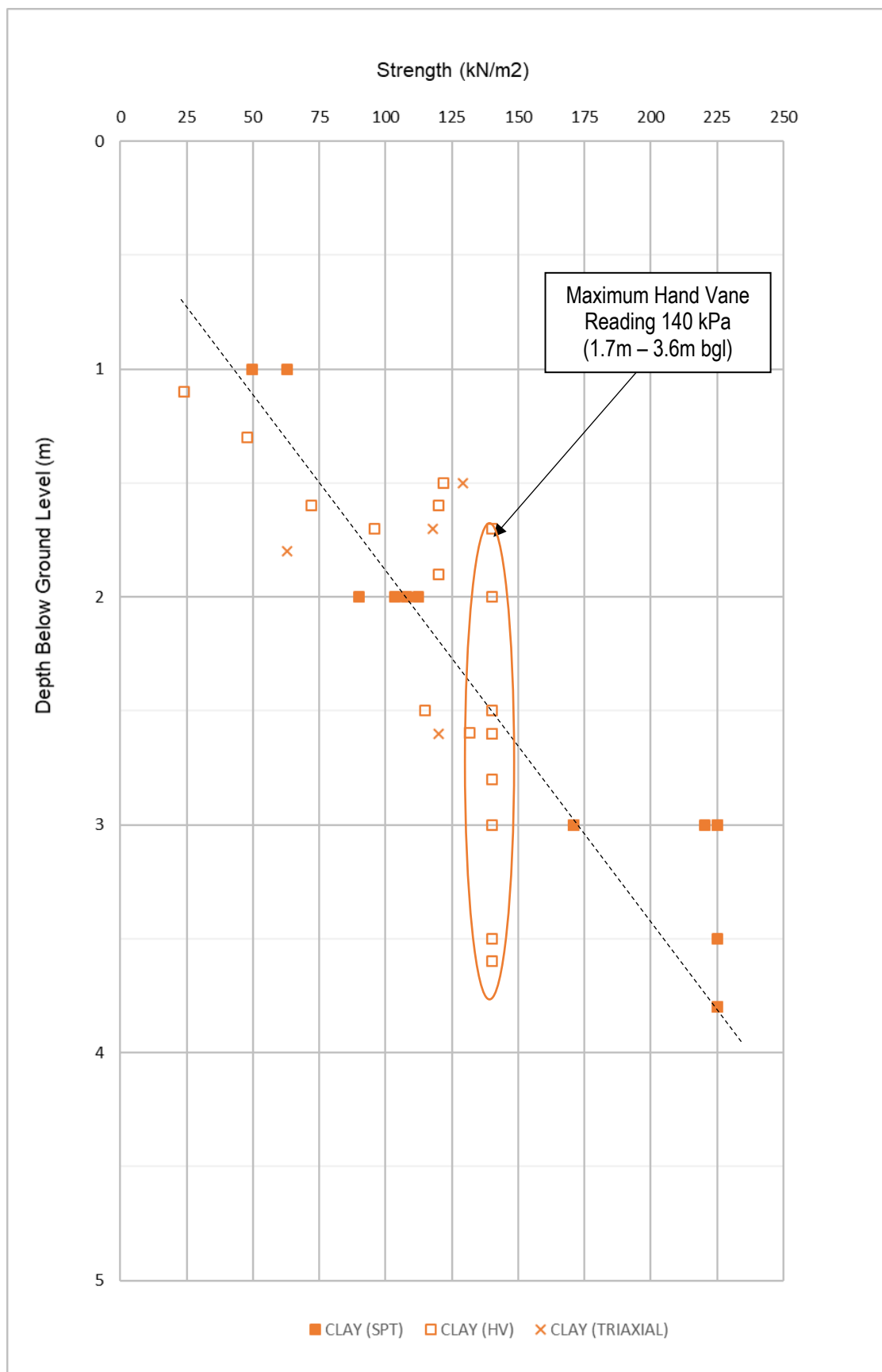


Figure 10 Strength vs Depth Plot

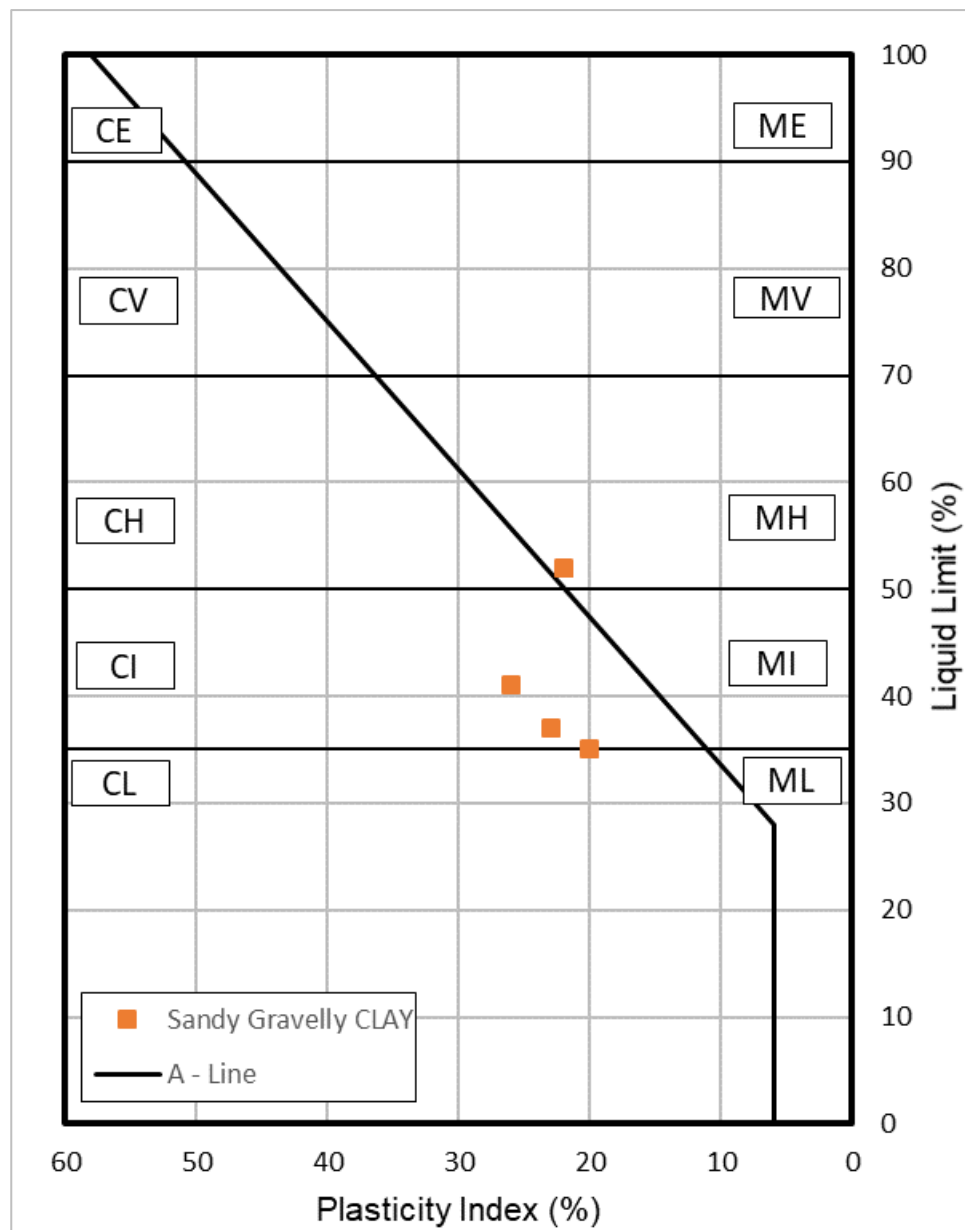


Atterberg Limit tests were carried out on four samples of the Clay. Results of the tests reported **liquid limit** values of between 35% and 52%, and **plastic limit** values of between 15% and 30%, resulting in **plasticity index** values of 20% to 26%. These results suggest the Clay is of **intermediate to high plasticity**.

It should be noted that the sample displaying **high plasticity** properties was retrieved from WS2 at 1.2m bgl, and was described by the lab as a clayey sandy silt.

Results are shown on the Plasticity Chart below. Full test results are included in Appendix 3.

Figure 11 Plasticity Chart



For design purposes, a value of plasticity index = 23% is recommended, based on the average of the results.

In accordance with NHBC Chapter 4.2 Building Near Trees⁽²⁰⁰³⁾ soils can be classified in terms of volume change potential, using the relationship:

$$I_p' = I_p \times \frac{\% \text{ less than } 425\mu\text{m}}{100\%}$$

I_p' = modified plasticity index

I_p = plasticity index.

Based on the laboratory test results, the above relationship and Table 1 of NHBC Chapter 4.2, the samples of Clay have a **low to medium volume change potential**.

The **Natural Moisture Content** (NMC) and **Liquid Limit** (LL) of the soil can be used to give an indication of **soil desiccation**, i.e. where the NMC is less than 40% of the LL, the soil is inferred to be desiccated, as summarised in Table 3 below.

Table 3: Soil Desiccation Indicators in the Clay

Location	Depth (m)	Liquid Limit (%)	40% Liquid Limit (%)	Natural Moisture Content (%)	Desiccation
WS1	2.7	37	14.8	18	No
WS2	1.2	52	20.8	43	No
WS3	1.8	35	14	19	No
WS5	1.7	41	16.4	20	No

The results in the above table show that none of the soils tested present evidence of desiccation.

Results of the SPT, HV and triaxial compression tests in the Clay are summarised in the table below.

Table 4: Summary of Design Parameters (Clay)

Depth	SPT N Value Range	Design N Value*	Equivalent Shear Strength** (kN/m ²)	Average Hand Vane Shear Strength (kN/m ²)	Laboratory Undrained Shear Strength (kN/m ²)	Coefficient of Volume Compressibility**
1.0	11-14	11	50	66	63	0.20
2.0	14-25	20	90	124	118-129	0.11
3.0	38-50	38	171	140	120	0.06
*Based on lower quartile of SPT N value						
**Based on correlation by Stroud & Butler ⁽¹⁹⁷⁵⁾						

Based on Figure 10 and the table above, there appears to be a good correlation between the shear strength values derived from each method of testing, although in the interest of safety, it would be prudent to apply the more conservative values of 50kN/m² (medium strength) at 1.0m and 90kN/m² (high strength) at 2.0m in the design of foundations.

The coefficient of volume compressibility (mv) has been estimated using the following correlation by Stroud and Butler ⁽¹⁹⁷⁵⁾: for a clay with a plasticity index of 23%, $mv = 1 / (450 \times N \text{ value})$.

Sulphate content and pH value determinations were carried out by the geotechnical laboratory on four samples of the Clay. Values of **water-soluble sulphate** ranged from 210mg/l SO₄ to 360mg/l SO₄, with **pH values** ranging from 6.9 to 7.2.

6.0 GEOTECHNICAL ASSESSMENT

6.1 Proposed Development

It is understood that the client intends to construct seven residential houses with associated driveways and gardens.

Detailed information regarding structural loadings and proposed foundation type was not available, however, we anticipate the loadings to be typical of a two-storey house (50kN/m² to 75kN/m²).

6.2 Ground Conditions

The exploratory holes generally encountered Made Ground over stiff natural Clay containing occasional sandy bands.

The Made Ground extended to 2.20m bgl in the north of the site (WS1); in the area of the former public house (presumed cellar backfill material). Elsewhere, the Made Ground was 0.80m to 1.40m deep. Soft silty clay with high plasticity was also encountered between 1.00 and 1.40m bgl in WS2.

Groundwater seepages were encountered during the fieldwork within the Made Ground soils at 0.40m bgl. Groundwater strikes in the natural Clay were not encountered.

6.3 Foundation Considerations

Conventional shallow strip foundations are considered suitable for the site, bearing into the natural stiff Clay and are considered in Section 6.3.1, overleaf.

It should, however, be noted that Made Ground may extend deeper than recorded in the area of the former Public House in the north of the site (2.20m bgl WS1), and an alternative foundation solution may be required in this part of the site.

For clays of medium volume change potential, the NHBC recommended a minimum foundation depth of 0.90m below the lowest of the existing or finished ground level.

The natural clay soils are susceptible to volume change due to the influence of trees although no evidence of desiccation has been encountered. Mature trees (mixed species) are present along the eastern boundary of the site (offsite) and will remain in situ.

The proposed development will be within influencing distance of the trees that border the site. In accordance with NHBC Chapter 4.2 (2016) guidance, the foundations may therefore need to be extended to depths of greater than 2.50m bgl depending on tree species and proximity.

Based on the proposed development layout provided, the new structures will be within 10m to 12m of the boundary trees. Within this proximity, foundations may be required to be 2.0m to 2.5m deep, dependent on species.

On that basis, it is unlikely that foundation depths will need to be extended beyond 2.5m based on tree influence, and therefore specialist foundation design (piles) are not thought to be required. It is recommended that a tree survey is carried out to identify the species present in order to accurately determine suitable foundation depth.

6.3.1 Shallow Strip Foundations

The following table summarises anticipated allowable bearing pressures for strip foundations placed at different depths in the natural Clays at founding level. The bearing capacities are calculated based on Hansen's ⁽¹⁹⁷⁸⁾ method and assuming a factor of safety against bearing capacity failure of 3. For the purpose of the calculation, groundwater has been assumed to be at 3.0m bgl.

Table 5: Summary of Allowable Bearing Pressures for Strip Foundations

Foundation Depth	Strata	Design Value (Section 6)	Strip Foundation Width	Allowable Bearing Pressure
1.0m	CLAY	$c_u = 50\text{kN/m}^2$	0.60m	177kN/m ²
			0.75m	181kN/m ²
			0.90m	185kN/m ²
1.5m		$c_u = 70\text{kN/m}^2$	0.60m	301kN/m ²
			0.75m	305kN/m ²
			0.90m	310kN/m ²
2.0m		$c_u = 90\text{kN/m}^2$	0.60m	474kN/m ²
			0.75m	480kN/m ²
			0.90m	486kN/m ²
2.5m		$c_u = 120\text{kN/m}^2$	0.60m	777kN/m ²
			0.75m	783kN/m ²
			0.90m	787kN/m ²

Assuming materials beneath foundations are homogeneous over the depth of influence of the foundation for a loading of 50kN/m², settlement of the order of around 5-6mm is anticipated for 0.60m wide strip foundations placed in the natural Clay.

Settlements for other bearing pressures may be estimated on a pro-rata basis but bearing pressures should not exceed the allowable net bearing pressure based on ultimate bearing capacity.

Foundations should be designed in accordance with NHBC Chapter 4.2, where constructed within the zone of influence of any trees. In this context soils beneath the site should be considered as having medium volume change potential.

If any Made Ground, particularly loose or soft material is encountered at foundation level this should be excavated and replaced with suitable granular fill or the foundation extended to suitable strata. Floor slabs may be designed as ground bearing where Made Ground is excavated and replaced with suitable granular fill.

All foundation excavations should be inspected by a suitable qualified engineer to prove that the founding strata is suitable and uniform along the length of the foundation, and capable of taking the anticipated structural loadings.

6.4 Ground Floor Slabs

Floor slabs should be designed as suspended with a subfloor void appropriate to medium volume change potential where located within the zone of influence of a tree or if Made Ground of 600mm thickness or greater is present.

6.5 Pavement Design

The ground investigation identified the soil type at subgrade level to typically be Made Ground. Based on the recommendations for design CBR values provided in Interim advice note 73/06, Revision 1 ⁽²⁰⁰⁹⁾, a conservative design CBR value of 1% should be adopted in areas where Made Ground is encountered at subgrade level.

It is recommended that in-situ CBR testing is carried out in areas of proposed road pavement in order to determine a suitable design value.

Once formation level for the new road pavements has been achieved, formation excavations should be examined by a suitably experienced engineer or inspector to check for soft or unsuitable material, which should be removed and replaced with compacted granular fill. Also, to ensure good compaction and remove unevenness, the formation should be compacted with equipment suitable for use in the ground conditions encountered. Careful inspection of this work will also help identify any soft spots at or just below formation level.

Exposed subgrades are likely to deteriorate rapidly on exposure to wet weather and should be shaped to shed water. Subbase should be placed as soon as possible to minimise the exposure of subgrade to adverse weather conditions.

6.6 Chemical Attack on Buried Concrete

Water soluble sulphate content and pH value determinations were carried out by both the geotechnical and chemical laboratories.

Based on the assumption of mobile groundwater, the results have been compared to current guidance provided within BRE Special Digest 1 'Concrete in Aggressive Ground' (2005) and the recommended classification for the strata encountered is summarised in the table below:

Table 6: Summary of Concrete Classification for Encountered Soils

Soil Type	Sulphate Content Range (mg/l)	Characteristic Sulphate Content (mg/l)	pH Content Range	Characteristic pH Value	Design Sulphate Class	Aggressive Chemical Environment for Concrete
Made Ground	32-1350	1250	7.6-8.3	7.6	DS-2	AC-2
Devensian Till (Clay)	210-360	360	6.9-7.2	6.9	DS-1	AC-1

The above table is based on characteristic values derived from the water-soluble sulphate content (2:1 water/soil extract).

The above classifications should be applied to concrete foundations and ground bearing floor slabs.

6.7 Suitability of Excavated Materials

Acceptability criteria and testing, and methods of compaction/placement will depend on the type of contract and specification used for the construction of the proposed development and it is recommended that earthworks specifications are reviewed by a suitably qualified engineer, once these have been prepared by the relevant parties.

Demolition rubble may be re-used as structural fill, providing it is not contaminated and subject to processing (breaking down etc.). Granular Made Ground could be suitable as structural fill providing it is not contaminated and doesn't have excessive amounts of clay.

6.8 Temporary Works

Formations in the Made Ground and natural Clay will be susceptible to damage both by weather and trafficking, and should be protected immediately on exposure, particularly in areas where construction plant will access the site.

Excavations in Made Ground are likely to be unstable and should be battered back to an angle of 1 in 2, or a system of close sheeting and shoring adopted to ensure stability, and in particular where personnel are required to enter excavations. All excavations should be adequately supported where personnel are required to enter.

Groundwater seepages could be encountered near surface within excavations, particularly during the wetter months of the year. Pumping of excavations from a suitable located sump is likely to be required to keep excavations dry.

All natural materials on site should be capable of being excavated using conventional excavating machinery.

7.0 SOIL CONTAMINATION RISK ASSESSMENT

7.1 Tier I Human Health Soil Risk Assessment – Groundworkers During Development

To assess the risk of soil contamination to construction and ground workers during development, guidelines from the HSE Document 'Protection of workers and the general public during development of contaminated land' ⁽¹⁹⁹¹⁾ are used. The document assesses soil contamination test results and classifies the site as being uncontaminated or contaminated with varying degrees of contamination from 'slight' to 'unusually heavy'.

The guideline values and laboratory test results are summarised in the following table:

Table 7: Summary of Guideline Values for Protection of Workers and the General Public During Development of Contaminated Land

Contaminant	Typical Values* for:					Test Results	Class
	Uncontaminated Soils	Slight Contamination	Contaminated	Heavy Contamination	Unusually Heavy Contamination		
	Class A	Class B	Class C	Class D	Class E		
pH (alkaline)	7 - 8	8 - 9	9 - 10	10 - 12	12	7.6-8.3	A-B
Arsenic	0 - 30	30 - 50	50 - 100	100 - 500	500	8-18	A
Cadmium	0 - 1	1 - 3	3 - 10	10 - 50	50	< 0.2-1.6	A-B
Chromium	0 - 100	100 - 200	200 - 500	500 - 2500	2500	11-19	A
Copper	0 - 100	100 - 200	200 - 500	500 - 2500	2500	24-195	A-B
Lead	0 - 500	500 - 1000	1000 - 2000	2000 - 1%	1.0%	53-323	A
Mercury	0 - 1	1 - 3	3 - 10	10 - 50	50	< 1	A
Nickel	0 - 20	20 - 50	50 - 200	200 - 1000	1000	11-26	A-B
Zinc	0 - 250	250 - 500	500 - 1000	1000 - 5000	5000	49-507	A-C
Boron	0 - 2	2 - 5	5 - 50	50 - 250	250	< 1	A
Beryllium	0 - 5	5 - 10	10 - 20	20 - 50	50	0.6-1	A
Vanadium	0 - 100	100 - 200	200 - 500	500 - 2500	2500	19-33	A
Sulphate	0 - 2000	2000 - 5000	5000 - 1%	1% - 5%	5.05%	372-3.99%	A-D
Sulphide	0 - 10	10 - 20	20 - 100	100 - 500	500	< 5	A
Cyanide (free)	0 - 1	1 - 5	5 - 50	50 - 100	100	< 2	A
Phenol	0 - 2	2 - 5	5 - 50	50 - 250	250	< 2	A

Based on the above results the soils are generally classified as a combination of non-contaminated and slightly contaminated.

However, due to a high concentration of Zinc in the made ground in WS2, the material is classified as contaminated. Similarly, due to elevated sulphate concentrations in the made ground in WS1, the material is classified as heavily contaminated.

The overall potential risk from soil contamination to construction workers, ground workers and members of the public during construction is therefore considered **MODERATE**.

7.2 Tier I Human Health Soil Risk Assessment – Future Site Users

The following sections provide a Human Health Soil Assessment for groundworkers during development and future residential end users together with an assessment of the risk to flora (plants) in soft landscapes areas.

At a Tier I stage the long term (chronic) human health toxicity of the soil has been assessed with reference to DEFRA/Environment Agency Contaminated Land Exposure Assessment (CLEA) Soil Guideline Values (SGV) for generic site land uses, soils and exposure. Where Environment Agency generic guidance is absent, reference has been made to the Chartered Institute of Environmental Health (CIEH) S4ULs for human health risk assessment.

In the case of arsenic, cadmium, hexavalent chromium, lead and benzo(a)pyrene DEFRA Category 4 Screening Levels (C4SL) have been adopted.

A conservative Soil Organic Matter (SOM) of 1% has been adopted for organic chemicals for the purposes of the initial assessment. A SOM of 6% has been adopted for inorganic chemicals as detailed in 'The LQM / CIEH S4ULS for human health assessment', (2015).

The soil chemical testing results are presented in Appendix 2 and summarised in Table 8, below.

Table 8: Assessment of Soil Chemical Data

Parameter	WS1 0.30m MG	WS1 1.00m MG	WS2 0.60m MG	WS3 0.60m MG	WS4 0.40m MG	WS4 0.90m MG	WS5 0.50m MG	Assessment Criteria (mg/kg)
Arsenic	14	12	11	8	18	13	15	37
Boron	< 1	< 1	< 1	< 1	< 1	< 1	< 1	290
Beryllium	0.6	1	0.9	0.7	1	0.9	0.6	1.7
Cadmium	1.4	0.2	0.3	< 0.2	1.6	0.7	0.5	11
Chromium	11	19	14	17	19	17	15	910
Free Cyanide	< 2	< 2	< 2	< 2	< 2	< 2	< 2	41
Hexavalent Chromium	< 2	< 2	< 2	< 2	< 2	< 2	< 2	21
Copper	195	30	91	24	51	39	34	2400
Lead	323	127	97	53	209	268	218	200
Mercury	< 1	< 1	< 1	< 1	< 1	< 1	< 1	40
Nickel	11	20	17	13	26	19	22	180
Selenium	< 3	< 3	< 3	< 3	< 3	< 3	< 3	250
Vanadium	21	25	22	22	33	27	19	410
Zinc	175	55	507	49	471	272	138	3700
pH	7.6	8.3	7.9	7.8	7.8	7.6	7.8	N/A
Naphthalene	< 0.1	5.02	0.13	< 0.1	0.2	< 0.1	< 0.1	2.3
Acenaphthylene	< 0.1	0.21	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	170
Acenaphthene	< 0.1	< 0.1	0.15	< 0.1	< 0.1	< 0.1	< 0.1	210
Fluorene	< 0.1	0.16	0.16	< 0.1	< 0.1	< 0.1	< 0.1	170
Phenanthrene	0.49	1.54	0.81	0.56	0.31	0.14	0.19	95
Anthracene	0.17	1.52	0.3	0.15	< 0.1	< 0.1	< 0.1	2400
Fluoranthene	1.28	0.89	1.35	0.74	0.53	0.31	0.42	280

Parameter	WS1 0.30m MG	WS1 1.00m MG	WS2 0.60m MG	WS3 0.60m MG	WS4 0.40m MG	WS4 0.90m MG	WS5 0.50m MG	Assessment Criteria (mg/kg)
Pyrene	1.36	0.87	1.37	0.71	0.55	0.31	0.41	620
Benzo(a)anthracene	0.66	0.9	0.64	0.51	0.4	0.32	0.35	7.2
Chrysene	0.72	2.08	0.46	0.26	0.2	< 0.1	< 0.1	15
Benzo(b)fluoranthene	0.73	1.58	0.72	0.51	0.46	0.31	0.33	2.6
Benzo(k)fluoranthene	0.13	1.37	0.15	< 0.1	< 0.1	< 0.1	< 0.1	77
Benzo(a)pyrene	0.4	4.79	0.45	0.32	0.24	0.14	0.16	5.0
Indeno(1,2,3-cd)pyrene	0.5	1.76	0.51	0.45	0.42	0.38	0.37	27
Di-benz(a,h)anthracene	0.34	0.55	0.33	0.32	0.31	< 0.1	< 0.1	0.24
Benzo(ghi)perylene	< 0.1	2.6	0.32	0.29	0.28	0.22	0.2	320
Phenol	< 2	< 2	< 2	< 2	< 2	< 2	< 2	280
Benzene	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	87
Toluene	< 0.005	0.010	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	130
Ethylbenzene	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	47
Xylene	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	60
Aliphatic >C5 - C6	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	78
Aliphatic >C6 - C8	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	230
Aliphatic >C8 - C10	< 2	< 2	< 2	< 2	< 2	< 2	< 2	65
Aliphatic >C10 - C12	< 2	< 2	< 2	< 2	< 2	< 2	< 2	330
Aliphatic >C12 - C16	< 3	< 3	< 3	< 3	< 3	< 3	< 3	2400
Aliphatic >C16 - C21	22	< 3	< 3	< 3	9	< 3	11	92000
Aliphatic >C21 - C34	1172	54	39	77	294	48	162	92000
Aromatic >C5 - C7	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	140
Aromatic >C7 - C8	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	290
Aromatic >C8 - C10	< 2	< 2	< 2	< 2	< 2	< 2	< 2	83
Aromatic >C10 - C12	< 2	< 2	< 2	< 2	< 2	< 2	< 2	180
Aromatic >C12 - C16	3	< 2	5	3	2	< 2	< 2	330
Aromatic >C16 - C21	42	5	33	12	21	12	6	540
Aromatic >C21 - C35	1478	97	149	209	241	132	189	1500
Asbestos	D	ND	ND	ND	D	ND	ND	-

Notes for Table 8Concentrations in **red** above assessment criteriaND = Not Detected, **D** = Detected

Based on the results of the chemical testing, each of the samples tested contained concentrations of contaminants in exceedance of screening criteria relevant to residential end use with plant uptake.

Lead was in exceedance in WS1, WS4 and WS5, Naphthalene was in exceedance in WS1 and Di-benz(a,h)anthracene was in exceedance in WS1, WS2, WS3 and WS4.

The samples from WS1, WS3 and WS5 are beneath plots and therefore do not pose a risk. Samples from WS2 and WS4 are within garden areas and remedial measures are required within these areas.

Asbestos was detected in WS1 at 0.30m as microscopic loose fibres of Chrysotile and in WS4 at 0.40m as a Chrysotile fibre bundle. The asbestos has been quantified by the chemical laboratory as 0.055 % in WS1 and <0.001% in WS4.

7.3 Soil Waste Assessment

An assessment of the disposal characteristics of the soil in accordance with Environment Agency guidance WM3.1, edition of May 2018, "Guidance on the classification and assessment of waste" has been carried out on soils recovered from the site, using HazWasteOnline.

The results are summarised in the table below and presented in full in Appendix 4.

Table 9: Waste Classification of Soils

Location	Depth (m bgl)	HazWaste Classification
WS1	0.30	Hazardous
WS1	1.00	Non-Hazardous
WS2	0.60	Non-Hazardous
WS3	0.60	Non-Hazardous
WS4	0.40	Non-Hazardous
WS4	0.90	Non-Hazardous
WS5	0.50	Non-Hazardous

As shown above, with the exception of the Made Ground at 0.30m in WS1, the soils have been classified as Non-Hazardous in accordance with Environment Agency guidance WM3.

Waste Acceptance Criteria testing would be required to determine whether the Non-Hazardous samples could be classified as Inert, however, this was outside the scope of this investigation.

8.0 REVIEW OF CONCEPTUAL MODEL

A Revised Conceptual Model has been prepared for the site and is presented as Table 12, overleaf. The Revised Conceptual Model reviews the Preliminary Conceptual Model (PCM) presented as Table 3 in Section 6.0 of EEG Phase 1 GeoEnvironmental Investigation report (Reference: A2212/17, dated September 2017) using the information obtained during this site investigation and considers the source-pathway-receptor linkages present alongside the likelihood, severity and risk level as defined within Table 10 and Table 11 below. The assessment of probability, a modified risk table, and certain consequence definitions are based on CIRIA C552 and CLR11.

Table 12 considers whether a pollution linkage is present and provides a preliminary qualitative assessment of risk based on the information currently available. Where a possible linkage is identified, it does not necessarily mean that a significant risk exists but indicates that further information is required through appropriate site investigation to substantiate the conceptual model.

The Revised Conceptual Model is based on a proposed residential end use.

Table 10: Consequence, Probability and Risk

Probability	Consequence	Risk
High Likelihood- There is a pollution linkage and an event either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution	Very High – acute risk to the human health likely to result in significant harm. Risk of severe or irreversible effect on ground/surface water quality. Catastrophic damage to buildings / property.	Very High – there is a high potential that the source-pathway-receptor scenarios may give rise to harm to human health or the environment and remedial action is likely to be required.
Likely – there is a pollution linkage and all the elements are present, which means that it is probable an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.	High – Severe or irreversible effect on human health. Temporary severe or irreversible effect on ground/surface water quality. Reduction of water quality rendering groundwater or surface water unfit to drink and/or substantial adverse impact on groundwater dependant environmental receptors.	High – it is likely that the source-pathway-receptor scenarios may give rise to an impact on human health or the environment, which may require remediation and/or control measures to mitigate risks
Low likelihood– there is a pollutant linkage and circumstances are possible for an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term	Moderate – Long term or short term moderate effect on human health. Moderate effect on ground/surface water quality, reversible with time. Reduced reliability of a supply at a groundwater or surface water abstraction source	Moderate – it is possible that the source-pathway-receptor scenarios may give rise to an impact on human health or the environment, however it is either relatively unlikely that such are would be severe, or if any harm were to occur it is more likely that harm would be mild.
Unlikely – there is a pollution linkage but circumstances are such that it is doubtful that an event would occur even in the very long term.	Low – Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc.) Slight effect on ground/surface water quality, reversible with time. Marginal reduced reliability of a supply at a groundwater or surface water abstraction source.	Low – it is possible that harm could arise at the source, however it is likely that the risk would at worst be mild.
		Very Low – it is unlikely that the source-pathway-receptor scenarios will give rise to an impact on human health or the environment.

Table 11: Estimation of Level of Risk

		Consequence			
		High	Moderate	Low	Very low
Probability	High Likelihood	Very High	High risk	Moderate risk	Moderate to low risk
	Likely	High risk	Moderate risk	Moderate to low risk	Low risk
	Low Likelihood	Moderate risk	Moderate to low risk	Low risk	Very low risk
	Unlikely	Moderate to low risk	Low risk	Very low risk	Very low risk

8.1 Sources of Contamination

The Phase I Desk Study report for the site outlined the potential for the presence of soil contamination associated with:

- Works and Public House on-site
- Made Ground and asbestos containing materials (ACM) associated with the former structures

The site investigation identified the following:

- Made Ground to a maximum depth of 2.20m bgl.
- Each of the Made Ground soil samples contained concentrations of contaminants exceedance of screening criteria relevant to residential end use with plant uptake.
- Asbestos (Chrysotile) was detected in the Made Ground at two locations.

8.2 Receptors

The following receptors have been considered for the construction and operational stages of the proposed redevelopment.

- Current site users
- Adjacent land users
- Future land users
- Construction workers during site development works
- Underlying Groundwater

8.3 Pollutant Pathways

The following pathways have been considered for the construction and operational stages of the proposed redevelopment.

- Direct contact via dermal contact, ingestion, inhalation of potentially contaminated soils.
- Downward vertical migration of contaminants to shallow groundwater and lateral migration to on-site drainage ditch.
- Vertical and lateral migration of ground gas associated with Made Ground soils.

Table 12: Revised Conceptual Model

Source	Pathway	Receptor	Probability	Consequence	Risk	Comment
Made Ground (Exceedances of Lead, Naphthalene and Di-benz(a,h)anthracene)	Dermal contact, ingestion and inhalation of soils dust	Current Site Users	Unlikely	Moderate	Low	The site is currently a storage yard covered by hardstanding, with infrequent use. The risk to current site users from direct contact with potential contamination is considered to be LOW .
		Adjacent land users	Low Likelihood	Moderate	Moderate to Low	The site is located within a residential area. Soil dust may be generated during the construction phase. The risk is therefore considered MODERATE to LOW . Implementation of usual dust control measures as part of good site working practices would reduce this risk to LOW .
		Future land users	Likely	Moderate	Moderate	Contaminant exceedances have been encountered in Made Ground soils across the site. The proposed development will include residential properties with private gardens. The risk to future site users via direct exposure is therefore considered to be MODERATE . Appropriate remediation in the form of clean capping in proposed garden areas will reduce this risk to LOW .
		Construction Workers	Likely	Moderate	Moderate	Construction workers are likely to be exposed to contaminated soils during construction works. The risk is therefore MODERATE , however, assuming appropriate health and safety measures are adopted (in line with CDM and other relevant health and safety guidance) a LOW risk to construction workers is anticipated.
	Downward vertical/lateral leaching and migration of contaminants	Underlying shallow groundwater	Low Likelihood	Moderate	Moderate to Low	The site is underlain by a Principal Aquifer; however, shallow groundwater was not encountered beneath (except perched water in the Made Ground). The underlying superficial soils are predominantly cohesive with generally low permeability, which will inhibit migration to the underlying Aquifer. Furthermore, there are no nearby abstraction licenses nearby, therefore the risk to controlled waters is considered LOW .
	Vertical or lateral migration of ground gas	Current Site Users	Unlikely	Moderate	Low risk	The site is currently a storage yard covered by hardstanding, with no frequent or permanent occupiers. The risk to current site users from ground gas is therefore considered LOW .
		Adjacent land users	Unlikely	Moderate	Low risk	The cohesive low permeability nature of the underlying superficial deposits will act as a barrier to ground gas migration. The risk to adjacent site users from potential ground gas is considered LOW .

Source	Pathway	Receptor	Probability	Consequence	Risk	Comment
		Future land users	Low Likelihood	Moderate	Moderate to Low	Given the presence of Made Ground at the site, there may be potential for ground gas generation. The risk to future site users is therefore considered MODERATE to LOW . The excavation and removal of the potential source or installation of gas membranes would reduce this risk to LOW .
		Construction Workers	Low Likelihood	Moderate	Moderate to Low	Construction workers may be exposed to elevated CH4 and CO2 conditions or depleted oxygen conditions in confined spaces/excavations. However, the duration will be short term. The risk is considered MODERATE to LOW .
Asbestos (Chrysotile <0.001-0.055%)	Inhalation of fibres	Current Site Users	Unlikely	High	Low	Asbestos is only harmful when disturbed. The site is currently a storage yard covered by hardstanding, with infrequent use. The risk of direct contact with receptors is therefore considered LOW .
		Adjacent land users	Low Likelihood	High	Moderate	Asbestos (up to 0.055%) has been detected in the Made Ground at the site. Ground disturbance during the construction phase may allow fibres to become airborne. The risk to adjacent users is therefore considered MODERATE . Implementation as Asbestos Management Plan would reduce this risk to LOW .
		Future land users	Likely	High	High	Asbestos (up to 0.055%) has been detected in the Made Ground at the site. The proposed development will include residential properties with private gardens. The risk to future site users via direct exposure is therefore considered to be HIGH . Implementation as Asbestos Management Plan together with appropriate remediation in the form of removal, burial, or clean capping in proposed garden areas would reduce this risk to LOW .
		Construction Workers	Likely	High	High	Asbestos (up to 0.055%) has been detected in the Made Ground at the site. Construction workers are likely to be exposed to airborne fibres during construction/excavation works due to ground disturbance. The risk to construction workers is HIGH . Implementation as Asbestos Management Plan would reduce this risk to LOW . Communication of risk, suitable training and PPE/RPE will be required.

9.0 CONCLUSIONS AND RECOMMENDATIONS

The following section provides a summary of the conclusions and recommendations based on the findings of the site investigation.

9.1 Soil Contamination

Ground conditions across the site generally comprised Made Ground (to a maximum depth of 2.20m bgl) over stiff natural clays.

Based on the results of the chemical testing, seven soil samples of Made Ground from five locations contained contaminant concentrations (including Lead, Naphthalene and Di-benz(a,h)anthracene) in exceedance of screening criteria relevant to residential end use with plant uptake.

There is therefore considered to be a **MODERATE** risk from soil contamination to residential end users. Remediation will therefore be required in order to mitigate this risk.

It is recommended that all garden and landscaped areas are capped with a minimum 600mm of validated clean cover soils, incorporating an appropriate physical barrier at the base of the capping layer, to act as a no dig layer for future residents and to prevent potential bioturbation.

Based on the soil contamination test results there is also considered to be a **MODERATE** potential risk to construction workers, ground workers and members of the public. Appropriate measures, such as PPE, site health plans, appropriate disposal of material arisings will mitigate this risk.

The groundworks contractor must provide a soil management plan including methods of dealing with any unanticipated soil contamination encountered during groundworks

9.2 Asbestos

Asbestos was detected in WS1 at 0.30m as microscopic loose fibres of Chrysotile (0.055% by mass) and in WS4 at 0.40m as a Chrysotile fibre bundle (<0.001% by mass).

An Asbestos Management Plan will therefore need to be prepared for the site. Precautions will include (but are not limited to):

- Ensuring that the risk is communicated to all site personnel at induction stage
- Ensuring all site personnel have suitable training and PPE/RPE
- Ensuring that the soils do not become dry and dusty

All garden and landscaped areas in proximity of where asbestos has been encountered should be capped with a minimum 600mm of validated clean cover soils, incorporating an appropriate physical barrier at the base of the capping layer.

Additional sampling in the vicinity of WS1 and WS4 may be carried out to determine the extent of the asbestos impacted soils requiring remediation.

9.3 Soil Waste Assessment

With the exception of the Made Ground at 0.30m in WS1, the soils have been classified as Non-Hazardous in accordance with Environment Agency guidance WM3. Shallow made ground soils in the vicinity of WS1 have been classified as Hazardous.

9.4 Foundation Recommendations

Ground conditions generally comprised Made Ground (to a maximum depth of 2.20m bgl) over stiff natural Clay.

Conventional shallow strip foundations are considered suitable for the site, bearing into the natural firm/stiff Clay at a minimum recommended depth of 1.0m bgl providing suitable bearing strata is encountered. Foundations will need to be extended deeper in the northern part of the site in the area of the former Public House due to the presence of deeper Made Ground (presumed cellar backfill).

Where foundations are within influencing distance of existing trees (whether removed or retained), these may need to be extended to up to 2.5m in accordance with NHBC Chapter 4.2.

It is recommended that a full tree survey be carried out in order to accurately determine suitable foundation depths for the proposed new buildings.

9.5 Site Personnel

As with all construction sites, personnel working on the site during the construction period should be encouraged to maintain a high standard of personal hygiene and on site washing facilities should be available.

APPENDIX 1

EXPLORATORY HOLE LOGS

APPENDIX 2

CHEMICAL TESTING RESULTS

APPENDIX 3

GEOTECHNICAL TESTING RESULTS

APPENDIX 4

SOIL WASTE ASSESSMENT

APPENDIX 5

REPORT LIMITATIONS

REPORT LIMITATIONS

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Environmental & Geotechnical Ltd 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 whilst Earth Environmental & Geotechnical Ltd have no reason to doubt the accuracy and that it has been provided in full of those it was requested from, the items relied on have not been verified.

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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 can also be variable and as investigation excavations 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. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and Earth Environmental & Geotechnical Ltd] based on an understanding of the available operational and historical information, and it should not be inferred that other chemical species are not present.

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APPENDIX 3

ASSESSMENT CRITERIA FOR CLEAN COVER SYSTEM

Assessment Criteria Based on Residential with Homegrown Produce End Use

Inorganic Compounds	Assessment Criterial - Residential with Homegrown Produce (mg/kg)		
Arsenic	37		
Cadmium	11		
Chromium (III)	910		
Chromium (VI)	6		
Lead	200		
Mercury	1.2		
Nickel	180		
Selenium	250		
Copper	2400		
Zinc	3700		
Organic Compounds	1% SOM	2.5% SOM	6% SOM
Naphthalene	2.3	5.6	13
Acenaphthene	210	510	1100
Acenaphthylene	170	420	920
Fluorene	170	400	860
Phenanthrene	95	220	440
Anthracene	2400	5400	11000
Fluoranthene	280	560	890
Pyrene	620	1200	2000
Benzo(a)anthracene	7.2	11	13
Chrysene	15	22	27
Benzo(b)fluoranthene	2.6	3.3	3.7
Benzo(k)fluoranthene	77	93	100
Benzo(a)pyrene	2.2	2.7	3.0
Dibenz (a, h) anthracene	0.24	0.28	0.3
Indeno(1,2,3-cd) pyrene	27	36	41
Benzo (g, h, i) perylene	320	340	350
Benzene	0.087	0.17	0.37
Toluene	130	290	660
Ethylbenzene	47	110	260
o-Xylene	60	140	330
m-Xylene	59	140	320
p-Xylene	56	130	310
TPH Fractions	1% SOM	2.5% SOM	6% SOM
Aliphatic EC 5-6	42	78	160
Aliphatic EC >6-8	100	230	530
Aliphatic EC >8-10	27	65	150
Aliphatic EC >10-12	130 (48) ^{vap}	330 (118) ^{vap}	760 (283) ^{vap}
Aliphatic EC >12-16	1100 (24) ^{sol}	2400 (59) ^{sol}	4,300 (142) ^{sol}
Aliphatic EC >16-35	65,000 (8.48) ^{f, sol}	92,000 (21) ^{f, sol}	110,000 ^f
Aliphatic EC >35-44	65,000 (8.48) ^{f, sol}	92,000 (21) ^{f, sol}	110,000 ^f
Aromatic EC 5-7	70	140	300
Aromatic EC >7-8	130	290	660

	Assessment Criterial - Residential with Homegrown Produce (mg/kg)		
TPH Fractions	1% SOM	2.5% SOM	6% SOM
Aromatic EC>8-10	34	83	190
Aromatic EC >10-12	74	180	380
Aromatic EC >12-16	140	330	660
Aromatic EC >16-21	260 ^f	540 ^f	930 ^f
Aromatic EC >21-35	1,100 ^f	1,500 ^f	1,700 ^f
Aromatic EC >35-44	1,100 ^f	1,500 ^f	1,700 ^f
Asbestos Fibres	< 0.001%		

The site-specific risk-based criteria are based upon DEFRA/EA CLEA 1.07 modelling assuming a sandy loam with 1% Soil Organic Matter and pH of 7.

Purpose	Classification	Testing Frequency	Chemical Analysis
Source Testing & Suitability For Use	Topsoil	1 sample per 50m ³ [Minimum of 3 per source]	➤ Inorganic Compounds; ➤ Speciated Polycyclic Aromatic Hydrocarbons; ➤ Speciated Petroleum hydrocarbons; ➤ Asbestos Identification.
	Sub-Soil	1 sample per 250m ³ [Minimum of 3 per source]	
Validation Testing	Topsoil	1 sample per 3 plots	
	Sub-Soil	1 sample per 3 plots	

The sampling frequency for materials intended for gardens is to be managed under the Remediation Strategy.

APPENDIX 4

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