



GROUNDTECH
CONSULTING

123 BARLOW MOOR ROAD, DIDSBURY

GEO-ENVIRONMENTAL APPRAISAL

TAHIR AHMED

MARCH 2024

Document Control Form	
PROJECT	123 BARLOW MOOR ROAD, DIDSBURY
REPORT NAME	GEO-ENVIRONMENTAL APPRAISAL
REPORT REFERENCE	GRO-23382-5055
STATUS	FINAL
ISSUE DATE	06 MARCH 2024
REVISION	
CLIENT	TAHIR AHMED
CLIENT CONTACT	-
For and Behalf of Groundtech Consulting	
SIGNATURE	
AUTHOR	Rebecca Rowlinson BSc (Hons) FGS
SIGNATURE	
CHECKED	Luke Harrison BSc (Hons) FGS
SIGNATURE	
REVIEWED	James Doyle BSc (Hons) CGeol FGS

SUMMARY

Site Details		
Site Location	The site is located circa 4.8 miles south of Manchester City Centre and is approximately centred on National Grid Reference 383692, 391745.	
Site Area	The site is currently occupied by an existing single storey dwelling of brick construction located in the centre of the site. A driveway is present in the north of the site and a private garden area in the south. A detached garage is also present in the south west of the site.	
	The site is surfaced by tarmac and concrete in the northern and western sections. The south of the site is surfaced by grass. The east of the site is surfaced with paving flags. Shrubbery along with semi mature and mature trees are present in the south east and north east of the site.	
Preliminary Risk Assessment		
History	Historical maps indicate the site remained undeveloped until 1894 when buildings encroach onto the south of the site associated with the adjacent Stormarn building. Maps from 1907 show residential buildings in the extreme east of west of the site and a small development in the north of the site. Maps from 1955 show the site to be in its current configuration. Greenhouses were historically located surrounding the site.	
Geology/Hydrogeology	The superficial deposits are indicated to be Glaciofluvial Sheet deposits characteristically comprising Sand and Gravel. The superficial deposits are classified as a Secondary A Aquifer.	
	The Bedrock geology is indicated to be the Wilmslow Sandstone Formation comprising Sandstone. The bedrock geology is classified as a Principal Aquifer.	
Environmental Setting	Waste exemptions are located 45m and 356m Northeast that relate sorting and de-naturing of controlled drugs for disposal.	
	No active or historical landfill is present surrounding the site.	
	There are five current industrial land uses all within 217m of the site, three locations are electrical sub stations located 217m north east, 157m west and 121m north west. Two other industrial land uses are located 202m north west and 141m south of the site.	
Pollution Linkage (PL) Assessment	Human Health	The risk to Human Health is considered to be Moderate.
	Controlled Waters	The risk to controlled waters is considered to be Low.
	Permanent Ground Gas	The risk from Ground Gas is considered to be Low.
Ground Model		
Made Ground Soils	Made Ground was encountered in the north and west of the site to a maximum depth of 1.35m bgl and generally comprised sandy gravel with minor constituents of brick, concrete and ceramic.	
Natural Soils	Natural granular soils were encountered from minimum depths of between 0.2m and 1.35m bgl and consisted of clayey gravelly Sand with gravel of Sandstone.	

Bedrock	<i>Bedrock was not encountered during the Ground Investigation.</i>
Groundwater	<i>No groundwater was encountered during the Ground Investigation.</i>
Ground Engineering Assessment	
Foundations	<i>The most suitable foundations for the proposed development are considered to be traditional shallow strip trench foundations constructed within the medium dense Sand deposits. Foundations should be deepened through all Made Ground and loose to medium dense Sand deposits.</i>
Highways	<i>CBR values of greater than 5% are likely to be achieved in undisturbed natural granular soils for pavement design purposes, unless proven otherwise by in-situ testing at sub-base level by a specialist geotechnical engineer. Untreated Made Ground should be assumed to have a CBR value of <2.5%, unless proven otherwise.</i>
SuDS	<i>The use of SuDS drainage may be feasible for the proposed development if sufficient attenuation and storage is available.</i>
Constraints	<i>The main constraint of the site is the existing building on the site restricting the areas of investigation. A watching brief should be maintained during the demolition of the existing buildings to ensure that ground conditions remain consistent across the site.</i>
GQRA and Revised (PL) Assessment	
Human Health	<i>Due to the elevated levels of CoC identified through laboratory testing, the risk to Human Health is considered to be Moderate. A cover system is required in garden areas where Made Ground is present at formation level.</i>
Controlled Waters	<i>The risk to controlled waters is considered to be Low due to no mobile contamination being identified during the Ground Investigation.</i>
Permanent Ground Gas	<i>No source of ground gas has been identified during the PRA or Ground Investigation. The risk from ground gas is considered to be Low.</i> <i>No radon protective measures are required for the proposed development.</i>
Final Appraisal	

The following further work is required to progress the site into the construction phase:

- *Watching brief during demolition of existing buildings*
- *Demolition asbestos survey*
- *Detailed Foundation design*
- *Topsoil strip and delineation*
- *Confirmation of recommendations made in this appraisal with regulators*

TABLE OF CONTENTS

1.0	INTRODUCTION	1
1.1	PROJECT OBJECTIVES	1
1.2	PROPOSED DEVELOPMENT	1
1.3	LIMITATIONS	1
2.0	SITE SETTING.....	3
2.1	LOCATION.....	3
2.2	SITE DESCRIPTION	3
3.0	ENVIRONMENTAL SETTING	5
3.1	SITE HISTORY	5
3.2	GEOLOGY	5
3.3	HYDROGEOLOGY	7
3.4	HYDROLOGY.....	7
3.5	ENVIRONMENTAL CONSULTATIONS	7
3.6	RADON	8
4.0	LAND QUALITY CONCEPTUAL SITE MODEL AND RISK ASSESSMENT	9
4.1	INTRODUCTION.....	9
4.2	POTENTIAL CONTAMINATION SOURCES.....	9
4.3	POLLUTION LINKAGES	10
4.4	RECEPTORS	10
4.5	PRELIMINARY CONCEPTUAL SITE MODEL (CSM)	10
5.0	SCOPE OF INVESTIGATION AND RATIONALE	16
5.1	PROJECT OBJECTIVES	16
5.2	SCOPE OF WORKS	16
5.3	SOIL SAMPLING	16
5.4	GEO-ENVIRONMENTAL TESTING.....	17
6.0	GROUND MODEL.....	18
6.1	MADE GROUND.....	18
6.2	NATURAL GROUND.....	18
6.3	BEDROCK.....	19
6.4	GROUNDWATER.....	19
6.5	WATCHING BRIEF.....	19
6.6	EXCAVATION STABILITY.....	19
6.7	EXCAVATION PROGRESS.....	19
7.0	GROUND ENGINEERING.....	20
7.1	ASSESSMENT BACKGROUND	20
7.2	GEOTECHNICAL PARAMETERS	20
7.3	PRELIMINARY FOUNDATION DESIGN.....	21
7.4	BUILDING NEAR TREES	21
7.5	FLOOR SLABS	21
7.6	CONSTRUCTION	22
7.7	CONCRETE CLASSIFICATION	22
7.8	HIGHWAY DESIGN	22
7.9	SUSTAINABLE URBAN DRAINAGE SYSTEM (SUDS)	23
8.0	LAND QUALITY.....	24

8.1	GEO-ENVIRONMENTAL TESTING RESULTS - SOILS	24
8.2	GENERIC QUANTITATIVE RISK ASSESSMENT - SOILS	25
8.3	REVISED POLLUTION LINKAGE ASSESSMENT	26
8.4	OUTLINE REMEDIAL STRATEGY	32
8.5	ASBESTOS IN SOILS	32
8.6	HEALTH AND SAFETY - CONSTRUCTION AND GROUND WORKERS	32
8.7	WASTE CLASSIFICATION BY ASSESSMENT	33
8.8	WASTE ACCEPTANCE CRITERIA (WAC) RESULTS.....	34
9.0	FINAL APPRAISAL.....	36
9.1	LAND QUALITY	36
9.2	GROUND ENGINEERING	36
9.3	REQUIRED FURTHER WORK	36
10.0	RELEVANT INDUSTRY REFERENCES.....	38

APPENDIX 1 - PLANS
APPENDIX 2 - SITE PHOTOGRAPHS
APPENDIX 3 - HISTORICAL PLANS
APPENDIX 4 - GROUNDSURE REPORT
APPENDIX 5 - CIRIA RISK ASSESSMENT METHODOLOGY
APPENDIX 6 - EXPLORATORY HOLE LOGS
APPENDIX 7 - GEO-ENVIRONMENTAL TESTING RESULTS
APPENDIX 8 - GENERALISED GROUND MODEL
APPENDIX 9 - SOIL PERCOLATION TESTING RESULTS
APPENDIX 10 - GENERIC SCREENING VALUES (RESIDENTIAL END USE)
APPENDIX 11 - WASTE CLASSIFICATION REPORT
APPENDIX 12 - CONTAMINATED LAND LEGISLATIVE BACKGROUND
APPENDIX 13 - LIMITATIONS

Plans		
<i>Plan Reference</i>	<i>Revision</i>	<i>Title</i>
GRO-23382-P01	-	Project Location Plan
GRO-23382-P02	-	Preliminary Findings and Constraints Plan
GRO-23382-P03	-	Illustrative Preliminary Conceptual Site Model (CSM)
GRO-23382-P04	-	Exploratory Hole Location Plan
GRO-23382-P05	-	Ground Model
GRO-23382-P06	-	Soil Contamination Plan
GRO-23382-P07	-	Revised Illustrative Conceptual Site Model (CSM)

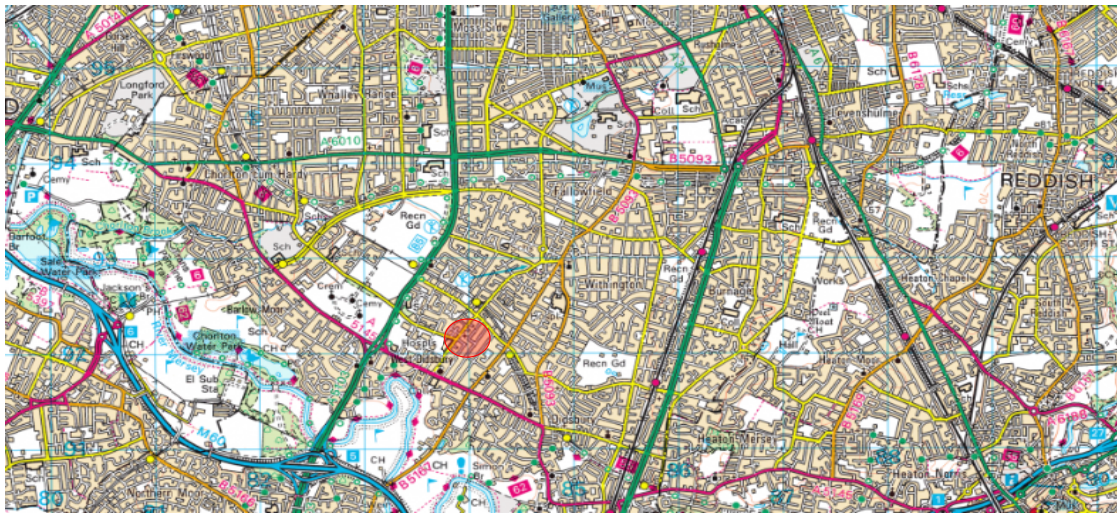


The assessment has been prepared for the exclusive use of the client. No third parties may rely on or reproduce the contents of the report without the written permission of Groundtech Consulting Limited. If any unauthorised third party comes into possession of the report, they rely on it at their own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

2.0 SITE SETTING

2.1 Location

The site is located circa 4.8 miles south of Manchester City Centre, as shown on the Project Location Plan GRO-23382-P01. The site is approximately centred on National Grid Reference 383692, 391745.



Project Location

Access to the site is gained off Barlow Moor Road to north of the site.

2.2 Site Description

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

The site is currently occupied by an existing single storey dwelling of brick construction located in the centre of the site. A driveway is present in the north of the site and a private garden area in the south. A detached garage is also present in the south west of the site.

The site is surfaced by tarmac and concrete in the northern and western extents, the south of the site is surfaced by grass. The east of the site is surfaced with paving flags. Shrubbery along with semi-mature and mature trees are present in the south east and north east of the site.

Site Boundaries

The north of the site is bounded by a circa 0.5m high wall of brick construction. The east, south and west of the site is bounded by a circa 2.0m high wooden fence. Semi-mature and mature trees are also present along the southern boundary.

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

- North - A5145 Barlow Moor Road followed by Douglas House and residential housing
- East - Broomfield Court and Residential dwellings
- South - Residential dwellings
- West - Residential dwellings followed by Palatine Road



Site photographs are presented in *Appendix 2* and relevant features are recorded on the Preliminary Development and Constraints Plan *GRO-23382-P02*.

3.0 ENVIRONMENTAL SETTING

3.1 Site History

Available historical maps have been obtained, a list of dates and scale are listed in the table below:

Scale	Date
1:1,250	1955, 1964, 1983/87, 1989/92, 1992, 1994, 1993/94, 2003
1:2,500	1881, 1894, 1907, 1910, 1922, 1935, 1955, 1971/74
1:10,000/10,560	1849, 1892, 1893, 1897, 1905, 1908/11, 1911, 1923, 1934/38, 1938, 1955, 1965/66, 1981/83, 1988/89, 2001, 2010, 2023

The plans were examined and potential issues have been identified and summarised in the table below:

Date	Site	Surrounding Area
1881	Site occupied by fields.	Greenhouses located c.50m south and c.150m south west. Residential buildings surround the site to the north and south c.50m.
1894	Southern area of site comprises a portion of the adjacent Stormarn building.	Netherby building located c.50m east. Expansion of residential buildings surrounding. Greenhouse located c.10m west.
1907	Residential buildings encroach onto the eastern and western extent and small development present in northern area.	Expansion of surrounding residential developments.
1922	Small greenhouse encroaching on the western area from adjacent property.	Expansion of surrounding residential developments. Tennis grounds c.130m north west of the site.
1955	A building is located centrally to the site and in the southern area in its current configuration. Other buildings have been demolished .	Expansion of surrounding residential developments.
1964	No Change.	Tennis Court c.200m south west and 180m south.
1989/92	Buildings onsite labelled as part of Broomfield Court.	-
2003	No Change.	-

The historical plans are presented in *Appendix 3*.

3.2 Geology

The following British Geological Survey (BGS) records and other available information were inspected to accurately determine the geology underlying the site:

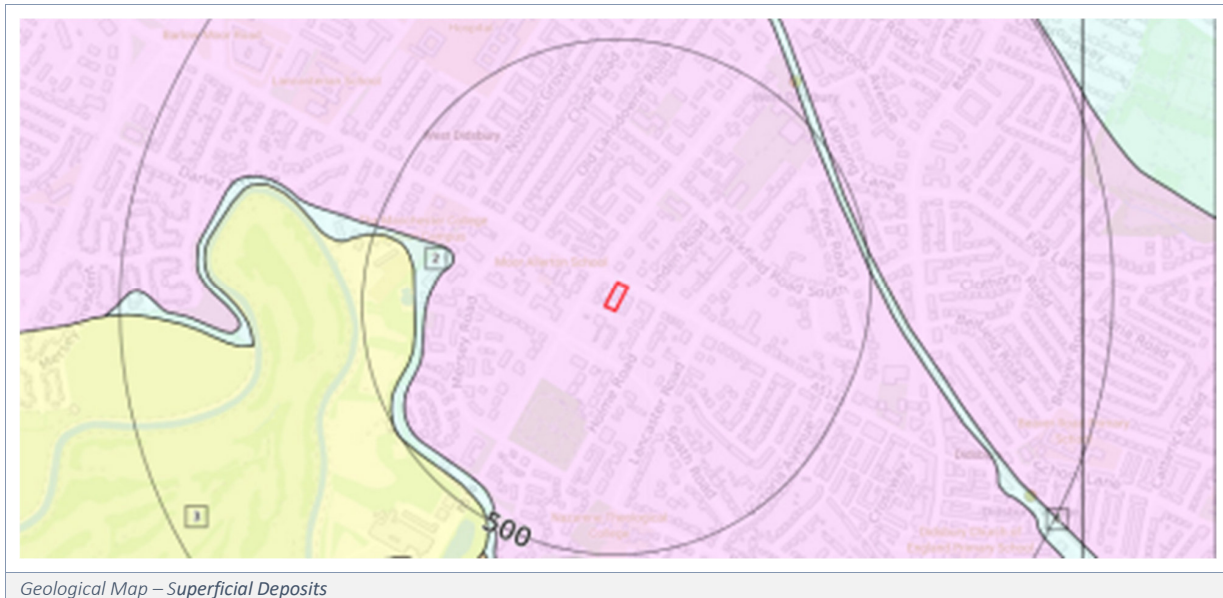
- 1:63,360 Scale Geological Sheet 98, Stockport - Drift Edition
- 1:50,000 Scale Geological Sheet 98, Stockport - Solid Edition
- BGS Records

Made Ground

Based off the Groundsure report and available geological plans Made Ground is not indicated to be present beneath the site. However due to previous and current developments, Made Ground is anticipated to be present.

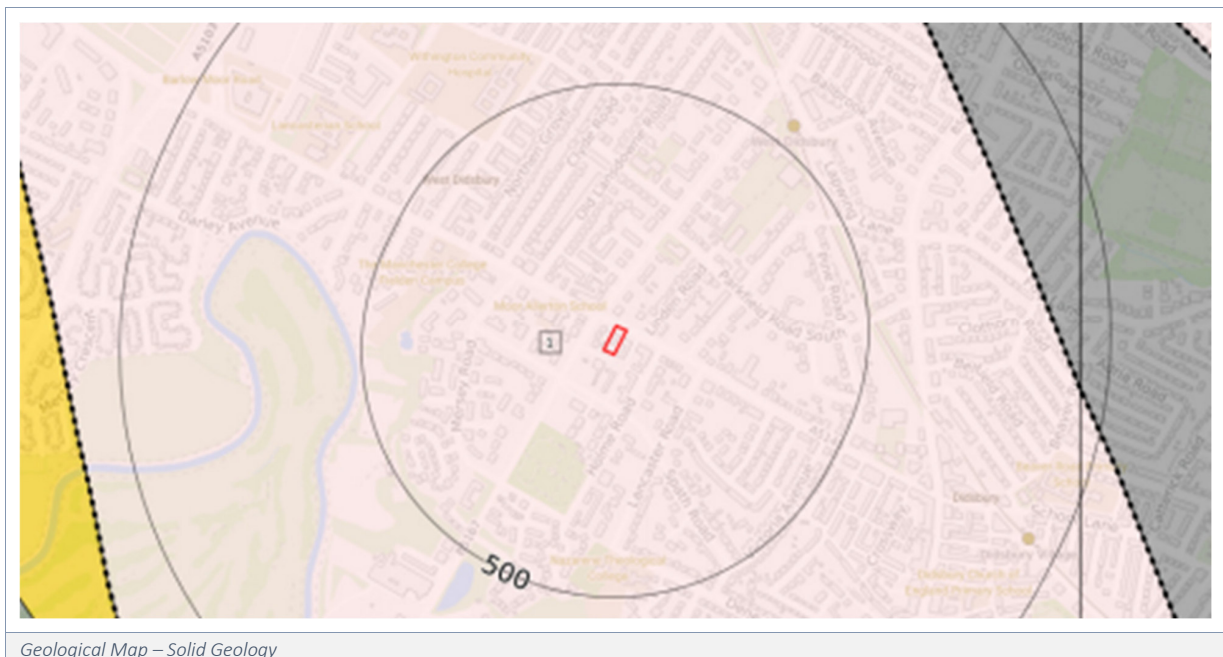
Superficial Deposits

The superficial deposits beneath this site are indicated to be glaciofluvial sheet deposits comprising mainly of Sand and Gravel.



Solid geology

The solid geology present on the site is of the Wilmslow Sandstone Formation which characteristically comprises Sandstone.



Geological faults

No faults are shown on or within an influencing distance of the site.

BGS Records

There are no available BGS records within 250m of the site.

3.3 Hydrogeology

The superficial glaciofluvial sheet deposits in this area are classified by the Environment Agency as a Secondary A Aquifer. These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

The bedrock geology is classified as a Principal Aquifer (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).

The site does not lie within a Source Protection Zone and there are no potable abstraction points within 2000m of the site.

There are four groundwater abstraction points within 2000m of the site, two of which are active located 1054m south of the site that is used for spray irrigation at Didsbury Golf Club and 1874m west that is used for spray irrigation at Chorlton Golf Club.

3.4 Hydrology

There are no named watercourses within 250m of the site, the nearest surface water feature which is the River Mersey 516m west of the site.

There are two historical surface water abstraction points within 2000m of the site. The two historical abstractions are located 1458m west of the site and was used for general washing, process washing and dust suppression for AMEC/ALFRED MCALPINE JV.

There are no potable water abstraction points within 2000m of the site.

Environment Agency information indicates that the site is outside a flood risk zone and is not at risk of flooding.

3.5 Environmental Consultations

An environmental consultation has been conducted through Groundsure, which accesses British Geological Survey and Environment Agency databases. The complete EnviroInsight Report can be found in *Appendix 4*, a summary of the more relevant points are presented in the table below.

Record	<250m	250 – 500m	Description
<i>Authorised Processes</i>	-	1	<i>There is one licensed pollutant release 343m south west of the site which related to petrol vapour recovery and no enforcement was noted.</i>
<i>Pollution Incidents</i>	-	3	<i>There are three historical pollution incidents involving inert materials and waste with minor impact on land.</i>
<i>Landfill and Waste Treatment</i>	-	2	<i>Waste exemptions are located 45m and 356m north east that relate sorting and de-naturing of controlled drugs for disposal.</i>

Record	<250m	250 – 500m	Description
<i>Discharge Consents</i>	-	-	-
<i>Petrol Filling Stations</i>	-	-	-
<i>Current industrial Uses</i>	-	5	<i>There are five current industrial land uses all within 217m of the site, three locations are electrical sub stations located 217m north east, 157m west and 121m north west. Two other industrial land uses are located 202m north west and 141m south of the site.</i>

3.6 Radon

In accordance with the latest Radon maps launched by UKHSA in December 2023, this site is in an area where less than 1% of homes exceed the Radon action level, therefore no Radon protection measures are required for the proposed dwelling.

The radon data in the Groundsure report is supplied by the BGS/Public Health England and is the definitive map of Radon Affected Areas in Great Britain and Northern Ireland and confirms the recommendations of radon maps. The dataset was created using long-term radon measurements in over 479,000 homes across Great Britain and 23,000 homes across Northern Ireland, combined with geological data. The dataset is considered accurate to 50m to allow for the margin of error in geological lines, and the findings of this report supersede any answer given in the less accurate Indicative Atlas of Radon in Great Britain, which simplifies the data to give the highest risk within any given 1km grid square.

4.0 LAND QUALITY CONCEPTUAL SITE MODEL AND RISK ASSESSMENT

4.1 Introduction

The potential level of risk posed by contaminants in soil and/or groundwater will be influenced by the type and concentration of the contamination at source, the likelihood of exposure occurring, the potential pollution linkages and the likely chronic or acute effects on the receptors.

A contaminant is defined as a substance that has the potential to cause harm, a risk is considered to exist if such a substance is present at sufficient concentrations to cause harm and if a pathway is present a receptor could be exposed to the contaminant.

Section 4.0 compiles the information from the previous sections to assemble a Conceptual Site Model to inform the risk assessment process. The potential sources identified on the site and off the site that are within influencing distance are assessed to determine if pollution linkages exist and an unacceptable risk is posed to human health and controlled waters. The assessment has been carried out on a qualitative basis and aims to produce a complete and comprehensive Preliminary Conceptual Site Model; the potential pollution linkages are displayed on *GRO-23382-PO3* Illustrative Preliminary CSM.

Three potential types of impacts exist for a site and all three need to be considered in the qualitative preliminary risk assessment:

- *Impacts from sources on the subject site*
- *Impacts to the surrounding area from the subject site*
- *Impacts to the subject site from the surrounding area*

4.2 Potential Contamination Sources

Onsite Sources and Associated Contaminants of Concern (CoC)

From the information obtained during the preliminary risk assessment, a single potentially contaminative on the site source has been identified which may affect the redevelopment of the site for residential end use, This consists the former buildings on the site which will subsequently be demolished.

The potential Made Ground associated with the former and present buildings is a potential source of CoC including heavy metals, speciated Polycyclic Aromatic Hydrocarbons (PAHs), and asbestos.

Offsite Sources and Associated Contaminants of Concern (CoC)

There are several potential offsite sources of contamination which have been identified through the PRA and include the following:

- *Electrical substations approximately 217m and 121m north east and 157m west*
- *Two industries producing industrial products located 202m north west and 141m south*
- *Tennis Ground circa 130m north west approximately 200m south west and circa 180m south*
- *Greenhouses circa 50m south and approximately 150m south west*

The former electricity substations at 217m, 121m north east and 157m west are potentially sources of Polychlorinated biphenyls (PCBs) dependant on their age as these were widely used as cooling agents in transformers prior to being banned.

The current industrial land uses located 202m north west and 141m south are a potential source of heavy metals, inorganic compounds and asbestos. Additionally, they are a potential source of speciated PAHs and hydrocarbons due to machinery that may utilised and stored.

4.3 Pollution Linkages

The definition of a pollution linkage is a medium which allows a contaminant to impact a receptor. Potential pollution linkages have been recognized for the residential development from the identified contamination sources that exist.

At this stage the contaminants identified above are considered to potentially pose an unacceptable risk human health and controlled waters through the following pollution linkages:

- *Direct soil and dust ingestion*
- *Dermal contact with soil both indoors and outdoors*
- *Indoor air inhalation from soil and vapour*
- *Outdoor inhalation of soil and vapour*
- *Migration and accumulation of ground gas into internal spaces*
- *Impaction of groundwater from soil contamination (diffuse and point)*
- *Impaction of groundwater from groundwater plume*
- *Migration of soil and groundwater contamination impacting surface waters*

4.4 Receptors

Receptors generally fall into the categories of human health or controlled waters within the river basin system. The recognized receptors are listed below:

- *Site End Users*
- *Clean potable water supply pipe*
- *Secondary A Superficial Aquifer*
- *Principal Bedrock Aquifer*

4.5 Preliminary Conceptual Site Model (CSM)

The factual information obtained from the consultations and summarised in Section 2.0 and 3.0 has been used to compile a Preliminary CSM. Using Source-Pathway-Receptor assessment criteria that is applicable in the UK, a risk assessment has been completed to determine if a plausible pollution linkage exists between the identified contaminants and receptors. The risk classification has been estimated in accordance with the CIRIA C552 assessment criteria outlined in *Appendix 5*. The CSM is visually represented on Groundtech Plan GRO-23382-P03.



Human Health Pollution Linkage Assessment



- The table below represents the first stage in the land quality risk assessment process - **the Qualitative Risk Assessment**.
- In order for a development site to be deemed 'suitable for use' the level of risk needs to be reduced to an acceptable level - low to negligible risk. The purpose of each stage of risk assessment is to establish if there is a requirement for additional stages of assessment in order to have sufficient confidence to support a risk characterisation or remedial action.

Conceptual Site Model					Qualitative Risk Assessment
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating
PL1	Contaminated Soils	ingestion of soil and dust. Dermal contact with soil.	Low Likelihood to Likely	Medium	Moderate
					<i>Pollution Linkage 1 refers to proposed site users coming into contact with contaminated soils on the site.</i> <i>The site is currently occupied by an existing residential building, Made Ground is therefore anticipated beneath the site which may be a source of heavy metals, speciated PAHs and asbestos. Made ground may also be a product of former buildings which have since been demolished.</i> <i>PCBs may have been used in the former electricity substations that are located 217m NW, 121m NE and 157m West, however this are mobile and will be localised. PCB contamination from offsite substations is unlikely to have affected the site given the distance.</i> <i>Other offsite sources of contamination are at a considerable at a distance unlikely to impact the subject site.</i>

Conceptual Site Model					Qualitative Risk Assessment	
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	Rationale and Action
						The proposed development is residential end use comprising a pair of semi-detached residential dwellings and a pair of annexes towards the rear of the garden, Made Ground is likely to be present and a plausible pollution linkage has been identified.
PL2	Contaminated Soils	Inhalation of vapour.	Unlikely	Medium to Severe	Low	Pollution linkage 2 refers to vapours migrating into confined spaces within the proposed development. No significant sources of volatile vapours have been identified on the site through the PRA and a plausible pollution linkage is not considered to exist.
PL3	Contaminated Soils	Inhalation of soil dust by adjacent site users.	Unlikely	Medium	Low	Pollution Linkage 3 relates to contamination on the subject site affecting adjacent site users. Significant sources of mobile contamination have not been identified on the site through the desk-based study, a viable pollution linkage is not considered to be present.
PL4	Contaminated Soils	Attacking potable water supply pipe.	Likely	Medium	Low	Pollution Linkage 4 refers to the possible contaminants permeating potable water pipes and consumption by the future site end users of the tainted water supply. Shallow Made Ground is expected to be present on site due to the presence of an existing residential structure, however deep Made Ground is not anticipated and it is assumed that potable water pipes will be placed in the natural strata, therefore a contamination linkage is not considered to exist.



Conceptual Site Model					Qualitative Risk Assessment	
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	Rationale and Action
PL5	Ground Gas	Migration and accumulation of ground gas in internal spaces.	Unlikely	Medium to Severe	Low	No significant on-site or offsite sources of Ground Gas has been identified through the desk based study. No Radon protection measures are required for the proposed dwelling.

Controlled Waters Pollution Linkage Assessment



- The table below represents the first stage in the land quality risk assessment process – **Qualitative Risk Assessment**.
- In order for a development site to be deemed 'suitable for use' the level of risk needs to be reduced to an acceptable level - low to negligible risk. The purpose of each stage of risk assessment is to establish if there is a requirement for additional stages of assessment in order to have sufficient confidence to support a risk characterisation or remedial action.

Conceptual Site Model					Qualitative Risk Assessment	
PL	Potential source	Pollution linkage	Likelihood	Severity	Level of risk	Rationale
PL6	Contaminated Soils	Impaction of groundwater from soil contamination (diffuse and point). Impaction of groundwater from groundwater plume.	Unlikely	Mild	Very Low	Based on the history of the site, limited Made Ground is likely to be present associated with the former residential dwelling. No sources of mobile contamination have been identified through the PRA. Geological maps indicate that the site is underlain by superficial deposits underlain by the solid rock geology of Wilmslow Sandstone formation (Secondary A Aquifer). The site is not within a groundwater SPZ and the groundwater is not considered to be a sensitive resource. There are also no potable abstraction licenses within 2000m. As a potential source of mobile contamination has not been identified, no realistic pollution linkage is present.
PL7	Contaminated Soils	Migration of soil and groundwater contamination impacting surface waters.	Unlikely	Mild	Very Low	Pollution Linkage 7 refers to the impaction of nearby surface watercourses from contaminated soils and groundwater.



Conceptual Site Model					Qualitative Risk Assessment	
PL	Potential source	Pollution linkage	Likelihood	Severity	Level of risk	Rationale
						There are no surface water features within 250m and no sources of mobile contamination have been identified on the site. Therefore, no pollution linkage is considered to exist

5.0 SCOPE OF INVESTIGATION AND RATIONALE

5.1 Project Objectives

The aim of the fieldwork was to:

Determine the stratification beneath the site
Maintain watching brief for visual and olfactory evidence of contamination
Obtain samples using methodology in current guidance for contamination testing
Identify realistic pollution linkages to groundwater.
Obtain relevant geotechnical parameters for preliminary foundation design to address both ULS and SLS conditions
Determine if targeted supplementary investigation in areas of concern is required and for remedial design
Assess the identified pollution linkages in the CSM
Determine the feasibility of SuDS drainage

5.2 Scope of Works

The following scope of works was completed on 16th January 2024:

- 6 No. Windowless sample boreholes (WS01 to WS06) were drilled to a maximum depth of 5.0m bgl
- 1 No soil percolation trial pit (SuDS01) was undertaken at 2.0m bgl

The exploratory hole locations are presented on Groundtech Plan GRO-23382-P04 and the exploratory hole logs are in Appendix 6.

The exploratory holes were positioned to establish the stratification beneath the site and target any areas of concern as summarised in the table below:

Location	Target Rationale
WS01 to WS06	Site coverage
WS01 and WS02	Proposed garage
WS03 to WS05	Former buildings/greenhouses Proposed dwellings
SuDS1	Proposed SuDS location

The exploratory holes were logged by a suitably experienced Geo-Environmental engineer in general accordance with the following current guidance:

- BS 5930 'Code of Practice for Site Investigations' 2020
- BS EN 14688-1:2002 'Geotechnical Investigation and Testing – Identification and classification of soil'

5.3 Soil Sampling

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

The samples obtained are summarised in the table below:

Soil Sample	Number
<i>Environmental Sample</i>	<i>15</i>
<i>Disturbed Sample</i>	<i>28</i>

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

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

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

5.4 Geo-Environmental Testing

To inform the Generic Quantitative Risk Assessment, the following geo-environmental testing was scheduled to assess the risk from contamination on the site. The testing is based on the potential sources identified in the PRA and observations during the Ground Investigation.

Contaminant of Concern (CoC)	Matrix	Number
<i>Arsenic, cadmium, chromium (total and hexavalent), copper, lead, mercury, nickel, selenium, zinc, sulphate and pH.</i>	<i>Soil</i>	<i>4</i>
<i>Speciated Polycyclic Aromatic Hydrocarbons (PAHs)</i>	<i>Soil</i>	<i>4</i>
<i>Asbestos Screening</i>	<i>Soil</i>	<i>4</i>

The Geo-Environmental Laboratory Testing Results are presented in *Appendix 7*.

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

British Standard	Test Method	Number
<i>Part 3</i>	<i>pH Value</i>	<i>3</i>
<i>Part 3</i>	<i>Water Soluble Sulphate Content</i>	<i>3</i>

6.0 GROUND MODEL

6.1 Made Ground

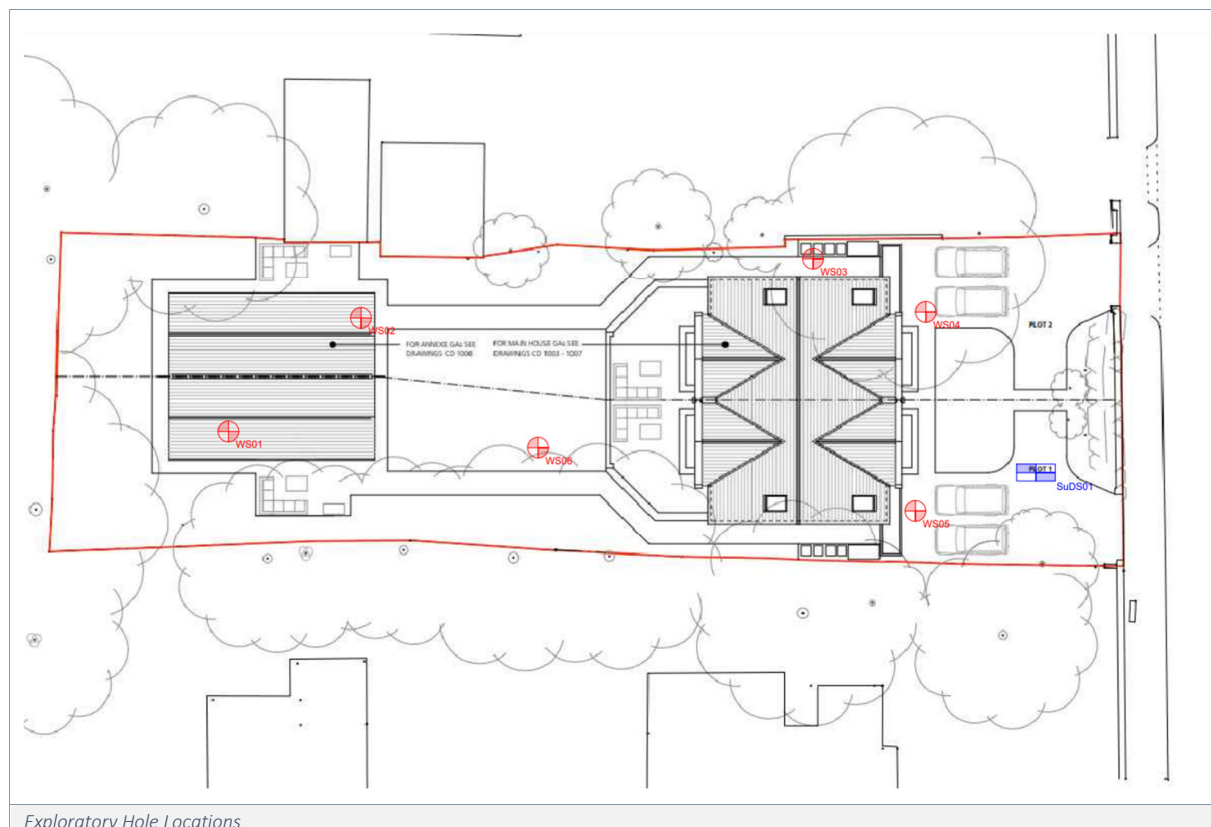
Made Ground was encountered in the north and west of the site to a maximum depth of 1.35m bgl.

The site was surfaced by tarmac and concrete in the north and west of the site to a depth of 0.15m bgl. The south east of the site is surfaced by grass. Grass surfacing is also present around the perimeter of the north eastern boundary. Dark brown sandy topsoil was encountered in WS01, WS05 and WS06 to a maximum depth of between 0.2m and 0.4m bgl.

One main Made Ground populations were encountered during the investigation and are described below:

1. *Brown sandy angular to subangular fine to coarse gravel of brick, ceramic, tarmac and sandstone in WS02, WS03, WS04 and SuDS01 from 0.15m depths of between 0.3m and 1.35m bgl.*

Brown gravelly fine to coarse sand was encountered locally in SuDS01 between 0.15m and 1.05m bgl.



6.2 Natural Ground

The natural strata encountered generally confirmed the published geological records. One main natural stratification encountered during the investigation and consisted of loose to very dense brown clayey gravelly fine to coarse Sand in all exploratory hole locations between 0.2 and 5.0m bgl.

6.3 Bedrock

Bedrock was not encountered during the investigation.

6.4 Groundwater

Groundwater was not encountered during the Ground Investigation.

6.5 Watching Brief

A watching brief was maintained during the Ground Investigation for visual and olfactory evidence of contamination. No visual or olfactory evidence of contamination was noted.

6.6 Excavation Stability

No evidence of spalling or collapse was noted during excavation of the trial pit or drilling of the boreholes.

6.7 Excavation Progress

Slow progress while excavating the trial pit was not experienced.

SPT refusals were recorded in WS01 to WS03, WS05 and WS06 between 4.0m and 5.0m bgl.

7.0 GROUND ENGINEERING

7.1 Assessment Background

The ground engineering investigation has been undertaken to formulate an accurate ground model in order to undertake preliminary foundation design. The ground model has been constructed with a moderate level of confidence, the ground model has evolved from the information obtained by the PRA.

Background

The site is currently occupied by a single storey residential dwelling the centre of the site with associated driveway and garden. It is proposed to demolish the current buildings on the site and construct a pair of semi-detached residential dwellings in the north of the site and a pair of annexes in the south.

Ground Conditions

The site is surfaced with tarmac and concrete in the north and west. Grass over sandy topsoil covers the south of the site. Made Ground was encountered in WS02 and WS03 in the north west of the site to a maximum depth of 1.35m bgl and comprised brown sandy angular to subangular fine to coarse gravel of brick, concrete and ceramic.

Superficial deposits were encountered at minimum depths of between 0.2m and 1.35m bgl to depths of between 4.0m and 5.0m bgl and generally comprised medium dense brown clayey gravelly fine to coarse Sand with gravel of sandstone.

No groundwater was encountered during the Ground Investigation.

Limitations

The main limitation of the site is the existing building in the centre of site limiting the investigation area. A watching brief should be maintained during the demolition of the existing buildings to ensure that the ground conditions beneath the building are consistent with the remainder of the site.

All below ground substructure and hardsurfacing associated with the demolition of the current building on site and tarmac surfacing will require grubbing up as part of the enabling works. A watching brief should be maintained during the demolition of the existing building for any evidence contamination not identified during the Ground Investigation.

Consideration should be given to the existing surrounding properties during the enabling and construction phase.

7.2 Geotechnical Parameters

The geotechnical test results have been evaluated to derive geotechnical parameters for the soils underlying the site. A 'depth to SPT N value' graph is presented on Plan GRO-23382-P05 in *Appendix 8* to provide a generalised ground model for the site.

Characterisation of the geotechnical parameters above has been undertaken based on the correlation to SPT values to select a characteristic value, which is a cautious estimate of the value affecting the occurrence of the limit state.

The characteristic values for the Ultimate Limit State (ULS) conditions selected are presented in the table below:

Stratum	Parameter	Selected Characteristic Value
<i>Loose Sand</i>	<i>Drained angle of friction (ϕ')</i>	<i>29°</i>
<i>Medium Dense Sand</i>	<i>Drained angle of friction (ϕ')</i>	<i>32°</i>
<i>Dense Sand</i>	<i>Drained angle of friction (ϕ')</i>	<i>37°</i>
<i>Very Dense Sand</i>	<i>Drained angle of friction (ϕ')</i>	<i>41°</i>

7.3 Preliminary Foundation Design

The most suitable foundations for the proposed residential development are considered to be traditional shallow strip trench foundations constructed in the medium dense Sand at a minimum depth of 0.6m bgl. Loose to Medium Dense Sand was encountered in the north eastern corner of the proposed development. All foundations should be deepened through Made Ground and unsuitable Sand deposits.

Preliminary foundation design has been undertaken by calculation, a safe allowable bearing pressure of 140kN/m² is provided for ultimate limit state design based on a 0.6m wide strip trench foundation constructed within the medium dense Sand deposits.

The settlement of the medium dense Sand will be immediate and will predominantly occur during the construction phase. Settlement will be negligible and Serviceability Limit State conditions will be satisfied.

Construction Recommendations

The recommendations in this appraisal are preliminary and the detailed design should be developed in advance and during the construction phase. If the ground conditions or groundwater regime encountered during the construction phase differ significantly to the conditions encountered during the Ground Investigation, work should cease and Groundtech Consulting contacted for further advice.

During the construction phase, supervision by a suitably qualified geotechnical engineer should be on a continuous basis to check the design assumptions are correct and construction conforms to design in accordance with EC7. Supervision should include inspections, Control Ground Investigations and monitoring by a suitably qualified geotechnical engineer.

7.4 Building Near Trees

Semi-mature and mature trees are present along the southern boundary of the site. Foundations are to be constructed within granular soils therefore heave precautions are not required.

All foundations should be deepened below roots of greater than 5mm diameter during excavations for footings.

7.5 Floor Slabs

Made Ground is generally greater than 600mm in thickness has been recorded beneath the western end of site and floor slabs for the proposed development should be suspended. Clay strata was not encountered during the Ground Investigation and does not influence the floor slab design.

A ground bearing floor slab is potentially an option subject to suitable earthworks design and validation testing, this would include a drainage strategy to prevent inundation settlement.

7.6 Construction

The trial pits indicate that instability of excavations is not anticipated provided they are not exposed to adverse weather conditions for any substantial period of time. Instability of the Made Ground is a possibility and should be considered in the groundworks method statements.

Tracked high specification plant is recommended to maintain the build programme. Breaking equipment may also be required locally to penetrate obstructions following the demolition of the existing building on the site.

No groundwater was encountered during the Ground Investigation and is not anticipated to be present during foundation excavations.

7.7 Concrete Classification

Made Ground

Water soluble sulphate testing was undertaken on three samples of the Made Ground. The range of soluble sulphate (SO_4) recorded is 6.6mg/l to 74.7mg/l. Associated pH values ranged between 8.08 and 9.1 indicating slightly alkaline conditions.

For a dataset containing less than five results, the highest soluble sulphate value is taken as the characteristic value along with the lowest of the pH results. For the Made Ground, the characteristic soluble sulphate value is 74.7mg/l and the associated pH value is 8.08.

Natural Strata

Water soluble sulphate testing was undertaken on three samples of the natural strata. The range of soluble sulphate (SO_4) recorded is <1.5mg/l to 4.8mg/l. Associated pH values ranged between 7.2 and 7.95 indicating neutral conditions.

For a dataset containing less than five results, the highest soluble sulphate value is taken as the characteristic value along with the lowest of the pH results. For the natural strata, the characteristic soluble sulphate value is 4.8mg/l and the associated pH value is 7.2.

Due to the granular deposits beneath the site, the groundwater is considered to be mobile.

The results of laboratory pH and sulphate content indicate that ACEC Class AC-1 and sulphate class DS-1 conditions prevail in accordance with BRE Special Digest 1 "Concrete in aggressive ground" 2005. The specific concrete mixes (the Design Concrete Class) to be used on site will be determined by the site specific concrete requirements in terms of the durability and structural performance. These are assessed in terms of the Structural Performance Level (SPL) and any need for Additional Protective Measures (APM) detailed in Part D of BRE Special Digest 1 with further guidance in Pt E and F.

7.8 Highway Design

CBR values of greater than 5% are likely to be achieved in undisturbed natural granular soils for pavement design purposes, unless proven otherwise by in-situ testing at sub-base level by a specialist geotechnical engineer. As a minimum the subgrade should be proof rolled prior to construction.

Untreated Made Ground should be assumed to have a CBR value of <2.5%, unless proven otherwise. Highways Agency document HD25 'Interim Advice Note 73/06 Revision 1' (2009) states that where a

subgrade has a CBR value lower than 2.5%, it is considered unsuitable support for a pavement foundation since it would tend to deform under construction traffic, and must be improved.

The soils are considered to frost susceptible due to the fines content, highway construction should be a minimum thickness of 450mm to mitigate against the risk.

7.9 Sustainable Urban Drainage System (SuDS)

Soil infiltration testing was undertaken at one location across the site where SuDS drainage is proposed in accordance with BRE Digest 365 'Soakaways' (2016). A summary of the soil percolation test results is given below, and the full results are presented in *Appendix 9*.

<i>Location</i>	<i>Depth (m bgl)</i>	<i>Test No.</i>	<i>Soil Infiltration Rate (m/sec)</i>
<i>SuDS1</i>	<i>1.55</i>	<i>1</i>	<i>1.14×10^{-5}</i>
<i>SuDS1</i>	<i>1.55</i>	<i>2</i>	<i>8.78×10^{-6}</i>
<i>SuDS1</i>	<i>1.55</i>	<i>3</i>	<i>3.94×10^{-6}</i>

The soil infiltration rates in the natural ground at the proposed locations displayed moderate soil infiltration rates due to the presence of clay as a minor constituent in the granular soils. The use of soakaways may be considered feasible if sufficient attenuation and storage is available.

8.0 LAND QUALITY

8.1 Geo-Environmental Testing Results - Soils

Samples of Made Ground have been tested for a range of relevant Contaminants of Concern. In accordance with LCRM, a Generic Quantitative Risk Assessment (GQRA) has been undertaken to determine the significance of the concentrations as derived through Geo-Environmental testing.

The GQRA process comprises the comparison of the actual concentrations measured on site with Generic Assessment Criteria (GACs) for the protection of human health.

The GACs used for the assessment of soil concentrations have been derived using the CLEA model. The GACs used are listed below:

- *Soil Guideline Values (SGVs) which demonstrate minimal risk.*
- *LQM/CIEH S4ULs which use the same toxicological data as the SGVs but different exposure criteria.*
- *C4SLs which demonstrate low risk.*

In deriving the GACs for use on Brownfield sites we have assumed a 1% Soil Organic Matter, unless the results indicate otherwise.

The proposed end-use for the site is a residential development comprising a pair of semi-detached two storey dwellings with private domestic gardens and associated driveways, pavements and garages. We have therefore undertaken the GQRA on the basis that the proposed development site falls under the Residential (with Plant Uptake) land-use scenario as defined in SR3 (EA, 2009b).

The strata or sources of contamination targeted by the laboratory testing scheduled is summarised in the table below:

Strata	Number of Samples Tested	Locations
<i>Granular Made Ground</i>	3	WS02, WS03, WS04
<i>Made Ground Topsoil</i>	1	WS06
<i>Former greenhouses</i>	2	WS03, WS04

A summary of the Geo-Environmental Testing results is presented below and the GQRA screening values are presented in *Appendix 10*:

Metals				
Contaminant	Range (mg/kg)	Screening value (mg/kg)	Exceedances	Locations
<i>Arsenic</i>	9.8 – 16.8	37	-	-
<i>Cadmium</i>	<0.1 – 0.5	10	-	-
<i>Chromium</i>	32.8 – 39.7	910	-	-
<i>Hexavalent Chromium</i>	<0.3	21	-	-
<i>Copper</i>	12 – 38	2400	-	-
<i>Lead</i>	87 – 274	200	2	WS04 at 0.20 WS06 at 0.10
<i>Mercury</i>	<0.1 – 0.2	1.2	-	-
<i>Nickel</i>	5.3 – 15.4	130	-	-

Selenium	<1	350	-	-
Zinc	94 – 258	3700	-	-
Polycyclic Aromatic Hydrocarbons (PAHs)				
Contaminant	Range (mg/kg)	Screening value (mg/kg)	Exceedances	Locations
Naphthalene	<0.04 – 1.16	2.3	-	-
Acenaphthylene	0.10 – 0.17	170	-	-
Acenaphthene	<0.05 – 0.24	210	-	-
Fluorene	0.07 – 0.16	170	-	-
Phenanthrene	0.82 – 2.26	95	-	-
Anthracene	0.19 – 0.52	2400	-	-
Fluoranthene	1.52 – 4.83	280	-	-
Pyrene	1.32 – 4.30	620	-	-
Benzo(a)anthracene	0.60 – 2.01	7.2	-	-
Chrysene	0.62 – 2.46	15	-	-
Benzo(b)fluoranthene	0.68 – 2.92	2.6	1	WS04 at 0.20
Benzo(k)fluoranthene	0.26 – 1.13	77	-	-
Benzo(a)pyrene	0.58 – 2.33	2.2	1	WS04 at 0.20
Indeno(123cd)pyrene	0.34 – 1.61	27	-	-
Dibenzo(ah)anthracene	0.08 – 0.31	0.24	1	WS04 at 0.20
Benzo(ghi)perylene	0.33 – 1.49	320	-	-
Others				
Organic Matter	1.6 – 6.4%			
Asbestos Screen				
Position	Depth (m bgl)	Result	Quantification	
WS02	0.40	None Detected	n/a	
WS03	1.10	None Detected	n/a	
WS04	0.20	None Detected	n/a	
WS06	0.10	None Detected	n/a	

8.2 Generic Quantitative Risk Assessment - Soils

The site is currently occupied by a single storey residential dwelling with an associated driveway, garden area and garage. The north and west of the site is surfaced with tarmac and concrete. The south of the site is surfaced with grass. Made Ground has been encountered locally to western end of site to 1.35m bgl and generally consisted of sandy gravel of brick and sandstone. Natural granular stratum was encountered across the site to a maximum depth of 5.0m bgl.

No visual or olfactory evidence of contamination was noted.

Metals

Elevated levels of lead were recorded in the granular Made Ground subbase of WS04 at 0.2m bgl in the north of the site and in the Made Ground topsoil in WS06 in the east. The elevated heavy metals concentration is likely associated with the sites former use as greenhouses and the associated pesticides and fertilizers.

No other elevated levels of heavy metals were recorded against residential with plant uptake screening values.

Speciated Polycyclic Aromatic Hydrocarbons (PAHs)

Elevated concentrations of speciated PAHs including Benzo(b)fluoranthene, Benzo(a)pyrene and Dibenzo(ah)anthracene have been recorded in WS04 at 0.2m bgl when compared to residential with plant uptake screening values. No other elevated levels of PAHs were recorded in other samples tested.

The elevated levels of PAHs are likely to be associated with tarmac content of the subbase in the northern area of site.

Asbestos

Four samples of the granular Made Ground and Made Ground topsoil were screened for asbestos and no asbestos was detected.

Other Contaminants of Concern

No other contamination was noted during the Ground Investigation.

All elevated Contaminants of Concern are presented on Groundtech Plan *GRO-23382-P06*.

8.3 Revised Pollution Linkage Assessment

A pollution linkage assessment has been revised based on the findings of the Ground Investigation and testing to identify any realistic pollution linkages in order to quantify the risks to human health and controlled waters. An Illustrative CSM is presented as Plan *GRO-23382-P07*.



Human Health Pollution Linkage Assessment



- The table below represents the second stage in the land quality risk assessment process - **the Generic Quantitative Risk Assessment**.
- In order for a development site to be deemed 'suitable for use' the level of risk needs to be reduced to an acceptable level - low to negligible risk. The purpose of each stage of risk assessment is to establish if there is a requirement for additional stages of assessment in order to have sufficient confidence to support a risk characterisation or remedial action.

Conceptual Site Model					Generic Quantitative Risk Assessment	
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	Rationale and Action
PL1	Contaminated Soils	Ingestion of soil and dust. Dermal contact with soil.	Unlikely	Medium	Moderate	<i>Pollution Linkage 1 refers to proposed site users coming into contact with contaminated soils on the site.</i> <i>The proposed development is residential end use comprising a pair of semi detached two storey dwellings with a pair of annexes in the rear of the garden.</i> <i>Made Ground has been encountered along the western end of the site to a maximum depth of 1.35m bgl and generally comprised granular soils with minor constituents of brick, tarmac and ceramic. Elevated levels of lead were identified in the Made Ground subbase of WSO4 at 0.2m bgl in the north of the site and the Made Ground topsoil of WSO6 at 0.1m bgl in the east of the site. Elevated levels of PAHs (Benzo(b)fluoranthene, Benzo(a)pyrene and Dibenzo(ah)anthracene) were also identified in the granular subbase of WSO4 at 0.2m bgl. No asbestos was identified in the samples screened through laboratory testing.</i>



Conceptual Site Model					Generic Quantitative Risk Assessment	
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	Rationale and Action
						Soft landscaping is proposed as a part of the development - as elevated CoC were identified a source, pathway and receptor is present and a pollution linkage is considered to exist.
PL2	Contaminated Soils	Inhalation of vapour.	Unlikely	Medium to Severe	Low	No source of volatile contamination was identified during the Ground Investigation or PRA and therefore a plausible pollution linkage is not considered to exist.
PL3	Contaminated Soils	Inhalation of soil dust by adjacent site users.	Unlikely	Medium	Low	No evidence or source of contamination has been identified on site and a plausible pollution linkage is not considered to exist.
PL4	Contaminated Soils	Attacking potable water supply pipe.	Likely	Medium	Low	Pollution Linkage 4 refers to the possible contaminants permeating potable water pipes and consumption by the future site end users of the tainted water supply. Made Ground was encountered to a maximum depth of 1.35m bgl and water pipes may be installed in Made Ground, no sources of organic contaminants have been identified in the Made Ground at this depth and a pollution linkage is not considered to exist.



Conceptual Site Model				Generic Quantitative Risk Assessment		
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	Rationale and Action
PL5	Ground Gas	Migration and accumulation of ground gas in internal spaces.	Likely	Medium to Severe	Low	No source of ground gas has been identified on site or in the surrounding area therefore a plausible pollution linkage is not considered to exist. The site is not within an area requiring radon precautions within foundations.



Controlled Waters Pollution Linkage Assessment



- The table below represents the second stage in the land quality risk assessment process – **Generic Quantitative Risk Assessment**.
- In order for a development site to be deemed 'suitable for use' the level of risk needs to be reduced to an acceptable level - low to negligible risk. The purpose of each stage of risk assessment is to establish if there is a requirement for additional stages of assessment in order to have sufficient confidence to support a risk characterisation or remedial action.

Conceptual Site Model					Generic Quantitative Risk Assessment	
PL	Potential source	Pollution linkage	Likelihood	Severity	Level of risk	Rationale
PL6	Contaminated Soils	Impaction of groundwater from soil contamination (diffuse and point). Impaction of groundwater from groundwater plume.	Unlikely	Medium	Very Low	Made Ground was encountered to a maximum depth of 1.35m bgl.
						The site is underlain by a Secondary A superficial and Principal bedrock Aquifer. The site is not within a Source Protection Zone and there are no active potable water abstractions within 500m of the site.
						No groundwater was encountered during the Ground Investigation and groundwater is not considered to be a sensitive resource.
PL7	Contaminated Soils	Migration of soil and groundwater	Likely	Medium	Very Low	No pollution linkage is considered to exist as no significant impaction of the groundwater has been recorded.
						Pollution linkage 7 refers to the impaction of nearby surface water features from contaminated soils and groundwater.



Conceptual Site Model					Generic Quantitative Risk Assessment	
PL	Potential source	Pollution linkage	Likelihood	Severity	Level of risk	Rationale
		contamination impacting surface waters.				No source of mobile contamination has been identified during the Ground Investigation and all surface water features are at a distance from site to allow considerable attenuation. No pollution linkage is considered to exist.

8.4 Outline Remedial Strategy

Soils

Elevated Lead was identified in the granular Made Ground subbase and WS06 in the Made Ground topsoil when compared to residential with plant uptake screening values. Elevated PAHs were also identified in the granular Made Ground of WS04 at 0.2m bgl. No asbestos was identified in any of the four samples screened through laboratory testing.

It is anticipated that the tarmac and associated subbase in the north and west of the site will be grubbed up and if reused will be below proposed hardsurfacing. A nominal 150mm cover system comprising suitably clean topsoil should be placed in soft landscaping areas where no Made Ground is present. Where Made Ground is present, 450mm of cover system should be placed.

The topsoil around WS06 is not suitable for reuse in private residential gardens due to the elevated level of Lead. The topsoil in this area should be stockpiled separately to be removed from site to a licensed waste site or a commercial development site. The remainder of the topsoil across the site should be stripped and stockpiled separately to be tested for reuse.

A watching brief should be maintained during the demolition of the existing buildings onsite to ensure that ground conditions are consistent with the rest of the site and recommendations can remain the same.

Vapours

No visual or olfactory evidence of mobile contamination was noted during the Ground Investigation, no remedial action is required.

Ground Gas

No source of ground gas was identified on the site or offsite in the preliminary risk assessment and no source was identified during the Ground Investigation - no remediation is required with respect to ground gas.

In addition, the site is not in an area affected by radon and precaution measure are not required.

Watching Brief and Regulatory Liaison

A watching brief is recommended during future ground works for any previously unseen contamination. If identified, work should cease in that area and advice sought from Groundtech Consulting Limited.

Approval from the regulators should be obtained prior to the development commencing to avoid any delays at the construction stage.

8.5 Asbestos in Soils

No asbestos was identified in the samples screened by laboratory testing, the contractor should implement control measures to their satisfaction.

8.6 Health and Safety - Construction and Ground Workers

During the reclamation and construction phases of the site development it will be necessary to protect the health and safety of site personnel. The risk to construction and ground workers is assessed in the table below:

PL Ref	Potential Source	Pollution Linkage	Likelihood	Severity	Level of Risk
PL8	Made Ground	Ingestion, direct contact, inhalation of dusts.	Likely	Medium	Moderate to Low
PL8	Asbestos	Ingestion, direct contact, inhalation of dusts.	Likely	Medium	Low

Elevated levels of lead and speciated PAHs were recorded, the risk to site personnel should be communicated through inductions and information boards.

General guidance on these matters is given in the Health and Safety Executive (HSE) document “Protection of Workers and the General Public during the Redevelopment of Contaminated Land”. In summary, the following measures are suggested to provide a minimum level of protection:

- All ground workers should be issued with the relevant protective clothing, footwear and gloves. These protective items should not be removed from the site and personnel should be instructed as to why and how they are to be used.
- Hand-washing and boot-washing facilities should be provided.
- Care should be taken to minimise the potential for off-site migration of contamination by the provision of dust suppression control and wheel cleaning equipment during the construction works.
- Good practices relating to personal hygiene should be adopted on the site.
- The contractor shall satisfy the Health and Safety Executive with regard to any other matters concerning the health, safety and welfare of persons on the site.

8.7 Waste Classification by Assessment

We have reviewed the testing results and inputted them into the HazWasteOnline model which allows users to code and classify waste as defined in the EWC (European Waste Catalogue 2002) based on EC Regulation 1272/2008 on the Classification, labelling and packaging of substances and mixtures (CLP) and latest Environment Agency guidance (WM3 “Guidance on the classification and assessment of waste (1st edition 2015)-Technical Guidance”).

This is a useful tool as waste producers have the legal responsibility to classify any waste they produce.

Four samples were tested to assess whether they contained any contaminants in the hazardous range when screened against assessment criteria within WM3. The results are in the Waste Classification Report presented in *Appendix 11*.

Location	Depth (m bgl)	Material	Classification	Hazardous Properties
WS02	0.60	Made Ground	Non-Hazardous	-
WS03	1.10	Made Ground	Non-Hazardous	-
WS04	0.20	Made Ground	Non-Hazardous	-
WS06	0.10	Made Ground topsoil	Non-Hazardous	-

Based on the assessment tool the Made Ground has been classified as *Non-Hazardous*. Total testing was not undertaken on the natural soils and are assumed to also be *Non-Hazardous*.

No asbestos was identified in the samples screened by the laboratory testing and does not influence the classification.

8.8 Waste Acceptance Criteria (WAC) Results

The Landfill Directive (Directive 1999/31/EC on the landfilling of waste) led to the establishment of a methodology for classifying wastes. Wastes can only be accepted at a landfill if they meet the relevant Waste Acceptance Criteria (WAC) for that type of landfill. There are three different WAC, these are for:

- *Inert waste*
- *Non-Hazardous waste*
- *Hazardous waste*

Wastes should first be classified based on their total concentrations as detailed in the previous section. WAC testing is then required if the end disposal route is a landfill.

Waste Acceptance Criteria (WAC) testing was outside the scope of this investigation and the guidance given below is general.

The possibility of automatic inert classification of the natural soils should be explored in accordance with Section 4.3 of the EA guidance document. The Council Decision includes a list of wastes in Section 2.1.1 of the document that are assumed to be inert and therefore acceptable at a landfill for inert waste without testing, this is the case if:

- *They are single stream waste of a single waste type (although different waste types from the list may be accepted together if they are from a single source)*
and
- *There is no suspicion of material or substances such as metals, asbestos, plastics, chemicals, etc to an extent which increases the risk associated with the waste sufficiently to justify contamination and they do not contain other their disposal in other classes of landfill.*

If any organic contaminated material is encountered during the construction phase, it is possible that this may be classified as hazardous and testing should be undertaken at that time.

Materials should be segregated and where necessary sufficient time is allowed to further classify the material properly, including discussion with landfill sites and waste transfer stations to find the best disposal route. It is recommended that where possible that the soils could be recycled at a suitable local waste treatment plant or transfer station rather than a landfill disposal route.

The reuse of soils on the site this should be done in accordance with the CL:AIRE "Development Industry Code of Practice for the Definition of Waste" (CL:AIRE CoP). Any re-use scheme should be designed to minimise disposal costs.

After a cut and fill balance plan/volume calculation has been carried out, a U1 and T5 exemption could be registered. This will allow the use of the following soils without a waste permit or under Dow CoP MMP:

- *1,000 tonnes (c. 600m³) of non-hazardous soil*
- *5,000 tonnes (c. 3,000m³) of natural sand and gravels.*
- *50,000 tonnes (c. 25,000m³) of bituminous material to be used in roadways.*



- 5,000 tonnes (c. 3,000m³) of crushed concrete/stone.

9.0 FINAL APPRAISAL

9.1 Land Quality

Historical maps indicate the site remained undeveloped until 1894 when buildings encroach onto the south of the site associated with the adjacent Stormarn building. Maps from 1907 show residential buildings in the extreme east of west of the site and a small development in the north of the site. Maps from 1955 show the site to be in its current configuration. Greenhouses were historically located surrounding the site.

Made Ground was encountered beneath the northern and western end of the site to a maximum depth of 1.35m bgl and consisted of granular soils with constituents of brick, tarmac and ceramic. Natural granular strata was encountered in all exploratory hole locations to a maximum depth of 5.0m bgl. No visual or olfactory evidence of contamination was noted during the Ground Investigation.

Elevated levels of lead were identified in WS04 at 0.2m in the granular Made Ground tarmac subbase and in WS06 at 0.1m bgl within the Made Ground topsoil. Elevated levels of PAHs were also identified in WS04 at 0.2m bgl.

The risk from contaminated soils is considered to be *Moderate*. In private gardens, a nominal 150mm of topsoil should be placed where no Made Ground is present at formation level and 450mm where Made Ground is observed.

The existing topsoil around WS06 will be stripped and stockpiled separately and disposed from site. The remainder of the topsoil should be stripped and tested for proposed residential garden reuse.

The risk from vapours is considered to be *Low* as no source of volatile contamination has been identified during the Ground Investigation.

The risk to controlled waters is considered to be *Low*, no mobile contamination was identified during the Ground Investigation and no further action is required.

No evidence or sources of ground gas were identified in the PRA or the Ground Investigation. No radon protective measures are required for the proposed development.

The Made Ground has been classified as *Non-Hazardous* for waste disposal purposes.

9.2 Ground Engineering

The most suitable foundation solution for the proposed residential development will be traditional shallow strip trench foundations constructed within the medium dense Sand deposits at a minimum depth of 0.6m bgl.

SuDS drainage may be feasible at the site if sufficient attenuation and storage is available.

A watching brief should be maintained during the demolition of existing buildings on site to ensure that ground conditions are consistent across the site.

9.3 Required Further Work

The following further work is considered necessary to progress the site to construction phase:



Watching brief during demolition of existing buildings
Demolition asbestos survey
Detailed Foundation design
Topsoil strip and delineation
Confirmation of recommendations made in this appraisal with regulators

10.0 RELEVANT INDUSTRY REFERENCES

- British Standards Institution. *Investigation of Potentially Contaminated sites - code of practice*. BS 10175:2017.
- British Standards Institution '*Code of Practice for Site Investigations*' BS 5930:2020.
- British Standards Institution "*Geotechnical investigation and testing – Identification and classification of soil*" BS EN ISO 14688:2002.
- British Standards Institution "*Geotechnical investigation and testing – Identification and classification of rock*" BS EN ISO 14689:2002.
- BRE Report BR211 '*Radon – Guidance on protective measures for new buildings*' 2015 Edition.
- BRE Special Digest 1: "*Concrete in Aggressive Ground*" 3rd Ed 2005.
- CIRIA 552 "*Contaminated Land Risk Assessment – A guide to good practice*" 2001.
- CIRIA C665 "*Assessing Risks Posed by Hazardous Ground Gases to Buildings*" 2007.
- Wilson & Card "*Proposed method classifying gassing sites*" Ground Engineering 1999.
- Card & Steve Wilson in "*A pragmatic approach to ground gas risk assessment for the 21st Century*" – CIRIA/Environmental Protection UK Ground gas seminar 2011.
- BS 8576:2013 '*Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs)*'
- BS 8485:2015 '*Code of practise for the design of protective measures for methane and carbon dioxide ground gases for new buildings*'
- The Hazardous Waste (England) Regulations 2005.
- Environment Agency Hazardous Waste: "*Guidance on the classification and assessment of waste*" WM3 ver 1 May 2015.
- The National Planning Policy Framework (NPPF) March 2012
- DETR. Circular 02/2000 Contaminated Land.
- Environment Agency, 2009 '*Using Soil Guideline Values*'.
- Environment Agency, 2009 '*Updated Technical Background to the CLEA model*'.
- Environment Agency, 2009 '*Human health toxicological assessment of contaminants in soil*'.
- Department of the Environment, 1994, CLR Report No 1 '*A framework for assessing the impact of contaminated land on groundwater and surface water*'.
- Department of the Environment, 1994, CLR Report No 2 '*Guidance on Preliminary Site Inspection of Contaminated Land*'.
- Department of the Environment, 1994, CLR Report No 3 '*Documentary research on Industrial Sites*'.
- Department of the Environment, 1994, CLR Report No 4 '*Sampling Strategies for Contaminated Land*'.
- DEFRA and the Environment Agency, 2002-2004, CLR10 '*Soil Guideline Value Reports for Individual Soil Contaminants*'.
- LCRM "*Land Contamination Risk Management*", April 2021.
- Nathanail, C. P., McCaffrey, C., Gillett, A., Ogden, R. C. and Nathanail, J.F. 2015. The LQM/CIEH S4ULs for Human Health Risk Assessment. Land Quality Press, Nottingham.
- CL:AIRE, 2014 '*Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination*'.
- Water Framework Directive.
- Environmental Quality Standards.

UK Drinking Water Standards: Water Supply (Water Quality) Regulations 1989 (SI 1989/1147) and Water Supply (Water Quality) Regulations

UKWIR Report 10/WM/03/21 2010 “Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites”

Health & Safety Executive, 1991. ‘Protection of Workers & the General Public during the Development of Contaminated Land’.

Environment Agency & NHBC, 2000. R&D Publication 66. Guidance for the Safe Development of Housing on Land Affected by Contamination.

Environment Agency “Guidance on the classification and assessment of waste (1st edition 2015) Technical Guidance WM3”

NHBC Standards 2024

CL:AIRE “*The Definition of Waste: Development Industry Code of Practice*” Version 2 March 2011.

CIRIA “*Asbestos in soil and made ground: a guide to understanding and managing risks*” C733 2014.

Control of Asbestos Regulations (CAR) 2012.

Harris, M R, Herbert, S. M, Smith, M A ‘Remedial Treatment for Contaminated Land’ (twelve volumes), special publications 101-112, CIRIA 1996.

Department of the Environment. 1995. Industry Profiles - 48 separate publications available from The Stationery Office, London.

BRE Report 465 “Cover Systems for Land Regeneration” 2004.

Privett, K D, Matthews, S C, & Hodges, R, A, ‘Barriers, liners and cover systems for containment and control of land contamination’ 1996. CIRIA Special Publication 124.

BRE Digest 365 “Soakaway Design” 2016.

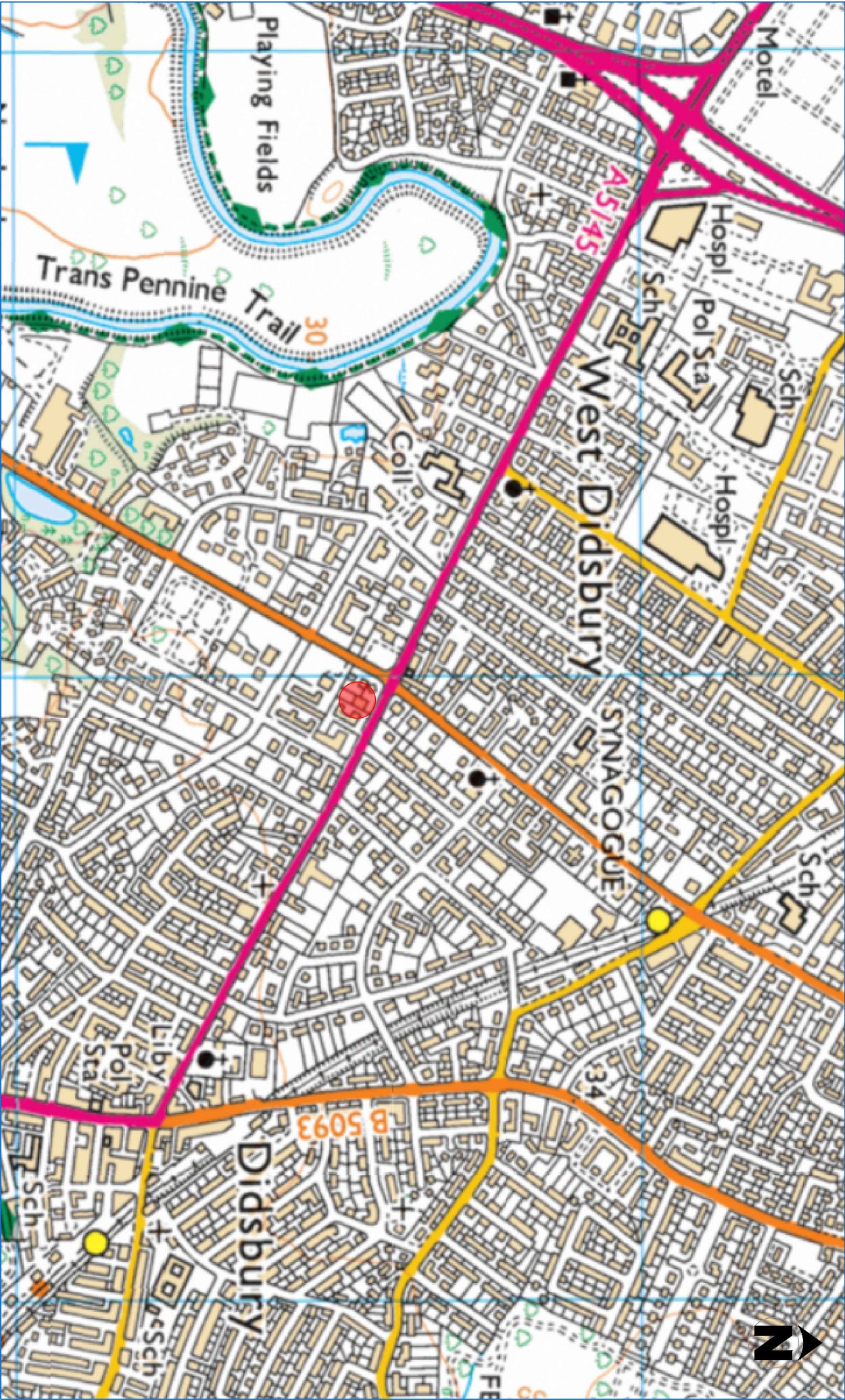
Environment Agency. R&D Publication 20. Methodology for the Derivation of Remedial Targets for Soil and Groundwater to Protect Water Resources. 1999.

Environment Agency Technical Guidance Note 01. Hydrogeological Risk Assessment for Landfills.

Specification for Highways Works – Series 600 Earthworks November 2016.



APPENDIX 1 - Plans



GROUNDTECH
CONSULTING



CLIENT	TAHIR AHMED
PROJECT TITLE	123 BARLOW MOOR ROAD, DIDSBUURY
PLAN TITLE	PROJECT LOCATION PLAN

DATE	MARCH 2024
SCALE	NIS
PLAN NUMBER	GRO-23382-P01

Rev.	Details		Date

Status	
Preliminary	
Draft	
Issued	●
For Comment	
Approved	

Notes

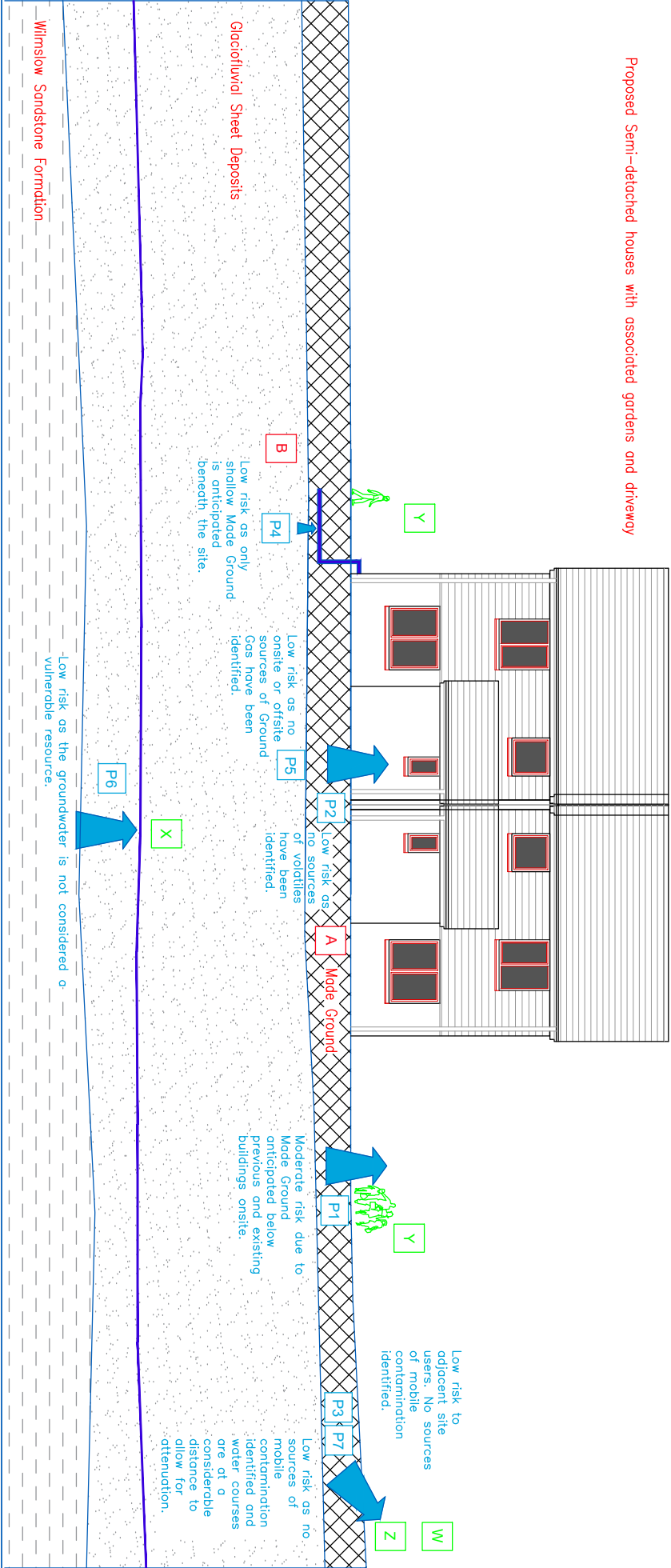
● Site Location



SOURCES
A. Contaminated soils / Made ground. B. Ground gas.

POLLUTION LINKAGES
P1. Ingestion of soil and dust. P2. Inhalation of vapour. P3. Inhalation of soil dust by adjacent site users. P4. Attacking of potable water supply pipe. P5. Migration and accumulation of ground gas in internal places. P6. Impaction of groundwater from soil contamination. P7. Migration of soil and groundwater contamination impacting surface waters.

RECEPTORS
Y. Site end users. X. Groundwater within the Secondary A superficial and Principal bedrock Aquifers. Z. Adjacent site users. W. Surface Water Features.

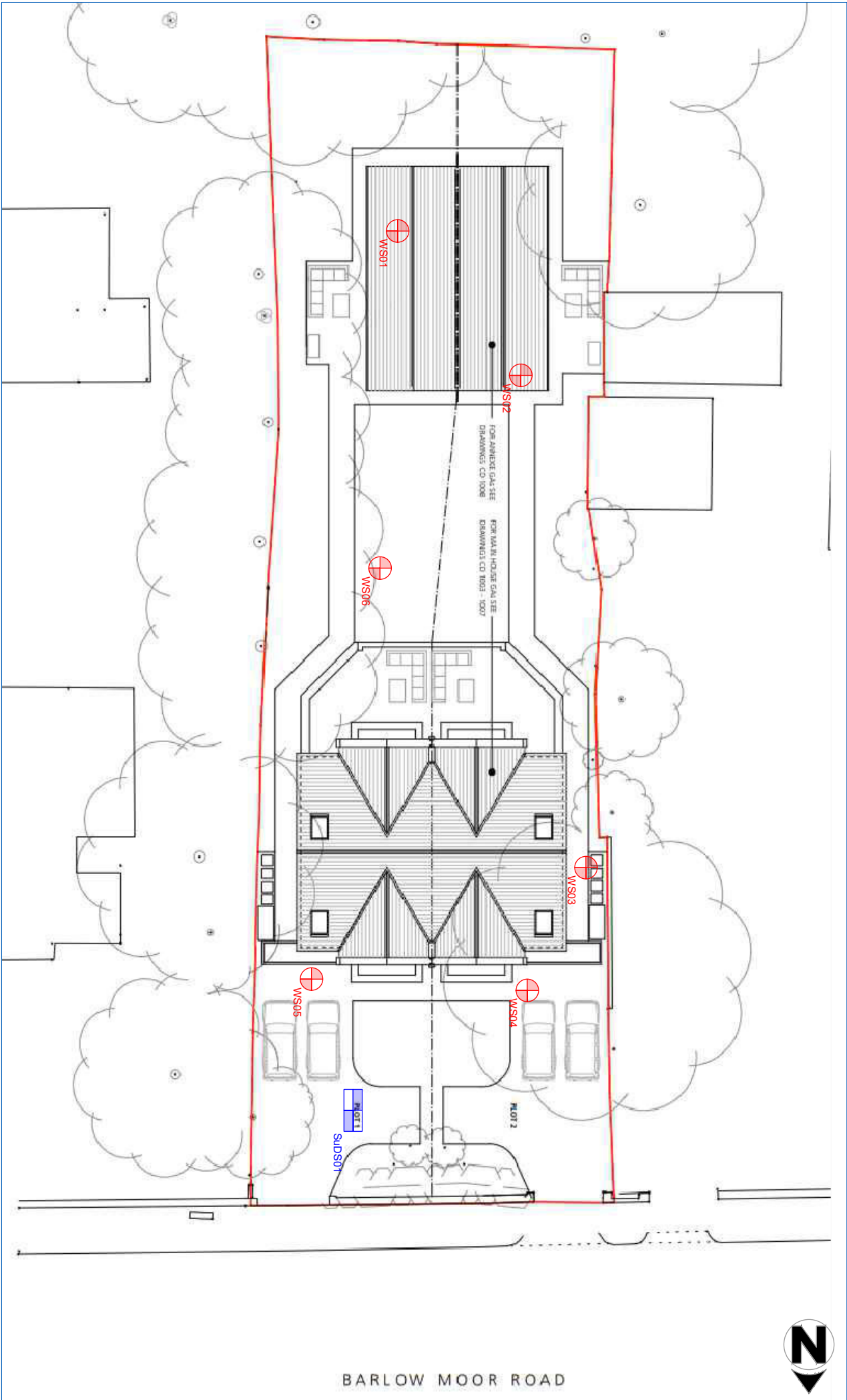


GROUNDTECH CONSULTING 	CLIENT	DATE		Status		Notes
	TAHIR AHMED	MARCH 2024		Preliminary		
	PROJECT TITLE	SCALE		Draft		
	123 BARLOW MOOR ROAD	NTS		Issued		
	PLAN TITLE	PLAN NUMBER		For Comment		
ILLUSTRATIVE PRELIMINARY CSM	GRO-23382-P03		Approved			
	Rev.	Details	Date			
						

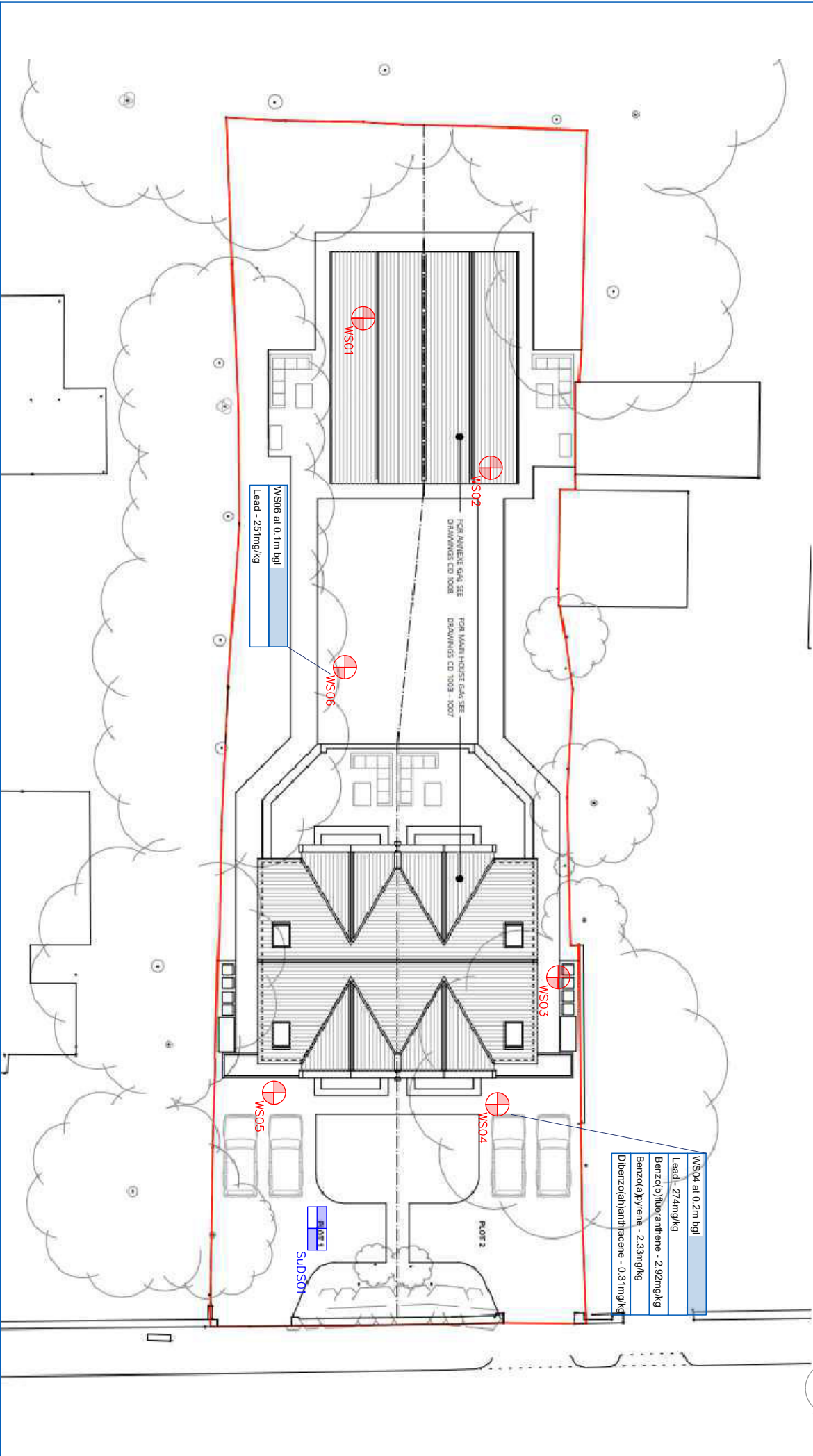




BARLOW MOOR ROAD



GROUNDTECH CONSULTING	CLIENT	TAHIR AHMED						Notes			
	PROJECT TITLE	123 BARLOW MOOR ROAD, DIDSBUURY						Windowless Sample Borehole Location			
	PLAN TITLE	EXPLORATORY HOLE LOCATION PLAN						Soil Percolation Test Location			
	DATE	JANUARY 2024									
	SCALE	NTS									
	PLAN NUMBER	GRO-23382-P04									
	Rev.	Details	Date		Status						
					Preliminary						
					Draft						
					Issued						
					For Comment						
					Approved						

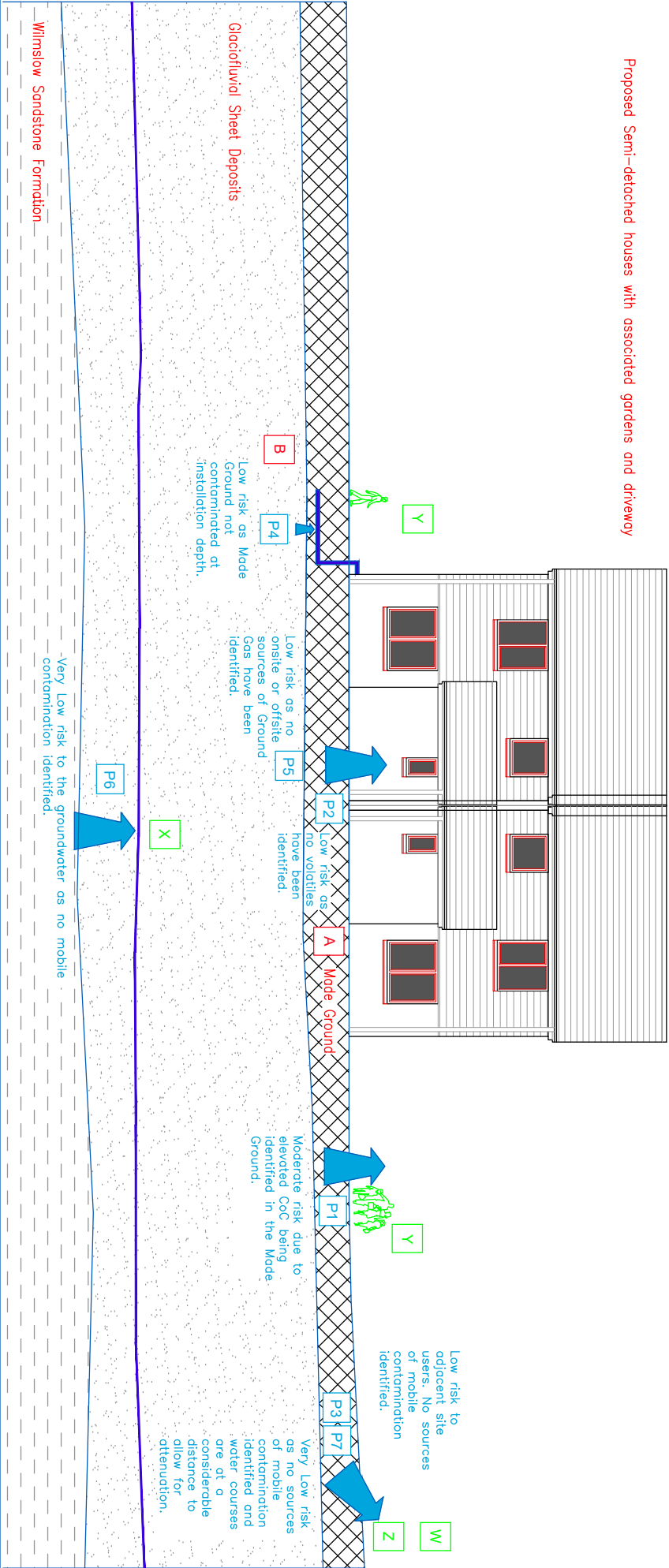


GROUNDTECH CONSULTING							
CLIENT				TAHIR AHMED			
PROJECT TITLE				123 BARLOW MOOR ROAD, DIDSBURY			
PLAN TITLE				SOIL CONTAMINATION PLAN			
DATE				MARCH 2024			
SCALE				NTS			
PLAN NUMBER				GRO-23382-P06			
Rev.		Details		Date		Status	
						Preliminary	
						Draft	
						Issued	
						For Comment	
						Approved	
				Notes			
							

SOURCES
A. Contaminated soils / Made ground. B. Ground gas.

POLLUTION LINKAGES
P1. Ingestion of soil and dust. P2. Inhalation of vapour. P3. Inhalation of soil dust by adjacent site users. P4. Attacking of potable water supply pipe. P5. Migration and accumulation of ground gas in internal places. P6. Impaction of groundwater from soil contamination. P7. Migration of soil and groundwater contamination impacting surface waters.

RECEPTORS
Y. Site end users. X. Groundwater within the Secondary A superficial and Principal bedrock Aquifers. Z. Adjacent site users. W. Surface Water Features.



GROUNDTECH CONSULTING 	CLIENT	DATE					Status		Notes
	TAHIR AHMED	MARCH 2024					Preliminary		
	PROJECT TITLE	SCALE					Draft		
	123 BARLOW MOOR ROAD, DIDSBURY	NTS					Issued		
	PLAN TITLE	PLAN NUMBER					For Comment		
REVISED ILLUSTRATIVE PRELIMINARY CSM	GRO-23382-P07		Rev.	Details	Date		Approved		
									

