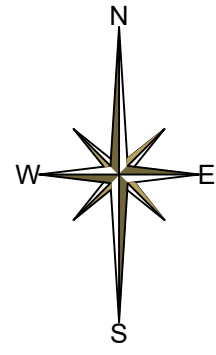


KEY

- EXISTING SURFACE WATER SEWER
- EXISTING COMBINED WATER SEWER
- EXISTING SURFACE WATER DRAIN
- EXISTING FOUL WATER DRAIN
- PROPOSED SURFACE WATER DRAIN
- PROPOSED FOUL WATER DRAIN
- PROPOSED SUMP MANHOLE
- PROPOSED MUGA SOAKAWAY SYSTEM
- EXISTING GULLY
- RED LINE BOUNDARY
- PHASE 2 BOUNDARY



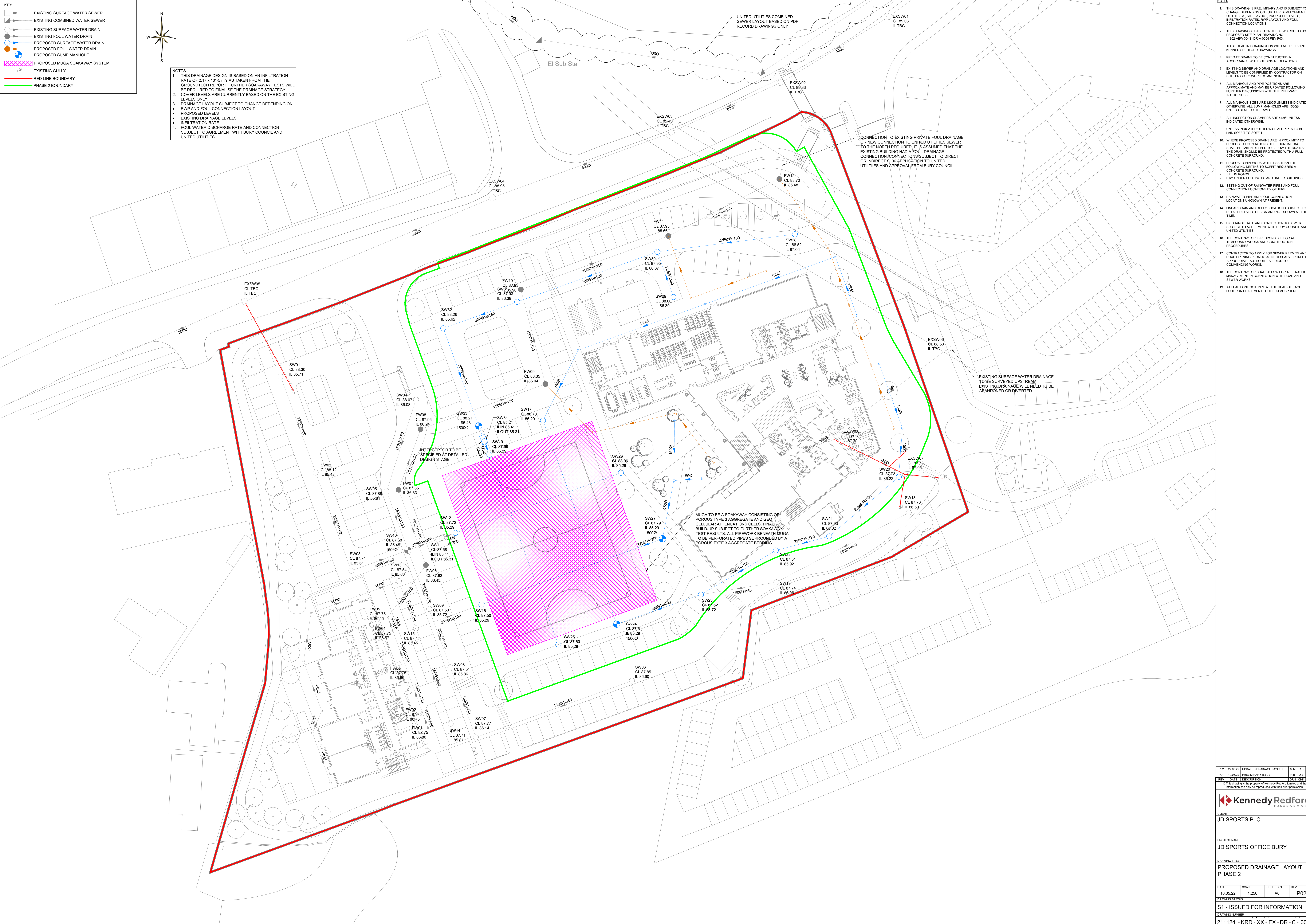
NOTES

1. THIS DRAINAGE DESIGN IS BASED ON AN INFILTRATION RATE OF 2.17 x 10⁻⁵ m/s AS TAKEN FROM THE GROUNDTECH REPORT. FURTHER SOAKAWAY TESTS WILL BE REQUIRED TO FINALISE THE DRAINAGE STRATEGY.

2. COVER LEVELS ARE CURRENTLY BASED ON THE EXISTING LEVELS ONLY.

3. DRAINAGE LAYOUT SUBJECT TO CHANGE DEPENDING ON:
• RWP AND FOUL CONNECTION LAYOUT
• PROPOSED LEVELS
• EXISTING DRAINAGE LEVELS
• INFILTRATION RATE

4. FOUL WATER DISCHARGE RATE AND CONNECTION SUBJECT TO AGREEMENT WITH BURY COUNCIL AND UNITED UTILITIES.



- NOTES**
- THIS DRAWING IS PRELIMINARY AND IS SUBJECT TO CHANGE DEPENDING ON FURTHER DEVELOPMENT OF THE D.A., SITE LAYOUT, PROPOSED LEVELS, INFILTRATION RATES, RWP LAYOUT AND FOUL CONNECTION LOCATIONS.
 - THIS DRAWING IS BASED ON THE AEW ARCHITECTS PROPOSED SITE PLAN, DRAWING NO. 11502-ARW-XS-SH08-A-0004 REV P03.
 - TO BE READ IN CONJUNCTION WITH ALL RELEVANT KENNEDY REDFORD DRAWINGS.
 - PRIVATE DRAINS TO BE CONSTRUCTED IN ACCORDANCE WITH BUILDING REGULATIONS.
 - EXISTING SEWER AND DRAINAGE LOCATIONS AND LEVELS TO BE CONFIRMED BY CONTRACTOR ON SITE, PRIOR TO WORK COMMENCING.
 - ALL MANHOLE AND PIPE POSITIONS ARE APPROXIMATE AND MAY BE UPDATED FOLLOWING FURTHER DISCUSSIONS WITH THE RELEVANT AUTHORITIES.
 - ALL MANHOLE SIZES ARE 1200MM UNLESS INDICATED OTHERWISE. ALL SUMP MANHOLES ARE 1500MM UNLESS STATED OTHERWISE.
 - ALL INSPECTION CHAMBERS ARE 475MM UNLESS INDICATED OTHERWISE.
 - UNLESS INDICATED OTHERWISE ALL PIPES TO BE Laid SOFFIT TO SOFFIT.
 - WHERE PROPOSED DRAINS ARE IN PROXIMITY TO PROPOSED FOUNDATIONS, THE FOUNDATIONS SHALL BE TAKEN DEEPER TO BELOW THE DRAINS OR THE DRAIN SHOULD BE PROTECTED WITH A FULL CONCRETE SURROUND.
 - PROPOSED PREWORK WITH LESS THAN THE FOLLOWING DEPTHS TO SOFFIT REQUIRES A CONCRETE SURROUND:
 - 1.3m IN ROADS
 - 0.6m UNDER FOOTPATHS AND UNDER BUILDINGS.
 - SETTING OUT OF RAINWATER PIPES AND FOUL CONNECTION LOCATIONS BY OTHERS.
 - RAINWATER PIPE AND FOUL CONNECTION LOCATIONS UNKNOWN AT PRESENT.
 - LINEAR DRAIN AND GULLY LOCATIONS SUBJECT TO DETAILED LEVELS DESIGN AND NOT SHOWN AT THIS TIME.
 - DISCHARGE RATE AND CONNECTION TO SEWER SUBJECT TO AGREEMENT WITH BURY COUNCIL AND UNITED UTILITIES.
 - THE CONTRACTOR IS RESPONSIBLE FOR ALL TEMPORARY WORKS AND CONSTRUCTION PROCEDURES.
 - CONTRACTOR TO APPLY FOR SEWER PERMITS AND ROAD OPENING PERMITS AS NECESSARY FROM THE APPROPRIATE AUTHORITIES, PRIOR TO COMMENCING WORKS.
 - THE CONTRACTOR SHALL ALLOW FOR ALL TRAFFIC MANAGEMENT IN CONNECTION WITH ROAD AND SEWER WORKS.
 - AT LEAST ONE SOIL PIPE AT THE HEAD OF EACH FOUL RUN SHALL VENT TO THE ATMOSPHERE.

PO2	27.05.22	UPDATED DRAINAGE LAYOUT	M.M.	R.B.	R.K.
PO1	10.05.22	PRELIMINARY ISSUE	R.B.	D.B.	R.K.
REV	DATE	DESCRIPTION	DRN	CHK	APP

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CLIENT
JD SPORTS PLC

PROJECT NAME
JD SPORTS OFFICE BURY

DRAWING TITLE
PROPOSED DRAINAGE LAYOUT
PHASE 2

DATE	SCALE	SHEET SIZE	REV
10.05.22	1:250	A0	PO2

DRAWING STATUS
S1 - ISSUED FOR INFORMATION

DRAWING NUMBER
211124 - KRD - XX - EX - DR - C - 0002

Appendix H – Site Investigation

Geo-Environmental Appraisal by GroundTech – 31 March 2022 (162 pages)

Phase 2 Site Investigation by ROC Consulting – 1 December 2021 (59 pages)



GROUNDTECH
CONSULTING

Job title: New Office Block, Bury

Report type: Geo-Environmental Appraisal

Prepared for: JD Sports

Date: 31 March 2022

Document Control Form	
PROJECT	NEW OFFICE BLOCK, BURY
REPORT NAME	GEO-ENVIRONMENTAL APPRAISAL
REPORT REFERENCE	GRO-21438-3308
STATUS	FINAL
ISSUE DATE	31 MARCH 2022
REVISION	
CLIENT	JD SPORTS
CLIENT CONTACT	-
For and Behalf of Groundtech Consulting	
SIGNATURE	
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SIGNATURE	
CHECKED	Callum Holden BSc (Hons) FGS
SIGNATURE	
REVIEWED	James Doyle BSc (Hons) CGeol FGS

SUMMARY

Site Details		
Site Location	The site is located circa 2.4km south east of Bury Town Centre and is approximately centred on National Grid Reference 381527, 408662.	
Site Area	The site is relatively level across its footprint and roughly rectangular in shape, encompassing an area of approximately 1.5 Ha. The site is predominantly formed by concrete hardstanding and is generally featureless. Unsurfaced rough ground is present in the north east in the footprint of the former warehouse building.	
Preliminary Risk Assessment		
Pollution Linkage (PL) Assessment	Human Health	The risk to human health was considered to be Moderate to Low.
	Controlled Waters	The risk to controlled waters was considered to be Low.
	Permanent Ground Gas	The risk from permanent ground gases was considered to be Moderate to High.
Ground Model		
Made Ground Soils	Made Ground was encountered in all locations to a maximum depth of 1.8m bgl, although it was generally less than 1.0m thick and typically comprised concrete or tarmac overlying brown gravelly sand or sandy gravel.	
Natural Soils	The natural strata encountered generally comprised orange brown slightly gravelly occasionally clayey Sand which was encountered underlying the Made Ground to depths between 4.0m and 6.0m bgl. This was in turn generally underlain by interbedded soft to firm sandy Clay and silty clayey Sand to depths between 15.5m and 17.0m bgl where firm to stiff sandy slightly gravelly Clay was encountered to the base of the Cable Percussive boreholes that progressed to this depth.	
Bedrock	Sandstone bedrock was encountered within BH01 at 23.5m and BH04 at 27.3m bgl and was present to the base of the boreholes at 45.0m bgl.	
Groundwater	Groundwater strikes were observed within the natural sand across the site from depths between 1.6m and 6.5m bgl.	
Ground Engineering Assessment		
Foundations	The most suitable foundations for the proposed development are considered to be piles transferring loads to the underlying medium dense to dense Sand. Based on the proposed loadings provided, pile groups will be required.	
Highways	Plate load testing was undertaken at five locations across the site and CBR values ranged between 1.6% and 5.4%. Proof rolling of the subgrade will be required as a minimum.	

SuDS	<i>Soil percolation testing was undertaken at a single location (SuDS1) within the natural Sand and infiltration rates recorded ranged between 2.17×10^{-5} and 4.37×10^{-5} m/s which are considered good drainage conditions and SuDS drainage is likely to be feasible for the proposed development.</i>
Constraints	<i>The main limitation of the site is the poor ground conditions observed to a maximum depth of 11.5m bgl in the form of loose to medium dense sand deposits overlying very soft to soft Low strength Clay in all boreholes. The loose Sand and low strength Clay are not considered a suitable bearing stratum for the proposed development which will exert high column loads.</i> <i>A high-pressure gas main is present in the north eastern corner of the site. An easement will be required in the vicinity of the gas main which should be accurately located prior to development.</i>
GQRA and Revised (PL) Assessment	
Human Health	<i>No elevated contamination has been detected, asbestos has been detected in two out of eight samples at low concentrations. Where present the proposed building and hardstanding will act as a cover layer for asbestos containing soils, in areas of soft landscaping a 600mm cover system should be in place. The risk to human health is considered to be Moderate prior to remedial action.</i>
Controlled Waters	<i>The risk to controlled waters is considered to be Low.</i>
Permanent Ground Gas	<i>A single gas monitoring visit has been undertaken to date and the site has been classified as CS1 and gas protection measures are not considered necessary at this stage. This will be confirmed or otherwise on completion of the monitoring programme.</i> <i>The site is not in an area affected by radon.</i>
Final Appraisal	

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

- *Completion of gas monitoring programme.*
- *Issue gas assessment.*
- *Detailed Foundation design.*
- *Confirmation of remedial recommendations with regulators.*

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Plans		
<i>Plan Reference</i>	<i>Revision</i>	<i>Title</i>
GRO-21438-P01	-	Project Location Plan
GRO-21438-P04	-	Exploratory Hole Location Plan
GRO-21438-P05	-	Generalised Ground Model
GRO-21438-P06	-	Revised Illustrative CSM

1.0 INTRODUCTION

1.1 Project Objectives

Groundtech Consulting Limited have been instructed by Kennedy Redford on behalf of their client JD Sports to undertake a Geo-Environmental Appraisal for a site off Pilsworth Road in Bury.

A main investigation was undertaken in accordance with BS 5930:2015, BS 10175:2017, BS 8576:2013, CIRIA C758 and Eurocode 7 to revise the CSM and quantify the level of risk identified in the PRA. The Appraisal has been prepared in accordance with current UK Legislation and to discharge Land Quality pre-commencement planning conditions.

The following reports have previously been produced for the site:

- Preliminary Risk Assessment referenced GRO-21438-3118, dated February 2022 produced by Groundtech Consulting Limited.
- Coal Mining Risk Assessment referenced GRO-21438-3119, dated 26 January 2022 produced by Groundtech Consulting Limited.
- Phase 2 Site Investigation referenced 4251-ROC-ZZ-XX-RP-ES-PH2SI, dated 01 December 2021 produced by RoC Consulting.

1.2 Proposed Development

The proposed development is commercial end use comprising a three-storey office block with associated staff welfare facilities including two five-a-side football pitches.



1.3 Limitations

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

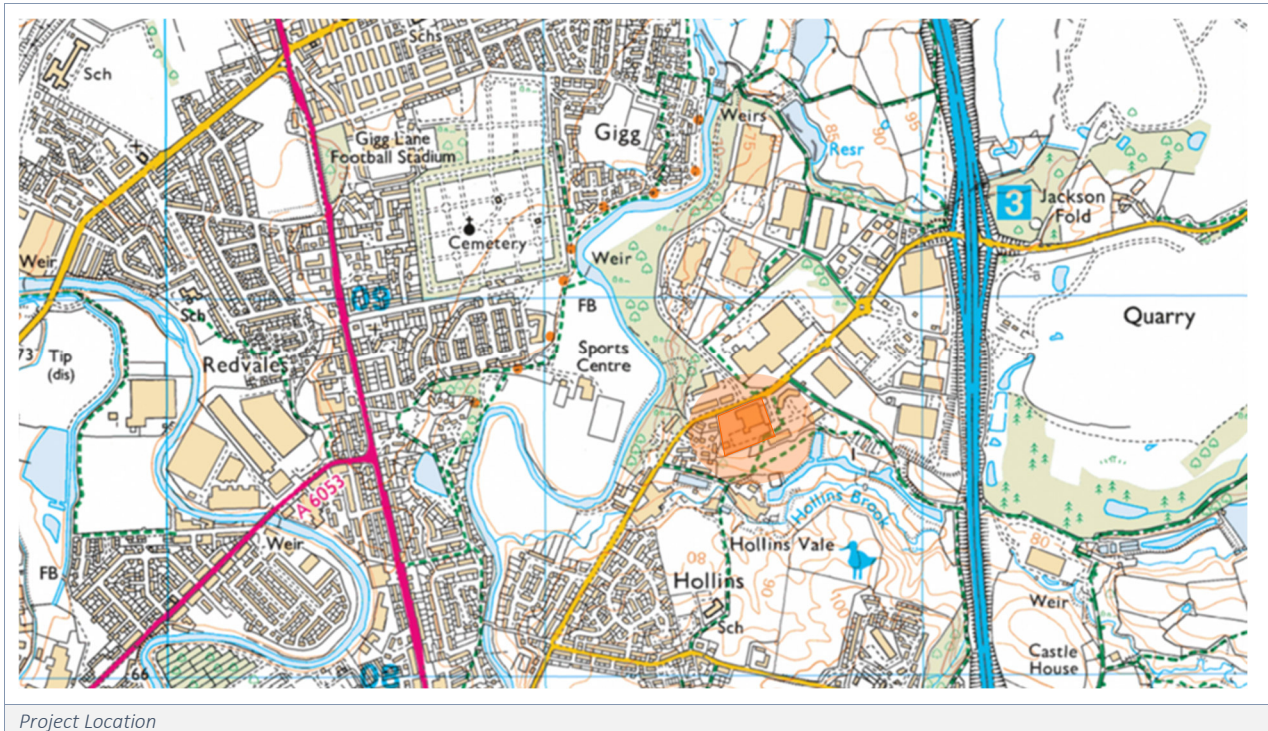


The assessment has been prepared for the exclusive use of the client. No third parties may rely on or reproduce the contents of the report without the written permission of Groundtech Consulting Limited. If any unauthorised third party comes into possession of the report they rely on it at their own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

2.0 SITE SETTING

2.1 Location

The site is located circa 2.4km south east of Bury Town Centre, as shown on the Project Location Plan GRO-21438-P01. The site is approximately centred on National Grid Reference 381527, 408662.



Access to the site is gained off Pilsworth Road to the north east of the site.

2.2 Site Description

The site is relatively level across its footprint and roughly rectangular in shape, encompassing an area of approximately 1.5 hectares.

Site Features

The site was most recently occupied by a large warehouse unit which has recently been demolished. The footprint of the former building is surfaced with uneven ground with grass and some light vegetation. The remainder of the site is surfaced predominantly with concrete and is generally featureless.

A gas main crosses the north east corner of the site.

A vegetated strip is present along the sites northern boundary with some semi-mature and mature trees present.

Site Boundaries and Surrounding Features

The site boundaries are formed by metal fencing and trees are present close to the sites northern, eastern and southern boundaries.

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



- North - *Pilsworth Road followed by light industrial/commercial units.*
- East - *Hollins Brook Way, commercial offices and an associated car park.*
- South - *Commercial office premises and Local Nature Reserve.*
- West - *Commercial buildings and residential housing estate.*

Site photographs are presented in *Appendix 2*.

3.0 PREVIOUS INVESTIGATIONS SUMMARY

3.1 Introduction

The following sections summarise the following reports previously completed for the site:

- *Preliminary Risk Assessment referenced GRO-21438-3118, dated February 2022 produced by Groundtech Consulting Limited.*
- *Coal Mining Risk Assessment referenced GRO-21438-3119, dated 26 January 2022 produced by Groundtech Consulting Limited.*
- *Phase 2 Site Investigation referenced 4251-ROC-ZZ-XX-RP-ES-PH2SI, dated 01 December 2021 produced by RoC Consulting.*

3.2 Site History and Consultations

Site History

The earliest historical records from 1848/51 indicate the site was formed by fields and was undeveloped. Six reservoirs were located between 80m and 150m south. The site remained undeveloped and formed by fields until the 1980s when a warehouse was constructed on the site which has been the only development on site until it was recently demolished.

3.3 Geology and Hydrogeology

Made Ground was not indicated to be present beneath the site, however Made Ground is thought to be present due to past development on the site.

The superficial deposits indicated to underly the site are Hummocky (moundy) Glacial Deposits which characteristically comprises clay, sand, and gravel and are classified as a Secondary A Aquifer.

The solid geology is indicated to be the Trencherbone Rock comprising Sandstone which is classified as a Secondary A Aquifer.

A coal seam is shown to subcrop on site striking north west to south east, dipping to the south west at an angle of 15°. The seam subcropping the site is not named on BGS geological maps.

3.4 Preliminary Conceptual Site Model

The following risks were identified by Groundtech Consulting Limited:

Receptor	Risk	Discussion
Site End Users from Contaminated Soils	Moderate to Low	Made Ground is likely present associated with the previous demolished commercial building and may be contaminated with a range of CoC. Soft landscaping will be present as part of the development.
Site End Users from Inhalation of Vapours	Low	Gross hydrocarbon contamination from former plant hire yard not anticipated.
Potable Water Supply Pipe	Moderate to Low	Former plant hire yard may be a source of organic contamination at installation depths.
Site End Users from Inhalation of Gas	Moderate to High	Deep Made Ground may be present associated with demolition of previous building on site. Numerous

		<i>sources identified in vicinity of site including landfills, ponds and reservoirs.</i>
<i>Controlled Waters</i>	<i>Low</i>	<i>Gross mobile contamination not anticipated and hardstanding across site will have restricted downward migration of contaminants.</i>

3.5 Coal Mining Risk Assessment

A Coal Mining Risk assessment was carried out by Groundtech Consulting which comprised a desk-based review of all available information related to coal mining at the site and should be read in conjunction with this report. The key findings are summarised below:

Recorded Coal Mining

The site is in an area requiring a Coal Mining Report. The Coal Authority Report confirms the property is not within a surface area that could be affected by any past recorded underground coal mining. However, the property is in an area where the Coal Authority believes there is coal which may have been worked at some time in the past.

There are no mine entries on or within 20m of the site and the site is not affected by recorded opencast coal mining.

No risk has been identified from recorded underground coal mine workings at the site.

Unrecorded Coal Mining

The southern half of the site, to the south of the coal seam bisecting the site is indicated to be within a Development High Risk Area and probable unrecorded coal mine workings are indicated in this area.

The coal seam subcropping at the site is anticipated to be the Blenfire Coal or Trencherbone Coal, both of which are recorded as being worked in the area.

A potential risk was identified from unrecorded mine workings and further investigation including intrusive boreholes was required.

3.6 Ground Model

RoC Consulting undertook a Ground Investigation at the site previously to inform proposed road widening works on Hollins Brook Way. The exploratory holes were resultantly localised to the eastern site boundary and are therefore not representative of wider site conditions.

The following scope of works was undertaken by RoC Consulting in October 2021:

- 3 No. windowless sample boreholes drilled to 5.45m bgl (WS101 to WS103).
- 2 No. TRL DCP tests (DCP101 to DCP102).
- 3 No. vacuum excavated slit trenches to locate the high pressure gas main (ST101 to ST103).

Made Ground was encountered at surface level in WS101 and WS102 as tarmac ranging in thickness from 0.05 to 0.1m bgl which was underlain by a limestone gravel subbase to circa 0.2m bgl.

At WS103 Topsoil was encountered at the surface to 0.2m bgl and underlain by a granular demolition fill material containing brick and limestone to 0.8m bgl this was also encountered in WS101 and WS102 to 0.5 and 0.7m bgl respectively.

In WS101 a thin layer of demolition fill material contained within a clay matrix was encountered at 0.50 to 0.75m bgl.

Groundwater strikes were not recorded within the Made Ground.

Immediately underlying Made Ground deposits at all boreholes was interbedded Sand and Clay deposits. Clay was generally comprised of orangish brown sandy clay gravelly Clay. Sand deposits were found to comprise a light brown fine to medium sand/gravelly silty sand.

The Phase 2 site investigation undertaken by RoC Consulting states that SPT values ranged from 2 to 16 in Clay deposits and 2 to 16 in Sand deposits.

Groundwater was not encountered within Glacial Clay deposits or Sand deposits

No visual or olfactory evidence of contamination was observed during the site works.

3.7 Geo-Environmental Testing Results

Six samples were screened for a range of CoC associated with the sites former use. Results from chemical testing analysis indicate there were no exceedances of Contaminants of Concern when screened against a commercial end use scenario. As such the site is not considered to pose a risk toward future users or construction persons during the development process. No asbestos was detected in any of the samples.

Groundwater was not encountered during the investigation and therefore no groundwater testing was undertaken.

3.8 Ground Gas

Ground gas monitoring standpipes were not included as part of the RoC investigation as the proposed development was associated with highway works.

3.9 Remedial Strategy

No specific remedial measures were recommended with respect to contaminated soils at the site due to the lack of elevated contamination identified.

3.10 Geotechnical

The Phase 2 site investigation undertaken by RoC Consulting states that CBR values ranged between 1% and 33% at the two locations where tests were undertaken with less than 5% being acceptable.

The plasticity index range varied between 4 and 16% with a mean value of 11%. These results indicate the Clay to be of a low plasticity.

Two Glacial Clay samples were tested for the determination of undrained shear strength from a depth of 1.0m bgl. Shear strength results vary between 103 and 194kPa with a mean value of 148.5kPa. These results indicate shallow Clay strengths vary between high to very high.



3.11 Gas Main Delineation

The high-pressure gas main present below the site was exposed by vacuum and hand excavation techniques. It was discovered that a protective concrete slab (c.900m in width) was present above the pipe along the entirety of the proposed junction works and beyond.

4.0 SCOPE OF INVESTIGATION AND RATIONALE

4.1 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 analysis.
Identify realistic pollution linkages to groundwater.
Determine the presence of unrecorded mine workings.
Calculate soil infiltration rates to determine feasibility of SuDS drainage.
Determine modulus of subgrade reaction to inform highway/pavement design.
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.
Install monitoring standpipes for gas and groundwater monitoring.
Assess the identified pollution linkages in the CSM.

4.2 Scope of Works

The following scope of works was completed between the dates of 24th January and 4th February 2022:

- 4 No. cable percussive boreholes (BH01 to BH04) were drilled to depths between 15m and 20m bgl.
- Follow on Rotary open hole drilling was carried out from the base of cable percussive boreholes (BH01 & BH04) to a final depth of 45.0m bgl.
- 5 No. plate load tests were carried out at depths between 0.5m and 0.7m bgl.
- 3 No. trial pits (TP01 to TP03) were carried out to a maximum depth of 3.0m bgl.
- 1 No. soil percolation test (SuDS01) was carried out at a depth of 1.5m bgl.

The exploratory hole locations are presented on Groundtech Plan GRO-21438-P02 and the exploratory hole logs are in Appendix 3.

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
BH01 & BH04	Potential coal mine workings and building footprints
BH01 to BH04	Proposed building footprints
TP01 to TP03	Proposed car park/ Highways & Former plant hire yard
SuDS1	Feasibility of SuDS drainage
CBR1 to CBR5	Proposed highways, car parks and landscaped areas

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

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

4.3 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>22</i>
<i>Disturbed Sample</i>	<i>74</i>
<i>Undisturbed U100 Sample</i>	<i>9</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.

4.4 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.

Determinand	Matrix	Number
<i>Arsenic, cadmium, chromium (total and hexavalent), copper, lead, mercury, nickel, selenium, zinc and pH.</i>	<i>Soil</i>	<i>8</i>
<i>Total Petroleum Hydrocarbons (TPH CWG)</i>	<i>Soil</i>	<i>3</i>
<i>Asbestos Screening</i>	<i>Soil</i>	<i>8</i>
<i>Asbestos Quantification</i>	<i>Soil</i>	<i>2</i>
<i>Waste Acceptance Criteria (WAC)</i>	<i>Soil</i>	<i>2</i>

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

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

BS 1377	Test Method	Number
Part 2	Water Content	5
Part 2	Plasticity Index Analysis	5
Part 2	Particle Size Distribution	2
Part 7	Determination of Undrained Shear Strength in Triaxial Compression	8
BRE	BRE Full Suite	5

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

4.5 Gas and Groundwater Monitoring/Sampling

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

Location	Depth	Response Zone (m bgl)	Targeted Strata	Reason
BH01	5.0	1.0 - 5.0	Sand	Ground Gas
BH02	5.0	1.0 - 5.0	Sand & Clay	Ground Gas
BH04	5.0	1.0 - 5.0	Gravel, Sand & Clay	Ground Gas

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

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

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

Interim permanent gas and groundwater monitoring results are presented in *Appendix 6*.

5.0 GROUND MODEL

5.1 Made Ground

Made Ground was encountered across the site to a maximum depth of 1.8m bgl and the surface of the site was almost entirely covered with concrete to a maximum depth of 0.3m bgl encountered at location SuDS1, TP01, TP02, TP03 and BH04.

Where the previously existing building had been demolished, the surface consisted of backfill material. In the east of the site. Where BH03 was drilled, there was tarmac surfacing to a depth of 0.15m bgl.

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

- *Dark brown to black sandy gravel in SuDS1, TP01, TP03, BH03, and BH04 underlying the hardstanding from a minimum depth of 0.3m bgl to a maximum depth of 1.3m bgl.*
- *Dark brown clayey gravelly sand in TP02, BH01, and BH02 from a minimum depth at ground level to a maximum depth of 0.9m bgl.*
- *Orange brown sandy gravel in BH03 between depths of 0.4m and 1.8m bgl.*



Exploratory Hole Locations

5.2 Natural Ground

The natural strata encountered generally confirmed the published geological records and typically comprised orange brown slightly gravelly occasionally clayey Sand which was encountered underlying the Made Ground to depths between 4.0m and 6.0m bgl.

This was in turn generally underlain by interbedded soft to firm sandy Clay and silty clayey Sand to depths between 15.5m and 17.0m bgl where firm to stiff sandy slightly gravelly Clay was encountered to the base of the Cable Percussive boreholes.

Four main natural stratification encountered during the investigation and are described below:

- *Orange brown slightly gravelly locally clayey medium to coarse Sand in SuDS1, TP01, TP02, TP03, BH01, BH02, and BH03 between depths of 0.75m and 6.0m bgl.*
- *Very soft to soft brown sandy Clay was encountered in BH01 to BH04 from a minimum depth of 4.0m bgl to a maximum depth of 11.5m bgl.*
- *Firm to stiff brown locally gravelly sandy Clay was in BH01 to BH04 from a minimum depth of 6.0m bgl to a maximum depth of 20.0m bgl.*
- *Brown, occasionally silty, occasionally clayey Sand in BH01 to BH04 from a minimum depth of 7.5m bgl to a maximum depth of 17.5m bgl.*

5.3 Bedrock

Bedrock was encountered within BH01 and BH04 at 23.5m and 27.3m bgl respectively and consisted of Sandstone to the maximum investigation depth of 45.0m bgl where the boreholes were terminated.

5.4 Groundwater

Groundwater strikes were observed at locations TP01 to TP03, BH02 and BH03 at depths between 1.6m and 4.0m bgl and were observed within the natural Sand deposits.

5.5 Watching Brief

A watching brief was maintained during the ground investigation for visual and olfactory evidence of contamination.

Ash was encountered within the Made Ground in BH03 between the depths of 0.4m and 1.8m bgl. No other evidence of potential contamination was noted during the investigation.

5.6 Excavation Stability

Collapse was noted during excavation of all trial pits within the natural Sand deposits locally due to the presence of groundwater.

5.7 Excavation/ Borehole Progress

Slow progress while excavating the trial pits or advancing the boreholes was not experienced. No obstructions were noted during the investigation.

6.0 GROUND ENGINEERING

6.1 Geotechnical Testing Results

Comparison of water content and the value of 0.4 times the Liquid Limit in accordance with BRE Digest 412 'Desiccation in Clay Soils' suggests significant desiccation has taken place when 0.4 times the Liquid Limit is greater than the actual water measured water content. This is a rudimentary method but also a good guide.

Results of the plasticity testing and the volume change potential of the Clay is summarised in the table below:

Reference	Depth	Modified PI	Volume Change Potential	Dessicated Y/N
TP02	0.70	23.00	Medium	No
BH01	6.00	19.00	Low	No
BH02	4.00	18.00	Low	No
BH03	6.50	20.68	Medium	No
BH04	4.00	19.40	Low	No

Quick undrained triaxial testing was carried out on eight samples of natural undisturbed Clay and the results of the triaxial test are summarised in the table below:

Reference	Depth (m)	Undrained Shear Strength (kN/m ²)	Relative Strength
BH01	6.5	24.0	Low
BH01	9.5	30.0	Low
BH01	12.5	89.0	High
BH02	6.5	23.0	Low
BH02	9.5	31.0	Low
BH03	5.0	23.0	Low
BH03	9.0	69.0	Medium
BH04	17.0	71.0	Medium

Particle Size Distribution Testing was undertaken two samples of silty sandy Clay and the results are included within the strata descriptions on the exploratory hole logs presented in *Appendix 3*.

6.2 Assessment Background

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 to high level of confidence, the ground model has evolved from the information obtained by the PRA.

The site is flat lying and was most recently occupied by a large warehouse unit which has recently been demolished. The footprint of the former building is surfaced with uneven ground with grass and some light vegetation. The remainder of the site is surfaced predominantly with concrete and is generally featureless. A high pressure gas main crosses the north east corner of the site. The hardstanding across the site will require breaking out and crushing as part of the enabling works, any below ground substructure associated with the former building will require grubbing out, and also sorted and crushed for reuse.

It is proposed to develop a maximum 3-storey office block to the east of the site and separate Creche facility building on the western boundary of the site. The design of the superstructure elements has not yet been fully developed, but it is envisaged that a framed structure of beams and columns supporting upper floors and roof will be appropriate. It is anticipated that columns loads for the development will be in the order 500 to 2000 kN (SLS).

Ground Conditions

Made Ground was encountered across the entire site to a maximum depth of 1.8m bgl. However, Made Ground was generally present to less than 1.0m bgl. The Made Ground was almost entirely composed of granular material. Natural strata encountered generally comprised orange brown medium to coarse Sand between the depths of 0.75m and 6.0m bgl which was underlain by interbedded very soft to soft brown sandy Clay/brown locally clayey Sand. Firm to stiff dark brown sandy locally gravelly Clay was encountered to a maximum depth of 20.0m bgl in the cable percussive boreholes.

Bedrock was encountered within BH01 and BH04 at 23.5m and 27.3m bgl respectively and consisted of Sandstone to a maximum depth of 45.0m bgl where the boreholes were terminated. No coal seams or evidence of coal mine workings were encountered during the investigation.

Groundwater has been encountered across the site within the natural Sand deposits between depth of 1.6m and 4.0m bgl.

Limitations

The main limitation of the site is the poor ground conditions observed to a maximum depth of 11.5m bgl in the form of loose to medium dense sand deposits overlying very soft to soft Low strength Clay which was encountered in all boreholes. The loose Sand and low strength Clay is not considered a suitable bearing stratum for the proposed development which will exert high column loads.

Due to the proposed loadings it is anticipated that a deep foundation solution will be required, transferring loads to the underlying high strength Sand strata at depth. The depth to bedrock is another factor that will need to be taken into consideration for foundation design.

A high-pressure gas main is present in the north eastern corner of the site which has previously been located and exposed by RoC Consulting during a previous investigation. Where exposed the gas main had a protective concrete covering. However, this may not be present across the entire length of the gas main on site. An easement will be required in the vicinity of the gas main which should be accurately located prior to development and Cadent should be consulted and informed of the proposed development plans so that necessary mitigation measures can be implemented.

Groundwater has been encountered across the site between 1.6m and 4.0m bgl and dewatering of excavations may be required due to seasonal fluctuations or artificial ground levels caused by construction activities.

6.3 Geotechnical Parameters

The geotechnical test results have been evaluated to derive geotechnical parameters for the soils underlying the site. A 'Depth to C_u ' and 'Depth to SPT N ' value graph is presented on GRO-21438-P05 to provide a generalised ground model for the site.

Characterization of the geotechnical parameters above has been undertaken to select a characteristic value, which is a cautious estimate of the value affecting the occurrence of the limit state.

- For the loose Sand, a characteristic SPT 'N' value of 6 has been recorded and by correlation a ϕ' of 28° has been selected for ULS conditions.
- For the medium dense Sand, a characteristic SPT 'N' value of 11 has been recorded and by correlation a ϕ' of 30° has been selected for ULS conditions.
- For the dense Sand, a characteristic SPT 'N' value of 40 has been recorded and by correlation a ϕ' of 45° has been selected for ULS conditions.
- For the low strength Clay an undrained shear strength (C_u) characteristic value of 23kPa has been selected to satisfy ULS conditions based on direct measurement from laboratory testing.
- For the medium strength Clay an undrained shear strength (C_u) characteristic value of 69kPa has been selected to satisfy ULS conditions based on direct measurement from laboratory testing.
- For the high strength Clay an undrained shear strength (C_u) characteristic value of 89kPa has been selected to satisfy ULS conditions based on direct measurement from laboratory testing.

6.4 Preliminary Foundation Design – Office Building

As loose Sand and soft low strength Clay has been encountered beneath the site to a maximum depth of 11.5m bgl, traditional shallow foundations are not considered suitable for the proposed commercial development. We understand that it is anticipated that column loads for the development will be in the order 500 to 2000 kN (SLS). Preliminary design has been undertaken based on this criterion.

Loads will be transferred to the piles from ground beams, pile caps and floor slabs of the superstructure. Transverse loading on the piles and the requirement for reinforcement should be taken into consideration in the detailed design to satisfy Equilibrium Limit State conditions.

Pile Foundations

The most suitable foundations for the proposed development are considered to be piles end-bearing within the medium dense to dense Sand. Deepening the piles to the underlying Sandstone which has been encountered from depths between 23.5m and 27.3m bgl is also an option, however unlikely to be economical. End bearing in the firm to stiff Clay does not provide sufficient allowable load for a single pile.

Good workmanship will be required when installing the piles to ensure the assumptions in the design by calculation are met. The type of pile should provide sufficient lateral stability due to the poor ground conditions observed up to 11.5m bgl.

Both CFA and driven piles are considered to be suitable, the allowable loads for the different diameter and types of piles are discussed below.

A suitable working platform should be designed in accordance with BR470 in advance of the piling works.

Piled Solution – Design by Calculation

Preliminary design by calculation has been carried out using due skill and care using the global factor of safety method for pile design, a global factor of safety of 3 has been used. An allowable load has been calculated for a single pile for each cable percussive borehole and is summarised in the table below:

	BH01	BH02	BH03	BH04
CFA Pile (600mm 15-16m)	1350kN*	1550kN	1450kN	1320kN
Driven Pile (300mm 15-16m)	530kN*	600kN	600kN	560kN

*proposed creche area and piles unlikely to be required

For a 600mm diameter pile 15m in length end bearing in the medium dense Sand, allowable loads between 1320kN and 1550kN can be achieved for a 600mm diameter CFA pile. Pile groups will be required for the proposed maximum allowable load of 2000kN. The allowable loads are based on the assumption the piles end bear in the medium dense to dense Sand.

The end bearing resistance of CFA piles will depend on the drilling technique and magnitude of disruption of the medium dense to dense Sand which may reduce the base resistance.

The variability of the Sand end bearing strata requires discussion with the piling contractor. In BH03 and BH04 the Sand strata was encountered shallower at between 7.5m and 10.3m bgl, the strata was in excess of 4.7m and 8m thick. The Sand was encountered between 14m and 17.5m bgl in BH02 (where the borehole was terminated) and was interbedded with stiff Clay. High SPT values of between 40 and 44 were recorded in this strata.

Based on the variability of the end bearing strata, driven piles may be a better solution as they can be driven to sett using pile driving formulae. This will allow the drilling process to determine the end bearing strata over the piling area and the design to be verified or revised accordingly. Relatively conservative N_q bearing capacity factors have been used for the Sand strata and driven piles would allow a more efficient design to be produced if favourable ground conditions are encountered.

In BH03 and BH04 Clay strata beneath the Sand was circa 15m bgl, therefore piles should be shorter to ensure they end bear in the Sand strata and sufficient Sand for the depth of influence of the pile is beneath.

Deepening the piles to the Sandstone bedrock would provide consistent end bearing strata, however is unlikely to be cost beneficial.

Depending on the proposed finished site levels, the ground conditions indicate downdrag may be an issue and should be taken into consideration in the detailed design.

Design Validation

The piling type, length, depth of reinforcement and design should be discussed with a specialist piling contractor. They can then undertake the detailed design including drawings and specifications to provide fitness for purpose design. In accordance with EC7, static load testing is recommended to validate the design, static load testing may also allow a more efficient design to be produced. Static load testing can be undertaken on preliminary piles or more than 1% of working piles to 1.5 times the characteristic load.

The piling works should be carried out in accordance with Execution Standard EN 1536 for Bored Piles or BS EN 12699:2015 for Displacement Piles.

If the ground conditions 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 should be on a continuous basis to check the design assumptions are correct and construction conforms to design. Supervision should include inspections, Control Ground Investigations and monitoring.

6.5 Preliminary Foundation Design – Creche

The loadings of the proposed creche building is no greater than 250kN, BH01 was drilled in this area and encountered medium dense Sand between 0.9m and 5m bgl, the Sand became loose between 5m and 6m overlying the Soft Clay strata beneath. The Sand strata will provide a safe Allowable Bearing Pressure of 150kN/m² for a 1.5m square pad foundation. Using the bearing pressure the total settlement will be minimal and will be immediate occurring in the construction phase.

Only one exploratory location has been undertaken in this location of the site to obtain parameters for preliminary design, a watching brief should be maintained during the enabling works/removing slab to confirm the ground conditions are consistent. The watching brief will also confirm or otherwise if differential settlement is a potential issue.

If the ground conditions 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 should be on a continuous basis to check the design assumptions are correct and construction conforms to design. Supervision should include inspections, Control Ground Investigations and monitoring.

6.6 Building Near Trees

Trees and bushes are present along the site boundaries including mature trees, and some small bushes and trees are present in the north eastern corner of the site. Foundation excavations will not encounter cohesive strata in the vicinity of existing, proposed or recently removed trees and therefore foundation depths will not requires deepening in accordance with current guidance or heave precautions installed.

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

6.7 Floor Slabs

Made Ground is generally present in excess of 0.6m bgl and therefore a suspended floor slab is recommended. A suspended floor slab is considered to be suitable for the proposed development and is compatible with the proposed piled foundations.

6.8 Construction

The trial pits indicate that instability of excavations is anticipated within the natural Sand deposits where collapse of the trial pits has been observed. 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 will also be required for the hardsurfacing and locally to penetrate obstructions associated with the former building on site. No notable obstructions have been encountered during the investigation, however they cannot be ruled out.

Groundwater has been encountered within the natural Sand deposits at depths between 1.6m and 4.0m bgl and dewatering of excavations may be required locally.

6.9 Concrete Classification

Made Ground

Water soluble sulphate testing was undertaken on eight samples of the Made Ground. The range of soluble sulphate (SO_4) recorded is 15.4mg/l to 1350mg/l. Associated pH values ranged between 7.6 and 10.8 indicating slightly alkaline to alkaline conditions.

For a dataset containing five to nine results, the mean of the highest two sulphate test results should be taken as the characteristic value along with the lowest of the pH results. For the Made Ground, the characteristic water soluble sulphate concentration is 1320mg/l and the pH value is 7.6.

Natural Strata

Water soluble sulphate testing was undertaken on 5 samples of the natural ground. The range of soluble sulphate (SO_4) recorded is 43.2mg/l to 413mg/l. Associated pH values ranged between 7.0 and 8.9 indicating neutral to slightly alkaline conditions.

For a dataset containing less than five results, the highest sulphate test result should be taken as the characteristic value along with the lowest of the pH results. For the natural strata, the characteristic water soluble sulphate concentration is 413mg/l and the pH value is 7.0.

Discussion and Assessment

Due to the granular deposits present beneath the site where groundwater has been encountered, the groundwater regime is considered to be mobile.

The results of laboratory pH and sulphate content indicate that ACEC Class AC-2 and sulphate class DS-2 conditions prevail within the Made Ground soils, and ACEC Class AC-1 and sulphate class DS-1^d conditions prevail within the natural ground 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.

Pyritic Ground

To classify site locations where natural strata may contain sulphides, it is essential to take into account of the total potential sulphate content which may result from oxidation following ground disturbance.

The value of oxidisable sulphides has been calculated by subtracting the results of the acid-soluble sulphate test (AS % SO_4) from the results of the total potential sulphate (TPS % SO_4) and the results are below 0.3% indicating pyrite is not present and this does not affect the classification.

6.10 Highway Design

Five plate load tests were undertaken across the site and the results are presented in the table below. The CBR testing results are presented in *Appendix 7*.

Location	Depth	Strata	CBR Value (%)
CBR1	0.5	Brown Clay	2.1
CBR2	0.5	MG: Dark brown sandy gravel	3.1
CBR3	0.5	Brown Clay	1.6

CBR4	0.7	MG: Dark brown sandy gravel	5.4
CBR5	0.6	Brown Clay	1.8

CBR values of less than 5% were typically achieved for pavement design purposes, with exception of CBR4. As a minimum the subgrade should be proof rolled prior to construction. Some reengineering of the subgrade is required prior to highway construction to achieve the required design CBR value.

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

6.11 Sustainable Urban Drainage System (SuDS)

Soil percolation testing was carried out in general accordance with BRE Digest 365 at position SuDS1. The results are presented in *Appendix 8* and a summary is presented in the table below:

Location	Test No.	Depth (m bgl)	Stratum	Soil Infiltration Rate (m/sec)
SuDS1	1	1.50	Sand	4.37×10^{-5}
SuDS1	2	1.50	Sand	3.03×10^{-5}
SuDS1	3	1.40	Sand	2.17×10^{-5}

In SuDS1, the natural strata where the infiltration test was carried out consisted of orange brown slightly gravelly fine to coarse Sand. Three soil fills were carried out and soil infiltration rates of between 2.17×10^{-5} and 4.37×10^{-5} m/s were calculated. The first two tests were BRE compliant and the final test was not BRE compliant due to insufficient time to drain past 25% effective depth.

The results at this location and depth indicate that the use of a SuDS drainage scheme within the natural Sand deposits is a possibility as good drainage conditions have been recorded. Groundwater levels observed across the site were generally between 4.0m and 6.5m bgl. Locally, perched groundwater was present between the depths of 1.6m and 2.7m bgl within the trial pits. This will need to be considered within the design of SuDS drainage as the groundwater table should be below 1m of the base of SuDS drainage to account for seasonal variations.

6.12 Revised Coal Mining Risk Assessment

Recorded Coal Mining

No risk was identified by the Coal Authority Report and no further action was recommended at the preliminary stage.

Unrecorded Coal Mining

A potential risk from unrecorded shallow mine working was identified by the Coal Mining Risk Assessment undertaken by Groundtech Consulting. This was based on the coal outcrop beneath the southern area of the site and the uncertainty of depth to bedrock.

Sandstone bedrock has been encountered at locations BH01 and BH04 from depths between 23.5m and 27.3m bgl respectively. The Sandstone bedrock was present to the base of both boreholes at 45.0m bgl and no coal or evidence of coal mine workings was encountered.

The risk of unrecorded workings was within either the Blenfire Coal seam or Trencherbone Coal seam which had recorded thicknesses of 0.7m and 1.83m respectively.



The depth of superficial deposits and presence of groundwater indicates the presence of unrecorded mine entries or workings is highly unlikely. In addition, the depth of rock cover proves in excess of ten times the thickness of the coal seams in accordance with CIRIA C758, therefore the risk to the stability of the surface of the site is *Very Low* and no further action is required.

7.0 LAND QUALITY

7.1 Geo-Environmental Testing Results - Soils

Samples of Made Ground and natural strata have been tested for a range of relevant Contaminants of Concern. A Generic Quantitative Risk Assessment (GQRA) has been undertaken to determine the significance of the concentrations as derived through Geo-Environmental analysis.

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 and their ranking of importance 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 commercial development comprising a maximum 3-storey office block to the east of the site and separate Creche facility building on the western boundary of the site. Areas of soft landscaping and two football pitches will also be included as part of the development. We have therefore undertaken the GQRA on the basis that the proposed development site falls under the Commercial 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>	<i>7</i>	<i>TP01 to TP03, BH01, BH03, BH04</i>
<i>Natural Sand</i>	<i>1</i>	<i>BH02</i>

A summary of the Geo-Environmental Testing results is presented below and the GQRA Screening Values are presented in *Appendix 9*:

Contaminant	Range (mg/kg)	Metals		
		Commercial Screening Value	Exceedances	Locations
<i>Arsenic</i>	<i>6.6 - 11</i>	<i>640</i>	<i>0</i>	<i>-</i>
<i>Cadmium</i>	<i><0.2 - 0.6</i>	<i>230</i>	<i>0</i>	<i>-</i>
<i>Chromium</i>	<i>10 - 28</i>	<i>8600</i>	<i>0</i>	<i>-</i>
<i>Hexavalent Chromium</i>	<i><4.0</i>	<i>49</i>	<i>0</i>	<i>-</i>
<i>Copper</i>	<i>12 - 34</i>	<i>68000</i>	<i>0</i>	<i>-</i>
<i>Lead</i>	<i>14 - 110</i>	<i>2300</i>	<i>0</i>	<i>-</i>
<i>Mercury</i>	<i><0.3</i>	<i>26</i>	<i>0</i>	<i>-</i>
<i>Nickel</i>	<i>13-37</i>	<i>1800</i>	<i>0</i>	<i>-</i>
<i>Selenium</i>	<i><1.0</i>	<i>13000</i>	<i>0</i>	<i>-</i>

<i>Zinc</i>	<i>31-130</i>	<i>730000</i>	<i>0</i>	<i>-</i>
Polycyclic Aromatic Hydrocarbons (PAHs)				
Contaminant	Range (mg/kg)	Commercial Screening Values	Exceedances	Locations
<i>Naphthalene</i>	<i><0.05</i>	<i>190</i>	<i>0</i>	<i>-</i>
<i>Acenaphthylene</i>	<i><0.05</i>	<i>83000</i>	<i>0</i>	<i>-</i>
<i>Acenaphthene</i>	<i><0.05 - 0.44</i>	<i>84000</i>	<i>0</i>	<i>-</i>
<i>Fluorene</i>	<i><0.05 - 0.29</i>	<i>63000</i>	<i>0</i>	<i>-</i>
<i>Phenanthrene</i>	<i><0.05 - 2.5</i>	<i>22000</i>	<i>0</i>	<i>-</i>
<i>Anthracene</i>	<i><0.05 - 0.63</i>	<i>520000</i>	<i>0</i>	<i>-</i>
<i>Fluoranthene</i>	<i><0.05 - 3.8</i>	<i>23000</i>	<i>0</i>	<i>-</i>
<i>Pyrene</i>	<i><0.05 - 3.5</i>	<i>54000</i>	<i>0</i>	<i>-</i>
<i>Benzo(a)anthracene</i>	<i><0.05 - 2.0</i>	<i>170</i>	<i>0</i>	<i>-</i>
<i>Chrysene</i>	<i><0.05 - 1.4</i>	<i>350</i>	<i>0</i>	<i>-</i>
<i>Benzo(b)fluoranthene</i>	<i><0.05 - 2.1</i>	<i>44</i>	<i>0</i>	<i>-</i>
<i>Benzo(k)fluoranthene</i>	<i><0.05 - 0.86</i>	<i>1200</i>	<i>0</i>	<i>-</i>
<i>Benzo(a)pyrene</i>	<i><0.05 - 2.1</i>	<i>35</i>	<i>0</i>	<i>-</i>
<i>Indeno(123cd)pyrene</i>	<i><0.05 - 1.0</i>	<i>500</i>	<i>0</i>	<i>-</i>
<i>Dibenzo(ah)anthracene</i>	<i><0.05</i>	<i>3.5</i>	<i>0</i>	<i>-</i>
<i>Benzo(ghi)perylene</i>	<i><0.05 - 1.3</i>	<i>3900</i>	<i>0</i>	<i>-</i>
TPH CWG – Aliphatics				
Contaminant	Range (mg/kg)	Commercial Screening Values	Exceedances	Locations
<i>>C5-C6</i>	<i><0.001</i>	<i>3200</i>	<i>0</i>	<i>-</i>
<i>>C6-C8</i>	<i><0.001</i>	<i>7800</i>	<i>0</i>	<i>-</i>
<i>>C8-C10</i>	<i><0.001</i>	<i>2000</i>	<i>0</i>	<i>-</i>
<i>>C10-C12</i>	<i><1.0</i>	<i>9700</i>	<i>0</i>	<i>-</i>
<i>>C12-C16</i>	<i><2.0</i>	<i>59000</i>	<i>0</i>	<i>-</i>
<i>>C16-C21</i>	<i><8.0</i>	<i>1600000</i>	<i>0</i>	<i>-</i>
<i>>C21-C35</i>	<i><8.0</i>	<i>1600000</i>	<i>0</i>	<i>-</i>
<i>Total aliphatics C5-35</i>	<i><10.0</i>		<i>0</i>	<i>-</i>
TPH CWG – Aromatics				
Contaminant	Range (mg/l)	Commercial Screening Values	Exceedances	Locations
<i>>C5-EC7</i>	<i><0.001</i>	<i>26000</i>	<i>0</i>	<i>-</i>
<i>>EC7-EC8</i>	<i><0.001</i>	<i>56000</i>	<i>0</i>	<i>-</i>
<i>>EC8-EC10</i>	<i><0.001</i>	<i>3500</i>	<i>0</i>	<i>-</i>
<i>>EC10-EC12</i>	<i><1.0</i>	<i>16000</i>	<i>0</i>	<i>-</i>
<i>>EC12-EC16</i>	<i><2.0</i>	<i>36000</i>	<i>0</i>	<i>-</i>
<i>>EC16-EC21</i>	<i><10.0</i>	<i>28000</i>	<i>0</i>	<i>-</i>
<i>>EC21-EC35</i>	<i><10.0 – 48.0</i>	<i>28000</i>	<i>0</i>	<i>-</i>
<i>Total aromatics C5-35</i>	<i><10.0 – 53.0</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>Total aliphatics and aromatics(C5-35)</i>	<i><10.0 – 53.0</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>MTBE</i>	<i><1.00 ug/kg</i>	<i>7900</i>	<i>0</i>	<i>-</i>
<i>Benzene</i>	<i><1.00 ug/kg</i>	<i>95</i>	<i>0</i>	<i>-</i>
<i>Toluene</i>	<i><1.00 ug/kg</i>	<i>4400</i>	<i>0</i>	<i>-</i>

<i>Ethylbenzene</i>	<i><1.00 ug/kg</i>	<i>2800</i>	<i>0</i>	<i>-</i>
<i>m/p-Xylene</i>	<i><1.00 ug/kg</i>	<i>3200</i>	<i>0</i>	<i>-</i>
<i>o-Xylene</i>	<i><1.00 ug/kg</i>	<i>2600</i>	<i>0</i>	<i>-</i>
Others				
<i>Natural Moisture Content 5.9 – 15.0%</i>				
<i>pH value 7.6 – 10.8</i>				
<i>Organic Matter 0.6 – 3.0%</i>				
Asbestos Screen				
Position	Depth (m bgl)	Asbestos Type	Quantification (mass%)	
<i>TP01</i>	<i>0.25</i>	<i>None Detected</i>	<i>-</i>	
<i>TP01</i>	<i>0.7</i>	<i>Amosite-Loose Fibres</i>	<i><0.001</i>	
<i>TP02</i>	<i>0.35</i>	<i>None Detected</i>	<i>-</i>	
<i>TP03</i>	<i>0.55</i>	<i>Chrysotile-Loose Fibrous Debris</i>	<i>0.005</i>	
<i>BH01</i>	<i>0.5</i>	<i>None Detected</i>	<i>-</i>	
<i>BH02</i>	<i>1.0</i>	<i>None Detected</i>	<i>-</i>	
<i>BH03</i>	<i>1.0</i>	<i>None Detected</i>	<i>-</i>	
<i>BH04</i>	<i>0.5</i>	<i>None Detected</i>	<i>-</i>	

7.2 Generic Quantitative Risk Assessment - Soils

Made Ground was encountered beneath the site to a maximum depth of 1.8m bgl. However, it was generally present to depths of less than 1.0m bgl. Made Ground generally consisted of dark brown gravelly sand and dark brown sandy gravel. No evidence of contamination was noted during the investigation.

No elevated concentrations of metals, speciated Polycyclic Aromatic Hydrocarbons (PAHs) or hydrocarbons have been recorded by the laboratory testing based on the site having a commercial end use. Furthermore, TPH concentrations were almost entirely recorded at levels below the laboratory limits of detection.

A creche is to be included in the proposed development. Young children are a more sensitive receptor, therefore the samples tested were also screened against more stringent screening values of residential without plant uptake. No elevated concentrations of metals, speciated Polycyclic Aromatic Hydrocarbons (PAHs) or hydrocarbons were identified based on using more stringent CoC screening values.

Asbestos

Amosite loose fibres were detected at a trace concentration of <0.001 mass% in TP01 at a depth of 0.7m bgl in the west of the site. Chrysotile loose fibrous debris was detected at a concentration of 0.005 mass% in TP03 at a depth of 0.55m bgl in the south east of the site.

The asbestos was associated with black brown sandy gravel with fragments of brick and tarmac present at both locations. The source of the asbestos is likely to be the previously demolished commercial building. No other asbestos has been identified within the samples screened through laboratory testing. The source of the asbestos is likely the subgrade material imported historically to construct the hardsurfacing and warehouse, shown on historical maps in 1988/92, for use within the subbase. No other asbestos has been identified within the samples screened through laboratory testing, however should be assumed to be widespread as the Made Ground is similar in nature.

7.3 Permanent Ground Gases

Three standpipes were installed for gas monitoring within BH01, BH02 and BH04. One monitoring visit has been carried out to date on 28th February 2022 and a further three visits are planned.

Concentrations of methane (CH₄) were not recorded within any monitoring locations. Carbon dioxide (CO₂) has been recorded at a maximum concentration of 4.3% v/v within BH01. Detectable levels of oxygen (O₂) were recorded within the standpipes at a minimum level of 12.3% v/v.

No positive gas flow rates were detected during the monitoring visits.

The atmospheric pressure was 1008mb on the monitoring visit which was completed during a period of falling barometric pressure.

Groundwater was recorded within all standpipes, at depths of between 0.47m and 4.0m bgl.

Characterisation of the Gas Screening Value (GSV)

Based upon the initial results recorded, in accordance with CIRIA Report C665, the risk to the site from ground gases has been assessed by converting the results to gas screening values (GSVs), calculated by multiplying the typical maximum gas concentrations with the recorded maximum positive flow rates. In addition, individual “hazardous gas flow rates” (Q_{hg}) have been derived for each monitoring point. As no levels of methane have been recorded, a GSV for carbon dioxide only has been calculated.

$$GSV (l/hr) = \text{max borehole flow rate (l/hr)} \times \text{max gas concentration (\%)}$$

For this assessment, the maximum recorded concentration of carbon dioxide of 4.3%v/v has been used. No positive gas flow rates have been detected therefore the limit of detection of the gas analyser of 0.1l/hr has been adopted to calculate the GSV.

$$\text{Carbon Dioxide GSV} = 0.043 (4.3\%) \times 0.1 = 0.0043 \text{ l/hr}$$

Assessment

In order to assess the ground gas regime beneath the site and the need to incorporate ground gas precautions, guidance was taken from CIRIA C655 ‘Assessing risks posed by hazardous ground gases to buildings’. Based on the site having commercial end use, the Wilson and Card method has been used to carry out the assessment.

When considering the results to date in accordance with CIRIA C665 (Section A Development and Table 8.5 – Modified Wilson and Card Classification) it can be seen that the GSV value for carbon dioxide is below the assessment GSV of 0.07l/hr and typical carbon dioxide concentrations are generally less than 5% v/v, the site falls into CS1 based on the monitoring undertaken to date.

Characteristic Situation 1

The proposed development is classified as Building Type C in accordance with BS 8485:2015 and the site falls into CS1 in accordance with Table 2 of the above guidance and no gas protection measures are required.



The above recommendations are based on the gas monitoring carried out to date and a full assessment will be provided upon completion of the gas monitoring programme.

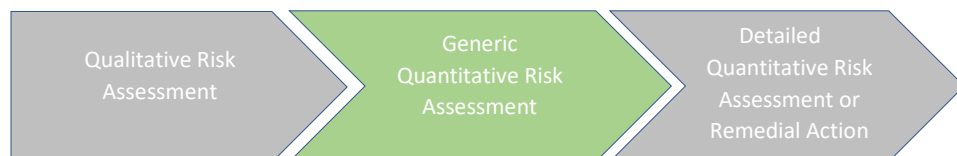
Radon

The site is not located in an area where radon precautions are required within new structures.

7.4 Revised Pollution Linkage Assessment

A pollution linkage assessment has been revised based on the Ground Investigation and testing in accordance with LCRM and CIRA C552 as set out in *Appendix 10* to identify any realistic pollution linkages in order to quantify the risks to human health and controlled waters. The revised pollution linkages are displayed on *GRO-21438-P06* - Illustrative Revised CSM.

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 to Low Likelihood	Medium	Moderate	Pollution Linkage 1 refers to proposed site users coming into contact with contaminated soils on the site. The site is currently utilised as an overflow car park to the adjacent JD Sports offices to the east. Historically, there has been a warehouse located on the site which has now been demolished. Made Ground was present beneath the site, no evidence of contamination was noted. No elevated concentrations of metals, speciated PAHs or hydrocarbons were detected by the laboratory testing. Asbestos fibres were detected within TP01 at 0.7m bgl and TP03 at 0.55m bgl at concentrations between <0.001 mass% and 0.005 mass%. The source of the asbestos is likely to be demolition material from the previous warehouse. The JIWG Receptor tool concluded the overall ranking is Low. No elevated contamination or asbestos was detected in the previous investigation undertaken by RoC Consulting.

Conceptual Site Model					Generic Quantitative Risk Assessment	
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	Rationale and Action
						The proposed development is commercial end use comprising a three-storey office block in the east and separate Creche facility building on the western boundary of the site with associated staff welfare facilities including two five-a-side football pitches. Asbestos has been detected in the west and east of the site and should be assumed to be site wide at low concentrations. In conclusion, Made Ground is present beneath the site however no elevated levels of CoC were detected within the samples tested. Asbestos has been detected and areas of soft landscaping are proposed. Therefore a 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 contamination have been identified on the site and no visual or olfactory evidence of hydrocarbon contamination was noted during the Ground Investigation. No elevated concentrations of hydrocarbons were detected by the laboratory testing and recorded concentrations were predominantly below laboratory detection limits. Therefore, no plausible pollution linkage is 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. No sources of mobile contamination have been identified on the site therefore a viable pollution linkage has not been identified.

Conceptual Site Model					Generic Quantitative Risk Assessment	
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	Rationale and Action
PL4	Contaminated Soils	Attacking potable water supply pipe.	Unlikely	Medium	Low	<i>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 is present at installation depths across the site. However, no evidence of organic contamination was noted during the investigation and hydrocarbon concentrations recorded were predominantly below laboratory detection limits. It is anticipated that standard PE pipes will be suitable. However, it would be prudent to undertake a local water company risk assessment to select the correct material.</i>
PL5	Ground Gas	Migration and accumulation of ground gas in internal spaces.	Unlikely	Medium to Severe	Low	<i>Made Ground is present beneath the site, it is generally present at shallow depths of less than 1.0m bgl. Deep Made ground was encountered at a single location to 1.8m bgl. Widespread demolition material does not appear to be present on site associated with the former warehouse.</i> <i>No methane has been detected by the monitoring undertaken to date and a maximum carbon dioxide concentration of 4.3%v/v has been recorded along with no positive flow rates. Interim gas monitoring results categorise the site as CS1 based on the GSV and therefore no gas protection measures are considered necessary at this stage.</i> <i>This will be confirmed upon completion of the gas monitoring programme.</i> <i>The site is not within an area requiring radon precautions within foundations.</i>

Conceptual Site Model					Generic Quantitative Risk Assessment	
PL	Potential source	Pollution linkage	Likelihood	Severity	Level of risk	Rationale
PL7	Contaminated Soils	Migration of soil and groundwater contamination impacting surface waters.	Unlikely	Medium	Very Low	Pollution Linkage 7 refers to the impaction of Hollins Brook 91m south of the site from contaminated soils and groundwater. No sources of mobile contamination have been identified through the Ground Investigation and a plausible pollution linkage does not exist.

7.5 Outline Remedial Strategy

Soils

Made Ground was encountered beneath the entire site to a maximum depth of 1.8m bgl. No elevated concentrations of CoC above commercial screening values were detected by the laboratory testing. Asbestos was detected locally at concentrations between <0.001 mass% and 0.005 mass%.

The majority of the site will be covered with hardsurfacing which will break the pollution linkage to the Made Ground containing asbestos fibres. Where soft landscaping areas are present, it is recommended that 600mm of suitably clean topsoil is placed including a demarcation layer or a 100mm thick hard dig layer to mitigate the risk of asbestos fibres in the Made Ground.

Controlled Waters

No specific remedial measures are required with respect to controlled waters.

Permanent Ground Gasses

Based on the single gas monitoring visit undertaken to date the site falls into CS1 and gas protection measures are not considered necessary at this stage. This will be confirmed or otherwise on completion of the monitoring programme.

The site is not in an area requiring radon precautions.

Watching Brief and Regulatory Compliance

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.

7.6 Asbestos in Soils

Asbestos fibres were detected within two out of eight samples of Made Ground that were screened. One of the samples had trace concentrations of <0.001 mass% and one sample had concentrations of 0.005 mass% where loose fibrous debris was present.

Where possible, it is advised that any Made Ground soils containing asbestos are left in the ground undisturbed.

Where soils will be disturbed as part of the ground works, in accordance with the Joint Industry Working Group (JIWG) decision support tool for CAR2012 work categories, the combined hazard and exposure ranking is Medium for the asbestos detected. The work is classified as non-licensed, and CAR does not apply.

The JIWG tables are presented in *Appendix 11*. This should be used as an aid to classify risk and recommend the level of protection required, the final decision on how asbestos within the soils should be managed should be made by the contractor.

7.7 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.	Unlikely	Medium	Low
PL8	Asbestos	Inhalation of dusts	Low likelihood	Medium	Medium

The risks from asbestos fibres and loose fibrous debris should be communicated to ground workers through a site induction and information on noticeboards.

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.

7.8 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.

Eight 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 12*.

Location	Depth (m bgl)	Material	Classification	Hazardous Properties
TP01	0.25	MG: Dark brown sandy gravel	Non-Hazardous	-
TP01	0.70	MG: Black clayey sandy gravel	Non-Hazardous	-
TP02	0.35	MG: Dark brown gravelly sand	Non-Hazardous	-
TP03	0.55	MG: Dark brown sandy gravel	Non-Hazardous	-

BH01	0.50	MG: Dark brown clayey gravelly sand	Non-Hazardous	-
BH02	1.00	Brown slightly gravelly clayey Sand	Non-Hazardous	-
BH03	1.00	MG: Orange brown sandy gravel	Non-Hazardous	-
BH04	0.50	MG: Brown sandy gravel	Non-Hazardous	-

Asbestos fibres were detected at concentrations of less than 0.1 mass% and these concentrations therefore do not affect the classification.

7.9 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.

Solid and eluate WAC analysis was undertaken on two samples, the findings of which are presented in the table below.

Reference	Depth (m)	Strata Type	Classification	WAC Analysis	Landfill Disposal
TP01	0.25	MG: Dark brown sandy gravel	Non-Hazardous	SNR	Non-hazardous
BH03	1.0	MG: Brown sandy gravel	Non-Hazardous	Inert	Inert Landfill

The WAC testing has revealed that if the end disposal route of the Made Ground is landfill the material would be accepted at an Inert or Non-Hazardous landfill.

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.*

8.0 FINAL APPRAISAL

8.1 Land Quality

Made Ground has been encountered across the site to a maximum depth of 1.8m bgl and generally consisted of either dark brown gravelly sand or sandy gravel. No visual or olfactory evidence of contamination has been noted.

Geo-Environmental testing indicates that there are no elevated concentrations of metals, speciated PAHs or hydrocarbons above commercial screening values. Asbestos fibres were detected within TP01 at 0.7m and TP03 at 0.55m bgl at concentrations of <0.001 mass% and 0.005 mass% respectively. No elevated contamination or asbestos was detected during the previous investigation of the site undertaken by RoC Consulting.

The risk from contaminated soils is considered to be *Moderate*. The majority of the redevelopment will be covered by hardsurfacing which will act as a cover system, in areas of soft landscaping a 600mm of suitably clean subsoil/topsoil and hard dig layer should be placed to mitigate the risk from asbestos fibres.

No evidence of hydrocarbon contamination has been observed or detected during the investigation and hydrocarbons were generally present at concentrations below laboratory detection limits. The risk from vapours is considered to be *Low*.

Based on the initial ground gas monitoring visits, the site falls into CS1 and gas protection measures are not considered necessary at this stage. This will be confirmed on completion of the gas monitoring programme. The site is not in an area affected by radon.

The risk to controlled water has been assessed as *Low*.

Eight samples of Made Ground/natural ground have been analysed and all have been classified as *Non-Hazardous* for waste disposal.

8.2 Ground Engineering

The most suitable foundations for the proposed development are considered to be piles transferring loads to the underlying medium dense to dense Sands. A range of allowable loads have been calculated for different types of piles and diameters. Based on the proposed loading provided, pile groups will be required.

Suspended floor slabs should be adopted at the site due to the compatibility with the proposed pile foundation solution and depth of Made Ground.

Three soil percolation tests were undertaken at a single location and the use of SuDS drainage is considered feasible within the natural Sand deposits where good soil infiltration rates have been calculated.

Five plate load tests have been undertaken across the site and CBR values for the underlying Clay ranged between 1.6% and 5.4%. Proof rolling of the subgrade will be required as a minimum.

Constraints

A high-pressure gas main is present in the north east of the site which has been located by slit trenches carried out in a previous investigation by RoC Consulting. An easement will be required around the gas main and its location need to be considered by the development layout.



8.3 Required Supplementary Investigation

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

Completion of gas monitoring programme.

Issue gas assessment.

Detailed foundation design.

Confirmation of remedial recommendations with regulators.

9.0 RELEVANT INDUSTRY REFERENCES

- British Standards Institution. *Investigation of Potentially Contaminated sites - code of practice*. BS 10175:2017.
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NHBC Standards 2019

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

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APPENDIX 1 - Plans

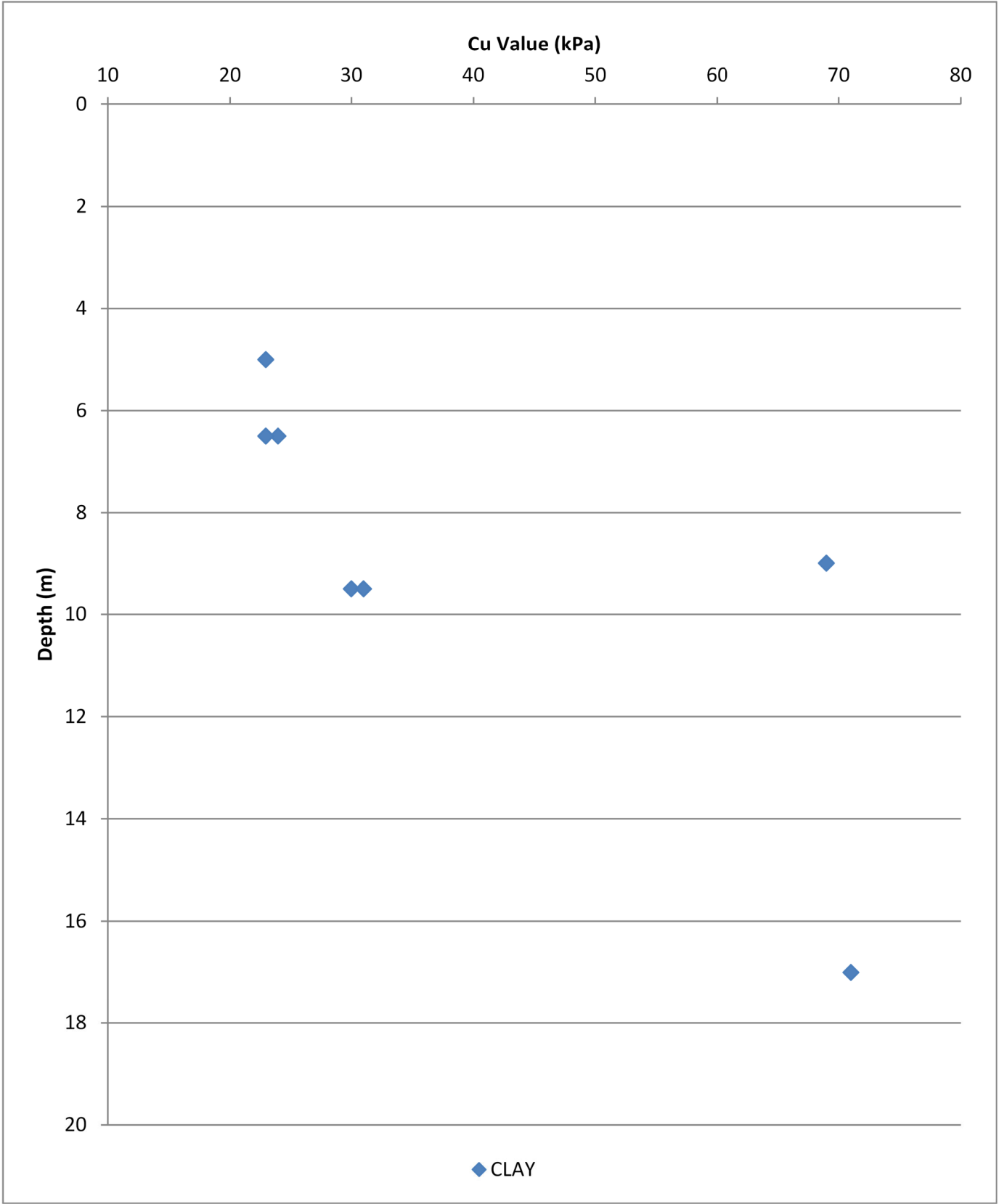
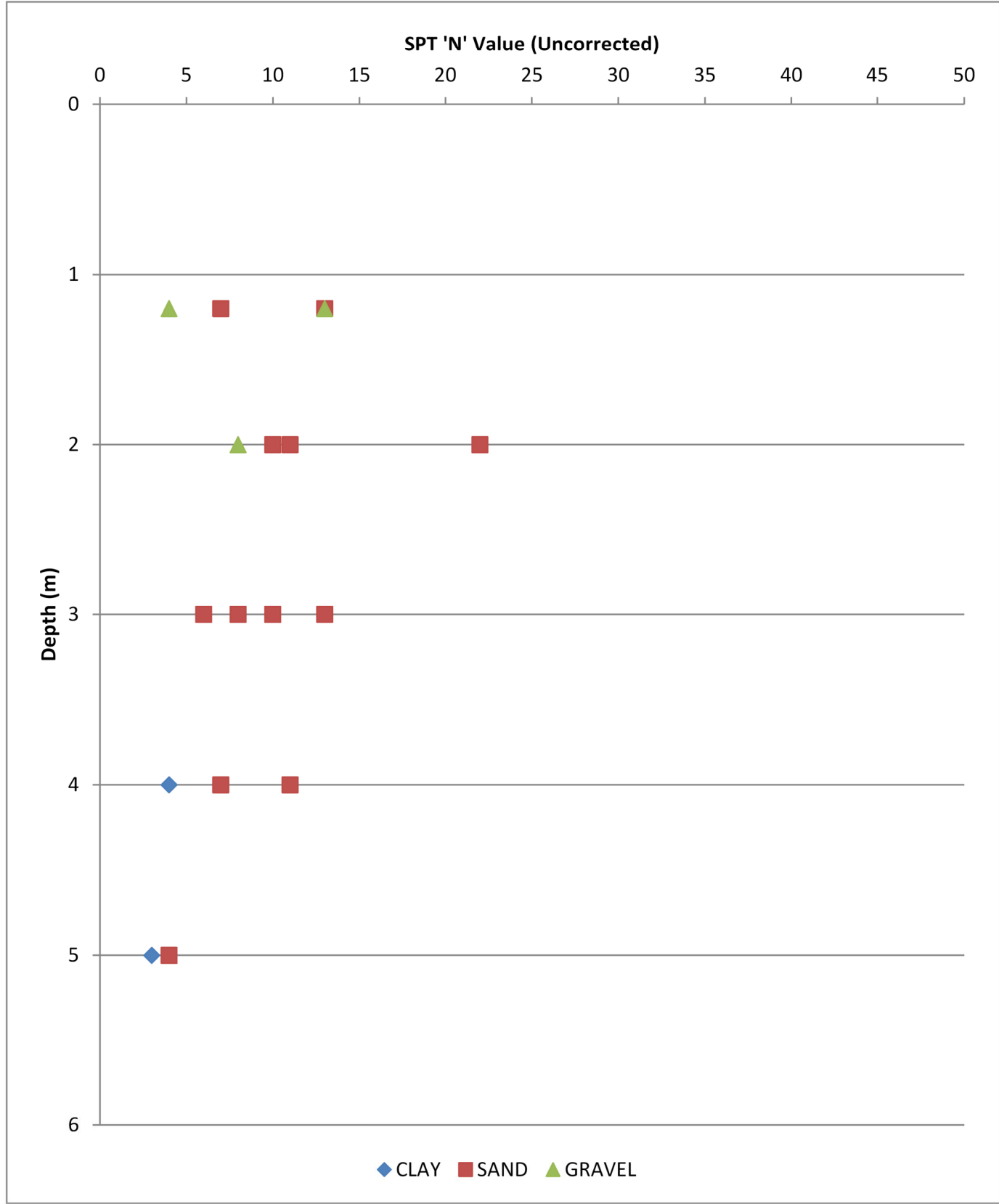


GROUNDTECH CONSULTING	CLIENT	DATE			Status	Notes - Site Location
	JD SPORTS	JANUARY 2022			Preliminary	
	PROJECT TITLE	SCALE			Draft	
	NEW OFFICE BLOCK, BURY	NTS			Issued	
	PLAN TITLE	PLAN NUMBER			For Comment	
	PROJECT LOCATION PLAN	GRO-21438-P01	Rev.	Details	Date	Approved





GROUNDTECH CONSULTING	CLIENT	DATE			Status		Notes - Site Location - Borehole Location - Trial Pit Location - CBR Location
	JD SPORTS	JANUARY 2022			Preliminary		
	PROJECT TITLE	SCALE			Draft		
	NEW OFFICE BLOCK, BURY	NTS			Issued		
	PLAN TITLE	PLAN NUMBER			For Comment		
	EXPLORATORY HOLE LOCATION PLAN	GRO-21438-P04	Rev.	Details	Date	Approved	



GROUNDTECH
CONSULTING



CLIENT

JD SPORTS

PROJECT TITLE

NEW OFFICE BLOCK, BURY

PLAN TITLE

GENERALISED GROUND MODEL

DATE

FEBRUARY 2022

SCALE

NTS

PLAN NUMBER

GRO-21438-P05

Rev.

Details

Date

Status

Preliminary

Draft

Issued

For Comment

Approved

Notes

