



**GEOENVIRONMENTAL SITE INVESTIGATION REPORT
PHASE II SITE INVESTIGATION
ON LAND AT
KIRKWAY SERVICE STATION
MIDDLETON.**

Prepared for: -

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1.0 INTRODUCTION

1.1 Instruction

- 1.1.1 GeoCon Site Investigations Ltd (GeoCon) have been commissioned by GKR Homes Limited (the client) to undertake a Phase II Geoenvironmental Site Investigation on Land at Kirkway Service Station, Middleton, M24 1LW.
- 1.1.2 It is understood that a Phase II Site Investigation are required to assist with the resubmission of planning application 22/00278/ful relating to a proposed residential development at the site.
- 1.1.3 It is understood that this is required following the results of a Phase I Preliminary Risk Assessment carried out by Ashton Bennet in November 2021 referenced GKRH 3483 which should be referred to in conjunction with this report.
- 1.1.4 This report is therefore provided to establish the potential for contamination at the site as a result of current and historic land uses both on site and within influencing distance of the site, to understand the type nature and extent of contamination present, and to identify the anticipated ground conditions and any potential geological and or geotechnical impact on the proposed development.
- 1.1.5 This report is written in accordance with the guidance set out in Land Contamination Risk Management (LCRM), Guiding Principles for Land Contamination (GPLC) 1 – 3, and the National Planning Policy Framework (NPPF).

1.2 Scope of Works

- 1.2.1 Prior to commencing the site works the proposed scope of investigation was as follows, however the proposed scope will be subject to change dependent upon site conditions, access, restrictions and obstructions. The actual works undertaken following the completion of the site works and any on site amendments are detailed in section 3.0.
 - One day's Dynamic sampling at approximately five locations to a nominal depth of up to 5.00mbgl or refusal.
 - Insitu environmental and geotechnical sampling, and insitu geotechnical testing;
 - Full supervision of all works by engineering geologist including sampling and detailed geotechnical descriptions to BS5930, EN ISO 14688-1 EN ISO 14688-2 and EN ISO 14689 of all strata types encountered within the exploratory holes.
 - The installation of four No. gas and groundwater monitoring wells to a nominal depth of 3.00mbgl.
 - Subsequent gas and groundwater monitoring on six occasions over a three-month period in accordance with CIRIA 665 commencing approximately one week after the completion of the ground investigation.
 - A suite of chemical laboratory analysis.
 - A suite of geotechnical laboratory analysis.
 - Production of an interpretative report.

1.3 Reliance and Limitations

- 1.3.1 This report has been prepared using published information and information provided by the Client and their professional advisers which has been made available to GeoCon at the time of writing only. GeoCon accepts no liability for any changes resulting from new information which has become available since this time.

- 1.3.2 This report is provided for the sole use of the client and their professional advisors and is confidential to them unless agreed otherwise in writing. This report may only be used and relied on once the work has been paid for in full.
- 1.3.3 GeoCon owes no duty of care and has no liability to any third party who is not authorised by GeoCon to use this report. Any unauthorised third parties using information contained in this report do so at their own risk.
- 1.3.4 This assessment has been carried out to determine the potential risks posed to future end users, along with other key receptors, resulting from potential contamination at the site, based on the proposed development. Should any revisions in the development proposals result in a change any assessment parameters detailed in this report, a re-assessment of the risk should be carried out.
- 1.3.5 Whilst this report may reference observations made regarding the presence of features/ issues such as invasive species, ACM, site drainage and evidence of structural abnormalities, this report does not constitute specialist surveys on these matters. Should further specialist surveys be carried out in this regard, the findings of these should be reported to GeoCon so that we may determine if this has any impact on the findings of this report.
- 1.3.6 The assessment and interpretation of the factual data obtained as part of this Phase II Site Investigation has been undertaken in accordance with standard consulting practise and with current national and international guidance.
- 1.3.7 This report presents the observations made during the Phase II Site Investigation and the factual data obtained. The conclusions and recommendations in this report are limited to those which can be made based on the findings of the survey and information provided by third parties. GeoCon assumes all third-party data to be true and correct. No responsibility can be accepted by GeoCon for inaccuracies in the information provided by any other party.
- 1.3.8 This report is written in the context of an agreed scope of works and should not be used in a different context. Furthermore, new information, improved practises, and changes in legislation may require the reinterpretation of the report in whole or in part after its original issue. GeoCon reserve the right to alter their conclusions and recommendations in the light of further information that may become available. This report is provided for the sole use of the client and their professional advisors and is confidential to them unless agreed otherwise in writing.
- 1.3.9 Ground conditions can be variable and change rapidly, especially in areas of Made Ground, however it is assumed that the ground conditions encountered and observed are typical and representative of the site as a whole. Most specifically with regard to this limited investigation, the ground conditions have been determined from a limited number of exploratory holes formed across the site, therefore only a small percentage of the total area of the site has been investigated. Interpolation between exploratory holes has enabled a general picture of the subsurface conditions to be produced. Conclusions drawn from the ground investigation should be read in this context. GeoCon cannot accept responsibility for any situations resulting from locally unforeseen ground conditions occurring between exploratory holes.
- 1.3.10 In addition, subsurface conditions including contaminant concentrations and groundwater levels may vary spatially with time. This factor should be given due consideration in the event that the information contained within this report is used after any significant period of time has elapsed.

2.0 SITE LOCATION AND DESCRIPTION

2.1 Site Location

- 2.1.1 The site is located at land off Kirkway Service Station, Middleton, at approximate National Grid Reference NGR: 387288, 404459 (centre of the site).
- 2.1.2 A site location plan is presented as Drawing No. GSI 1676/01 in Appendix A.

2.2 Site Reconnaissance

- 2.2.1 A site reconnaissance was carried out on 31st May 2022. Details from the site walkover are included in the site description below.

2.3 Site Description

- 2.3.1 The site is roughly a rectangular shaped piece of land with an approximate area of 0.16Ha.
- 2.3.2 The topography of the site is generally flat.
- 2.3.3 The site is currently occupied by a derelict service station with associated roadways and overgrown vegetation in areas. From the Phase I study, it is stated that below ground tanks and fuelling features were decommissioned and removed in 1996.
- 2.3.4 An approximate distribution of the surface covering is given below in Table 2.1: Site Surface Covering

Table 2.1: Site Surface Covering

Type of Surface Cover	Distribution (%)
Soft Ground (grassed and landscaped areas)	10
Hardstanding	70
Roadways	10
Buildings	10
Water (ponds, streams)	0

- 2.3.5 The site is bound to the north by thick vegetation and commercial properties, to the east by vegetation and open land, to the south by residential properties and Kirkway road to the west.
- 2.3.6 Access to the site is via Kirkway road to the West.

2.4 Surrounding Area

- 2.4.1 The current surrounding land use to the site is generally residential and commercial properties in all directions.
- 2.4.2 The topography of the surrounding area is generally flat.

2.5 Future Site Usage

- 2.5.1 It is currently proposed to demolish the existing structures on site and construct three 2-storey structures; totalling six semi-detached residential properties at the site; which includes for hardstanding parking and access and soft landscaped areas.
- 2.5.2 The proposed development plan as provided by the client, referenced Plot 5 Proposed Street Scene 2 Rev 1, is presented in Appendix A.

3.0 GROUND INVESTIGATION

3.1 General

- 3.1.1 The intrusive investigation was carried out on 31st May 2022.
- 3.1.2 The specification and scope of works for the ground investigation has been provided by the client
- 3.1.3 The ground investigation has been carried out in accordance with BS5930 and the UK Specification for Ground Investigation Second Edition 2012.
- 3.1.4 All strata descriptions were undertaken in accordance with BS5930 Amendment 1; EN ISO 14688 -1; EN ISO 14688 -2; and EN ISO 14689.
- 3.1.5 The final scope of the ground investigation was as per the scope of works as defined in section 1.2.
- 3.1.6 The ground investigation was carried out to determine the geotechnical and geoenvironmental properties of the soils and rock beneath the site for a proposed residential development at the site.
- 3.1.7 The locations of the exploratory holes were specified by GeoCon and were positioned to gain key information beneath the site in relation to the proposed development.
- 3.1.8 All locations were checked against buried service location plans and then scanned with a Cable Avoidance Tool (CAT) and Genny prior to excavation, and a permit to dig was then issued. Each location was then continued by hand down to a minimum of 1.20mbgl to clear any buried services or other subsurface obstructions. All locations were then checked again with a Cable Avoidance Tool (CAT) at the base of the hand excavated inspection pit by GeoCon prior to commencement of drilling.
- 3.1.9 All access permissions were arranged by the Client prior to the ground investigation commencing.
- 3.1.10 An exploratory hole location plan is presented in Appendix A as drawing number GSI 1676/02.

Dynamic Sample Boreholes

- 3.1.11 Four dynamic sample boreholes were drilled at the site referenced DS01 to DS04 and were drilled at the site to depths of between 3.45 and 5.45mbgl.
- 3.1.12 The dynamic sample boreholes were drilled using a tracked dynamic sample rig in order to facilitate geoenvironmental sampling and to gain an understanding of the environmental and geotechnical properties of the soils and rock beneath the site, and to facilitate the installation of gas and groundwater monitoring standpipes.
- 3.1.13 The dynamic sample boreholes were drilled using 100mm diameter barrel reducing in size with depth. to achieve the target depths.
- 3.1.14 All dynamic sample borehole logs are presented in Appendix B.

3.2 Sampling and Insitu Testing

- 3.2.1 The environmental and geotechnical sampling regime and insitu testing regime included the following:
 - Environmental samples for subsequent chemical analysis were taken from each strata type, with a minimum of three samples taken from the upper 1.00 m, then at 1.00 m intervals in made ground with a minimum of one sample from the natural strata.
 - Small disturbed samples taken from each strata type and then at 1.00 m intervals thereafter.
 - Bulk disturbed samples taken at 1.00 m intervals to a depth of 5.00 mbgl, then 1.50 m intervals thereafter

- Insitu Standard Penetration Tests (SPTs) were carried out at 1.00 m intervals down to 5.00 mbgl and at 1.50 m intervals thereafter in granular soils to collate insitu strength information (relative density) for the soils beneath the site.

- 3.2.2 Soil samples were collected for environmental and geotechnical analysis by the engineering geologist on site based on physical and visual inspection in addition to standard sampling.
- 3.2.3 All samples were stored in pre-chilled cool-boxes prior to immediate dispatch to laboratory. Where there has been a delay in transporting the samples to the laboratory, samples have been kept in a cool dark storage unit inside cool boxes packed with ice, which is regularly replaced to maintain sample quality.
- 3.2.4 The environmental samples were subsequently transported to a chemical laboratory in plastic tubs, glass jars and soils vials. The geotechnical samples were subsequently transported to a geotechnical laboratory in prepared bulk bags and plastic tubs.

3.3 Installations and Backfill

- 3.3.1 Three of the Dynamic sample boreholes were installed with combined gas and ground water monitoring standpipes. The details of the gas and ground water monitoring standpipes are summarised below in Table 3.1: Gas and Groundwater Monitoring Installations:

Table 3.1: Gas and Groundwater Monitoring Installations

BH ID	Installation Depth (mbgl)	Response Zone (mbgl)	Installation Date	Strata	Comments
DS01	3.00	1.00-3.00	31/05/22	Gravelly SAND	N/A
DS03	1.00	0.50-1.00	31/05/22	Granular Made Ground	Depth of response zone due to depth of water strike encountered.
DS04	3.00	1.00-3.00	31/05/22	Gravelly CLAY	N/A

- 3.3.2 Full details of the installations and backfill are presented on the relevant exploratory hole logs.
- 3.3.3 All monitoring standpipes are constructed using 50mm slotted pipe with a Geosock filter and gravel surround medium within the response zone, and 50mm plain pipe with a bentonite seal above the response zone (minimum 0.50m thick).
- 3.3.4 All remaining exploratory holes were backfilled with arisings and made level at the surface to a similar condition as prior to the work.

3.4 Groundwater

- 3.4.1 Where groundwater was encountered a waiting period of 20 minutes was allowed to monitor any change (rise or fall) in the levels of each groundwater strike.

3.5 Groundwater Monitoring

- 3.5.1 Groundwater monitoring has been carried out across the site on six occasions in conjunction with the gas monitoring regime, to establish the standing water levels beneath the site.

3.6 Laboratory testing

- 3.6.1 Chemical laboratory testing was subsequently carried out on selected samples of soil. Further details of the chemical laboratory testing are given within section **Error! Reference source not found.** – Chemical Testing and Results.
- 3.6.2 All chemical laboratory testing will be scheduled by GeoCon.

- 3.6.3 Geotechnical laboratory testing was subsequently carried out on selected samples of soil. Further details of the geotechnical laboratory testing are given within section 5.0 – Geotechnical Testing and Results.
- 3.6.4 All geotechnical laboratory testing will be scheduled by GeoCon.

3.7 Restrictions

- 3.7.1 No restrictions were encountered during this site investigation that would have prevented parts of the site being accessed and consequently resulting in any of the exploratory locations being abandoned.

4.0 GROUND CONDITIONS

4.1 Published Geology

- 4.1.1 The British Geological Survey shows the site to be underlain by the geological succession outlined below
Table 4.1: Published Geology

Table 4.1: Published Geology

Geology	Description /strata	BGS General Description (Lexicon)
Artificial	None recorded	N/A
Superficial	Till, Devensian	No BGS description available
Bedrock	Pennine Middle Coal Measures Formation	<i>“Interbedded grey mudstone, siltstone, pale grey sandstone and commonly coal seams, with a bed of mudstone containing marine fossils at the base.”</i>

4.2 General

- 4.2.1 A generalised summary of the ground conditions encountered, depths to base, and thickness recorded from the exploratory hole records is presented below in Table 4.2: Summary of Ground Conditions.

Table 4.2: Summary of Ground Conditions

Geology / Strata	Depth (mbgl)				Thickness (m)		Locations encountered
	Top		Base		Min	Max	
	Min	Max	Min	Max			
Made Ground	0.00	-	0.60	1.00	0.60	1.00	Encountered in all locations
Till, Devensian	0.60	1.00	3.45	5.45	2.55	4.82	Encountered in all locations
Groundwater	Strike depth (mbgl)		Rest Level (mbgl)		Locations encountered		
	Min	Max	Min	Max			
Strike	0.30	2.00	0.70	2.43	DS01, DS03 and DS04		

- 4.2.2 The general ground conditions encountered have been summarised below.
- 4.2.3 Detailed strata descriptions are presented on the dynamic sample borehole logs presented in Appendix B.
- 4.2.4 The actual ground conditions encountered across the site were generally uniform and comprised Made ground overlying Till deposits.

4.3 Made Ground

- 4.3.1 Made ground was encountered in all exploratory hole locations from ground level to depths of between, 0.60 to 1.00mbgl. The made ground generally comprised hardstanding or reworked topsoil overlying layers of granular made ground materials.

Reworked Topsoil:

- 4.3.3 Reworked topsoil was encountered in DS01 and DS02 from ground level to depths of 0.30mbgl, and generally comprised slightly sandy gravelly clay, with frequent rootlets.

Hardstanding:

- 4.3.4 Hardstanding was encountered in DS03 and DS04 from ground level to depths of between 0.10 and 0.20mbgl, and generally comprised of light grey asphalt.

Granular Made Ground:

- 4.3.5 Granular made ground materials were encountered in all locations from beneath the reworked topsoil or hardstanding to depths of between 0.60 and 1.00mbgl, and generally comprised sandy gravel of brick, tarmac and concrete.

4.4 Superficial Deposits (Till, Devensian)

- 4.4.1 Soils considered to represent Till, Devensian were encountered in all locations directly beneath the Granular Made Ground and were proven to depths of between 3.45 and 5.45mbgl.
- 4.4.2 The Till, Devensian deposits generally comprised of two main strata. Granular, loose to medium dense gravelly fine to coarse sand or cohesive, soft to stiff gravelly clay.

4.5 Bedrock (Pennine Middle Coal Measures Formation)

- 4.5.1 Bedrock was not encountered during this ground investigation.

4.6 Groundwater

- 4.6.1 Groundwater was encountered in three of the four exploratory holes formed across the site. Further details are as follows:-
- DS01 – strike at 2.00mbgl falling to 2.43mbgl after 20 minutes.
 - DS03 – strike at 0.74mbgl falling to 0.76mbgl after 20 minutes.
 - DS04 – strike at 0.30mbgl falling to 0.70mbgl after 20 minutes.

4.7 Groundwater Monitoring

- 4.7.1 A groundwater monitoring regime was carried out at the site to establish the ground water levels beneath the site, which included monitoring on six occasions.
- 4.7.2 Table 4.3: Groundwater Monitoring Results, below presents the details of the groundwater monitoring regime. All boreholes were purged and developed accordingly to prior to the groundwater monitoring.

Table 4.3: Groundwater Monitoring Results

Exploratory Hole ID	Base of Hole (mbgl)	Standing Water Level (SWL) (mbgl)					
		Date of Visit					
		10/06/22	20/06/22	05/07/22	21/07/22	04/08/22	17/08/22
DS01	3.00	1.56	1.84	2.02	1.50	1.40	0.67
DS03	1.00	0.73	0.87	0.75	0.80	0.75	0.19
DS04	3.00	1.10	1.00	0.80	0.95	0.40	1.29

4.8 Obstructions

- 4.8.1 No obstructions were encountered during this ground investigation.

4.9 Contamination

- 4.9.1 No visual or olfactory evidence of contamination was encountered or observed during this ground investigation, in particular no obvious visual or olfactory evidence of mobile contamination was observed during the ground investigation.

5.0 CHEMICAL TESTING AND RESULTS

5.1 General

- 5.1.1 All samples were sent to a UCAS accredited chemical testing laboratory, and MCERTS were used where available. The analytical strategy focussed on a general suite of potential contaminants and the analytical suites are summarised in Table 5.1: Summary of Chemical Testing Suite. Chemical results have been screened against current guideline values where applicable for a residential end use.
- 5.1.2 All chemical testing results are presented in Appendix C.

Table 5.1: Summary of Chemical Testing Suite

Testing	Comment	No. of soil samples analysed
General metals suite including: Arsenic, cadmium, chromium, copper, cyanide, lead, mercury, nickel, phenol, selenium, zinc, pH, and water-soluble sulphate	General analysis of soils beneath the site to achieve general site coverage, and targeting former uses on site and off site within influencing distance	4
Speciated PAH	General analysis of soils beneath the site to achieve general site coverage, and targeting former uses on site and off site within influencing distance	4
TPH CWG	General analysis of soils beneath the site to achieve general site coverage, and targeting former uses on site and off site within influencing distance	4
Asbestos Screen	General analysis of soils beneath the site to achieve general site coverage, and targeting former uses on site and off site within influencing distance	4

5.2 Chemical Results

- 5.2.1 Only detectable concentrations of contaminants reported above the screening value are presented overleaf in Table 5.2: Summary of Soil Chemical Testing Results.
- 5.2.2 All chemical results have initially been compared against screening criteria for a residential end use with plant uptake.
- 5.2.3 Total Organic Carbon (TOC) was analysed in four samples from the site. The results of the TOC recorded values between 1.05% and 7.39%. From this Soil Organic Matter (SOM) has been calculated at values of between 0.61% and 4.28%. Therefore, a worst-case scenario of 1% SOM has been used where appropriate in the chemical assessment overleaf.

Table 5.2: Summary of Soil Chemical Testing Results

Determinand	No. Of samples analysed	Screening value (mg/kg) (where applicable)	Determinand concentration range (mg/kg)		No of Samples exceeding screening value
			Min	Max	
Lead	4	210	12.00	562.00	1
Mercury	4	2.31	0.17	20.00	1
Total Aromatics (C8-C10)	4	34-74	1	181	1
Total Aliphatics (C8-C10)	4	27	1	198	1

- 5.2.4 Four samples were analysed for asbestos screen. No fibres were detected in any of the samples.

6.0 GENERIC QUANTITATIVE RISK ASSESSMENT (GQRA)

6.1 Criteria for interpretation

- 6.1.1 The regime for contaminated land was set out in Part IIA of the Environmental Protection Act (EPA) 1990, as inserted by S.57 of The Environment Act 1995 and came into effect in England on 1st April 2000 as The Contaminated Land (England) Regulations 2000 (SI 2000/227). These regulations were subsequently updated with the provision of The Contaminated Land (England) Regulations 2006 (SI 2006/1380), which consolidated the previous regulations and amendments and added in provisions regarding radioactive contaminated land. These regulations came into force on 4th August 2006. This modified the wording for “Contaminated Land” under Part IIA of the EPA. Section 78A (2) defines contaminated land as “land which appears to be in such a condition, by reason of substances in, on or under the land, that:

- significant harm is being caused, or there is a significant possibility of significant harm being caused (SPOSH);

6.2 Human Health Receptors

- 6.2.1 An initial Generic Quantitative Risk Assessment (GQRA) for human health has been undertaken by comparison of the soil analytical results with published guidance criteria. These can be classified as Generic Assessment Criteria (GAC) and are widely referred to by consultants, Regulatory Authorities and other professionals within the industry and include the following:

- Current published Soil Guideline Values (SGVs) published by the Environmental Agency (EA).
- Land Quality Management (LQM) have published a series of GACs via the CLEA v1.04 software which are applicable to the UK for common Determinands. The GAC’s can be applied to a wide range of land contamination problems, which can be used as initial screening criteria in order to assess potentially contaminated land.
- ATRISK Soil SSV’s (Soil Screening Values) at 1% SOM for a sand soil derived by Atkins in line with the Environment Agency 2009 guidance (SR2, SR3, SR4, SR7) using the CLEA v1.04 and CLEA v1.06 software; and WSV’s (Water Screening Values) for Human Health using the RBCA v2.5 software. The modelling inputs were made compliant with the SR3 residential conceptual site model and follow the guidance provided within SR3 where possible.
- Contaminated Land: Applications in Real Environments (CL:AIRE) ‘The Soil Generic Assessment Criteria for Human Health Risk Assessment’ GAC’s via the CLEA v1.06 software (updated version of the v1.04 update after the release of LQM GAC’s).
- Defra C4SL’s: Development of Category 4 Screening Levels for assessment of land affected by contamination.

- 6.2.2 It should be noted that the above guidance criteria are generally restricted with depth i.e. the values quoted with reference to human health are generally only applicable in the top 1.00m of soil and do not (dependant on the conceptual site model and conditions identified on site) necessarily identify significant harm.

6.3 Risk to Human Health

- 6.3.1 The previous reports for the site states that the existing garage contained underground fuel tanks and served petrol and diesel from fuel pumps until 1996. Fugro Environmental Ltd (FEL) undertook investigations at the site for Mobil Oil Company Ltd (Mobil) (dated June 1995 and April 1996). On the basis of the information gathered from the historical site investigations and with the details of the remediation work performed, the Phase I report stated that petroleum hydrocarbons are at low levels on the site, which is consequently described as suitable for commercial use.

6.3.2 The majority of the chemical Determinands analysed recorded levels below the relevant screening criteria for a residential with the exception of Lead, Mercury, Aromatic (C8-C10) and Aliphatic (C8-C10) petroleum hydrocarbons.

6.3.3 Elevated concentrations of the above Determinands are listed below in Table 6.1: Chemical Determinands Exceeding Screening Criteria.

Table 6.1: Chemical Determinands Exceeding Screening Criteria

Location ID	Depth Range (mbgl)	Determinand Concentration Result (mg/kg)
Lead - Screening Criteria = 310mg/kg		
DS04	0.40	526
Mercury - Screening Criteria = 1.2mg/kg		
DS03	0.70	2.31
Total Aromatics (C8-C10) - Screening Criteria = 27 mg/kg		
DS03	0.70	198
Total Aliphatics (C8-C10)- Screening Criteria = 0.74mg/kg		
DS03	0.70	183

6.3.4 Based on the above, contamination does appear to be present beneath parts of the site within the made ground or shallow natural soils. The elevated levels of contamination may represent either localised hotspots of contamination or could be representative of the site as a whole. At this stage it is not possible to determine the full extent of the soil contamination.

6.3.5 It is understood that the proposed development comprises residential properties with shared gardens and associated access road and driveways.

6.3.6 Therefore, a pollutant linkage is considered to be present and the risk to human end users are considered to be **moderate** at this stage. However, where the localised contamination has been found It is shown to be under a proposed building which would stop the linkage.

6.3.7 Risks to construction workers are considered to be **low to moderate**. All construction workers should wear appropriate Personal Protective Equipment (PPE) including latex gloves and dust masks. Provisions should be made for water on site to 'damp down' any dust in dry conditions.

6.3.8 In areas where site soils are to be exposed at the surface such as areas of landscaping then these areas will need remedial action.

6.3.9 Possible remedial options at this stage would be as follows:

1. Made ground materials are removed from the site and replaced with clean imported materials to provide a "cover system".
2. Alternative remediation of the site.

6.3.10 Based on the above, it is recommended that a remediation strategy is commissioned for the site and the proposed remedial design is agreed with the Local Planning Authority.

6.3.11 A watching brief should be maintained during construction to ensure that any unsuitable materials are removed at the time.

6.3.12 Should any erroneous materials or previously unidentified contamination be encountered during construction then further sampling and analysis may be required.

6.3.13 The above recommendations should be agreed in principle with the Local Planning Authority prior to development to avoid any delays or complications at a later stage.

6.4 Risk to Controlled Waters

Groundwater

- 6.4.1 The Environmental Agency aquifer classification scheme indicates that the superficial aquifer designation for the site is classed as secondary aquifer and the bedrock aquifer designation for the site is classed as secondary A aquifer.
- 6.4.2 There are no licensed groundwater abstraction points or no public drinking water abstractions within 2000m of the site.
- 6.4.3 The site is not located within a Source Protection Zones (SPZ) or within 2000m of one.
- 6.4.4 Therefore, based on the above information, the results of the soil testing, the generally impermeable geology beneath the site, and considering that natural attenuation, dilution and dispersion will take place, the risks to groundwater and drinking waters are considered to be **low** at this stage.

Surface Water

- 6.4.5 There are no major surface water courses within 250m of the site.
- 6.4.6 Therefore, based on the above information, the results of the soil testing, the generally impermeable geology beneath the site, and considering that natural attenuation, dilution and dispersion will take place, the risks to surface waters are considered to be **low** at this stage.

6.5 Ground Gas Risk Assessment

General

- 6.5.1 There are no landfill sites or other waste associated sites within 250m of the site boundary. There are five areas of potentially infilled land and one registered waste transfer site within 250m of the site.
- 6.5.2 Made ground was also encountered beneath the site and was proven to depths of up to 1.00mbgl.
- 6.5.3 Gas monitoring has been carried out at the above site on six occasions over a three-month period to assess the risks to the proposed commercial development from potential hazardous ground gasses.
- 6.5.4 Ground gas monitoring standpipes have been installed at a depth of 3.00mbgl with response zones placed within the made ground and natural deposits (where the made ground was less than 3.00m thick) beneath the site.
- 6.5.5 It is considered that hazardous ground gasses if present would migrate vertically upwards through the permeable sands beneath the site into the proposed development.

Results

- 6.5.6 The monitoring period has been carried between 10th June 2022 and 17th August 2022.
- 6.5.7 The following ground gas risk assessment was carried out in accordance with CIRIA 665, CIRIA 149 and BS 8485.
- 6.5.8 The full results of the gas monitoring regime are presented Appendix E, and are summarised below.
- 6.5.9 Where possible, monitoring has been carried out under a minimum of two occasions where low and falling atmospheric pressure were present together.
- 6.5.10 Methane concentrations ranged between <0.1 and 0.6% v/v; Carbon dioxide concentrations ranged between <0.1 and 10.4% v/v; oxygen concentrations ranged between 0.20 and 19.6% v/v; with peak flows recorded at 3.0 and 4.0l/hr, reducing to a steady 0.0l/hr immediately following the peak reading.
- 6.5.11 Hydrogen sulphide concentrations were recorded at 0ppm
- 6.5.12 Carbon monoxide concentrations were recorded at 0ppm.

- 6.5.13 Based on these recorded values a maximum Gas Screening Values (GSVs) for methane were calculated at 0.0240l/hr; and a maximum GSV for carbon dioxide were calculated at 0.4160/hr.

Conclusions and Recommendations

- 6.5.14 Based on the above information to date, and considering the elevated CO₂ (>5.00% {DS01, DS03, DS04}), this site has been categorised as falling under Characteristic Situation (CS) 2 – Low risk.
- 6.5.15 BS 8485 2015 recommends a point system for protection measures. The proposed development would class as building type A, and therefore this development would require a total of 3.5 points. BS 8485:2015 provides details of the different options that can be used in order to make up the required points which include a combination of a structural barrier, ventilation measures and gas resistant membrane.
- 6.5.16 Professional advice should be sought from a suitably qualified structural engineer as to the appropriateness of any gas protection scheme to the intended construction. All gas protection measures should be designed by a competent person and they should refer to BS 8485 and BRE 414.
- 6.5.17 The site would be classed as Amber 1 under the NHBC traffic light system which would mean that low-level ground gas protection measures are required, creating a permeability contrast to prevent ingress of ground gas into buildings. Ventilation of the sub-floor void should be designed to provide a minimum of one complete volume change per 24 hours. It may be that further gas monitoring and more detailed risk assessment is required, and possible remediation / removal of the gas source.
- 6.5.18 It is recommended that the above conclusions should be agreed with the local Planning Authority to gain their approval prior to commencing with the construction of the new development.
- 6.5.19 Following the installation of any gas resistant membranes the local authority may require verification to prove the membrane has been installed correctly.
- 6.5.20 With regards carbon monoxide: Information provided by the World Health Organisation (WHO) provides air quality guidelines for Europe 2000, which provides time weighted average exposures that have been determined in such a way that the carboxyhaemoglobin (COHb) level of 2.5% is not exceeded. These are as follows:
- 87ppm for 15 minutes
 - 52ppm for 30 minutes
 - 26ppm for one hour
 - 9ppm for eight hours
- 6.5.21 In addition, recommended WHO European guidelines for indoor air quality is as follow:
- 6ppm for twenty-four hours so as not to exceed 2% COHb for chronic exposure.
- 6.5.22 CIRIA 665 provides occupational exposures limits for carbon monoxide of 200ppm for short term exposure and 30ppm for long term exposure.
- 6.5.23 Based on the above, the risks from carbon monoxide are considered to be **low**.
- 6.5.24 Therefore, based on the above results, no protection is considered necessary against carbon monoxide.
- 6.5.25 With regards hydrogen sulphide: Information taken directly from the HSE (Health & Safety Executive) Online provides the following:
- 0.0047 ppm is the recognition threshold of human smell, the concentration at which 50% of humans can detect the characteristic odour of hydrogen sulphide.
 - 10-20 ppm is the borderline concentration for eye irritation.
 - 50-100 ppm leads to eye damage.

- At 150-250 ppm the olfactory nerve is paralyzed after a few inhalations, and the sense of smell disappears, often together with awareness of danger.
- 320-530 ppm leads to pulmonary edema with the possibility of death.
- 530-1000 ppm causes strong stimulation of the central nervous system and rapid breathing, leading to loss of breathing.
- Concentrations over 1000 ppm cause immediate collapse with loss of breathing, even after inhalation of a single breath.

6.5.26 CIRIA 665 provides occupational exposures limits for hydrogen sulphide of 10ppm for short term exposure and 5ppm for long term exposure.

6.5.27 Based on the above, the risks from hydrogen sulphide are considered to be **low**.

6.5.28 Therefore, based on the above results, no protection is considered necessary against hydrogen sulphide.

6.6 Plants and Native grasses

6.6.1 Any plants that may be grown at the site in areas of landscaping may potentially be at risk from phytotoxic elements in any artificial soils beneath the site. Guideline screening values are currently available for copper, nickel and zinc which are considered to be the most harmful to plant life.

6.6.2 All three chemical Determinands recorded levels below the relevant phytotoxic screening criteria. In addition, all plant growth appeared normal during the site walkover. Given the above and the generally low potential for contamination and the results of the wider soil analysis, the risks to plants and native grasses are considered to be low.

6.7 Buried Services and Utilities

6.7.1 Any organic contamination present in the soils or groundwater beneath the site would pose a risk of premature failure to below ground services via chemical reaction. Based on the chemical analysis carried out during this ground investigation, the risks to buried services and pipelines are considered to be **moderate**.

6.7.2 It is the responsibility of the utility providers to confirm the risk status and determine what materials should be used in the provision of any newly proposed buried services and utilities based on the results of the chemical analysis with this report. A copy of this report should therefore be provided to the utility contractors.

6.7.3 It is recommended that prior to the placement of any newly proposed buried services, that adequate testing of the soils of which the pipes / cables will be laid in is carried out to determine the suitability of those soils for the utility provider's equipment.

6.8 Updated Conceptual Site Model (CSM)

6.8.1 Following the results of the site investigation and above assessment, an updated Conceptual Site Model (CSM) has been produced overleaf as Table 6.2: Updated Conceptual Site Model (CSM).

Table 6.2: Updated Conceptual Site Model (CSM)

Potential Sources	Contaminants of Concern	Potential Pathway	Potential Receptor	Pollutant Linkage	Probability	Consequence	Risk Classification	Action / Mitigation / Justification
Made Ground both on site and within influencing distance of the site Current and former land uses both on site and within influencing distance of the site	Heavy metals, sulphates and inorganics PAH's Asbestos Mobile organic contamination Leachable contamination	Ingestion Inhalation Dermal Contact	Human health animals and plants: Including current site users, future site users, neighbouring residents and constructions workers	Considered potentially active	Low	Medium	Low to Moderate	Results of the site investigation confirm exceedances of lead, mercury and aromatic and aliphatic contamination contained within Made Ground in DS03 and DS04 As the proposed development contains soft landscaping, remedial actions will be required; either dig and replace made ground materials / implementation of suitable cover system in areas of soft landscaping.
Made Ground on site Current and former land uses on site	Heavy metals, sulphates and inorganics PAH's Mobile organic contamination Leachable contamination	Lateral and vertical migration and leaching of contaminants into surface water bodies via permeable strata and features.	Local water courses and associated flora and fauna	Considered potentially active	Unlikely	Medium	Low	Given the topography & distance to nearest surface feature from the site, it is considered unlikely the limited contamination is impacting this receptor. No further action.
Made Ground on site Current and former land uses on site	Heavy metals, sulphates and inorganics PAH's Mobile organic contamination Leachable contamination	Lateral and vertical migration and leaching of contaminants into local groundwater	Underlying Aquifer (Drinking water)	Considered potentially active	Low	Medium	Low to Moderate	Results of the site investigation confirm exceedances of lead, mercury and aromatic and aliphatic contamination contained within Made Ground in DS03 and DS04 Given the presence of Secondary A aquifer, it is considered that a low likelihood of contamination impacting the receptor is present. As the proposed development contains soft landscaping, remedial actions will be required; it is considered that removal of impacted made ground materials would reduce this risk to low.

Potential Sources	Contaminants of Concern	Potential Pathway	Potential Receptor	Pollutant Linkage	Probability	Consequence	Risk Classification	Action / Mitigation / Justification
Made Ground beneath the site Current and former site uses	Phytotoxic elements	Plant uptake	Plants and vegetation	Considered potentially active	Unlikely	Mild	Low	Results of the site investigation confirm exceedances of lead, mercury and aromatic and aliphatic contamination contained within Made Ground in DS03 and DS04 As the proposed development contains soft landscaping, remedial actions will be required; either dig and replace made ground materials / implementation of suitable cover system in areas of soft landscaping.
Landfill sites Potentially infilled Land (ponds, quarries, reservoirs etc) Made Ground Natural organic soils Fuel storage (on and off-site sources)	Hazardous ground gases including CO ₂ , CH ₄ CO, H ₂ S Vapours	Inhalation	Human health animals and plants: Including current site users, future site users, neighbouring residents and constructions workers	Considered potentially active	Likely	Severe	Low (CS2)	Results of the site investigation confirm that ground conditions show Made ground deposits to 1.00mbgl and no organic materials were encountered. Results of the ground gas monitoring indicated the site to be Characteristic Situation 2 – Low Risk; with protection measures necessary.
Landfill sites Potentially infilled Land (ponds, quarries, reservoirs etc) Made Ground Natural organic soils Fuel storage (on and off-site sources)	Hazardous ground gases including CO ₂ , CH ₄ CO, H ₂ S Vapours	Explosion	Buildings	Considered potentially active	Likely	High	Low (CS2)	Results of the site investigation confirm that ground conditions show Made ground deposits to 1.00mbgl and no organic materials were encountered. Results of the ground gas monitoring indicated the site to be Characteristic Situation 2 – Low Risk; with protection measures necessary.

6.9 Further Work

- 6.9.1 Given the presence of contamination recorded at the site, it is likely that the Local Authority will require a Remediation Strategy to outline the proposed methodology for remediation of the site in order to make it suitable for use.

7.0 GEOTECHNICAL TESTING AND RESULTS

7.1 General

- 7.1.1 This geotechnical investigation was undertaken to provide details of the ground conditions, soils strengths, engineering properties of the soils and rock beneath the site, and subsequent advice on suitable foundation solutions.
- 7.1.2 At this stage the precise construction details have not been provided to GeoCon; however, it is understood the site is to be demolished and construction undertaken of three 2-storey structures, totalling six semi-detached residential properties at the site; which includes for hardstanding parking and access and soft landscaped areas.
- 7.1.3 It should be noted that GeoCon have not been provided with any further details regarding the structural loading at this stage.

7.2 Geotechnical Testing

- 7.2.1 In-situ Standard Penetration Tests (SPTs) were undertaken in accordance with BS1377 (1990) within the window sample boreholes. A summary of the insitu testing is given below in Table 7.1: Insitu Geotechnical Testing:

Table 7.1: Insitu Geotechnical Testing

Strata	Depth Range (mbgl) vs SPT N Value	Locations Encountered
Till, Devensian (Cohesive)	1.20 – 1.65 N= 6 2.00 – 2.45 N= 10-14 3.00 – 3.45 N= 22-23 4.00 – 4.45 N= 17 5.00 – 5.45 N=34	DS02, DS04
Till, Devensian (Granular)	1.20 – 1.65 N= 4-16 2.00 – 2.45 N= 0-14 3.00 – 3.45 N= 6-23 4.00 – 4.45 N= 17-22 5.00 – 5.45 N=21-22	DS01, DS03, DS04

NR = Not Recorded In This Strata

- 7.2.2 A programme of geotechnical laboratory testing was undertaken in accordance with BS1377 (1990) 'Methods of tests for soils for civil engineering purposes. The geotechnical testing regime has been summarised below in Table 7.2: Geotechnical Laboratory Analysis

Table 7.2: Geotechnical Laboratory Analysis

BS 1377 Test Number	Test Description	Quantity Analysed
BS 1377 1990: Part 2. Clause 3.2	Moisture content	3
BS 1377 1990: Part 2. Clause 4.3, 5.3 & 5.4	Atterberg Limits	3
BS 1377 1990: Part 3. Clause 5.3 & BRE CP2/79	BRE SD 1	4

- 7.2.3 The results of the geotechnical testing are presented in Appendix D.

Plasticity Index

- 7.2.4 Atterberg limit testing was carried out on selected samples of cohesive soils taken from the site to establish the plasticity index of the clay beneath the site. The results of this testing is presented below in Table 7.3: Atterberg Limits Testing Results

Table 7.3: Atterberg Limits Testing Results

Test	Range
Moisture Content (%)	18 – 22
Liquid Limit (%)	38 – 45
Plastic Limit (%)	19 – 23
Plasticity Index (%)	19 – 22
Modified plasticity index (%)	19 - 22

- 7.2.5 Based on these results the clay beneath the site can be classed as intermediate plasticity.
- 7.2.6 Chapter 4.2 ‘Building near Trees’ of the NHBC standards indicates that from the testing results, the modified plasticity index is between 19 and 22% and therefore, the clay beneath the site is of medium volume change potential.

BRE SD 1

- 7.2.7 Four soil samples were analysed for BRE SD 1 reduced suite to assess the risk to buried concrete at the site, which includes total sulphate, water soluble sulphate, pH and total sulphur. The results of the testing are summarised below in Table 7.4: Summary of BRE SD 1 Results.

Table 7.4: Summary of BRE SD 1 Results

Test	Soil Test - Results Range
Total sulphate (%)	0.4 – 2.50
Water soluble sulphate (mg/l)	10.00 - 83.00
Total sulphur (%)	0.03 - 0.08
pH	6.10 - 8.82
Total Potential Sulphate (%)	0.09 – 0.24
Potential amount of Oxidisable Sulphate Present (%)	0.07 – 0.14

- 7.2.8 Design/mix of buried concrete should be undertaken in accordance with the “Aggressive Chemical Environment for Concrete” (ACEC) classification, of BRE Special Digest 1:2005 (Concrete in Aggressive Ground).
- 7.2.9 The above results indicate that pyrite is unlikely to be present within the soils beneath the site.

8.0 GEOTECHNICAL ASSESSMENT

8.1 General

- 8.1.1 At this stage GeoCon have not been provided with any loadings for the proposed development.
- 8.1.2 The recommendations given below assume that ground levels intended for the redevelopment will be similar to those existing at present. If ground levels are subject to significant change as part of the proposed development, then the recommendations in this report may require reinterpretation.

8.2 Geotechnical Model

- 8.2.1 Four Dynamic sample boreholes were formed over the site to be where the proposed buildings would be built.
- 8.2.2 The ground conditions encountered within the exploratory holes are summarised below in Table 8.1: Summary of Ground Conditions.

Table 8.1: Summary of Ground Conditions

Stratum	Depth Range to Base of Stratum (mbgl) (Thickness Range)	Strength/Consistency	Notes
Made Ground and Topsoil			
Made Ground	0.60 to 1.00mbgl (0.60 to 1.00m+)	Not recorded.	Made Ground was recorded in all exploratory holes. It comprised of brown clayey , gravel fine to coarse sand topsoil (to 0.30m) or light grey asphalt (to 0.20m) over clayey gravelly sand. Topsoil was encountered in DS01 and DS02 to 0.30mbgl. Asphalt was encountered in DS03 and DS04 to 0.20mbgl.
Natural Strata			
Till, Devensian (Cohesive)	3.45 to 5.45mbgl (2.55 to 3.95m+)	Soft to very stiff consistency. SPT 'N' values obtained from WS02 & DS04 only: 1.20 – 1.65 N= 6 2.00 – 2.45 N= 10-14 3.00 – 3.45 N= 22-23 4.00 – 4.45 N= 17 5.00 – 5.45 N=34	Described in the field as a soft to stiff grey sandy gravelly CLAY, with some layers containing orange mottling. Encountered directly beneath the Made Ground in DS02, Encountered beneath the clayey sand layer in DS04 and then in layers of Sand and Clay to 5.45mbgl. <u>Atterberg & Moisture Content Tests (10no. samples analysed)</u> Moisture Contents – 18 to 22% Plastic Limits – 19 to 23% Liquid Limits – 35 to 45% Consistency index - 0.9 to 1.1% The Atterberg Limit tests indicate that the clay is of low to intermediate plasticity and medium volume change potential. A number of samples had natural moisture contents lower than the plastic limit of the clay sample being analysed; this suggests that these samples were in a desiccated condition when analysed.
Till, Devensian (Granular)	4.95 to 4.45mbgl (4.45 to 4.75m+)	SPT 'N' values: 1.20 – 1.65 N= 4-16 2.00 – 2.45 N= 0-14 3.00 – 3.45 N= 6-23 4.00 – 4.45 N= 17-22 5.00 – 5.45 N=21-22	Described in the field as a very loose to medium dense dark brown to orangish brown clayey gravelly SAND. Encountered directly beneath the Made Ground in all locations excluding DS02, where it is not encountered. .

- 8.2.3 The liquid and plastic limits of nine samples within the clay deposits have been determined. The results of the testing yielded liquid limits of between 38 and 45% in association with plastic limits of between 19% and 23% thus, with respect to the recorded moisture content, a consistency index of between 0.9 and 1.2.
- 8.2.4 These results demonstrate that this cohesive soil may be generally classified as clay of intermediate plasticity; and on the basis of the consistency index has a stiff to very stiff consistency. In addition, the NHBC classification indicates that the clay revealed at this site possesses a medium volume change potential.
- 8.2.5 Groundwater was encountered in three boreholes, DS01, DS03, DS04, with monitoring data indicating a shallow water table at the base of the made ground materials (0.70 - 1.00mbgl)

8.3 Foundations

- 8.3.1 The made ground and shallow natural ground in its current setting would not be suitable for the construction of shallow foundations due to the risk of unacceptable total and differential settlement occurring. These soils are present in a weak and variable condition such that excessive total and or differential settlement could occur under moderately light surface loading.
- 8.3.2 Where made ground is either not present or present only at shallow depths, it would be possible to adopt strip or spread foundations in the underlying glacial clay (DS02, DS04), which generally consists of firm sandy clay. It is considered that this material will provide a suitable bearing stratum, provided that the foundations are placed within a single soil type, and where cohesive generally described as being present in a firm (or higher) insitu condition. It is considered that strip or spread foundations constructed within this material at a minimum depth of say 2.00m could be designed assuming an allowable increase in load given below in Table 8.2: Allowable increase in stress. However, the majority of the site has variable soil types of very loose to loose granular material; which may make this solution uneconomic.

Table 8.2: Allowable increase in stress

Foundation Type	Strip Footings (m)			Spread Foundation (m)		
Foundation Width (m)	0.60	1.00	1.50	1.00	2.00	3.00
Foundation Depth (m)	2.00			2.00		
Allowable Increase in Stress (kN/m ²)	95	90	85	145	130	125

- 8.3.3 The allowable increase in stress given above assumes a factor of safety of 3 against general shear failure, with cohesion of 40kN/m² at the foundation depths. Settlements at the above loading intensities should remain within tolerable limits for the type of structure proposed provided that the underlying soils are carefully inspected immediately final trimming has taken place. Should any soft or weak material be encountered they should be locally removed and replaced with lean-mix concrete or compacted granular soil.
- 8.3.4 Once excavated, the formation may be subject to heave, which may result in settlement when the new foundation loads are applied. The designer should ensure that any settlement would remain within serviceable limits for the new and existing structures.
- 8.3.5 Foundation depths may need to be increased where they are within influencing distance of trees. Heave precautions may also be required. Advice on these issues is given in NHBC Standards Chapter 4.2.
- 8.3.6 In areas of underlying natural granular material and on the basis of strip or spread foundations with a minimum width of 1.00m and constructed at minimum depths of 1.20mbgl, an allowable increase in stress of 40kN/m² should be achievable, with a factor of safety against general shear failure of in excess of 3. Settlements at these loading intensities should remain within tolerable limits (<25mm) for the type

of structure proposed provided that the underlying soils are carefully inspected immediately after final trimming has taken place. Should any very loose, cohesive or weak material be encountered they should be locally removed and replaced with lean-mix concrete or compacted granular soil. In addition, if the excavations are required to stand open for any period of time, then a blinding layer of lean-mix concrete should be placed in the excavation bases. This expedient will reduce loosening of the sub-grade due to the ingress of surface water.

- 8.3.7 Due to the variable soil strengths and density, the allowable increase in stress of 40kN/m² is considered unacceptable for the loadings of a 2-storey residential building. Therefore, it is considered that the following foundation solutions are possible:

- Raft Foundations; and
- Ground Improvement

Raft Foundations

- 8.3.8 Raft foundations are a possible foundation option for lightly loaded one or two storey houses. Raft foundations will need to be designed by suitably experienced structural engineer; in accordance with recommendations contained within the NHBC Standards.
- 8.3.9 Engineered granular infill will be required beneath the raft foundations in the zone of influence of existing or proposed trees. The infill should not be less than 50% of the foundation depth derived in accordance with NHBC Standards Chapter 4.2 and should not exceed 1.25m.
- 8.3.10 It is considered that a maximum depth of 1.25 m of engineered fill should be placed beneath proposed raft foundations.
- 8.3.11 Interactions between new and existing foundations would need to be considered, as would the potential for differential settlement between new and existing structures. A construction joint should be incorporated at the interface between any new and existing structures. Particular care will be required to ensure that the new basement does not adversely impact the existing foundations.

Ground Improvement

- 8.3.12 Where deep Made Ground (>1.50mbgl), loose sands or variable granular and cohesive soil matrices are present, the ground can be engineered by the construction of Vibro-Stone Columns which basically treat the soils to ensure uniform settlement and safe ABP.
- 8.3.13 Once the VSC have been installed, the ground is then suitable for the construction of a reinforced strip footing 600mm wide and 300mm deep; with mesh to the top and bottom. This structure must be constructed a minimum of 600mm below the top of the stone column.
- 8.3.14 As an alternative to the use of vibro, consideration may be directed towards other ground improvement techniques such as dynamic compaction or modification with lime or cement. In order to formulate a suitable design, it is recommended that the advice of a competent structural engineer is sought.

8.4 Floor Slabs

- 8.4.1 Suspended floorslabs should be used at this site due to the presence and thickness of made ground and loose soils immediately beneath the site.

8.5 Concrete

- 8.5.1 A review of the pH and sulphate concentrations indicates that all concrete used in the foundations at this site should be designed to "Design Sulphate Class" DS-1, and the "Aggressive Chemical Environment for Concrete" (ACEC) class AC-2z.

8.6 Groundwater and Excavations

- 8.6.1 Groundwater is unlikely to represent a particular problem to the construction of the proposed development at this site. However, it should be recognized that slight seepages and minor water entries may combine in any long trench excavations to create a significant volume of water which may cause local problems during the construction phase. Any minor groundwater seepages or significant standing water within excavations made upon this site may be removed by using a simple form of de-watering. Such a system could include the excavation of sumps from which the water could be pumped. Advice on Groundwater Control is given in CIRIA Report No 515 – Groundwater Control Design and Practice.
- 8.6.2 It is recommended that the borehole installation is grouted up during the construction works to prevent it from acting as a future conduit for potential artesian water.
- 8.6.3 With respect to buoyancy effects / hydrostatic water pressure, in the absence of long-term groundwater level monitoring data, it is recommended that a design groundwater level of 0.00mbgl is adopted for basement design purposes. The structural design engineer should check that the stiffness of the floor slab is sufficient to resist bending due to potential groundwater uplift pressures, and that the structure is heavy enough to resist buoyancy effects.
- 8.6.4 Foundation excavations should be feasible using conventional plant.
- 8.6.5 The stability of the excavation faces cannot be guaranteed, thus temporary support to the excavation faces may become necessary. Alternatively, subject to space constraints, excavations could be battered back to a suitable angle of repose. However, if there is a requirement to protect nearby structures or services, appropriate supports may still be required. Advice on excavation support is given in CIRIA Report No 97 – Trenching Practice.

8.7 Road Pavement

- 8.7.1 Any new pavements will require assessment of the existing sub grade in terms of its California Bearing Ratio (CBR) to facilitate the actual pavement design.

8.8 Sustainable Drainage

- 8.8.1 In accordance with National Planning and Policy Framework (NPPF) the Planning Authority are likely to insist that surface water drainage from any new-build or redevelopment complies with current design practices for Sustainable Urban Drainage (SUD's) construction of separate drainage systems for foul and surface water. Surface water shall be required to be attenuated reducing the discharge of water from the site requiring treatment and disposal. A 20% reduction in surface water discharge rates off the site is to be expected – allowing for the 1 in 100-year storm event and allowing for climate change.
- 8.8.2 Based on the groundwater encountered it is unlikely that sustainable drainage would be suitable at the site. If sustainable drainage is to be considered, it is recommended that soak-away testing is carried out in accordance with BRE 365 at the site to establish the sites suitability for sustainable drainage.

8.9 Existing structures

- 8.9.1 Any existing structures and foundations if found should be grubbed up and replaced with a suitable engineered granular backfill and should be compacted in layers.

8.10 Material Re-Use

- 8.10.1 Any site won soils / materials may be available for reuse across the site subject to the appropriate classification, analysis and engineered solution.

9.0 OTHER POTENTIAL DEVELOPMENT CONSIDERATIONS

9.1 Waste Soils Characterisation

- 9.1.1 Any excavation works may potentially produce waste soils for which appropriate waste management will be required. Any soils requiring removal and disposal from site would require appropriate classification testing prior to disposal and the results would need to be confirmed with the landfill operator. Isolated hotspots if encountered may need to be taken off as Non-Hazardous or Hazardous waste. Any off-site disposal of soil requires careful management and due consideration of appropriate legislation, guidance and Duty of Care responsibilities.
- 9.1.2 A Hazardous Waste Assessment should be carried out on any materials requiring removal and disposal from site. Waste Acceptance Criteria (WAC) testing may also be required and the results of the Hazardous Waste Assessment and WAC testing (if appropriate) should be presented to the landfill operator for their confirmation of waste category.

9.2 Imported Fill

- 9.2.1 Any imported fill will be subject to specific quality requirements, particularly in any proposed areas of landscaping. Allowance should be made for the testing of imported fill materials prior to emplacement to ensure suitability should the materials be delivered with no testing certification.

9.3 Construction Activities

- 9.3.1 Due consideration should be given to the suppression of noise, dust and vibration emissions from the site during construction.

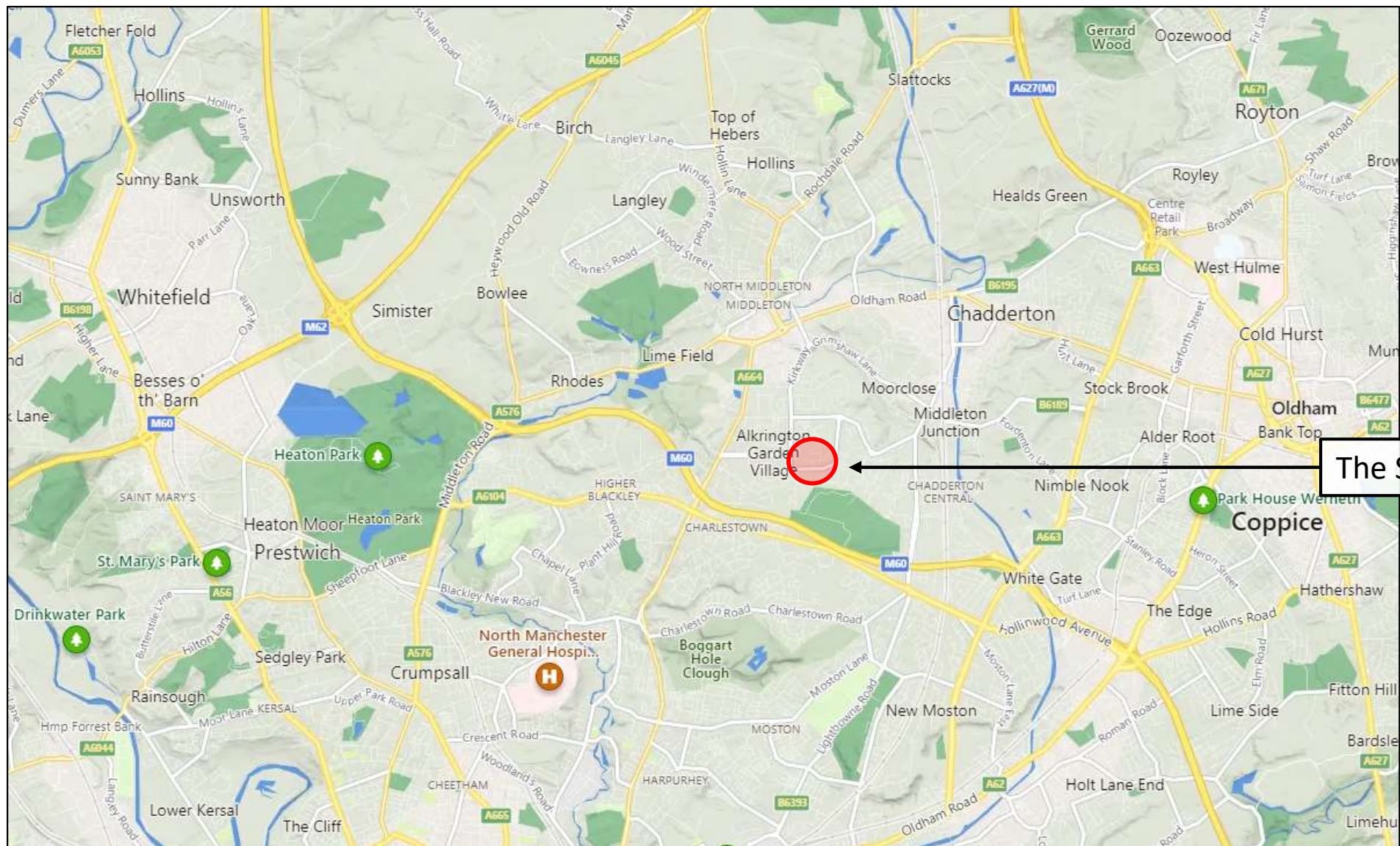
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LIST OF ACRONYMS

Acronym	Meaning
BGS	British Geological Survey
BH	Borehole
CDM	Construction Design and Management
CL:AIRE	Contaminated Land: Applications In Real Environments
CLR	Contaminated Land Report
COSHH	Control Of Substances Hazardous to Health
CSM	Conceptual Site Model
DCP	Dynamic Cone Penetrometer
DEFRA	Department for Environment Foods and Rural Affairs
DP	Dynamic Probe
DoE	Department of Environment
DWS	Drinking Water Standard
EA	Environment Agency
EQS	Environmental Quality Standard
GAC	Generic Acceptance Criteria
HP	Hand Pit
HA	Hand Auger
LPA	Local Planning Authority
LQM	Land Quality Management
mbgl	Metres Below Ground Level
MP	Mackintosh Probe
NPPF	National Planning Policy Framework
NGR	National Grid Reference
OS	Ordnance Survey
SGV	Soil Guideline Value
SSV	Soil Screening Value
WSV	Water Screening Value
SPOSH	Significant Possibility of Significant Harm
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
TP	Trial Pit
TT	Trial Trench
WS	Windowless Sample / Window Sample

APPENDIX A
DRAWINGS



GeoCon Site Investigations Ltd
 Suite 2 Marple House,
 39 Stockport Road,
 Marple,
 Stockport,
 SK6 6BD.
 Tel: 0844 504 3901, Fax: 0844 504 3902,
 Email: info@geoconsiteinvestigations.com
 Web: www.geoconsiteinvestigations.com

PROJECT ID

GSI 1676 Kirkway Service Station, Middleton

TITLE

Site Location Plan

DRAWING NUMBER

GSI 1676/01

DATE

May 2022

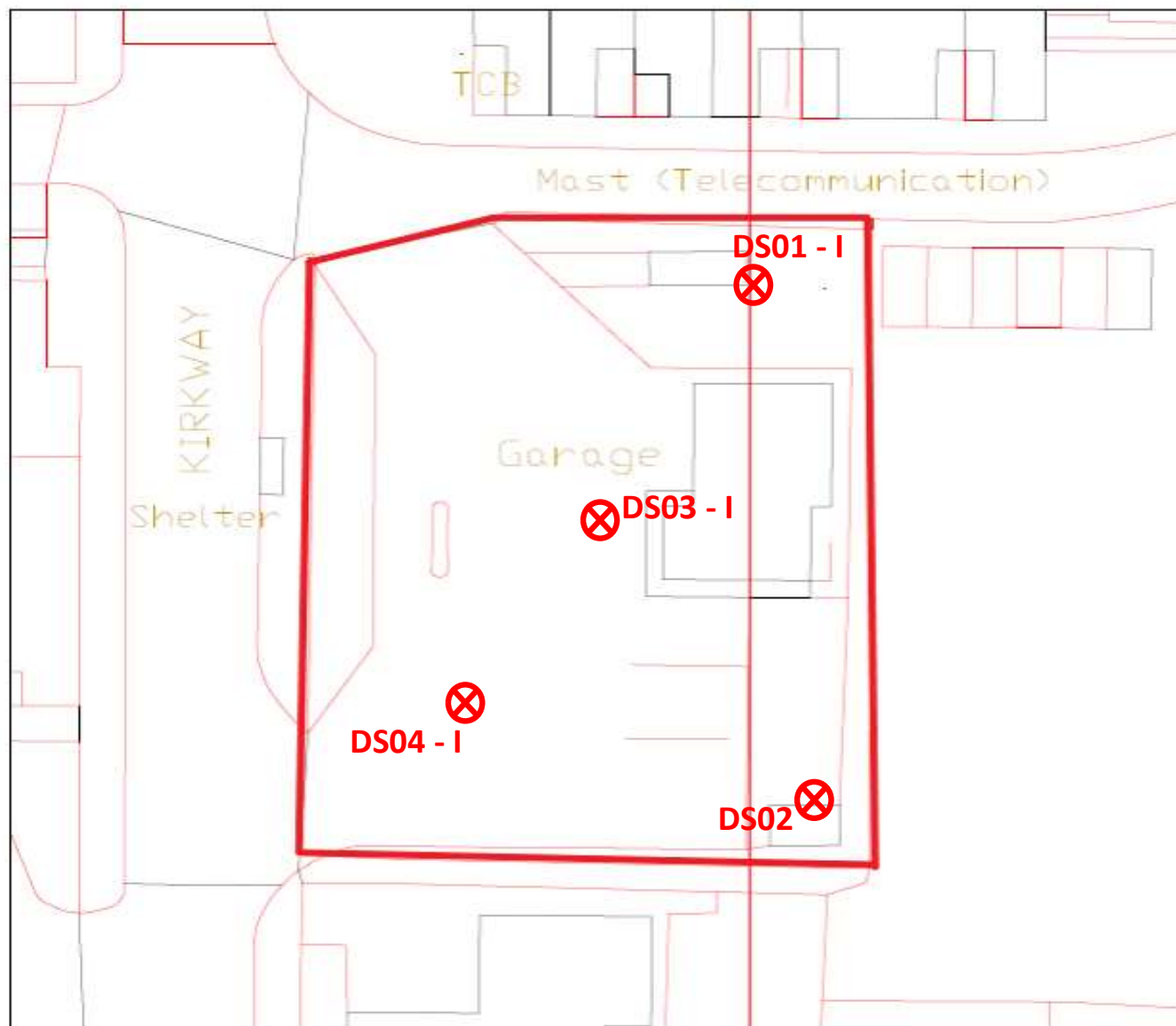
SCALE

N.T.S

DRAWN BY

JEM

N



Legend:



Dynamic Sample Borehole Location



Dynamic Sample Install



GeoCon Site Investigations Ltd
Suite 2 Marple House,
39 Stockport Road,
Marple,
Stockport,
SK6 6BD.
Tel: 0844 504 3901, Fax: 0844 504 3902,
Email: info@geoconsiteinvestigations.com
Web: www.geoconsiteinvestigations.com

PROJECT ID

GSI 1676 Kirkway Service Station, Middleton

TITLE

Exploratory Hole Location Plan

DRAWING NUMBER

GSI 1676/02

DATE

May 2022

SCALE

N.T.S

DRAWN BY

JEM

APPENDIX B

BOREHOLE LOGS

WINDOWLESS SAMPLE BOREHOLE LOG



Project Kirkway Service Station, Middleton				WINDOWLESS SAMPLE BOREHOLE No DS01
Project ID GSI 1676	Date 31-05-22 31-05-22	Ground Level (m)	Co-Ordinates	
Contractor				Sheet 1 of 1

SAMPLES & TESTS			STRATA					Geology	Instrument & Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.20	ES					(0.30) 0.30	MADE GROUND: Dark brown slightly clayey slightly gravelly fine to coarse SAND. Gravel is subangular, fine to medium of brick. (REWORKED TOPSOIL)	TS	
0.50	ES					(0.30) 0.60	MADE GROUND: Dark brown slightly clayey slightly gravelly fine to medium SAND. Gravel is subangular, fine to medium of brick.	MG	
0.70	ES					(0.80)	Brown slightly clayey slightly gravelly fine to coarse SAND. Gravel is subangular, fine to medium of flint and sandstone. (TILL, DEVENSIAN) 0.60 - 1.40 Occasional pockets of CLAY.	TILLD	
1.20 1.20-1.65	D SPT	N16				1.40			
1.50	D					(0.45) 1.85	Medium dense light grey slightly clayey slightly gravelly fine to coarse SAND. Gravel is subangular, fine to medium of flint and sandstone. (TILL, DEVENSIAN)	TILLD	
2.00-2.45	SPT	N0	↓			(1.15)	Very loose grey clayey fine to coarse SAND. (TILL, DEVENSIAN)	TILLD	
2.50	D					3.00			
3.00-3.45	SPT	N14				(1.50)	No Recovery.	TILLD	
4.00-4.45	SPT	N22				4.50			
4.50	D					(0.95)	Medium dense grey clayey fine to coarse SAND. (TILL, DEVENSIAN)	TILLD	
5.00-5.45	SPT	N22				5.45			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Depth	From	To	Hours	From	To	
All dimensions in metres Scale 1:37.5						Client Ashton Bennett			Method / Plant Used Competitor Dart		Logged By JEM

Inspection hand pit excavated to 1.20 mbgl prior to drilling and cleared of buried services using a C.A.T scanner. Groundwater was encountered at 2.00 mbgl, falling to 2.43 mbgl after 20 minutes. Upon completion, exploratory location installed with 50 mm diameter standpipe, with a response zone between 1.00 mbgl and 3.00 mbgl.

WINDOWLESS SAMPLE BOREHOLE LOG



Project Kirkway Service Station, Middleton				WINDOWLESS SAMPLE BOREHOLE No DS02
Project ID GSI 1676	Date 31-05-22 31-05-22	Ground Level (m)	Co-Ordinates	
Contractor				Sheet 1 of 1

SAMPLES & TESTS			STRATA					Geology	Instrument & Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.20	ES					(0.30) 0.30	MADE GROUND: Dark brown slightly clayey slightly gravelly fine to coarse SAND. Gravel is subangular, fine to medium of brick. (REWORKED TOPSOIL)	TS	
0.50	ES					(0.60)	MADE GROUND: Dark brown slightly clayey slightly gravelly fine to medium SAND. Gravel is subangular, fine to medium of brick.	MG	
0.70	ES					0.90			
1.20-1.65 1.30	SPT D	N6				(1.00) 1.90	Soft grey mottled orange slightly sandy slightly gravelly CLAY. Gravel is rounded, fine to medium of flint and sandstone. (TILL, DEVENSIAN)	TILLD	
2.00-2.45 2.30	SPT D	N10				(1.55)	Firm grey slightly sandy slightly gravelly CLAY. Gravel is rounded, fine to medium of flint and sandstone. (TILL, DEVENSIAN)	TILLD	
2.80 3.00-3.45	D SPT	N22				3.45	3.00 Becomes Stiff		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To	
All dimensions in metres Scale 1:37.5						Client Ashton Bennett			Method / Plant Used Competitor Dart		Logged By JEM

Inspection hand pit excavated to 1.20 mbgl prior to drilling and cleared of buried services using a C.A.T scanner. Groundwater was not encountered. Upon completion, exploratory location backfilled with arisings.

WINDOWLESS SAMPLE BOREHOLE LOG



Project Kirkway Service Station, Middleton				WINDOWLESS SAMPLE BOREHOLE No DS03
Project ID GSI 1676	Date 31-05-22 31-05-22	Ground Level (m)	Co-Ordinates	
Contractor				Sheet 1 of 1

SAMPLES & TESTS			STRATA					Geology	Instrument & Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.00-0.20	CORE					0.20	MADE GROUND: Light grey ASPHALT. 50-60% aggregate, subangular, fine to medium (minimum 1 mm, maximum 4 mm). 1% voids (minimum 1mm, maximum 2 mm).	C	
0.40	ES					(0.30) 0.50	MADE GROUND: Greyish brown sandy GRAVEL with cobbles. Gravel is subangular, fine to medium of brick and concrete. Cobbles are subangular of brick and concrete.	MG	
0.70	ES					(0.50) 1.00	MADE GROUND: Greyish brown slightly clayey slightly gravelly fine to coarse SAND with cobbles. Gravel is subangular, fine to medium of brick and concrete. Cobbles are subangular of brick and concrete.	MG	
1.20-1.65	SPT	N4				(1.00) 2.00	0.50 - 1.00 Hydrocarbon odour No Recovery.	TILLD	
2.00-2.45	SPT	N3				(1.00) 3.00	Very loose dark brown slightly clayey slightly gravelly fine to coarse SAND. Gravel is subrounded, fine to medium of sandstone. (TILL, DEVENSIAN)	TILLD	
2.60	D								
3.00-3.45	SPT	N6				(1.00) 4.00	No Recovery.	TILLD	
4.00-5.00	D					(1.45) 5.45	Medium dense dark brown slightly clayey slightly gravelly fine to coarse SAND. Gravel is subrounded, fine to medium of sandstone (10% Recovery). (TILL, DEVENSIAN)	TILLD	
4.00-4.45	SPT	N20							
5.00-5.45	SPT	N21							

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To	
All dimensions in metres Scale 1:37.5						Client Ashton Bennett			Method / Plant Used Competitor Dart		Logged By JEM

Inspection hand pit excavated to 1.20 mbgl prior to drilling and cleared of buried services using a C.A.T scanner. Groundwater was encountered at 0.74 mbgl, falling to 0.76 mbgl after 20 minutes. Upon completion, exploratory location installed with 50 mm diameter standpipe, with a response zone between 0.50 mbgl and 1.00 mbgl.

WINDOWLESS SAMPLE BOREHOLE LOG



Project Kirkway Service Station, Middleton				WINDOWLESS SAMPLE BOREHOLE No DS04
Project ID GSI 1676	Date 31-05-22 31-05-22	Ground Level (m)	Co-Ordinates	
Contractor				Sheet 1 of 1

SAMPLES & TESTS			STRATA					Geology	Instrument & Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.00-0.10	B					0.10	MADE GROUND: Light grey ASPHALT. 50-60% aggregate, subangular, fine to medium (minimum 1 mm, maximum 4 mm). 1% voids (minimum 1mm, maximum 2 mm).	C	
0.40	ES					(0.60) 0.70	MADE GROUND: Greyish brown sandy GRAVEL with cobbles. Gravel is subangular, fine to medium of brick and concrete. Cobbles are subangular of brick and concrete.	MG	
0.80 0.80	D ES					(0.80)	Greyish brown clayey fine to coarse SAND. (TILL, DEVENSIAN)	TILLD	
1.20-1.65	SPT	N5				1.50	Soft grey mottled brown slightly sandy slightly gravelly CLAY with occasional roots. Gravel is rounded, fine to medium of flint and sandstone. (TILL, DEVENSIAN)	TILLD	
1.50	D					(1.60)	2.00 Becomes firm	TILLD	
1.80	D							TILLD	
2.00-2.45	SPT	N14						TILLD	
2.60	D							TILLD	
3.00-3.45	SPT	N23				3.10	Medium dense brown fine to coarse SAND. (TILL, DEVENSIAN)	TILLD	
3.60	D					(0.70) 3.80	Stiff grey mottled brown slightly sandy slightly gravelly CLAY with occasional roots. Gravel is rounded, fine to medium of flint and sandstone. (TILL, DEVENSIAN)	TILLD	
4.00-4.45	SPT	N17				(0.30) 4.10	Medium dense brown fine to coarse SAND. (TILL, DEVENSIAN)	TILLD	
4.60	D					(0.80) 4.90	Very stiff grey mottled brown CLAY. (TILL, DEVENSIAN)	TILLD	
5.00-5.45	SPT	N34				(0.55) 5.45		TILLD	

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Depth	From	To	Hours	From	To	
All dimensions in metres Scale 1:37.5						Client Ashton Bennett			Method / Plant Used Competitor Dart		Logged By JEM

Inspection hand pit excavated to 1.20 mbgl prior to drilling and cleared of buried services using a C.A.T scanner. Groundwater was encountered at 0.30 mbgl, falling to 0.70 mbgl after 20 minutes. Upon completion, exploratory location installed with 50 mm diameter standpipe, with a response zone between 1.00 mbgl and 3.00 mbgl.

APPENDIX C
CHEMICAL TESTING RESULTS

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 22/05596
Issue Number: 1
Date: 22 June, 2022

Client: Geocon Site Investigations Ltd
Suite 2 Marple House,
39 Stockport Road,
Marple
Stockport
UK
SK6 6BD

Project Manager: Use - Mailing list/Use - Mailing list 2
Project Name: Kirkway Service Station, Middleton
Project Ref: GSI 1676
Order No: PO 22/0283
Date Samples Received: 01/06/22
Date Instructions Received: 08/06/22
Date Analysis Completed: 22/06/22

Approved by:



Sophie France
Client Service Manager

Envirolab Job Number: 22/05596

Client Project Name: Kirkway Service Station, Middleton

Client Project Ref: GSI 1676

Lab Sample ID	22/05596/3	22/05596/5	22/05596/6	22/05596/8	22/05596/9	22/05596/10	22/05596/11	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	DS01	DS02	DS02	DS03	DS03	DS04	DS04			
Depth to Top	0.70	0.50	0.70	0.70	2.20	0.40	0.80			
Depth To Bottom										
Date Sampled	31-May-22	31-May-22	31-May-22	31-May-22	31-May-22	31-May-22	31-May-22			
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES			
Sample Matrix Code	5A	4AE	4AE	5A	6A	5A	5			
% Stones >10mm _A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	% w/w	0.1	A-T-044
pH _D ^{M#}	6.68	6.04	-	11.47	-	8.62	-	pH	0.01	A-T-031s
pH BRE _D ^{M#}	6.68	-	6.10	-	8.82	-	7.90	pH	0.01	A-T-031s
Ammonium NH ₄ BRE (water sol 2:1) _D	2.60	-	1.21	-	4.88	-	1.75	mg/l	1	A-T-033s
Chloride BRE, SO ₄ equiv. (water sol 2:1) _D ^{M#}	<7	-	15	-	24	-	<7	mg/l	7	A-T-026s
Nitrate BRE, SO ₄ equiv. (water sol 2:1) _D	2.0	-	2.5	-	<0.4	-	<0.4	mg/l	0.4	A-T-026s
Sulphate BRE (water sol 2:1) _D ^{M#}	<10	-	83	-	82	-	<10	mg/l	10	A-T-026s
Sulphate BRE (acid sol) _D ^{M#}	<0.02	-	0.10	-	0.04	-	0.02	% w/w	0.02	A-T-028s
Sulphur BRE (total) _D	0.03	-	0.08	-	0.04	-	0.03	% w/w	0.01	A-T-024s
Magnesium BRE (water sol 2:1) _D	<1	-	<1	-	16	-	1	mg/l	1	A-T-SOLMETS
Cyanide (total) _A ^{M#}	<1	<1	-	<1	-	<1	-	mg/kg	1	A-T-042sTCN
Phenols - Total by HPLC _A	<0.2	<0.2	-	<0.2	-	<0.2	-	mg/kg	0.2	A-T-050s
Total Organic Carbon _D ^{M#}	4.85	7.39	-	1.05	-	1.64	-	% w/w	0.03	A-T-032s
Arsenic _D ^{M#}	<1	13	-	14	-	24	-	mg/kg	1	A-T-024s
Cadmium _D ^{M#}	<0.5	0.5	-	<0.5	-	0.6	-	mg/kg	0.5	A-T-024s
Copper _D ^{M#}	9	44	-	18	-	58	-	mg/kg	1	A-T-024s
Chromium _D ^{M#}	5	21	-	18	-	18	-	mg/kg	1	A-T-024s
Chromium (hexavalent) _D	-	<1	-	<1	-	<1	-	mg/kg	1	A-T-040s
Lead _D ^{M#}	12	89	-	64	-	526	-	mg/kg	1	A-T-024s
Mercury _D	<0.17	0.20	-	2.31	-	0.94	-	mg/kg	0.17	A-T-024s
Nickel _D ^{M#}	4	20	-	14	-	16	-	mg/kg	1	A-T-024s
Selenium _D ^{M#}	1	1	-	<1	-	<1	-	mg/kg	1	A-T-024s
Zinc _D ^{M#}	15	87	-	70	-	89	-	mg/kg	5	A-T-024s

Envirolab Job Number: 22/05596

Client Project Name: Kirkway Service Station, Middleton

Client Project Ref: GSI 1676

Lab Sample ID	22/05596/3	22/05596/5	22/05596/6	22/05596/8	22/05596/9	22/05596/10	22/05596/11	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	DS01	DS02	DS02	DS03	DS03	DS04	DS04			
Depth to Top	0.70	0.50	0.70	0.70	2.20	0.40	0.80			
Depth To Bottom										
Date Sampled	31-May-22	31-May-22	31-May-22	31-May-22	31-May-22	31-May-22	31-May-22			
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES			
Sample Matrix Code	5A	4AE	4AE	5A	6A	5A	5			
Asbestos in Soil (inc. matrix)										
Asbestos in soil _D [#]	NAD	NAD	-	NAD	-	NAD	-			A-T-045
Asbestos Matrix (visual) _D	-	-	-	-	-	-	-			A-T-045
Asbestos Matrix (microscope) _D	-	-	-	-	-	-	-			A-T-045
Asbestos ACM - Suitable for Water Absorption Test? _D	N/A	N/A	-	N/A	-	N/A	-			A-T-045

Envirolab Job Number: 22/05596

Client Project Name: Kirkway Service Station, Middleton

Client Project Ref: GSI 1676

Lab Sample ID	22/05596/3	22/05596/5	22/05596/6	22/05596/8	22/05596/9	22/05596/10	22/05596/11	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	DS01	DS02	DS02	DS03	DS03	DS04	DS04			
Depth to Top	0.70	0.50	0.70	0.70	2.20	0.40	0.80			
Depth To Bottom										
Date Sampled	31-May-22	31-May-22	31-May-22	31-May-22	31-May-22	31-May-22	31-May-22			
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES			
Sample Matrix Code	5A	4AE	4AE	5A	6A	5A	5			
PAH-16MS										
Acenaphthene _A ^{M#}	<0.01	0.04	-	0.10	-	0.11	-	mg/kg	0.01	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	<0.01	-	<0.01	-	0.04	-	mg/kg	0.01	A-T-019s
Anthracene _A ^{M#}	<0.02	0.10	-	0.18	-	0.22	-	mg/kg	0.02	A-T-019s
Benzo(a)anthracene _A ^{M#}	<0.04	0.34	-	0.56	-	0.94	-	mg/kg	0.04	A-T-019s
Benzo(a)pyrene _A ^{M#}	<0.04	0.27	-	0.39	-	0.99	-	mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	<0.05	0.41	-	0.48	-	1.23	-	mg/kg	0.05	A-T-019s
Benzo(ghi)perylene _A ^{M#}	<0.05	0.13	-	0.16	-	0.50	-	mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	0.14	-	0.20	-	0.46	-	mg/kg	0.07	A-T-019s
Chrysene _A ^{M#}	<0.06	0.36	-	0.52	-	1.11	-	mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	<0.04	<0.04	-	<0.04	-	0.14	-	mg/kg	0.04	A-T-019s
Fluoranthene _A ^{M#}	<0.08	0.67	-	1.49	-	2.43	-	mg/kg	0.08	A-T-019s
Fluorene _A ^{M#}	<0.01	0.02	-	0.09	-	0.09	-	mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	<0.03	0.17	-	0.19	-	0.59	-	mg/kg	0.03	A-T-019s
Naphthalene _A ^{M#}	<0.03	<0.03	-	0.16	-	<0.03	-	mg/kg	0.03	A-T-019s
Phenanthrene _A ^{M#}	<0.03	0.34	-	0.63	-	0.81	-	mg/kg	0.03	A-T-019s
Pyrene _A ^{M#}	<0.07	0.60	-	1.24	-	2.32	-	mg/kg	0.07	A-T-019s
Total PAH-16MS _A ^{M#}	<0.08	3.59	-	6.39	-	12	-	mg/kg	0.01	A-T-019s

Envirolab Job Number: 22/05596

Client Project Name: Kirkway Service Station, Middleton

Client Project Ref: GSI 1676

Lab Sample ID	22/05596/3	22/05596/5	22/05596/6	22/05596/8	22/05596/9	22/05596/10	22/05596/11	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	DS01	DS02	DS02	DS03	DS03	DS04	DS04			
Depth to Top	0.70	0.50	0.70	0.70	2.20	0.40	0.80			
Depth To Bottom										
Date Sampled	31-May-22	31-May-22	31-May-22	31-May-22	31-May-22	31-May-22	31-May-22			
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES			
Sample Matrix Code	5A	4AE	4AE	5A	6A	5A	5			
TPH CWG with Clean Up *C1										
Ali >C5-C6 _A [#]	<0.01	<0.01	-	0.03	-	<0.01	-	mg/kg	0.01	A-T-022s
Ali >C6-C8 _A [#]	<0.01	<0.01	-	0.64	-	<0.01	-	mg/kg	0.01	A-T-022s
Ali >C8-C10 _A	<1	<1	-	198	-	<1	-	mg/kg	1	A-T-055s
Ali >C10-C12 _A ^{M#}	<1	<1	-	89	-	<1	-	mg/kg	1	A-T-055s
Ali >C12-C16 _A ^{M#}	<1	1	-	15	-	2	-	mg/kg	1	A-T-055s
Ali >C16-C21 _A ^{M#}	<1	4	-	10	-	7	-	mg/kg	1	A-T-055s
Ali >C21-C35 _A ^{M#}	21	55	-	144	-	26	-	mg/kg	1	A-T-055s
Total Aliphatics _A	21	60	-	456	-	36	-	mg/kg	1	A-T-055s
Aro >C5-C7 _A [#]	<0.01	<0.01	-	<0.01	-	<0.01	-	mg/kg	0.01	A-T-022s
Aro >C7-C8 _A [#]	<0.01	<0.01	-	<0.01	-	<0.01	-	mg/kg	0.01	A-T-022s
Aro >C8-C10 _A	<1	<1	-	181	-	1	-	mg/kg	1	A-T-055s
Aro >C10-C12 _A	<1	<1	-	385	-	2	-	mg/kg	1	A-T-055s
Aro >C12-C16 _A	<1	7	-	102	-	10	-	mg/kg	1	A-T-055s
Aro >C16-C21 _A ^{M#}	1	8	-	61	-	63	-	mg/kg	1	A-T-055s
Aro >C21-C35 _A	13	24	-	115	-	266	-	mg/kg	1	A-T-055s
Total Aromatics _A	15	40	-	844	-	342	-	mg/kg	1	A-T-055s
TPH (Ali & Aro >C5-C35) _A	36	100	-	1300	-	378	-	mg/kg	1	A-T-055s
BTEX - Benzene _A [#]	<0.01	<0.01	-	<0.01	-	<0.01	-	mg/kg	0.01	A-T-022s
BTEX - Toluene _A [#]	<0.01	<0.01	-	<0.01	-	<0.01	-	mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene _A [#]	<0.01	<0.01	-	<0.01	-	<0.01	-	mg/kg	0.01	A-T-022s
BTEX - m & p Xylene _A [#]	<0.01	<0.01	-	0.11	-	<0.01	-	mg/kg	0.01	A-T-022s
BTEX - o Xylene _A [#]	<0.01	<0.01	-	0.10	-	<0.01	-	mg/kg	0.01	A-T-022s
MTBE _A [#]	<0.01	<0.01	-	<0.01	-	<0.01	-	mg/kg	0.01	A-T-022s

REPORT NOTES

General

This report shall not be reproduced, except in full, without written approval from Envirolab.

The results reported herein relate only to the material supplied to the laboratory.

The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.

Analytical results reflect the quality of the sample at the time of analysis only.

Opinions and interpretations expressed are outside the scope of our accreditation.

If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.

A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

Soil chemical analysis:

All results are reported as dry weight (<40°C).

For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.

For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts

All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:

Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:

Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:

Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.

Stones etc. are not removed from the sample prior to analysis.

Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:

1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample, 9 = INCINERATOR ASH.

Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.

Secondary Matrix Codes:

A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,

E = contains roots/twigs.

Key:

IS indicates Insufficient Sample for analysis.

US indicates Unsuitable Sample for analysis.

NDP indicates No Determination Possible.

NAD indicates No Asbestos Detected.

N/A indicates Not Applicable.

Superscript # indicates method accredited to ISO 17025.

Superscript "M" indicates method accredited to MCERTS.

Subscript "A" indicates analysis performed on the sample as received.

Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

EPH CWG results have humics mathematically subtracted through instrument calculation

TPH results "with Cleanup" indicates results cleaned up with Silica during extraction

EPH CWG GCxGC ID from TPH CWG

Where we have identified humic substances in any ID's from TPH CWG with Clean Up please note that the concentration of these humic substances is not included in the quantified results and are included in the ID for information.

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: Geocon Site Investigations Ltd, Suite 2 Marple House, 39 Stockport Road,
Marple, Stockport, UK, SK6 6BD

Project: Kirkway Service Station, Middleton

Clients Project No: GSI 1676

Project No: 22/05596

Date Received: 08/06/2022 (am)

Cool Box Temperatures (°C): 12.9 & 13.2

Lab Sample ID	22/05596/3	22/05596/5	22/05596/8	22/05596/10
Client Sample No				
Client Sample ID/Depth	DS01 0.70m	DS02 0.50m	DS03 0.70m	DS04 0.40m
Date Sampled	31/05/22	31/05/22	31/05/22	31/05/22
Deviation Code				
F	✓	✓	✓	✓

Key

F Maximum holding time exceeded between sampling date and analysis for analytes listed below

HOLDING TIME EXCEEDANCES

Lab Sample ID	22/05596/3	22/05596/5	22/05596/8	22/05596/10
Client Sample No				
Client Sample ID/Depth	DS01 0.70m	DS02 0.50m	DS03 0.70m	DS04 0.40m
Date Sampled	31/05/22	31/05/22	31/05/22	31/05/22
PAH-16MS	✓	✓	✓	✓

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Envirolab Analysis Dates

Lab Sample ID	22/05596/3	22/05596/5	22/05596/6	22/05596/8	22/05596/9	22/05596/10	22/05596/11
Client Sample No							
Client Sample ID/Depth	DS01 0.70m	DS02 0.50m	DS02 0.70m	DS03 0.70m	DS03 2.20m	DS04 0.40m	DS04 0.80m
Date Sampled	31/05/22	31/05/22	31/05/22	31/05/22	31/05/22	31/05/22	31/05/22
A-T-019s	22/06/2022	22/06/2022		22/06/2022		22/06/2022	
A-T-022s	14/06/2022	14/06/2022		14/06/2022		14/06/2022	
A-T-024s	14/06/2022	14/06/2022	14/06/2022	14/06/2022	14/06/2022	14/06/2022	14/06/2022
A-T-026s	11/06/2022		11/06/2022		11/06/2022		11/06/2022
A-T-028s	13/06/2022		13/06/2022		13/06/2022		13/06/2022
A-T-031s	13/06/2022	13/06/2022	13/06/2022	13/06/2022	13/06/2022	13/06/2022	13/06/2022
A-T-032s	14/06/2022	14/06/2022		14/06/2022		14/06/2022	
A-T-033s	15/06/2022		15/06/2022		15/06/2022		15/06/2022
A-T-040s		17/06/2022		17/06/2022		17/06/2022	
A-T-042sTCN	10/06/2022	10/06/2022		10/06/2022		10/06/2022	
A-T-044	10/06/2022	10/06/2022	10/06/2022	10/06/2022	10/06/2022	10/06/2022	10/06/2022
A-T-045	09/06/2022	09/06/2022		09/06/2022		09/06/2022	
A-T-050s	10/06/2022	10/06/2022		10/06/2022		10/06/2022	
A-T-055s	14/06/2022	14/06/2022		14/06/2022		14/06/2022	
A-T-SOLMETS	13/06/2022		13/06/2022		13/06/2022		13/06/2022

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

End of Report

APPENDIX D
GEOTECHNICAL TESTING
RESULTS



LABORATORY REPORT



4043

Contract Number: PSL22/5491

Report Date: 26 August 2022

Client's Reference: GSI 1676

Client Name: Geocon Site Investigations Ltd
Suite 2, Marple House
39 Stockport Road
Marple
Stockport
SK6 6BD

For the attention of: Ian Walker

Contract Title: Kirkway Service Station, Middleton

Date Received: 19/8/2022

Date Commenced: 19/8/2022

Date Completed: 25/08/2022

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

Checked and Approved Signatories:

A Watkins
(Director)

R Berriman
(Quality Manager)

S Royle
(Laboratory Manager)

L Knight
(Assistant Laboratory Manager)

S Eyre
(Senior Technician)

M Fennell
(Senior Technician)

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Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

[illegible]

4043

PSL
Professional Soils Laboratory

Kirkway Service Station, Middleton

Contract No:

PSL22/5491

Client Ref:**GSI1676**

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

[illegible]

SYMBOLS : NP : Non Plastic

*** : Liquid Limit and Plastic Limit Wet Sieved.**



4043

PSL
Professional Soils Laboratory

Kirkway Service Station, Middleton

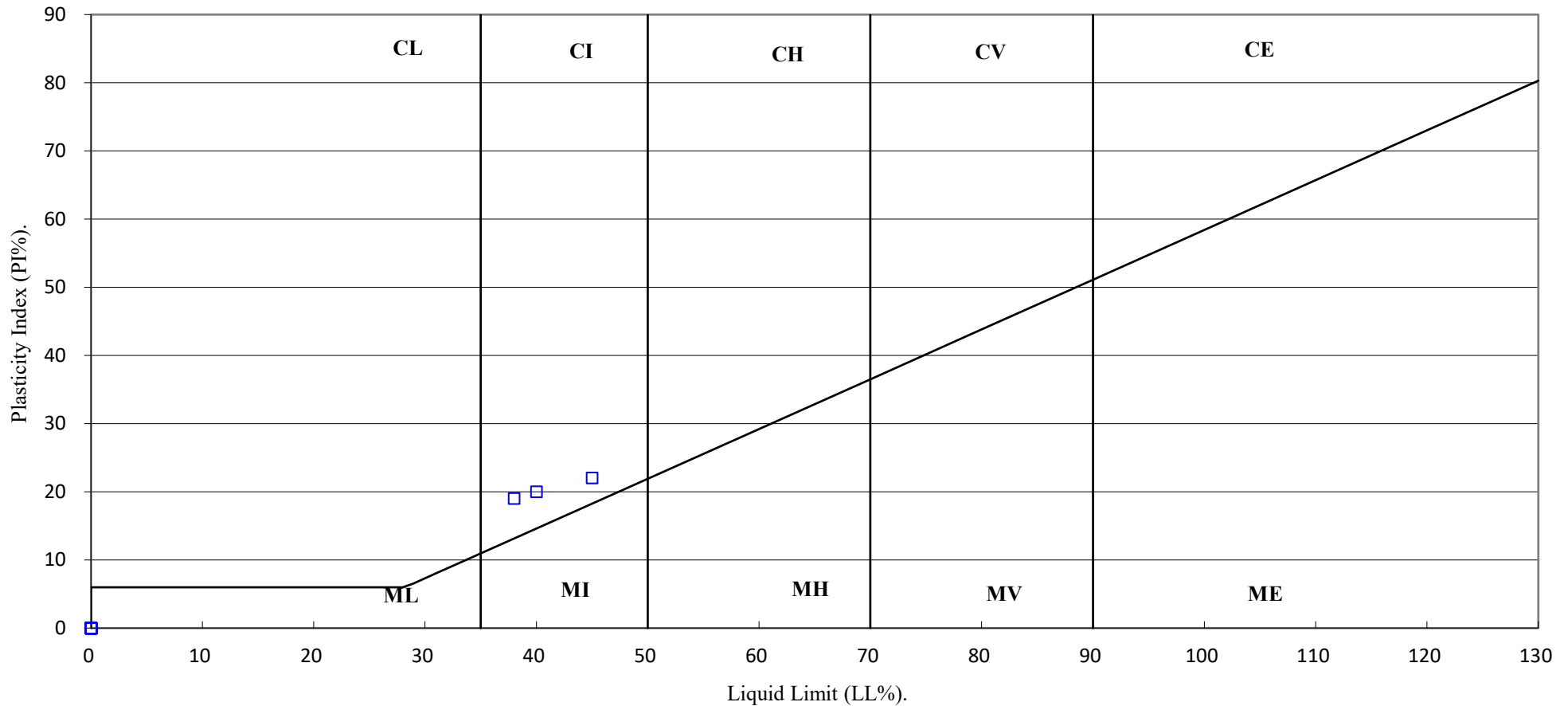
Contract No:

PSL22/5491

Client Ref:

GSI1676

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



4043

PSL

Professional Soils Laboratory

Kirkway Service Station, Middleton

Contract No:

PSL22/5491

Client Ref:

GSI1676

APPENDIX E
MONITORING DATA

Gas Monitoring Results Sheet



Site: Kirkway Service Station, Middleton
 Project Number: GSI 1676
 National Grid Reference:
 Instrument: GFM 436

GeoCon Site Investigations Ltd

Monitoring Point Reference	Date	Atmospheric pressure (mb)	Flow Range (l/hr)		Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Methane Gas Screening Value (GSV) (l/hr)	Carbon Dioxide Gas Screening Value (GSV) (l/hr)	Hydrogen Sulphide (ppm)	Carbon Monoxide (ppm)	Standing Water Level (mbgl)	Well Depth (mbgl)
			Peak	Steady	Peak	Steady	Peak	Steady	Low	Steady						
DS01	10 June 2022	1002	0.0	0.0	0.0	0.0	6.8	6.8	18.8	16.5	0.0000	0.0000	0.0	0.0	1.56	2.85
	20 June 2022	1009	0.0	0.0	0.0	0.0	6.6	6.6	16.8	16.8	0.0000	0.0000	0.0	0.0	1.84	2.90
	05 July 2022	1011	0.0	0.0	0.0	0.0	6.4	6.4	16.4	16.4	0.0000	0.0000	0.0	0.0	2.02	2.82
	21 July 2022	1008	0.0	0.0	0.0	0.0	6.5	6.5	16.4	16.4	0.0000	0.0000	0.0	0.0	1.50	2.80
	04 August 2022	1006	0.0	0.0	0.0	0.0	6.4	6.4	17.1	17.1	0.0000	0.0000	0.0	0.0	1.40	2.80
	17 August 2022	1004	0.0	0.0	0.0	0.0	4.6	4.6	16.8	16.8	0.0000	0.0000	0.0	0.0	0.67	2.77
DS03	10 June 2022	1002	0.0	0.0	0.0	0.0	0.1	0.1	17.1	19.6	0.0000	0.0000	0.0	0.0	0.73	0.95
	20 June 2022	1007	0.0	0.0	0.0	0.0	0.1	0.1	18.6	18.6	0.0000	0.0000	0.0	0.0	0.87	1.00
	05 July 2022	1011	0.0	0.0	0.0	0.0	5.5	0.1	6.5	6.5	0.0000	0.0000	0.0	0.0	0.75	0.96
	21 July 2022	1007	0.0	0.0	0.0	0.0	0.1	0.1	18.7	18.1	0.0000	0.0000	0.0	0.0	0.80	1.01
	04 August 2022	1006	0.0	0.0	0.0	0.0	0.2	0.2	18.7	18.7	0.0000	0.0000	0.0	0.0	0.75	0.98
	17 August 2022	1003	0.0	0.0	0.8	0.8	4.5	0.1	17.5	17.5	0.0000	0.0000	0.0	0.0	0.19	0.95
DS04	10 June 2022	1002	0.0	0.0	0.2	0.2	2.7	2.7	13.0	13.0	0.0000	0.0000	0.0	0.0	1.10	2.99
	20 June 2022	1007	0.0	0.0	0.0	0.0	3.5	3.5	14.9	14.9	0.0000	0.0000	0.0	0.0	1.00	3.02
	05 July 2022	1011	3.0	0.0	0.0	0.0	7.4	7.4	9.3	9.4	0.0000	0.2220	0.0	0.0	0.80	2.94
	21 July 2022	1007	0.0	0.0	0.0	0.0	2.8	2.8	14.8	14.8	0.0000	0.0000	0.0	0.0	0.95	2.95
	04 August 2022	1006	0.0	0.0	0.0	0.0	3.0	3.0	14.0	14.0	0.0000	0.0000	0.0	0.0	0.40	2.95
	17 August 2022	1003	4.0	0.0	0.6	0.1	10.4	10.4	0.2	0.2	0.0240	0.4160	0.0	0.0	1.29	2.94
Maximum					0.8		10.4		0.2		0.0240	0.4160	0.0	0.0		

Additional Information:

Date	Weather	Air Temperature (°C)	Ground Conditions	Pressure Trend	Comments
10 June 2022	Overcast/Sunny	19.0	Dry	Steady	
20 June 2022	Sunny	19.0	Dry	Rising	
05 July 2022	Overcast	18.0	Dry	Falling	
21 July 2022	Sunny	19.0	Dry	Rising	
04 August 2022	Sunny	18.0	Dry	Rising	
17 August 2022	Overcast	15.0	Dry	Falling	

- * All monitoring point locations are monitored for a minimum of 60 seconds, and both the peak reading and the steady / rest readings are recorded
- * BD = Below the detection limit of the gas analyser (0.1units)
- * NR = No reading taken