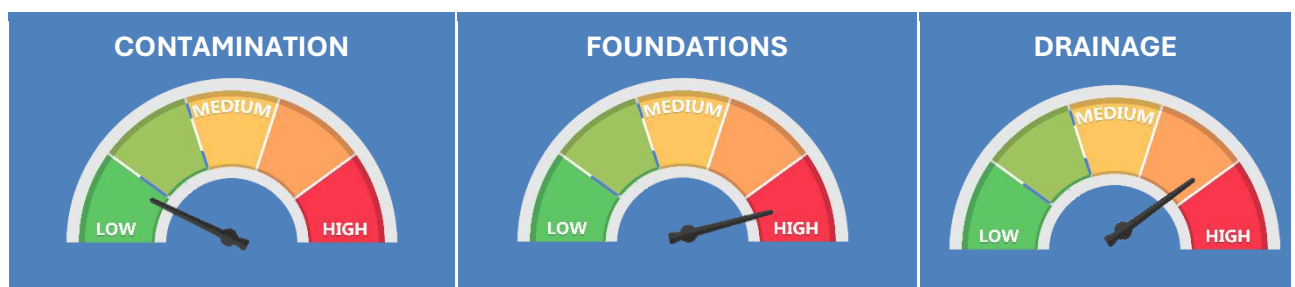


Phase 2 Geo-Environmental Assessment
Highwood, Hitchwood Lane
Preston
SG4 7RY

Client: Mrs S Boyle

Issue Date: January 2026
Report Ref: 21217R2 (Issue A)





Document Verification Schedule				
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Name	Charlotte Bird	Jason Fitzgerald	Joanne Chesney	Simon Ware
Position	Consultant	Principal Consultant	Admin Assistant	Managing Director
Date	January 2026	January 2026	January 2026	January 2026

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WDE has prepared this report with reasonable skill, care and diligence in accordance with the current guidance and common practice at the time of issue. It represents a limited assessment which may fail to identify potential hazards outside the agreed areas that have been assessed. Groundwater levels are particularly susceptible to variations due to seasonal or other effects and hence any comments relating to groundwater are limited to the dates they were obtained. The subsurface geological profiles and other plots are generalised by necessity and have been based on the information found at the locations of the exploratory holes and depths sampled and tested. Interpretation of the results contained within this document are based on the proposed site usage and the findings may not be valid should the proposed land use and/or the regulatory regime/guidance change. The findings and opinions conveyed via this document are based on information obtained from a variety of sources as detailed within this report, which WDE Consulting Limited believes are reliable. Nevertheless, WDE Consulting Limited cannot and does not guarantee the authenticity or reliability of the information it has relied upon. In preparing this report, it has been assumed that all past and present occupants have provided all relevant and other information, especially relating to known or potential hazards.

WDE believes that providing information about limitations is essential to help the client identify and thereby manage their risks. These risks can be mitigated, but they cannot be eliminated, through additional assessments. WDE will on request, advise the client of the additional assessment opportunities available, their impact on risk, and their potential cost benefit. It should be noted that WDE does not provide legal advice, and the advice of lawyers may also be required.

The work is also subject to WDE Consulting's standard terms and conditions.



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1.0 EXECUTIVE SUMMARY

Phase 2 Intrusive	Comments	Risk Rating
Proven Ground Conditions (Average depths)	- Made ground 0.00 - 0.35m bgl - Gravelly clay 0.35 - 3.90m bgl - Chalk (Grade Dc) 3.90 - 4.00+m bgl (found in 1no Location)	
Groundwater	Groundwater was encountered at 2.50m bgl in BH3 and BH4	Low/Moderate
Contamination	1 out of 3 samples have complied with the GAC - Exceedances of non-volatile PAHs from made ground materials in upper 0.4m	Low/Moderate
Ground Engineering	- Potential desiccation identified in BH2 at 2-3.0m bgl - Piled foundations are likely required due to the high volume change potential of clay and identified desiccation.	Moderate/High
Recommendations	- Deep borehole for pile design and deep soakage testing within the chalk - Placement of cover layer in garden areas comprising 400mm of validated topsoil/subsoil	

2.0 INTRODUCTION

WDE Consulting Limited (WDE) was appointed by Mrs S Boyle (the *client*) to conduct a Phase 2 Geo-Environmental Assessment at Highwood, Hitchwood Lane, Preston, SG4 7RY (Figure 1). The current site comprises a disused chicken shed and is situated at NGR TL 18889 24399, What 3 Words closed.rainy.squad.

2.1 Context

WDE understands that the client is proposing to convert the existing chicken shed into a residential dwelling (Figure 2). WDE have previously produced a Phase 1 Desk Study Report¹ which should be referred to for a full understanding of the site.

The works have been completed in line with the current regulations, guidance and good practice presented in Appendix [A](#).

2.2 Agreed Scope of Works and Objectives

The scope of work that was agreed with the client is presented in Table 1.

Table 1 – Agreed Scope of Works and Objectives

Item	Scope of Works	Objectives
1	Intrusive site investigation	- To identify whether there is any contamination onsite which is considered to pose an unacceptable risk to human health, controlled waters or the environment. - To identify the geotechnical properties of the ground to enable design parameters for foundations and drainage.
2	Laboratory analyses	Contamination and geotechnical soil samples are analysed at a UKAS accredited laboratory.
3	Reporting	- Complete a Preliminary Risk Assessment following review of Phase 1 information. - Conduct a Generic Risk Assessment following review of analytical laboratory tests. - Assessment of grounds' parameters with respect to foundation options - Assessment of soakage results with respect to drainage options

3.0 BACKGROUND INFORMATION

3.1 Information Sources

The sources of information that were used during the desk study included the following items:

- Phase 1 Desk Study Report¹
- Site walkover (photos presented in Appendix [B](#))

3.2 Site Description and Walkover

The site consists of a former chicken shed of partial brick and wooden panel construction with a concrete floor, which is surrounded by soft-standing area. The building is rectangular in shape and measures roughly 20m long by 7m wide.

At the time of the Phase 1 site walkover¹ there were several conifer trees (Leyland Cypress) to the N and E of the structure which were ~15m tall, which have since been removed.

During the site investigation no signs of gross contamination, bulk fuel tanks or surface staining was observed.

3.3 Phase 1 Desk Study Report

The key findings from the Phase 1 Desk Study¹ are presented below:

- Published geology comprises Clay-with-Flints Formation overlying Lewes Nodular and Seaford Chalk Formation.
- Superficial deposits classified as an unproductive aquifer, with the chalk classified as a Principal Aquifer. The site lies within a SPZ 3 (Total Catchment).
- Risks from natural geological hazards are negligible to low.
- Low flood risk and outside of Flood Risk Zone.
- The areas of concern consist of potentially imported made ground on the access route and beneath the current structure.
- Conceptual site model appraised the site as a low/moderate risk for human health, controlled waters and ground gas

¹ WDE Consulting. 21217R1 - Phase1 Highwood, Preston-Issue B. June 2023

PHASE II INVESTIGATION WORKS

3.4 Summary Of Works

The locations of the intrusive investigation are presented on Figure 3 and comprised the following:

Table 2 – Summary of Phase II Intrusive Works

Item	Details	Appendix
Shallow Boreholes	4no boreholes (BH1-BH4) to a maximum depth of 4.0m	C
Analytical Testing	Representative soil samples sent for analytical testing.	D
Geotechnical Testing	Representative soil samples sent for geotechnical testing.	E

3.5 Constraints

Access was not possible directly to the west of the structure due to the fencing which limited access for the drill rig. No other constraints were encountered during the intrusive investigation.

3.6 Rationale for Selection of Intrusive Locations

The intrusive locations are indicated on Figure 3 and were selected to target potentially imported made ground over the site and provide geotechnical design parameters.

3.7 Field Results

3.7.1 Geology

A summary of the geology encountered during the intrusive investigation is summarised in Table 3 and are presented in full Appendix [D](#).

Table 3 – Summary of Geology Proved Onsite (m bgl)

Strata	Descriptions	Min - Max Depth	Average Depth	Locations
Made Ground	Brown sandy gravel with red brick and concrete fragments	0.30 - 0.40	0.0 - 0.35	All
Clay-with-Flints	Firm to stiff red/orange/grey silty gravelly CLAY.	3.60 - 4.00+	0.35 - 3.90	All
Chalk	White chalk (Grade Dc)	Absent - 4.00+	3.90 - 4.00+	BH1



3.7.2 Groundwater

Groundwater was encountered during the investigation at a depth of 2.50m in BH3 and BH4.

3.7.3 Contamination Observations

No grossly contaminated material was observed during the investigation with PID values of <0.1ppm.

4.0 CONTAMINATION ASSESSMENT

4.1 Soil Analytical Test Results

Based on the context of the assessment, the proposed land use is assumed to be residential dwellings with private gardens. A comparison of the soil analytical test results with the adopted GACs is presented in Appendix D, along with laboratory certificates of analyses.

A total of 1 out of 3 samples have complied with the adopted GACs. The exceedances are within the made ground and are summarised below:

- BH2 @ 0.20m bgl – Benzo(a)anthracene (23mg/kg), Chrysene (22mg/kg), Benzo(b)fluoranthene (32mg/kg), Benzo(a)pyrene(25mg/kg) and Dibenzo(a,h)anthracene (3.8mg/kg)
- BH3 @ 0.40m bgl – Benzo(a)anthracene (9.8mg/kg), Benzo(b)fluoranthene (12mg/kg), Benzo(a)pyrene (10mg/kg) and Dibenzo(a,h)anthracene (0.88mg/kg)

4.2 Conclusions on Contamination

There have been two exceedances of the GACs associated with the made ground within the upper 0.40m.

A revised *source-pathway-receptor* assessment is presented in Table 4.

Table 4 – Summary of Revised Active Source-Pathway-Target Assessment

Sources	Potential Pathway	Potential Receptor	Risk Classification
Onsite Sources (potential made ground)	Dermal contact, outdoor and indoor inhalation, ingestion, homegrown produce	Human Health (Onsite Residential)	Low/moderate
	Vapour inhalation from dissolved phase groundwater migrating from site to neighbouring properties	Human Health (Offsite Residential)	Low
	Impacted soil leaching to groundwater within Principal Aquifer	Controlled Waters (Groundwater)	Low
	Impacted soil leaching to groundwater and migration to surface water	Controlled Waters (Surface water)	Low
Ground Gas	Thickness of made ground and potential for ground gas generation from degradable materials	Human Health (Onsite Residential)	Low



The exceedances are non-volatile and have low solubility and can be managed via pathway control measures comprising the following items:

- Garden areas to have made ground removed to a depth of 400mm
- Placement of 400mm clean cover comprising validated topsoil/subsoil from a certified source

5.0 GROUND ENGINEERING

5.1 Field Testing Results

A summary of the ground engineering field testing results is provided in Table 5 and are presented in on the logs in Appendix C. This includes the calculated SPT N value.

Table 5 – Field Geotechnical Results, SPT N-Value

Depth (m)	BH1	BH2	BH3	BH4
1.0	8	10	9	12
2.0	17	40	13	12
3.0	19	19	18	19
4.0	27	31	19	20

5.2 Geotechnical Testing

Triaxial undrained shear strength (Cu) and Atterberg limit (PI) testing of the encountered strata are summarised below in Table 6 with the full results presented in Appendix E.

Table 6 – Summary of Geotechnical Test Results

Description	Average Depth (m bgl)	MC %	Modified PI %	Triaxial kPa
Gravelly Clay	0.35 - 3.90	39.3 - 41.5	51 - 54	52 - 80

Testing of the gravelly clay between 1.00 and 3.00m bgl returned very high plasticity values. The modified plasticity index of 51.15% to 54.72% indicates that there is a high volume change potential (VCP) of the gravelly clay. The gravelly clay recorded a shear strength of 52-80kPa indicating a medium to high strength material.

5.3 Potential Desiccation

An assessment of potential desiccation has been undertaken, a summary of which is presented in Table 7.

Table 7 - Desiccation Assessment

Borehole	Soil Type	Depth (m)	MC (%)	Corrected MC (%)	Corrected Liquidity Index	Potential Desiccation (Y/N)
BH2	Gravelly Clay	1.0	39.5	42	0.018	N
BH2	Gravelly Clay	2.0	39.3	41.8	-0.096	Y
BH2	Gravelly Clay	3.0	41.5	44	-0.070	Y

Potential desiccation has been identified in BH2 (2.00-3.00m) which will need to be considered within the foundation design.

5.4 Concrete Design Parameters

A summary of the sulphate, pH and corresponding BRE³⁹ concrete in aggressive ground parameters for concrete design are presented in Table 8.

Table 8 – Summary of BRE Concrete in Aggressive Ground Parameters

Location	Concrete Parameters
pH (pH Units)	7.6 - 8.2
Water Soluble Sulphate as (2:1 Leachate Equivalent) (mg/l)	27.5 - 183
ACEC Classification	AC-1
Design Sulphate Class	DS-1

5.5 Comparison with Water UK Threshold Concentration Values

Selection of inappropriate water pipe materials for the conditions of the site could have significant consequences and pollute the water supply. An assessment of the chemical contamination and selection of suitable pipe material has been undertaken in line with current guidance^{22, 23}.

The soil laboratory results from the upper 1.00m have been compared to the UKWIR thresholds for the selection of water supply pipes in Table 9 with full results presented in Appendix E.

Table 9 - Comparison of Soil Laboratory Results from the upper 1.35m with UKWIR (mg/kg)

Parameter Group	No. of Samples	UKWIR Threshold for Pipe Type				Max	Samples Exceeded
		PE	PVC	Barrier	Steel/Fe/Cu		
Total BTEX & MTBE	3	0.1	0.03	Pass	Pass	BDL	-
C5-C10 aliphatic and aromatic	3	2	1.4	Pass	Pass	BDL	-

Parameter Group	No. of Samples	UKWIR Threshold for Pipe Type				Max	Samples Exceeded
		PE	PVC	Barrier	Steel/Fe/Cu		
Mineral oil C11-C20	3	10	Pass	Pass	Pass	180	BH2, BH3
Mineral oil C21-EC40	3	500	Pass	Pass	Pass	410	-
Phenol	3	2	0.4	Pass	Pass	BDL	-
Cresols/chlorinated phenols	3	2	0.04	Pass	Pass	-	-
Corrosive	3	Various				8.2	-

There have been exceedances of the UKWIR threshold values which indicate that polyethylene (PE) is not likely to be suitable for water supply pipe due to potential pollutant degradation. Therefore, PVC, barrier (multi-layer plastic with protective metal barrier) or metal (steel, iron or copper) pipe should be considered to limit permeation of soil contaminants through the pipe and into the water supply.

Further consultation should be sought with the water supply company as they may issue a preferred list of materials.

5.6 Excavations, Groundwater Control and Services

Groundwater was encountered during the investigation within the upper 2.50m so is unlikely to require dewatering for shallow excavations except for periods of heavy rainfall. Excavations within the cohesive materials are not likely to require additional support.

5.7 Preliminary Road Design Parameters

5.7.1 Frost Susceptibility

Frost susceptibility tends to be a feature of silty and sandy clays, of low to medium plasticity⁴⁰. Where susceptible to frost, a suitable capping layer should be included below the sub-base to a suitable depth to ensure that the construction will not be affected by frost heave.

Table 10 gives an indication of frost susceptibility and permeability with grading and plasticity index for preliminary identification.

Table 10 – Likely Frost Susceptibility of Soil Materials (adapted from TRRL)

Permeability	Soil Texture	Frost Susceptible
High Permeability	Granular, <10% finer than 75 microns	No
Intermediate Permeability	Granular, >10% finer than 75 microns. Cohesive PI <20%	Yes
Low Permeability	Cohesive PI >20%	No

This site has recorded a PI of 54-57% and therefore is **not considered** to have frost susceptible soil materials.

5.7.2 CBR value

An indicative CBR design value of 2.5% would appear to be present at ~1m depth in line with published guidance^{41,42}, which may need further CBR testing to confirm road and pavement thicknesses.

5.8 Preliminary Floor Design

The ground gas risk for the site has been characterised as a Low Risk. There is considered no requirement for enhancement of the membrane above the standard specification (CS1/NHBC Green).

The radon risk is less than 1% which in line BRE guidance requires no additional measures.

5.9 Soakage Potential

Traditional soakage's to ground will require at least 1m of unsaturated permeable strata to be considered to be viable. There has been identified clay materials to ~3m depth which are not likely to be suitable for shallow soakage's to ground.

Drainage could be taken into the chalk (>3.60m bgl) using a deep borehole soakage. Alternative drainage options will need to be considered in line with SuDS guidance⁴⁷.

It is recommended a drainage engineer is consulted to formulate the drainage design.

5.10 Preliminary Foundation Design

Factors that will need to be considered when selecting the type and depth of foundations includes:

- Anticipated loads required by proposed development is for a single storey residential dwelling
- Depth of groundwater is 2.50m bgl but is likely perched
- Depth of made ground is 0.40m bgl
- No areas containing soft/loose or peaty materials identified during field testing
- Founding within different strata (Clay and Chalk) should be avoided to prevent issues with differential settlement

- The previously removed mature moderate water demand trees in combination with high volume change potential of the clays will need to be considered
- Potential desiccation had been identified in BH2 between 2.00 and 3.00m

The preliminary foundation parameters are included in Table 11.

Table 11 – Preliminary Foundation Parameters

BH	Distance to trees* (m)	Depth to Water (m bgl)	Min Foundation Depth (m bgl)	Foundation Material (m bgl)	Foundation Type	Comments
BH1	<5	-	>2.50	Firm clay	Piled	NHBC Chapter 4.2
BH2	<5	-	>2.50	Firm clay	Piled	Desiccation to 3.00m
BH3	<5	2.50	>2.50	Firm clay	Piled	NHBC Chapter 4.2
BH4	<5	2.50	>2.50	Firm clay	Piled	NHBC Chapter 4.2

Based on the identified ground conditions, it is likely shallow foundation are unviable and that piled foundations will be required for the structure.

It is recommended that a structural engineer is consulted for the detailed foundation design.



6.0 RECOMMENDATIONS FOR FURTHER WORK

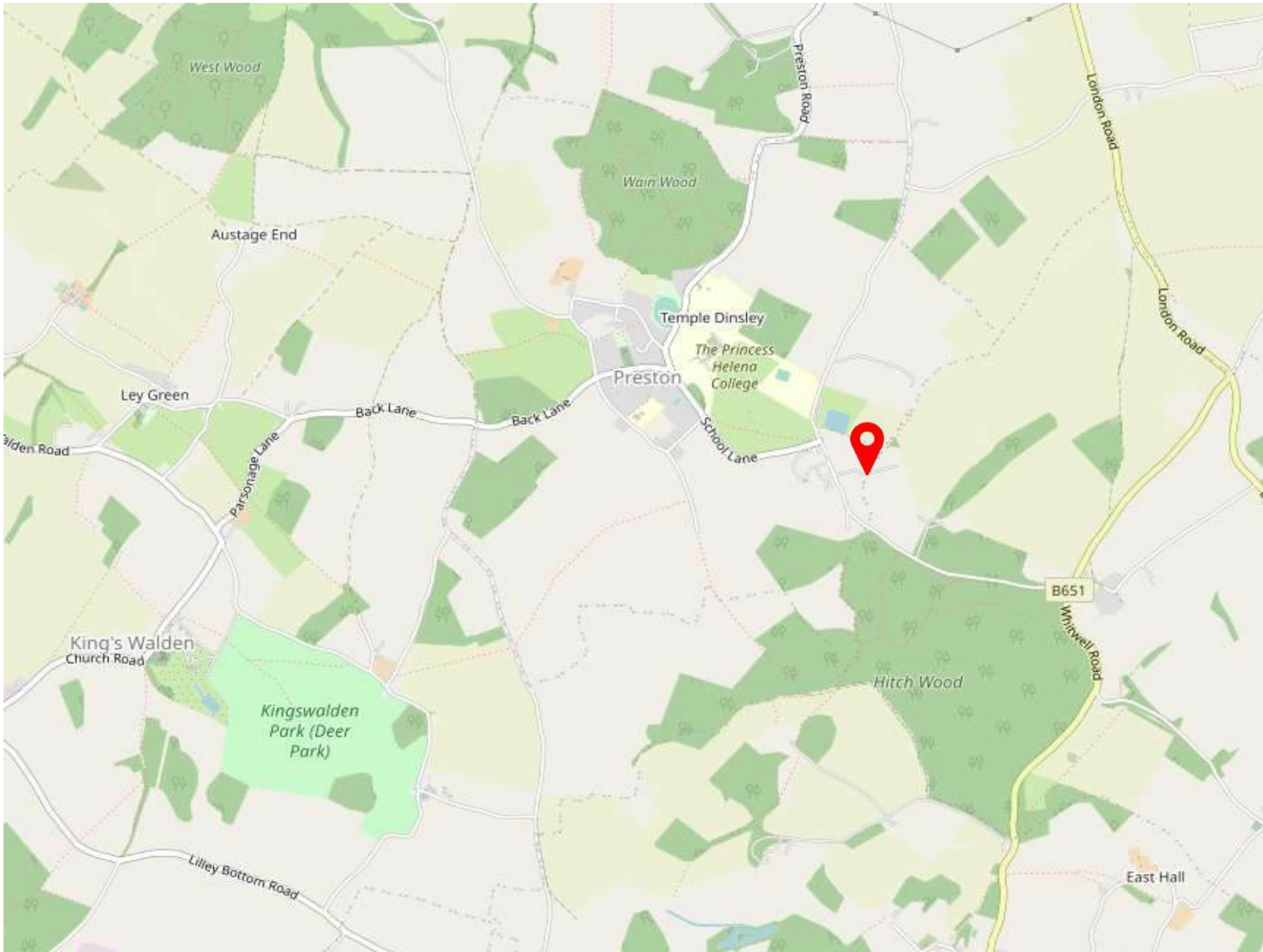
WDE recommends that the following items are undertaken:

- Deep borehole for pile design and deep soakage testing within the chalk
- Placement of 400mm thick cover layer in garden areas comprising validated topsoil/subsoil



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Phase 2 Geo-Environmental Assessment

FIGURES



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Client
MRS BOYLE

Project
HIGHWOOD, PRESTON

Title
SITE LOCATION PLAN

© OpenStreetMap contributors



APPENDIX A: RELEVANT GUIDANCE AND LEGISLATION

WDE Consulting has duly taken account of the recommendation contained within relevant guidance documents and legislation during the preparation of this report.

CONTAMINATION

Part IIa of the Environmental Protection Act 1990 defined contamination in relation to continued land use and introduced the “polluter pays” principal. The Groundwater Regulations 1998 defined List 1 and List 2 substances and the procedures for preventing them from entering groundwater. The Water Resources Act of 1991 introduced the term “controlled waters” and gave powers to the Environment Agency to require remediation where there was pollution of controlled waters.

The National Planning Policy Framework² requires the following:

- The site is made suitable for its intended use, taking account of all ground conditions arising from natural and former activities, pollution arising from previous uses and proposals for mitigation including land remediation.
- After remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990.
- Adequate site information, prepared by a competent person, is presented.

The methodology adopted for this report follows the guidance and procedures for Land Contamination Risk Management (LCRM) produced by the Agency³. The LCRM process provides a reasoned and structured mechanism to identify potential risk issues and, where necessary, provide a way forward to develop a robust risk management strategy to address potentially unacceptable risks in an appropriate manner. Contained within the LCRM Framework are the following stages:

1. Stage 1 risk assessment
2. Stage 2 options appraisal
3. Stage 3 remediation and verification

British Standards has issued guidance for the Investigation of Potentially Contaminated Sites⁴ and for undertaking Site Investigations⁵ which have duly been considered. An update to the potential human health exposure pathways is provided in the Environment Agency Soil Science Report SR3⁶. In 2008 the Environment Agency and the National House-Building Council (NHBC), Chartered Institute of Environmental Health (CIEH) released a joint publication for the Safe Development of Housing on Land

² Department of Communities and Local Government. March 2012

³ Environment Agency. 2020. Land Contamination Risk Management (LCRM)

⁴ British Standards 2011. Investigation of Potentially Contaminated Sites-Codes of Practice. BS10175:2011

⁵ British Standards. 2015. Code of Practice for Site Investigations. BS5930

⁶ Environment Agency, August 2008, Updated technical background to the CLEA model, Science Report - SC050021/SR3

Affected by Contamination⁷. Guidance is provided in the CLR Report No 4 on sampling strategies for contaminated land⁸.

An assessment of the potential risk from PCBs is provided in the DOE which takes into account their low solubility and potential for migration within the ground⁹.

QUALITATIVE RISK ASSESSMENT

The potentially active human health are based on the Agency Soil Science Report SR3¹⁰. The potential contaminants of PCBs arising from the electricity substation located offsite have been discounted as PCBs are not considered to be sufficiently mobile or soluble¹¹.

To assess the potential for risk, the Source ® Pathway ® Receptor relationships have been evaluated to determine whether there are potentially active pollutant linkages between sources and receptors. Only when there is an active pollutant linkage, can there be a potential risk to a receptor from a source via a particular pathway. Each active pathway has been assigned a qualitative assessment as to the level of risk as shown in the below table and as per R&D 66⁷.

Qualitative Risk Classification Scheme

		CONSEQUENCE			
		Severe	Medium	Mild	Minor
PROBABILITY (Likelihood)	High likelihood	Very High Risk	High risk	Moderate risk	Low risk
	Likely	High risk	Moderate risk	Moderate/low risk	Low risk
	Low likelihood	Moderate risk	Moderate/low risk	Low risk	Very low risk
	Unlikely	Moderate/low risk	Low risk	Very low risk	Very low risk

ADOPTED GACS

The Generic Assessment Criteria (GACs) that have been adopted are based on the Land Quality Management (LQM) Suitable for Use Levels (S4UL)¹². These published values are available for residential with/without home grown produce, commercial, allotment and public open space land use

⁷ Environment Agency, 2008. Guidance for the Safe Development of Housing on Land Affected by Contamination. R&D 66

⁸ DOE, 1994. Sampling Strategies for Contaminated Land. CLR Report No 4

⁹ Department of the Environment, 1996, Industry Profile: Engineering works. P.14 Sect 3.2.1

¹⁰ Environment Agency, August 2008, Updated technical background to the CLEA model, Science Report - SC050021/SR3

¹¹ Department of the Environment, 1996, Industry Profile: Engineering works. P.14 Sect 3.2.1

¹² LQM/CIEH 2014. The LQM/CIEH S4ULs for Human Health Risk Assessment.



scenarios. As there is no current UK GAC for lead or cyanide, the Category 4 Screening Level (C4SL) will be adopted for lead and the Dutch Intervention Value (DIV) for cyanide. In the absence of any UK published value, the detection limits have been adopted.

For asbestos, there are no current GAC for asbestos fibres in soils. For surface soils within a residential/allotments setting, it is best practice to take a conservative approach and to adopt the detection limit (0.001%) as the threshold. A *very low quantity* threshold for asbestos of 0.01% had been proposed by CL:AIRE²⁷, which is considered to be appropriate for adoption within a commercial/public open space scenario.

GACs For Various Land Uses (mg/kg)

Contaminant of Concern	Residential with HGP	Residential without HGP	Allotments	Commercial	Public Open Space Res
Asbestos	DL	DL	DL	DL	DL
Asbestos Quantification %	0.001	0.001	0.001	0.01	0.01
Total Cyanide	50	50	50	50	50
Total Phenols	280	750	66	760	760
Naphthalene	2.3	2.3	4.1	190	4900
Acenaphthylene	170	2900	28	83000	15000
Acenaphthene	210	3000	34	84000	15000
Fluorene	170	2800	27	63000	9900
Phenanthrene	95	1300	15	22000	3100
Anthracene	2400	31000	380	520000	74000
Fluoranthene	280	1500	52	23000	3100
Pyrene	620	3700	110	54000	7400
Benzo(a)anthracene	7.2	11	2.9	170	29
Chrysene	15	30	4.1	350	57
Benzo(b)fluoranthene	2.6	3.9	0.99	44	7.1
Benzo(k)fluoranthene	77	110	37	1200	190
Benzo(a)pyrene	2.2	3.2	0.97	35	5.7
Indeno(1,2,3-cd)pyrene	27	45	9.5	500	82
Dibenz(a,h)anthracene	0.24	0.31	0.14	3.5	0.57
Benzo(ghi)perylene	320	360	290	3900	640
Arsenic	37	40	43	640	79
Beryllium	1.7	1.7	35	12	2.2
Boron	290	11000	45	240000	21000
Cadmium	11	85	1.9	190	120
Chromium	910	910	18000	8600	1500
Copper	2400	7100	520	68000	12000
Lead	210	330	84	6600	760
Mercury	40	56	19	1100	120
Nickel	180	180	230	980	230
Selenium	250	430	88	12000	1100
Vanadium	410	1200	91	9000	2000
Zinc	3700	40000	620	730000	81000
Benzene	0.087	0.38	0.017	27	72
Toluene	130	880	22	56000	56000
Ethylbenzene	47	83	16	5700	24000
Xylenes (sum)	56	79	28	5900	41000



Contaminant of Concern	Residential with HGP	Residential without HGP	Allotments	Commercial	Public Open Space Res
MTBE	49	73	23	7900	7900
TPH - Aliphatic >C5 - C6	42	42	730	3200	570000
TPH - Aliphatic >C6 - C8	100	100	2300	7800	600000
TPH - Aliphatic >C8 - C10	27	27	320	2000	13000
TPH - Aliphatic >C10 - C12	130	130	2200	9700	13000
TPH - Aliphatic >C12 - C16	1100	1100	11000	59000	13000
TPH - Aliphatic >C16 - C21	65000	65000	260000	1600000	250000
TPH - Aliphatic >C21 - C35	65000	65000	260000	1600000	250000
TPH - Aliphatic >C35 - C44	65000	65000	260000	1600000	250000
TPH - Aromatic >C5 - C7	70	370	13	26000	56000
TPH - Aromatic >C7 - C8	130	860	22	56000	56000
TPH - Aromatic >C8 - C10	34	47	8.6	3500	5000
TPH - Aromatic >C10 - C12	74	250	13	16000	5000
TPH - Aromatic >C12 - C16	140	1800	23	36000	5100
TPH - Aromatic >C16 - C21	260	1900	46	28000	3800
TPH - Aromatic >C21 - C35	1100	1900	370	28000	3800
TPH - Aromatic >C35 - C44	1100	1900	370	28000	3800

GROUND GAS

The following relevant guidance will be used to assess the risks posed by ground gas:

- CIRIA Assessing risks posed by hazardous ground gases to buildings¹³
- NHBC: Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present¹⁴
- NHBC: Technical Extra¹⁵
- The Building Regulations Site Preparation and resistance to contaminants and moisture. ¹⁶
- British Standard. Guidance on Investigations for Ground Gas¹⁷
- NHBC guidance on Hazardous ground gas¹⁸
- EPG Limited. Screening Approach¹⁹

The NHBC guidance¹⁸ states that the landfills from the 1960s and 1970s are unlikely to be able to generate ground gas and will have a declining source. Landfills from the 2000s are not likely suitable for residential development, which leaves the landfills from the 1980s and 1990s as the most critical. Additional guidance is also available from EPG Limited¹⁹ which states that for landfills of 20 years, the gas generation will have reduced significantly, whereas over 40 years will have reached maturation phase and gas generation will be at very low levels. All published cases for offsite migration of ground gas have been from landfills which have either been operational or only recently closed.

¹³ CIRIA 2007. Assessing Risks Posed by Hazardous Ground Gases to Buildings. C665

¹⁴ NHBC 2007. Guidance on Evaluation of Development Proposals on Sites where methane and carbon dioxide are present

¹⁵ NHBC 2016. Technical Extra. Ground Gas Update. April 2016. Issue 20

¹⁶ Building Regulations 2004. Approved Document C, Site Preparation and resistance to contaminants and moisture.

¹⁷ British Standards 2013. Guidance on Investigation for Ground Gas. BS8576. 2013

¹⁸ NHBC 2023. Hazardous Ground Gas – an essential guide for housebuilders. NF94

¹⁹ EPG 2018. Screening Approach for landfill gas migration around landfill sites

Published guidance from GGS²⁰ also emphasises the importance of a conceptual model for the relationship between source-pathway-receptor.

Summary of NHBC Traffic Light System

Gas Regime	Methane		Carbon Dioxide	
	Typical max %	Gas Screening Value (l/hr)	Typical max %	Gas Screening Value (l/hr)
Green	<1	<0.16	<5	<0.78
Amber 1	1 – 5	0.16 – 0.63	5 – 10	0.78 – 1.56
Amber 2	5 – 20	0.63 – 1.56	10 – 30	1.56 – 3.13
Red	20+	1.56+	30+	3.13+

RADON GAS

The following guidance has been followed for the assessment of the risk from radon gas:

- UK Radon www.ukradon.org
- BRE 2023. Radon Guidance²¹

The UK Health Security Agency recommends that radon levels should be reduced in homes where the average is >200 Bq m⁻³ (known as the Action Level), with the Target Level of 100 Bq m⁻³. Radon potential bands for having a building that is at least as high as the Action Level, are assigned across the UK in grids, with slight variations for the required actions across the Home Nations, as seen below:

Radon potential band (%)	General risk	Affected area?	Test advised?	Building Control Regulations?		
				England & Wales	Scotland	Northern Ireland
0 - 1	Low	No	No#	No#	No#	No#
1 - 3	Medium	Yes	Yes	No#	Yes - Stage 1	Yes - Zone 1
3 - 5	Medium	Yes	Yes	Yes - Basic	Yes - Stage 1	Yes - Zone 1

²⁰ GGS 2024. Ground has Hazards, Desk Studies, CSM's and when not to monitor.

²¹ BRE 2023. Radon. Guidance on the protective measures for new buildings (including supplementary advice for extensions, conversions and refurbishment projects)

Radon potential band (%)	General risk	Affected area?	Test advised?	Building Control Regulations?		
				England & Wales	Scotland	Northern Ireland
5 -10	Medium	Yes	Yes	Yes - Basic	Yes - Stage 1	Yes - Zone 1
10 - 30	High	Yes	Yes	Yes - Full	Yes - Stage 2	Yes - Zone 2
Over 30	High	Yes	Yes	Yes - Full	Yes - Stage 2	Yes - Zone 2

Basic radon protection is relatively cheap and simple to install and requires a radon membrane, cavity tray, telescopic air vent and rigid installation. Full radon protection is more complicated and will require a radon sump chamber or a ventilated subfloor, which can if needed have extraction fan fitted.

UK WATER SUPPLY PIPES

The following guidance has been followed for the selection of water supply pipes:

- UKWIR Guidance for the selection of Water Supply Pipes²²
- Water UK Contaminated Land Assessment Guidance²³

These mainly apply to brownfield sites, although may apply to greenfield sites should the preliminary risk assessment identify there is a potential for contamination to be present.

WASTE MANAGEMENT

The EU Waste Framework Directive 2008 presents the legislative framework for the collection, transport, recovery, and disposal of waste. This framework provides a five-step hierarchical plan for managing waste comprising prevention, preparing for re-use, recycling, recovery, and disposal, which have been made into UK law via the UK Waste Regulations 2011. This requires all businesses/organisations that either produces or handles waste to either prevent waste or to apply the waste hierarchy for the transfer of waste. The Environment Protection (Duty of Care) Regulations 1991 require that transfer notes are used to identify the type of waste, volume, source and intended destination along with the details of the licensed carrier.

The Agency have published guidance on the classification of Hazardous Waste²⁴, which defines how man-made materials are classified as being hazardous by exceeding at least one of the fifteen hazardous properties (H1 to H15). Man Made materials can either be absolute hazardous, absolute

²² UK Water Industry Research 2011. Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites. 10/WM/03/21.

²³ Water UK 2014. Contaminated Land Assessment Guidance.

²⁴ Environment Agency. 2013. Interpretation of the Definition and Classification of Hazardous Waste. Technical Guidance WM2



non-hazardous or mirror and if mirror then an assessment needs to be made as to whether the materials poses any of the hazardous properties before classifying the materials as being either hazardous or non-hazardous. The Agency has also published guidance on the Waste Acceptance at Landfills²⁵. Landfills are classified as to whether they can accept hazardous, non-hazardous, or inert materials. Waste Acceptance Criteria (WAC) thresholds have been set to determine the class of landfill that can accept the materials. Disposal of hazardous materials requires pre-treatment. WAC limits are not to be used for determining whether waste is hazardous.

The CL:AIRE CoP of the Definition of Waste²⁶ was developed to provide clarity on when the reuse of site won materials will cease to the waste. It requires the development of Material Management Plan (MMP) that is specific to the site and the intended reuse of materials. The MMP will need to be based on a site-specific Remedial Strategy/Design Statement that will demonstrate that the reuse of the site won materials will not pose an unacceptable risk to sensitive receptors. There will then need to be a requirement for verification that the proposed reuse has been carried out as was planned.

CLIMATE CHANGE

The UK has signed up to achieving a net zero target by 2050 under the COP 21 Paris Agreement in 2015, which requires all industry to reduce its emissions by 78% by 2035 compared to 1990 levels. Approximately 1.25% of the UK total greenhouse gases are attributable to the built environment, with CO2 emissions amounting to 40-50million tonnes, more than for aviation and shipping combined²⁷. The use of low carbon materials, retrofitting old ones and the need for considering whole-life carbon of new buildings needs to be balanced with the need for additional housing.

The National Planning Policy Framework (NPPF) and LCRM advocates the adoption of sustainable development practices. The Sustainable Management Practices for the Management of Land Contamination issued in 2021 by CL:AIRE/SuRF-UK promote sustainability principles for all aspects of land contamination management, a summary of which is provided below.

²⁵ Environment Agency. 2010 Waste Acceptance at Landfills. Version 1.

²⁶ CL:AIRE 2001. The Definition of Waste: Development Industry Code of Practice. Version 2.

²⁷ UK Parliament. Building to new zero: costing carbon in construction. First Report of Session 2022-23

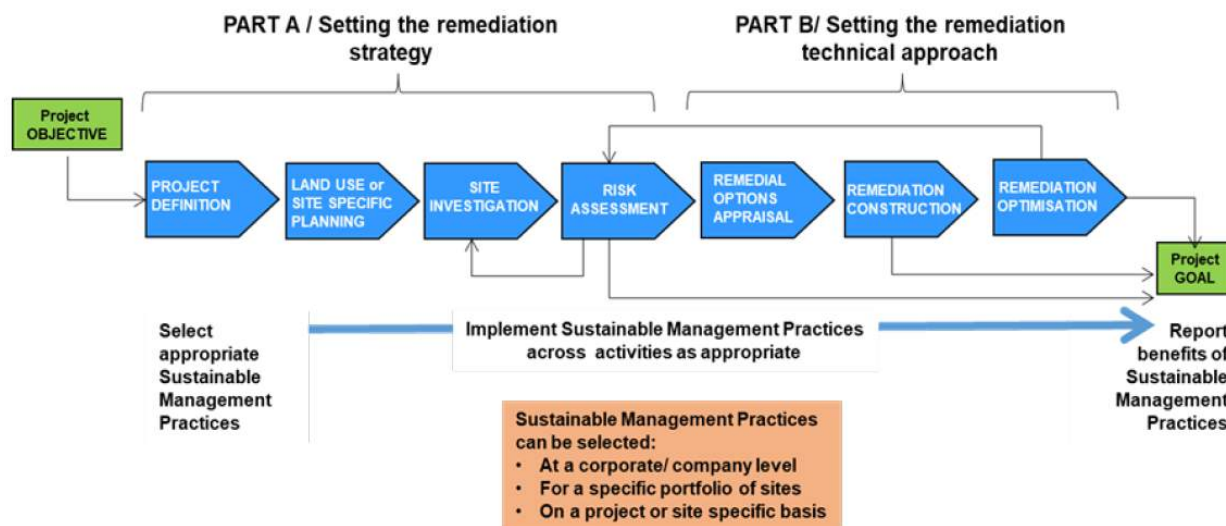


Figure 2.1: Application of sustainable management practices in context of life cycle of land contamination management and SuRF UK Framework

GROUND ENGINEERING

In accordance with BS-EN-1997-1 2004 Geotechnical Design: General Rules, engineering parameters for use in geotechnical design have been assessed using a three-step process:

1. Compilation of test data to determine a range of values for each relevant engineering parameter either by using direct results, geotechnical theory/correlations, or empiricism
2. Use of engineering judgement to determine a characteristic value for each parameter
3. Application of partial factors to give a design value for each parameter

Geotechnical site assessments were carried out in accordance where practical with the recommendations of BS EN 1997:2 2007 Eurocode 7 Geotechnical Design: Ground Investigation and Testing. This report has been written in line with the requirements of a Ground Investigation Report (GIR) as set out in BS EN 1997:2 and does not constitute a Geotechnical Design Report.

The following guidance has been followed for determining the foundation depths:

- The Building Regulations 2010²⁸
- BS8004:2015. Code of practice for foundations²⁹
- NHBC Standards 2024 Part 4 Foundations³⁰

²⁸ The Building Regulations 2010. Building and Buildings, England and Wales

²⁹ BS804:2015+A1:2020: Code of Practice for Foundations

³⁰ NHBC Standards 2024

The NHBC Standards includes guidance on likely foundation depth required when taking into account the volume change potential of materials in combination with the distance to different tree species (height and water demand status).

DESICCATION TESTING

There are a number of methods for determining desiccation in clay soils. These include:

Driscoll's Method: Following laboratory testing of cohesive soils, the most commonly accepted method for determining the degree of desiccation³¹ is Richard Driscoll's method that significant desiccation has occurred when the moisture content is less than 0.4 x the liquid limit.

Weeks' Method: Another method for determining desiccation and first developed by Dr Alan Weeks, involves the use of a pocket penetrometer with measurements taken directly on borehole core samples³². The depth and extent of desiccation is assessed by comparison of penetrometer readings against a control. An assessment of desiccation can be made by comparing the results of each borehole to the profile representing equilibrium conditions for London Clay, however the technique should equally be applicable to any stiff, over consolidated, shrinkable clay and has been used successfully for Gault, Weald and Wadhurst Clays.

Liquidity Index from BRE412

To overcome issues with control boreholes and local variations in soil, it may be possible to plot the results in terms of the soil's Liquidity Index and comparing profiles of the resulting values. A value of 0 means that the soil's water content is at the Plastic Limit, while negative values indicate that the soil is drier than the Plastic Limit. Apart from these difficulties, this method often works reasonably well, and the information obtained can be used to estimate the ground heave potential.

Sensitivity Assessment on Potentially Desiccated Samples

To account for potential moisture loss during sampling, transport, and laboratory handling, a sensitivity analysis has been carried out on the soil samples as part of the desiccation assessment.

Although samples are handled in accordance with BS 1377-2:1990 and stored in sealed containers, some degree of drying can occur between field sampling and testing, particularly for coarser-textured or low-plasticity soils^{33,34}. These studies report measurable reductions in moisture content (MC) of 1 to >10% over time due to storage, handling effects and soil type.

³¹ BRE 1996. Desiccation in clay soils. Digest 412.

³² Proceedings of The Institute of Civil Engineers: Geotechnical Engineering. 1995, 113, 25-30

³³ MDPI (2024). Effect of Storage Time on the Structural Integrity of Silts and Organic Soils: An Analysis of Moisture Content, Unconfined Compressive Strength, and Elasticity. Applied Sciences, 14(17):8060.

³⁴ Bednarz, M. (2002). *Effects of drying and rewetting on Atterberg limits of fine-grained soils*. Portland State University

A sensitivity analysis will be undertaken to assess the potential influence of small moisture variations on the measured Atterberg limits. Moisture content will be adjusted by +1%, +2.5 and +5%, representing the likely range of potential moisture loss identified in the literature and practical experience. The full results are provided below.

Sensitivity Analysis of Effect on Liquidity Index with Incremental Moisture Increases

ID	Soil Type	Depth (m)	Reported MC (%)	Liquidity Index	+1% MC	+2.5% MC	+5% MC
BH2	Clay	1	39.5	-0.027	-0.009	0.018	0.064
BH2	Clay	2	39.3	-0.143	-0.124	-0.096	-0.050
BH2	Clay	3	41.5	-0.114	-0.096	-0.070	-0.026

Orange - Potential desiccation (semi-solid)

Green – Not potentially desiccated (plastic state)

Adjustment for Soil Type

Based on the sensitivity analysis the following corrections will be applied to the test results to approximate the likely in-situ condition prior to laboratory handling:

- **Clay samples:** moisture content **increased by 2.5%**, reflecting the lower susceptibility of fine, high-plasticity clays to drying due to their strong adsorptive water retention and low vapour diffusivity.

The corrected values will be used for comparative analysis of plasticity behaviour and soil classification.

SURFACE WATER DRAINAGE

The selection and design of surface water drainage is to follow the SuDS guidance³⁵ which proposes the following hierarchy:

1. Management for discharge of surface water via soakaways to ground on the subject site
2. Attenuation and discharge of surface water offsite into existing drainage network
3. Discharge into combined sewer if option 1 and 2 are not feasible (such as in built up urban areas)

The following guidance has been followed during the soakage testing:

- Falling Head Tests in boreholes – BS5930⁵
- BRE Digest 365 2003 Soakage testing

³⁵ DEFRA. 2011. National Standards for Sustainable Drainage Systems.

The CIRIA publication³⁶ provides guidance as to the required distance of buildings from soakage's to ground in chalk as follows:

- 20m distance of soakaways from buildings where dissolution features are known to be prevalent
- 10m distance of soakaways from buildings where chalk is low density or unknown
- 5m distance of soakaways from buildings where chalk is of medium to high density

The CIRIA publication³⁷ provides guidance that covers design, construction and maintenance of sustainable urban drainage systems (SuDS) to assist with their effective implementation within developments.

EFFECTS OF TREES AND SHRINKABLE MATERIALS ON FOUNDATION DEPTHS

The following guidance has been followed for determining the foundation depths:

- NHBC Standards 2024 Part 4 Foundations³⁸

This document includes guidance on likely foundation depth required when taking into account the volume change potential of materials in combination with the distance to different tree species (height and water demand status).

CONCRETE DESIGN PARAMETERS

Chemical agents that can destroy concrete may be found in the ground. In the UK, sulphates and acids naturally occurring in soil and groundwater are the agents most likely to attack concrete. The effects can be serious leading to expansion and softening of concrete. Many other substances are aggressive, most resulting from human activity, but they present less of a problem since they only rarely come into contact with concrete in the ground.

The following guidance has been followed for determining the concrete design:

- BRE SD1 Concrete in aggressive grounds³⁹

This BRE Special Digest 1 (SD1:2005) guidance provides practical guidance on the specification of concrete for installation in natural ground and in brownfield locations. The procedures given for ground assessment and concrete specification cover the fairly common occurrence of sulphates, sulphides,

³⁶ CIRIA. 2002. Engineering in Chalk. C574.

³⁷ CIRIA. 2015. SuDS Manual. C753.

³⁸ NHBC Standards 2024

³⁹ BRE 2005. SD1. Concrete in aggressive ground

and acids. They also cover the more rarely occurring aggressive carbon dioxide found in some ground and surface waters.

PRELIMINARY ROAD DESIGN PARAMETERS

The following guidance has been followed for the preliminary likelihood of frost susceptible soils affecting the site:

- Transport and Road Research Laboratory (TRRL) ⁴⁰

Charts are available to estimate CBR test results based upon a description of soil type, construction condition and moisture content. CD225⁴¹ allows the use of Table C1 from LR1132⁴² to estimate CBR value for foundation design where no CBR measure is available.

TABLE C 1

Equilibrium suction-index CBR values

TYPE OF SOIL	PLASTICITY INDEX	HIGH WATER TABLE						LOW WATER TABLE					
		CONSTRUCTION CONDITIONS:						CONSTRUCTION CONDITIONS:					
		POOR		AVERAGE		GOOD		POOR		AVERAGE		GOOD	
		THIN	THICK	THIN	THICK	THIN	THICK	THIN	THICK	THIN	THICK	THIN	THICK
HEAVY CLAY	70	1.5	2	2	2	2	2	1.5	2	2	2	2	2.5
	60	1.5	2	2	2	2	2.5	1.5	2	2	2	2	2.5
	50	1.5	2	2	2.5	2	2.5	2	2	2	2.5	2	2.5
SILTY CLAY	40	2	2.5	2.5	3	2.5	3	2.5	2.5	3	3	3	3.5
	30	2.5	3.5	3	4	3.5	5	3	3.5	4	4	4	6
	20	2.5	4	4	5	4.5	7	3	4	5	6	6	8
SANDY CLAY	10	1.5	3.5	3	6	3.5	7	2.5	4	4.5	7	6	>8
SILT *	—	1	1	1	1	2	2	1	1	2	2	2	2
SAND (POORLY GRADED)	—	← 20 →											
SAND (WELL GRADED)	—	← 40 →											
SANDY GRAVEL (WELL GRADED)	—	← 60 →											

* estimated assuming some probability of material saturating

Table C1 reproduced from LR1132

40 TRRL 1984 Structure Design of Bituminous Roads. Report LR1132

41 CD 225. Design for new pavement foundations. 2020. Highways England

42 Transport and Road Research Laboratory (TRRL). 1984. Laboratory Report 1132

Typically, a design CBR value of 15% is adopted for structured chalk with a minimum thickness of 450mm, with a CBR design value of 2% for highly weathered in-situ chalk².

Engineering fill used beneath roads will need to comply with the Highways Specification⁴³, which follows a method compaction. This will require classification of the materials via laboratory testing, followed by conducting the associated compaction method for that class of materials

A minimum CBR value of 5% is considered to be required within the engineered fill/natural materials in line with the TRRL guidance⁴². The NHBC standards⁴⁴ has provided guidance on minimum sub-base thicknesses for construction of paved areas which are summarised below.

Minimum Sub-base Thickness for Paved Areas (adapted from NHBC)

CBR Values (%)	Minimum thickness (mm) of sub-base
Less than 2	Subgrade requires improvement
2-3	325
3-5	250
5-7	150
7-20	100

SURFACE WATER DRAINAGE

The National Standards for Sustainable Drainage Systems (SuDS)⁴⁵ is to be adopted for the management of surface water from developments to ensure that runoff is to be treated as a resource and is managed to avoid increased flood risk, negative impacts on water quality and the environment.

The selection and design of surface water drainage is to follow the following hierarchy:

4. Collected for non-potable use
5. Infiltrated to ground
6. Discharge to an above ground surface water body
7. Discharge to a surface water sewer, or another pipe surface water drainage system
8. Discharge to a combined sewer

The following guidance has been followed during the soakage testing:

43 Series 600 Earthworks. Volume 1 Specification for Highway Works

44 NHBC Standards 2024. Chapter 10.2.6.4. Table 4: Minimum sub-base thickness for paved areas

45 DEFRA. 2025. National Standards for Sustainable Drainage Systems.



- Falling Head Tests in boreholes – BS5930⁵
- BRE Digest 365 2003 Soakage testing

The CIRIA publication⁴⁶ provides guidance as to the required distance of buildings from soakage's to ground in chalk as follows:

- 20m distance of soakaways from buildings where dissolution features are known to be prevalent
- 10m distance of soakaways from buildings where chalk is low density or unknown
- 5m distance of soakaways from buildings where chalk is of medium to high density

The CIRIA publication⁴⁷ provides guidance that covers design, construction, and maintenance of SuDS to assist with their effective implementation within developments.

⁴⁶ CIRIA. 2002. Engineering in Chalk. C574.

⁴⁷ CIRIA. 2015. SuDS Manual. C753.

APPENDIX B: SITE PHOTOS

Photo 1 - Site Overview



Photo 2 - Site Overview



Photo 3 - Window Sampling at BH2



Photo 4 - Window Sampling at BH3





Mrs S Boyle
Highwood, Hitchwood Lane, Preston
Phase 2 Geo-Environmental Assessment

APPENDIX C: FIELD LOGS



Window Sampler

BH1

Sheet 1 of 1

Hole Type WS	Easting	Northing	Ground Level (m)	Scale 1:50
Project Name Highwood, Preston	Project No. 21217	Start Date 2025-12-09	End Date 2025-12-09	

Client Mrs Boyle	Consultant Charlotte Bird	Contractor
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Inst/ Backfill	Water Levels	Samples and Tests			Level (m)	Depth (m) (thickness)	Strata		
		Depth (m)	Type/ Ref	Results			Legend	Description	
		0.30	J			(0.40) 0.40		MADE GROUND: Brown sandy clayey fine to coarse subrounded to angular gravel with red brick and concrete fragments	
		1.00 1.00 1.00-2.00	SPT(C) D L	N=8 (1,1/1,2,2,3)				Firm to stiff red/orange/grey mottled slightly silty gravelly CLAY. Gravels are fine to coarse subrounded to subangular flints	0.5 1.0 1.5
		2.00 2.00	SPT(C) D	N=17 (3,4/4,4,4,5)		(3.20)		No sample recovery due to large flint (2.50 - 3.00m)	2.0 2.5
		3.00	SPT(C)	N=19 (3,4/4,5,5,5)					3.0
						3.60 (0.40)		White CHALK (Grade Dc)	3.5
		4.00	SPT(C)	N=27 (4,4/5,7,7,8)		4.00		End of Borehole at 4.00m	4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0

Remarks Groundwater not encountered	Method, Plant, Stability, Dimensions 0.00 - 4.00m WS	Logger CNB
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Window Sampler

BH2
Sheet 1 of 1

Hole Type WS	Easting	Northing	Ground Level (m)	Scale 1:50
Project Name Highwood, Preston	Project No. 21217	Start Date 2025-12-09	End Date 2025-12-09	

Client Mrs Boyle	Consultant Charlotte Bird	Contractor
---------------------	------------------------------	------------

Inst/ Backfill	Water Levels	Samples and Tests			Level (m)	Depth (m) (thickness)	Strata		
		Depth (m)	Type/ Ref	Results			Legend	Description	
		0.20	J			(0.30) 0.30		MADE GROUND: Brown sandy clayey fine to coarse subrounded to angular gravel with red brick and concrete fragments	
		1.00 1.00	SPT(C) D	N=10 (1,2/2,2,3,3)		(0.90) 1.20		Soft to firm brown/grey/orange slightly gravelly CLAY. Gravels are fine to coarse subrounded to subangular flints	0.5 1.0
		2.00 2.00	SPT(C) D	N=40 (2,5/8,10,11,11)		(2.80)		Firm to stiff red slightly silty very gravelly CLAY. Gravels are fine to coarse subrounded to subangular flints	1.5 2.0
		3.00 3.00	SPT(C) D	N=19 (4,4/5,4,5,5)				Clay becomes less red/more orange (3.00m)	2.5 3.0 3.5
		4.00	SPT(C)	N=31 (4,5/5,7,8,11)		4.00		End of Borehole at 4.00m	4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0

Remarks Groundwater not encountered	Method, Plant, Stability, Dimensions 0.00 - 4.00m WS	Logger CNB
--	---	---------------



Window Sampler

BH3
Sheet 1 of 1

Hole Type WS	Easting	Northing	Ground Level (m)	Scale 1:50
Project Name Highwood, Preston	Project No. 21217	Start Date 2025-12-09	End Date 2025-12-09	

Client Mrs Boyle	Consultant Charlotte Bird	Contractor
---------------------	------------------------------	------------

Inst/ Backfill	Water Levels	Samples and Tests			Level (m)	Depth (m) (thickness)	Strata		
		Depth (m)	Type/ Ref	Results			Legend	Description	
		0.40	J			(0.40) 0.40		MADE GROUND: Brown sandy clayey fine to coarse subrounded to angular gravel with red brick and concrete fragments	
		1.00 1.00	SPT(C) D	N=9 (2,2/2,2,2,3)				Soft to firm brown/grey/orange slightly gravelly CLAY. Gravels are fine to coarse subrounded to subangular flints	0.5 1.0
		2.00 2.00	SPT(C) D	N=13 (2,3/3,3,3,4)		(1.80)		Becomes very gravelly and red mottled (1.20m)	1.5 2.0
		3.00	SPT(C)	N=18 (2,3/4,4,4,6)		2.20		Firm to stiff red slightly silty sandy very gravelly CLAY. Gravels are fine to coarse subrounded to subangular flints	2.5 3.0
		4.00	SPT(C)	N=19 (2,3/4,4,5,6)		(1.80) 4.00		End of Borehole at 4.00m	3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0

Remarks	Method, Plant, Stability, Dimensions 0.00 - 4.00m WS	Logger CNB
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Window Sampler

BH4
Sheet 1 of 1

Hole Type WS	Easting	Northing	Ground Level (m)	Scale 1:50
Project Name Highwood, Preston	Project No. 21217	Start Date 2025-12-09	End Date 2025-12-09	

Client Mrs Boyle	Consultant Charlotte Bird	Contractor
---------------------	------------------------------	------------

Inst/ Backfill	Water Levels	Samples and Tests			Level (m)	Depth (m) (thickness)	Strata		
		Depth (m)	Type/ Ref	Results			Legend	Description	
		0.30	J			(0.35) 0.35		MADE GROUND: Brown sandy gravelly clay with red brick and concrete fragments. Gravels are fine to coarse subrounded to angular	
		1.00 1.00 1.00-2.00	SPT(C) D L	N=12 (2,3/3,3,3,3)				Firm to stiff orange/brown/red slightly silty gravelly CLAY. Gravels are fine to coarse subrounded to subangular flints	0.5
		2.00 2.00	SPT(C) D	N=12 (3,3/3,3,3,3)		(3.65)			1.0
	▽								1.5
		3.00	SPT(C)	N=19 (3,3/3,5,6,5)					2.0
									2.5
									3.0
								Becomes very gravelly and grey mottled (3.00 - 3.50m)	3.5
		4.00	SPT(C)	N=20 (3,3/5,5,4,6)		4.00			4.0
								End of Borehole at 4.00m	4.5
									5.0
									5.5
									6.0
									6.5
									7.0
									7.5
									8.0
									8.5
									9.0
									9.5
									10.0

Remarks	Method, Plant, Stability, Dimensions 0.00 - 4.00m WS	Logger CNB
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Mrs S Boyle
Highwood, Hitchwood Lane, Preston
Phase 2 Geo-Environmental Assessment

APPENDIX D: ANALYTICAL TEST RESULTS



WDE Standard QRA suite

	No. of Samples	Unit	Target Concentration	Source	Min	Max	No. That Exceed	Sample Ref	BH2	BH3	BH4
								Type	SOIL	SOIL	SOIL
								Depth	0.20	0.40	0.30
								Date	09/12/2025	09/12/2025	09/12/2025
			Residential with hgp					ACM Lab			
Moisture Content	0	%	-								
Asbestos	3	N/A	DL	WDE					NAD	NAD	NAD
Asbestos Quantification	0	%	0.001	DL	0	BDL	0				
pH	3	pH Units	-	-	7.6	8.2	0		8.2	7.6	7.6
Total Cyanide	3	mg/kg	50	DIV	0	BDL	0		< 1.0	< 1.0	< 1.0
Sulphate Total	3	%	-	-	0.039	0.101	-		0.071	0.101	0.039
Sulphate as SO ₄	3	g/l	-	-	0.0275	0.183	-		0.0275	0.183	0.0303
Sulphide	3	mg/kg	-	-	29	36	-		36	29	< 1.0
Total Organic Carbon (TOC)	3	%	-	-	1.1	2.8	-		2.8	2.4	1.1
Total Phenols (monohydric)	3	mg/kg	280	LQM	0	BDL	0		< 1.0	< 1.0	< 1.0
Naphthalene	3	mg/kg	2.3	LQM	BDL	2.1	0		1.9	2.1	< 0.05
Acenaphthylene	3	mg/kg	170	LQM	BDL	0.68	0		0.68	0.29	< 0.05
Acenaphthene	3	mg/kg	210	LQM	BDL	6.4	0		6.4	5.1	< 0.05
Fluorene	3	mg/kg	170	LQM	0.05	5.2	0		5.2	4.8	0.05
Phenanthrene	3	mg/kg	95	LQM	0.29	39	0		39	24	0.29
Anthracene	3	mg/kg	2400	LQM	0.08	9.9	0		9.9	7.2	0.08
Fluoranthene	3	mg/kg	280	LQM	0.32	55	0		55	25	0.32
Pyrene	3	mg/kg	620	LQM	0.3	49	0		49	23	0.3
Benzo(a)anthracene	3	mg/kg	7.2	LQM	0.15	23	2		23	9.8	0.15
Chrysene	3	mg/kg	15	LQM	0.16	22	1		22	9.5	0.16
Benzo(b)fluoranthene	3	mg/kg	2.6	LQM	0.19	32	2		32	12	0.19
Benzo(k)fluoranthene	3	mg/kg	77	LQM	0.09	12	0		12	5	0.09
Benzo(a)pyrene	3	mg/kg	2.2	LQM	0.15	25	2		25	10	0.15
Indeno(1,2,3-cd)pyrene	3	mg/kg	27	LQM	0.12	13	0		13	5.2	0.12
Dibenz(a,h)anthracene	3	mg/kg	0.24	LQM	BDL	3.8	2		3.8	0.88	< 0.05
Benzo(ghi)perylene	3	mg/kg	320	LQM	0.18	15	0		15	6.1	0.18
Total EPA-16 PAHs	3	mg/kg	-	-	2.09	312	0		312	149	2.09
Arsenic (dissolved)	3	mg/kg	37	LQM	13	19	0		13	19	14
Beryllium	3	mg/kg	1.7	LQM	1.1	1.2	0		1.2	1.2	1.1
Boron (dissolved)	3	mg/kg	290	LQM	0.3	0.6	0		0.6	0.3	0.5
Cadmium (dissolved)	3	mg/kg	11	LQM	0.3	0.5	0		0.3	0.5	0.4
Chromium (dissolved)	3	mg/kg	910	LQM	25	36	0		25	34	36
Copper (dissolved)	3	mg/kg	2400	LQM	15	29	0		28	29	15
Lead (dissolved)	3	mg/kg	210	C4SL	27	46	0		36	46	27
Mercury (dissolved)	3	mg/kg	40	LQM	BDL	BDL	0		< 0.3	< 0.3	< 0.3
Nickel (dissolved)	3	mg/kg	180	LQM	17	18	0		17	18	17
Selenium (dissolved)	3	mg/kg	250	LQM	BDL	1.1	0		1.1	< 1.0	< 1.0
Vanadium	3	mg/kg	410	LQM	45	52	0		47	52	45
Zinc (dissolved)	3	mg/kg	3700	LQM	54	75	0		70	75	54
Benzene	3	mg/kg	0.087	LQM	BDL	BDL	0		<0.005	<0.005	<0.005
Toluene	3	mg/kg	130	LQM	BDL	BDL	0		<0.005	<0.005	<0.005
Ethylbenzene	3	mg/kg	47	LQM	BDL	BDL	0		<0.005	<0.005	<0.005
Xylenes (o)	3	mg/kg	60	LQM	BDL	BDL	0		<0.005	<0.005	<0.005
Xylenes (m p)	3	mg/kg	56	LQM	BDL	BDL	0		<0.008	<0.008	<0.008
MTBE (Methyl Tertiary Butyl Ether)	3	mg/kg	49	CLAIRE	BDL	BDL	0		<0.005	<0.005	<0.005
Total Petroleum Hydrocarbons	0	mg/kg	-	-	BDL	BDL	0				
TPH-CWG - Aliphatic >C5 - C6	3	mg/kg	42	LQM	BDL	BDL	0		< 0.010	< 0.010	< 0.010
TPH-CWG - Aliphatic >C6 - C8	3	mg/kg	100	LQM	BDL	BDL	0		< 0.010	< 0.010	< 0.010
TPH-CWG - Aliphatic >C8 - C10	3	mg/kg	27	LQM	BDL	BDL	0		< 0.010	< 0.010	< 0.010
TPH-CWG - Aliphatic >C10 - C12	3	mg/kg	130	LQM	BDL	6.1	0		6.1	< 1.0	< 1.0
TPH-CWG - Aliphatic >C12 - C16	3	mg/kg	1100	LQM	BDL	20	0		20	< 2.0	< 2.0
TPH-CWG - Aliphatic >C16 - C21	3	mg/kg	65000	LQM	BDL	34	0		34	< 8.0	< 8.0
TPH-CWG - Aliphatic >C21 - C35	3	mg/kg	65000	LQM	BDL	220	0		220	14	< 8.0
TPH-CWG - Aliphatic >C35 - C44	3	mg/kg	65000	LQM	BDL	170	0		170	< 8.4	< 8.4
Total Aliphatic Hydrocarbons	3	mg/kg	-	-	BDL	450	0		450	14	< 10
TPH-CWG - Aromatic >C5 - C7	3	mg/kg	70	LQM	BDL	BDL	0		< 0.010	< 0.010	< 0.010
TPH-CWG - Aromatic >C7 - C8	3	mg/kg	130	LQM	BDL	BDL	0		< 0.010	< 0.010	< 0.010
TPH-CWG - Aromatic >C8 - C10	3	mg/kg	34	LQM	BDL	BDL	0		< 0.020	< 0.020	< 0.020
TPH-CWG - Aromatic >C10 - C12	3	mg/kg	74	LQM	BDL	2.5	0		2.5	1.9	< 1.0
TPH-CWG - Aromatic >C12 - C16	3	mg/kg	140	LQM	BDL	35	0		35	27	< 2.0
TPH-CWG - Aromatic >C16 - C21	3	mg/kg	260	LQM	BDL	180	0		180	110	< 10
TPH-CWG - Aromatic >C21 - C35	3	mg/kg	1100	LQM	BDL	410	0		410	190	< 10
TPH-CWG - Aromatic >C35 - C44	3	mg/kg	1100	LQM	BDL	210	0		210	58	< 8.4
Total Aromatic Hydrocarbon	3	mg/kg	-	-	BDL	840	0		840	390	< 10

Below GAC
Exceedence

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Analytical Report Number : 25-067117

Project / Site name:	21217	Samples received on:	12/12/2025
Your job number:	HIGHWOOD PRESTON	Samples instructed on/ Analysis started on:	12/12/2025
Your order number:	25-585	Analysis completed by:	29/12/2025
Report Issue Number:	1	Report issued on:	29/12/2025
Samples Analysed:	3 soil samples		



Signed:

Anna Goc
PL Head of Reporting Team
For & on behalf of i2 Analytical Ltd.

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

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

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

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting
air	- once the analysis is complete

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Retention period for records and reports is minimum 6 years from the date of issue of the final report.
Some records may be kept for longer according to other legal/best practice requirements.

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

Analytical Report Number: 25-067117

Project / Site name: 21217

Your Order No: 25-585

Lab Sample Number	779860	779861	779862
Sample Reference	BH2	BH3	BH4
Sample Number	None Supplied	None Supplied	None Supplied
Water Matrix	N/A	N/A	N/A
Depth (m)	0.20	0.40	0.30
Date Sampled	09/12/2025	09/12/2025	09/12/2025
Time Taken	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Test Limit of detection	Test Accreditation Status

Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	13	20	15
Total mass of sample received	kg	0.1	NONE	1.2	1.3	1.1

Asbestos

Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	SPU	SPU	SPU
Analysis completed	N/A	N/A	N/A	22/12/2025	22/12/2025	22/12/2025

General Inorganics

pH (L099)	pH Units	N/A	MCERTS	8.2	7.6	7.6
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Total Sulphate as SO ₄	%	0.005	MCERTS	0.071	0.101	0.039
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	55	370	61
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	27.5	183	30.3
Sulphide	mg/kg	1	MCERTS	36	29	< 1.0
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	2.8	2.4	1.1

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	1.9	2.1	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	0.68	0.29	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	6.4	5.1	< 0.05
Fluorene	mg/kg	0.05	MCERTS	5.2	4.8	0.05
Phenanthrene	mg/kg	0.05	MCERTS	39	24	0.29
Anthracene	mg/kg	0.05	MCERTS	9.9	7.2	0.08
Fluoranthene	mg/kg	0.05	MCERTS	55	25	0.32
Pyrene	mg/kg	0.05	MCERTS	49	23	0.3
Benzo(a)anthracene	mg/kg	0.05	MCERTS	23	9.8	0.15
Chrysene	mg/kg	0.05	MCERTS	22	9.5	0.16
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	32	12	0.19
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	12	5	0.09
Benzo(a)pyrene	mg/kg	0.05	MCERTS	25	10	0.15
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	13	5.2	0.12
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	3.8	0.88	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	15	6.1	0.18

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	312	149	2.09
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Analytical Report Number: 25-067117

Project / Site name: 21217

Your Order No: 25-585

Lab Sample Number	779860	779861	779862
Sample Reference	BH2	BH3	BH4
Sample Number	None Supplied	None Supplied	None Supplied
Water Matrix	N/A	N/A	N/A
Depth (m)	0.20	0.40	0.30
Date Sampled	09/12/2025	09/12/2025	09/12/2025
Time Taken	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Test Limit of detection	Test Accreditation Status

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	13	19	14
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	1.2	1.2	1.1
Boron (water soluble)	mg/kg	0.2	MCERTS	0.6	0.3	0.5
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.3	0.5	0.4
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	25	34	36
Copper (aqua regia extractable)	mg/kg	1	MCERTS	28	29	15
Lead (aqua regia extractable)	mg/kg	1	MCERTS	36	46	27
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	17	18	17
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	1.1	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	47	52	45
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	70	75	54

Petroleum Hydrocarbons

TPHCWG - Aliphatic >EC5 - EC6 HS_1D_AL	mg/kg	0.01	MCERTS	< 0.010	< 0.010	< 0.010
TPHCWG - Aliphatic >EC6 - EC8 HS_1D_AL	mg/kg	0.01	MCERTS	< 0.010	< 0.010	< 0.010
TPHCWG - Aliphatic >EC8 - EC10 HS_1D_AL	mg/kg	0.01	MCERTS	< 0.010	< 0.010	< 0.010
TPHCWG - Aliphatic >EC10 - EC12 EH_CU_1D_AL	mg/kg	1	MCERTS	6.1	< 1.0	< 1.0
TPHCWG - Aliphatic >EC12 - EC16 EH_CU_1D_AL	mg/kg	2	MCERTS	20	< 2.0	< 2.0
TPHCWG - Aliphatic >EC16 - EC21 EH_CU_1D_AL	mg/kg	8	MCERTS	34	< 8.0	< 8.0
TPHCWG - Aliphatic >EC21 - EC35 EH_CU_1D_AL	mg/kg	8	MCERTS	220	14	< 8.0
TPHCWG - Aliphatic >EC35 - EC44 EH_CU_1D_AL	mg/kg	8.4	NONE	170	< 8.4	< 8.4
TPHCWG - Aliphatic >EC5 - EC35 EH_CU+HS_1D_AL	mg/kg	10	NONE	270	14	< 10
TPHCWG - Aliphatic >EC5 - EC44 EH_CU+HS_1D_AL	mg/kg	10	NONE	450	14	< 10

TPHCWG - Aromatic >EC5 - EC7 HS_1D_AR	mg/kg	0.01	MCERTS	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC7 - EC8 HS_1D_AR	mg/kg	0.01	MCERTS	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC8 - EC10 HS_1D_AR	mg/kg	0.02	MCERTS	< 0.020	< 0.020	< 0.020
TPHCWG - Aromatic >EC10 - EC12 EH_CU_1D_AR	mg/kg	1	MCERTS	2.5	1.9	< 1.0
TPHCWG - Aromatic >EC12 - EC16 EH_CU_1D_AR	mg/kg	2	MCERTS	35	27	< 2.0
TPHCWG - Aromatic >EC16 - EC21 EH_CU_1D_AR	mg/kg	10	MCERTS	180	110	< 10
TPHCWG - Aromatic >EC21 - EC35 EH_CU_1D_AR	mg/kg	10	MCERTS	410	190	< 10
TPHCWG - Aromatic >EC35 - EC44 EH_CU_1D_AR	mg/kg	8.4	NONE	210	58	< 8.4
TPHCWG - Aromatic >EC5 - EC35 EH_CU+HS_1D_AR	mg/kg	10	NONE	620	330	< 10
TPHCWG - Aromatic >EC5 - EC44 EH_CU+HS_1D_AR	mg/kg	10	NONE	840	390	< 10

VOCs

MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
Benzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
Toluene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
p & m-Xylene	µg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0
o-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number : 25-067117

Project / Site name: 21217

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
779860	BH2	None Supplied	0.2	Brown sandy clay with gravel and vegetation
779861	BH3	None Supplied	0.4	Brown clay with gravel
779862	BH4	None Supplied	0.3	Brown sandy clay with gravel and vegetation

Analytical Report Number : 25-067117

Project / Site name: 21217

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters Heating/Cooling (PrW) DI Process Water (DI PrW)

Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in Soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques	In-house method based on HSG 248, 2021	A001B	D	ISO 17025
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate (Walkley Black Method)	In-house method	L009B	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode	In-house method	L010-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight	In-house method based on British Standard Methods and MCERTS requirements.	L019B	D	NONE
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L038B	D	MCERTS
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES	In-house method based on Second Site Properties version 3	L038B	D	MCERTS
Total sulphate (as SO ₄ in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES	In-house method	L038B	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Sulphate, water soluble, in soil (16hr extraction)	In-house method	L038B	D	MCERTS
Speciated PAHs and/or Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds (including PAH) in soil by extraction in dichloromethane and hexane followed by GC-MS	In-house method based on USEPA 8270	L064B	D	MCERTS
BTEX and/or Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS	In-house method based on USEPA 8260	L073B	W	MCERTS
Total petroleum hydrocarbons with carbon banding by GC-FID in soil	Determination of total petroleum hydrocarbons in soil by GC-FID with carbon banding aliphatic and aromatic	In-house method	L076B	D	MCERTS
Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil (Summed Bands)	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS with carbon banding aliphatic and aromatic (Summed Bands).	Calculation	L076B/L088-PL	D/W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	MCERTS
Total petroleum hydrocarbons with carbon banding by HS-GC/MS in soil	Determination of total petroleum hydrocarbons in soil by HS-GC/MS with carbon banding aliphatic and aromatic	In-house method	L088-PL	W	MCERTS

Analytical Report Number : 25-067117

Project / Site name: 21217

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters Heating/Cooling (PrW) DI Process Water (DI PrW)

Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement	In-house method	L099-PL	D	MCERTS
Soil Descriptions	Textural classification	In-house method	L019B	W	NONE

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

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

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

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

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

Quality control parameter failure associated with individual result applies to calculated sum of individuals.

The result for sum should be interpreted with caution



Mrs S Boyle
Highwood, Hitchwood Lane, Preston
Phase 2 Geo-Environmental Assessment

APPENDIX E: GEOTECHNICAL TEST RESULTS

Unconsolidated Undrained Triaxial Compression tests without measurement of pore pressure

Summary of Results

Tests carried out in accordance with BS EN ISO 17892-8:2018

Job No.	Project Name	Programme	
38260	Highwood, Preston	Samples received	12/12/2025
		Schedule received	12/12/2025
Project No.	Client	Project started	12/12/2025
21217-PO:25-586	WDE Consulting	Testing Started	05/01/2026

[illegible]

Legend	UU - single stage test (single and multiple specimens)	σ_3	Cell pressure	Mode of failure ;	B - Brittle
	UUM - Multistage test on a single specimen	$\sigma_1 - \sigma_3$	Maximum corrected deviator stress		P - Plastic
	suffix R - remoulded or recompacted	cu	Undrained shear strength, $\frac{1}{2}(\sigma_1 - \sigma_3)$		C - Compound



Test Report by K4 SOILS LABORATORY
Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU
Tel: 01923 711 288 Email: james@k4soils.com
Email: james@k4soils.com

Checked and Approved

Initials: J.P
Date: 09/01/2026

These results only apply to the items tested. The report shall not be reproduced except in full without authority of the laboratory

2519

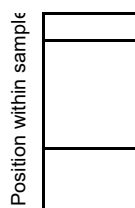
Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

MSF-5-R7b

	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen			Job Ref	38260
				Borehole/Pit No.	BH1
Site Name	Highwood, Preston			Sample No.	-
Project No.	21217-PO:25-586	Client	WDE Consulting	Depth Top	1.00 m
Soil Description	High strength orangish brown mottled light grey and brown slightly gravelly silty CLAY (gravel is fmc and sub-angular to sub-rounded)			Depth Base	2.00 m
				Sample Type	C
				Samples received	12/12/2025
				Schedules received	12/12/2025
Test Method	BS EN ISO 17892-8:2018			Date of test	05/01/2026

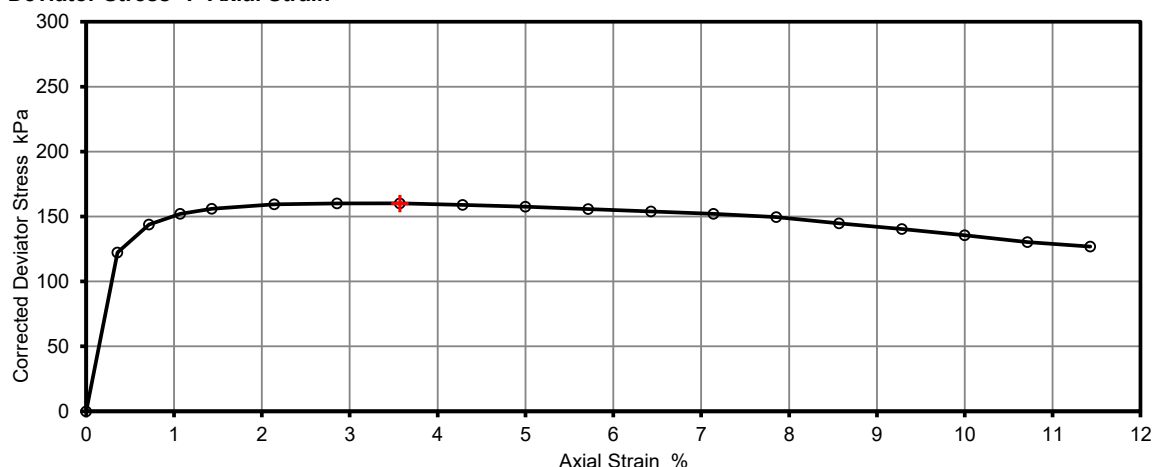
Remarks

Test specimen taken from 1.05-1.25m

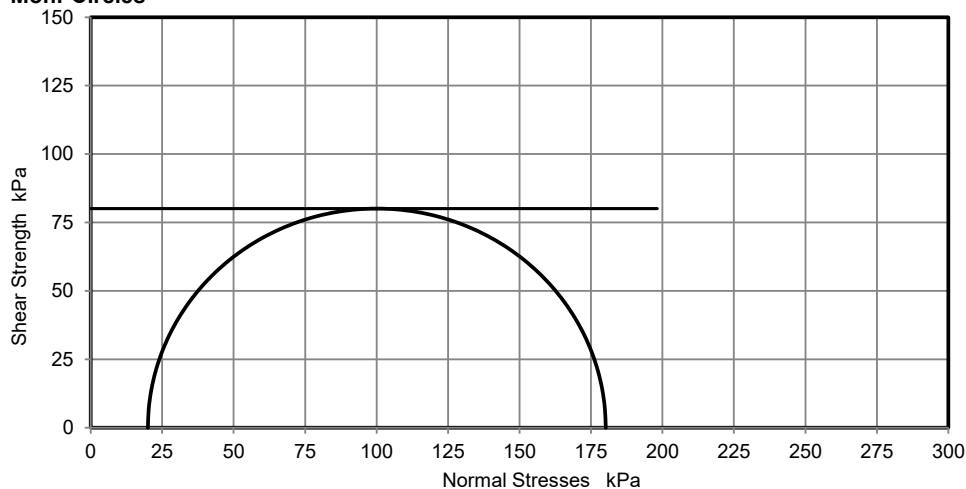


Test Number	1
Length	140.0 mm
Diameter	70.0 mm
Bulk Density	1.85 Mg/m3
Water Content	45.2 %
Dry Density	1.27 Mg/m3
Rate of Strain	2.0 %/min
Cell Pressure	20 kPa
Axial Strain	3.6 %
Deviator Stress, $(\sigma_1 - \sigma_3) f$	160 kPa
Undrained Shear Strength, c_u	80 kPa $\frac{1}{2}(\sigma_1 - \sigma_3) f$
Mode of Failure	Brittle

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.



Test Report by **K4 SOILS LABORATORY**
Unit 8 Olds Close Olds Approach
Watford Herts WD18 9RU
Tel: 01923 711 288 Email: James@k4soils.com

Checked and Approved

Initials: J.P

Date 09/01/2026

	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen			Job Ref	38260
				Borehole/Pit No.	BH4
Site Name	Highwood, Preston			Sample No.	-
Project No.	21217-PO:25-586	Client	WDE Consulting	Depth Top	1.00 m
Soil Description	Medium strength orangish brown mottled light grey slightly sandy gravelly silty CLAY (gravel is fmc and sub-angular to sub-rounded)			Depth Base	2.00 m
				Sample Type	C
				Samples received	12/12/2025
				Schedules received	12/12/2025
Test Method	BS EN ISO 17892-8:2018			Date of test	05/01/2026

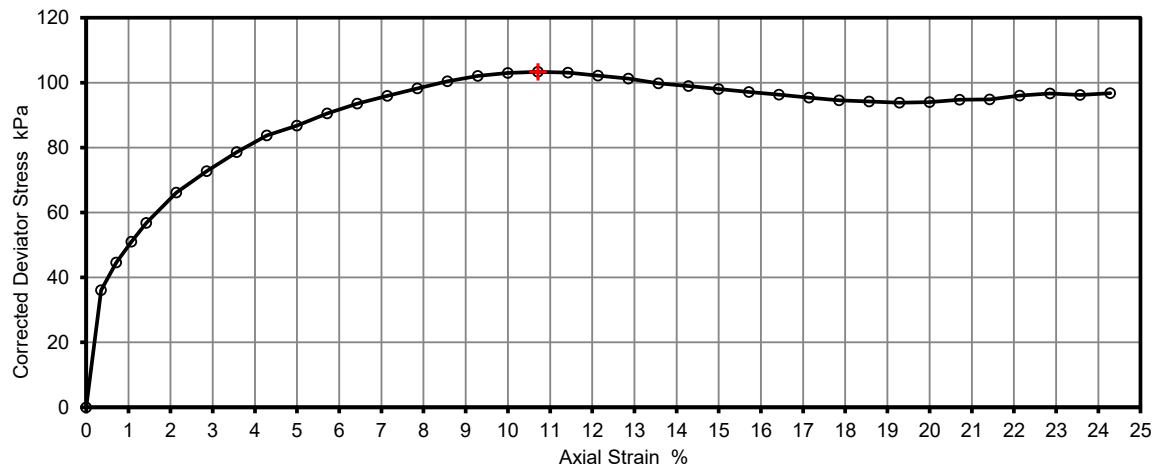
Remarks

Test specimen taken from 1.10-1.30m

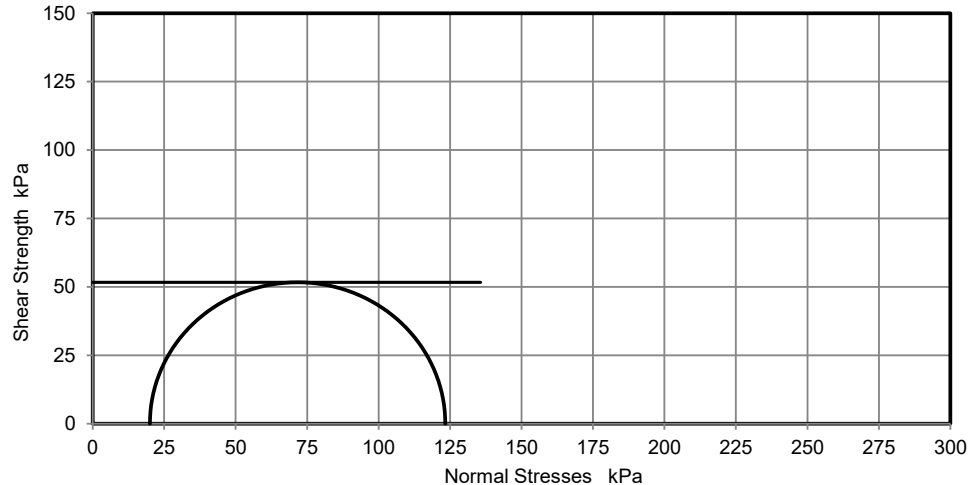


Test Number	1
Length	140.0 mm
Diameter	70.0 mm
Bulk Density	2.21 Mg/m3
Water Content	25.9 %
Dry Density	1.75 Mg/m3
Rate of Strain	2.0 %/min
Cell Pressure	20 kPa
Axial Strain	11 %
Deviator Stress, $(\sigma_1 - \sigma_3) f$	103 kPa
Undrained Shear Strength, c_u	52 kPa $\frac{1}{2}(\sigma_1 - \sigma_3) f$
Mode of Failure	Compound

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.



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Summary of Water Content, Liquid Limit (1 point) and Plastic Limit Results

Job No.

38260

Project Name	
--------------	--

Highwood, Preston

Programme

Samples received	
------------------	--

12/12/2025

Schedule received

12/12/2025

Project No.

21217-PO:25-586

Client	
--------	--

WDE Consulting

Project started

12/12/2025

Testing Started

07/01/2026

[illegible]

80q/300 cone used unless otherwise stated. Correlation factor for 1 point method carried out using Table 1 (BS1377: 1990, Part 2)



Test Methods: BS EN ISO 17892

Part 1: 2014+A1:2022 Water content

Part 12: 2018 +A2:2022 Liquid & plastic limit

These results only apply to the items tested

NOTE: The report shall not be reproduced except in full without authority of the laboratory

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Checked and
Approved

Initials J.P

Date: 09/01/2026

2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

MSF-5-R1(b)



LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

Job No. 38260

Borehole/Pit No. BH2

Site Name Highwood, Preston

Sample No. -

Project No. 21217-PO:25-586 Client WDE Consulting

Depth Top m 1.00

Soil Description Light reddish brown slightly mottled grey slightly gravelly silty CLAY (gravel is fm and sub-angular to rounded)

Depth Base m -

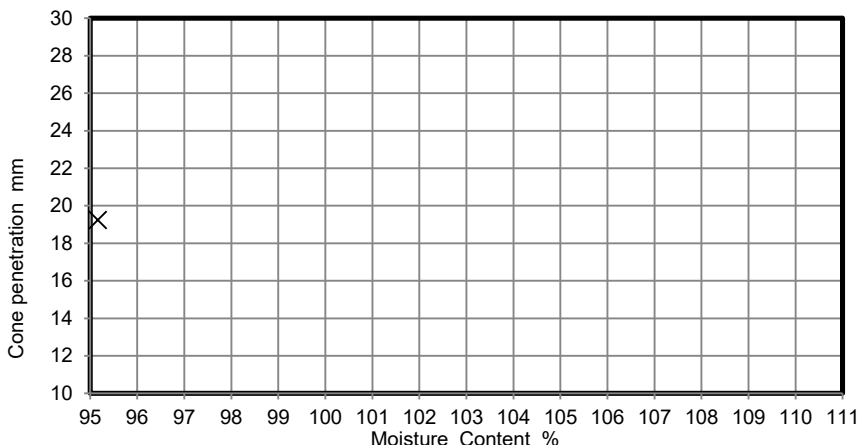
Sample Type D

Samples received 12/12/2025

Schedules received 12/12/2025

Project Started 12/12/2025

Date Tested 07/01/2026



WATER CONTENT 39.5 %

% PASSING 425µm SIEVE 93 %

LIQUID LIMIT 96 %

PLASTIC LIMIT 41 %

PLASTICITY INDEX 55 %

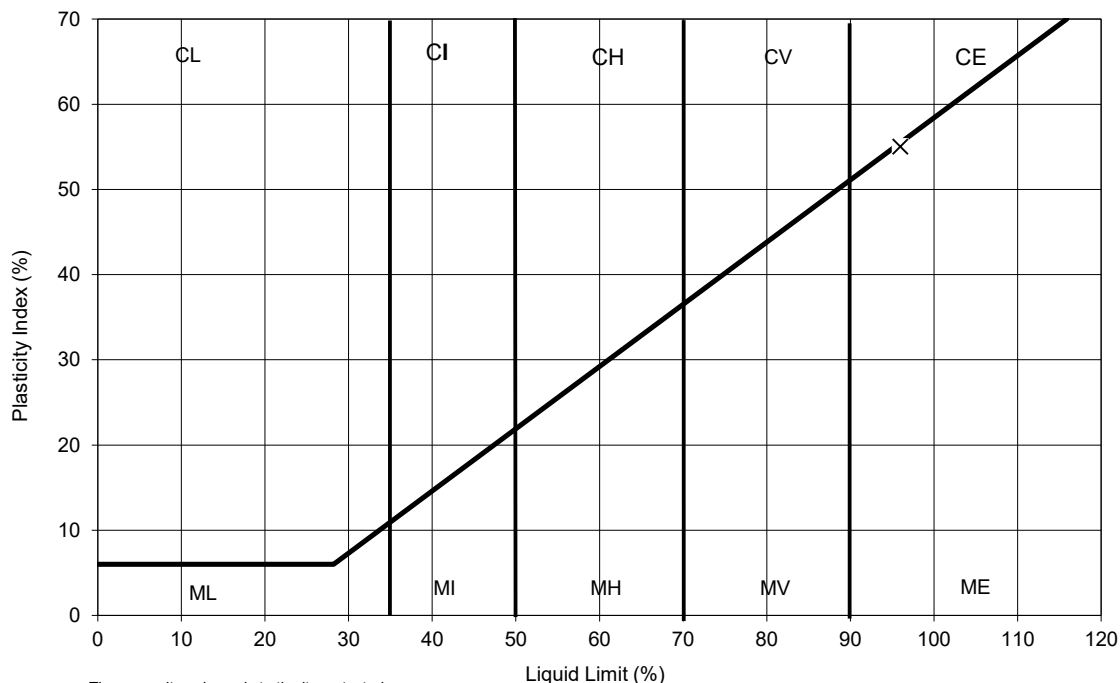
Preparation Method

Tested after >425µm removed by hand

Remarks

Factors corresponding to the cone penetration and moisture content range in Table 1 (BS1377:1990 ; Part 2)

PLASTICITY INDEX



These results only apply to the items tested

NOTE: The report shall not be reproduced except in full without authority of the laboratory

TEST METHOD

BS EN ISO17892: Part 1:2014+A1:2022 Water Content

BS EN ISO 17892: Part 12:2018+A2:2022 Liquid Limit & Plastic Limit

Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU

Tel: 01923 711 288 Email: James@k4soils.com

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

Checked and Approved

Initials: J.P

Date: 09/01/2026

MSF-5 R2



2519



LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

Job No. 38260

Borehole/Pit No. BH2

Site Name Highwood, Preston

Sample No. -

Project No. 21217-PO:25-586 Client WDE Consulting

Depth Top m 2.00

Soil Description Light reddish brown slightly mottled grey silty CLAY with rare fine gravel

Depth Base m -

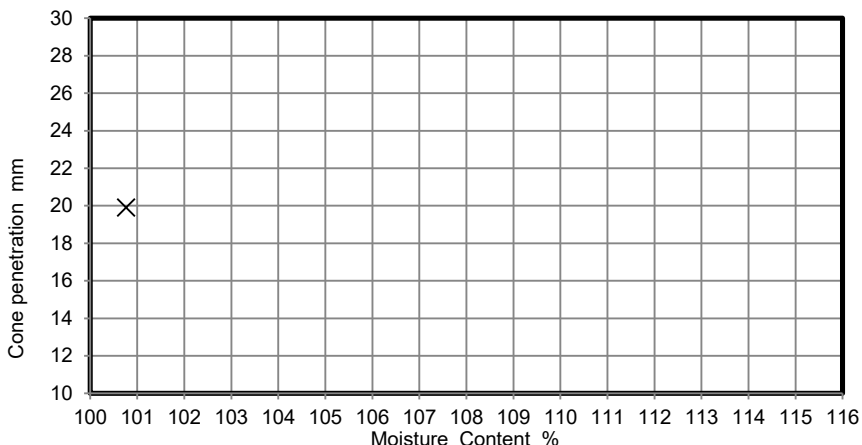
Sample Type D

Samples received 12/12/2025

Schedules received 12/12/2025

Project Started 12/12/2025

Date Tested 07/01/2026



WATER CONTENT 39.3 %

% PASSING 425µm SIEVE 99 %

LIQUID LIMIT 101 %

PLASTIC LIMIT 47 %

PLASTICITY INDEX 54 %

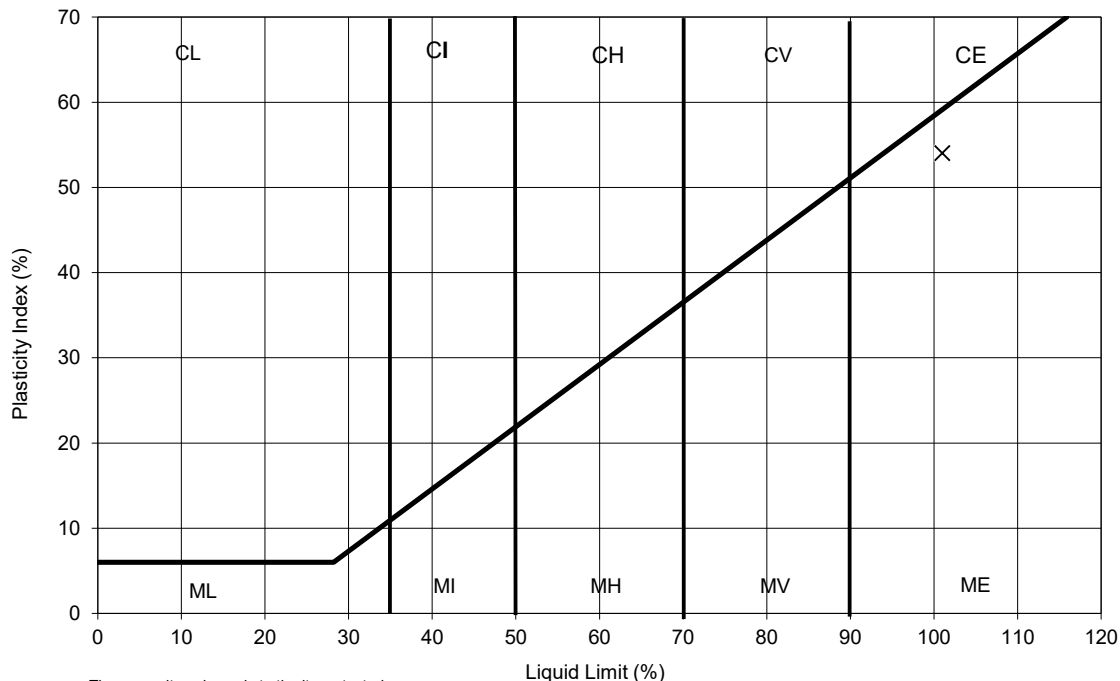
Preparation Method

Tested after >425µm removed by hand

Remarks

Factors corresponding to the cone penetration and moisture content range in Table 1 (BS1377:1990 ; Part 2)

PLASTICITY INDEX



These results only apply to the items tested

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TEST METHOD

BS EN ISO17892: Part 1:2014+A1:2022 Water Content

BS EN ISO 17892: Part 12:2018+A2:2022 Liquid Limit & Plastic Limit

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Date: 09/01/2026

MSF-5 R2



2519



LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

Job No. 38260

Borehole/Pit No. BH2

Site Name Highwood, Preston

Sample No. -

Project No. 21217-PO:25-586 Client WDE Consulting

Depth Top m 3.00

Soil Description Reddish brown slightly mottled grey slightly gravelly silty CLAY (gravel is fm and sub-angular to rounded)

Depth Base m -

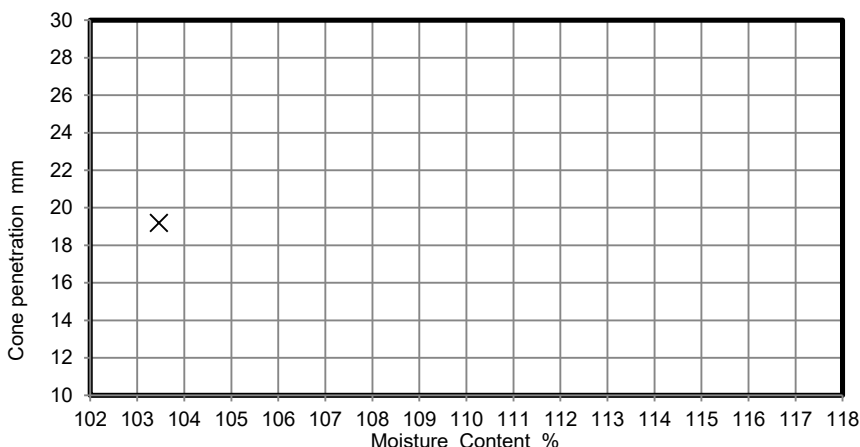
Sample Type D

Samples received 12/12/2025

Schedules received 12/12/2025

Project Started 12/12/2025

Date Tested 07/01/2026



WATER CONTENT 41.5 %

% PASSING 425µm SIEVE 96 %

LIQUID LIMIT 105 %

PLASTIC LIMIT 48 %

PLASTICITY INDEX 57 %

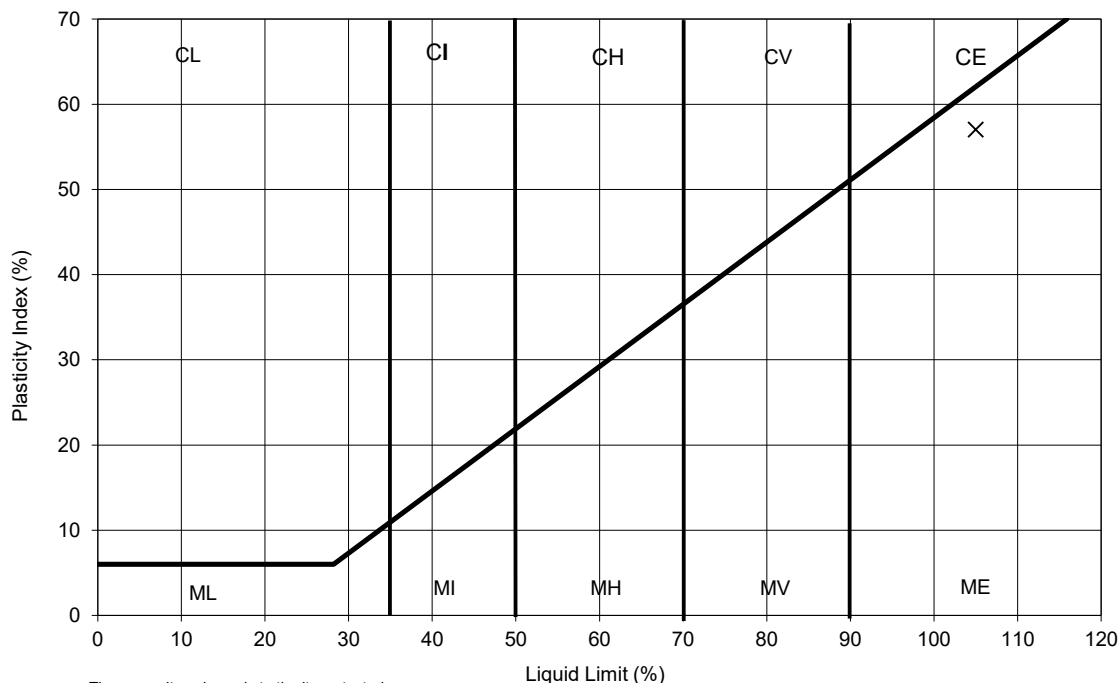
Preparation Method

Tested after >425µm removed by hand

Remarks

Factors corresponding to the cone penetration and moisture content range in Table 1 (BS1377:1990 ; Part 2)

PLASTICITY INDEX



These results only apply to the items tested

NOTE: The report shall not be reproduced except in full without authority of the laboratory

TEST METHOD

BS EN ISO17892: Part 1:2014+A1:2022 Water Content

BS EN ISO 17892: Part 12:2018+A2:2022 Liquid Limit & Plastic Limit

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MSF-5 R2



2519



Liquidity Index from BRE412

BH	Depth (m)	Moisture Content	Liquid Limit	Plastic Limit	Plastic Index	Liquidity Index
2	1	39.5	96	41	55	-0.027
2	2	39.3	101	47	54	-0.143
2	3	41.5	105	48	57	-0.114

1% MC

BH	Depth (m)	Moisture Content	Liquid Limit	Plastic Limit	Plastic Index	Liquidity Index
2	1	40.5	96	41	55	-0.009
2	2	40.3	101	47	54	-0.124
2	3	42.5	105	48	57	-0.096

2.5% MC

BH	Depth (m)	Moisture Content	Liquid Limit	Plastic Limit	Plastic Index	Liquidity Index
2	1	42	96	41	55	0.018
2	2	41.8	101	47	54	-0.096
2	3	44	105	48	57	-0.070

5% MC

BH	Depth (m)	Moisture Content	Liquid Limit	Plastic Limit	Plastic Index	Liquidity Index
2	1	44.5	96	41	55	0.064
2	2	44.3	101	47	54	-0.050
2	3	46.5	105	48	57	-0.026

	Potentially slightly desiccated (plastic limits)
	Potentially desiccated (semi-solid state)



WDE RANGE OF SERVICES

