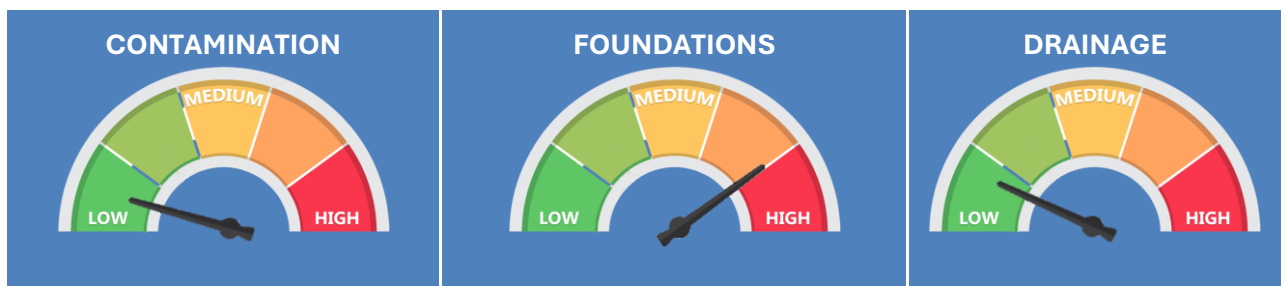


Geo-Environmental Assessment
21 Danesbury Park Road
Welwyn
AL6 9SH

Saints Homes Ltd

Issue Date: May 2024
Report Ref: 21286R1 (Issue A)



Document verification schedule				
Project Name	21 Danesbury Park Road, AL6 9SH			
Document title	Geo-Environmental Assessment			
Document ref	21286R1 (Issue A)			
Date of Issue	May 2024			
Comments	Issued to client			
	Prepared by	Checked by	Quality Check	Approved by
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Date	May 2024	May 2024	May 2024	May 2024

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APPENDIX A

Relevant Guidance and Legislation

APPENDIX B

Site Photos

APPENDIX C

Environmental Database

APPENDIX D

Field Logs

APPENDIX E

Analytical Test Results

APPENDIX F

Geotechnical Test Results, Geotechnical Sheets

1.0 EXECUTIVE SUMMARY

Phase 1 Desk Study	Comments	Risk Rating
Site Setting	Semi-rural residential setting ~300m west of the A1(M) and ~1300m north of Welwyn, AL6 4JD	Low/Moderate
Published Geology and Hydrogeology	Bedrock geology of Lewes Nodular and Seaford Chalk Formation, with superficial Glaciofluvial Deposits. Principal Aquifer bedrock/superficial Secondary A aquifer. Within a SPZ3.	Moderate
Hydrology/Flood Risk	No surface water features present within 250m. Low groundwater flood risk on site.	Low
Historical land use	Open land until 1937 until structure (presumably residential) appears. No significant changes until present day.	Low
Landfill/Infilled land	No recorded entries within 250m of subject site	Low
UXO	Low risk	Low
Phase 2 Intrusive	Comments	Risk Rating
Proven Ground Conditions	Topsoil (0 to 0.4m) and Made Ground (0 to 0.7m) overlying soft to firm gravelly clay (0.4 to 2.4m) and clayey sandy gravel (1.3 to 4.0m), with bedrock chalk beneath (3.4 to 8.0m)	
Groundwater/Drainage	Groundwater measured at 3.64m in BH1	Low/Moderate
Ground Gas	Low risk for ground gas and radon	Low
Contamination	No soil exceedances of GACs for residential land use	Low
Ground Engineering	Piled foundations may be required due to potential issues with differential settlement, clays and mature trees.	Moderate/High
Recommendation	BRE365 Soakage testing	

2.0 INTRODUCTION

WDE Consulting Limited (WDE) was appointed by Mr and Mrs Taylor (the client) to conduct a Geo-Environmental Assessment at 21 Danesbury Park Road, Welwyn, AL6 4JD (Figure 1). The current site comprises an uninhabited residential dwelling with associated soft standing garden to the front and rear, and a hardstanding driveway. There is also a landscaped area to the rear of the property with a disused pond. The site is situated at NGR TL 23707 17727, What 3 Words *humans.snake.analogy*.

2.1 Context

The purpose of this assessment was to determine the potential ground risks at the subject site associated with potential future residential development (Figure 2).

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 client is presented in Table 1.

Table 1 – Agreed Scope of Works and Objectives

Item	Scope of Works	Objectives
1	Site walkover	To identify any areas of potential contamination
2	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
3	Monitoring rounds	To undertake groundwater monitoring
4	Permeability testing	Investigate the drainage potential of the materials through borehole permeability testing
5	Laboratory analyses	Contamination and geotechnical soil/water samples are analysed at a laboratory
6	Reporting	- Complete a Phase 1 desk-based study of the site to ascertain information on the site geology, hydrology, and surrounding land uses - Compare onsite soil and water concentrations with generic UK based assessment criteria - Provide recommendations on contamination, foundations, and drainage

3.0 PHASE 1 DESK STUDY

3.1 Information Sources

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

- Site walkover (photos presented in Appendix B)
- Environmental database information (Appendix C)
- Publicly available information

3.2 Site Description and Walkover

The site measures ~50 N-S, and ~50m E-W (~1500 m²) and comprises a derelict two-storey residential building with associated garage, hard standing driveway, and soft standing garden to the front and rear (Figure 2).

The house is situated in the centre of the site, with the garage to the northeast, driveway to the east, landscaped garden area to the west, and garden to the north and south. There is also an area of concrete slab behind the garage. There are several mature deciduous trees on the site, including cedar, spruce and leylandii. No tanks or visible contamination was observed during the site walkover.

3.2.1 Key Findings of Desk Study

The key findings from the desk study are presented in Table 2.

Table 2 – Key Findings of Desk Study

Item	Details
Published Geology	Bedrock geology consists of Lewes Nodular Chalk Formation and Seaford Chalk Formation, with superficial Glaciofluvial Deposits.
Geological Hazards	All hazards low or less
Hydrogeology	The bedrock is deemed a Principal Aquifer. The superficial is deemed a Secondary A aquifer. The site lies within a Source Protection Zone 3
Hydrology	No surface water bodies within 250m of the site, low surface water flooding
Current Land Use on site	Residential
Current Land Use within 250m radius	• 57mE – Electricity Substation • 205m NE – Gas Converter Station • 232m NW – Water Tower
Radon Risk	Low (between 1 and 3%) – No protective measures required
Historical land use on site	The site is clear until c1937 when an unnamed structure was built. By c1970 minor alterations were added, and the site was named 'Linton'. The existing garage was built in c1993, and this represents the current configuration of buildings on the subject site.
Historical land use with 250m radius	Pottersheath Farm was located ~10mS of the subject site until 1924, and residential development started by 1937. • 184m SE – Chalk Pit (1897) • 184m SE – Unspecified Pit (1922 – 1947)

	188m SE – Unspecified Pit (1881) 199m N – Water Works (1947) 227m N – Unspecified Tank (1947)
Landfills/Infilled Land	No landfills or infilled land within 250m of the site
Identified potential areas of concern	Garage and potentially imported made ground
Pollution Incidents	236m SW – Inert materials and wastes, Category 3 (Minor) land impact (2002)
UXO Risk	Low – No further actions likely
Environmental Sensitive Land Uses	- Green belt - Nitrate Vulnerable Zone - SSSI Impact Risk Zone

3.3 Preliminary Risk Assessment

3.3.1 Identification of Critical Receptors

The identified potentially critical receptors are presented in Table 3.

Table 3 – Identification of Potential Receptors

Receptor Type	Current/Future	Receptor Details	Active
Human Health	Future	Residential receptors onsite	Yes
	Current	Residential receptors offsite	Yes
Controlled waters	Current	Groundwater within aquifer	Yes
	Current	Groundwater within SPZ (SPZ3)	Yes

The risks to onsite workers can be minimised by following appropriate health and safety guidance on site (i.e. wearing protective clothing and washing).

3.3.2 Identification of Potential Areas of Concern

The list of potential areas of concern on site and in the surrounding area are summarised in Table 4, and presented on Figure 2.

Table 4 – Identification of Potential Areas of Concern

Location	Potential Risk	Comments
Onsite	Garage, potentially imported made ground	Hydrocarbons (TPH, BTEX, PAH), heavy metals, inorganics, asbestos, cyanide, phenols, ground gas
Onsite	Trees	High water demand trees up to 24m tall

3.3.3 Identified Potential Pathways

Human Health Pathways

The potential human health exposure pathways for a residential/commercial receptor are indicated in Table 5.

Table 5 – Identification of Potentially Active Human Health Exposure Pathways

Potential Pathway	Active/ Inactive	Notes
Ingestion of soil and dusts	Active	Qualitative Risk Assessment required
Ingestion of home grown produce	Active	Qualitative Risk Assessment required
Dermal contact with soils and dust	Active	Qualitative Risk Assessment required
Inhalation of dusts	Active	Qualitative Risk Assessment required
Inhalation of organic vapours (generated by shallow soils) in external areas or inside buildings	Active	Qualitative Risk Assessment required
Inhalation of organic vapours generated by dissolved phase groundwater migrating offsite to neighbouring residential properties	Active	Qualitative Risk Assessment required
Inhalation of organic vapours generated by dissolved phase groundwater migrating onto site from surrounding offsite sources	Active	Qualitative Risk Assessment required
Contaminants from site entering groundwater and migrating into public water abstraction borehole for human consumption	Inactive	No potable abstractions within 500m. No further assessment necessary

Controlled Waters Pathways

The potentially active controlled waters migration pathways are indicated in Table 6.

Table 6 – Identification of Potentially Active Controlled Water Pathways

Potential Pathway	Active/ Inactive	Notes
Impacted soils leaching to groundwater within Principal Aquifer	Active	Qualitative Risk Assessment required
Impacted soils leaching to groundwater and migration to surface water	Inactive	No surface water bodies within 250m

Ground Gas Pathways

The potential for ground gas risk depends on source-pathway-receptor linkages, with the age of infilling and type of waste as controlling factors. The potentially active migration pathways for ground gas are indicated in Table 7, along with a qualitative risk assessment.

Table 7 – Identification of Potentially Active Ground Gas Pathways

Potential Pathway	Active/ Inactive	Notes
Potential for natural materials with high organic content, such as peat (>4% TOC)	Active	Further assessment needed
Availability of readily degradable material, such as vegetable matter and food waste	Inactive	No landfills within 500m
Nature of fill material - depth of fill >1m, incohesive materials, poorly compacted and within unsaturated zone.	Active	Further assessment needed
Age of Materials - Ground gas generated from current/historical landfills <25yrs old	Inactive	No landfill identified on site
Distance from receptor – a higher distance reduces the potential risk for offsite migration. High risk generally limited to within 100m distance.	Active	Residential dwellings <100m
Presence of Preferential Pathways – fissures/fractures in bedrock or permeable strata beneath an impermeable cover	Active	Published geology is nodular chalk and glaciofluvial deposits
Chemical storage/spillages with potential for hydrocarbon vapours	Inactive	No tanks identified on site
Shallow or deep mine workings	Inactive	No mine workings identified on site
Radon gas protective measures required	Inactive	<3% Low risk

3.3.4 Qualitative Risk Assessment

A summary of the relevant pollutant linkages based on a source-pathway-receptors analysis is provided in Table 8.

Table 8 – Summary of Potentially Active Source-Pathway-Target Assessment

Sources	Potential Pathway	Potential Receptor	Risk Classification
Onsite Sources (garage, 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/Moderate
	Impacted soil leaching to groundwater and migration to surface water	Controlled Waters (Surface water)	Low
Offsite Source (Industrial land uses)	Vapour inhalation from dissolved phase migration from offsite sources	Human Health (Onsite Commercial)	Low
Historical landfill and infilled land	Source for ground gas generation	Human Health (Onsite Commercial)	Low

4.0 PHASE II INVESTIGATION WORKS

4.1 Summary Of Works

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

Table 9 – Summary of Phase II Intrusive Works

Item	Details	Appendix
Shallow Boreholes	3no window sample boreholes were drilled with SPTs to a maximum of 4.0m depth (BH1, BH2, BH3)	D
Deep Boreholes	1no window sample borehole was drilled with SPTs to 8.0m depth (BH4)	D
Groundwater monitoring	1no groundwater monitoring visit to monitor 2no boreholes (BH1, BH4)	E
Permeability Testing	1no permeability testing visit on 2no monitoring wells (BH1, BH4)	E
Analytical Testing	1no standard QRA suite	F
Geotechnical Testing	Atterberg limit, particle size distribution, saturation moisture content and triaxial testing undertaken	G

4.2 Constraints/Selection of Intrusive Locations

Access was not possible to the rear of the property due to a narrow alleyway and a raised step. Access was only possible in external areas, with no access available within the building footprint.

4.3 Rationale for Selection of Intrusive Locations

The intrusive locations are indicated on Figure 3, with rationale used for the selection of locations presented in Table 10.

Table 10 – Rationale for Exploratory Hole Locations

Description	Location	Intrusive Locations
Contamination, geotechnical and groundwater	Soft standing external areas	BH1 to BH4
Mature trees near proposed infrastructure	Central/southern portion	BH2, BH3
Garage	Eastern portion	BH4

4.4 Field Results

4.4.1 Geology

A summary of the geology encountered during the intrusive investigation is summarised in Table 11 and are presented in full Appendix [D](#).

Table 11 – Summary of Geology Proved Onsite

Strata	Descriptions	Min - Max Depth (m bgl)	Average Depth (m bgl)	Locations
Made Ground	Brown clay with red brick fragments	Absent – 0.70	0.00 – 0.70	BH4
Topsoil		0.25 – 0.40	0.00 – 0.30	BH1, BH2, BH3
Glaciofluvial Deposits	Soft to stiff grey/brown gravelly Clay	0.90 - 2.40	0.30 – 2.00	All
	Stiff grey cobbly Clay	Absent – 4.00	-	BH4
	Loose to very dense brown slightly clayey sandy Gravel	2.00 – 6.70	2.00 – 4.00	All
Seaford/Lewes	White chalk (grade Dm/Dc)	Absent – 8.00	4.00 – 8.00+	BH3, BH4

4.4.2 Groundwater

A summary of the groundwater monitoring results is presented in Table 12.

Table 12 – Groundwater Field Monitoring Results (m bgl) – 10/05/24

Parameter	BH1	BH4
Depth to water	3.64	Dry
Depth of well	4.00	4.00

4.4.3 Contamination Observations

No grossly contaminated materials were observed during the investigation with all PID values <0.1ppm.

4.4.4 Permeability Results

A summary of the borehole permeability testing results is presented in Table 13 and are presented in full in Appendix [E](#).

Table 13 – Soakage Test Results

Location	Test Type	Material	Depth of Test m bgl	Drainage (m/sec)	Qualitative Soakage Potential
BH1	Borehole	Clay & Gravel	3.90	>10E-4	Good
BH4	Borehole	Clay & Gravel	3.64	>10E-4	Good

5.0 GROUND GAS ASSESSMENT

5.1 Published Guidance

A ground gas assessment has been undertaken to assess risks associated with carbon dioxide and methane to new buildings and their users, adopting the current guidance presented in Appendix A.

5.2 Updated Ground Gas Conceptual Site Model

An update to the ground gas conceptual model is presented in Table 14 which has incorporated the information obtained from this assessment.

Table 14 – Update of Ground Gas Conceptual Model

Potential Pathway	Site value	Notes
Potential for natural materials with high organic content, such as peat (>4% TOC)	1.4%	Low risk
Nature of fill material - depth of fill >1m, incohesive materials, poorly compacted and within unsaturated zone.	<1m	Low risk
Presence of Preferential Pathways – fissures/fractures in bedrock or permeable strata beneath an impermeable cover	Chalk and gravels beneath clay	Low risk as no source
Chemical storage/spillages with potential for hydrocarbon vapours	None	Low risk

Gas monitoring is therefore not considered to be required.

6.0 CONTAMINATION ASSESSMENT

6.1 Soil Analytical Test Results

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

There are no exceedances of the adopted GACs for residential land use (with home grown produce).

6.2 Waste Classification/Onsite Reuse Options

Table 15 provides an overview of the likely waste classification for onsite materials, as well as onsite reuse options, with the waste classification sheets presented in Appendix E.

Table 15 – Likely Waste Classification/Reuse Options for Onsite Materials

Material	Waste Classification	On Site Reuse Options
Topsoil	Inert	Private gardens
Made Ground	Non-hazardous	Beneath roads, hardstanding

Reuse of site won materials is to be encouraged in line with a sustainable approach, which will require a CL:AIRE DoW:CoP Materials Management Plan (MMP) or U1 waste exemption form to be completed.

6.3 Conclusions on Contamination

There have been no exceedances of the adopted GACs, and the site is considered suitable for the intended use without any further remedial measures.

A revised *source-pathway-receptor* assessment is presented in Table 16.

Table 16 – Summary of Revised Active Source-Pathway-Target Assessment

Sources	Potential Pathway	Potential Receptor	Risk Classification
Onsite Sources (garage, potential made ground)	Dermal contact, outdoor and indoor inhalation, ingestion, homegrown produce	Human Health (Onsite Residential)	Low
	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
Offsite Source (Industrial land uses)	Vapour inhalation from dissolved phase migration from offsite sources	Human Health (Onsite Commercial)	Low
Historical landfill and infilled land	Source for ground gas generation	Human Health (Onsite Commercial)	Low

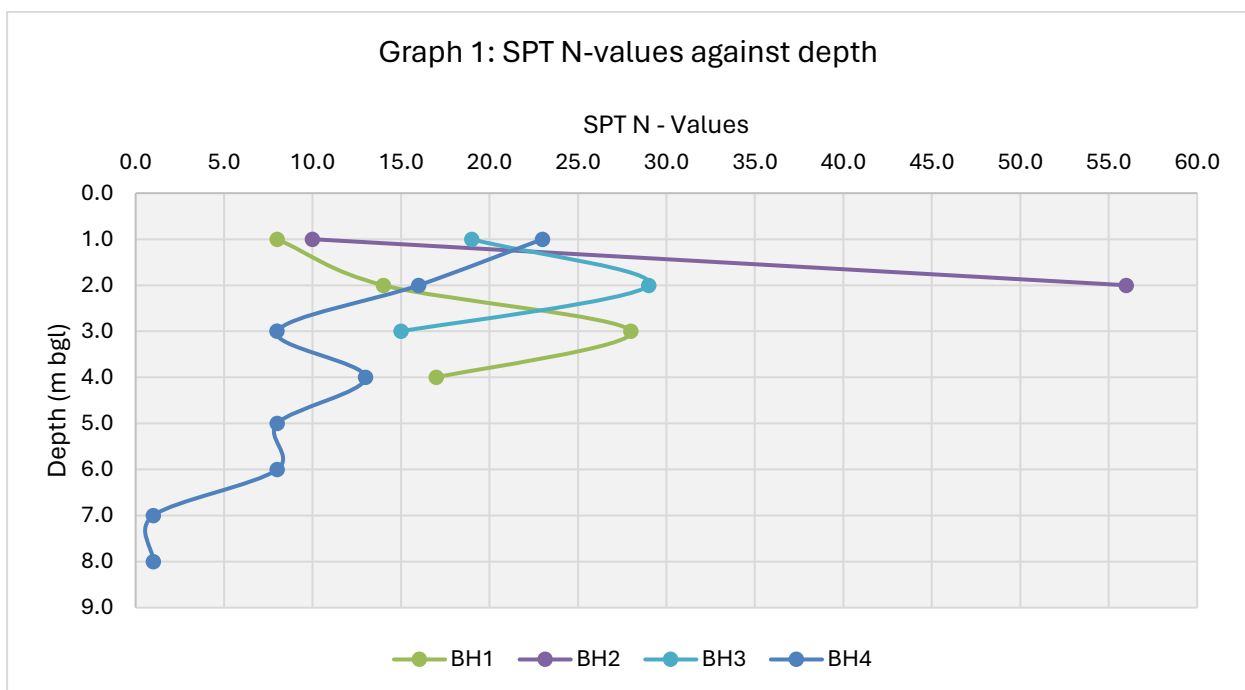
7.0 GROUND ENGINEERING

7.1 Field Testing Results

A summary of the ground engineering field testing results is provided in Table 17 and are presented in on the logs in Appendix D. This includes the calculated SPT N value and inferred shear strength (Cu) using a pocket penetrometer (PP).

Table 17 – Field Geotechnical Results

Depth (m)	BH1		BH2		BH3		BH4	
	N value	PP kPa	N value	PP kPa	N value	PP kPa	N Value	PP kPa
1.0	8	160	10	250	19	-	23	-
2.0	14	175	56	-	29	-	16	-
3.0	28	-	-	-	15	-	8	-
4.0	17	-	-	-	-	-	13	-
5.0	-	-	-	-	-	-	8	-
6.0	-	-	-	-	-	-	8	-
7.0	-	-	-	-	-	-	1	-
8.0	-	-	-	-	-	-	1	-



Soft spots were identified within the chalk at 7 and 8m depth in BH4 with N-values of 1.

7.2 Geotechnical Testing

Particle size distribution (PSD), Triaxial undrained shear strength (Cu), saturation moisture content and Atterberg limit (PI) testing of the encountered strata are summarised below in Table 18 with the full results presented in Appendix G.

Table 18 – Summary of Geotechnical Test Results

Description	Average Depth (m bgl)	MC %	Modified PI %	PSD %			Triaxial kPa
				Gravel	Sand	Fines	
Gravelly Clay	0.30 – 2.00	17 – 19	16 – 23	40	17	42	85
Clayey Sandy Gravel	2.00 – 4.00	–	-	40 – 70	17 – 22	13 – 22	-

Testing on the gravelly clay returned a low to medium volume change potential and a shear strength of 85 kPa indicating a high strength material.

Table 19 - Summary of Geotechnical Test Results on Chalk

Description	Depth (m bgl)	SMC (%)	Intact Dry Density (mg/m3)
Chalk	7.00 – 8.00	38	1.33

Testing on the chalk between 7 and 8m indicates there is a low CIRIA¹ chalk density.

7.3 Potential Desiccation

An assessment of potential desiccation of the clay in the upper 2m has been undertaken and is presented in Appendix G.

No potential desiccation has been identified in the upper 2m, which is therefore unlikely to warrant further actions.

7.4 Concrete Design Parameters

A summary of the sulphate, pH and corresponding BRE concrete in aggressive ground parameters for concrete design are presented in Table 20.

¹ CIRIA 2002. Engineering in Chalk. C674

Table 20 – Summary of BRE Concrete in Aggressive Ground Parameters

Location	Concrete Parameters
pH (pH Units)	8.1
Water Soluble Sulphate as (2:1 Leachate Equivalent) (mg/l)	36.6
ACEC Classification	AC-1
Design Sulphate Class	DS-1

7.5 Comparison with Water UK Threshold Concentration Values

The soil laboratory results from the upper 1.35m have been compared to the UKWIR thresholds for the selection of water supply pipes in Table 21 with full results presented in Appendix E.

Table 21 - Comparison of Soil Laboratory Results from the upper 1.35m with UKWIR (mg/kg)

Contaminant of Concern	No. of Samples	UKWIR Threshold	Max	No. Samples > GAC	Samples Exceeded
Total BTEX & MTBE	1	0.1	BDL	0	-
EC5-EC10 Aliphatic	1	2	BDL	0	-
EC10-EC16 Aliphatic	1	10	9.6	0	-
EC16-EC40 Aliphatic	1	500	BDL	0	-
EC5-EC10 Aromatic	1	2	BDL	0	-
EC10-EC16 Aromatic	1	10	4.4	0	-
EC16-EC40 Aromatic	1	500	BDL	0	-
Phenol	1	2	BDL	0	-
Cresols and chlorinated phenols	1	2	-	-	-
Corrosive	1	Various	-	-	-

There have been no exceedances of the UKWIR threshold values and therefore it is unlikely that additional mitigation measures in the form of protective pipe will be necessary. Further consultation should be sought with the water supply company.

7.6 Excavations, Groundwater Control and Services

Groundwater was encountered during the investigation at 3.6m bgl and hence is unlikely to require dewatering for shallow excavations. Excavation walls are likely to require additional support within the granular material. There are a number of potentially live electrical services beneath the site which will need to be safely dealt with during construction.

7.7 Preliminary Road Design Parameters

It is anticipated that the soils encountered at formation level will a mixture of cohesive and incohesive materials and will be above the water table. The amount of loading is unknown for the roads and

pavements, but for poor to good construction conditions², a CBR design value of 2.5 to 3% is recommended for initial design.

7.8 Preliminary Floor Design

The ground gas risk for the site has been characterised as a Very Low Risk requiring only a standard membrane (CS1/NHBC Green). A block and beam vented subfloor should also be allowed for in the floor design which would also accommodate potential heave within the shallow clays.

7.9 Soakage Potential

The borehole permeability tests indicate good permeability ($>10^{-4}$ m/sec) within the sand and gravel materials. This may need to be confirmed via BRE365 testing should a soakaway be proposed within the design. It is recommended a drainage engineer is consulted to formulate the drainage design.

7.10 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
- Depth of groundwater
- Depth of made ground
- Areas containing soft/loose or peaty materials identified during field testing
- Differences in founding materials to avoid differential settlement issues
- Type/height and types of trees in combination with volume change potential of soils
- Potential desiccation

It is understood that the development is to comprise the demolition of the existing structures and construction of a two-storey residential dwelling. Traditional strip foundations are likely to be viable for consideration, adopting an allowable bearing capacity of 100 to 150kPa within the stiff gravelly clay and 200kPa within the medium dense clayey gravels. Consideration will need to be given to deepening foundations where near to mature trees in line with NHBC Chapter 4 guidance. A potential high-water demand ~15m tall tree is present within 2m of the proposed foundations on the NE boundary and therefore foundations may need to extend beyond 2.50m depth. Also, shallow foundations are likely to intercept clay in BH1 and BH2 and gravel in BH3 and BH4 which may lead to differential settlement issues.

Therefore, a piled foundation solution may be more preferable. It is recommended that a structural engineer is consulted for the detailed foundation design.

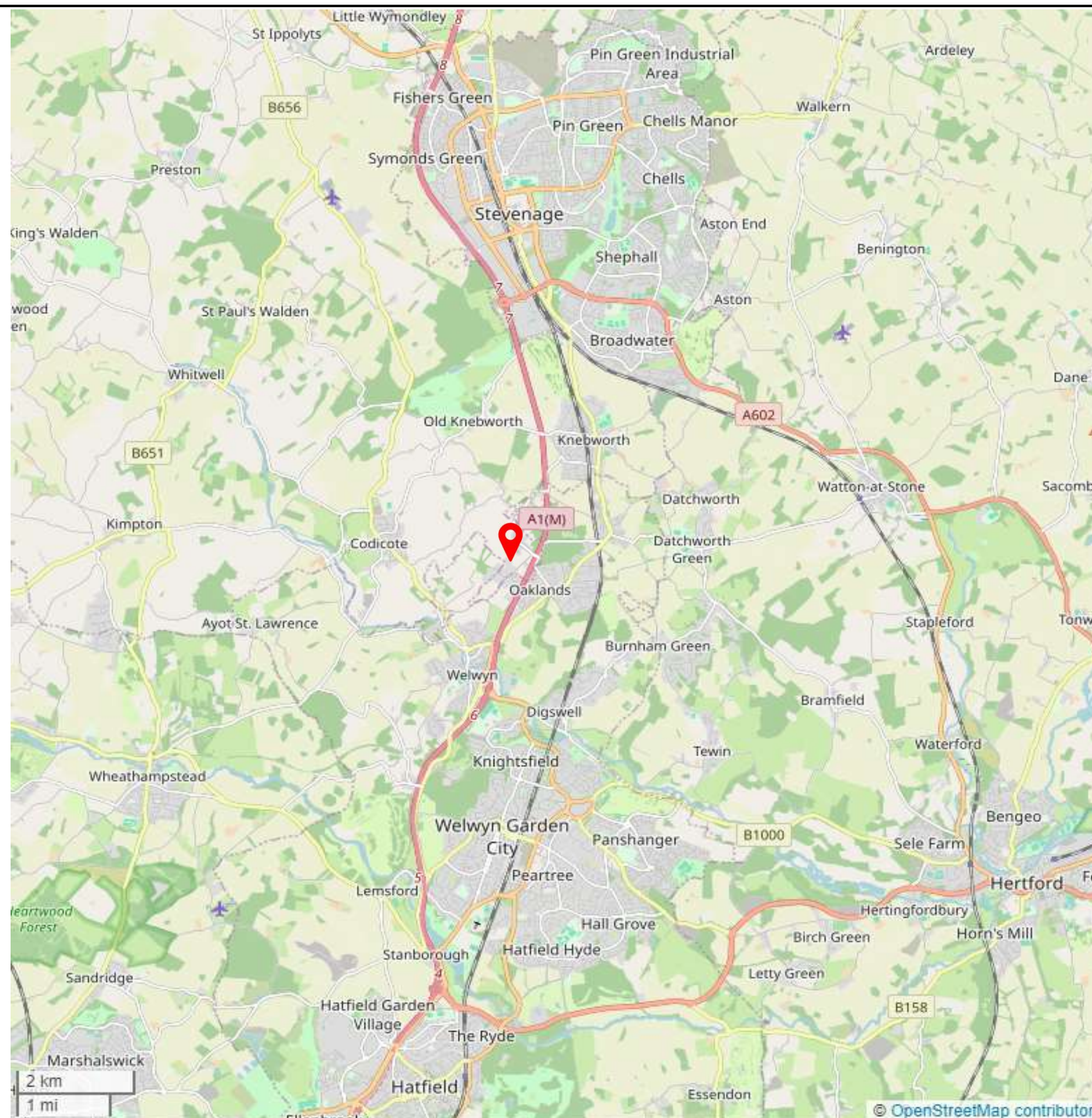
² TRRL 1984 Structure Design of Bituminous Roads. Report LR1132

8.0 RECOMMENDATIONS FOR FUTURE WORK

WDE recommends that the following items are undertaken:

- BRE365 soakage testing to confirm drainage design parameters

FIGURES



62A Western Road
Tring
HERTS
HP23 4BB
T: 01442 825570

Client

Mr & MRS TAYLOR

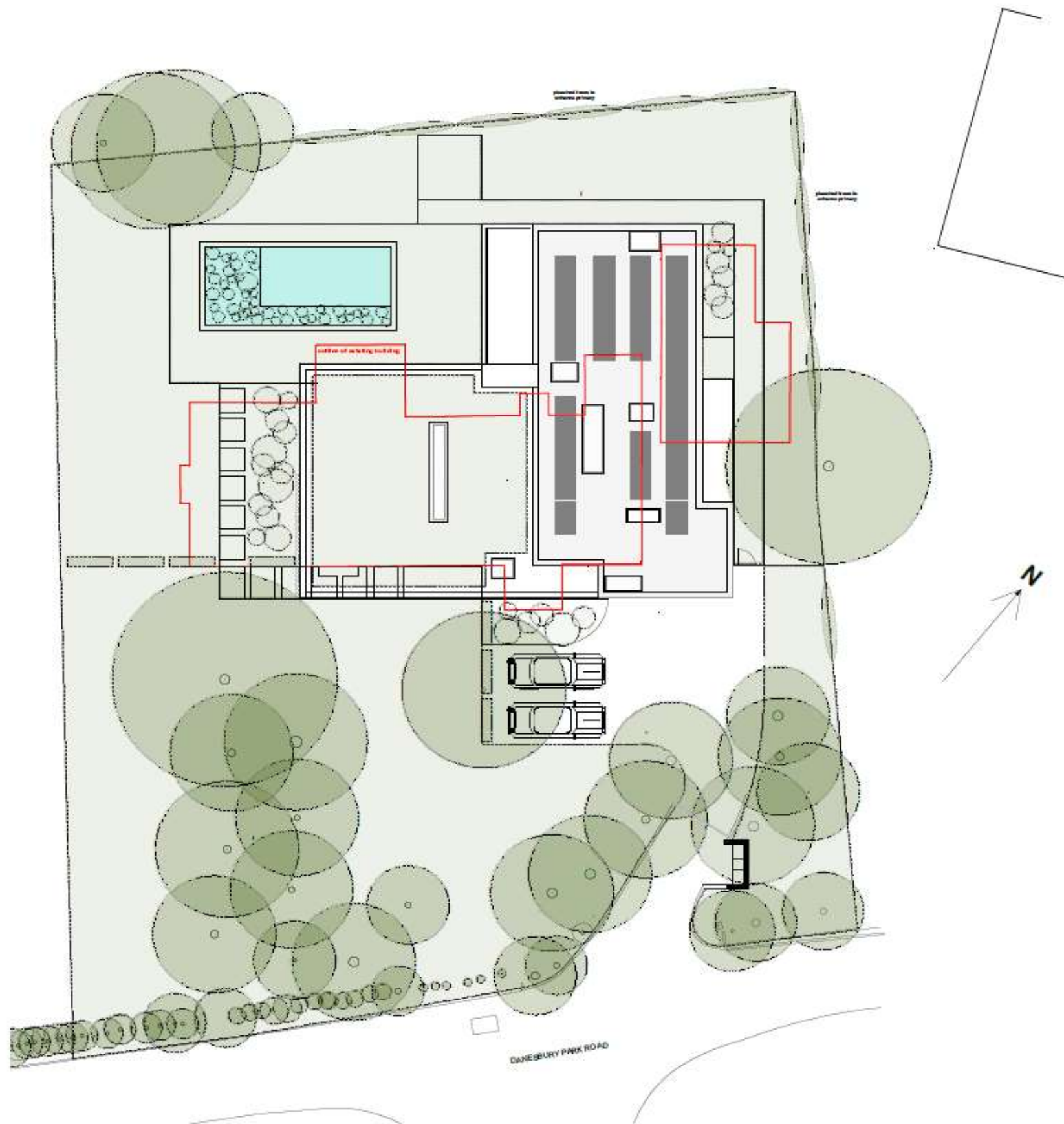
Project

21 DANESBURY PARK ROAD

Title

FIGURE 1: SITE LOCATION PLAN

© OpenStreetMap contributors



LEGEND

— Existing building outline

Client

Mr & Mrs Taylor

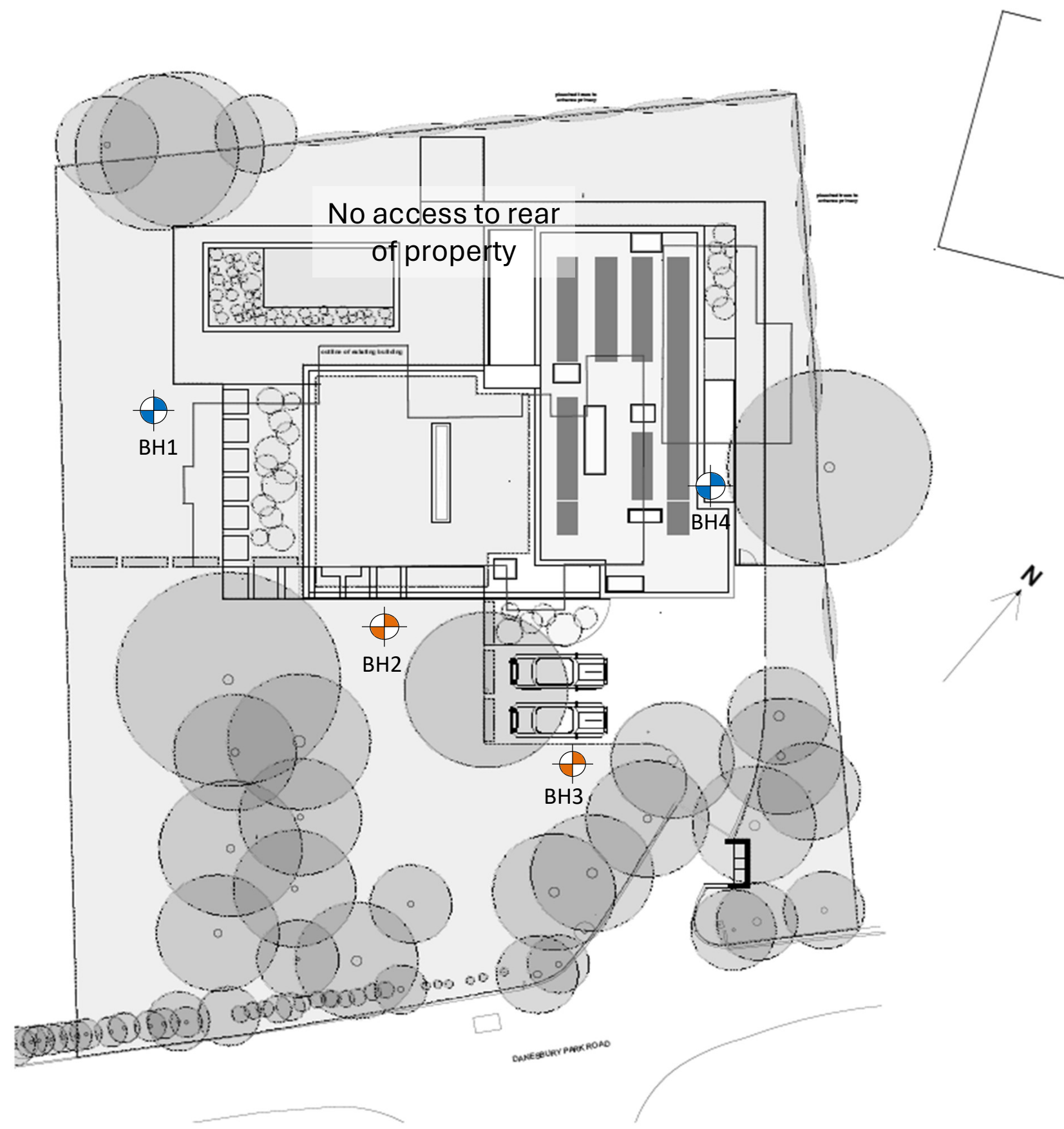
Project

21 Danesbury Park Road, Welwyn

Title

FIGURE 2: PROPOSED SITE PLAN

Drawing supplied by client



LEGEND

-  Borehole
-  Borehole with monitoring well

Client
Mr & Mrs Taylor

Project
21 Danesbury Park Road, Welwyn

Title
FIGURE 3: INTRUSIVE LOCATION PLAN

Drawing supplied by client

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 Framework³ 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 Agency⁴. 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 Sites⁵ and for undertaking Site Investigations⁶ which have duly been considered. An update to the potential human health exposure pathways is provided in the Environment Agency Soil Science Report SR3⁷. 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

³ Department of Communities and Local Government. March 2012

⁴ Environment Agency. 2020. Land Contamination Risk Management (LCRM)

⁵ British Standards 2011. Investigation of Potentially Contaminated Sites-Codes of Practice. BS10175:2011

⁶ British Standards. 2015. Code of Practice for Site Investigations. BS5930

⁷ Environment Agency, August 2008, Updated technical background to the CLEA model, Science Report - SC050021/SR3

Affected by Contamination⁸. Guidance is provided in the CLR Report No 4 on sampling strategies for contaminated land⁹.

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 66⁸.

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 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.

⁸ Environment Agency, 2008. Guidance for the Safe Development of Housing on Land Affected by Contamination. R&D 66

⁹ DOE, 1994. Sampling Strategies for Contaminated Land. CLR Report No 4

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.

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
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

GROUNDING SOLUTIONS

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

CONTROLLED WATER EALS

In the UK there are two published Environmental Assessment Levels (EALs) available for comparison with groundwater, the Water Framework Directive¹³ and the Water Supply Regulations¹⁴, apart from TPH fractions, Ethylbenzene and Xylenes where the DWS and EQS values has been adopted, respectively. Detection Limit (DL) is used where a standard has not been derived. SoBRA have calculated the risks from vapour inhalation from volatile dissolved phase contaminants for residential and commercial human health receptors.

Adopted Controlled Water Targets (mg/l)

Contaminant Concern	of	EAL	Source	SoBRA Res	SoBRA Comm
Total Phenols		0.0077	UK WFD	-	-
Cyanide		0.05	UK WSR	-	-
Naphthalene		0.002	UK WFD	-	-
Acenaphthylene		0.0001	UK WSR	-	-
Acenaphthene		0.0001	UK WSR	-	-
Fluorene		0.0001	UK WSR	-	-
Phenanthrene		0.0001	UK WSR	-	-
Anthracene		0.0001	UK WSR	-	-
Fluoranthene		0.0001	UK WSR	-	-
Pyrene		0.0001	UK WSR	-	-
Benzo(a)anthracene		0.0001	UK WSR	-	-
Chrysene		0.0001	UK WSR	-	-
Benzo(b)fluoranthene		0.0001	UK WSR	-	-
Benzo(k)fluoranthene		0.0001	UK WSR	-	-
Benzo(a)pyrene		0.00001	UK WSR	-	-
Indeno(1,2,3-cd)pyrene		0.0001	UK WSR	-	-
Dibenz(a,h)anthracene		0.0001	UK WSR	-	-
Benzo(ghi)perylene		0.0001	UK WSR	-	-
Arsenic		0.01	UK WSR	-	-
Boron		1	UK WSR	-	-
Cadmium		0.005	UK WSR	-	-
Chromium		0.05	UK WSR	-	-
Copper		2	UK WSR	-	-
Lead		0.01	UK WSR	-	-
Mercury		0.001	UK WSR	-	-
Nickel		0.02	UK WSR	-	-
Selenium		0.01	UK WSR	-	-
Zinc		0.0123	UK WFD	-	-
Benzene		0.001	UK WSR	0.21	20
Toluene		0.074	UK WFD	230	21000
Ethylbenzene		0.02	UK EQS	10	960
Xylenes (sum)		0.03	UK EQS	31.4	3020
MTBE		DL	WDE	-	-
TPH - Aliphatic >C5 - C6		0.01	UK DWS	1.9	190
TPH - Aliphatic >C6 - C8		0.01	UK DWS	1.5	150

¹³ The Water Framework Directive (Standards and Classifications) Directions (England and Wales). 2015.

¹⁴ The Water Supply (Water Quality) Regulations. 2016.

GROUNDING SOLUTIONS

TPH - Aliphatic >C8 - C10	0.01	UK DWS	0.057	5.7
TPH - Aliphatic >C10 - C12	0.01	UK DWS	0.037	3.6
TPH - Aliphatic >C12 - C16	0.01	UK DWS	-	-
TPH - Aliphatic >C16 - C21	0.01	UK DWS	-	-
TPH - Aliphatic >C21 - C35	0.01	UK DWS	-	-
TPH - Aromatic >C5 - C7	0.01	UK DWS	210	20000
TPH - Aromatic >C7 - C8	0.01	UK DWS	220	21000
TPH - Aromatic >C8 - C10	0.01	UK DWS	1.9	190
TPH - Aromatic >C10 - C12	0.01	UK DWS	6.8	660
TPH - Aromatic >C12 - C16	0.01	UK DWS	39	3700
TPH - Aromatic >C16 - C21	0.01	UK DWS	-	-
TPH - Aromatic >C21 - C35	0.01	UK DWS	-	-

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 buildings¹⁵
- NHBC: Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present¹⁶
- NHBC: Technical Extra¹⁷
- The Building Regulations Site Preparation and resistance to contaminants and moisture. ¹⁸
- British Standard. Guidance on Investigations for Ground Gas¹⁹
- NHBC guidance on Hazardous groundgas²⁰

The 2007 CIRIA guidance calculates a gas screening value to identify the protective measures required, as shown below.

Summary of CIRIA 2007 Guidance

Characterisation Situation	Risk Classification	Gas Screening Value (l/hr)	Typical Factors	Protective Measure
1	Very Low	<0.07	Methane <1% or carbon dioxide <5%; otherwise increase to Situation 2	No special precautions (See recommendation)
2	Low	<0.7	Air Flow rate <70l/hr; otherwise increase to Situation 3	Block and beam with 2,000g, Cast in situ with 1,200g. All joints and penetrations sealed
3	Moderate	<3.5	-	As above but with gas resistant membranes and passively ventilated or positive pressured sub-floor void

¹⁵ CIRIA 2007. Assessing Risks Posed by Hazardous Ground Gases to Buildings. C665

¹⁶ NHBC 2007. Guidance on Evaluation of Development Proposals on Sites where methane and carbon dioxide are present

¹⁷ NHBC 2016. Technical Extra. Ground Gas Update. April 2016. Issue 20

¹⁸ Building Regulations 2004. Approved Document C, Site Preparation and resistance to contaminants and moisture.

¹⁹ British Standards 2013. Guidance on Investigation for Ground Gas. BS8576. 2013

²⁰ NHBC 2023. Hazardous Ground Gas – an essential guide for housebuilders. NF94

4	Moderate to High	<15	QRA recommended	As above but with oversite capping, in-ground venting layer and in ground wells or barriers
5 – 6	High to Very High	<70		Not suitable unless gas regime is reduced first and QRA completed

Summary of NHBC Traffic Light System

Gas Regime	Methane		Carbon Dioxide	
	Typical max %	Gas Screening Value (U/hr)	Typical max %	Gas Screening Value (U/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+

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 Pipes²¹
- Water UK Contaminated Land Assessment Guidance²²

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.

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

²² Water UK 2014. Contaminated Land Assessment Guidance.

The Agency have published guidance on the classification of Hazardous Waste²³, 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 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 Landfills²⁴. 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 Waste²⁵ was developed to provide clarity on when the reuse of site won materials will cease to be 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 combined²⁶. 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.

²³ Environment Agency. 2013. Interpretation of the Definition and Classification of Hazardous Waste. Technical Guidance WM2

²⁴ Environment Agency. 2010 Waste Acceptance at Landfills. Version 1.

²⁵ CL:AIRE 2001. The Definition of Waste: Development Industry Code of Practice. Version 2.

²⁶ UK Parliament. Building to new zero: costing carbon in construction. First Report of Session 2022-23

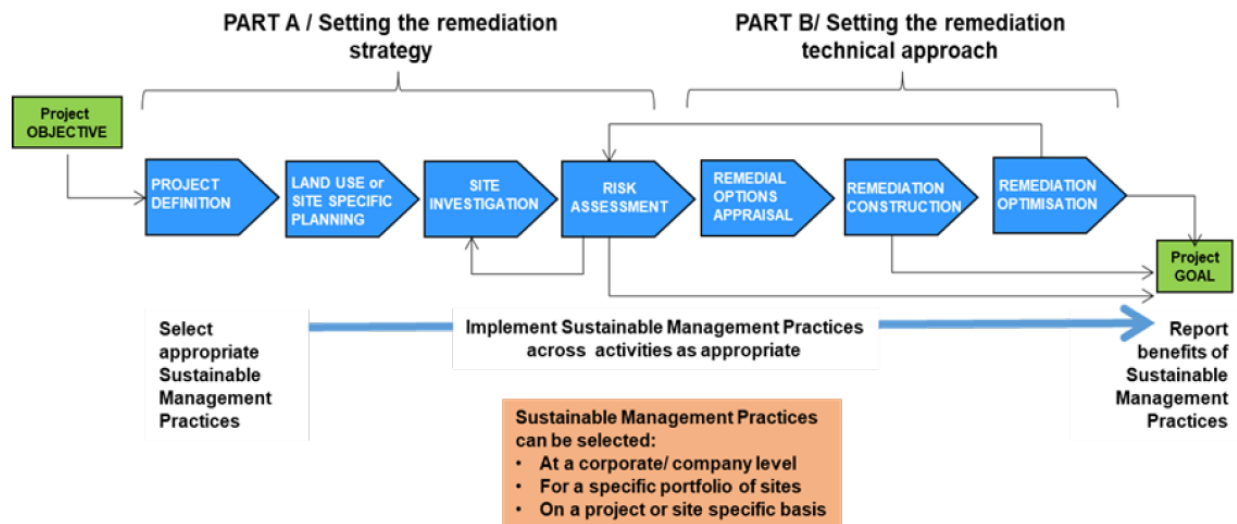


Figure 2.1: Application of sustainable management practices in context of life cycle of land contamination management and SuRF UK Framework

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.

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 desiccation²⁷ is Richard Driscoll's method that significant desiccation has occurred when the moisture content is less than 0.4 x the liquid limit.

²⁷ BRE 1996. Desiccation in clay soils. Digest 412.

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 samples²⁸. 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 BRE412²⁷

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.

SOAKAGE TESTING AND DESIGN

The following guidance has been followed during the soakage testing:

- Falling Head Tests in boreholes – BS5930⁶
- BRE Digest 365 2003 Soakage testing

The CIRIA publication²⁹ provides guidance as to the required distance of buildings from soakages 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

EFFECTS OF TREES AND SHRINKABLE MATERIALS ON FOUNDATION DEPTHS

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

- NHBC Standards 2010 Part 4 Foundations

²⁸ Proceedings of The Institute of Civil Engineers: Geotechnical Engineering. 1995, 113, 25-30

²⁹ CIRIA. 2002. Engineering in Chalk. C574.

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).

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 (1970) (TRRL)

APPENDIX B: SITE PHOTOS

Photo 1 – Intrusive investigation at BH2



Photo 2 – Mature trees at the front of the property



Photo 3 – Area to rear of the property with restricted access



Photo 4 – Mature trees ~5m south of the proposed foundations

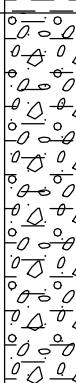


APPENDIX C: [ENVIRONMENTAL DATABASE](#)

APPENDIX D: FIELD LOGS

WDE consulting 62a Western Road Tring, Hertfordshire HP23 4BB Tel. 01442 825570 Fax. 01442 891410				Site 21 Danesbury Park Road, Welwyn		Borehole Number BH1			
Excavation Method Window Sampler		Dimensions		Ground Level (mOD)		Client Mr & Mrs Taylor		Job Number 21286	
		Location		Dates 10/04/2024		Engineer Cameron Burchell		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	DESCRIPTION	Legend	Water	Instr
1.00	D1/C2 160 kPa SPT N=8		1,1/2,2,2,2		0.30	TOPSOIL			
					(2.10)	Soft to firm grey/brown/orange gravelly CLAY. Gravels are fine to coarse, subangular to angular			
2.00	D3/B4 175 kPa SPT N=14		2,2/2,2,2,8		2.40	Medium dense brown/orange clayey sandy fine to coarse, subangular to rounded GRAVEL			
3.00	SPT N=28		5,5/5,7,8,8		(1.60)				
4.00	SPT N=17	3.90	Water Strike at 3.90m 6,5/5,4,4,4		4.00	Complete at 4.00m			
Remarks							Scale (approx) 1:50	Logged By	
							Figure Number 21286.BH1		

WDEconsulting 62a Western Road Tring, Hertfordshire HP23 4BB Tel. 01442 825570 Fax. 01442 891410			Site 21 Danesbury Park Road, Welwyn		Borehole Number BH2				
Excavation Method Window Sampler		Dimensions		Ground Level (mOD)		Client Mr & Mrs Taylor		Job Number 21286	
		Location		Dates 10/04/2024		Engineer Cameron Burchell		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	DESCRIPTION	Legend	Water	Instr
1.00	D1/B2 250 kPa SPT N=10		2,2/2,2,3,3		0.25	TOPSOIL			
					(1.05)	Stiff brown silty gravelly CLAY. Gravels are medium to coarse, rounded to subrounded			
2.00	SPT N=56		7,11/11,14,15,16		1.30	Very dense brown silty sandy fine to coarse, subangular to rounded GRAVEL			
					(0.70)				
					2.00	Refusal on dense gravels at 2.0m Complete at 2.00m			
Remarks Groundwater not encountered							Scale (approx) 1:50	Logged By	
							Figure Number 21286.BH2		

WDE consulting				62a Western Road Tring, Hertfordshire HP23 4BB Tel. 01442 825570 Fax. 01442 891410		Site 21 Danesbury Park Road, Welwyn		Borehole Number BH3	
Excavation Method Window Sampler		Dimensions		Ground Level (mOD)		Client Mr & Mrs Taylor		Job Number 21286	
		Location		Dates 10/04/2024		Engineer Cameron Burchell		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	DESCRIPTION	Legend	Water	Instr
1.00	B1 SPT N=19	4,4/4,5,5,5			(0.40)	TOPSOIL			
					0.40 (0.50)	Firm brown/grey gravelly CLAY. Gravels are fine to coarse, subangular to rounded			
					0.90	Medium dense brown slightly clayey, sandy GRAVEL			
2.00	SPT N=29	6,7/8,7,7,7			(2.50)				
3.00	SPT N=15	3,4/4,4,4,3							
3.40	B2				3.40 (0.60)	White CHALK (grade Dm/Dc) with flint			
4.00					4.00	Refusal of SPT on flint at 4.0m Complete at 4.00m			
Remarks Groundwater not encountered							Scale (approx)	Logged By	
							1:50		

WDEconsulting 62a Western Road Tring, Hertfordshire HP23 4BB Tel. 01442 825570 Fax. 01442 891410		Site 21 Danesbury Park Road, Welwyn		Borehole Number BH4					
Excavation Method Window Sampler		Dimensions		Ground Level (mOD)					
		Location		Dates 10/04/2024					
				Client Mr & Mrs Taylor					
				Engineer Cameron Burchell					
				Job Number 21286					
				Sheet 1/1					
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	DESCRIPTION	Legend	Water	Instr
0.30	J1				(0.70)	MADE GROUND: Red brick, sand fill, gravel, clay, brick fragments, tile fragments			
1.00	B1 SPT N=23	5,5/5,6,6,6			0.70 0.90	Soft brown/grey slightly gravelly CLAY. Gravels are fine to medium, subangular to subrounded			
2.00	SPT N=16	2.00	Water Strike at 2.00m 2,3/4,4,4,4		(2.40)	Medium dense brown clayey sandy coarse, subangular to subrounded GRAVEL. Gravels are flint			
3.00	B2 SPT N=8	1,2/2,2,2,2			3.30 (0.70)	Stiff grey cobbly CLAY. Cobbles are subrounded flint			
4.00	B3 SPT N=13	2,3/3,3,3,4			4.00	Loose to medium dense brown clayey sandy coarse, subangular to subrounded GRAVEL. Gravels are flint			
5.00	SPT N=8	2,2/2,2,2,2			(2.70)				
6.00	SPT N=8	2,2/2,2,2,2			6.70	White CHALK (grade Dm)			
7.00	B4 SPT N=1	0,0/0,0,0,1			(1.30)				
8.00	SPT N=1	0,0/0,0,1,0			8.00	Complete at 8.00m			
Remarks							Scale (approx)	Logged By	
							1:50		
							Figure Number 21286.BH4		

APPENDIX E: FIELD SHEETS

Depth to Water-M (TOC)	3.640
Diameter of well (m)	0.05

[illegible]

Comments:

>10⁻⁴



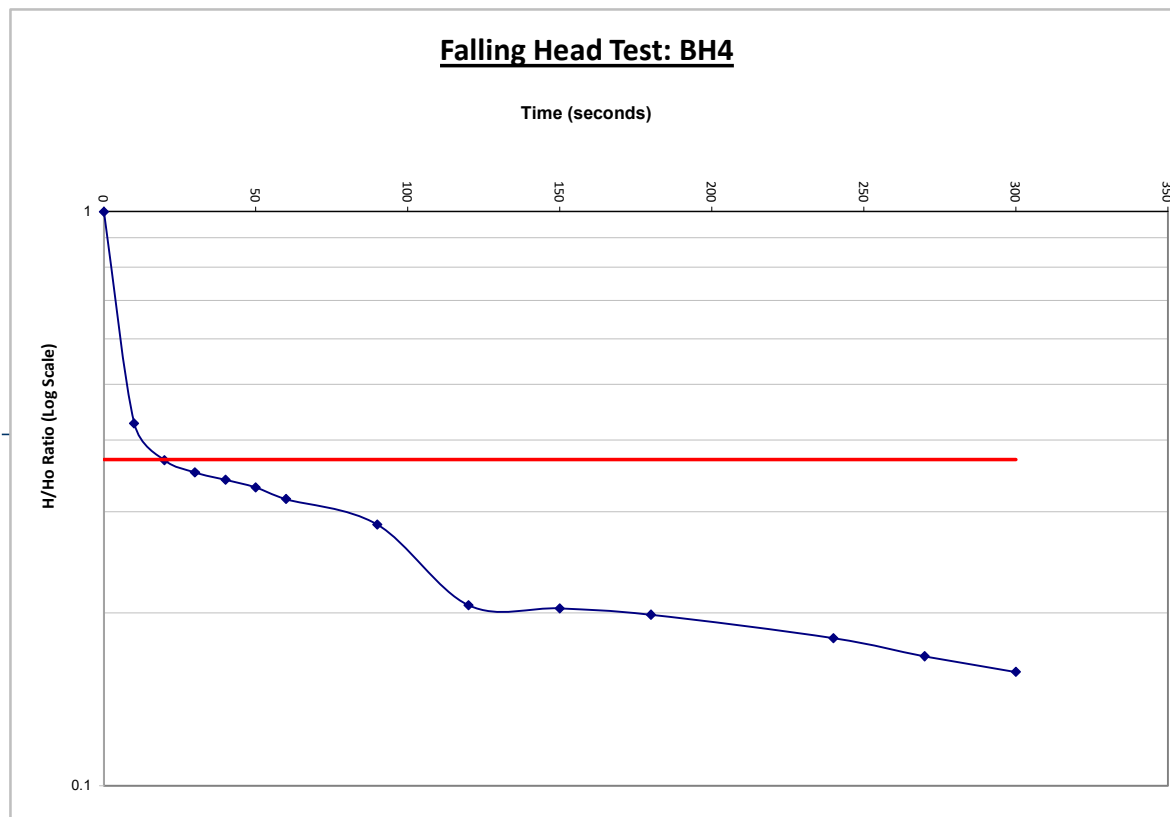
Date of Test	10/05/2024
Completed by	RS
Site Name	Danesbury Park Road, Welwyn
BH Location	BH4
Latitude/Longitude	

Depth to Water-M (TOC)	3.930
Diameter of well (m)	0.05

		Units
Area (A)	0.61701	m ²
F	0.1375	
Head (H ^o)	3.930	m
Time (T)	20	sec
Permeability K	0.224367273	m/sec

Comments:
>10-4

Time (Secs)	DTW	H	H/Ho Ratio
0	0.000	3.93000	1
10	2.250	1.68000	0.427480916
20	2.480	1.45000	0.368956743
30	2.550	1.38000	0.351145038
40	2.590	1.34000	0.340966921
50	2.630	1.30000	0.330788804
60	2.690	1.24000	0.315521628
90	2.810	1.12000	0.284987277
120	3.120	0.81000	0.20610687
150	3.130	0.80000	0.203562341
180	3.150	0.78000	0.198473282
240	3.220	0.71000	0.180661578
270	3.270	0.66000	0.167938931
300	3.310	0.62000	0.157760814



Visit Date: 10/05/2024

Visit Number: 1

Air Temperature: 22 °C

Borehole Number	BH1			BH4		
	0 mins	5 mins	10 mins	0 mins	5 mins	10 mins
Depth to Groundwater (m)	3.64			Dry		
Depth to Base of Borehole (m)	3.90			3.930		
Condition of Standpipe	Good			Good		

APPENDIX F: ANALYTICAL TEST RESULTS

WDE Consulting Ltd
62a Western Road
Tring
Hertfordshire
HP23 4BB

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

Analytical Report Number : 24-014111

Project / Site name: 21 Danesbury Park road, Welwyn

Samples received on: 15/04/2024

Your job number: 21286

**Samples instructed on/
Analysis started on:** 15/04/2024

Your order number: 24 147

Analysis completed by: 22/04/2024

Report Issue Number: 1

Report issued on: 22/04/2024

Samples Analysed: 1 soil sample

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

Excel copies of reports are only valid when accompanied by this PDF certificate.

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: 24-014111

Project / Site name: 21 Danesbury Park road, Welwyn

Your Order No: 24 147

Lab Sample Number	170590			
Sample Reference	BH4 - J1			
Sample Number	None Supplied			
Depth (m)	0.30			
Date Sampled	10/04/2024			
Time Taken	None Supplied			
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	

Stone Content	%	0.1	NONE	< 0.1
Moisture Content	%	0.01	NONE	11
Total mass of sample received	kg	0.1	NONE	1.4

Asbestos

Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	EWS

General Inorganics

pH (L099)	pH Units	N/A	MCERTS	8.1
Total Cyanide	mg/kg	1	MCERTS	< 1.0
Total Sulphate as SO ₄	%	0.005	MCERTS	0.041
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	73
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	36.6
Sulphide	mg/kg	1	MCERTS	< 1.0
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	1.4

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	< 0.80
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Analytical Report Number: 24-014111

Project / Site name: 21 Danesbury Park road, Welwyn

Your Order No: 24 147

Lab Sample Number				170590
Sample Reference				BH4 - J1
Sample Number				None Supplied
Depth (m)				0.30
Date Sampled				10/04/2024
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	12
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.65
Boron (water soluble)	mg/kg	0.2	MCERTS	0.3
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.4
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	17
Copper (aqua regia extractable)	mg/kg	1	MCERTS	9.3
Lead (aqua regia extractable)	mg/kg	1	MCERTS	31
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	13
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	30
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	200

Petroleum Hydrocarbons

TPHCWG - Aliphatic >C5 - C6 HS_1D_AL	mg/kg	0.02	NONE	< 0.020
TPHCWG - Aliphatic >C6 - C8 HS_1D_AL	mg/kg	0.02	NONE	< 0.020
TPHCWG - Aliphatic >C8 - C10 HS_1D_AL	mg/kg	0.05	NONE	< 0.050
TPHCWG - Aliphatic >C10 - C12 EH_CU_1D_AL	mg/kg	1	MCERTS	2.4
TPHCWG - Aliphatic >C12 - C16 EH_CU_1D_AL	mg/kg	2	MCERTS	7.2
TPHCWG - Aliphatic >C16 - C21 EH_CU_1D_AL	mg/kg	8	MCERTS	< 8.0
TPHCWG - Aliphatic >C21 - C35 EH_CU_1D_AL	mg/kg	8	MCERTS	< 8.0
TPHCWG - Aliphatic >C35 - C44 EH_CU_1D_AL	mg/kg	8.4	NONE	< 8.4
TPHCWG - Aliphatic >C5 - C35 EH_CU+HS_1D_AL	mg/kg	10	NONE	< 10
TPHCWG - Aliphatic >C5 - C44 EH_CU+HS_1D_AL	mg/kg	10	NONE	< 10

TPHCWG - Aromatic >EC5 - EC7 HS_1D_AR	mg/kg	0.01	NONE	< 0.010
TPHCWG - Aromatic >EC7 - EC8 HS_1D_AR	mg/kg	0.01	NONE	< 0.010
TPHCWG - Aromatic >EC8 - EC10 HS_1D_AR	mg/kg	0.05	NONE	< 0.050
TPHCWG - Aromatic >EC10 - EC12 EH_CU_1D_AR	mg/kg	1	MCERTS	< 1.0
TPHCWG - Aromatic >EC12 - EC16 EH_CU_1D_AR	mg/kg	2	MCERTS	4.4
TPHCWG - Aromatic >EC16 - EC21 EH_CU_1D_AR	mg/kg	10	MCERTS	< 10
TPHCWG - Aromatic >EC21 - EC35 EH_CU_1D_AR	mg/kg	10	MCERTS	< 10
TPHCWG - Aromatic >EC35 - EC44 EH_CU_1D_AR	mg/kg	8.4	NONE	< 8.4
TPHCWG - Aromatic >EC5 - EC35 EH_CU+HS_1D_AR	mg/kg	10	NONE	< 10
TPHCWG - Aromatic >EC5 - EC44 EH_CU+HS_1D_AR	mg/kg	10	NONE	< 10

VOCs

MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0
Benzene	µg/kg	5	MCERTS	< 5.0
Toluene	µg/kg	5	MCERTS	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0
p & m-Xylene	µg/kg	5	MCERTS	< 5.0
o-Xylene	µg/kg	5	MCERTS	< 5.0

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

Analytical Report Number : 24-014111

Project / Site name: 21 Danesbury Park road, Welwyn

* 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 *
170590	BH4 - J1	None Supplied	0.3	Brown clay and sand with gravel

Analytical Report Number : 24-014111

Project / Site name: 21 Danesbury Park road, Welwyn

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (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	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 EPA-16 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/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	L076B/L088	D/W	MCERTS
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	W	MCERTS

Analytical Report Number : 24-014111

Project / Site name: 21 Danesbury Park road, Welwyn

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement	In-house method	L099	D	MCERTS

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.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

Below GAC Exceedence

	No. of Samples	Unit	Target Concentration Residential with hgp	Source	Min	Max	No. That Exceed
Moisture Content	1	%	-				
Adhesives	1	%	N/A	DL			
Asbestos Quantification	1	%	0.001	PSE	0	BDL	0
pH	1	pH Units	-	-	8.1	8.1	0
Total Cyanide	1	mg/kg	50	DLV	0	BDL	0
Sulphate Total	1	g/l	-	-	0.041	0.041	-
Sulphate as SO ₄	1	g/l	-	-	0.0366	-	-
Sulphide	1	mg/kg	-	-	0	BDL	-
Total Organic Carbon (TOC)	1	%	-	-	1.4	1.4	-
Total Phenols (monohydric)	1	mg/kg	280	LQM	0	BDL	0
Naphthalene	1	mg/kg	2.3	LQM	0	BDL	0
Acenaphthylene	1	mg/kg	170	LQM	0	BDL	0
Acenaphthene	1	mg/kg	210	LQM	0	BDL	0
Fluorene	1	mg/kg	170	LQM	0	BDL	0
Phenanthrene	1	mg/kg	95	LQM	0	BDL	0
Anthracene	1	mg/kg	2400	LQM	0	BDL	0
Fluoranthene	1	mg/kg	280	LQM	0	BDL	0
Pyrene	1	mg/kg	620	LQM	0	BDL	0
Benzo(a)anthracene	1	mg/kg	7.2	LQM	0	BDL	0
Chrysene	1	mg/kg	15	LQM	0	BDL	0
Benzo(b)fluoranthene	1	mg/kg	2.6	LQM	0	BDL	0
Benzo(k)fluoranthene	1	mg/kg	77	LQM	0	BDL	0
Benzo(g)pyrene	1	mg/kg	2.2	LQM	0	BDL	0
Indeno(1,2,3-cd)pyrene	1	mg/kg	27	LQM	0	BDL	0
Dibenz(a,h)anthracene	1	mg/kg	0.24	LQM	0	BDL	0
Benzo(ghi)perylene	1	mg/kg	320	LQM	0	BDL	0
Total EPA-16 PAHs	1	mg/kg	-	-	0	BDL	0
Arsenic (dissolved)	1	mg/kg	37	LQM	12	12	0
Beryllium	1	mg/kg	1.7	LQM	0.65	0.65	0
Boron (dissolved)	1	mg/kg	290	LQM	0.3	0.3	0
Cadmium (dissolved)	1	mg/kg	11	LQM	0.4	0.4	0
Chromium (dissolved)	1	mg/kg	910	LQM	17	17	0
Copper (dissolved)	1	mg/kg	2400	LQM	9.3	9.3	0
Lead (dissolved)	1	mg/kg	210	C&S	31	31	0
Mercury (dissolved)	1	mg/kg	49	LQM	0	BDL	0
Nickel (dissolved)	1	mg/kg	180	LQM	13	13	0
Selenium (dissolved)	1	mg/kg	250	LQM	0	BDL	0
Vanadium	1	mg/kg	410	LQM	20	30	0
Zinc (dissolved)	1	mg/kg	3700	LQM	200	200	0
Benzene	1	mg/kg	0.087	LQM	0	BDL	0
Toluene	1	mg/kg	130	LQM	0	BDL	0
Ethylbenzene	1	mg/kg	47	LQM	0	BDL	0
Xylenes (o)	1	mg/kg	60	LQM	0	BDL	0
Xylenes (m,p)	1	mg/kg	56	LQM	0	BDL	0
MTBE (Methyl Tertiary Butyl Ether)	1	mg/kg	49	CLAIRE			
Total Petroleum Hydrocarbons	1	mg/kg	-	-	14	14	0
TPH-CWG - Aliphatic <C5 - C8	1	mg/kg	42	LQM	0	BDL	0
TPH-CWG - Aliphatic >C8 - C10	1	mg/kg	100	LQM	0	BDL	0
TPH-CWG - Aliphatic >C10 - C12	1	mg/kg	27	LQM	0	BDL	0
TPH-CWG - Aliphatic >C12 - C16	1	mg/kg	130	LQM	2.4	2.4	0
TPH-CWG - Aliphatic >C16 - C21	1	mg/kg	1100	LQM	7.2	7.2	0
TPH-CWG - Aliphatic >C21 - C35	1	mg/kg	65000	LQM	0	BDL	0
TPH-CWG - Aliphatic >C35 - C44	1	mg/kg	65000	LQM	0	BDL	0
Total Aliphatic Hydrocarbons	1	mg/kg	-	-	0	BDL	0
TPH-CWG - Aromatic >C5 - C7	1	mg/kg	70	LQM	0	BDL	0
TPH-CWG - Aromatic >C7 - C8	1	mg/kg	130	LQM	0	BDL	0
TPH-CWG - Aromatic >C8 - C10	1	mg/kg	34	LQM	0	BDL	0
TPH-CWG - Aromatic >C10 - C12	1	mg/kg	74	LQM	0	BDL	0
TPH-CWG - Aromatic >C12 - C16	1	mg/kg	140	LQM	4.4	4.4	0
TPH-CWG - Aromatic >C16 - C21	1	mg/kg	260	LQM	0	BDL	0
TPH-CWG - Aromatic >C21 - C35	1	mg/kg	1100	LQM	0	BDL	0
TPH-CWG - Aromatic >C35 - C44	1	mg/kg	1100	LQM	0	BDL	0
Total Aromatic Hydrocarbons	1	mg/kg	-	-	0	BDL	0

Below GAC Exceedence

APPENDIX G: GEOTECHNICAL TEST RESULTS and SHEETS



LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

Job No. 35156

Borehole/Pit No. BH1

Site Name 21 Danesbury Park Road, Welwyn

Sample No. -

Project No. 21286/PO 24-146 Client WDE Consulting

Depth Top m 1.00

Soil Description Orangish brown slightly sandy silty CLAY with rare fine gravel

Depth Base m -

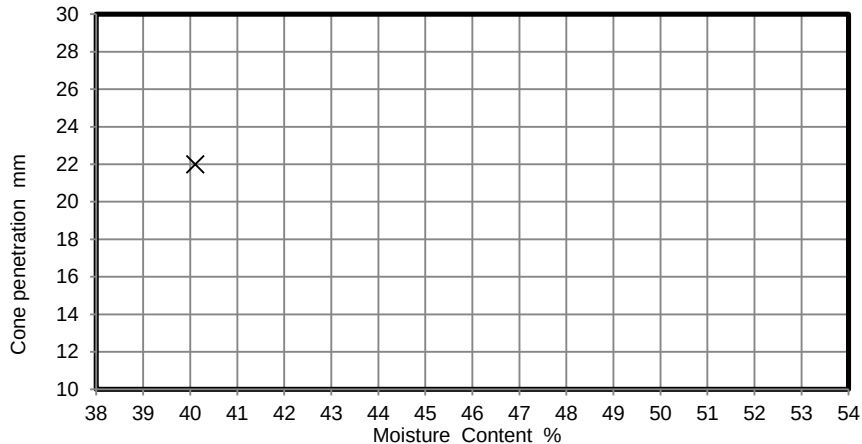
Sample Type D

Samples received 15/04/2024

Schedules received 12/04/2024

Project Started 16/04/2024

Date Tested 24/04/2024



NATURAL MOISTURE CONTENT

19

%

% PASSING 425µm SIEVE

99

%

LIQUID LIMIT

39

%

PLASTIC LIMIT

16

%

PLASTICITY INDEX

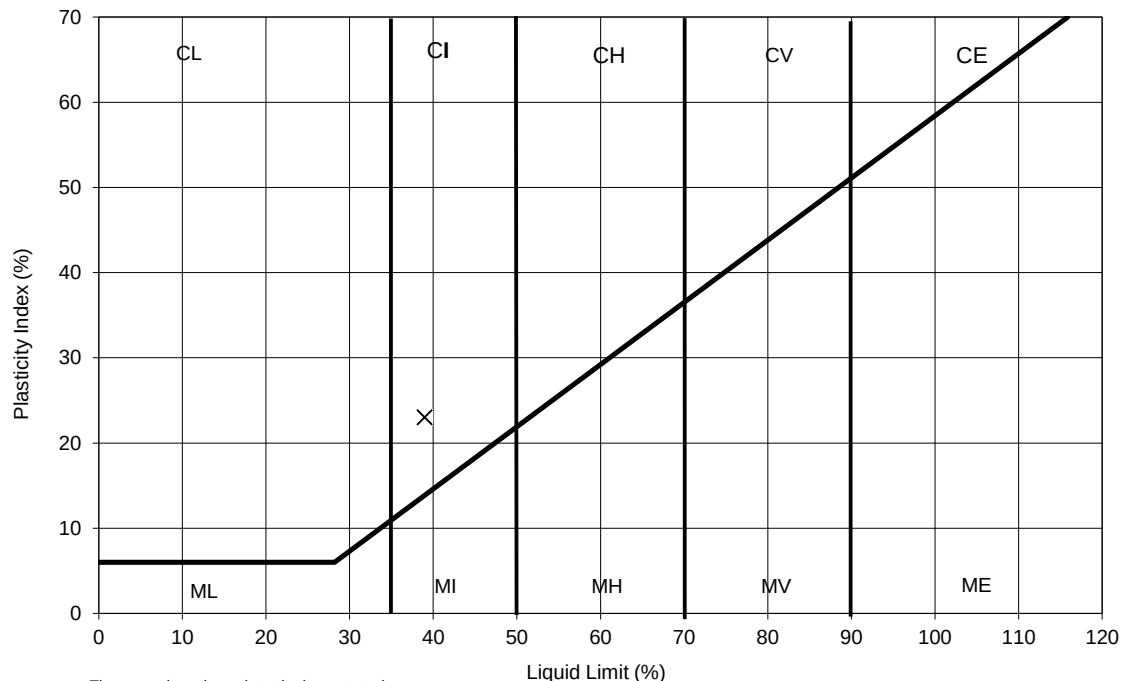
23

%

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

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method

BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index

BS1377: Part 2 :Clause 3.2 : 1990:Determination of the moisture content by the oven drying

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: 30/04/2024

2519

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

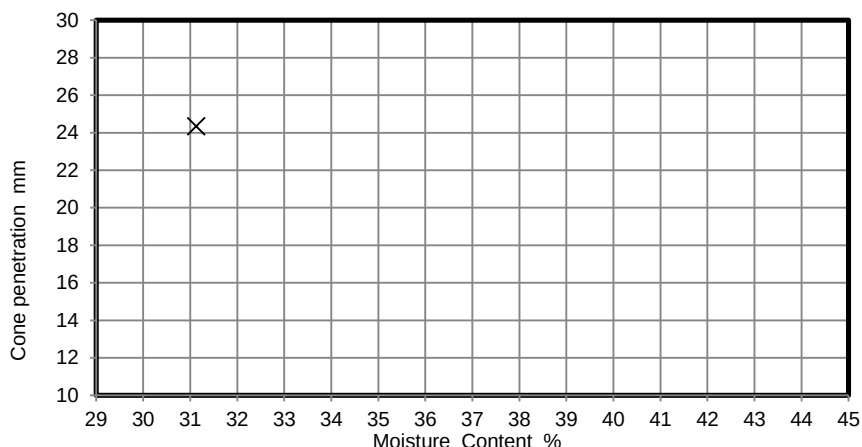
MSF-5 R2





LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

	LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX			Job No.	35156
				Borehole/Pit No.	BH1
Site Name	21 Danesbury Park Road, Welwyn			Sample No.	-
Project No.	21286/PO 24-146	Client	WDE Consulting	Depth Top m	2.00
Soil Description	Orangish brown slightly sandy slightly gravelly silty CLAY (gravel is fm and sub-angular to rounded)			Depth Base m	-
				Sample Type	D
				Samples received	15/04/2024
				Schedules received	12/04/2024
				Project Started	16/04/2024
				Date Tested	24/04/2024

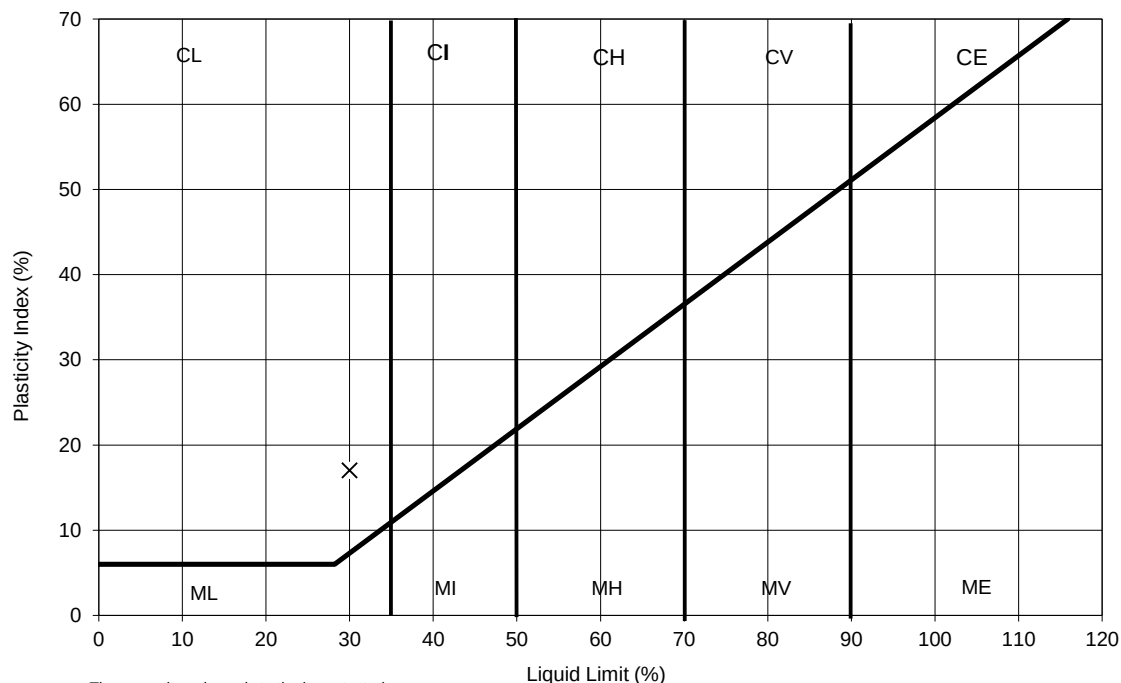


NATURAL MOISTURE CONTENT	17	%
% PASSING 425µm SIEVE	96	%
LIQUID LIMIT	30	%
PLASTIC LIMIT	13	%
PLASTICITY INDEX	17	%

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

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method

BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index

BS1377: Part 2 :Clause 3.2 : 1990:Determination of the moisture content by the oven drying

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

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

2519

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

Checked and Approved

Initials: J.P

Date: 30/04/2024

MSF-5 R2



LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

Job No. 35156

Borehole/Pit No. BH2

Site Name 21 Danesbury Park Road, Welwyn

Sample No. -

Project No. 21286/PO 24-146 Client WDE Consulting

Depth Top m 1.00

Soil Description Brown slightly sandy slightly gravelly silty CLAY with occasional roots (gravel is fm and sub-angular to rounded)

Depth Base m -

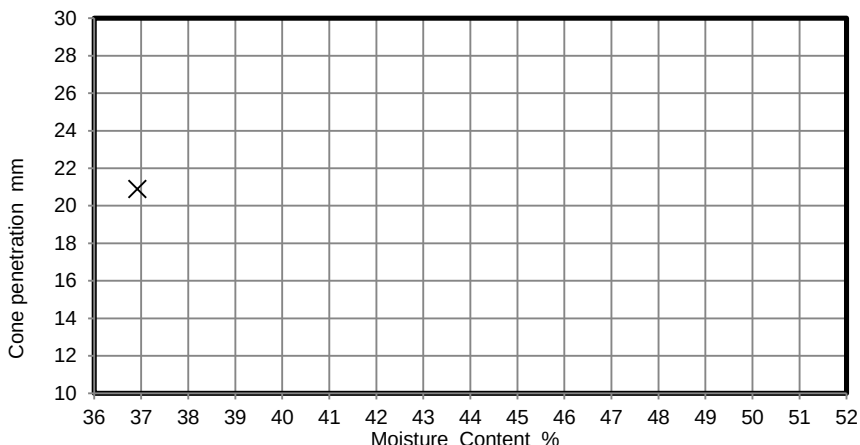
Sample Type D

Samples received 15/04/2024

Schedules received 12/04/2024

Project Started 16/04/2024

Date Tested 24/04/2024



NATURAL MOISTURE CONTENT

19 %

% PASSING 425µm SIEVE

97 %

LIQUID LIMIT

36 %

PLASTIC LIMIT

17 %

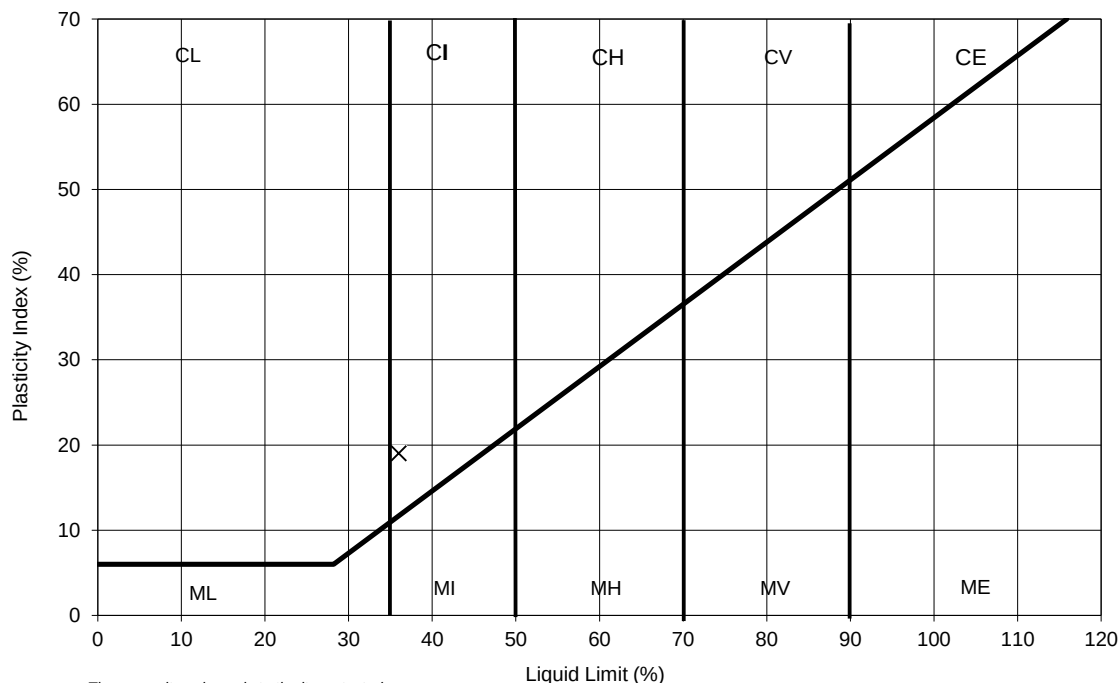
PLASTICITY INDEX

19 %

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

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method

BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index

BS1377: Part 2 :Clause 3.2 : 1990:Determination of the moisture content by the oven drying

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: 30/04/2024

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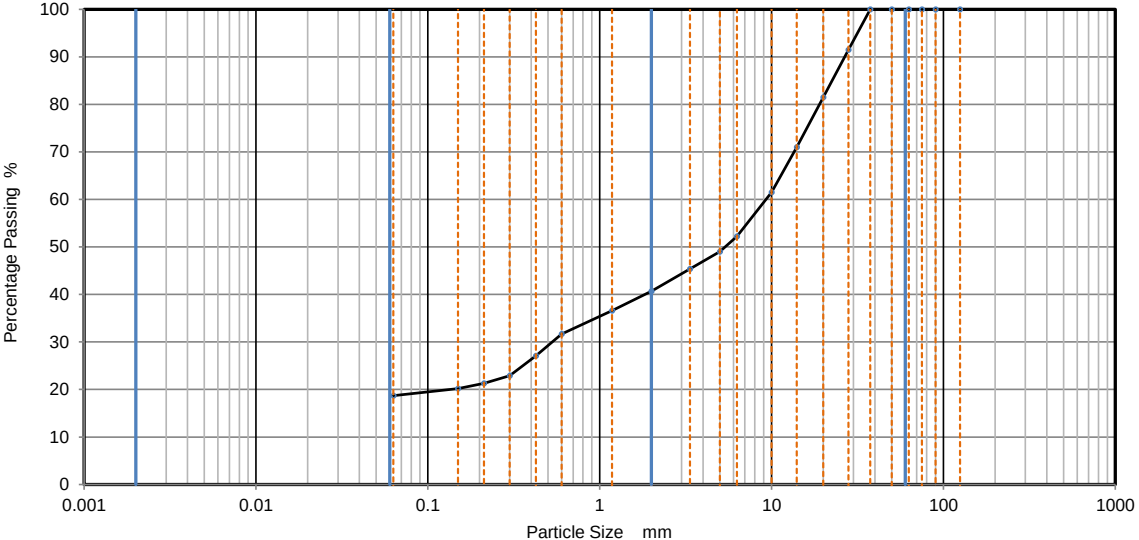
Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

MSF-5 R2

					Summary of Natural Moisture Content, Liquid Limit and Plastic Limit Results							
Job No. 35156					Project Name 21 Danesbury Park Road, Welwyn					Programme		
										Samples received	15/04/2024	
										Schedule received	12/04/2024	
Project No. 21286/PO 24-146					Client WDE Consulting					Project started	16/04/2024	
										Testing Started	24/04/2024	
Hole No.	Sample				Soil Description	NMC %	Passing 425µm %	LL %	PL %	PI %	Remarks	
	Ref	Top m	Base m	Type								
BH1	-	1.00	-	D	Orangish brown slightly sandy silty CLAY with rare fine gravel	19	99	39	16	23		
BH1	-	2.00	-	D	Orangish brown slightly sandy slightly gravelly silty CLAY (gravel is fm and sub-angular to rounded)	17	96	30	13	17		
BH2	-	1.00	-	D	Brown slightly sandy slightly gravelly silty CLAY with occasional roots (gravel is fm and sub-angular to rounded)	19	97	36	17	19		
					Test Methods: BS1377: Part 2: 1990: Natural Moisture Content : clause 3.2 Atterberg Limits: clause 4.3 and 5.0 <i>These results only apply to the items tested</i>					Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU		Checked and Approved Initials J.P
NOTE: The report shall not be reproduced except in full without authority of the laboratory					E T							
Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)										MSF-5-R1(b)		

	PARTICLE SIZE DISTRIBUTION			Job Ref	35156
				Borehole/Pit No.	BH1
Site Name	21 Danesbury Park Road, Welwyn			Sample No.	-
Project No.	21286/PO 24-146	Client	WDE Consulting	Depth Top	2.00 m
Soil Description	Brown silty clayey very sandy GRAVEL (gravel is fmc and angular to rounded)			Depth Base	3.00 m
				Sample Type	B
				Samples received	15/04/2024
				Schedules received	12/04/2024
Test Method	BS1377:Part 2: 1990, clause 9.0			Project started	16/04/2024
These results only apply to the items tested				Date tested	24/04/2024

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	92		
20	82		
14	71		
10	62		
6.3	52		
5	49		
3.35	45		
2	41		
1.18	37		
0.6	32		
0.425	27		
0.3	23		
0.212	21		
0.15	20		
0.063	19		

Sample Proportions		% dry mass
Very coarse		0.00
Gravel		59.26
Sand		22.01
Fines <0.063mm		18.73

Grading Analysis		
D100	mm	
D60	mm	9.27
D30	mm	0.528
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

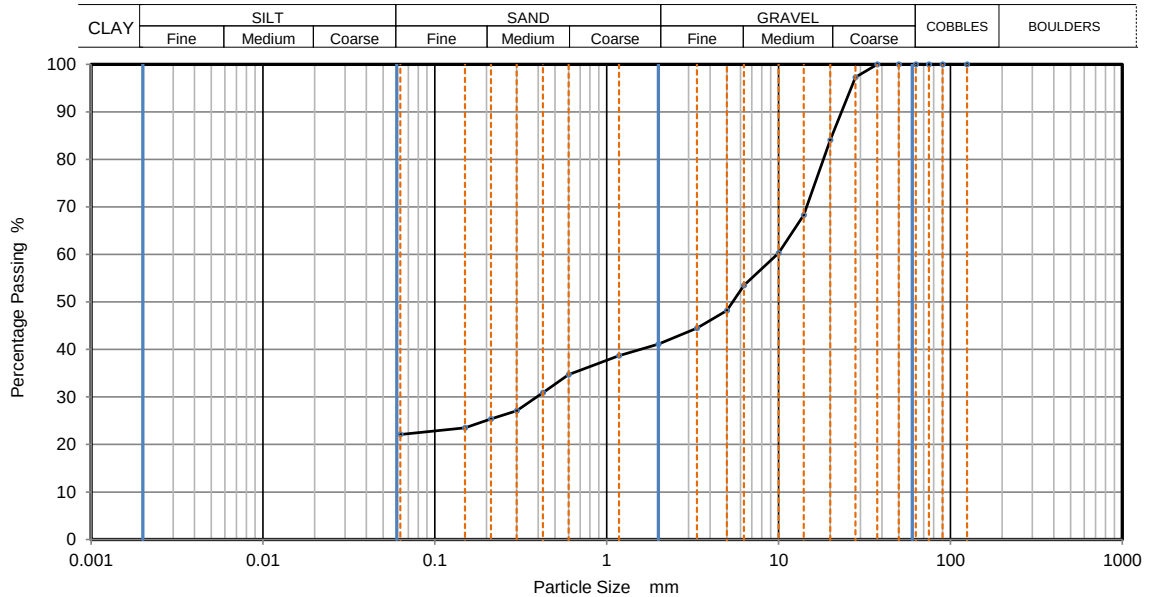
Remarks
Preparation and testing in accordance with BS1377 unless noted below

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	K4 Soils Laboratory Unit 8, Olds Close, Watford, Herts, WD18 9RU 		Checked and Approved Initials: J.P Date: 30/04/2024
	2519 Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)		MSF-5-R3

	PARTICLE SIZE DISTRIBUTION			Job Ref	35156
				Borehole/Pit No.	BH2
Site Name	21 Danesbury Park Road, Welwyn			Sample No.	-
Project No.	21286/PO 24-146	Client	WDE Consulting	Depth Top	1.00 m
Soil Description	Orangish brown silty clayey sandy GRAVEL (gravel is fmc and angular to rounded)			Depth Base	2.00 m
				Sample Type	B
				Samples received	15/04/2024
				Schedules received	12/04/2024
Test Method	BS1377:Part 2: 1990, clause 9.0			Project started	16/04/2024
				Date tested	24/04/2024

These results only apply to the items tested



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	97		
20	84		
14	68		
10	60		
6.3	54		
5	48		
3.35	45		
2	41		
1.18	39		
0.6	35		
0.425	31		
0.3	27		
0.212	25		
0.15	24		
0.063	22		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	58.89
Sand	18.99
Fines <0.063mm	22.12

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

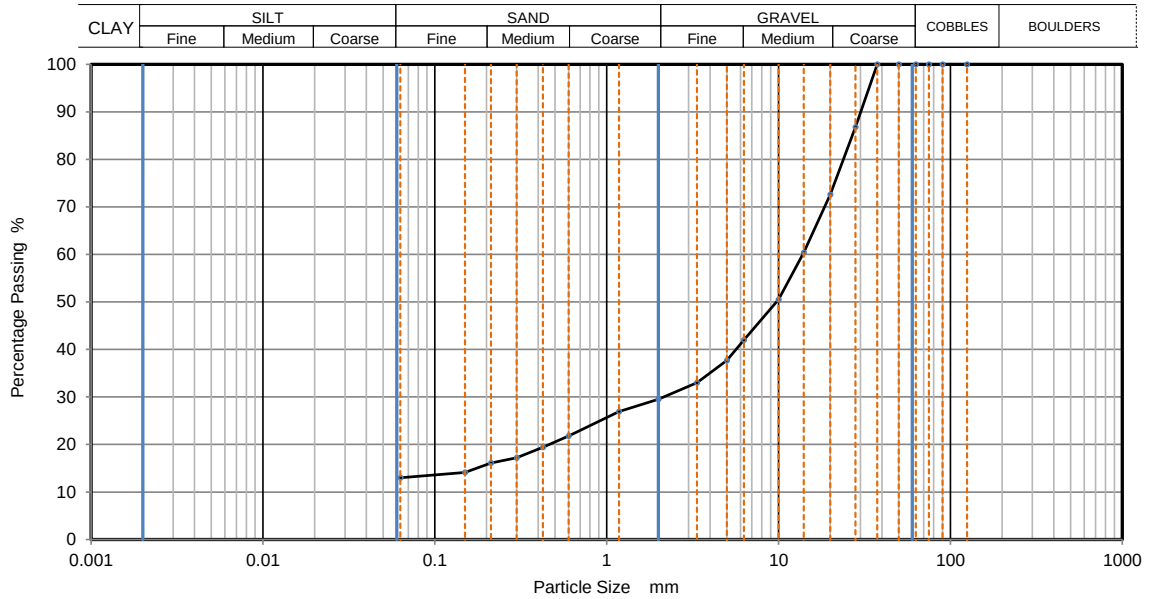
Remarks
Preparation and testing in accordance with BS1377 unless noted below

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	K4 Soils Laboratory	Checked and Approved
	Unit 8, O [REDACTED]	Date: 30/04/2024
2519	Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)	MSF-5-R3

	PARTICLE SIZE DISTRIBUTION			Job Ref	35156
				Borehole/Pit No.	BH4
Site Name	21 Danesbury Park Road, Welwyn			Sample No.	-
Project No.	21286/PO 24-146	Client	WDE Consulting	Depth Top	1.00 m
Soil Description	Orangish brown silty clayey sandy GRAVEL (gravel is fmc and angular to rounded)			Depth Base	2.00 m
				Sample Type	B
				Samples received	15/04/2024
				Schedules received	12/04/2024
Test Method	BS1377:Part 2: 1990, clause 9.0			Project started	16/04/2024
				Date tested	24/04/2024

These results only apply to the items tested



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	87		
20	73		
14	60		
10	51		
6.3	42		
5	38		
3.35	33		
2	30		
1.18	27		
0.6	22		
0.425	19		
0.3	17		
0.212	16		
0.15	14		
0.063	13		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	70.46
Sand	16.52
Fines <0.063mm	13.02

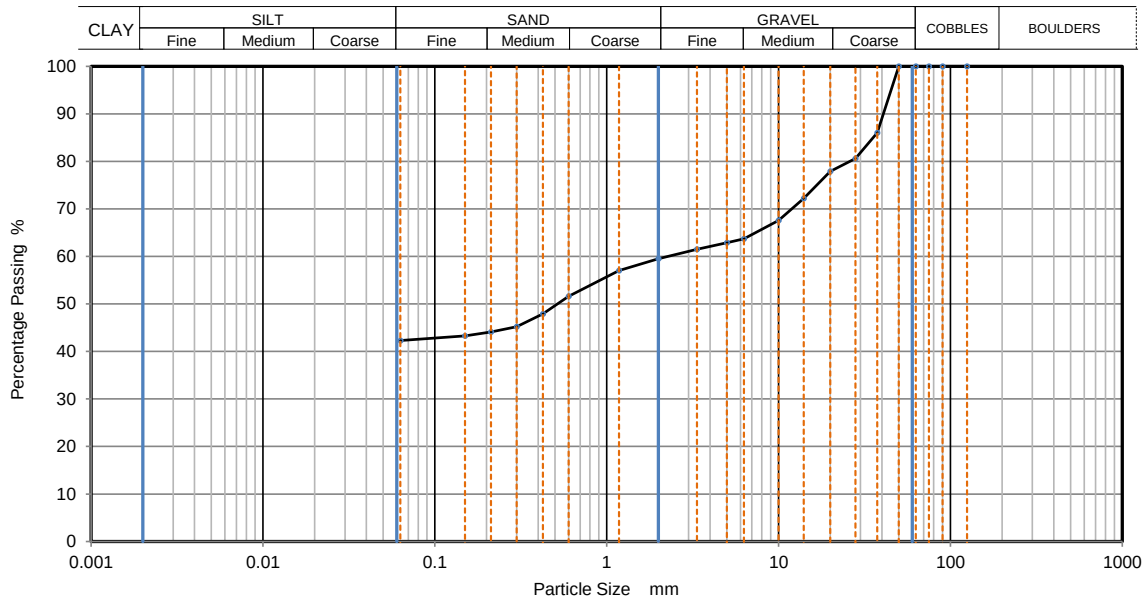
Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks
Preparation and testing in accordance with BS1377 unless noted below

	K4 Soils Laboratory		Checked and Approved
	Unit 8, Olds Close, Watford, Herts, WD18 9RU		Initials: J.P
			Date: 30/04/2024
2519	Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)		MSF-5-R3

	PARTICLE SIZE DISTRIBUTION			Job Ref	35156
				Borehole/Pit No.	BH4
Site Name	21 Danesbury Park Road, Welwyn			Sample No.	-
Project No.	21286/PO 24-146	Client	WDE Consulting	Depth Top	3.00 m
Soil Description	Orangish brown slightly sandy gravelly silty CLAY (gravel is fmc and angular to rounded)			Depth Base	4.00 m
				Sample Type	B
				Samples received	15/04/2024
				Schedules received	12/04/2024
Test Method	BS1377:Part 2: 1990, clause 9.0			Project started	16/04/2024
				Date tested	24/04/2024

These results only apply to the items tested



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	86		
28	81		
20	78		
14	72		
10	68		
6.3	64		
5	63		
3.35	62		
2	60		
1.18	57		
0.6	52		
0.425	48		
0.3	45		
0.212	44		
0.15	43		
0.063	42		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	40.54
Sand	17.11
Fines <0.063mm	42.34

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

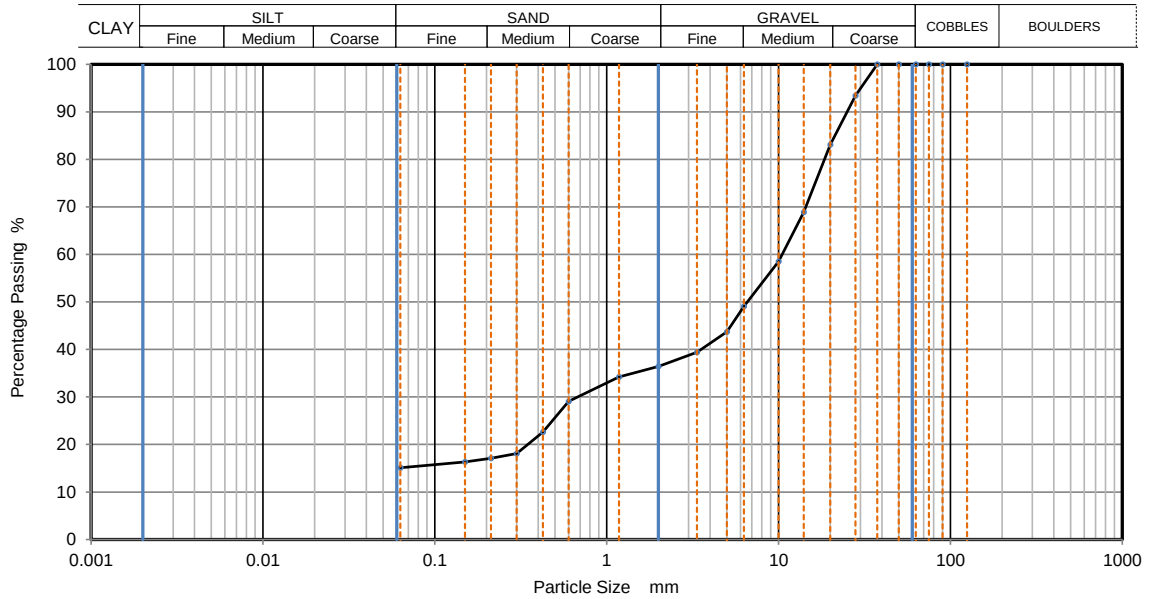
Remarks
Preparation and testing in accordance with BS1377 unless noted below

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	K4 Soils Laboratory		Checked and Approved
	Unit 8, O [REDACTED]		Date: 30/04/2024
2519	Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)		MSF-5-R3

	PARTICLE SIZE DISTRIBUTION		Job Ref	35156	
			Borehole/Pit No.	BH4	
Site Name	21 Danesbury Park Road, Welwyn		Sample No.	-	
Project No.	21286/PO 24-146	Client	WDE Consulting	Depth Top	4.00 m
Soil Description	Orangish brown silty clayey very sandy GRAVEL (gravel is fmc and angular to rounded)		Depth Base	5.00 m	
			Sample Type	B	
			Samples received	15/04/2024	
			Schedules received	12/04/2024	
Test Method	BS1377:Part 2: 1990, clause 9.0		Project started	16/04/2024	
			Date tested	24/04/2024	

These results only apply to the items tested



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	93		
20	83		
14	69		
10	59		
6.3	49		
5	44		
3.35	39		
2	36		
1.18	34		
0.6	29		
0.425	23		
0.3	18		
0.212	17		
0.15	16		
0.063	15		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	63.61
Sand	21.31
Fines <0.063mm	15.08

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks
Preparation and testing in accordance with BS1377 unless noted below

	K4 Soils Laboratory		Checked and Approved
	Unit 8, Olds Close, Watford, Herts, WD18 9RU		Initials: J.P
			Date: 30/04/2024
2519	Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)		MSF-5-R3

					Saturation Moisture Content - Summary of Results Tested in accordance with BS1377 : Part 2 : 1990, clause 3.3 unless annotated otherwise.						
Job No.		Project Name 21 Danesbury Park Road, Welwyn				Programme					
35156						Samples received	15/04/2024				
						Schedule received	12/04/2024				
Project No.		Client WDE Consulting				Project started					
21286/PO 24-146						16/04/2024					
						Testing Started					
						23/04/2024					
Hole No.	Sample				Description	SMC %	NMC %	Bulk Density Mg/m3	Dry Density Mg/m3	Remarks - Sample size complies with BS1377:1990: Part 2 (Yes/No)	
	Ref	Top m	Base m	Type							
BH3	-	3.40	4.00	B	Off white putty CHALK	-	33	-	-	Sample unsuitable	
BH4	-	7.00	8.00	B	Off white putty CHALK with rare fm sub-rounded gravel and rare fm intact chalk fragments	38	37	1.83	1.33	No	
		Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU 								Checked and Approved Initials J.P Date: 30/04/2024	
		<i>These results only apply to the items tested. The report shall not be reproduced except in full without authority of the laboratory</i>									
		Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)								MSF-5-R18	
2519											

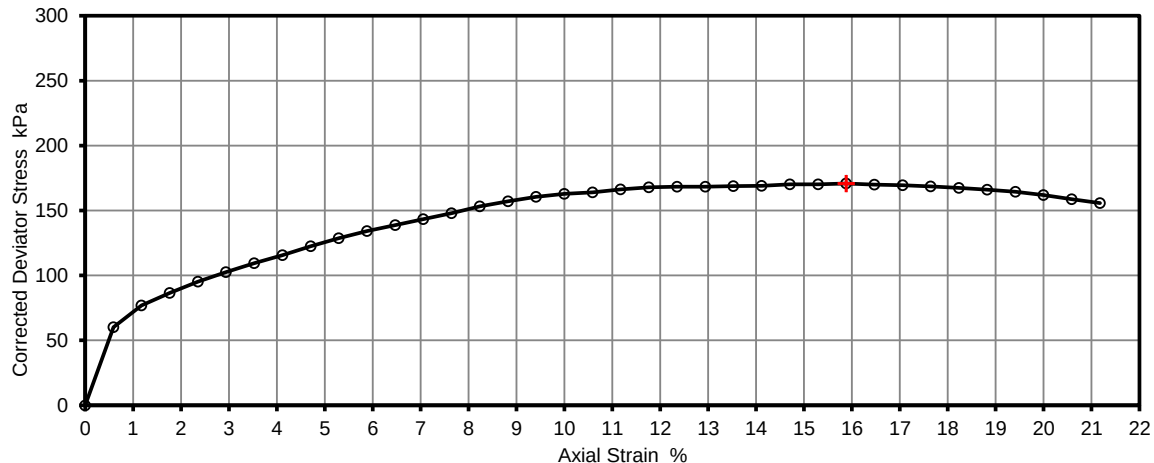
	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen			Job Ref	35156	
				Borehole/Pit No.	BH1	
Site Name	21 Danesbury Park Road, Welwyn			Sample No.	-	
Project No.	21286/PO 24-146	Client	WDE Consulting	Depth Top	1.00	m
Soil Description	High strength orangish brown slightly fine sandy silty CLAY with occasional fm mudstone fragments and occasional black flecks			Depth Base	2.00	m
				Sample Type	C	
				Samples received	15/04/2024	
				Schedules received	12/04/2024	
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	25/04/2024	

Remarks

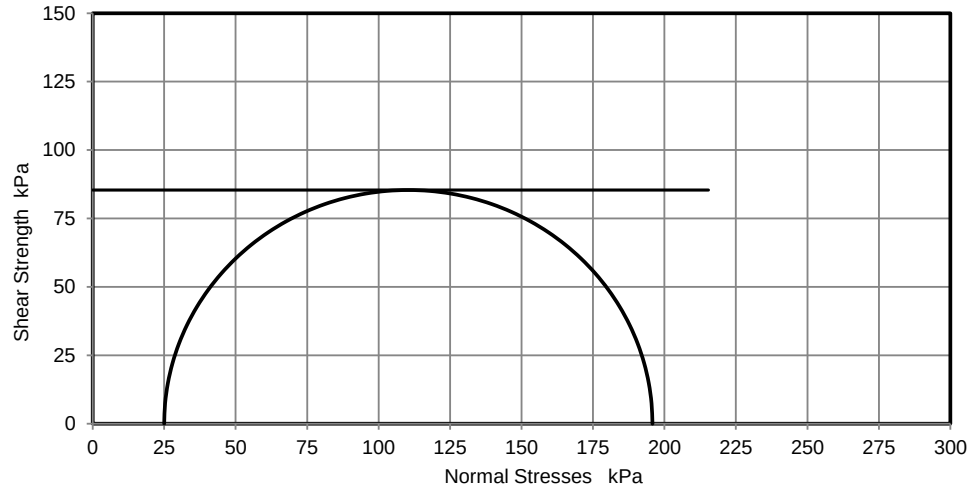
Position within sample

Test Number	1
Length	170.0 mm
Diameter	85.0 mm
Bulk Density	1.95 Mg/m3
Moisture Content	21 %
Dry Density	1.61 Mg/m3
Rate of Strain	2.0 %/min
Cell Pressure	25 kPa
Axial Strain	16 %
Deviator Stress, ($\sigma_1 - \sigma_3$)f	171 kPa
Undrained Shear Strength, cu	85 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.



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

Checked and Approved

Initials: J.P

Date 30/04/2024

Unconsolidated Undrained Triaxial Compression tests without measurement of pore pressure

Summary of Results

Tests carried out in accordance with BS1377:Part 7 : 1990 clause 8 or 9 as appropriate to test

Job No.	Project Name	Programme	
35156	21 Danesbury Park Road, Welwyn	Samples received	15/04/2024
		Schedule received	12/04/2024
Project No.	Client	Project started	16/04/2024
21286/PO 24-146	WDE Consulting	Testing Started	25/04/2024

[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
				3)	C - Compound

Potential Desiccation using Driscoll Method

BH	Depth (m)	Moisture Content	% Passing 425um Sieve	Liquid Limit (LL)	Modified LL	0.4 * LL
1	1	19	99	39	38.61	15.44
1	2	17	96	30	28.8	11.52
2	1	19	97	36	34.92	13.97

Potentially desiccated

21286

Borehole Transect: 21 Danesbury Park Road, Welwyn

