



Resource & Environmental Consultants Ltd

PHASE I & PHASE II GEO-ENVIRONMENTAL SITE INVESTIGATION

**Land Adjacent to Dilworth Lane
Longridge
Preston**

**REC Report:43926
Issued: March 2011**

Prepared for:

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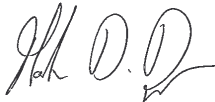
Doc. Ref – QR2-1Issued – December 2010 By – A Edgar



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QUALITY ASSURANCE

Issue/revision	Issue 1	Revision 2	Revision 3
Remarks	Interim		
Date	March 2011		
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Authorised by	A. Edgar		
Signature			
Project number	43926		

EXECUTIVE SUMMARY

Desk Study

A review of historical mapping, dating back to the mid 1893 suggests that the site has remained predominantly Greenfield to the present day. The area adjacent to the western site boundary was developed in the 1970s for residential end use comprising low rise housing units.

Historically the village of Longridge was surrounded by numerous quarries, which excavated the Pendle Grit Formation (sandstone). All of the mapped quarries are marked as disused on the latest map editions.

Exploratory Investigation

Five window sample probeholes were drilled over the duration of a full day to provide geotechnical information and confirm the findings of the Initial Conceptual Site Model (ICSM). All window sample probeholes were completed with gas and groundwater monitoring installations and in-situ geotechnical testing was completed within all exploratory hole locations to obtain geotechnical design parameters.

Trial Pits were excavated to retrieve environmental and geotechnical samples, the trial pits were spatially distributed to offer the maximum site coverage.

Ground Conditions

Ground conditions comprise Top Soil (virgin & re-worked) overlying stiff, high strength sandy, gravelly clay at a very shallow depth (circa 0.30m bgl). No evidence of any visual or olfactory signs of potential contamination have been observed to date.

Top Soil was encountered within every exploratory location and ranged in thickness from 0.20m to a maximum thickness of 0.65m in TP108. The Top Soil was observed to be homogeneous across the site and comprised clayey slightly gravelly fine to medium sand. Gravel fragments encountered were exclusively sandstone and mudstone.

A small channel / depression is located in the centre of the site with a watercourse flowing through the centre of the site with deposits of sand and gravel on either side.

Contaminated Land

The Tier 1 contaminated land risk assessment for a proposed residential end use (most sensitive receptor) determined that there is no unacceptable level of risk to human health, controlled waters, or the wider environ. It is therefore considered that the site is suitable for use within the context of a residential (or commercial) development with no requirement for any future investigation or remedial works.

Ground Gas Assessment

During the monitoring visits completed to date, no significantly elevated concentrations of methane were recorded within any of the probeholes. Peak carbon dioxide measurements (up to 2.9% v/v) were recorded in WS101 though this was also associated with undetectable flow rates of <0.1litres/hr.

In accordance with the methodology outlined with the CIRIA publication C665, and the NHBC guidelines, REC has utilised the results of the ground gas monitoring surveys to calculate a tentative Gas Screening Value (GSV). The maximum GSV calculated for methane was 0.0098l/hr (WS105) and for carbon dioxide was -0.0608l/hr (WS101).

The site is located within an area where less than 1% of homes are above the action level and therefore any new dwellings or extensions do not require Radon protection measures.

CIRIA C665 states that for Characteristic Situation 1, the maximum GSV for carbon dioxide and methane is <0.07l/hr. The GSVs for this site fall beneath this bracket and therefore can be considered Characteristic Situation 1.

Conceptual Site Model

The developed Conceptual Site Model (CSM) has not identified any potentially significant pollutant linkages based on a residential redevelopment of the site. It is therefore considered that the site is suitable for use without the requirement for any remedial works.

Geotechnical

The proposed residential dwellings could be founded on the underlying firm to stiff clay at a shallow depth using a conventional strip foundation.

Based on the SPT results, bearing capacities in excess of 100 kN/m² can be expected at depths of circa 1.00m bgl, however, due to the nature of the superficial drift deposits (cohesive and granular) the potential for differential settlement needs to be considered within the foundation design especially within the central area of the site where a depression is located.

The underlying clay would not provide the necessary level of effective porosity for the use of soak-away drainage.

Based upon the results of the chemical analyses summarised in Table 8.4 it is considered that subsurface concrete can be designed in accordance with Design Sulphate Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with the recommendations provided in BRE Special Digest 1 (2005).

TABLE OF CONTENTS

QUALITY ASSURANCE	I
EXECUTIVE SUMMARY	1
TABLE OF CONTENTS	3
1.0 INTRODUCTION	5
1.1 Background	5
1.2 Proposed Development	5
1.3 Objectives	5
1.4 Sources of Information	5
1.5 Limitations	6
1.6 Confidentiality	6
2.0 SITE SETTING	7
2.1 Site Description	7
2.2 Current Site Use	7
2.3 Surrounding Area	8
3.0 SITE HISTORY	9
3.1 Historical Development	9
4.0 ENVIRONMENTAL SETTING	11
4.1 Geology & Hydrogeology	11
4.2 Geotechnical Data	12
4.3 Hydrology	12
4.4 Radon Risk Potential	12
4.5 Industrial Land Uses	12
4.6 Sensitive Land Uses	12
4.7 Environmental Sensitivity	12
5.0 CONSULTATIONS	14
5.1 Local Authority Contaminated Land Officer	14
5.2 Local Authority Building Control Officer	14
5.3 Landfill Sites and Waste Treatment Sites	14
5.4 Regulatory Database	14
6.0 INITIAL CONCEPTUAL SITE MODEL (CSM)	15
6.1 Initial CSM	15
Contaminant Sources	15
Potential Pathways	15
Potential Receptors	15
7.0 SITE INVESTIGATION	16
7.1 Desk Study Information	16
7.2 Site Investigation	16
7.2.1 General	16
7.2.2 In-Situ Standard Penetration Testing (SPT)	17
7.3 Laboratory Analysis	17

8.0	GROUND AND GROUNDWATER CONDITIONS	18
8.1	Ground Conditions	18
8.1.1	Summary of Ground Conditions	18
8.1.2	Made Ground	18
8.1.3	Drift Deposits	18
8.1.4	Solid Geology	18
8.1.5	Soil Plasticity	20
8.1.6	pH and Sulphate	20
8.2	Groundwater Conditions	20
8.3	Ground Gas	21
9.0	TIER 1 QUALITATIVE RISK ASSESSMENT	23
9.1	Human Health Risk Assessment	23
9.2	Controlled Waters	25
9.3	Ground Gas	26
9.4	Conceptual Model	26
10.0	GEOTECHNICAL ASSESSMENT	27
10.1	Proposed Development	27
10.2	Summary of Ground Conditions	27
10.3	Site Preparation	27
10.4	Geotechnical Laboratory Analysis	27
10.5	Foundation Conditions and Bearing Capacity	28
10.6	Concrete Durability	30
10.7	Excavations	30
10.8	Minerals	30
10.9	Construction Activity and Inspection	30
11.0	CONCLUSIONS & RECOMMENDATIONS	32

APPENDICES

Appendix I	Limitations
Appendix II	Glossary
Appendix III	Figure 1 Site Location Plan Figure 2 Borehole location plan
Appendix IV	Historical Maps
Appendix V	REC Exploratory Hole Logs
Appendix VI	Chemical Testing Results
Appendix VII	Origin of Tier I Values
Appendix VIII	Geotechnical testing results

A CD containing all relevant environmental database information, historical & geological mapping and a complete PDF version of this report is attached to hard copy of the report.

1.0 INTRODUCTION

1.1 Background

Resource and Environmental Consultants (REC) Ltd have been commissioned by Rowland Homes to undertake a Geo Environmental Investigation to include a Phase I Desk Study and subsequent Phase II Intrusive Investigation at the land adjacent to Dilworth Lane, Longridge, Preston; the findings of which are detailed within this report.

The scope of work consisted of a comprehensive desk study and intrusive ground investigation (GI), comprising twenty probeholes, five of which were completed as environmental monitoring wells and twelve machine excavated trial pits in order to carry out laboratory testing and interpretive Geo Environmental assessments.

All acronyms used within this report are defined in the Glossary presented in Appendix I.

1.2 Proposed Development

Detailed development plans have not been provided but any future scheme is understood to comprise a low rise residential housing development with associated gardens to the front and rear, driveways and adopted estate roads.

1.3 Objectives

The objectives of the geo-environmental investigation are to:

- Review historical plans, geology, hydrogeology, site sensitivity and any local authority information available in order to complete a Desk Study in line with CLR11;
- Undertake a preliminary stage of sampling and analysis to provide an overview of environmental issues identified;
- Assess the implications of any potential environmental risks, liabilities and development constraints associated with the site in relation to the future use of the site and in relation to off-site receptors;
- Assess the geotechnical information and provide preliminary recommendations in relation to foundations, pavement construction and flood slabs; and,
- Provide recommendations regarding future works required.

1.4 Sources of Information

Background information was sought from the following sources:

- Envirocheck Database Search;
- Historical mapping dated 1847 to 2010. A selection of historical maps are reproduced in Appendix III;
- Environment Agency Groundwater Vulnerability Map (www.environment-agency.gov.uk/wiyby);
- Radon: Guidance on protective measures for new buildings (BRE Document BR 211, 2007); and,

- British Geological Survey Map (Sheet 66, 1:50,000 Garstang, Solid & Drift edition).

1.5 Limitations

The limitations of this report are presented in Appendix II.

1.6 Confidentiality

REC has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from REC; a charge may be levied against such approval.

2.0 SITE SETTING

2.1 Site Description

Site Address	Land located between Dilworth Lane and Lower Lane, Longridge, Preston
National Grid Reference	E361150 N437210
Site Area	2.02ha

A site location map and site layout plans are presented within Figures 1 to 3 included within Appendix III.

2.2 Current Site Use

A walk over survey of the site was carried out on 4th February 2011, including an inspection of the external areas of the site.

Site Description

The site is roughly triangular in shape with frequent changes in topography noted across the site. The site is currently bordered on the southern boundary by dense vegetation and trees.

The site comprises agricultural pasture. The previous tenant farmer stated that the field has only ever been used for grazing for the duration of his lease. It was problematic defining the site boundary in the south western corner of the site due to the dense vegetation.

A small channel / depression is located in the centre of the site with a watercourse flowing in through the centre of the site in a southern direction.

REC was informed by the previous tenant farmer that a septic tank was installed (on site) at the northwest corner which serves the adjacent residential dwellings.

A foul sewer is present at the eastern tip of the site running west from new build properties located circa 6.0m from southern site boundary. This is marked out by three wooden posts locating the service run. Three manhole covers are also located at intervals along the foul sewer.

The central area of the site was observed to be extremely water logged. This was also commented on by the previous farmer who stated that three natural springs are located north of the site within a wooded area of the hill towards current farming buildings (Off Site).

Hazardous Materials Storage

No evidence of hazardous materials storage was observed during the site walkover.

Polychlorinated Biphenyls (PCBs)

An electrical substation was observed off site supplying the large residential estate. This was constructed post 1977 and as such this is not considered to be a source of PCB.

Waste Storage

No potentially contaminative waste streams are routinely produced on site.

Drainage Issues

A drainage survey was undertaken as part of the site walkover to identify the depths of the foul sewer running along the southern border. From inspecting the drain via the three manhole covers, the sewer was observed to be in good condition. However due to the location of the covers within the field and the nature of the central water logged area of the site, large volumes of soil and leaf litter were beginning to build up within the manhole chambers.

Asbestos Containing Materials (ACMs)

During the site walkover no ACMs were noted.

2.3 Surrounding Area

The surrounding land uses are summarised below:

Direction	Land Use
North	Residential dwellings, Dilworth Lane and agricultural land beyond.
East	Residential dwellings with agricultural land beyond.
South	Lower Lane with agricultural land beyond.
West	Large residential estate.

3.0 Site History

3.1 Historical Development

A review of historical Ordnance Survey maps and information pertinent to the site and within a 1km radius is summarised in Table 3.1 (below). A selection of relevant historical maps has been presented within Appendix IV.

Table 3.1 Summary of Potentially Contaminative Historical Land Uses

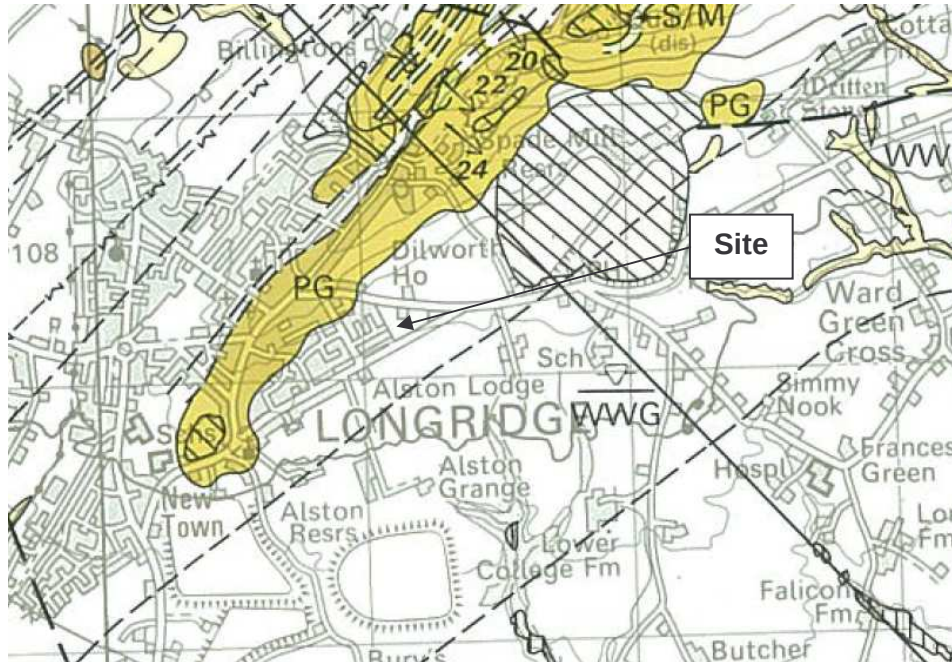
Map Edition	Historical Land Use	
	On Site	Off Site
1847	The site is undeveloped and classed as agricultural land.	Dilworth Lane runs along the northern boundary of the site. Beyond the lane is Dilworth House with agricultural fields beyond. Lower Lane runs along the southern boundary of the site with Alston Lodge on the opposite side of the road and agricultural fields beyond. The eastern tip of the site houses a small arrangement of farm buildings. The remaining area comprises agricultural fields with associated farm buildings and scattered residential properties. Small ponds are located throughout the surrounding land.
1895	The site is unchanged.	Longridge town, towards the east has been extensively developed.
1913-1914	The site is unchanged.	Alston Reservoir located over 100m south west of the site has expanded (Alston New Reservoir). A large number of mill buildings are shown throughout Longridge.
1932	The site is unchanged.	There are no significant changes.
1956	The site is unchanged.	Further expansion of Longridge has taken place.
1970	The site is unchanged.	A large housing estate has been developed 200m west of the site. Longridge town has undertaken dramatic expansion. Residential buildings have been developed on the north west boundary of the site.
1994	The site is unchanged.	The residential development west of the site has expanded closer towards the western site boundary.

Map Edition	Historical Land Use	
	On Site	Off Site
		Longridge town had been redeveloped and further buildings have been erected with associated road networks.
2001	The site is unchanged.	The surrounding area is mainly unchanged.
2006	The site is unchanged.	The surrounding area is mainly unchanged.
2010	The site is unchanged.	The surrounding area is mainly unchanged.

4.0 ENVIRONMENTAL SETTING

4.1 Geology & Hydrogeology

The British Geological Survey (BGS) map for the site, (Sheet 66 Garstang, Solid & Drift Edition) indicates that the site is underlain by the following geological sequence:



Geological Unit	Classification	Description	Aquifer Classification
Drift	Glacial Till	Sand and gravels / Gravelly Clay	High permeability drift.
Solid	PendleGrit Formation	Sandstone	Secondary A

The nearest fault line is located approximately 40m south east of the site, running north east to south west.

The Envirocheck Report identifies one groundwater abstraction within a 1km radius of the subject site. The abstraction is located 915m west of the site and is operated by Singletons Dairy Ltd and is operated for other industrial and commercial public services.

The site is not located within a Groundwater Source Protection Zone (SPZ).

4.2 Geotechnical Data

BGS information presented within the Envirocheck report identifies following ground conditions:

Hazard	Designation
Shallow Mining	In an area which may not be affected by coal mining.
Collapsible Ground	No Hazard
Compressible Ground	No Hazard
Ground Dissolution	No Hazard
Landslide	Very Low Hazard
Running Sand	Very Low Hazard
Swelling / Shrinking Clay	Very Low Hazard

4.3 Hydrology

The closest surface watercourse to the site is an unnamed water feature which flow south opposite to the southern site boundary. This feature runs directly in line with the waterlogged area observed during the site walkover.

The Envirocheck report indicates that the closest Discharge Consent is 277m south east of the site and is held by Mark Clegg, for sewer discharges at the final treated effluent stage.

4.4 Radon Risk Potential

The Envirocheck Report indicates between 1% and 3% of homes are above the Action Level. However the BGS reports that no radon protective measures are necessary in the construction of new dwellings or extensions.

4.5 Industrial Land Uses

The site is located within an agricultural area and no significant industrial activities have been identified on site. One industrial land use has been identified within 250m of the site and is registered to J F Gornall, located 88m west of the site. The land use is classed as active and is classified as road haulage services.

The Envirocheck Report indicates that there are no fuel station entries within 250m of the site boundary.

4.6 Sensitive Land Uses

A large residential estate is located on the western boundary of the site.

4.7 Environmental Sensitivity

Overall the site is considered to be of low to moderate sensitivity due to the following:

- The underlying Minor Aquifer is likely to be afforded protection by the presence of low permeability drift;
- One groundwater abstraction has been identified within a 1km radius (915m);

- The closest surface watercourse shown in the Envirocheck data is 10m to the south, however during the walkover survey, surface water is evident on site that runs in line with the feature shown on the site sensitivity plans;
- Residential properties are located to the west, east and north of the site.

5.0 CONSULTATIONS

5.1 Local Authority Contaminated Land Officer

The Contaminated Land Officer at Ribble Valley Borough Council was unable to respond to our request for information.

5.2 Local Authority Building Control Officer

The Building Controls Officer at Ribble Valley Borough Council was unable to respond to our request for information.

5.3 Landfill Sites and Waste Treatment Sites

The details regarding the landfill and waste treatment sites within a 500m radius is presented below:

Location	Distance from Site	Waste Accepted	Date of Closure
Old Tan Lane, Longridge, Preston	455m North	Not supplied	Not supplied

5.4 Regulatory Database

The following information has been obtained from a commercially available environmental database. Table 5.1 below only includes records not otherwise detailed in this report. A full copy of the database is provided in the CD attached to the hardcopy of this report.

Table 5.1 Summary of Envirocheck Data

	0- 249m	250- 500m	Details
Contaminated Land Register Entries and Notices	0	0	Not applicable (N/A)
Authorised industrial processes (IPC/IPPC/LAPPC).	0	0	Not applicable (N/A)
Licensed radioactive substances	0	0	N/A
Enforcements, prohibitions or prosecutions	0	0	N/A
Pollution Incidents	0	3	The Most serious incident was on the 8 th November 1993 and involved the release of milk into Higgin Brook 991m north west of the site. The EA classified the incident as a Category 2 Significant Incident.
Consents issued under the Planning (Hazardous Substances) Act 1990	0	0	N/A
Control of Major Accident Hazard (COMAH) sites	0	0	N/A

6.0 INITIAL CONCEPTUAL SITE MODEL (CSM)

6.1 Initial CSM

In accordance with Environment Agency, CLR 11 (2004) and BSI 10175 (Code of Practice for Investigation of Potentially Contaminated Land), REC Ltd have developed an initial CSM to identify potential contamination sources, migration pathways and receptors within the study area.

Contaminant Sources

On-site Potential Sources

There are no potential sources of contamination within the site boundary.

Off-site Potential Sources

There are no sources of contamination within 250m of the site boundary.

A landfill site has been identified approximately 455m to the north. No other information has been supplied and while this is not considered to be within influencing distance it may represent a potential source of ground gas.

Potential Pathways

Should the landfill site represent a potential source of ground gas to the subject site, then it could potentially migrate beneath the site via underground strata and accumulate with building structures.

Potential Receptors

Ground gas are a potential risk to human health, although given the distance from the subject site this is considered to be a low risk.

7.0 SITE INVESTIGATION

7.1 Desk Study Information

Ground gases from an off-site landfill site ca.450m to the north have been identified as a potential risk to human health.

7.2 Site Investigation

7.2.1 General

A Ground Investigation (GI) has been designed based on the findings of the desk study with exploratory holes advanced to characterise ground conditions and confirm the findings in the Initial Conceptual Site Model. In addition, exploratory holes have also been advanced to provide information on baseline conditions across the site. The investigation has also been used to collect geotechnical information to assist in the design and construction of the development.

Exploratory fieldwork was completed on the 4th February 2011. The works are summarised in Table 7.2.

Table 7.2 Summary of Fieldwork

Location Reference	Type	Maximum Depth (m bgl)	Monitoring Wells Response Zone
WS101 to WS105	Window Sample Probehole	5.45	(0.50-2.50 / 0.50-4.50)
TP101 to TP111	Trial Pit	3.00	N/A

Notes

m bgl – metres below ground level.

The window sample probeholes were designed to provide geotechnical information and confirm the findings of the Initial Conceptual Site Model (ICSM).

The Trial Pits were excavated to retrieve environmental and geotechnical samples. The trial pits were spatially distributed to offer the maximum site coverage.

Soil and groundwater samples destined for chemical analysis were collected at regular intervals in appropriate sampling containers. All samples were subsequently stored in cooled boxes prior to submission to Scientific Analysis Laboratories (SAL) for analysis in accordance with their UKAS accreditation where applicable.

Results of the analysis are included in Appendix VI. All samples were collected using appropriate PPE and sampling equipment that was cleaned at each sampling location. A detailed copy of REC Ltd sampling methodology, QA procedures and laboratory chain of custody forms can be provided upon request.

All samples were collected using the appropriate PPE and using sampling equipment that was cleaned using de-ionised water prior to each sampling location.

The sampling locations are illustrated in Figure 2 (Appendix III). The ground conditions encountered and details of monitoring well response zones are indicated on the logs which are provided in Appendix V.

Return visits are in place to monitor installations for groundwater level and ground gas concentrations.

7.2.2 In-Situ Standard Penetration Testing (SPT)

In-situ geotechnical testing was carried out in all exploratory hole locations to provide information on the geotechnical properties of the soils. The testing was conducted using the Standard Penetration Test (SPT) and in granular materials, a solid 60° cone which are recorded as SPT(C). The results are shown in the probehole logs in Appendix V.

7.3 Laboratory Analysis

Selected soil samples were submitted for a range of chemical analysis comprising, metals, pH, total sulphate, water soluble sulphate (2:1 extract), sulphide, cyanide, phenols, total and speciated poly-aromatic hydrocarbons (PAHs), asbestos, total organic carbon and total and speciated petroleum hydrocarbon (TPH).

Scientific Analysis Laboratories (SAL) Ltd of Manchester undertook the analytical work and the testing results are included in Appendix VI and discussed in Section 9.1.

Selected samples were submitted to PSL laboratory where the following geotechnical tests were undertaken:

- Atterburg Limits Determinations;
- Undrained Shear Strength.

Laboratory analysis sheets are included in Appendix VIII and are summarised in Section 10.0.

8.0 GROUND AND GROUNDWATER CONDITIONS

8.1 Ground Conditions

8.1.1 Summary of Ground Conditions

The ground investigation generally confirms the published geology and identifies the strata set out in Table 8.1 below:

Table 8.1 Summary of Strata

Strata	Typical Description	Max Thickness (m)
Top Soil	Brown slightly clayey gravelly fine to medium SAND. Gravel is fine to medium, sub-angular to sub-rounded of mudstone and sandstone.	0.65 (TP108)
Clay	Firm to stiff brown with grey veining silty CLAY.	5.10 (WS103)
Sand	Brown fine to medium SAND.	1.60 (TP101)

8.1.2 Made Ground

Made Ground was not encountered during the Ground Investigation works completed to date.

8.1.3 Drift Deposits

Top Soil

Top Soil was encountered within all exploratory hole locations and ranged in thickness from 0.20m to a maximum thickness of 0.65m in TP108. The Top Soil was observed to be homogeneous across the site and comprised clayey slightly gravelly fine to medium sand. Gravel fragments encountered were exclusively sandstone and mudstone.

Fluvio-Glacial Deposits

The window sample probeholes and trial pits found the underlying natural strata to comprise stiff, high strength sandy, gravelly clay at a very shallow depth (circa 0.30m bgl).

A small channel / depression is located in the centre of the site with a watercourse flowing in through the centre of the site. The channel is marked by sand & gravel deposits on either side.

8.1.4 Solid Geology

Solid strata were not encountered during the site investigation. The geological map for this area indicates that it comprises Dinantian Rocks, Pendle Grit Formation

Table 8.2 Standard Penetration Test Results

Boreholes	Depth (m bgl) (i)	Material Field Description	CPT/SPT "N" Value	Corrected "N" Value (N ₁) ₆₀	Terzaghi & Peck Relative Density (Sands)	Eurocode Soil strength	Consistency (BS5930)	Terzaghi & Peck Approximate Undrained Shear Strength (kN/m ²)
WS101	1.0	Sandy Silty CLAY	8	8.07	N/A	Medium strength	Firm	40.33
	2.0	Sandy Silty CLAY	11	10.05	N/A	Medium strength	Firm	50.24
	3.0	Sandy Silty CLAY	18	15.65	N/A	High strength	Stiff	78.27
	4.0	Sandy Silty CLAY	25	21.12	N/A	High strength	Stiff	105.61
WS102	1.0	Silty CLAY	17	17.14	N/A	High strength	Stiff	85.69
	2.0	Sandy Silty CLAY	14	12.79	N/A	Medium strength	Firm	63.95
	3.0	Fine to Medium SAND	22	22.00	Medium Dense	N/A	N/A	N/A
	4.0	Fine to Medium SAND	22	21.37	Medium Dense	N/A	N/A	N/A
WS103	1.0	Silty CLAY	14	14.11	N/A	Medium strength	Firm	70.57
	2.0	Silty CLAY	11	10.05	N/A	Medium strength	Firm	50.24
	3.0	Silty CLAY	9	7.83	N/A	Low strength	Soft	39.13
	4.0	Silty CLAY	11	9.29	N/A	Medium strength	Firm	46.47
	5.0	Silty CLAY	17	14.10	N/A	Medium strength	Firm	70.52
WS104	1.0	Silty CLAY	16	16.13	N/A	High strength	Stiff	80.65
	2.0	Fine to Medium SAND	4	4.20	Loose	N/A	N/A	N/A
	3.0	Fine to Medium SAND	4	4.00	Loose	N/A	N/A	N/A
WS105	1.0	Sandy Gravelly Silty CLAY	11	11.09	N/A	Medium strength	Firm	55.45
	2.0	Sandy Gravelly Silty CLAY	12	10.96	N/A	Medium strength	Firm	54.81
	3.0	Sandy Gravelly Silty CLAY	12	10.44	N/A	Medium strength	Firm	52.18

8.1.5 Soil Plasticity

The Atterberg Limits determinations, summarised in Table 8.3 below, show the clay to be of intermediate to high plasticity. Natural Moisture Content is close to the Plastic Limit.

The volume change potential is low to medium.

Table 8.3 Summary of Plasticity Index Test Results

Location	Depth (m)	Natural Moisture Content (%)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)	Percentage passing 425µm sieve (%)	Modified Plasticity Index
WS101	2.0	25	20	46	26	100	26
WS102	2.0	19	15	33	18	94	16.92
WS103	1.0	16	17	37	20	94	18.8

8.1.6 pH and Sulphate

Chemical analyses for pH and soluble sulphate content contained in Appendix VI (summarised below in Table 8.4), shows that the soils at the site generally meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with BRE Special Digest 1 (2005).

Table 8.4 Summary of pH and Sulphate Data

Location	Depth (m)	SO ₄ in 2:1 water / soil (g/l)	pH Value
TP101	0.4	<0.1	6.7
TP102	1.0	<0.1	7.9
TP104	0.5	<0.1	6.2
TP106	0.4	<0.1	6.2
TP108	1.0	<0.1	6.8
TP111	0.5	<0.1	7.8
WS102	0.3	<0.1	7.9
WS105	0.2	<0.1	6.6
Average		<0.1	7.0

8.2 Groundwater Conditions

Groundwater strikes were encountered across the western and central areas of the site. The depth of the seepages and the depth to which groundwater rose are shown on the exploratory hole records and summarised in Table 8.5 over:

Table 8.5 Summary Groundwater Strikes

Location	Depth to strike (m)	Depth to standing water (m)	Notes
WS101	1.50	0.38	
WS102	3.00	0.91	
WS103	NO VISUAL SIGN	0.18	
WS104	1.80	1.08	
WS105	NO VISUAL SIGN	0.65	
TP101	0.60	N/A	
TP103	0.60	N/A	
TP104	1.80	N/A	

Subsequent to the fieldwork, six groundwater monitoring surveys have been scheduled; three of which have been completed to date. Monitoring was undertaken using an electronic dip meter and interface probe to record the depth to groundwater and the thickness of any free phase hydrocarbon product, if present. The groundwater levels recorded are summarised in Tables 8.6 and 8.5.

8.3 Ground Gas

Six ground gas monitoring visits have been scheduled with three completed to date. Monitoring commenced 9th February 2011 with the final visit due to be completed by the end of April 2011. Concentrations of methane (CH₄), carbon dioxide (CO₂) and Oxygen (O₂) were measured using an infra red gas analyser (GA2000) calibrated to a reference standard (before and after each survey) and gas flow rates were measured using an attached flow pod.

Gas measurements were recorded for a minimum of sixty seconds at each location, at which point the maximum concentration of CH₄ and CO₂ together with the lowest concentration of O₂ were recorded. The results of the ground gas monitoring are presented in Table 8.6 overleaf.

Table 8.6 Summary of Ground Gas and Groundwater Monitoring Results

Well	Date	CH ₄ Initial %v/v	CH ₄ Steady %v/v	CH ₄ GSV l/hr	CO ₂ Initial %v/v	CO ₂ Steady %v/v	CO ₂ GSV l/hr	O ₂ %v/v	Atmos (mb)	Atmos. Dynamic	Flow (l/hr)	Response Zone (mbgl)	Depth to Base (mbgl)	Depth to Water (mbgl)
WS101	09/02/2011	0.20	0.20	0.0076	1.60	0.40	0.0608	18.00	998	Falling	3.80	0.50-2.50	1.71	0.38
	16/02/2011	0.1	0.1	0.0001	2.9	2.7	0.0029	16.9	980	Rising	0.10	0.50-2.50	1.733	0.375
	25/02/2011	0.1	0.1	0.0001	1.9	0.7	0.0019	17.2	1003	Falling	0.10	0.50-2.50	1.69	0.5
WS102	09/02/2011	0.20	0.20	0.0078	0.3	0.2	0.0117	18.3	998	Falling	3.90	0.50-2.50	2.49	0.91
	16/02/2011	0.10	0.10	0.0001	0.10	0.10	0.0001	20.40	980	Rising	0.10	0.50-2.50	2.50	0.89
	25/02/2011	0.1	0.1	0.0001	0.1	0.1	0.0001	17.60	1003	Falling	0.10	0.50-2.50	2.49	0.96
WS103	09/02/2011	0.20	0.20	0.0078	0.10	0.10	0.0039	18.40	998	Falling	3.90	0.50-4.50	4.07	0.18
	16/02/2011	0.10	0.10	0.0001	0.10	0.10	0.0001	20.60	980	Rising	0.10	0.50-4.50	4.07	0.11
	25/02/2011	0.1	0.1	0.0001	0.1	0.1	0.0001	17.60	1003	Falling	0.10	0.50-4.50	4.07	0.13
WS104	09/02/2011	0.20	0.20	0.0072	1.60	1.60	0.0576	17.20	998	Falling	3.60	0.50-2.50	2.32	1.08
	16/02/2011	0.10	0.10	0.0001	1.40	0.10	0.0014	20.40	980	Rising	0.10	0.50-2.50	2.26	1.09
	25/02/2011	0.1	0.1	0.0001	2.40	0.60	0.0024	17.20	1003	Falling	0.10	0.50-2.50	2.24	1.08
WS105	09/02/2011	0.20	0.20	0.0098	0.90	0.90	0.0441	17.40	998	Falling	4.90	0.50-2.50	2.88	0.65
	16/02/2011	0.10	0.10	0.0001	1.10	1.10	0.0011	17.50	980	Rising	0.10	0.50-2.50	2.88	0.62
	25/02/2011	0.1	0.1	-0.0001	2.80	2.80	-0.0028	13.90	1003	Falling	-0.10	0.50-2.50	2.88	0.65

9.0 TIER 1 QUALITATIVE RISK ASSESSMENT

REC has undertaken a Tier 1 qualitative risk assessment to determine if any potential contaminants within the underlying soils and groundwater pose an unacceptable level of risk to the identified receptors.

9.1 Human Health Risk Assessment

At a Tier 1 stage the long term (chronic) human health toxicity of the soil has been assessed by comparing the on-site concentrations of organic and inorganic compounds with reference values published by the EA (Contaminated Land Exposure Assessment (CLEA) Soil Guideline Values (SGV)) and where absent, General Acceptance Criteria (GACs) published by LQM/CIEH (2nd edition).

The results of this comparison have been summarised within Table 9.1 (overleaf).

Table 9.1 Summary of Inorganic and Hydrocarbon Toxicity Assessment for a Residential End Use (with plant uptake)

Determinand	Units	GAC ^(v1)	n	ME	Loc. of Ex	Pathway	Assessment
Arsenic	mg/kg	32	8	N/A	N/A	1	No Exceedance
Cadmium	mg/kg	10	8	N/A	N/A	1	No Exceedance
Chromium (Hexavalent)	mg/kg	4.3	8	N/A	N/A	1	No Exceedance
Lead ^(vi)	mg/kg	450	8	N/A	N/A	1	No Exceedance
Mercury ⁽ⁱⁱ⁾	mg/kg	11	8	N/A	N/A	2	No Exceedance
Nickel	mg/kg	130	8	N/A	N/A	1	No Exceedance
Selenium (New SGV)	mg/kg	350	8	N/A	N/A	1	No Exceedance
Copper	mg/kg	2330	8	N/A	N/A	1	No Exceedance
Zinc	mg/kg	3750	8	N/A	N/A	1	No Exceedance
Cyanide	mg/kg	791	8	N/A	N/A	1	No Exceedance
Phenol	mg/kg	210	8	N/A	N/A		No Exceedance
Naphthalene	mg/kg	1.5	8	N/A	N/A	2	No Exceedance
Acenaphthylene	mg/kg	170	8	N/A	N/A	3	No Exceedance
Acenaphthene	mg/kg	210	8	N/A	N/A	1	No Exceedance
Fluorene	mg/kg	160	8	N/A	N/A	1	No Exceedance
Phenanthrene	mg/kg	92	8	N/A	N/A	3	No Exceedance
Anthracene	mg/kg	2300	8	N/A	N/A	3	No Exceedance
Fluoranthene	mg/kg	260	8	N/A	N/A	3	No Exceedance
Pyrene	mg/kg	560	8	N/A	N/A	3	No Exceedance
Benzo(a)Anthracene	mg/kg	3.1	8	N/A	N/A	3	No Exceedance
Chrysene	mg/kg	6	8	N/A	N/A	3	No Exceedance
Benzo(b/k)Fluoranthene ⁽ⁱⁱⁱ⁾	mg/kg	5.6	8	N/A	N/A	3	No Exceedance
Benzo(a)Pyrene	mg/kg	0.83	8	N/A	N/A	3	No Exceedance
Indeno(123-cd)Pyrene	mg/kg	3.2	8	N/A	N/A	3	No Exceedance
Dibenzo(a,h)Anthracene	mg/kg	0.76	8	N/A	N/A	3	No Exceedance
Benzo(ghi)Perylene	mg/kg	44	8	N/A	N/A	3	No Exceedance
TPH C ₅ -C ₆ (aliphatic) ⁽ⁱ⁾	mg/kg	30	8	N/A	N/A	2	No Exceedance
TPH C ₆ -C ₈ (aliphatic) ⁽ⁱ⁾	mg/kg	73	8	N/A	N/A	2	No Exceedance
TPH C ₈ -C ₁₀ (aliphatic) ⁽ⁱ⁾	mg/kg	19	8	N/A	N/A	2	No Exceedance
TPH C ₁₀ -C ₁₂ (aromatic) ⁽ⁱ⁾	mg/kg	69	8	N/A	N/A	2	No Exceedance
TPH C ₁₂ -C ₁₆ (aromatic) ⁽ⁱ⁾	mg/kg	140	8	N/A	N/A	1	No Exceedance
TPH C ₁₆ -C ₂₁ (aromatic) ⁽ⁱ⁾	mg/kg	250	8	N/A	N/A	1	No Exceedance
TPH C ₂₁ -C ₃₅ (aromatic) ⁽ⁱ⁾	mg/kg	890	8	N/A	N/A	1	No Exceedance

Notes

Main Exposure Pathways: 1 = Soil Ingestion, 2 = Vapour Inhalation (indoor), 3 = Dermal Contact & Ingestion, 4 = Dust Inhalation.

Abbreviations: GAC = General Assessment Criteria, n = number of samples, ME = Maximum Exceedance concentration; NA – Not Applicable (no exceedance of assessment criteria)

* The Tier 1 GAC for the hydrocarbon fraction is derived from the CIEH assessment for petroleum hydrocarbons Criteria Working Group (CWG) for both aliphatic and aromatic compounds. REC has utilised the Tier 1 values for aliphatic compounds for the volatile and semi volatile fractions (C₅-C₁₂) and the Tier 1 values for aromatic compound for the non volatile fractions (C₁₂-C₃₅). The comparison of a total (aliphatic/aromatic) compounds to an individual fraction is considered to be a conservative approach and satisfactory for the protection of human health.

(i) Benzo (b) Fluoranthene (100mg/kg) Benzo (k) Fluoranthene (140mg/kg)

(ii). Xylenes based on p-xylene (o-xylene 2600mg/kg, m-xylene 3500mg/kg) and is capped by its solubility

(iii) BTEX is not SOM related

Referring to Table 9.1, the results of this direct comparison indicates that the data does not exceed any of the screening criteria for a commercial end use.

Asbestos was not identified in any of the soil samples submitted for screening analysis.

9.2 Controlled Waters

There is not considered to be a significant risk to controlled waters based on the following rationale:

- No visual or olfactory evidence of potentially mobile impact was observed during the investigation;
- No elevated concentrations of potentially mobile impact has been identified within the soil samples analysed; and,
- The pH conditions identified at the site would not be expected to facilitate leaching of any inorganic determinands.

9.3 Ground Gas

The potential impact on the development from ground gases has been assessed with reference to standards and guidelines published in CIRIA Report 665 (*Assessing risks posed by hazardous ground gases to buildings*, 2007). However, it is recommended that the ground monitoring be completed and that the full ground gas assessment and recommended protection measures are agreed with the local authority prior to their adoption on-site. Furthermore, all protection measures adopted should be validated by a suitably qualified engineer.

It should be noted that the ground investigation has not identified any notable depth of Made Ground on-site. However, a landfill site has been identified ca.450m to the north and glacial deposits can give rise to localised pockets of ground gas associated with relict plant remains.

During the monitoring visits completed to date, no elevated concentrations of methane or carbon dioxide were recorded within any of the monitoring wells. The highest concentration of carbon dioxide was recorded in WS101 (2.9%v/v) but this was associated with low flow rates of less than 0.1litres/hr.

During the first round of gas monitoring elevated flow levels were recorded within all monitoring wells. REC has concluded that the flows recorded on 9th February 2011 were produced from a pressure of water. Due to the amount of rainfall prior to the visit and the shallow groundwater a build up of pressure from associated water levels an initial peak of flow was recorded. Flow was monitored further to investigate the potential for flow, resulting in a flow that is below the detection limits of the GA2000.

In accordance with the methodology outlined with the CIRIA publication C665, REC have utilised the results of the ground gas monitoring surveys to calculate a tentative Gas Screening Value (GSV). The maximum GSV calculated for methane was 0.0098 (WS105) and for carbon dioxide was 0.0608 (WS101)

The GSV has been compared to the criteria outlined with CIRIA C665 to determine the level of risk to the proposed development and to ensure the appropriate remedial options are incorporated into any future building design in this area.

Given that the maximum GSV for carbon dioxide and methane are <0.07 l/hr and typical concentrations are less than 5% and 1% respectively the site would appear to be classified as Characteristic Situation 1 (very low risk) according to CIRIA 665.

This is an interim assessment based on preliminary ground gas readings, the final classification will be supplied as an addendum to this report on completion of the remaining monitoring visits.

9.4 Conceptual Model

The assessment and conceptual model has not identified any potentially significant pollutant linkages based on a commercial and/or residential redevelopment of the site. It is therefore concluded that the site is suitable for redevelopment without the requirement for significant remedial action.

However, REC recommends that the ground gas assessment be completed prior to specifying the ground gas protection measures.

10.0 GEOTECHNICAL ASSESSMENT

10.1 Proposed Development

It is understood that the proposed development will comprise low rise residential housing with associated gardens to the front and rear, driveways, drainage and adopted estate roads on the parcel of land in between Dilworth Lane and Lower Lane. Details of the proposed loadings are not known and therefore a line loading of 75kN/m has been assumed for preliminary assessment purposes only.

Given the nature of the proposed development it is considered that the structure meets the criteria of Geotechnical Category 1 of Euro Code 7.

10.2 Summary of Ground Conditions

Ground conditions identified at the site are summarised in Table 10.1 below:

Table 10.1 Summary of Ground Conditions

Strata	Typical Description	Max Thickness (m)
Top Soil	Brown slightly clayey gravelly fine to medium SAND. Gravel is fine to medium, sub-angular to sub-rounded of mudstone and sandstone.	0.65 (TP108)
Clay	Firm to stiff brown with grey veining silty CLAY.	5.10 (WS103)
Sand	Brown fine to medium SAND.	1.60 (TP101)

10.3 Site Preparation

The site should be cleared and any vegetation below areas of proposed development stripped in accordance with Series 200 of the Specification for Highway Works. This should include:

- Roots present below the footprint of proposed structures and infrastructure should be grubbed out and the resulting void in filled with suitable compacted engineered fill;
- Redundant services should be sealed off and grubbed out and replaced with suitable compacted engineered fill; and,

No invasive plant species were observed, however observations are limited due to the season.

10.4 Geotechnical Laboratory Analysis

Geotechnical laboratory testing (see Appendix VIII) has been undertaken on selected samples from the exploratory holes. The results of this testing are summarised in Table 10.1 overleaf.

To assess the volume change potential of the soil, the modified Plasticity Index has been calculated as ranging between 16.92% and 26% with an average of 20.573% giving a low to medium potential for volume change. It is however still recommended that the location of existing and proposed trees and their water demand be considered prior to the construction of any structures.

Table 10.1 Summary of Undrained Shear Strength Test Results

Location	Sample Depth (m)	Lab Description	Cell Pressure (kPa)	Undrained Shear Strength (kN/m ²)	Consistency
WS101	1.50-1.50	Brown CLAY	35	43	Medium Strength
WS103	1.50-2.00	Brown CLAY	35	136	High Strength
WS104	0.50-1.00	Brown silty CLAY	20	63	Medium Strength
WS105	0.50-1.00	Brown CLAY	20	75	High Strength
Average				79.25	Moderate/High

The single stage triaxial tests carried out on samples recovered from the boreholes expressed average undrained shear strengths in the order of 73.25kN/m² and an average consistency of moderate to high strength. When compared alongside in-situ SPT results the triaxial tests are considered representative across the site and for the purposes of the development of design bearing pressures are considered appropriate.

10.5 Foundation Conditions and Bearing Capacity

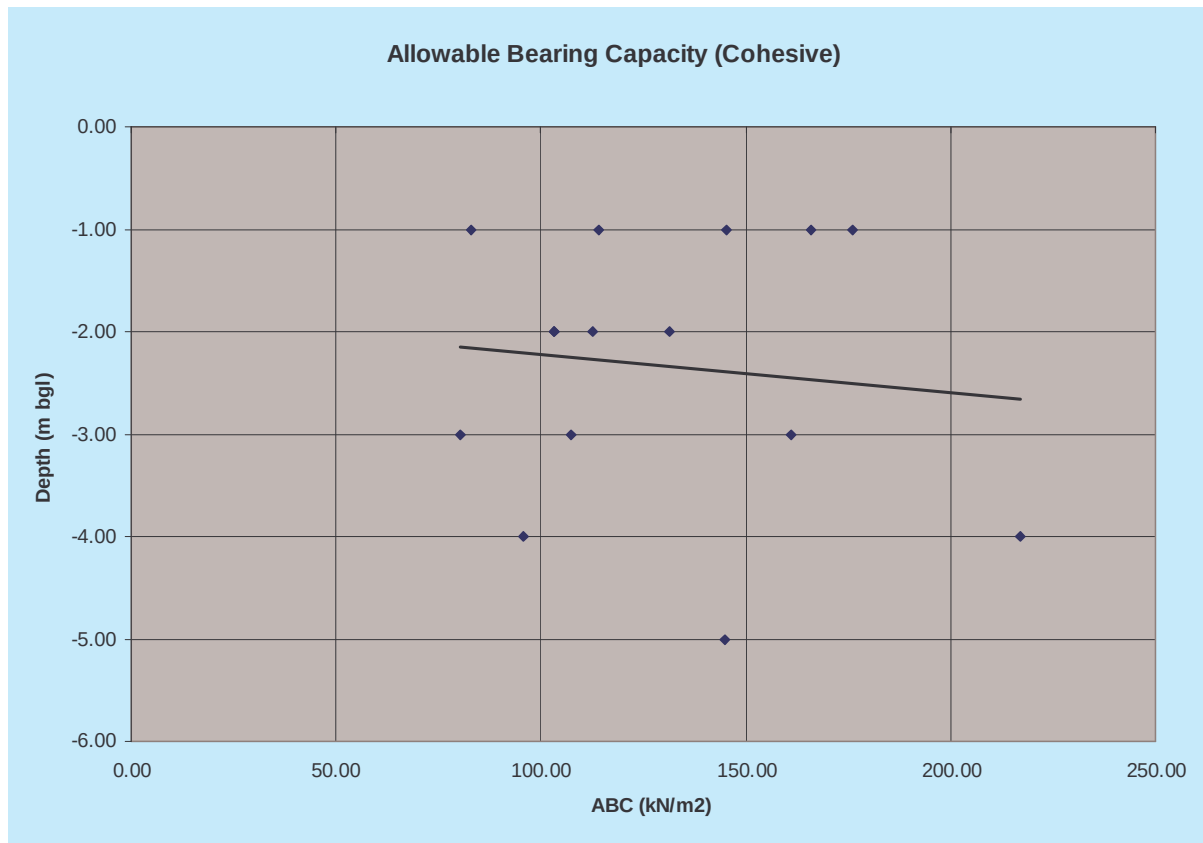
General

The proposed residential dwellings could be founded on the underlying moderate to high clay at a shallow depth using a conventional strip foundation, in accordance with NHBC recommending for a low to moderate plasticity clay.

The underlying clay to be exposed on completion of a site strip would provide a CBR design value of circa 3-8%; as such a standard adoptable highway build up is considered suitable.

The underlying clay would not provide the necessary level of effective porosity for the use of soak-away drainage.

Chart 10.1 Allowable Bearing Pressure for Cohesive Strata



The results as identified in Chart 10.1 above show a trend of increasing bearing pressure with depth with a conservative ABP in the order of 100kN/m² expected at 1.00mbgl increasing to 120kN/m² at 2.00mbgl.

Strip Foundations

Based on the SPT results, bearing capacities in excess of 100 kN/m² can be expected at depths below circa 1.00m bgl, however, due to the nature of the superficial drift deposits (cohesive and granular) the potential for differential settlement should be considered within the foundation design especially within the central area of the site where a depression is located.

Ground Improvement

The use of ground improvement techniques such as vibro granular columns will reduce concerns of differential settlement. The vibro granular columns should provide a bearing capacity of around 150kN/m², however specialist advice should be sought from a suitably experienced contractor with regard to allowable bearing capacity and settlements.

Piled Foundations

As an alternative, consideration can be given to a mini-piled foundation solution. Specialist contractors should be contacted for a cost proposal and foundation solution.

Ground Floor Slabs

Due to the presence of variable cohesive and granular strata, it is considered that ground bearing floor slabs, whilst viable, will require detailed design to accommodate variability of the formation and account for differential settlement.

If vibro granular columns are used for the foundations then this could be extended to the floor slab to improve formation conditions and reduce the risk of damage from settlement. However, it may be more reliable to opt for suspended floor slabs.

Where suspended floor slabs are employed ventilation of the under floor void will be required to address condensation issues. This should also address any potential gas ingress issue.

10.6 Concrete Durability

Based upon the results of the chemical analyses summarised in Table 8.4 it is considered that subsurface concrete can be designed in accordance with Design Sulphate Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with the recommendations provided in BRE Special Digest 1 (2005).

10.7 Excavations

Site observations indicated that excavations should be feasible in the near surface with normal plant. Groundwater seepage was recorded in a number of the exploratory holes, evident of a shallow water table within the natural sandy CLAY. Generally trial pits were unstable with collapse typically occurring within 1.50m to 3.00m of excavation within the sandy CLAY and upon encountering groundwater.

Due to the instability of the sandy CLAY deposits within the central bogged areas, it is considered that all excavations are supported or battered back in accordance with guidance contained in CIRIA RR97. Groundwater seepages were noted in majority of the exploratory holes, often initiating collapse of the hole and it is therefore considered that sump pumping will be required and if excavations are to extend to depth then consideration should be given to de-watering of the sandy CLAY deposits.

10.8 Minerals

There are no minerals of economic value underlying the site at shallow depth and mining is considered to be very unlikely. There are numerous quarries in the surrounding area, mining the Pendle Grit Formation.

The site is considered to be minerally stable.

10.9 Construction Activity and Inspection

It is considered that the following considerations and recommendations be incorporated in to the site works:

- Excavations where access is required should be subject to a risk assessment from a competent person and where appropriate mitigation measures such as benching back the sides or use of support systems in accordance with CIRIA 97 utilised;

- It is considered that de-watering may be required, especially following periods of heavy rainfall. Removal of surface water and water within trenches should be possible with conventional sump pumping. Discharge of any water should be agreed with the relevant regulatory body and be undertaken under a trade effluent discharge, where required. Measures to remove silt and suspended solids may be required and consideration should be given to provision of space for settling tanks or an attenuation pond;
- Where access to confined spaces is required appropriate mitigation measures should be addressed within the Construction Stage Health and Safety Plan. Particular account should be taken of the gas results; and,
- The presence of potential contamination and mitigation measures should be addressed as part of the Construction Stage Health and Safety Plan and should include measures to design out the risks, reduce their impact and finally the use of Personnel Protective Equipment (PPE).

11.0 CONCLUSIONS & RECOMMENDATIONS

Environmental

For the purposes of the Tier 1 assessment REC have compared the laboratory test data directly to the relevant Tier 1 GAC value for the protection of human health. The results of this direct comparison indicates that the data does not exceed any of the screening criteria for a residential end use.

Asbestos was not identified in any of the soil samples submitted for screening analysis.

Geotechnical

It is recommended that traditional shallow strip foundations bearing on the moderate to high strength clay at a depth of circa 1.0m bgl are utilised to support the proposed structures

Consideration should be given to the depth of shallow traditional foundations and NHBC guidelines for construction near trees with high water demand and clay strength with low to medium potential for volumetric instability.

Based on the SPT results, bearing capacities in excess of 100 kN/m² can be expected at depths of below 1.00m bgl, however, due to the nature of the superficial drift deposits (cohesive and granular) the potential for differential settlement needs to be considered within the foundation design especially within the central area of the site where the depression is located.

Based upon the results of the chemical analyses for pH and soluble sulphate content, REC Ltd consider that all subsurface concrete should be designed in accordance with Design Sulphate Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with the recommendations provided in BRE Special Digest 1 (2005).

APPENDIX I | LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between REC Ltd and the Client as indicated in Section 1.2.
2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.
3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.
4. During the site walkover reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not been made known or accessible.
5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.
6. In addition to the above REC Ltd note that when investigating, or developing, potentially contaminated land it is important to recognise that sub-surface conditions may vary spatially and also with time. The absence of certain ground, ground gas, and contamination or groundwater conditions at the positions tested is not a guarantee that such conditions do not exist anywhere across the site. Due to the presence of existing buildings and structures access could not be obtained to all areas. Additional contamination may be identified following the removal of the buildings or hard standing.
7. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.
8. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials this is for indicative purposes only and do not constitute or replace full and proper surveys.
9. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.
10. This report presents an interpretation of the geotechnical information established by excavation, observation and testing. Whilst every effort is made in interpretative reporting to assess the soil conditions over the Site it should be noted that natural strata vary from point to point and that man made deposits are subject to an even greater diversity. Groundwater conditions are dependent on seasonal and other factors. Consequently there may be conditions present not revealed by this investigation.
11. REC can not be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by REC is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by REC in this connection without their explicit written agreement there to by REC.
12. Rather, this investigation has been undertaken to provide a preliminary characterisation of the existing sub-surface geotechnical characteristics and make up and the findings of this study are our best interpretation of the data collected, within the scope of work and agreed budget. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.
13. This investigation has been undertaken to reasonably characterise existing sub-surface conditions and the findings of this study are our best interpretation of the data collected, within the scope of work and agreed budget. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.

APPENDIX II GLOSSARY

TERMS

AST	Above Ground Storage Tank
BGS	British Geological Survey
BSI	British Standards Institute
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CIEH	Chartered Institute of Environmental Health
CIRIA	Construction Industry Research Association
CLEA	Contaminated Land Exposure Assessment
CSM	Conceptual Site Model
DNAPL	Dense Non-Aqueous Phase Liquid (chlorinated solvents, PCB)
DWS	Drinking Water Standard
EA	Environment Agency
EQS	Environmental Quality Standard
GAC	General Assessment Criteria
GL	Ground Level
GSV	Gas Screening Value
HCV	Health Criteria Value
ICSM	Initial Conceptual Site Model
LNAPL	Light Non-Aqueous Phase Liquid (petrol, diesel, kerosene)
ND	Not Detected
LMRL	Lower Method Reporting Limit
NR	Not Recorded
PAH	Poly Aromatic Hydrocarbon
PCB	Poly-Chlorinated Biphenyl
PID	Photo Ionisation Detector
QA	Quality Assurance
SGV	Soil Guideline Value
SPH	Separate Phase Hydrocarbon
Sp.TPH (CWG)	Total Petroleum Hydrocarbon (Criteria Working Group)
SPT	Standard Penetration Test
SVOC	Semi Volatile Organic Compound
UST	Underground Storage Tank
VCCs	Vibro Concrete Columns
VOC	Volatile Organic Compound
WTE	Water Table Elevation

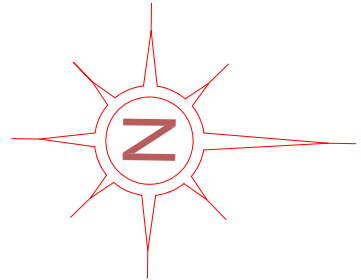
UNITS

m	Metres
km	Kilometres
%	Percent
%v/v	Percent volume in air
mb	Milli Bars (atmospheric pressure)
l/hr	Litres per hour
µg/l	Micrograms per Litre (parts per billion)
ppb	Parts Per Billion
mg/kg	Milligrams per kilogram (parts per million)
ppm	Parts Per Million
mg/m ³	Milligram per metre cubed

m bgl	Metres Below Ground Level
m bcl	Metre Below Cover Level
mAOD	Metres Above Ordnance Datum (sea level)
kN/m ²	Kilo Newtons per metre squared
µm	Micro metre

APPENDIX III FIGURES



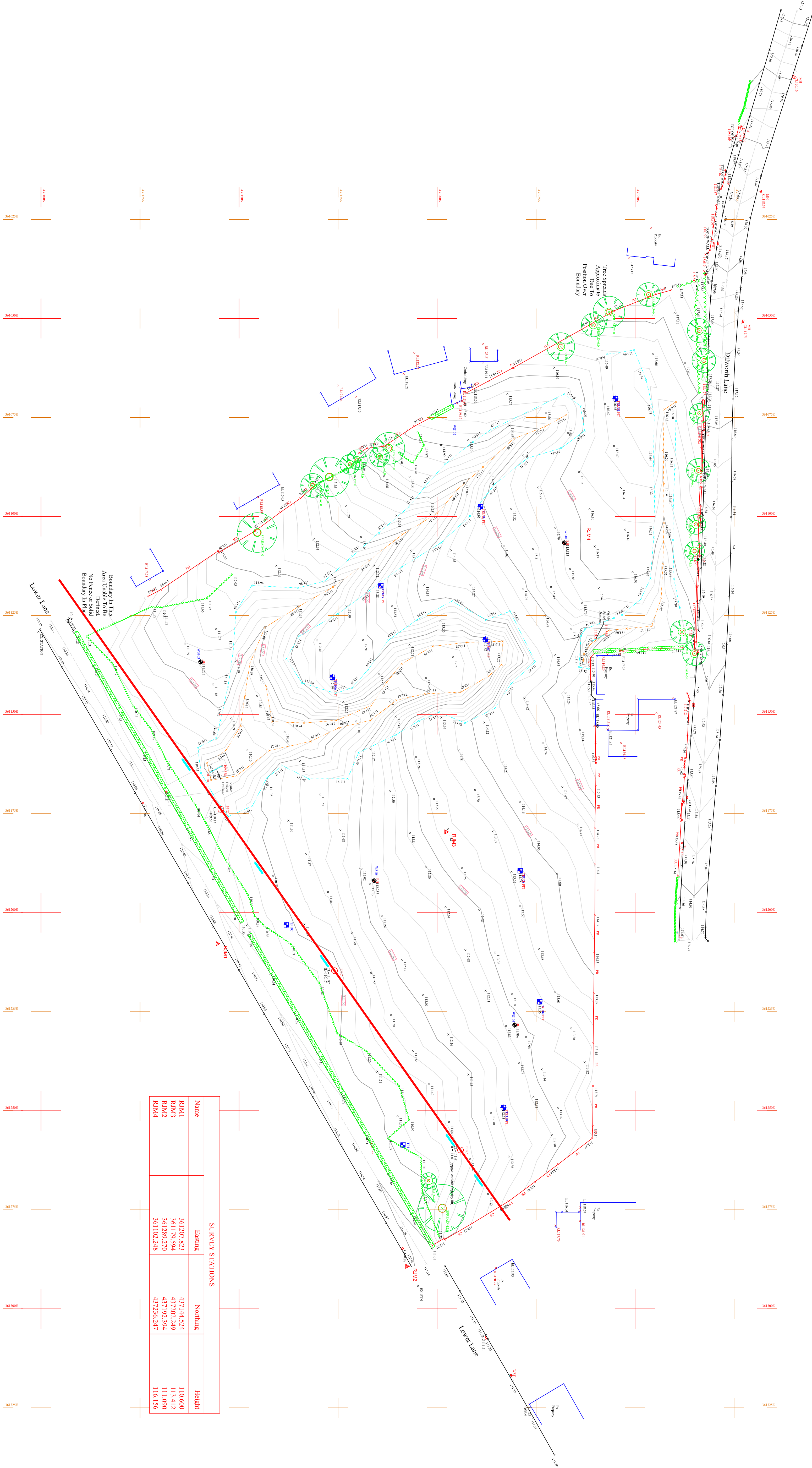


Legend:

- CBR
- CORE
- CABLE_PERCUSSIVE
- DCP
- HAND_AUGER
- HAND_PIT
- Hotspot
- MEXE_PROBE
- ROTARY_BORED
- PILE_RIG
- SOAKAWAY
- SONIC
- TRIAL PIT
- WINDOW SAMPLE

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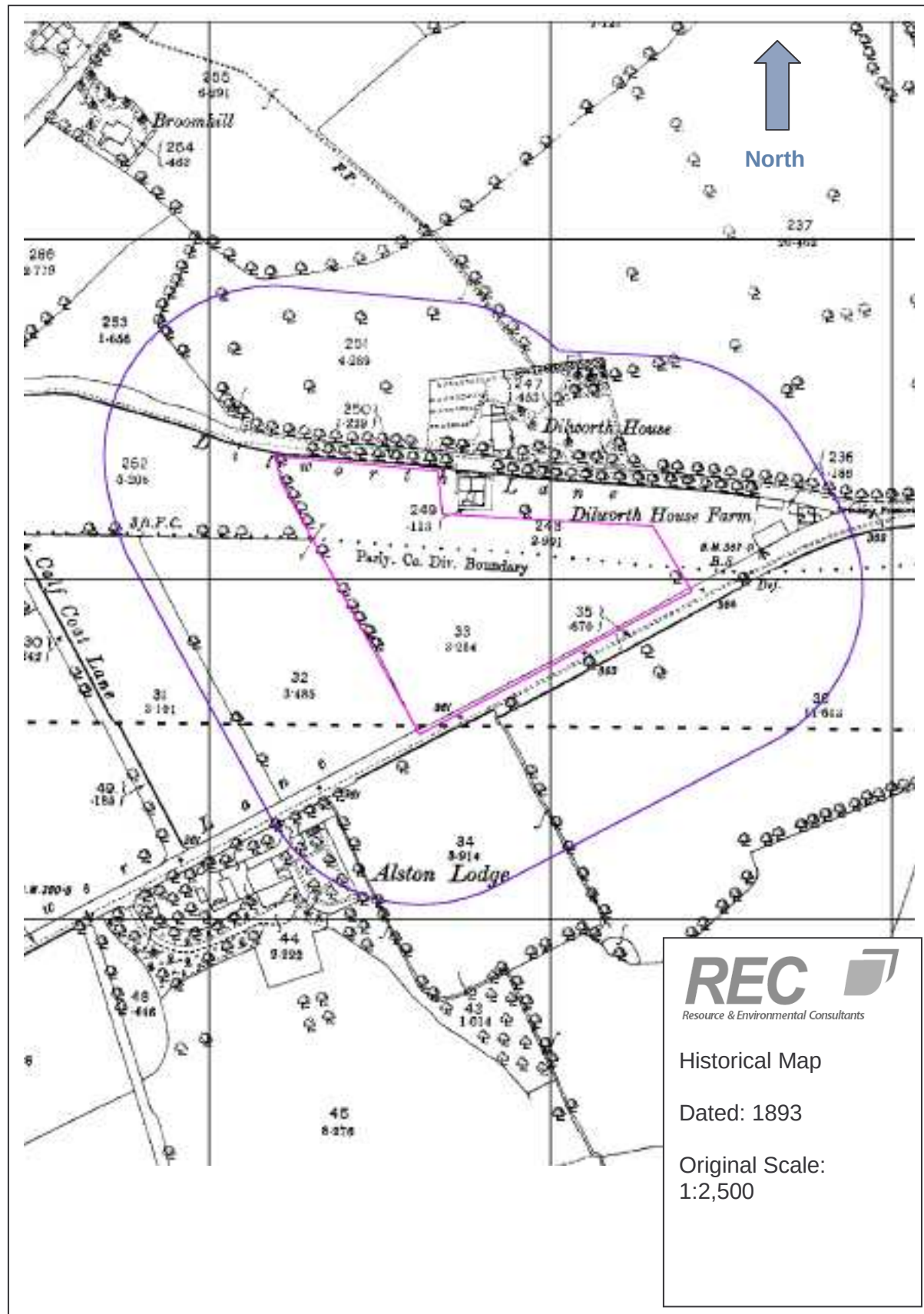
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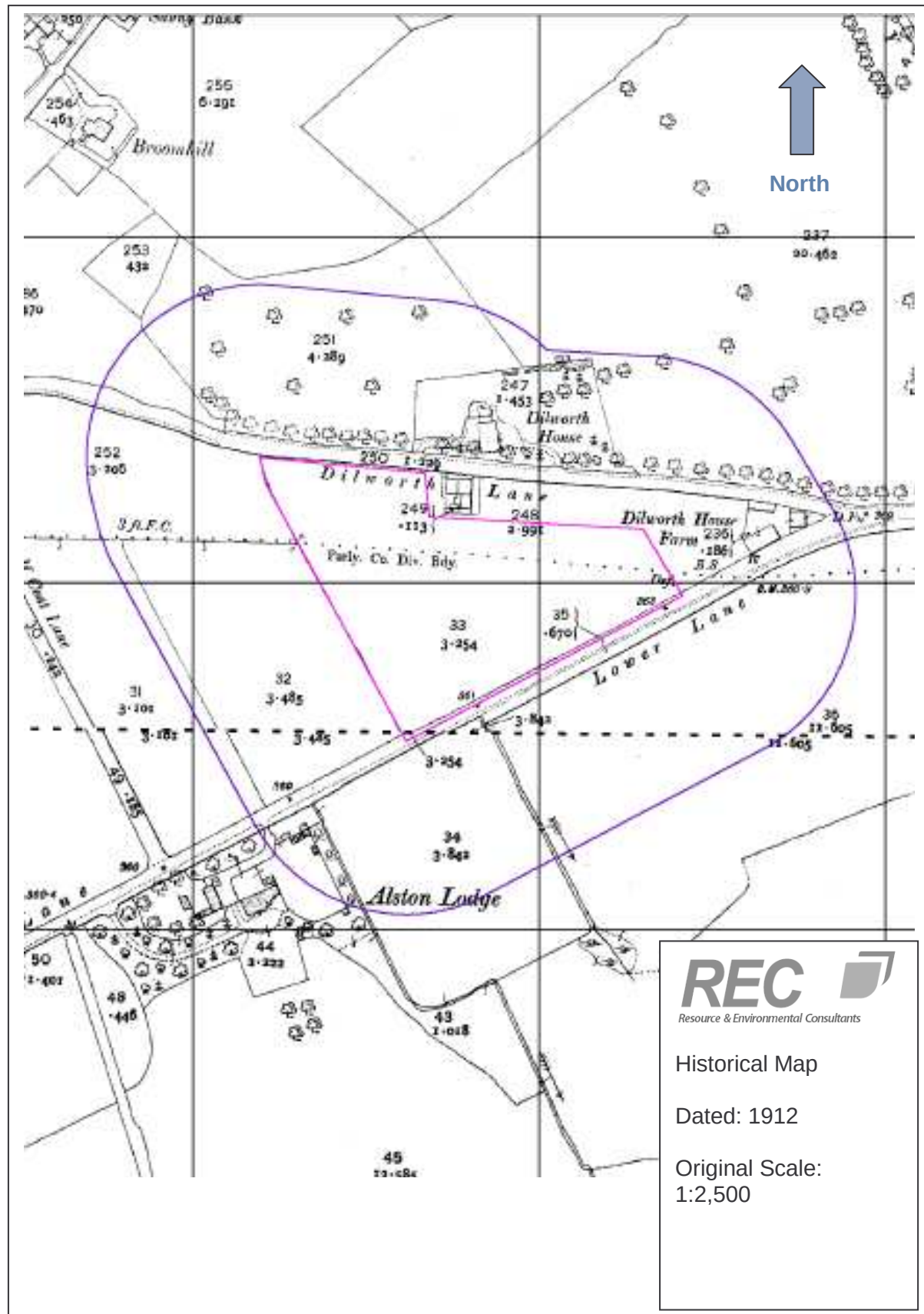


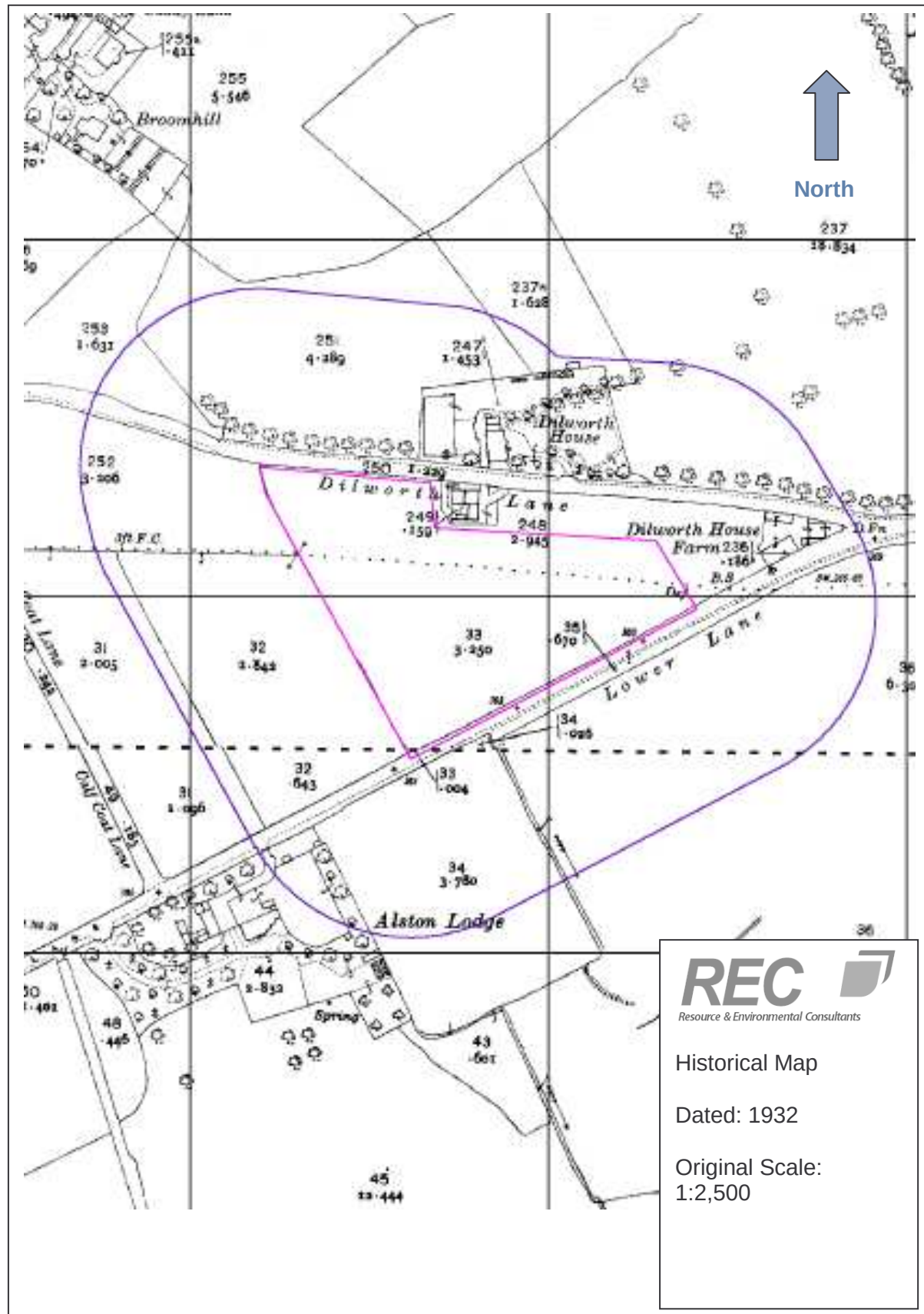
SURVEY STATIONS			
Name	Easting	Northing	Height
BM01	361207.823	437144.524	110.600
BM03	361179.594	437202.249	113.412
BM02	361289.270	437192.394	111.090
BM04	361102.248	437236.247	116.156

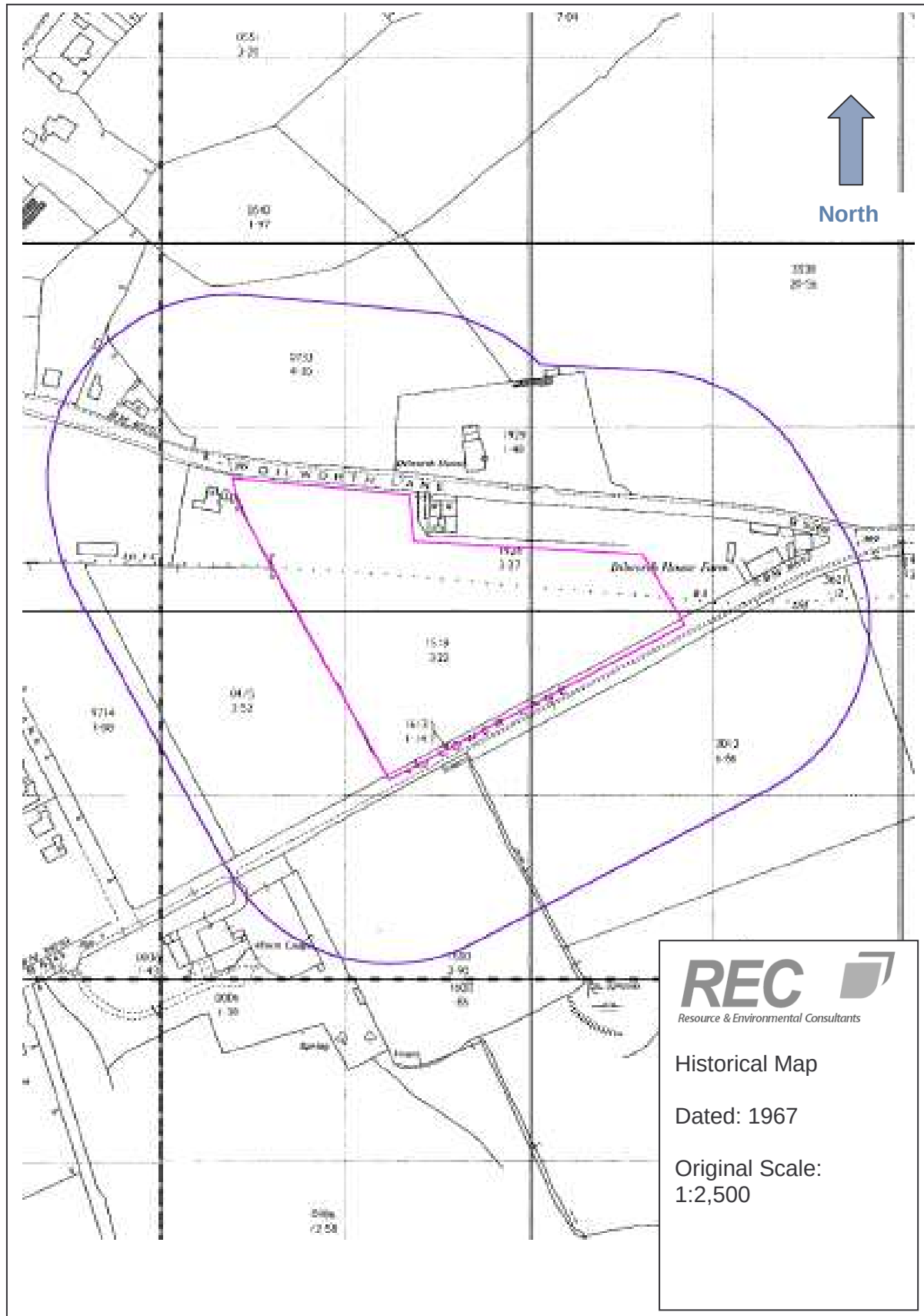
- Revision Notes:-**
- Additional Survey on Dilworth Road At Clients Request
 - Additional Survey of Adjacent Properties At Clients Request
 - Top of Wall levels on Dilworth Lane Added For Visibility Analysis

APPENDIX IV HISTORICAL MAPS













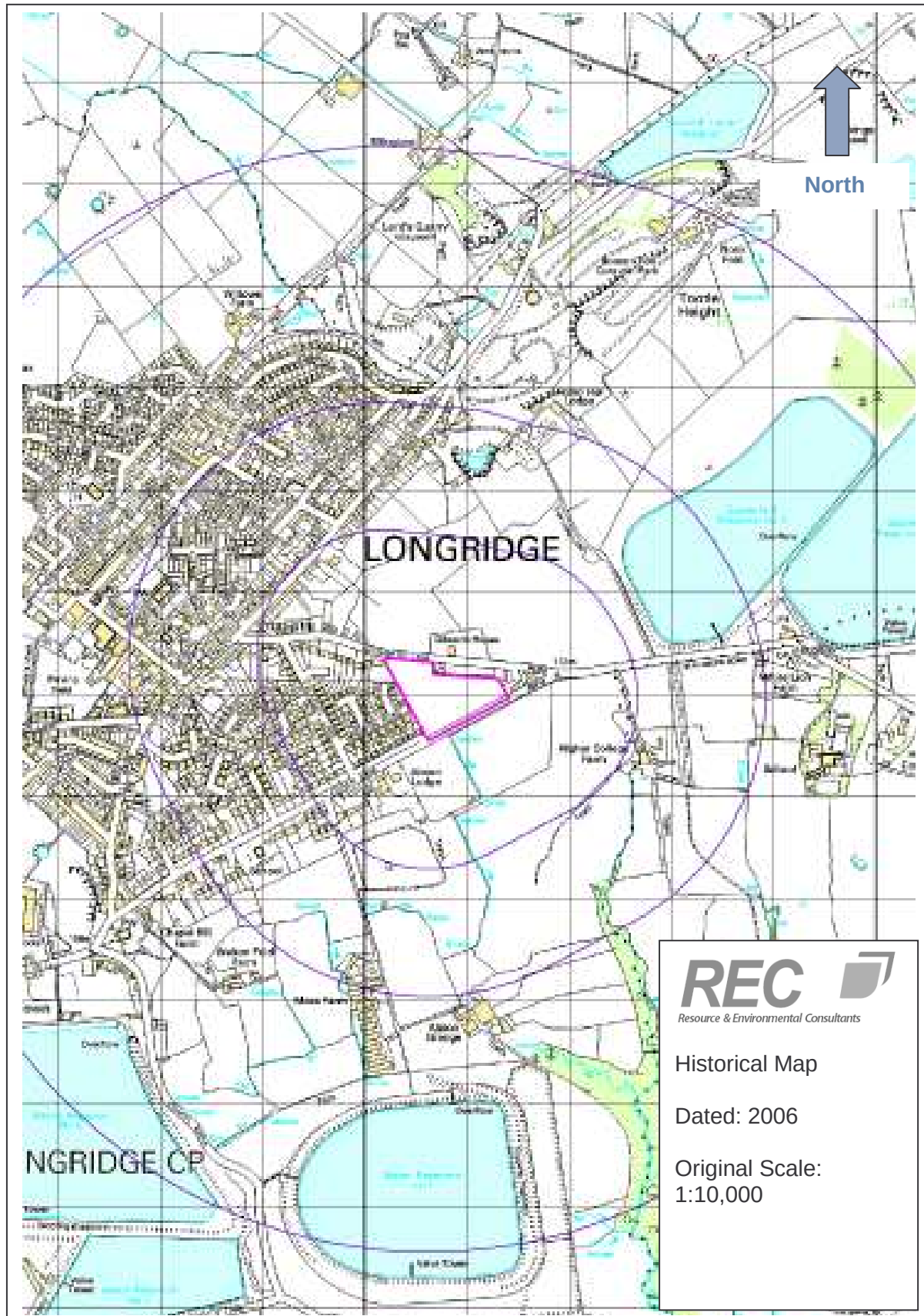
Original Scale:
1:2,500



Original Scale:
1:2,500



Original Scale:
1:10,000





APPENDIX V REC EXPLORATORY LOGS

Trial Pit Record

Trial Pit Number: TP101

Project Number: 43926

Contract Name: Dilworth Lane, Longridge

Client: Rowland Homes

Engineer: Daniel Cox

Date Started: 4/2/11

Date Completed: 4/2/11

Elevation AOD (m): N/A

Co-ordinates: N/A

Excavation Method: JCB 3CX



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SUBSURFACE PROFILE

SAMPLES AND IN-SITU TESTING

Depth (mbgl)	Legend	Description	Depth of Strata (mbgl)	Type	Depth (mbgl)	Water Level (mbgl)	P.I.D (ppm)	Field / Laboratory Testing
							0 25 50 75 100	
		Grey/brown slightly clayey slightly gravelly fine to medium SAND. Gravel is fine to coarse angular to sub-angular of sandstone and mudstone.	0.45	ES	0.40	0.60m bgl. 		
1.0		Firm to stiff orange/brown mottled grey slightly sandy silty CLAY.	1.40	HV	1.00			Peak 73.3 Residual 9.6
2.0		Brown clayey fine to medium SAND.	3.00	ES	1.50			
3.0		Trial pit completed at 3.00m bgl.						

Key

B. Bulk (Bag)

W. Water

U100. 100mm Undisturbed

U38. 38mm Undisturbed Sample

SPT. Standard Penetration Test

D. Disturbed

G. Amber Glass Jar / Bottle

CPT. Cone Penetration Test

U100. Blows (Recovery mm)

V. 40ml Glass Vial

T. Plastic Tub

N. 'N' Value

HV. Hand Shear Vane

PID. Photo Ionisation Detector

ES. Environmental Sample

Notes

Dimensions: 0.50m x 0.70m x 3.00m

Services: Prior to excavation the trial pit location was scanned with a Cable Avoidance Tool (CAT).

Stability: Stable

Groundwater: Water strike at 0.60m bgl.

Date: 16/2/11

Status: Prelim 2

Trial Pit Record

Trial Pit Number: TP102

Project Number: 43926

Contract Name: Dilworth Lane, Longridge

Client: Rowland Homes

Engineer: Daniel Cox

Date Started: 4/2/11

Date Completed: 4/2/11

Elevation AOD (m): N/A

Co-ordinates: N/A

Excavation Method: JCB 3CX



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SUBSURFACE PROFILE

SAMPLES AND IN-SITU TESTING

Depth (mbgl)	Legend	Description	Depth of Strata (mbgl)	Type	Depth (mbgl)	Water Level (mbgl)	P.I.D (ppm)	Field / Laboratory Testing
							0 25 50 75 100	
		Dark brown slightly clayey gravelly fine to medium SAND. Gravel is fine to medium sub-angular to sub-rounded of mudstone and sandstone.	0.36	ES	0.3			
1.0		Firm to stiff brown mottled grey slightly sandy silty CLAY.	1.30	ES HV	1.00 1.00			Peak 37 Residual 7.3
2.0		Firm to stiff brown with grey veining silty CLAY.	2.50	HV	2.00			Peak 86 Residual 10
3.0		Trial pit completed at 2.50m bgl.						

Key

B. Bulk (Bag)
W. Water
U100. 100mm Undisturbed
U38. 38mm Undisturbed Sample
SPT. Standard Penetration Test

D. Disturbed
G. Amber Glass Jar / Bottle
CPT. Cone Penetration Test
U100. Blows (Recovery mm)
V. 40ml Glass Vial

T. Plastic Tub
N. 'N' Value
HV. Hand Shear Vane
PID. Photo Ionisation Detector
ES. Environmental Sample

Notes

Dimensions: 0.50m x 0.70m x 2.50m

Date: 16/2/11

Services: Prior to excavation the trial pit location was scanned with a Cable Avoidance Tool (CAT).

Status: Prelim 2

Stability: Stable

Groundwater: None encountered.

Trial Pit Record

Trial Pit Number: TP103

Project Number: 43926

Contract Name: Dilworth Lane, Longridge

Client: Rowland Homes

Engineer: Daniel Cox

Date Started: 4/2/11

Date Completed: 4/2/11

Elevation AOD (m): N/A

Co-ordinates: N/A

Excavation Method: JCB 3CX



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SUBSURFACE PROFILE

SAMPLES AND IN-SITU TESTING

Depth (mbgl)	Legend	Description	Depth of Strata (mbgl)	Type	Depth (mbgl)	Water Level (mbgl)	P.I.D (ppm) 0 25 50 75 100	Field / Laboratory Testing
		Dark brown slightly clayey gravelly fine to medium SAND. Gravel is fine to medium sub-angular to sub-rounded of mudstone and sandstone.	0.40					
		Firm to stiff brown with grey veining silty CLAY.		ES HV	0.50 0.50	Strike at 0.60m bgl. 		Peak 30.3 Residual 6.6
1.0				HV	1.00			Peak 82 Residual 9.3
2.0				ES	2.00			
				HV	2.50			Peak 92.3 Residual 12
		Trial pit completed at 2.50m bgl.	2.50					
3.0								

Key

B. Bulk (Bag)

W. Water

U100. 100mm Undisturbed

U38. 38mm Undisturbed Sample

SPT. Standard Penetration Test

D. Disturbed

G. Amber Glass Jar / Bottle

CPT. Cone Penetration Test

U100. Blows (Recovery mm)

V. 40ml Glass Vial

T. Plastic Tub

N. 'N' Value

HV. Hand Shear Vane

PID. Photo Ionisation Detector

ES. Environmental Sample

Notes

Dimensions: 0.50m x 0.70m x 2.50m

Date: 16/2/11

Services: Prior to excavation the trial pit location was scanned with a Cable Avoidance Tool (CAT).

Status: Prelim 2

Stability: Stable

Groundwater: Water strike at 0.60m bgl.

Trial Pit Record

Trial Pit Number: TP104

Project Number: 43926

Contract Name: Dilworth Lane, Longridge

Client: Rowland Homes

Engineer: Daniel Cox

Date Started: 4/2/11

Date Completed: 4/2/11

Elevation AOD (m): N/A

Co-ordinates: N/A

Excavation Method: JCB 3CX



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SUBSURFACE PROFILE

SAMPLES AND IN-SITU TESTING

Depth (mbgl)	Legend	Description	Depth of Strata (mbgl)	Type	Depth (mbgl)	Water Level (mbgl)	P.I.D (ppm) 0 25 50 75 100	Field / Laboratory Testing
		Dark brown slightly clayey gravelly fine to medium SAND. Gravel is fine to medium sub-angular to sub-rounded of mudstone and sandstone.	0.38					
		Brown/orange fine to medium SAND with cobbles of sandstone.		ES	0.50			
1.0								
			1.90					
2.0		Stiff to very stiff grey/brown silty CLAY.		HV ES HV	1.90 2.00 2.00			>120 >120
				HV	2.50			>120
			3.00	HV	3.00			>120
3.0		Trial pit completed at 3.00m bgl.						

Key

B. Bulk (Bag)

W. Water

U100. 100mm Undisturbed

U38. 38mm Undisturbed Sample

SPT. Standard Penetration Test

D. Disturbed

G. Amber Glass Jar / Bottle

CPT. Cone Penetration Test

U100. Blows (Recovery mm)

V. 40ml Glass Vial

T. Plastic Tub

N. 'N' Value

HV. Hand Shear Vane

PID. Photo Ionisation Detector

ES. Environmental Sample

Notes

Dimensions: 0.50m x 0.70m x 3.00m

Services: Prior to excavation the trial pit location was scanned with a Cable Avoidance Tool (CAT).

Stability: Stable

Groundwater: Water strike at 1.80m bgl.

Date: 16/2/11

Status: Prelim 2

Trial Pit Record

Trial Pit Number: TP105

Project Number: 43926

Contract Name: Dilworth Lane, Longridge

Client: Rowland Homes

Engineer: Daniel Cox

Date Started: 4/2/11

Date Completed: 4/2/11

Elevation AOD (m): N/A

Co-ordinates: N/A

Excavation Method: JCB 3CX



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SUBSURFACE PROFILE

SAMPLES AND IN-SITU TESTING

Depth (mbgl)	Legend	Description	Depth of Strata (mbgl)	Type	Depth (mbgl)	Water Level (mbgl)	P.I.D (ppm)					Field / Laboratory Testing
							0	25	50	75	100	
		Dark brown slightly clayey gravelly fine to medium SAND. Gravel is fine to medium sub-angular to sub-rounded of mudstone and sandstone.	0.32									
		Firm to stiff brown with grey veining silty CLAY.		ES	0.50							Peak 58.6 Residual 8.3
1.0				HV	1.00							Peak 71 Residual 11
				HV	1.50							Peak 105 Residual 13.3
		Trial pit completed at 1.50m bgl.										
2.0												
3.0												

Key

B. Bulk (Bag)

W. Water

U100. 100mm Undisturbed

U38. 38mm Undisturbed Sample

SPT. Standard Penetration Test

D. Disturbed

G. Amber Glass Jar / Bottle

CPT. Cone Penetration Test

U100. Blows (Recovery mm)

V. 40ml Glass Vial

T. Plastic Tub

N. 'N' Value

HV. Hand Shear Vane

PID. Photo Ionisation Detector

ES. Environmental Sample

Notes

Dimensions: 0.50m x 0.70m x 1.50m

Date: 16/2/11

Services: Prior to excavation the trial pit location was scanned with a Cable Avoidance Tool (CAT).

Status: Prelim 2

Stability: Stable

Groundwater: None encountered.

Trial Pit Record

Trial Pit Number: TP106

Project Number: 43926

Contract Name: Dilworth Lane, Longridge

Client: Rowland Homes

Engineer: Daniel Cox

Date Started: 4/2/11

Date Completed: 4/2/11

Elevation AOD (m): N/A

Co-ordinates: N/A

Excavation Method: JCB 3CX



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SUBSURFACE PROFILE

SAMPLES AND IN-SITU TESTING

Depth (mbgl)	Legend	Description	Depth of Strata (mbgl)	Type	Depth (mbgl)	Water Level (mbgl)	P.I.D (ppm) 0 25 50 75 100	Field / Laboratory Testing
		Dark brown slightly clayey gravelly fine to medium SAND. Gravel is fine to medium sub-angular to sub-rounded of mudstone and sandstone.	0.39	ES	0.40			
		Brown/orange mottled grey slightly gravelly clayey fine to medium SAND. Gravel is fine to coarse sub-angular to sub-routine of sandstone.		HV	0.80			
1.0				ES	1.00			
			1.50					Peak 33 Residual 9.6
2.0		Trial pit completed at 1.50m bgl.						
3.0								

Key

B. Bulk (Bag)

W. Water

U100. 100mm Undisturbed

U38. 38mm Undisturbed Sample

SPT. Standard Penetration Test

D. Disturbed

G. Amber Glass Jar / Bottle

CPT. Cone Penetration Test

U100. Blows (Recovery mm)

V. 40ml Glass Vial

T. Plastic Tub

N. 'N' Value

HV. Hand Shear Vane

PID. Photo Ionisation Detector

ES. Environmental Sample

Notes

Dimensions: 0.50m x 0.70m x 1.50m

Services: Prior to excavation the trial pit location was scanned with a Cable Avoidance Tool (CAT).

Stability: Stable

Groundwater: None encountered.

Date: 2/3/11

Status: Prelim 2

Engineer: Daniel Cox

Excavation Method: JCB 3CX



<u>Notes</u>	Dimensions: 0.50m x 0.70m x 1.50m	Date: 2/3/11
	Services: Prior to excavation the trial pit location was scanned with a Cable Avoidance Tool (CAT).	Status: Prelim 2
	Stability: Stable	
	Groundwater: None encountered.	

Trial Pit Record

Trial Pit Number: TP108

Project Number: 43926

Contract Name: Dilworth Lane, Longridge

Client: Rowland Homes

Engineer: Daniel Cox

Date Started: 4/2/11

Date Completed: 4/2/11

Elevation AOD (m): N/A

Co-ordinates: N/A

Excavation Method: JCB 3CX



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SUBSURFACE PROFILE

SAMPLES AND IN-SITU TESTING

Depth (mbgl)	Legend	Description	Depth of Strata (mbgl)	Type	Depth (mbgl)	Water Level (mbgl)	P.I.D (ppm) 0 25 50 75 100	Field / Laboratory Testing
		Dark brown slightly clayey gravelly fine to medium SAND. Gravel is fine to medium sub-angular to sub-rounded of mudstone and sandstone.	0.65	ES	0.40			
1.0		Firm to stiff brown with grey veining silty CLAY.		HV	0.80			Peak 81.6 Residual 18
				ES	1.00			
			1.50	HV	1.50			>120
2.0		Trial pit completed at 1.50m bgl.						
3.0								

Key

B. Bulk (Bag)

W. Water

U100. 100mm Undisturbed

U38. 38mm Undisturbed Sample

SPT. Standard Penetration Test

D. Disturbed

G. Amber Glass Jar / Bottle

CPT. Cone Penetration Test

U100. Blows (Recovery mm)

V. 40ml Glass Vial

T. Plastic Tub

N. 'N' Value

HV. Hand Shear Vane

PID. Photo Ionisation Detector

ES. Environmental Sample

Notes

Dimensions: 0.50m x 0.70m x 1.50m

Services: Prior to excavation the trial pit location was scanned with a Cable Avoidance Tool (CAT).

Stability: Stable

Groundwater: None encountered.

Date: 2/3/11

Status: Prelim 2

Engineer: Daniel Cox

Excavation Method: JCB 3CX



<u>Notes</u>	Dimensions: 0.50m x 0.70m x 1.50m	Date: 2/3/11
	Services: Prior to excavation the trial pit location was scanned with a Cable Avoidance Tool (CAT).	Status: Prelim 2
	Stability: Stable	
	Groundwater: None encountered.	

Trial Pit Record

Trial Pit Number: TP110

Project Number: 43926

Contract Name: Dilworth Lane, Longridge

Client: Rowland Homes

Engineer: Daniel Cox

Date Started: 4/2/11

Date Completed: 4/2/11

Elevation AOD (m): N/A

Co-ordinates: N/A

Excavation Method: JCB 3CX



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SUBSURFACE PROFILE

SAMPLES AND IN-SITU TESTING

Depth (mbgl)	Legend	Description	Depth of Strata (mbgl)	Type	Depth (mbgl)	Water Level (mbgl)	P.I.D (ppm)	Field / Laboratory Testing
							0 25 50 75 100	
		Dark brown slightly clayey gravelly fine to medium sand. Gravel is fine to medium sub-angular to sub-rounded of mudstone and sandstone.	0.40	ES	0.30			
		Firm to stiff brown with grey veining silty CLAY.		HV	0.50			Peak 56.3 Residual 15
1.0								
				ES HV	1.50 1.50			Peak 102 Residual 8.6
2.0								
				HV	2.00			>120
			2.50					
		Trial pit completed at 2.50m bgl.						
3.0								

Key

B. Bulk (Bag)

W. Water

U100. 100mm Undisturbed

U38. 38mm Undisturbed Sample

SPT. Standard Penetration Test

D. Disturbed

G. Amber Glass Jar / Bottle

CPT. Cone Penetration Test

U100. Blows (Recovery mm)

V. 40ml Glass Vial

T. Plastic Tub

N. 'N' Value

HV. Hand Shear Vane

PID. Photo Ionisation Detector

ES. Environmental Sample

Notes

Dimensions: 0.50m x 0.70m x 2.50m

Date: 2/3/11

Services: Prior to excavation the trial pit location was scanned with a Cable Avoidance Tool (CAT).

Status: Prelim 2

Stability: Stable

Groundwater: None encountered.

Trial Pit Record

Trial Pit Number: TP111

Project Number: 43926

Contract Name: Dilworth Lane, Longridge

Client: Rowland Homes

Engineer: Daniel Cox

Date Started: 4/2/11

Date Completed: 4/2/11

Elevation AOD (m): N/A

Co-ordinates: N/A

Excavation Method: JCB 3CX



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SUBSURFACE PROFILE

SAMPLES AND IN-SITU TESTING

Depth (mbgl)	Legend	Description	Depth of Strata (mbgl)	Type	Depth (mbgl)	Water Level (mbgl)	P.I.D (ppm)	Field / Laboratory Testing
							0 25 50 75 100	
		Dark brown slightly clayey gravelly fine to medium sand. Gravel is fine to medium sub-angular to sub-rounded of mudstone and sandstone.	0.20					
		Firm to stiff brown with grey veining silty CLAY.		ES HV	0.50 0.50			Peak 55.3 Residual 11.6
1.0								
2.0				ES HV	2.00 2.00			Peak 114 Residual 16.6
3.0			3.00	HV	3.00			>120
		Trial pit completed at 3.00m bgl.						

Key

B. Bulk (Bag)

W. Water

U100. 100mm Undisturbed

U38. 38mm Undisturbed Sample

SPT. Standard Penetration Test

D. Disturbed

G. Amber Glass Jar / Bottle

CPT. Cone Penetration Test

U100. Blows (Recovery mm)

V. 40ml Glass Vial

T. Plastic Tub

N. 'N' Value

HV. Hand Shear Vane

PID. Photo Ionisation Detector

ES. Environmental Sample

Notes

Dimensions: 0.50m x 0.70m x 3.00m

Date: 2/3/11

Services: Prior to excavation the trial pit location was scanned with a Cable Avoidance Tool (CAT).

Status: Prelim 2

Stability: Stable

Groundwater: None encountered.

Borehole Record - Window Sample

Probehole Number: WS101

Project Number: 43926

Contract Name: Dilworth Lane, Longridge

Client: Rowland Homes

Engineer: Daniel Cox

Date Started: 4/2/11

Date Completed: 4/2/11

Elevation AOD (m): N/A

Co-ordinates: N/A

Drilling Equipment: Mini tracked window sampler rig



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SUBSURFACE PROFILE

SAMPLES AND IN-SITU TESTING

Depth (mbgl)	Legend	Description	Depth of Strata (mbgl)	Type	Depth (mbgl)	In-Situ Testing SPT / U100	Water Level (mbgl)	Monitoring Installation / Backfill
		Dark brown slightly clayey gravelly fine to medium SAND. Gravel is fine to medium sub-angular to sub-rounded of mudstone and sandstone.	0.42	ES	0.40			
1.0		Soft to firm brown/orange sandy slightly gravelly silty CLAY. Gravel is fine to medium sub-angular to sub-rounded of sandstone.	1.10	D SPT	1.00 1.00-1.45	1/1/1/2/3/2 N=8	Water strike at 1.50m bgl.	
		Brown fine to medium SAND.	1.50	ES Liner				
2.0		Firm to stiff brown mottled grey silty CLAY.	2.00	D SPT	2.00 2.00-2.45	1/1/2/3/3/3 N=11		
3.0		Stiff to very stiff brown mottled grey sandy silty CLAY.		SPT	3.00 3.00-3.45	2/2/2/3/6/7 N=18		
4.0				SPT	4.00 4.00-4.45	5/5/6/6/6/7 N=25		
			4.45					
5.0		Probehole completed at 4.45m bgl.						
6.0								

Key

B. Bulk (Bag)
W. Water
U100. 100mm Undisturbed
U38. 38mm Undisturbed Sample
SPT. Standard Penetration Test

D. Disturbed
G. Amber Glass Jar / Bottle
CPT. Cone Penetration Test
U100. Blows (Recovery mm)
V. 40ml Glass Vial

T. Plastic Tub
N. 'N' Value
HV. Hand Shear Vane
PID. Photo Ionisation Detector
ES. Environmental Sample

Notes

Groundwater: Water strike at 1.50m bgl.

Services: Prior to drilling the location was scanned with a cable avoidance tool (CAT).

Addition of water: None added.

Casing diameter: 110mm

Date logged: 2/3/11

Status: Prelim 2

Borehole Record - Window Sample

Probehole Number: WS102

Project Number: 43926

Contract Name: Dilworth Lane, Longridge

Client: Rowland Homes

Engineer: Daniel Cox

Date Started: 4/2/11

Date Completed: 4/2/11

Elevation AOD (m): N/A

Co-ordinates: N/A

Drilling Equipment: Mini tracked window sampler rig



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SUBSURFACE PROFILE

SAMPLES AND IN-SITU TESTING

Depth (mbgl)	Legend	Description	Depth of Strata (mbgl)	Type	Depth (mbgl)	In-Situ Testing SPT / U100	Water Level (mbgl)	Monitoring Installation / Backfill
		Dark brown slightly clayey gravelly fine to medium SAND. Gravel is fine to medium sub-angular to sub-rounded of mudstone and sandstone.	0.35	ES	0.30			
		Firm to stiff brown with grey veining silty CLAY.		D SPT	1.00 1.00-1.45	1/3/3/4/5/5 N=17		
1.0				ES	1.50			
		Firm to stiff brown silty sandy CLAY.	2.00	D SPT	2.00 2.00-2.45	2/2/4/3/3/4 N=14		
2.0								
		Loose grey/brown fine to medium SAND.	3.00	D SPT	3.00 3.00-3.45	2/3/4/4/6/8 N=22		
3.0								
				D SPT	4.00 4.00-4.45	2/3/3/6/6/7 N=22		
4.0								
		Probehole completed at 4.45m bgl.	4.45					
5.0								
6.0								

Key

B. Bulk (Bag)

W. Water

U100. 100mm Undisturbed

U38. 38mm Undisturbed Sample

SPT. Standard Penetration Test

D. Disturbed

G. Amber Glass Jar / Bottle

CPT. Cone Penetration Test

U100. Blows (Recovery mm)

V. 40ml Glass Vial

T. Plastic Tub

N. 'N' Value

HV. Hand Shear Vane

PID. Photo Ionisation Detector

ES. Environmental Sample

Notes

Groundwater: Water strike at 3.00m bgl.

Services: Prior to drilling the location was scanned with a cable avoidance tool (CAT).

Addition of water: None added.

Casing diameter: 110mm

Date logged: 2/3/11

Status: Prelim 2

Borehole Record - Window Sample

Probehole Number: WS103

Project Number: 43926

Contract Name: Dilworth Lane, Longridge

Client: Rowland Homes

Engineer: Daniel Cox

Date Started: 4/2/11

Date Completed: 4/2/11

Elevation AOD (m): N/A

Co-ordinates: N/A

Drilling Equipment: Mini tracked window sampler rig



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SUBSURFACE PROFILE

SAMPLES AND IN-SITU TESTING

Depth (mbgl)	Legend	Description	Depth of Strata (mbgl)	Type	Depth (mbgl)	In-Situ Testing SPT / U100	Water Level (mbgl)	Monitoring Installation / Backfill
		Dark brown slightly clayey gravelly fine to medium SAND. Gravel is fine to medium sub-angular to sub-rounded of mudstone and sandstone.	0.35	ES	0.30			
1.0		Firm to stiff brown silty CLAY with rare gravel. Gravel is fine to medium sub-rounded to rounded of mudstone.		ES D SPT	1.00 1.00 1.00-1.45	1/2/3/3/4/4 N=14		
2.0				D SPT	2.00 2.00-2.45	1/1/2/3/3/3 N=11		
3.0				D SPT	3.00 3.00-3.45	1/1/2/2/2/3 N=9		
4.0				D SPT	4.00 4.00-4.45	2/2/3/2/3/3 N=11		
5.0				D SPT	5.00 5.00-5.45	3/3/4/4/4/5 N=17		
		Probehole completed at 5.45m bgl.	5.45					
6.0								

Key

B. Bulk (Bag)

W. Water

U100. 100mm Undisturbed

U38. 38mm Undisturbed Sample

SPT. Standard Penetration Test

D. Disturbed

G. Amber Glass Jar / Bottle

CPT. Cone Penetration Test

U100. Blows (Recovery mm)

V. 40ml Glass Vial

T. Plastic Tub

N. 'N' Value

HV. Hand Shear Vane

PID. Photo Ionisation Detector

ES. Environmental Sample

Notes

Groundwater: None encountered.

Services: Prior to drilling the location was scanned with a cable avoidance tool (CAT).

Addition of water: None added.

Casing diameter: 110mm

Date logged: 2/3/11

Status: Prelim 2

Borehole Record - Window Sample

Probehole Number: WS104

Project Number: 43926

Contract Name: Dilworth Lane, Longridge

Client: Rowland Homes

Engineer: Daniel Cox

Date Started: 4/2/11

Date Completed: 4/2/11

Elevation AOD (m): N/A

Co-ordinates: N/A

Drilling Equipment: Mini tracked window sampler rig



Osprey House
Pacific Quay
Broadway
Manchester, M50 2UE
Tel: 0161 868 1300 / Fax: 0161 868 1301
www.recltd.co.uk

SUBSURFACE PROFILE

SAMPLES AND IN-SITU TESTING

Depth (mbgl)	Legend	Description	Depth of Strata (mbgl)	Type	Depth (mbgl)	In-Situ Testing SPT / U100	Water Level (mbgl)	Monitoring Installation / Backfill
		Dark brown slightly clayey gravelly fine to medium SAND. Gravel is fine to medium sub-angular to sub-rounded of mudstone and sandstone.	0.42					
		Firm to stiff brown with grey veining silty CLAY.		ES Liner	0.50 0.50-1.00			
1.0				D SPT	1.00 1.00-1.45	2/2/3/4/4/5 N=16		
		Dark brown fine to medium SAND.	1.80	ES D SPT	2.00 2.00 2.00-2.45	1/1/1/1/1/1 N=4		
2.0								
		Soft brown mottled grey silty CLAY.	2.50					
3.0				D SPT	3.00 3.00-3.45	1/1/1/1/1/1 N=4		
		Brown fine to medium SAND.	3.45					
		Probehole completed at 3.45m bgl.						
4.0								
5.0								
6.0								

Key

B. Bulk (Bag)

W. Water

U100. 100mm Undisturbed

U38. 38mm Undisturbed Sample

SPT. Standard Penetration Test

D. Disturbed

G. Amber Glass Jar / Bottle

CPT. Cone Penetration Test

U100. Blows (Recovery mm)

V. 40ml Glass Vial

T. Plastic Tub

N. 'N' Value

HV. Hand Shear Vane

PID. Photo Ionisation Detector

ES. Environmental Sample

Notes

Groundwater: Water strike at 1.80m bgl.

Services: Prior to drilling the location was scanned with a cable avoidance tool (CAT).

Addition of water: None added.

Casing diameter: 110mm

Date logged: 2/3/11

Status: Prelim 2

Borehole Record - Window Sample

Probehole Number: WS105

Project Number: 43926

Contract Name: Dilworth Lane, Longridge

Client: Rowland Homes

Engineer: Daniel Cox

Date Started: 4/2/11

Date Completed: 4/2/11

Elevation AOD (m): N/A

Co-ordinates: N/A

Drilling Equipment: Mini tracked window sampler rig



Osprey House
Pacific Quay
Broadway
Manchester, M50 2UE
Tel: 0161 868 1300 / Fax: 0161 868 1301
www.recltd.co.uk

SUBSURFACE PROFILE

SAMPLES AND IN-SITU TESTING

Depth (mbgl)	Legend	Description	Depth of Strata (mbgl)	Type	Depth (mbgl)	In-Situ Testing SPT / U100	Water Level (mbgl)	Monitoring Installation / Backfill
0.0		Dark brown slightly clayey gravelly fine to medium SAND. Gravel is fine to medium sub-angular to sub-rounded of mudstone and sandstone.	0.20	ES	0.20			
0.2		Firm to stiff mottled grey slightly sandy gravelly silty CLAY. Gravel is fine to medium sub-rounded to rounded of sandstone and mudstone.		Liner	0.50-1.00			
1.0				D SPT	1.00-1.45	2/2/2/3/3/3 N=11		
2.0				ES	1.50			
2.0				D SPT	2.00-2.45	1/2/2/3/3/4 N=12		
3.0				D SPT	3.00-3.45	1/2/3/3/3/3 N=12		
3.45		Probehole completed at 3.45m bgl.						
4.0								
5.0								
6.0								

Key

B. Bulk (Bag)

W. Water

U100. 100mm Undisturbed

U38. 38mm Undisturbed Sample

SPT. Standard Penetration Test

D. Disturbed

G. Amber Glass Jar / Bottle

CPT. Cone Penetration Test

U100. Blows (Recovery mm)

V. 40ml Glass Vial

T. Plastic Tub

N. 'N' Value

HV. Hand Shear Vane

PID. Photo Ionisation Detector

ES. Environmental Sample

Notes

Groundwater: None encountered.

Services: Prior to drilling the location was scanned with a cable avoidance tool (CAT).

Addition of water: None added.

Casing diameter: 110mm

Date logged: 2/3/11

Status: Prelim 2

APPENDIX VI CHEMICAL TESTING RESULTS



Scientific Analysis Laboratories is a
limited company registered in England and
Wales (No 2514788) whose address is at
Hadfield House, Hadfield Street, Manchester M16 9FE

Scientific Analysis Laboratories

Certificate of Analysis

Hadfield House
Hadfield Street
Cornbrook
Manchester
M16 9FE
Tel : 0161 874 2400
Fax : 0161 874 2468

Report Number: 227194-1

Date of Report: 15-Feb-2011

Customer: Resource Environmental Consultants Ltd
Osprey House
Pacific Quay
Broadway
Salford
M50 2UE

Customer Contact: Mr Martin Dyer

Customer Job Reference: 43926

Customer Site Reference: Dilworth Lane, Longridge

Date Job Received at SAL: 08-Feb-2011

Date Analysis Started: 08-Feb-2011

Date Analysis Completed: 15-Feb-2011

The results reported relate to samples received in the laboratory
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
Tests covered by this certificate were conducted in accordance with SAL SOPs



1549

Report checked
and authorised by :
Mr Ross Walker
Customer Services Manager

Issued by :
Mr Ross Walker
Customer Services Manager

Analysed as Soil

[illegible]

Analysed as Soil

SAL Reference					227194 001	227194 004	227194 007	227194 010	227194 015	227194 020	227194 024	227194 030
Customer Sample Reference					TP101	TP102	TP104	TP106	TP108	TP111	WS102	WS105
Date Sampled					04-FEB-2011	04-FEB-2011	04-FEB-2011	04-FEB-2011	04-FEB-2011	04-FEB-2011	04-FEB-2011	04-FEB-2011
Determinand	Method	Test Sample	LOD	Units								
Naphthalene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02
Fluorene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02
Phenanthrene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.03	0.11
Anthracene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.03
Fluoranthene	T149	AR	0.01	mg/kg	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.13
Pyrene	T149	AR	0.01	mg/kg	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.11
Benzo(a)Anthracene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.03
Chrysene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03
Benzo(b/k)Fluoranthene	T149	AR	0.01	mg/kg	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.06
Benzo(a)Pyrene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02
Indeno(123-cd)Pyrene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Dibenzo(ah)Anthracene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(ghi)Perylene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
PAH(total)	T149	AR	0.01	mg/kg	0.04	0.03	0.03	0.03	0.04	0.04	0.11	0.58

SAL Reference: 227194 Project Site: Dilworth Lane, Longridge Customer Reference: 43926 Soil Analysed as Soil REC Suite C (Banded TPH C5-C35)												
SAL Reference				227194 001	227194 004	227194 007	227194 010	227194 015	227194 020	227194 024	227194 030	
Customer Sample Reference				TP101	TP102	TP104	TP106	TP108	TP111	WS102	WS105	
Date Sampled				04-FEB-2011	04-FEB-2011	04-FEB-2011	04-FEB-2011	04-FEB-2011	04-FEB-2011	04-FEB-2011	04-FEB-2011	
Determinand	Method	Test Sample	LOD	Units								
TPH (C5-C6)	T54	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TPH (C6-C8)	T54	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TPH (C8-C10)	T54	AR	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
TPH (C10-C12)	T8	AR	1	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1
TPH (C12-C16)	T8	AR	1	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1
TPH (C16-C21)	T8	AR	1	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1
TPH (C21-C35)	T8	AR	1	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1

SAL Reference: 227194 Project Site: Dilworth Lane, Longridge Customer Reference: 43926 Soil Analysed as Soil Miscellaneous												
SAL Reference				227194 001	227194 004	227194 007	227194 010	227194 015	227194 020	227194 024	227194 030	
Customer Sample Reference				TP101	TP102	TP104	TP106	TP108	TP111	WS102	WS105	
Date Sampled				04-FEB-2011	04-FEB-2011	04-FEB-2011	04-FEB-2011	04-FEB-2011	04-FEB-2011	04-FEB-2011	04-FEB-2011	
Determinand	Method	Test Sample	LOD	Units								
Asbestos ID	T27	AR			N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Total Organic Carbon	T21	AR	0.1	%	0.2	-	-	-	0.5	-	-	-

Index to symbols used in 227194-1

Value	Description
AR	As Received
N.D.	Not Detected
S	Analysis was subcontracted
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Method Index

Value	Description
T149	GC/MS (SIR)
T4	Colorimetry
T8	GC/FID
T21	OX/IR
T6	ICP/OES
T27	PLM
T54	GC/MS (Headspace)
T7	Probe

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Naphthalene	T149	AR	0.01	mg/kg	U	001,004,007,010,015,020,024,030
Acenaphthylene	T149	AR	0.01	mg/kg	U	001,004,007,010,015,020,024,030
Acenaphthene	T149	AR	0.01	mg/kg	U	001,004,007,010,015,020,024,030
Fluorene	T149	AR	0.01	mg/kg	U	001,004,007,010,015,020,024,030
Phenanthrene	T149	AR	0.01	mg/kg	U	001,004,007,010,015,020,024,030
Anthracene	T149	AR	0.01	mg/kg	U	001,004,007,010,015,020,024,030
Fluoranthene	T149	AR	0.01	mg/kg	U	001,004,007,010,015,020,024,030
Pyrene	T149	AR	0.01	mg/kg	U	001,004,007,010,015,020,024,030
Benzo(a)Anthracene	T149	AR	0.01	mg/kg	U	001,004,007,010,015,020,024,030

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Chrysene	T149	AR	0.01	mg/kg	U	001,004,007,010,015,020,024,030
Benzo(b/k)Fluoranthene	T149	AR	0.01	mg/kg	U	001,004,007,010,015,020,024,030
Benzo(a)Pyrene	T149	AR	0.01	mg/kg	U	001,004,007,010,015,020,024,030
Indeno(123-cd)Pyrene	T149	AR	0.01	mg/kg	U	001,004,007,010,015,020,024,030
Dibenzo(ah)Anthracene	T149	AR	0.01	mg/kg	U	001,004,007,010,015,020,024,030
Benzo(ghi)Perylene	T149	AR	0.01	mg/kg	U	001,004,007,010,015,020,024,030
PAH(total)	T149	AR	0.01	mg/kg	U	001,004,007,010,015,020,024,030
TPH (C5-C6)	T54	AR	0.1	mg/kg	N	001,004,007,010,015,020,024,030
TPH (C6-C8)	T54	AR	0.1	mg/kg	N	001,004,007,010,015,020,024,030
TPH (C8-C10)	T54	AR	0.10	mg/kg	N	001,004,007,010,015,020,024,030
TPH (C10-C12)	T8	AR	1	mg/kg	U	001,004,007,010,015,020,024,030
TPH (C12-C16)	T8	AR	1	mg/kg	U	001,004,007,010,015,020,024,030
TPH (C16-C21)	T8	AR	1	mg/kg	U	001,004,007,010,015,020,024,030
TPH (C21-C35)	T8	AR	1	mg/kg	U	001,004,007,010,015,020,024,030
Asbestos ID	T27	AR			SU	001,004,007,010,015,020,024,030
Total Organic Carbon	T21	AR	0.1	%	N	001,015
Arsenic	T6	AR	1	mg/kg	U	001,004,007,010,015,020,024,030
Cadmium	T6	AR	1	mg/kg	U	001,004,007,010,015,020,024,030
Chromium	T6	AR	1	mg/kg	U	001,004,007,010,015,020,024,030
Lead	T6	AR	1	mg/kg	U	001,004,007,010,015,020,024,030
Mercury	T6	AR	1	mg/kg	U	001,004,007,010,015,020,024,030
Selenium	T6	AR	3	mg/kg	U	001,004,007,010,015,020,024,030
Copper	T6	AR	1	mg/kg	U	001,004,007,010,015,020,024,030
Nickel	T6	AR	1	mg/kg	U	001,004,007,010,015,020,024,030
Zinc	T6	AR	1	mg/kg	U	001,004,007,010,015,020,024,030
pH	T7	AR			U	001,004,007,010,015,020,024,030
SO4(Total)	T6	AR	0.01	%	N	001,004,007,010,015,020,024,030
SO4(2:1)	T6	AR	0.1	g/l	N	001,004,007,010,015,020,024,030
Cyanide(Total)	T4	AR	1	mg/kg	U	001,004,007,010,015,020,024,030
Phenols(Mono)	T4	AR	1	mg/kg	U	001,004,007,010,015,020,024,030
Chromium VI	T6	AR	1	mg/kg	N	001,004,007,010,015,020,024,030

APPENDIX VII ORIGIN OF TIER I VALUES

ORIGIN OF REC TIER I VALUES

Constituent	Origin of Risk Assessment Value
Arsenic	2009 SGV
Cadmium	LQM CIEH 2 nd Edition 2009
Chromium	LQM CIEH 2 nd Edition 2009
Lead	Half 2003 EA SGV based on planned target blood lead level reduction to 5µg/l.
Mercury	2009 SGV
Nickel	2009 SGV
Selenium	Soil guideline value, DEFRA/Environment Agency
Copper	LQM CIEH 2 nd Edition 2009
Zinc	LQM CIEH 2 nd Edition 2009
Cyanide - Total	CLEA 1.06 Derived Value
Phenols - Total.	LQM CIEH 2 nd Edition 2009 – 1% SOM
Naphthalene	General Assessment Criteria (GAC) developed by CIEH / LQM the using CLEA 1-06 with supporting data from SR3, SR7 and existing Tox report where applicable. 1% SOM
Acenaphthylene	
Acenaphthene	
Fluorene	
Phenanthrene	
Anthracene	
Fluoranthene	
Pyrene	
Benzo(a)Anthracene ⁽ⁱ⁾	
Chrysene	
Benzo(b/k)Fluoranthene ⁽ⁱⁱⁱ⁾	
Benzo(a)Pyrene	
Indeno(123-cd)Pyrene	
Dibenzo(a,h)Anthracene	
Benzo(ghi)Perylene	
TPH C ₅ -C ₆ (aliphatic)	
TPH C ₆ -C ₈ (aliphatic)	
TPH C ₈ -C ₁₀ (aliphatic)	
TPH C ₁₀ -C ₁₂ (aliphatic)	
TPH C ₁₂ -C ₁₆ (aromatic)	
TPH C ₁₆ -C ₂₁ (aromatic)	
TPH C ₂₁ -C ₃₅ (aromatic)	

APPENDIX VIII GEOTECHNICAL TESTING RESULTS



LABORATORY REPORT



4043

Contract Number: PSL11/0405

Client's Reference:

Report Date: 28 February 2011

Client Name: REC Resource & Environmental Consultants Ltd
Osprey House
Pacific Quay
Broadway
Manchester
M50 2UE

For the attention of: Dan Cox

Contract Title: Dilworth Lane, Longridge 43926

Date Received: 21-February-11

Date Commenced: 21-February-11

Date Completed: 28-February-11

Notes: Observations and Interpretations are outside the UKAS Accreditation

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

Checked and Approved Signatories:

R Gunson
(Director)

A Watkins
(Director)

M Beastall
(Laboratory Manager)

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

[illegible]

Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date
<i>Mar</i>	28/02/11	<i>H. bus</i>	28/02/11	<i>H. bus</i>	28/02/11
DILWORTH LANE, LONGRIDGE.				Contract No: PSL11/0405	
				Client Ref: 43926	

SUMMARY OF SOIL CLASSIFICATION TESTS

(B.S. 1377 : PART 2 : 1990)

[illegible]

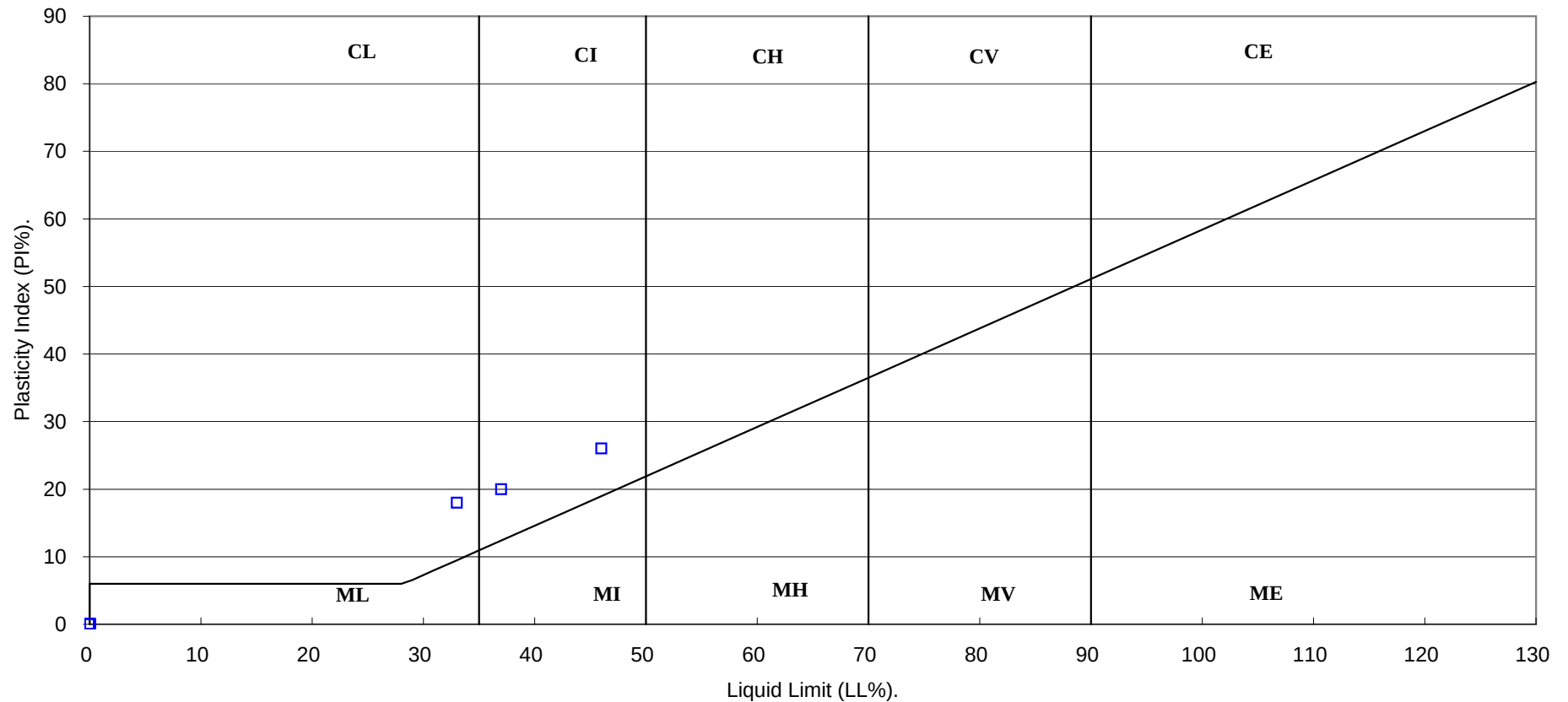
SYMBOLS : NP : Non Plastic

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

PSL Professional Soils Laboratory	Compiled by	Date	Checked by	Date	Approved by	Date
	<i>Mat</i>	28/02/11	<i>H. bus</i>	28/02/11	<i>H. bus</i>	28/02/11
	DIL WORTH LANE, LONGRIDGE.				Contract No: PSL11/0405	
					Client Ref: 43926	

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(B.S.5930 : 1999)



PSL

Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date
<i>Mar</i>	28/02/11	<i>H. S.</i>	28/02/11	<i>H. S.</i>	28/02/11
DILWORTH LANE, LONGRIDGE.				Contract No:	PSL11/0405
				Client Ref:	43926

Undrained Shear Strength in Triaxial Compression

without measurement of Pore Pressure

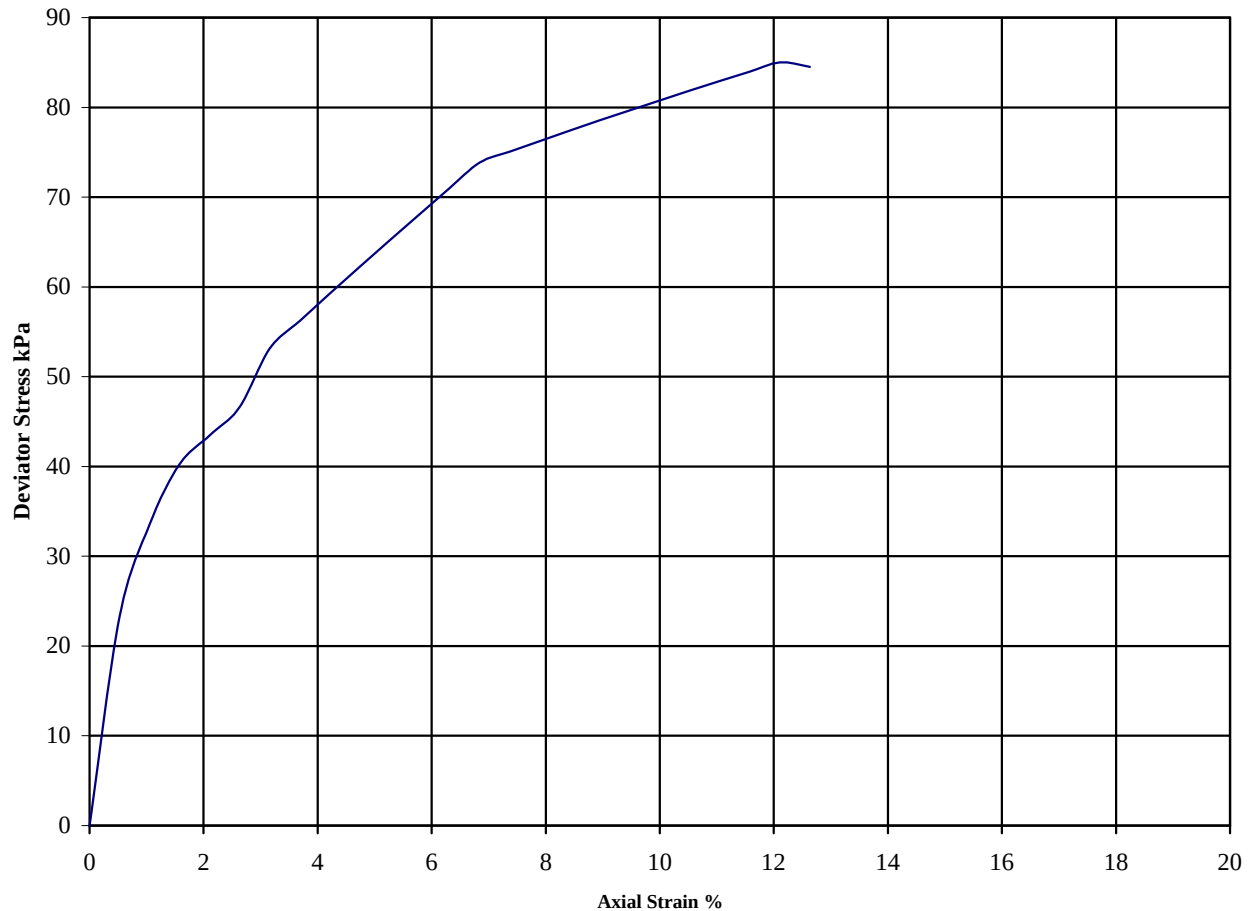
B.S. 1377 : Part 7 : Clause 8 : 1990

Borehole Number: WS101

Depth (m): 1.50

Sample Number 14

Sample Type: U



Diameter (mm):		38	Height (mm):		76	Test:	38 mm Single Stage.		
Specimen	Moisture	Bulk	Dry	Cell	Deviator	Cohesion	Failure	Mode	Remarks
	Content	Density	Density	Pressure	Stress		Strain	of	See summary of soil descriptions.
	(%)	(Mg/m3)	(Mg/m3)	(kPa)	(kPa)	(kPa)	(%)	Failure	
	A	35	1.89	1.40	35	85	43	12.1	

Checked and Approved By

Date

H. S. S.

28/02/11

PSL

Professional Soils Laboratory

DILWORTH LANE, LONGRIDGE.

Contract No:

PSL11/0405

Undrained Shear Strength in Triaxial Compression

without measurement of Pore Pressure

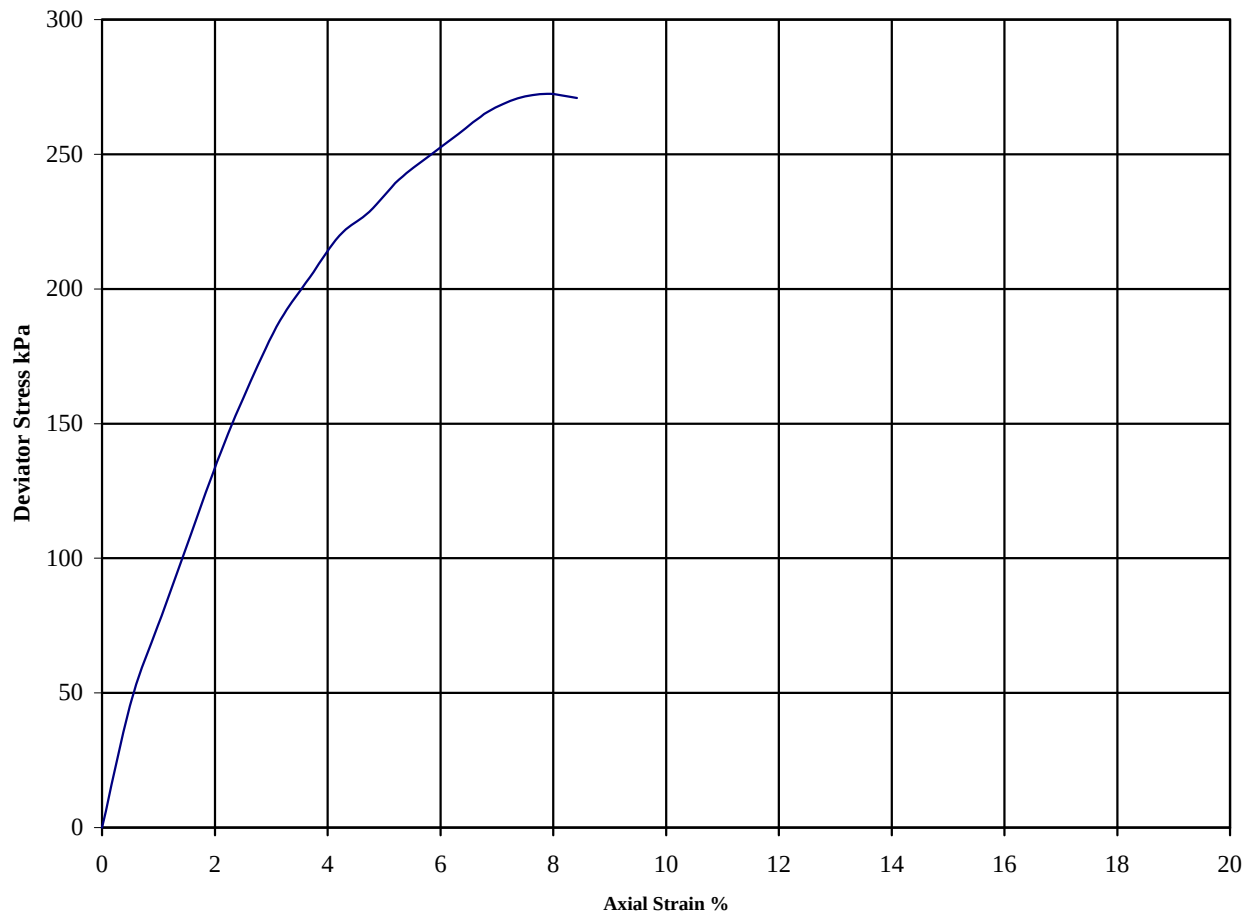
B.S. 1377 : Part 7 : Clause 8 : 1990

Borehole Number: WS103

Depth (m): 1.50

Sample Number 14

Sample Type: U



Diameter (mm):		38		Height (mm):		76		Test:	38 mm Single Stage.	
Specimen	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Deviator Stress (kPa)	Cohesion (kPa)	Failure Strain (%)	Mode of Failure	Remarks	
A	26	2.01	1.59	35	272	136	7.9	Brittle	See summary of soil descriptions.	

Checked and Approved By

Date

A. S. S.

28/02/11

PSL

Professional Soils Laboratory

DILWORTH LANE, LONGRIDGE.

Contract No:

PSL11/0405

Undrained Shear Strength in Triaxial Compression

without measurement of Pore Pressure

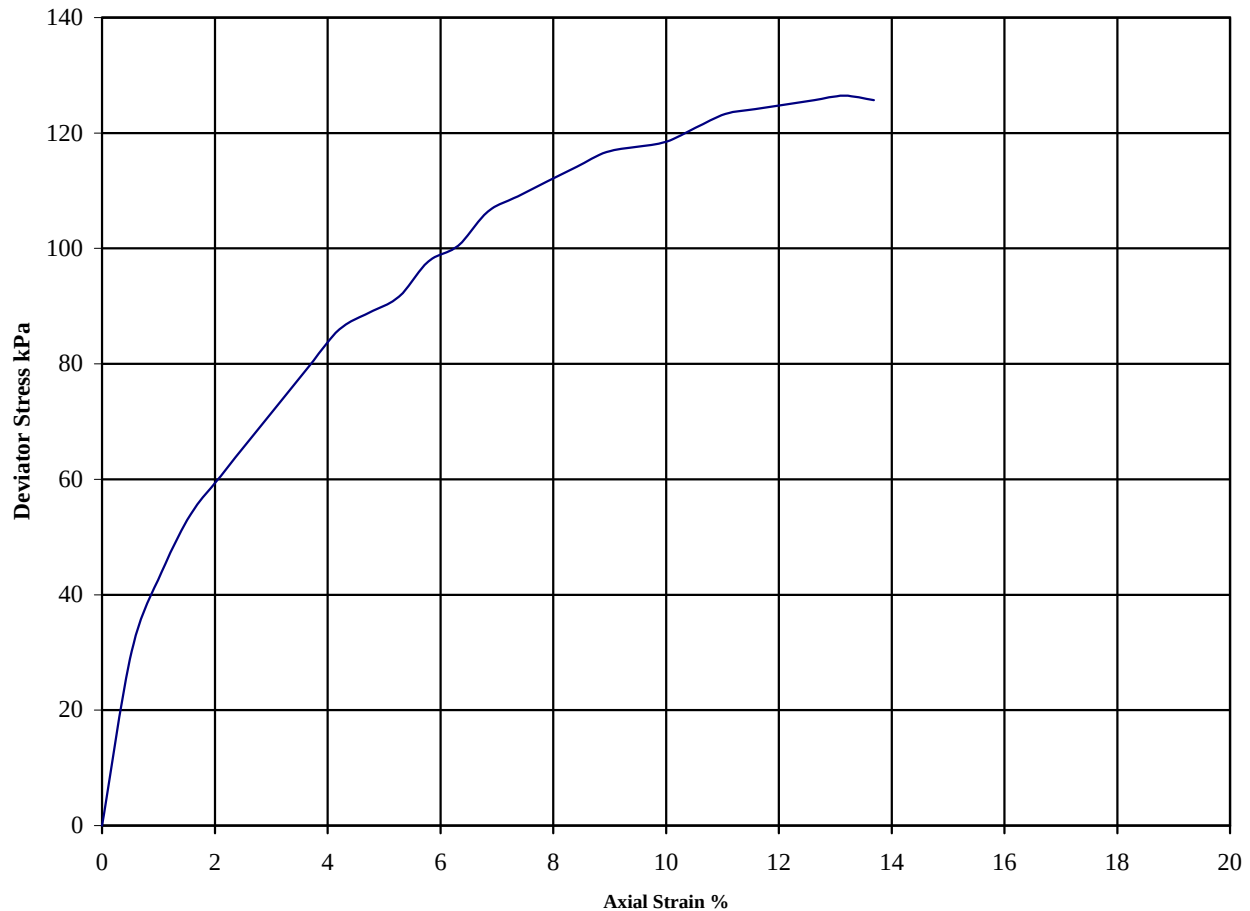
B.S. 1377 : Part 7 : Clause 8 : 1990

Borehole Number: WS104

Depth (m): 0.50

Sample Number 14

Sample Type: U



Diameter (mm):		38	Height (mm):		76	Test:	38 mm Single Stage.		
Specimen	Moisture	Bulk	Dry	Cell	Deviator	Cohesion	Failure	Mode	Remarks
	Content	Density	Density	Pressure	Stress		Strain	of	See summary of soil descriptions.
	(%)	(Mg/m3)	(Mg/m3)	(kPa)	(kPa)	(kPa)	(%)	Failure	
	A	32	1.91	1.44	20	126	63	13.2	

Checked and Approved By

Date

H. Smith

28/02/11

PSL

Professional Soils Laboratory

DILWORTH LANE, LONGRIDGE.

Contract No:

PSL11/0405

Undrained Shear Strength in Triaxial Compression

without measurement of Pore Pressure

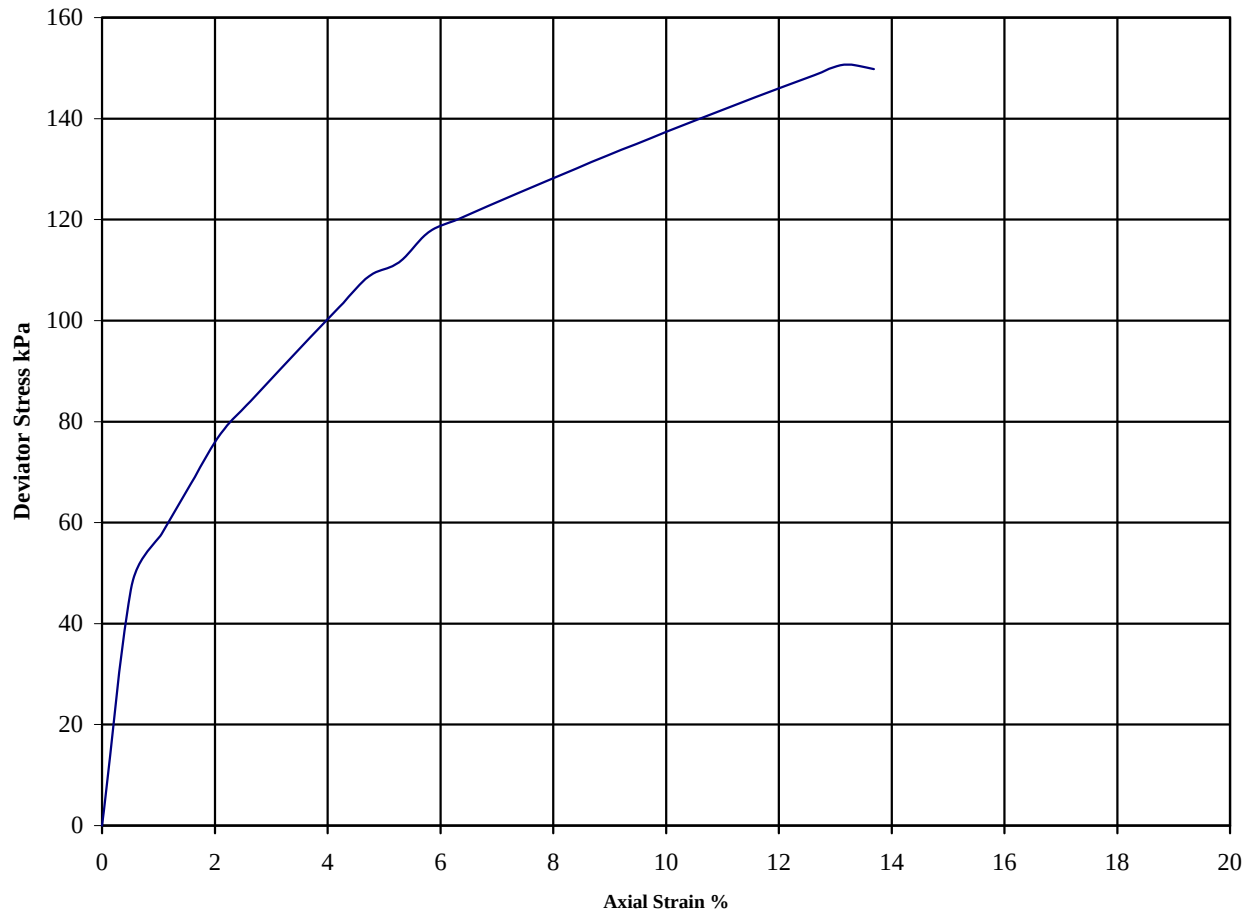
B.S. 1377 : Part 7 : Clause 8 : 1990

Borehole Number: WS105

Depth (m): 0.50

Sample Number 14

Sample Type: U



Diameter (mm):		38	Height (mm):		76	Test:	38 mm Single Stage.		
Specimen	Moisture	Bulk	Dry	Cell	Deviator	Cohesion	Failure	Mode	Remarks
	Content	Density	Density	Pressure	Stress		Strain	of	See summary of soil descriptions.
	(%)	(Mg/m3)	(Mg/m3)	(kPa)	(kPa)	(kPa)	(%)	Failure	
	A	24	2.02	1.62	20	151	75	13.2	

Checked and Approved By

Date

H. S.

28/02/11

PSL

Professional Soils Laboratory

DILWORTH LANE, LONGRIDGE.

Contract No:

PSL11/0405

CD CONTAINING
ENVIRONMENTAL & GEOLOGICAL DATA
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