

**PHASE I & PHASE II GEO-ENVIRONMENTAL
SITE INVESTIGATION**

**10 & 12 St James' Lane
Muswell Hill
London
N10 3DB**

**REC Report: 20436/Report 1.1
Issued: July 2013**

Prepared for:

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QUALITY ASSURANCE

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EXECUTIVE SUMMARY

Site Address	10 & 12 St James' Lane, Muswell Hill, London, N103DB
National Grid Reference	528666, 189359
Site Area	0.02 Ha

Preliminary Geotechnical Assessment

Ground Conditions The underlying clay deposits maybe subject to heave or swell should existing trees be removed or planted as part of the proposed development.

Instability The site is not situated in an area affected by coal mining.

Initial Conceptual Site Model (CSM)

On site potential sources of contamination have been identified including Asbestos Containing Materials (ACM), inorganic and organic impact associated with the historical redevelopment of the site. These may pose a risk to the future site users via dermal contact and direct ingestion of soils.

Offsite sources such as PAHs from the nearby railway line, and unidentified storage tanks surrounding the site, are unlikely to adversely affect human health given the distance from the site and the substances' low mobility.

Site Investigation

Investigation Findings	Made Ground – Clayey, gravelly sand with brick and concrete	0.0 to ~1.5m
	Natural Strata – Firm to stiff sandy Clay (Dollis Hill member)	1.5 to 5.00m
	Sulphate Class (natural)	DS1
	Plasticity (natural)	Low to Medium
	Permeability (natural)	1.55×10^{-6} to 2.37×10^{-6}
	Groundwater	Ca.1.4m to 2.4m
	Ground Gas	Green
Instability	Site is unaffected by coal mining. No special precautions required.	

Geotechnical Assessment

Compressible Ground and Subsidence Hazards – No hazard. No special precautions with regard to foundations anticipated.

It has been found that the underlying soils were predominantly cohesive in matrix and as such are unlikely to provide a high degree of soakage potential for drainage systems.

The Design Sulphate Class for the site is DS-1 and the Aggressive Environment for Concrete Class is AC-1s. It is recommended that any concrete used below ground on the site is designed for this class of environment.

It is recommended that deep piled foundations be adopted at between 3.0-5.0m bgl due to encountered shallow surface very soft to soft fine grained soils.

Revised Conceptual Site Model

The Tier I Human Health Risk has identified concentrations of constituents of concern that exceed the Tier I screening values for the protection of human health.

The ground gas assessment indicates a low risk to future site users.

Recommendations

REC recommends remedial works be undertaken within areas of proposed soft landscaping across the site. Remediation should include removal of soils within soft landscaping areas to a depth of 600mm or natural strata, whichever is encountered sooner. The area should then be backfilled with clean inert soil complying with the Tier I screening criteria and validated by a suitably qualified geo-environmental consultant.

Given that Asbestos fibres in soil were detected, consideration should be made to the Control of Asbestos Regulations (2012) and the use of appropriate PPE when removing the Made Ground from the site.

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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 Romala Design Ltd to undertake a Phase I and II Intrusive Investigation at the rear of number 10 & 12, St James' Road, Muswell Hill, London, N103DB.

The scope of work consisted of an intrusive ground investigation, comprising of three (3no.) window samples (max depth 5.0m bgl) and four (4 no.) hand dug trial holes (max depth 2.0m bgl) with hand shear vane testing of near surface fine grained soils and the installation of three groundwater/ground gas monitoring stations.

1.2 Proposed Development

The proposed development includes a new residential dwelling comprising of two storeys and 3 bedrooms. Also included is a subterranean garage/storage space, an over-ground garage and an access driveway. The land surrounding the proposed structures will be landscaped. A proposed site layout plan is prepared in figure 2, Appendix III

1.3 Objectives

The objectives of the geo-environmental investigation are to:

- Review historical plans, geology, hydrogeology, site sensitivity, flood-plain issues, mining records and any local authority information available in order to complete a Desk Study in line with Environment Agency (EA) document Model Procedures for the Management of Contaminated Land (Contaminated Land Report 11 (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 floor slabs;
- Provide an assessment of the soakage of the underlying soils to assist in the design of infiltration based SuDS.
- Provide recommendations regarding future works required.

1.4 Limitations

The limitations of this report are presented in Appendix I.

1.5 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 Details

Site Address	10 & 12 St James' Lane, Muswell Hill, London, N103DB
National Grid Reference	528666, 189359
Site Area	0.02 Ha

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

A site location map is presented in Appendix III.

2.2 Current Site Use

Site Description

The site comprised a roughly rectangular plot of land formally used as a garage complex. The site measures 0.02 hectares and features two main areas, a raised grassed area across the western portion of the site, and the former garages to the east.

Access to the site is gained via a drive which runs between number 10 and 12 of St James' Road. At the end of the drive was a locked gate.

To the east stand the remnants of 5 garage units which had been demolished and the rubble removed from site. An additional unit was still in use in the north east corner of the site. The remaining garage was used to store electrical goods and building materials. There was a toilet and sink in the corner of the garage. The removal of 5 of the garage units left behind a large amount of hard concrete standing, which covered the entirety of the eastern portion of the plot.

The western portion of the site was raised by 1.30 meters above the rest of the site. This area was grassed soft landscape with evidence of a bonfire in the centre.

A retaining wall, 3.3m in height, formed the southern boundary of the site. The elevation of the neighbouring garden to the south was 1.1m from the top of the boundary wall.

Hazardous Materials Storage

No above ground storage tanks (AST) or Underground Storage Tanks (USTs) were observed at the site.

Polychlorinated Biphenyls (PCBs)

No equipment that may potentially contain PCBs was observed at the site.

Waste Storage

No potentially hazardous waste streams are generated at the site.

Drainage Issues

A foul sewer was encountered across the North East corner of the site, which is assumed to run north along the driveway to the main sewer system on St James' Road.

2.3 Surrounding Area

The surrounding land uses are summarised below:

Direction	Land Use
North	Immediately north of the site is St James' Lane, which runs in an approximately NW-SE direction. A row of early 20 th century house are found on the opposite side of the road.
East	To the East of the site are a number of houses, which run perpendicular with the lane. Immediately to the East is Bishop's View Court, a large retirement home, with an associated garden.
South	Residential houses and associated gardens.
West	St James' Church and the vicarage are located to the West of the site. A screen of tall trees blocks the church from view.

3.0 SITE HISTORY

3.1 On-Site Historical Development

A review of historical mapping pertinent to the site is summarised in Table 3.1 below.

Table 3.1 Summary of Potentially Contaminative Historical Land Uses

Map Edition	Historical Land Use
1865 (1:2500)	The site forms part of a large open field.
1896 (1:2500)	No significant change in land use.
1913 (1:2500)	No significant change in land use
1950 (1:2500)	A row of 6 no. vehicle garages built along the eastern portion of the site.
1966 (1:2500)	No significant change in land use
1970 (1:2500)	No significant change in land use
1983 (1:2500)	No significant change in land use
1991 (1:2500)	No significant change in land use

3.2 Off-Site Historical Development

A review of potentially contaminative uses identified on historical Ordnance Survey maps within a 250m radius of the site is summarised below in Table 3.2.

Table 3.2 Summary of Potentially Contaminative Off-Site Historical Land Uses

Surrounding Feature	Distance	Dates	Direction
Railway Line (Embankment)	70m	<i>Pre 1894 - Post 1950</i>	S
Unidentified Above ground storage tank	150m	<i>Pre 1950 - Post 1970</i>	SW
Unidentified Above ground storage tank	150m	<i>Pre 1950 - Post 1970</i>	SW
Motor garage	200m	<i>Pre 1950 – Post 1970</i>	N

3.3 Planning History

REC has undertaken a review of on-line planning records held by Haringey Borough Council however no environmentally pertinent information could be obtained.

4.0 ENVIRONMENTAL SETTING

4.1 Geology & Hydrogeology

The British Geological Survey (BGS) map for the site, (Sheet 256, 1:50,000, North London, Solid & Drift edition) indicates that the site is underlain by the following geological sequence:

Geological Unit	Classification	Description	Aquifer Classification
London Clay Formation	Bedrock	Clay, Silt And Sand.	Unproductive
Dollis Hill Gravel Member	Superficial	Sand and Gravel.	Secondary A

The Groundsure report indicates that there are no licensed ground water abstraction sites within 1500m of the site, either static or mobile.

Due to the lack of a small local watercourse, it is likely that any surface water will follow the local topography and reach drain and sewer systems.

The site does not lie within an EA designated Groundwater Source Protection Zone (SPZ)

4.2 Geotechnical Data

Geotechnical Data presented within the Groundsure report identifies the following ground conditions:

Hazard	Designation
Shrink-Swell Clay	Moderate
Landslides	Low
Ground Dissolution	Negligible
Compressible Ground	Negligible
Collapse Deposits	Very Low
Running Sand	Very Low

4.3 Coal Mining

The site is in an area which is not affected by coal mining and therefore no Coal Authority Coal Mining Report was obtained for the purposes of this report.

4.4 Hydrology

No surface features or river networks were identified within 1500 m of the site.

The Groundsure report identifies no surface water abstractions within 1km of the site.

The site is not located within a currently defined flood risk zone.

4.5 Radon Risk Potential

The HPA Indicative Radon Atlas indicates the site is situated in an area where less than 1% of homes are above the Action Level and that the BGS reports that full radon protective measures are not necessary in the construction of new dwellings or extensions.

4.6 Industrial Land Uses

The site is situated within a mainly residential area. 130m to the East of the site is a small cluster of businesses and industrial units which include multiple vehicle servicing stations, clothing and bedding companies and industrial suppliers. 215m to the North West, is an electrical substation.

4.7 Sensitive Land Uses

The closest residential properties are located approximately adjacent to the subject site. The site does not sit within an environmentally sensitive area. There are a number of Local Nature Reserves close to the site, with the closest being 70m to the South East on the site of the disused railway line. A further site is located 500m to the South and the final site is found 1.25 km South of the site.

4.8 Site Sensitivity Assessment

The site is considered to be located within a low to moderate sensitivity setting due to the following reasons:

- Residential properties are located in close proximity;
- The underlying superficial geology comprising a secondary A aquifer; and,
- There are no surface watercourses within influencing distance of the site.

5.0 CONSULTATIONS

5.1 Local Authority Contaminated Land Officer

The Contaminated Land Officer at the Haringey Borough Council was contacted to determine any environmentally pertinent information about the site and surrounding area. A response is currently awaited and will be reported as soon as available, should this be environmentally pertinent.

5.2 Landfill Sites and Waste Treatment Sites

No landfill or wastewater treatment sites were identified by the GroundSure report, within 1km of the site.

5.3 Regulatory Database

The following information has been obtained from a commercially available environmental database. The summary table only includes records not otherwise detailed in the report. A full copy of the database report is provided on the CD at the rear of this report.

Table 5.1 Summary of Groundsure Data

	0-249m	250-500m	Details
Contaminated Land Register Entries and Notices	0	0	N/A
Authorised industrial processes (IPC/IPPC/LAPPC).	0	0	N/A
Fuel Stations Entries	0	0	N/A
Licensed radioactive substances	0	0	N/A
Enforcements, prohibitions or prosecutions	0	0	N/A
Discharge Consents	0	0	N/A
Pollution Incidents	0	0	N/A
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.

6.2 Contaminant Sources

On-site Potential Sources

On Site Potential Sources Include:

- Made Ground; and
- Bonfire on area of soft landscaping.

Off-site Potential Sources

No off-site sources within an influencing distance were found.

6.3 Potential Pathways

REC Ltd has identified the following possible pathways:

- Ingestion of contaminated soil and vegetables;
- Direct contact with contaminated soils;
- Inhalation of dust and fibres;
- Migration of ground gas; and
- Vertical migration.

6.4 Potential Receptors

REC Ltd has identified the following possible receptors:

- Current and future site occupants;
- Future planting; and
- Secondary (A) Aquifer

Construction workers are not considered to be a plausible receptor as exposure will be managed through the use of appropriate PPE and hygienic working practices as required under HSE / CDM regulations. Furthermore, the length of any exposure is likely to be for a short duration.

An Initial Conceptual Site Model has been prepared for the site and is presented on the next page within Table 6.1.

Table 6.1 Initial Conceptual Site Model

Source	Contaminant	Potential migration pathway	Potential Receptors	Likelihood of Occurrence	Magnitude of Occurrence	Overall Risk Rating	Active/Inactive
On Site							
Made Ground	Metals (As, Cd, Cr, Pb, Hg, Se, Ni)	Ingestion and contact with contaminated soils; Inhalation of dust.	Future Site Users	Likely	Medium	Moderate	Potentially Active -Further investigation
		Vertical Migration.	Secondary A Aquifer	Likely	Medium	Moderate	Potentially Active -Further investigation
	Metals (Bo, Cu, Ni, Zn)	Plant uptake.	Soft Landscaping, Future planting	Likely	Medium	Moderate	Potentially Active -Further investigation
	Polycyclic Aromatic Hydrocarbons (PAH)	Ingestion and contact with contaminated soils; Inhalation of dust.	Future Site Users	Likely	Medium	Moderate	Potentially Active -Further investigation
		Vertical Migration.	Secondary A Aquifer	Likely	Medium	Moderate	Potentially Active -Further investigation
	Asbestos Fibres	Inhalation of fibres.	Future Site Users	Unlikely	Medium	Low	Potentially Active -Further investigation
	Ground Gas (CH ₄ , CO ₂)	Migration into buildings.	Future site buildings.	Likely	Medium	Moderate	Potentially Active -Further investigation
Bonfire	Polycyclic Aromatic Hydrocarbons (PAH)	Ingestion and contact with contaminated soils; Inhalation of dust.	Future Site Users	Likely	Medium	Moderate	Potentially Active -Further investigation
	Metals (Cd, Pb, As, Cr, Hg)	Plant uptake.	Soft Landscaping, Future planting	Likely	Medium	Moderate	Potentially Active -Further investigation
		Ingestion and contact with contaminated soils; Inhalation of dust.	Future site users and buildings	Likely	Medium	Moderate	Potentially Active -Further investigation

7.0 SITE INVESTIGATION

7.1 Desk Study Information

Potential contamination sources have been identified from the desk study and these are listed in Table 7.1 below:

Table 7.1 Summary of Potential Contaminant Sources

Potential Source	Potential Contaminants	Potential Impact
Made Ground	Metals, PAHs, TPHs, Asbestos	Groundwater, plant uptake and human health
Bonfire Remains	Metals, PAHs	Plant uptake, human health

7.2 Site Investigation

7.2.1 General

A ground investigation has been designed based on the findings of the desk study with exploratory holes advanced to target specific potential contaminant sources summarised in Table 7.2. In addition 2 no. hand dug trial holes have also been advanced to provide information on the foundations of the Southern retaining wall. 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 21st June 2013. The works are summarised in Table 7.2, below

Table 7.2 Summary of Fieldwork

Potential Source/Rationale	Location Hole	Type	Maximum Depth (m bgl)	Monitoring Wells Response Zone
Determine ground conditions, confirm CSM	WS01	Window Sample	0-4m	0.5-3m
Determine ground conditions, confirm CSM	WS02	Window Sample	0-5m	0.5-4.5m
Determine ground conditions, confirm CSM	WS03	Window Sample	0-5m	0.5-4.5m
Inspect retaining wall, Determine ground conditions	HP01	Hand Pit	0.4m	N/A
Inspect retaining wall, Determine ground conditions	HP02	Hand Pit	1.2m	N/A
Determine ground conditions, confirm CSM	HP03	Hand Pit	1.8m	N/A
Determine ground conditions, confirm CSM	HP04	Hand Pit	2m	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). 2 no. Hand pits (HP01 + HP02) were advanced to gain information on the foundations of the Southern retaining boundary wall.

2 no. hand pits (HP03 + HP04) were dug to retrieve environmental and geotechnical samples where the ground was elevated by 1.3m and couldn't be accessed by the window sample rig. The sampling locations are illustrated in Figure 3 Appendix III. The ground conditions encountered and details of monitoring well response zones are indicated on the logs which are provided in Appendix V.

Three return visits were made to monitor installations for groundwater level and gas concentrations.

7.2.2 In-Situ Standard Penetration Testing (SPT)

In-situ geotechnical testing was conducted using the Standard Penetration Test (SPT) and where the ground is granular, a 60° cone (SPT(C)) was used instead of the sampling tube. The results are shown in the probehole logs in Appendix V and presented in Table 8.4 and discussed in Section 10.

7.2.3 In-Situ Hand Shear Vane Testing

In-situ Hand Shear Vane testing was undertaken within near surface fine grained soils. The tests were undertaken using 19mm shear vane. The results and undrained shear strengths derived from testing are presented within Table 8.3.

7.3 Laboratory Analysis

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

Scientific Analysis Laboratories (SAL) Ltd of Braintree undertook the analytical work and the testing results are included in Appendix VI and discussed in Section 9.0.

Selected samples were submitted to Geosynthetics Soil and Steel Laboratory (GSSL) Ltd where the following geotechnical tests were undertaken:

- Atterburg Limits Determinations;
- Particle Size Distribution Tests; and:
- pH and soluble sulphate (2:1 soil extract).

Laboratory analysis sheets are included in Appendix VIII and are summarised in Section 8.0:

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	Min Depth to Top of Strata (m)	Max Depth to Top of Strata (m)	Max Thickness (m)
Made Ground	Made ground including brick, concrete, ash, clinker and organic material.	0.05	0.05	0.6
Dollis Hill Member	Orange/Grey/Black Clay with varying sand and silt contents. Some gravel and flint.	0.3	0.6	Base not encountered

8.1.2 Made Ground

Made Ground was encountered across the site to 0.6mbgl, which comprised mainly of a gravelly sandy clay with fine to coarse brick and concrete and occasional ash and clinker. The Western side of the site was capped with topsoil.

8.1.3 Drift Deposits

Dollis Hill Member

A gravelly CLAY with varying amounts of sand and silt was encountered in all the sampling locations. It is considered that these are the Dollis Hill Member

8.1.4 Solid Geology

London Clay

London clay was not encountered within any of the sampling locations.

8.1.5 Particle Size Distribution

Four (4 no.) particle size distribution tests were undertaken on samples and the results are presented below in Table 8.2. The results of which were consistent with on-site descriptions.

Table 8.2 PSD Summary

Location	Depth (m)	Strata Description
WS01	2.40-2.60	Orange brown slightly gravelly slightly silty clayey SAND
WS02	1.50-1.70	Orange brown gravelly slightly sandy silty CLAY
WS03	1.40-1.70	Orange brown gravelly slightly sandy silty CLAY
HP03	1.20-1.40	Brown slightly gravelly slightly sandy silty CLAY

8.1.6 Soil Consistency

Undrained shear strength values were measured using a Hand Shear Vane. Results of the tests are presented in Table 8.3 (overleaf) and show the clay soils to vary between very low to medium strength.

Table 8.3 Summary of Undrained Shear Strength Test Results

Location	Sample Depth (m)	Lab Description	Method	Undrained Shear Strength (kN/m ²)	Eurocode Soil Strength
WS02	1.5	Soft slightly gravelly sandy CLAY	HSV	15	Very Low
WS02	4.9	Firm sandy CLAY	HSV	44	Medium
WS03	1.4	Gravelly CLAY	HSV	N/A	(Too gravelly)
WS03	3.6	Sandy CLAY	HSV	26	Low

Table 8.4 Standard Penetration Test Results

Boreholes	Depth (m bgl) (i)	Material Field Description	CPT/SPT "N" Value	Eurocode Soil strength	Consistency (BS5930)	Terzaghi & Peck Approximate Undrained Shear Strength (kN/m ²)
WS01	1.0	CLAY	2	Very Low Strength	Very Soft	10
	2.0	CLAY	5	Low Strength	Soft	23
	3.0	CLAY	5	Low Strength	Soft	22
	4.0	CLAY	10	Medium Strength	Soft to Firm	42
WS02	1.0	CLAY	4	Low Strength	Soft	20
	2.0	CLAY	7	Low Strength	Soft	32
	3.0	CLAY	8	Low Strength	Soft to Firm	35
	4.0	CLAY	7	Low Strength	Soft	30
	5.0	CLAY	11	Medium Strength	Firm	46
WS03	1.0	CLAY	5	Low Strength	Soft	25
	2.0	CLAY	7	Low Strength	Soft to Firm	32
	3.0	CLAY	7	Low Strength	Soft to Firm	30
	4.0	CLAY	12	Medium Strength	Firm	51
	5.0	CLAY	12	Medium Strength	Firm	50

8.1.7 Soil Infiltration

In-situ variable (falling) head permeability tests were undertaken within the monitoring well installations located in two probeholes (WS02 and WS03). Groundwater was noted to vary between depths of approximately 1.2 and 2.5m above the base of the wells and therefore the tests were undertaken in the unsaturated zone. As a result the data has been interpreted as soakaway tests rather than a permeability tests. The results are presented in Table 8.5.

Table 8.5 Soil Infiltration Results

Location	Depth (m)	Material	Test No.	Soil Infiltration Rate (m/s)
WS02	2.3 to 4.2m	Sandy clay	Test No.1	2.37×10^{-6}
WS03	1.5 to 3.8m	Sandy clay	Test No. 1	1.55×10^{-6}

Soil infiltration was taken over the wetted area from between 75% and 25% of the effective depth. Infiltration in the order of 10^{-6} is indicative of a low permeability.

The application of soakaway drainage will ultimately be dependent on the specific requirements of the development. All soakaways should be designed in accordance with BRE Special Digest 365 – *Soakaway Design*.

8.1.8 Soil Plasticity

The Atterberg Limits determinations, summarised in Table 8.6 (below), show the clay to be of low to medium plasticity. Natural Moisture Content is close to the Plastic Limit

Table 8.6 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 (%)
WS01	1.50-1.70	26.9	22	45	23	67.1	15
WS02	3.50-3.70	29.0	26	49	23	74.3	17
WS02	4.80-5.00	33.4	27	52	25	88.1	22
WS03	2.40-2.60	28.3	24	48	24	80.0	19
WS03	3.60-4.00	31.9	25	50	25	84.6	21
HP04	1.20-1.50	25.4	25	47	25	78.0	20

8.1.9 pH and Sulphate

Chemical analyses for pH and soluble sulphate content contained in Appendix VI and VII (summarised below in Table 8.7), shows that the soils at the site generally meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1 in accordance with BRE Special Digest 1 (2005).

Table 8.7 Summary of pH and Sulphate Data

Location	Depth (m)	SO ₄ in 2:1 water / soil (g/l)	pH Value
WS01	2.40-2.60	0.2	8.5
WS02	1.50-1.70	0.3	8.2
WS03	3.60-4.00	0.4	8.8
WS04	1.20-1.50	0.3	8.1

8.2 Groundwater Conditions

No groundwater was struck when the window sampling was undertaken. On return to the site, groundwater was encountered in the monitoring wells. Summary of ground water can be found in table 8.8

8.3 Ground Gas

Concentrations of methane (CH₄), carbon dioxide (CO₂) and Oxygen (O₂) were measured using an infra red gas analyser (GFM 435) calibrated to a reference standard (before and after each survey) and gas flow rates were measured using an internal 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 8.8 overleaf.

Table 8.8 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)
WS01	28/06/2013	0.10	0.10	0.0001	0.10	1.70	0.0017	17.30	1007	Rising	<0.10	0.50-3.00	2.50	1.38
	04/07/13	<0.10	<0.10	0.0001	<0.10	1.50	0.0015	18.40	1005	Falling	<0.10	0.50-3.00	2.40	1.40
	11/07/13	<0.10	<0.10	0.0001	<0.1	5.40	0.0054	14.9	1015	Rising	<0.10	0.50-3.00	2.40	1.50
WS02	28/06/2013	0.10	0.10	0.0001	1.70	0.10	0.0001	19.10	1007	Rising	<0.10	0.50-4.50	4.20	2.30
	04/07/13	<0.10	<0.10	0.0001	0.50	0.30	0.0003	17.90	1004	Falling	<0.10	0.50-4.50	4.10	2.40
	11/07/13	<0.10	<0.10	0.0001	0.20	0.50	0.0005	19.20	1015	Rising	<0.10	0.50-4.50	4.20	2.40
WS03	28/06/2013	0.10	0.10	0.0001	0.10	1.80	0.0018	18.50	1008	Rising	<0.10	0.50-4.50	4.20	1.51
	04/07/13	<0.10	<0.10	0.0001	1.20	1.80	0.0018	18.4	1007	Falling	<0.10	0.50 - 4.50	3.80	1.53
	11/07/13	<0.1	<0.10	0.0001	0.10	2.0	0.002	18.60	1015	Rising	<0.10	0.50-4.50	3.50	1.60

9.0 TIER 1 QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT

REC has undertaken a Tier 1 qualitative risk assessment to determine if any potential contaminants within the underlying soils 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, Generic Assessment 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

Determinant	Units	GAC ^{v3}	n	MC	Loc. of Ex	Path way	Assessment
Arsenic	mg/kg	32	8	64 53 44	HP01 @ 0.20 – 0.40m, HP02@ 0.3-0.60m, HP03@0.0-0.3m	1	Further Assessment
Cadmium	mg/kg	10	8	2.7	-	1	No Further Assessment
Chromium (III)	mg/kg	3000	8	46	-	1	No Further Assessment
Lead ⁽ⁱⁱⁱ⁾	mg/kg	225	8	1200 580 630	HP01 @ 0.20 – 0.40m, HP02@ 0.3-0.60m, HP03@0.0-0.3m	1	Further Assessment
Mercury	mg/kg	11	8	<1	-	2	No Further Assessment
Nickel	mg/kg	130	8	23	-	1	No Further Assessment
Selenium	mg/kg	350	8	<3	-	1	No Further Assessment
Copper ⁽ⁱⁱ⁾	mg/kg	2330	8	270	-	1	No Further Assessment
Zinc ⁽ⁱⁱⁱ⁾	mg/kg	3750	8	960	-	1	No Further Assessment
Naphthalene	mg/kg	1.5	8	0.2	-	2	No Further Assessment
Acenaphthylene	mg/kg	170	8	<0.1	-	3	No Further Assessment
Acenaphthene	mg/kg	210	8	0.2	-	1	No Further Assessment
Fluorene	mg/kg	160	8	0.2	-	1	No Further Assessment
Phenanthrene	mg/kg	92	8	2.6	-	3	No Further Assessment
Anthracene	mg/kg	2300	8	0.5	-	3	No Further Assessment
Fluoranthene	mg/kg	260	8	3.8	-	3	No Further Assessment
Pyrene	mg/kg	560	8	3.3	-	3	No Further Assessment
Benzo(a)Anthracene	mg/kg	3.1	8	1.7	-	3	No Further Assessment
Chrysene	mg/kg	6	8	1.8	-	3	No Further Assessment
Benzo(b/k)Fluoranthene ⁽ⁱ⁾	mg/kg	5.6	8	2.5	-	3	No Further Assessment
Benzo(a)Pyrene	mg/kg	0.83	8	1.4 1.1	HP01 @ 0.20 – 0.40m, WS01@0.10-0.30	3	Further Assessment
Indeno(123-cd)Pyrene	mg/kg	3.2	8	0.6	-	3	No Further Assessment
Dibenzo(a,h)Anthracene	mg/kg	0.76	8	0.2	-	3	No Further Assessment
Benzo(ghi)Perylene	mg/kg	44	8	0.6	-	3	No Further Assessment
TPH (aliphatic)* C ₅ -C ₆	mg/kg	30	4	<0.1	-	2	No Further Assessment
TPH (aliphatic)* C ₆ -C ₈	mg/kg	73	4	<0.1	-	2	No Further Assessment
TPH (aliphatic)* C ₈ -C ₁₀	mg/kg	19	4	<0.1	-	2	No Further Assessment
TPH (aromatic)* C ₁₀ -C ₁₂	mg/kg	69	4	<2	-	2	No Further Assessment
TPH (aromatic)* C ₁₂ -C ₁₆	mg/kg	140	4	<2	-	1	No Further Assessment
TPH (aromatic)* C ₁₆ -C ₂₁	mg/kg	250	4	<2	-	1	No Further Assessment
TPH (aromatic)* C ₂₁ -C ₃₅	mg/kg	890	4	69	-	1	No Further Assessment

Chrysotile asbestos was detected within WS01 soil sample at 0.1-0.3m.

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, MC = Maximum Concentration; Loc of Ex = Location of Exceedance.

* 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) GAC based on human health criteria. Ecotoxicological assessment will be made using EA guidance (EPR 8.01) on soil spreading (Cu 135mg/kg, Zinc 200mg/kg, Pb 300mg/kg)

9.2 Further Assessment

Referring to Table 9.1, the results of the direct comparison show that screening values have been exceeded for the following determinants:

- Lead;
- Arsenic; and
- Benzo(a)Pyrene; and
- Asbestos fibres in soil.

In the case of Lead and Arsenic the exposure pathway is ingestion. In the case of Benzo(a)Pyrene the exposure pathway is dermal contact and ingestion. The proposed development incorporates areas of soft landscaping and therefore it is considered that the made ground at the site has the potential to present a significant risk to human health within the areas of soft landscaping. Beneath areas of hard landscaping, the concentrations will not present a significant risk.

Asbestos fibres released from the Made Ground have the potential to present a risk to site works and future site users.

9.3 Groundwater

There are no groundwater abstractions within 250m of the site and given the underlying shallow surface geology has been shown to predominantly comprise fine grained soils, it is not considered likely that the identified elevated concentrations of determinands would migrate into the underlying Secondary (A) Aquifer.

9.4 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 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.

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 0.0001 l/hr (WS01) and for carbon dioxide was 0.0054 l/hr (WS02)

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.

The NHBC traffic light system for ground gas was used to classify the finding from the three visits. The site was classified as Green due to none of the calculated GSV values exceeding 0.16 l/hr for Methane and 0.78 l/hr for Carbon dioxide

9.5 Conceptual Model

Following the completion of the intrusive site investigation, chemical analysis and risk assessment, the revised conceptual site model, shown in Table 9.2 has been prepared for the site.

Table 9.2 Revised Conceptual Site Model

Source	Exposure Pathway	Potential Receptor	Probability of Exposure	Discussion of Pollutant Linkage
Human Health				
PAHs within the Made Ground	Dermal Contact	Future Site Users	Likely	The current investigation has indicated that identified elevated concentrations have the potential to present a significant risk to future site users across the site. Therefore the following should be undertaken: Remediation should occur to break the pollution linkage via removal of soils within soft landscaping areas to a depth of 600mm, or the discovery of natural strata, whichever is shallower. The area should then be backfilled with clean inert soil complying with the Tier I screening criteria and validated by a suitably qualified geo-environmental consultant. Given that Asbestos fibres in soil where detected, consideration should be made to the Control of Asbestos Regulations (2012) and the use of appropriate PPE when removing the Made Ground from the site.
	Ingestion			
Lead and Arsenic within the Made Ground	Ingestion			
Asbestos	Inhalation of fibres			

10.0 GEOTECHNICAL ASSESSMENT

10.1 Proposed Development

It is understood that the proposed development includes a new residential dwelling comprising of two storeys and 3 bedrooms. Also included is a subterranean garage/storage space, an over-ground garage and an access driveway. The land surrounding the proposed structures will be landscaped. A proposed site layout plan is prepared in figure 2, Appendix III. It is assumed that a development of this nature would carry an approximate loading of 75 kN/m².

10.2 Summary of Ground Conditions

Ground conditions identified at the site are summarised in Table 10.2 below:

Table 10.2 Summary of Ground Conditions

Strata	Typical Description	Min Depth to Top of Strata (m)	Max Depth to Top of Strata (m)	Max Thickness (m)
Made Ground	Soft orangey brown, slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded. Locally variable proportions of sand and gravel.	0.30	1.20	1.20
Dollis Hill Member	Greyey orange sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub rounded. Locally variable proportions of sand and gravel.	0.70	1.20	4.10 (Base not encountered)

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 infilled with suitable compacted engineered fill;
- Redundant services should be sealed off and grubbed out and replaced with suitable compacted engineered fill; and,
- Buried structures and old foundations have been encountered on site. These should be excavated from below the proposed development foot print with the resulting void backfilled.

10.4 Foundation Conditions and Bearing Capacity

General

At depths between 1.0m to 2.0m bgl the N values of the encountered very soft to soft fine grained soils ranged from 2 to 7, which would indicate shear strengths of between 9 and 35 kPa, equating to approximate bearing capacities of between 19-72 kN/m². As the proposed development may include a basement structure then the results of the deeper N values, taken between 2.0m and 3.0m have been considered. These indicate undrained shear strengths of between 22 and 35kPa equating to allowable bearing capacities between 45 and 75 kN/m², which although showing an improvement in bearing capacity with depth is not suitable for traditional strip foundations. The following foundation option is therefore considered to be more appropriate to the development:

Piled Foundations

Taking into account the above, consideration has been given to the use of piled foundations to depth between 3.0 and 5.0m bgl. For preliminary purposes the following initial pile carrying capacities have been calculated. When undertaking these preliminary calculations the following parameters have been used:

- Undrained shear strength values from Table 8.2 and 8.3;
- Depth to bearing stratum of 0.5m bgl;
- Adhesion Factor of 0.45 based on CFA piles;
- Factors of safety of 1.5 on side resistance and 3 on base resistance; and,
- Global Factor of safety of 2.5.

Table 10.2 Preliminary Pile Carrying Capacity

Depth of Pile Toe (m)	Pile Carrying Capacity (kN)		
	300mm dia	450mm dia	600mm dia
3.0	40	65	94
4.0	80	128	181
5.0	138	216	301

10.5 Proposed Subterranean Garage/Storage

It is understood that it is proposed to utilise the outdoor space by constructing an underground garage/storage area with garden/landscaping above. The excavation should be feasible with normal plant however due to the recorded depth to groundwater consideration must be given to the requirement for pumping and maintaining a dry excavation. The strength of the soils for this type of structure are not as critical as it is considered that an underground storage area will act as a buoyancy raft, with the weight of the soil removed replaced by the weight of the replacement structure and thus reducing the net load on the soil.

Consideration must also be given to any uplift forces resulting from the groundwater which may act in a sub-artesian manner. This may cause deterioration of the founding stratum and open up cracks within the structure which will allow water to seep in as well as give rise to

the potential for differential uplifts/settlements. It is recommended that any basement structure within influencing depth of groundwater is designed by a suitably qualified structural engineer. Consideration may have to be given to over engineering the structure to supply sufficient kentledge to negate this effect.

10.6 Ground Floor Slabs

Due to the presence of substantial thickness' of Made Ground across the site is considered that ground bearing floor slabs, whilst viable, will require detailed design to accommodate variability of the formation and account for differential settlement.

10.7 Pavement Construction

An assessment of the likely California Bearing Ratio (CBR) for the Made Ground has been assessed from the following sources:

■ Description of the materials encountered in the exploratory holes.

Based on this it is considered that an approximate CBR of between 10-20% may be achievable for the variable fine grained with minor coarse grained soil components within the made ground. It is, however, recommended that this be re-assessed using tests of the formation.

Following excavation the sub formation should be proof rolled and any soft material inspected and removed.

10.8 Drainage

The presence of substantial depths of Made Ground across the site may result in settlement. It is therefore recommended that drain runs are designed using steeper gradients and flexible joints to allow for some differential settlement.

The soil infiltration tests show little soakage potential within the underlying natural fine grained soils with recorded permeability of 1.55×10^{-6} m/sec (WS03) and 2.37×10^{-6} m/sec (WS02). Therefore, it is not recommended that soakaways are used for disposal of surface water runoff within the underlying natural fine grained soils.

10.9 Concrete Durability

Based upon the results of the chemical analyses summarised in 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).

10.10 Excavations

Site observations indicated that excavations should be feasible in the near surface with normal plant, however obstructions were identified in the near surface including former foundations and former floor slabs. It is anticipated that any obstructions will be grubbed out during the reduced level dig for the sub structure works.

Groundwater was recorded within every monitoring installation ranging from depths of 1.38m bgl to 2.40m bgl. Therefore during excavation for the construction of the subterranean garage/storage space, a design of a dewatering scheme and assessment of the stability of the excavation would be required.

Due to the variability of the Made Ground it is considered that all excavations are supported or battered back in accordance with guidance contained in CIRIA RR97. It is anticipated that the basement will be formed either with an open excavation, in which case the side slopes should be suitably battered, or the excavation will be supported with sheet pile or secant bored pile wall.

10.11 Re-Use of Materials

Consideration has been given to the potential re-use of site won arisings from substructure works as an engineered fill. The soils have been assessed using the following:

- Physical description of the soils encountered (variability and organic content);
- Particle Size Distribution in relation to Specification for Highway Works;
- Moisture Content and plasticity data in relation to Specification for Highway Works;
- Compaction Test or MCV Tests;
- Guidance given in HA44/91;
- Undrained Shear Strength (lower CU of 40 kN/m²); and,
- Plasticity Data (lower moisture content equals LI of 0.15).

Based on this it is considered that soils are suitable for re-use as a general engineered fill in accordance with Class 2A of the Specification for Highway Works.

10.12 Construction Activity and Inspection

The following activities and inspections should be incorporated in to the site works:

- Due to the variability of the soils at the site it is recommended that sufficient allowance is made for the inspection of formation and sub formations to foundations and pavement construction;
- 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 R97 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;
- 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 PPE.

11.0 CONCLUSIONS & RECOMMENDATIONS

Geotechnical Assessment

Compressible Ground and Subsidence Hazards – No hazard. No special precautions with regard to foundations anticipated.

It has been found that the underlying soils were predominantly cohesive in matrix and as such are unlikely to provide a high degree of soakage potential for drainage systems.

The Design Sulphate Class for the site is DS-1 and the Aggressive Environment for Concrete Class is AC-1s. It is recommended that any concrete used below ground on the site is designed for this class of environment.

It is recommended that deep piled foundations be adopted at between 3.0-5.0m bgl due to encountered shallow surface very soft to soft fine grained soils.

Revised Conceptual Site Model

The Tier I Human Health Risk has identified concentrations of constituents of concern that exceed the Tier I screening values for the protection of human health.

The ground gas assessment indicates a low risk to future site users.

Recommendations

REC recommends remedial works be undertaken within areas of proposed soft landscaping across the site. Remediation should include removal of soils within soft landscaping areas to a depth of 600mm or natural strata, whichever is encountered sooner. The area should then be backfilled with clean inert soil complying with the Tier I screening criteria and validated by a suitably qualified geo-environmental consultant.

Given that Asbestos fibres in soil were detected, consideration should be made to the Control of Asbestos Regulations (2012) and the use of appropriate PPE when removing the Made Ground from the site.

END OF REPORT

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.
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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

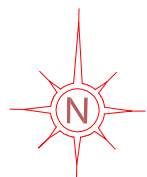
UNITS

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



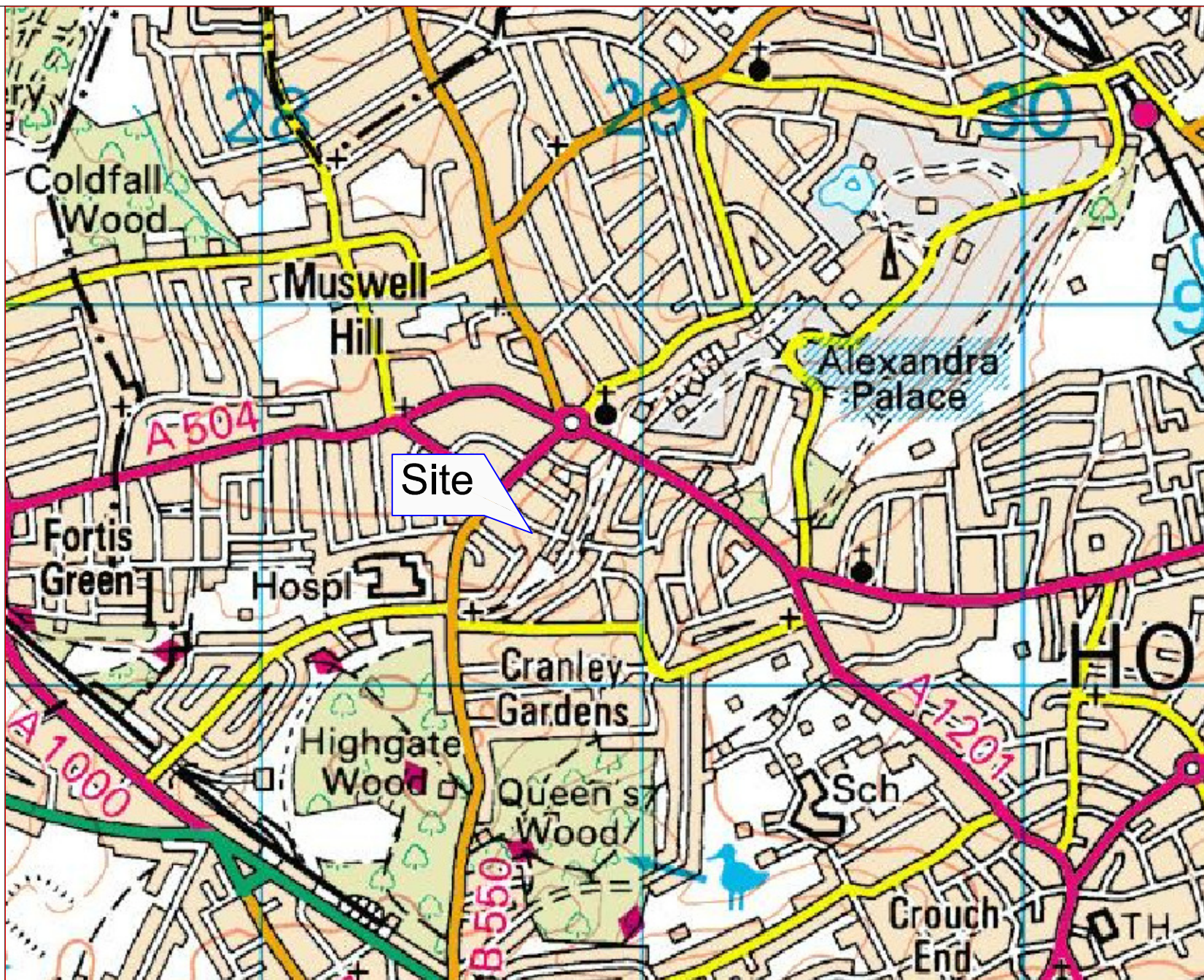
mg/m ³	Milligram per metre cubed
m bgl	Metres Below Ground Level
m bcl	Metre Below Cover Level
mAOD	Metres Above Ordnance Datum (sea level)
kN/m ²	Kilo Newtons per metre squared
µm	Micro metre

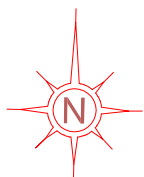
**APPENDIX III
FIGURES**



The client must not amend any drawing, design or other intellectual property produced by REC Ltd. without permission in writing from REC Ltd. in advance of any amendments being made.

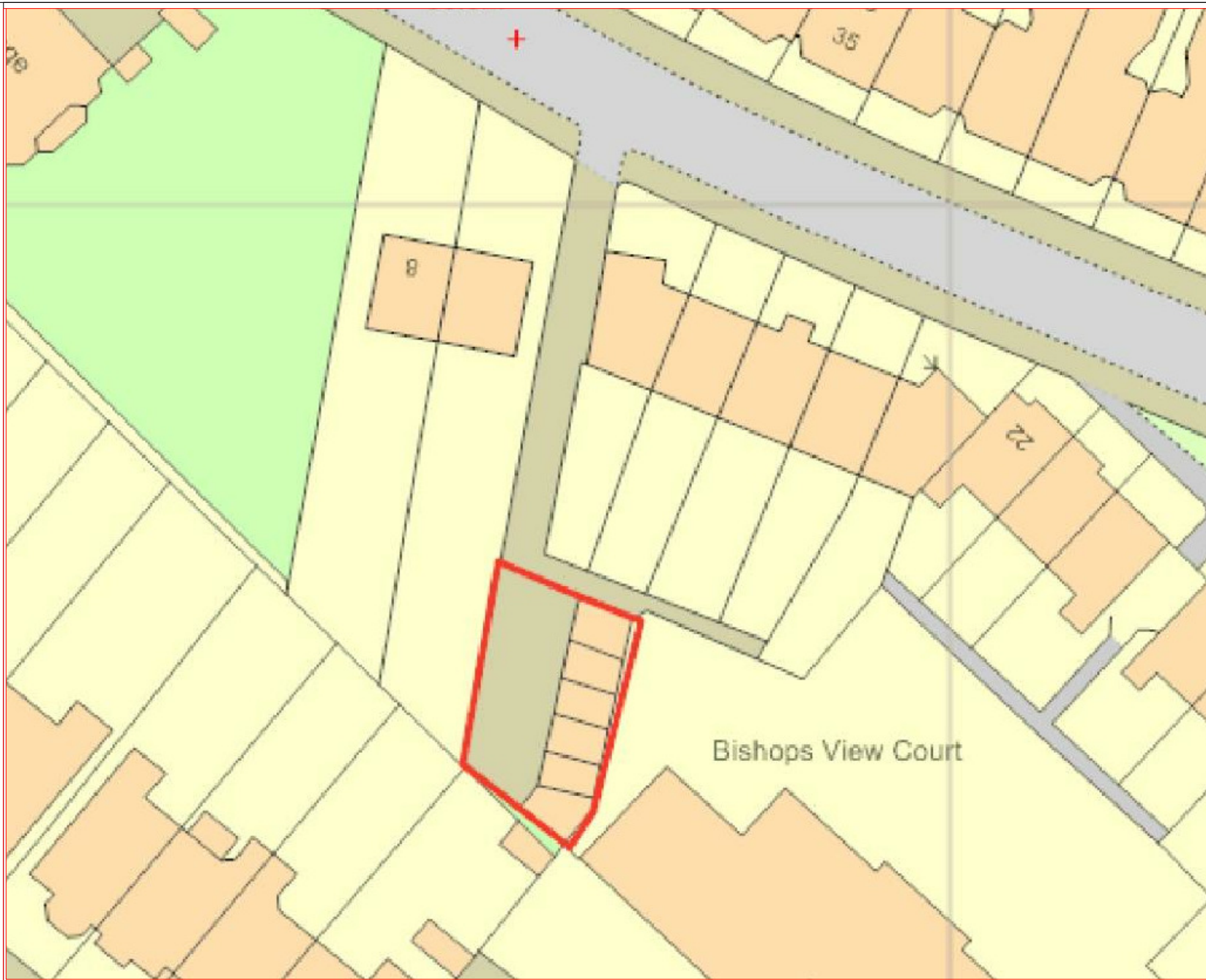
In the event that such written permission is not obtained in advance of the amendments being made, REC Ltd. shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.





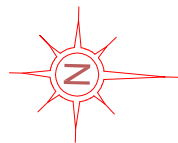
The client must not amend any drawing, design or other intellectual property produced by REC Ltd. without permission in writing from REC Ltd. in advance of any amendments being made.

In the event that such written permission is not obtained in advance of the amendments being made, REC Ltd. shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.



Key

-  WS01 Approximate Window Sample Probehole Location
-  HP01 Approximate Hand Dug Pit Location



The client must not amend any drawing, design or other intellectual property produced by REC Ltd. without permission in writing from REC Ltd. in advance of any amendments being made.

In the event that such written permission is not obtained in advance of the amendments being made, REC Ltd. shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.



**APPENDIX IV
PHOTOGRAPHS**



Figure 1, Bonfire on the raised soft landscaping



Figure 2, Looking East towards the demolished garages.

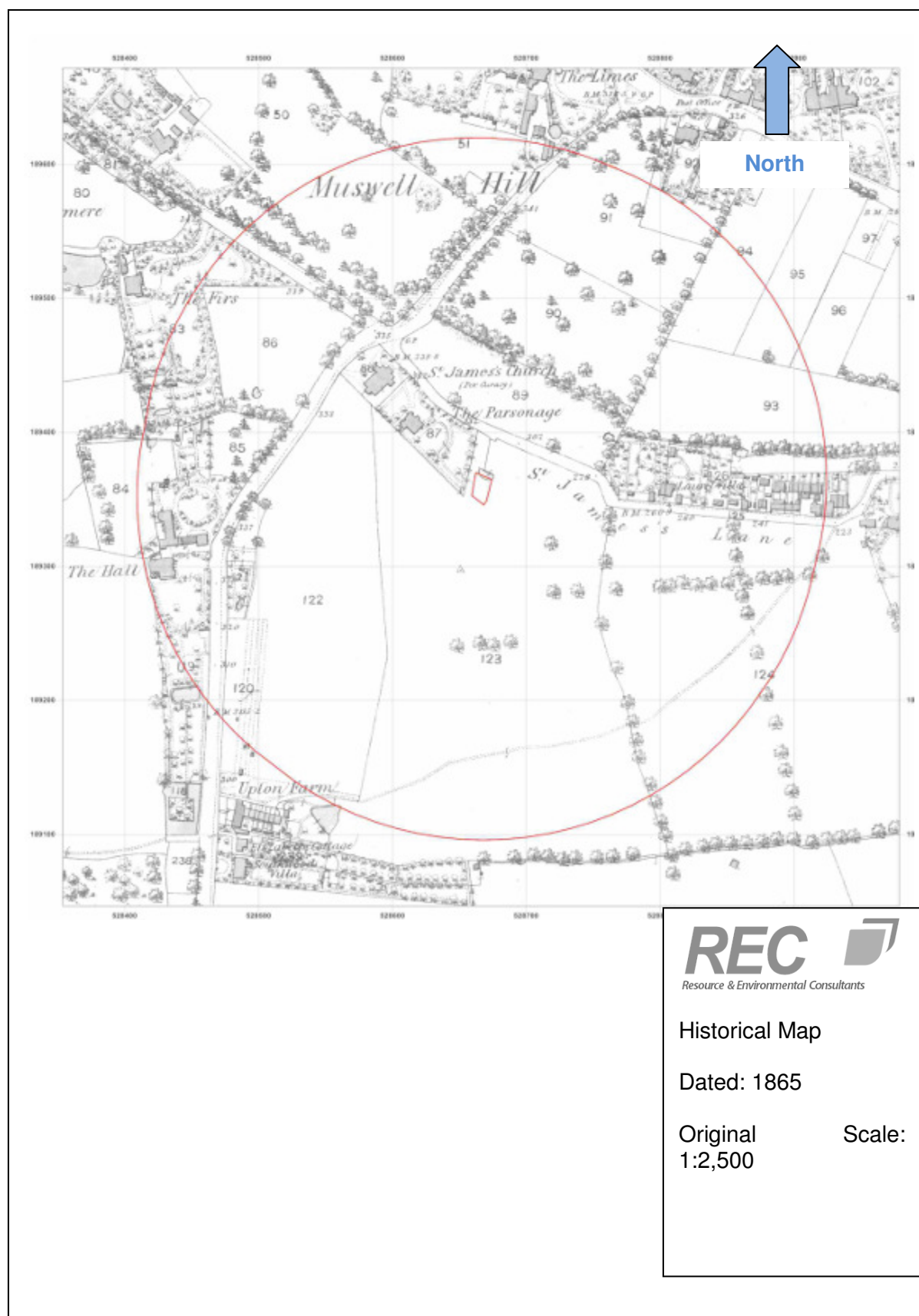


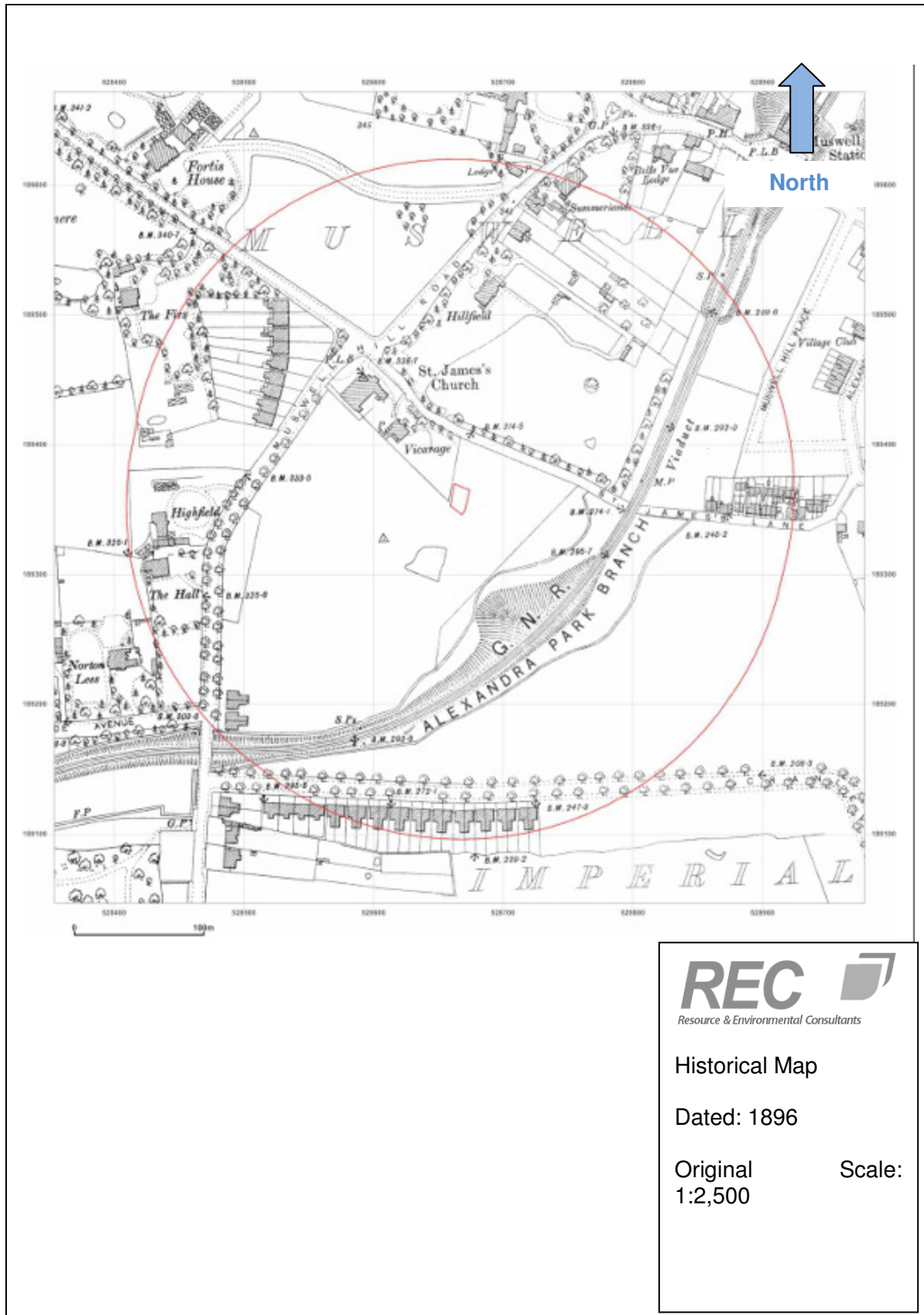
Figure 3, hand pit dug at the Southern boundary wall.

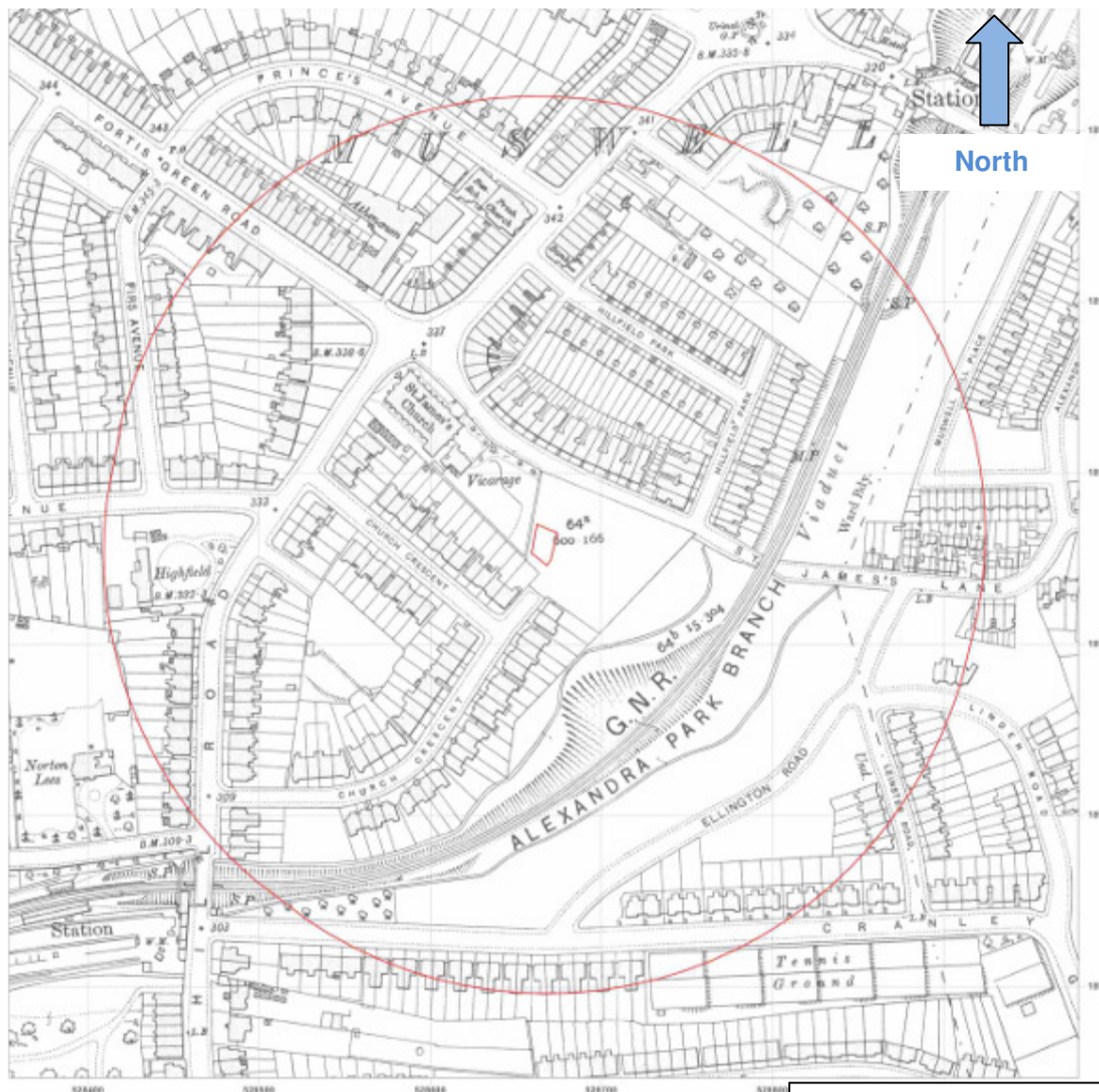


Figure 4, Looking West towards the raised soft landscaping

APPENDIX V
HISTORICAL MAPS







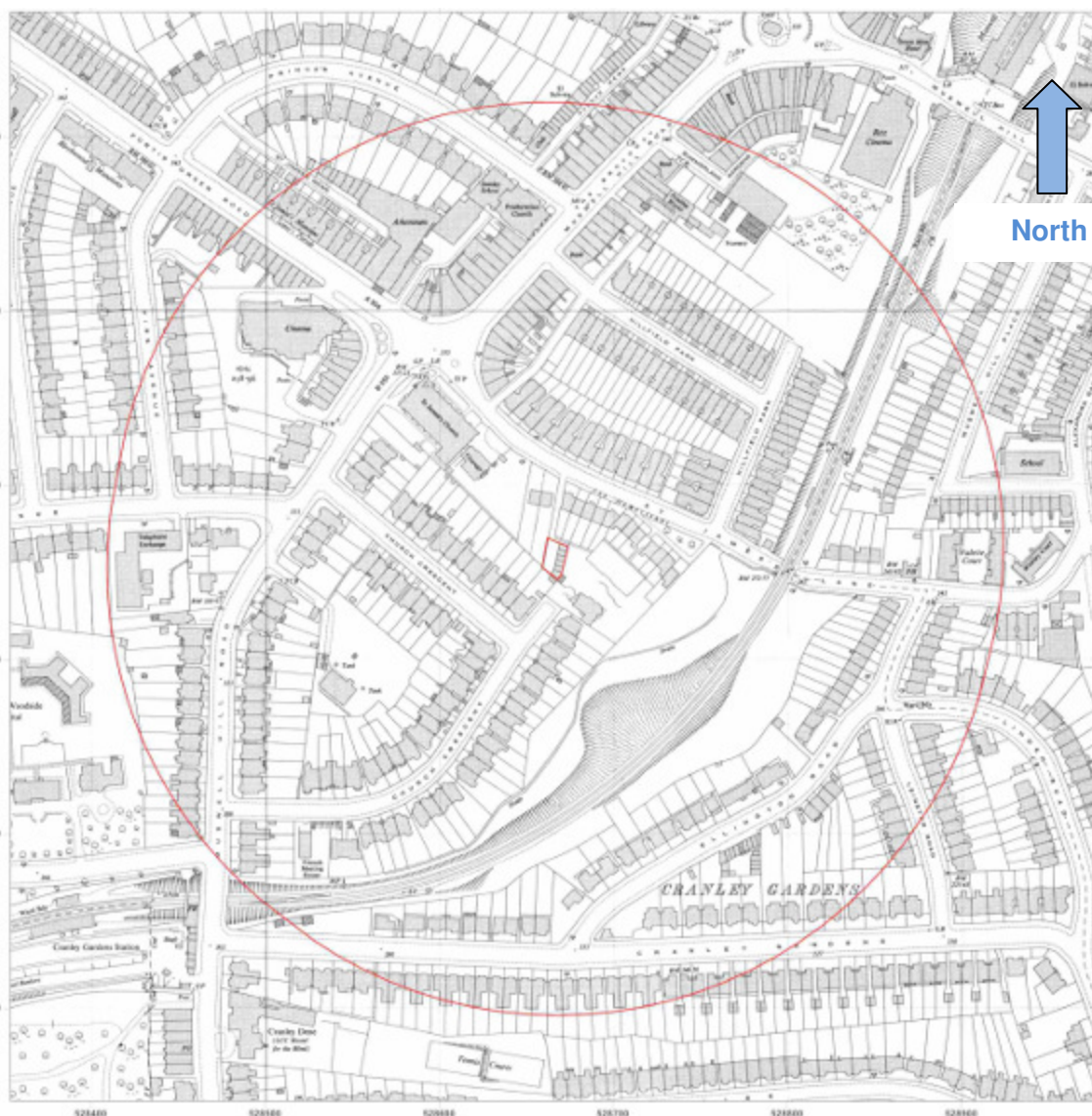
REC 
Resource & Environmental Consultants

Historical Map

Dated: 1913

Original
1:2,500

Scale:



REC 
Resource & Environmental Consultants

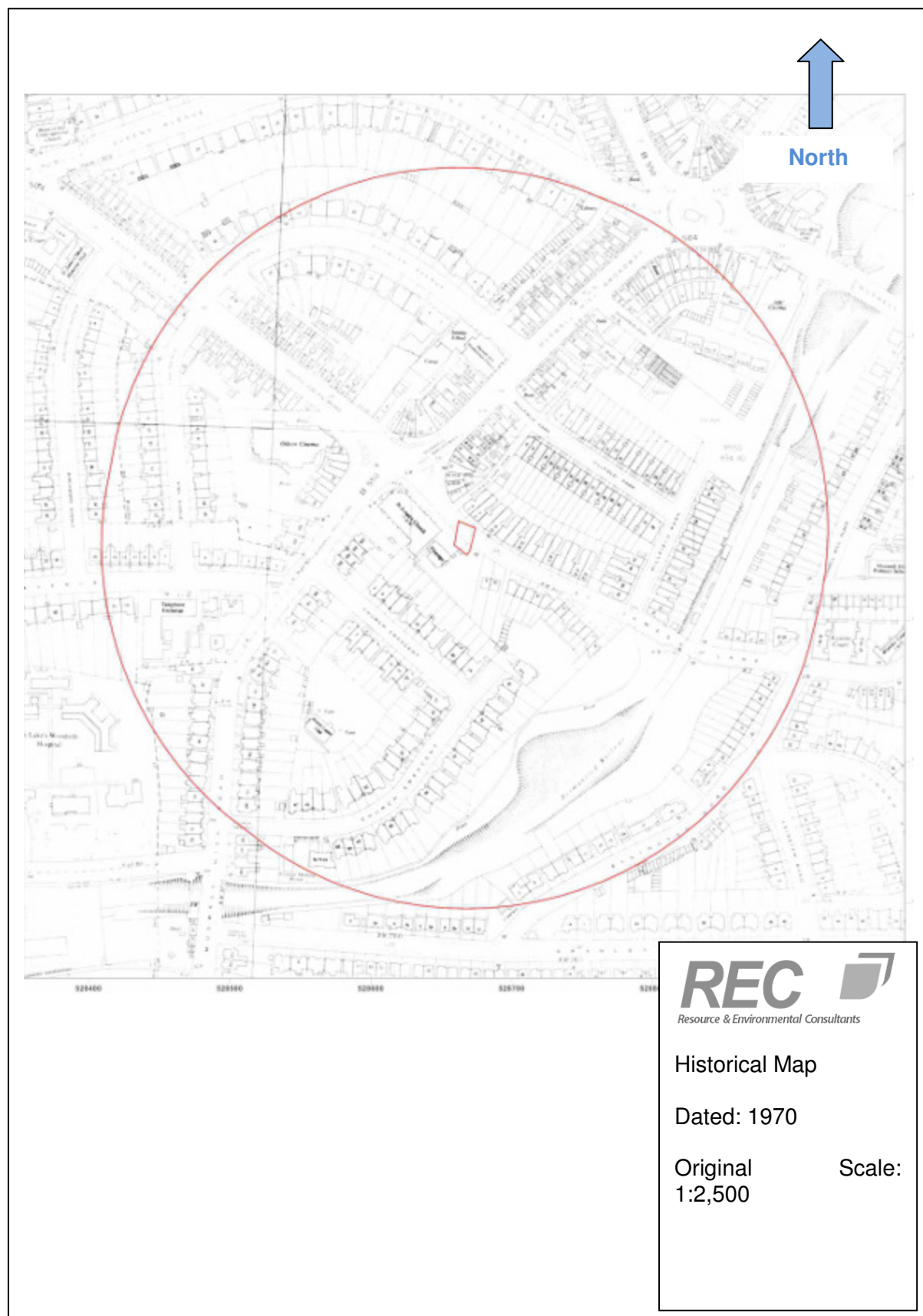
Historical Map

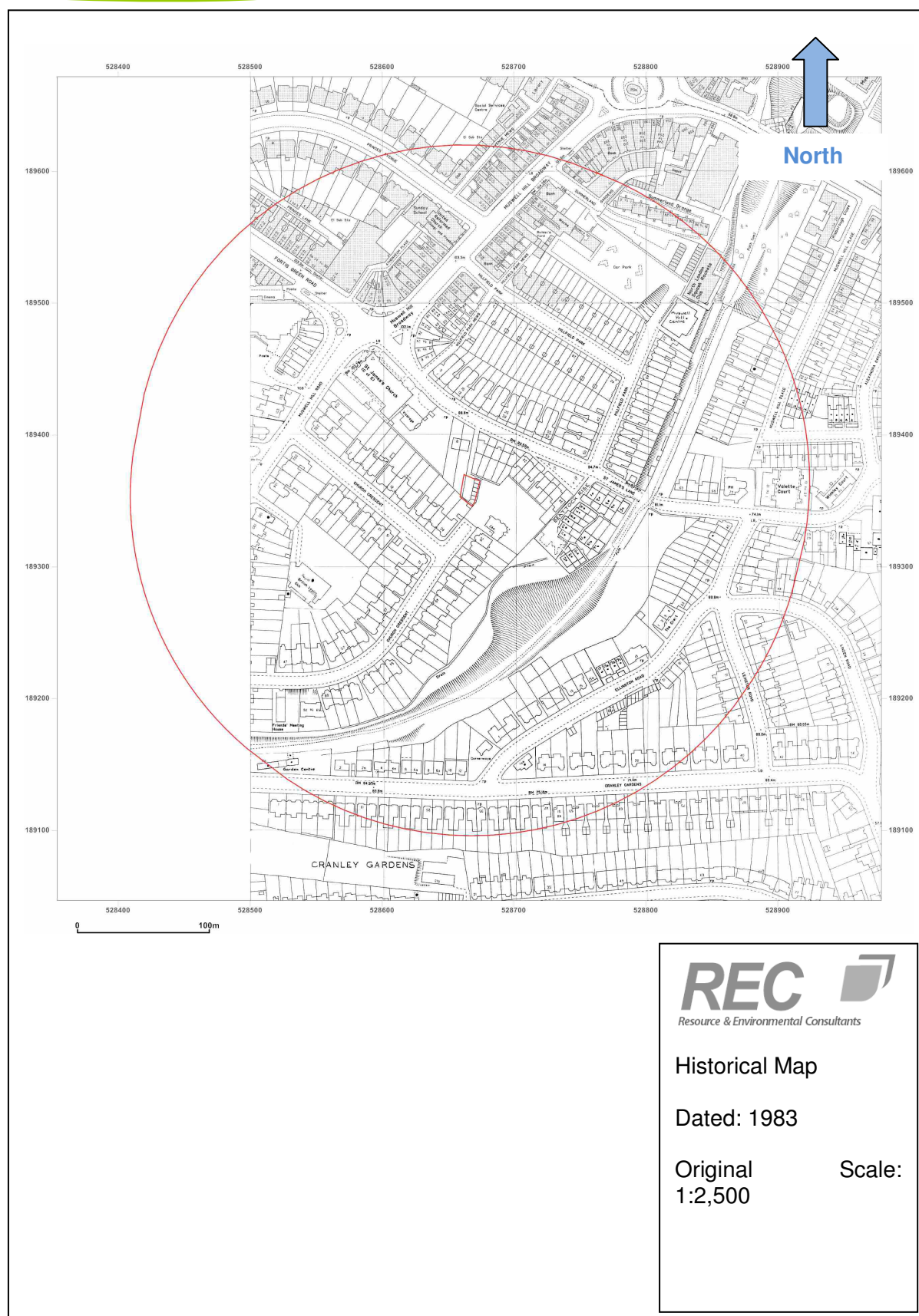
Dated: 1950

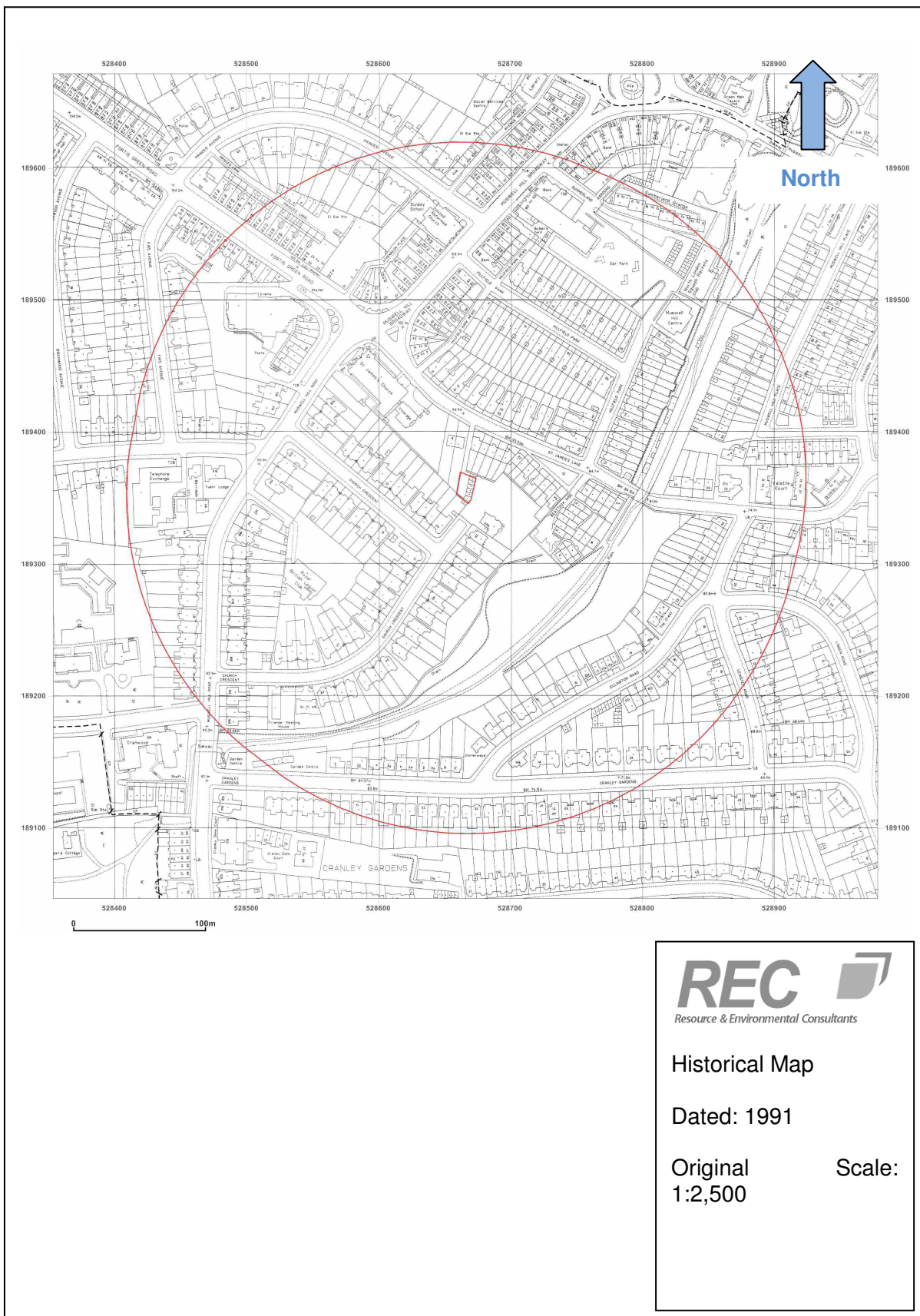
Original
1:2,500

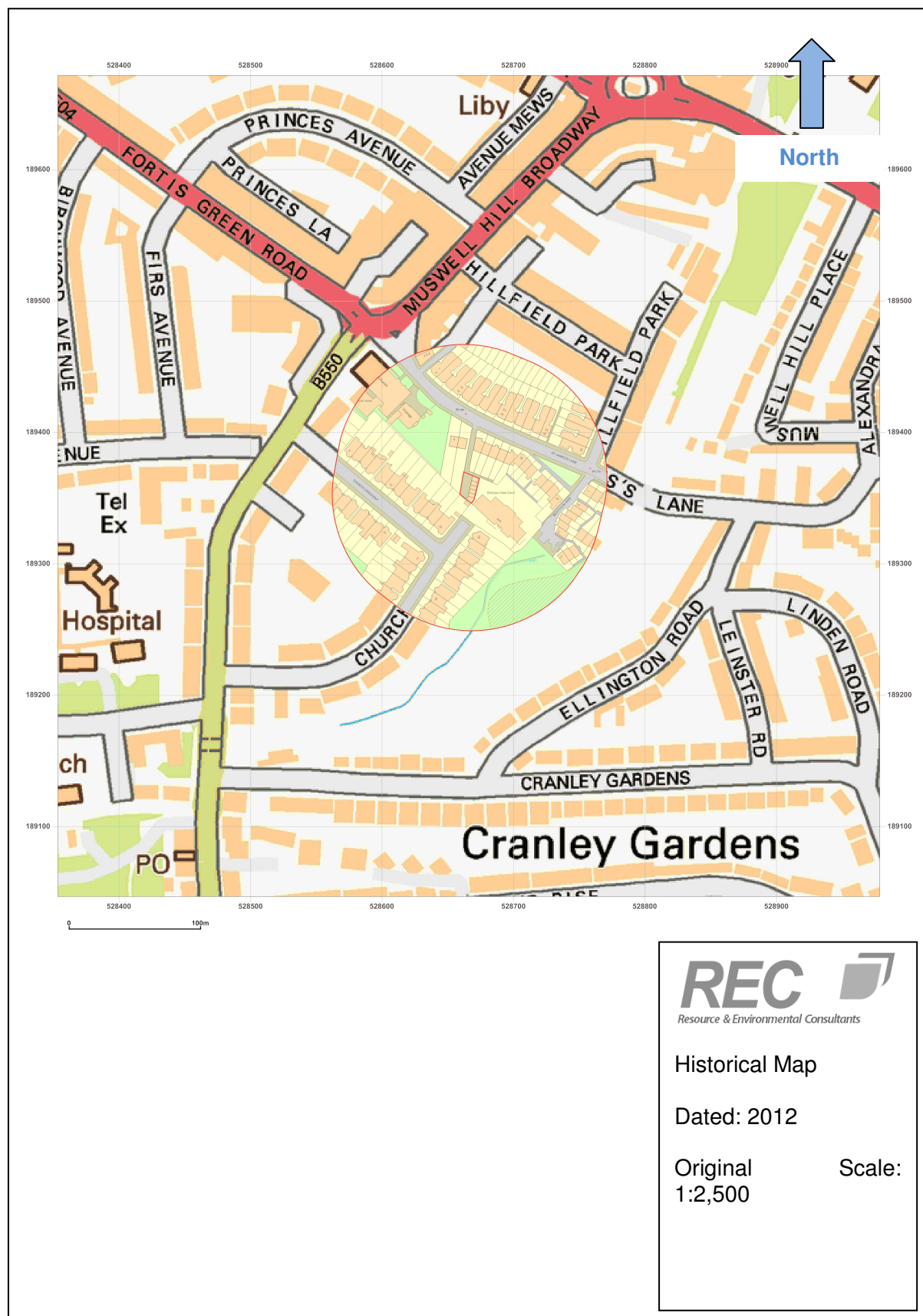
Scale:











APPENIDIX VI
REC EXPLORATORY LOGS

Trial Pit Record

Location Number: HP01

Project Number: 20436

Contract Name: 10 - 12 St James Lane

Client: Mr M. Jones - Romala Designs

Consultant: K. Channon

Date Started: 21/06/2013

Date Completed: 21/06/2013

Elevation AOD (m): .

Co-ordinates:

Excavation Method: Hand Excavated



Environment House
Segensworth Business Centre
Segensworth Road West
Fareham
Hampshire
PO15 5RQ
Tel: 01329 847 783
www.recltd.co.uk

SUBSURFACE PROFILE

SAMPLES AND IN-SITU TESTING

Depth (mbgl)	Legend	Description	Depth of Strata (mbgl)	Type	Depth (mbgl)	Water Level (mbgl)
		MADE GROUND: Concrete over brown sandy Gravel of angular to subangular fine to coarse brick and concrete.	0.15	TGV	0.20 - 0.40mbgl	
		MADE GROUND: Orangi brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is angular to rounded fine to coarse flint and mudstone with occasional rootlets and organic matter.	0.40			
		EOH @ 0.40mbgl				
1.0						
2.0						

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
S. Soil

Notes

Dimensions:

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

Groundwater: None Encountered

Notes:

Status: Complete

Stability: Stable

Trial Pit Record

Location Number: HP02

Project Number: 20436

Contract Name: 10 - 12 St James Lane

Client: Mr M. Jones - Romala Designs

Consultant: K. Channon

Date Started: 21/06/2013

Date Completed: 21/06/2013

Elevation AOD (m): .

Co-ordinates:

Excavation Method: Hand Excavated



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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)
		MADE GROUND: Black sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse brick, concrete, glass, pottery, ceramic, flint and mudstone with occasional clinker and ash.				
			0.80	TGV	0.30 - 0.60mbgl	
1.0		MADE GROUND: Orangey brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse flint and mudstone.				
			1.20			
		EOH @ 1.20mbgl				
2.0						

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
S. Soil

Notes

Dimensions:

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

Groundwater: None Encountered

Notes:

Status: Complete

Stability: Stable

Trial Pit Record

Location Number: HP03

Project Number: 20436

Contract Name: 10 - 12 St James Lane

Client: Mr M. Jones - Romala Designs

Consultant: K. Channon

Date Started: 21/06/2013

Date Completed: 21/06/2013

Elevation AOD (m): .

Co-ordinates:

Excavation Method: Hand Excavated



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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)
		MADE GROUND: Black sandy slightly gravelly CLAY topsoil. Sand is fine to coarse. Gravel is angular to rounded fine to coarse brick, concrete frequent rootlets and organic matter with occasional ash and clinker.	0.20	TGV	0.00 - 0.20mbgl	
		MADE GROUND: Orangey brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is angular to rounded fine to medium flint, brick and concrete with occasional ash and clinker.	1.00	TGV	0.40 - 0.60mbgl	
1.0		MADE GROUND: Orangey brown slightly gravelly sandy CLAY. Gravel is subangular to rounded fine to medium flint.	1.80	TGV	1.20 - 1.40mbgl	
		EOH @ 1.80mbgl				
2.0						

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
S. Soil

Notes

Dimensions:

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

Groundwater: None Encountered

Notes:

Status: Complete

Stability: Stable

Trial Pit Record

Location Number: HP04

Project Number: 20436
Contract Name: 10 - 12 St James Lane
Client: Mr M. Jones - Romala Designs
Consultant: K. Channon

Date Started: 21/06/2013
Date Completed: 21/06/2013
Elevation AOD (m): .
Co-ordinates:
Excavation Method: Hand Excavated



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Hampshire
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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)
		MADE GROUND: Redish brown very gravelly sandy CLAY. Gravel is angular to subangular fine to coarse brick ash and clinker.		TGV	0.00 - 0.20mbgl	
			0.60			
		MADE GROUND: Redish brown very gravelly sandy CLAY. Gravel is angular to subangular fine to coarse brick ash and clinker.		TGV	0.60 - 0.80mbgl	
			0.80			
1.0		MADE GROUND: Orangey brown gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse flint.				
		@1.40mbgl: Becomes less gravelly .		TGV	1.20 - 1.50mbgl	
			1.80			
		CLAY: Grey very sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded to rounded fine to medium flint with frequent organic matter.				
			2.00			
2.0		EOH @ 2.00mbgl				

Key B. Bulk (Bag) D. Disturbed T. Plastic Tub
W. Water G. Amber Glass Jar / Bottle N. 'N' Value
U100. 100mm Undisturbed CPT. Cone Penetration Test HV. Hand Shear Vane
U38. 38mm Undisturbed Sample U100. Blows (Recovery mm) PID. Photo Ionisation Detector
SPT. Standard Penetration Test V. 40ml Glass Vial S. Soil

Notes

Dimensions:
Services: Prior to excavation the location was scanned with a Cable Avoidance Tool (CAT) Status: Complete
Groundwater: None Encountered Stability: Stable
Notes:

Window Sample Record

Location Number: WS01

Project Number: 20436

Contract Name: 10 - 12 St James Lane

Client: Mr M. Jones - Romala Design

Consultant: K. Channon

Date Started: 21/06/2013

Date Completed: 21/06/2013

Elevation AOD (m): .

Co-ordinates:

Drilling Equipment: Dando 2000



Osprey House
Pacific Quay
Braudway
Manchester
M50 2UE
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www.recltd.co.uk

SUBSURFACE PROFILE

SAMPLES

Depth (mbgl)	Legend	Description	Depth of strata (mbgl)	Type	Depth (mbgl)	SPT (N-Value)	Monitoring Installation
		MADE GROUND: Concrete over black very gravelly CLAY with frequent wood ash and clinker. Gravel is angular to rounded fine to coarse mudstone, flint, brick and concrete.	0.30	TGV	0.1 - 0.3mbgl		
		MADE GROUND: Soft orangey brown, slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is angular to rounded fine to medium brick, flint and mudstone with occasional ash, clinker, rootlet, organic matter and coarse rounded mudstone.	0.70	TGV	0.5 - 0.7mbgl		
1.0		CLAY: Grey brown orange mottled very soft slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular to rounded fine to medium mudstone.	1.30	TGV SPT	0.9 - 1.1mbgl 1.00mbgl	(1,0,1,0,1,0) N = 2	
		CLAY: Soft light grey slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is angular to rounded fine to medium flint and mudstone.		TGV	1.5 - 1.7mbgl		
2.0			2.20	SPT	2.00mbgl	(2,1,1,1,2,1) N = 5	
		CLAY: Soft orange slightly mottled light grey very sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to rounded fine to medium flint.		TGV	2.4 - 2.6mbgl		
3.0			3.55	SPT	3.00mbgl	(1,1,1,1,1,2) N = 5	Backfilled Arrisings
		CLAY: Firm light grey mottled orange, brown and red sandy CLAY. Sand is fine to coarse.	4.00	SPT	4.00mbgl	(2,1,2,2,3,2) N = 10	
4.0		EOH @ 4.00mbgl					
5.0							

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

S. Soil

Notes

Dimensions: 150mm

Services: Prior to excavation the location was scanned using a Cable Avoidance Tool (CAT)

Groundwater: None Encountered

Notes:

Date: 21/06/2013

Status: Complete

Window Sample Record

Location Number: WS02

Project Number: 20436

Contract Name: 10 - 12 St James Lane

Client: Mr M. Jones - Romala Design

Consultant: K. Channon

Date Started: 21/06/2013

Date Completed: 21/06/2013

Elevation AOD (m): .

Co-ordinates:

Drilling Equipment: Dando 2000



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Braudway
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SUBSURFACE PROFILE

SAMPLES

Depth (mbgl)	Legend	Description	Depth of strata (mbgl)	Type	Depth (mbgl)	SPT (N-Value)	Monitoring Installation
		MADE GROUND: Concrete over brown gravelly sandy CLAY with occasional rootlets and organic matter. Sand is fine to coarse. Gravel is angular to subangular fine to coarse brick, concrete and flint.	0.30	TGV	0.1 - 0.3mbgl		
		MADE GROUND: Soft to firm orangey brown occasionally mottled grey, slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is angular to rounded fine to medium flint with occasional rootlets and black organic matter.	0.90	TGV	0.5 - 0.7mbgl		
1.0		CLAY: Firm grey mottled orange, red and brown, slightly sandy very gravelly CLAY. Sand is fine to coarse. Gravel is angular to rounded fine to coarse flint with occasional rounded flint, rootlets and organic matter.		SPT	1.00mbgl	(1,1,1,1,1) N = 4	
				TGV HV	1.5 - 1.7mbgl 4.60mbgl	33mm/ 15kpa	
2.0				SPT	2.00mbgl	(2,1,2,2,1,2) N = 7	
				TGV	2.5 - 2.7mbgl		
3.0				SPT	3.00mbgl	(2,2,2,2,2,2) N = 8	
				TGV	3.5 - 3.7mbgl		
4.0		CLAY: Firm light grey orange mottled sandy CLAY. Sand is fine to coarse.	3.80	SPT	4.00mbgl	(1,3,3,2,1,1) N = 7	
5.0		EOH @ 5.00mbgl	5.00	TGV HV SPT	4.8 - 5.0mbgl 4.90mbgl 5.00mbgl	19mm/ 44kpa (2,1,2,2,4,3) N = 11	

Key

B. Bulk (Bag)	D. Disturbed	T. Plastic Tub
W. Water	G. Amber Glass Jar / Bottle	N. 'N' Value
U100. 100mm Undisturbed	CPT. Cone Penetration Test	HV. Hand Shear Vane
U38. 38mm Undisturbed Sample	U100. Blows (Recovery mm)	PID. Photo Ionisation Detector
SPT. Standard Penetration Test	V. 40ml Glass Vial	S. Soil

Notes

Dimensions: 150mm
Services: Prior to excavation the location was scanned using a Cable Avoidance Tool (CAT)
Groundwater: None Encountered
Notes:

Date: 21/06/2013

Status: Complete

Window Sample Record

Location Number: WS03

Project Number: 20436

Contract Name: 10 - 12 St James Lane

Client: Mr M. Jones - Romala Design

Consultant: K. Channon

Date Started: 21/06/2013

Date Completed: 21/06/2013

Elevation AOD (m): .

Co-ordinates:

Drilling Equipment: Dando 2000



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Pacific Quay
Braudway
Manchester
M50 2UE
Tel: 0161 868 1300
www.recitd.co.uk

SUBSURFACE PROFILE

SAMPLES

Depth (mbgl)	Legend	Description	Depth of strata (mbgl)	Type	Depth (mbgl)	SPT (N-Value)	Monitoring Installation
		MADE GROUND: Concrete over orangey brown gravelly sandy CLAY with occasional rootlets and organic matter. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse flint and clinker.	0.60	TGV	0.2 - 0.4mbgl		
1.0		MADE GROUND: Soft brown gravelly sandy CLAY. Sand is fine to coarse. Gravel is angular to rounded fine to coarse flint, brick, concrete with occasional ash clinker, wood, rootlets and organic matter.	1.20	TGV	0.7 - 0.9mbgl	(1,0,1,1,1,2) N = 5	
		CLAY: Firm light grey mottled brown, gravelly sandy CLAY with frequent rootlets and organic matter. Sand is fine to coarse. Gravel is angular to rounded fine to coarse flint.	2.20	SPT	1.00mbgl		
2.0				HV TGV	1.40mbgl 1.4 - 1.7mbgl	Too Gravelly	
		CLAY: Grey gravelly sandy CLAY. Gravel of subangular to rounded fine to medium flint.	2.80	SPT	2.00mbgl	(0,0,1,2,2,2) N = 7	
3.0		CLAY: Orangey brown very sandy clay. Sand is fine to coarse.	3.40	TGV	2.4 - 2.6mbgl		
		CLAY: Orangey brown CLAY.		SPT	3.00mbgl	(1,1,3,2,1,1) N = 7	
4.0				HV TGV	3.60mbgl 3.6 - 4.0mbgl	26kpa	
				HV	3.80mbgl	32kpa	
				SPT	4.00mbgl	(2,2,2,3,3,4) N = 12	
5.0		EOH @ 5.00mbgl	5.00	HV SPT	4.90mbgl 5.00mbgl	26kpa (2,2,2,2,4,4) N = 12	

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

S. Soil

Notes

Dimensions: 150mm

Services: Prior to excavation the location was scanned using a Cable Avoidance Tool (CAT)

Groundwater: None Encountered

Notes:

Date: 21/06/2013

Status: Complete

APPENDIX VII
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 Ltd

Certificate of Analysis

3 Crittall Drive
Springwood Industrial
Estate
Braintree
Essex
CM7 2RT
Tel : 01376 560120
Fax : 01376 552923

Report Number: 337150-1

Date of Report: 02-Jul-2013

Customer: Resource Environmental Consultants Ltd
Environment House
Segensworth Business Centre
Segensworth Road (West)
Fareham
PO15 5RQ

Customer Contact: Mrs Kathryn Channon

Customer Job Reference: 20436

Customer Site Reference: 10-12 St James Lane

Date Job Received at SAL: 26-Jun-2013

Date Analysis Started: 27-Jun-2013

Date Analysis Completed: 02-Jul-2013

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
All results have been reviewed in accordance with QP22



1650

Report checked
and authorised by :
Miss Claire Brown
Customer Service Manager

Issued by :
Miss Claire Brown
Customer Service Manager

SAL Reference					337150 001	337150 002	337150 003	337150 004	337150 005
Customer Sample Reference					WS01 @ 0.10-0.30m	WS02 @ 0.10-0.30m	WS02 @ 0.50-0.70m	WS03 @ 0.20-0.40m	HP01 @ 0.20-0.40m
Date Sampled					21-JUN-2013	21-JUN-2013	21-JUN-2013	21-JUN-2013	21-JUN-2013
Determinand	Method	Test Sample	LOD	Units					
Arsenic	T257	A40	2.0	mg/kg	14	10	12	12	64
Boron (water-soluble)	T82	A40	1	mg/kg	<1	<1	<1	<1	<1
Cadmium	T257	A40	0.1	mg/kg	0.2	<0.1	<0.1	<0.1	2.0
Chromium	T245	A40	0.5	mg/kg	31	26	35	32	27
Copper	T245	A40	1.0	mg/kg	62	20	18	22	170
Lead	T257	A40	0.5	mg/kg	210	57	46	36	1200
Mercury	T245	A40	1.0	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Nickel	T257	A40	0.5	mg/kg	20	13	17	17	45
Selenium	T257	A40	3	mg/kg	<3	<3	<3	<3	<3
Zinc	T257	A40	0.5	mg/kg	120	43	54	48	960
(Water Soluble) SO4-- expressed as SO4	T242	A40	0.01	g/l	0.04	0.45	0.53	0.03	-
pH	T7	A40			8.2	9.0	6.8	8.3	-
Asbestos ID	T27	A40			Chrysotile Detected -	Asbestos not detected -	-	Asbestos not detected -	Asbestos not detected -

SAL Reference					337150 006	337150 007	337150 008
Customer Sample Reference					HP02 @ 0.30-0.60m	HP03 @ 0.00-0.20m	HP04 @ 0.00-0.20m
Date Sampled					21-JUN-2013	21-JUN-2013	21-JUN-2013
Determinand	Method	Test Sample	LOD	Units			
Arsenic	T257	A40	2.0	mg/kg	53	44	11
Boron (water-soluble)	T82	A40	1	mg/kg	<1	<1	<1
Cadmium	T257	A40	0.1	mg/kg	2.7	1.2	<0.1
Chromium	T245	A40	0.5	mg/kg	46	37	32
Copper	T245	A40	1.0	mg/kg	270	89	17
Lead	T257	A40	0.5	mg/kg	580	630	43
Mercury	T245	A40	1.0	mg/kg	<1.0	<1.0	<1.0
Nickel	T257	A40	0.5	mg/kg	22	23	16
Selenium	T257	A40	3	mg/kg	<3	<3	<3
Zinc	T257	A40	0.5	mg/kg	630	430	48
Asbestos ID	T27	A40			Asbestos not detected	Asbestos not detected	Asbestos not detected

Soil	Analysed as Soil
Suite C	

SAL Reference					337150 001	337150 004	337150 007	337150 008
Customer Sample Reference					WS01 @ 0.10-0.30m	WS03 @ 0.20-0.40m	HP03 @ 0.00-0.20m	HP04 @ 0.00-0.20m
Date Sampled					21-JUN-2013	21-JUN-2013	21-JUN-2013	21-JUN-2013
Determinand	Method	Test Sample	LOD	Units				
TPH (C5-C6)	T54	AR	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10
TPH (C6-C8)	T54	AR	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10
TPH (C8-C10)	T54	AR	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10
TPH (C10-C12)	T219	AR	2	mg/kg	<2	<2	<2	<2
TPH (C12-C16)	T219	AR	2	mg/kg	<2	<2	<2	<2
TPH (C16-C21)	T219	AR	2	mg/kg	<2	<2	<2	<2
TPH (C21-C35)	T219	AR	2	mg/kg	60	<2	69	<2

Soil	Analysed as Soil
Total and Speciated USEPA16 PAH (SE)	

SAL Reference					337150 001	337150 002	337150 003	337150 004	337150 005
Customer Sample Reference					WS01 @ 0.10-0.30m	WS02 @ 0.10-0.30m	WS02 @ 0.50-0.70m	WS03 @ 0.20-0.40m	HP01 @ 0.20-0.40m
Date Sampled					21-JUN-2013	21-JUN-2013	21-JUN-2013	21-JUN-2013	21-JUN-2013
Determinand	Method	Test Sample	LOD	Units					
Naphthalene	T16	AR	0.1	mg/kg	<0.1	0.2	<0.1	<0.1	<0.1
Acenaphthylene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	T16	AR	0.1	mg/kg	0.1	0.1	<0.1	<0.1	0.2
Fluorene	T16	AR	0.1	mg/kg	0.1	0.1	<0.1	<0.1	0.2
Phenanthrene	T16	AR	0.1	mg/kg	2.4	2.0	1.0	0.4	2.6
Anthracene	T16	AR	0.1	mg/kg	0.5	0.3	0.2	<0.1	0.5
Fluoranthene	T16	AR	0.1	mg/kg	3.2	2.2	1.1	0.4	3.8
Pyrene	T16	AR	0.1	mg/kg	2.9	2.0	1.0	0.4	3.3
Benzo(a)Anthracene	T16	AR	0.1	mg/kg	1.1	0.7	0.4	0.1	1.7
Chrysene	T16	AR	0.1	mg/kg	1.1	0.8	0.4	0.2	1.8
Benzo(b/k)Fluoranthene	T16	AR	0.1	mg/kg	1.7	1.2	0.5	0.2	2.5
Benzo(a)Pyrene	T16	AR	0.1	mg/kg	1.1	0.7	0.3	0.1	1.4
Indeno(123-cd)Pyrene	T16	AR	0.1	mg/kg	0.5	0.4	0.2	<0.1	0.6
Dibenzo(ah)Anthracene	T16	AR	0.1	mg/kg	0.2	0.1	<0.1	<0.1	0.2
Benzo(ghi)Perylene	T16	AR	0.1	mg/kg	0.6	0.4	0.2	<0.1	0.6
PAH(total)	T16	AR	0.1	mg/kg	16	11	5.0	1.8	19

Customer Reference: 20436

SAL Reference					337150 006	337150 007	337150 008
Customer Sample Reference					HP02 @ 0.30-0.60m	HP03 @ 0.00-0.20m	HP04 @ 0.00-0.20m
Date Sampled					21-JUN-2013	21-JUN-2013	21-JUN-2013
Determinand	Method	Test Sample	LOD	Units			
Naphthalene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Acenaphthylene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Acenaphthene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Fluorene	T16	AR	0.1	mg/kg	<0.1	<0.1	<0.1
Phenanthrene	T16	AR	0.1	mg/kg	0.7	0.8	<0.1
Anthracene	T16	AR	0.1	mg/kg	0.1	0.2	<0.1
Fluoranthene	T16	AR	0.1	mg/kg	1.6	2.1	<0.1
Pyrene	T16	AR	0.1	mg/kg	1.4	1.8	<0.1
Benzo(a)Anthracene	T16	AR	0.1	mg/kg	0.8	0.9	<0.1
Chrysene	T16	AR	0.1	mg/kg	0.8	1.0	<0.1
Benzo(b/k)Fluoranthene	T16	AR	0.1	mg/kg	1.2	1.5	<0.1
Benzo(a)Pyrene	T16	AR	0.1	mg/kg	0.7	0.8	<0.1
Indeno(123-cd)Pyrene	T16	AR	0.1	mg/kg	0.3	0.4	<0.1
Dibenzo(ah)Anthracene	T16	AR	0.1	mg/kg	0.1	0.1	<0.1
Benzo(ghi)Perylene	T16	AR	0.1	mg/kg	0.3	0.4	<0.1
PAH(total)	T16	AR	0.1	mg/kg	8.0	10	<0.1

Value	Description
A40	Assisted dried < 40C
AR	As Received
S	Analysis was subcontracted
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Where an asbestos result of none detected is reported, this is obtained from analysis of a representative sub sample.

Value	Description
T245	ICP/OES(Aqua Regia Extraction)
T16	GC/MS
T82	ICP/OES (Sim)
T257	ICP/OES (SIM) (Aqua Regia Extraction)
T54	GC/MS (Headspace)
T219	GC/FID (SE)
T242	2:1 Extraction/ICP/OES (TRL 447 T1)
T7	Probe
T27	PLM

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Arsenic	T257	A40	2.0	mg/kg	U	001-008
Boron (water-soluble)	T82	A40	1	mg/kg	N	001-008
Cadmium	T257	A40	0.1	mg/kg	U	001-008
Chromium	T245	A40	0.5	mg/kg	U	001-008
Copper	T245	A40	1.0	mg/kg	U	001-008
Lead	T257	A40	0.5	mg/kg	U	001-008
Mercury	T245	A40	1.0	mg/kg	U	001-008
Nickel	T257	A40	0.5	mg/kg	U	001-008
Selenium	T257	A40	3	mg/kg	U	001-008

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Zinc	T257	A40	0.5	mg/kg	U	001-008
(Water Soluble) SO4-- expressed as SO4	T242	A40	0.01	g/l	U	001-004
pH	T7	A40			U	001-004
Asbestos ID	T27	A40			SU	001-002,004-008
TPH (C5-C6)	T54	AR	0.10	mg/kg	N	001,004,007-008
TPH (C6-C8)	T54	AR	0.10	mg/kg	N	001,004,007-008
TPH (C8-C10)	T54	AR	0.10	mg/kg	N	001,004,007-008
TPH (C10-C12)	T219	AR	2	mg/kg	U	001,004,007-008
TPH (C12-C16)	T219	AR	2	mg/kg	U	001,004,007-008
TPH (C16-C21)	T219	AR	2	mg/kg	U	001,004,007-008
TPH (C21-C35)	T219	AR	2	mg/kg	U	001,004,007-008
Naphthalene	T16	AR	0.1	mg/kg	U	001-008
Acenaphthylene	T16	AR	0.1	mg/kg	U	001-008
Acenaphthene	T16	AR	0.1	mg/kg	U	001-008
Fluorene	T16	AR	0.1	mg/kg	U	001-008
Phenanthrene	T16	AR	0.1	mg/kg	U	001-008
Anthracene	T16	AR	0.1	mg/kg	U	001-008
Fluoranthene	T16	AR	0.1	mg/kg	N	001-008
Pyrene	T16	AR	0.1	mg/kg	N	001-008
Benzo(a)Anthracene	T16	AR	0.1	mg/kg	U	001-008
Chrysene	T16	AR	0.1	mg/kg	U	001-008
Benzo(b/k)Fluoranthene	T16	AR	0.1	mg/kg	U	001-008
Benzo(a)Pyrene	T16	AR	0.1	mg/kg	U	001-008
Indeno(123-cd)Pyrene	T16	AR	0.1	mg/kg	U	001-008
Dibenzo(ah)Anthracene	T16	AR	0.1	mg/kg	U	001-008
Benzo(ghi)Perylene	T16	AR	0.1	mg/kg	U	001-008
PAH(total)	T16	AR	0.1	mg/kg	U	001-008



APPENDIX VIII
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	Residential Half 2003 EA SGV based on planned target blood lead level reduction to 5µg/l. Commercial Calculated using commercial exposure equation within lead SGV 2003 with revised input data from HPA and taking proposed blood lead levels into account.
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 IX
GEOTECHNICAL TESTING RESULTS



Summary of laboratory soil descriptions

Contract Ref: 20436 – St James Lane

Report Ref. No: GS-20436

Client ID	Depth (m)	Description of Sample
WS01	1.50-1.70	Very soft grey slightly gravelly sandy CLAY
WS01	2.40-2.60	Orange brown slightly gravelly slightly silty clayey SAND
WS02	1.50-1.70	Orange brown gravelly slightly sandy silty CLAY
WS02	3.50-3.70	Soft orange brown gravelly CLAY
WS02	4.80-5.00	Soft grey brown slightly sandy CLAY
WS03	1.40-1.70	Orange brown gravelly slightly sandy silty CLAY
WS03	2.40-2.60	Soft orange brown slightly gravelly sandy CLAY
WS03	3.60-4.00	Soft orange dark brown mottled grey CLAY
HP03	1.20-1.40	Brown slightly gravelly slightly sandy silty CLAY
HP04	1.20-1.50	Soft orange brown slightly gravelly sandy CLAY

Approved Signatory:

Date Reported: 05/07/13



BRE SD1 Reduced Suite: Chemical properties of Soil Acid & Water Soluble Sulphate, Total Sulphur & Ph Value of Soil. BS 1377:1990: Part 3 cl.3, 5.2, 5.5, 7.2 & 9.

Contract Ref: 20436 – St James Lane

Report Ref. No: GS-20436

TP/BH No.	DEPTH (m)	Material passing 2mm BS Test Sieve (% dry mass of original sample)	Acid Extractable Sulphate		Water Soluble Sulphate 2:1		Total Sulphur (%)	pH Value
			Sulphate content as SO ₃ of soil passing 2mm BS Test sieve %	Sulphate content as SO ₄ of soil passing 2mm BS Test sieve %	Sulphate content as SO ₃ of 2:1 soil/water extract (g/l)	Sulphate content as SO ₄ of 2:1 soil/water extract (g/l)		
WS01	2.40-2.60	100	0.08	0.09	0.1	0.2	0.1	8.5
WS02	1.50-1.70	100	0.10	0.11	0.2	0.3	0.2	8.2
WS03	3.60-4.00	100	0.11	0.12	0.3	0.4	0.3	8.8
HP04	1.20-1.50	100	0.10	0.11	0.2	0.3	0.1	8.1

Certification:-

Chemical Analysis – Sample Preparation and testing: In accordance with the methods as detailed in BS1377 : Part 3:1990 Clause 5.2, 5.5, 7.2 & 9 used in conjunction with BRE Special digest 1. Test results reported herein do not apply to samples other than those supplied. GSSL Ltd neither accepts responsibility for nor makes claim as to the final use & purpose of the materials(s).

Approved Signatory:

Date Reported: 05/07/13



Determination of Moisture Content & Atterberg Limits

Contract Ref:

20436 – St James Lane

Report Ref. No: GS-20436

Sample Preparation:

Specimens taken from their Wet State

Client ID	Depth (m)	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index %	% Passing 425µm test sieve	Remarks
WS01	1.50-1.70	26.9	45	22	23	67.1	Intermediate Plasticity CI
WS02	3.50-3.70	29.0	49	26	23	74.3	Intermediate Plasticity CI
WS02	4.80-5.00	33.4	52	27	25	88.1	High Plasticity CH
WS03	2.40-2.60	28.3	48	24	24	80.0	Intermediate Plasticity CI
WS03	3.60-4.00	31.9	50	25	25	84.6	High Plasticity CH
HP04	1.20-1.50	25.4	47	22	25	78.0	Intermediate Plasticity CI

Certification:-

Sample Preparation: In accordance with BS 1377-1 & 2 :1990. Moisture Content, Liquid Limit & Plastic Limit were determined in accordance with BS 1377-2: 1990 Method 3.2, 4.3 & 5. Test results reported herein do not apply to samples other than those supplied. GSSL Ltd neither accepts responsibility for nor makes claim as to the final use & purpose of the materials(s).

Approved Signatory:

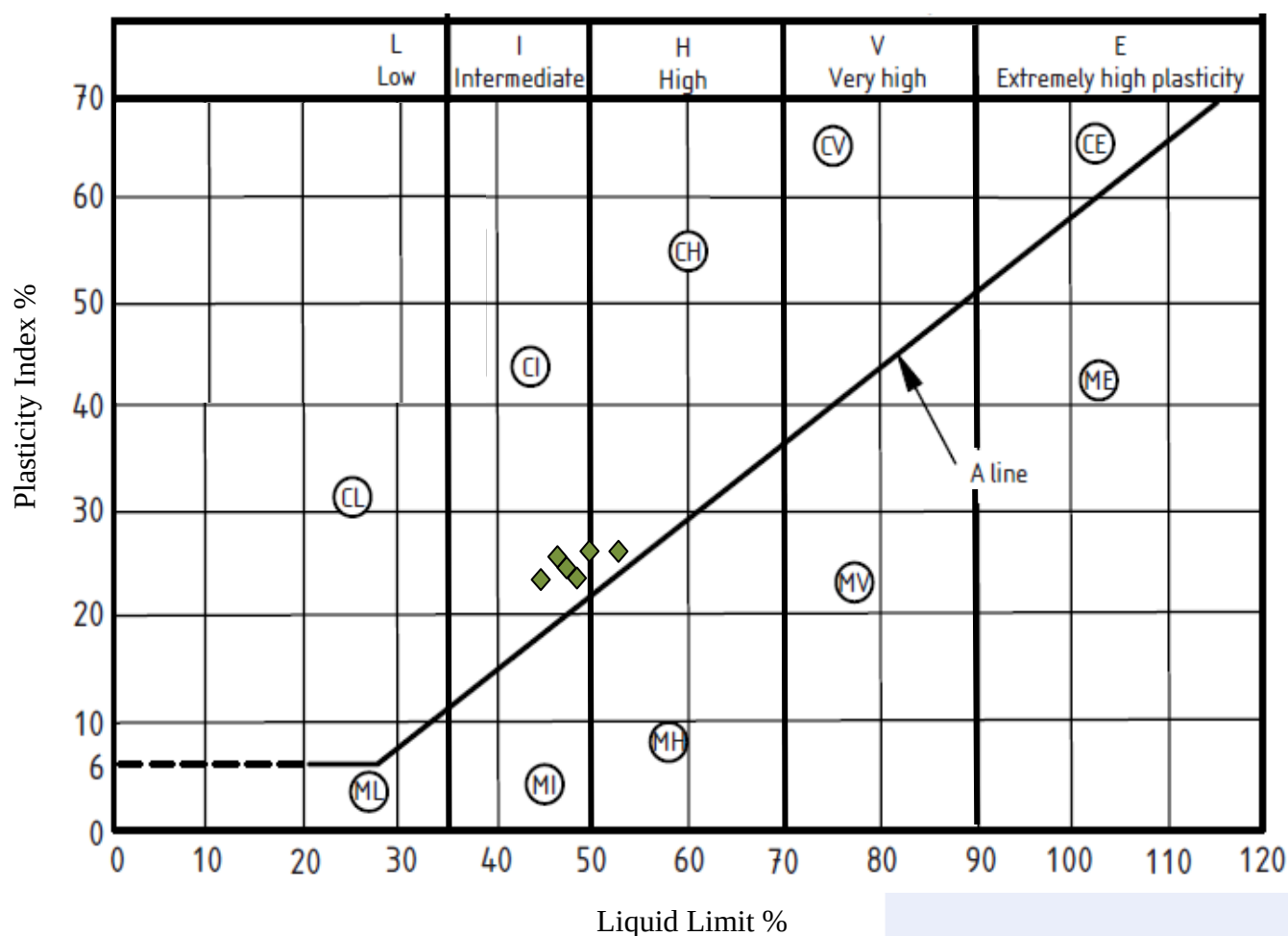
Date Reported: 05/07/13



Plasticity Chart for Casagrande Classification (BS5930: 1999+A2: 2010)

Contract Ref: 20436 – St James Lane

Report Ref. No: GS-20436



Approved Signatory:

Date Reported: 05/07/13



Determination of Particle Size Distribution (Dry Sieving)

Report Ref. No: GS-20436

GSSL Sample ID A1

Client ID WS01 @ 2.40-2.60m

Client: REC Ltd
Site: 20436 – St James Lane

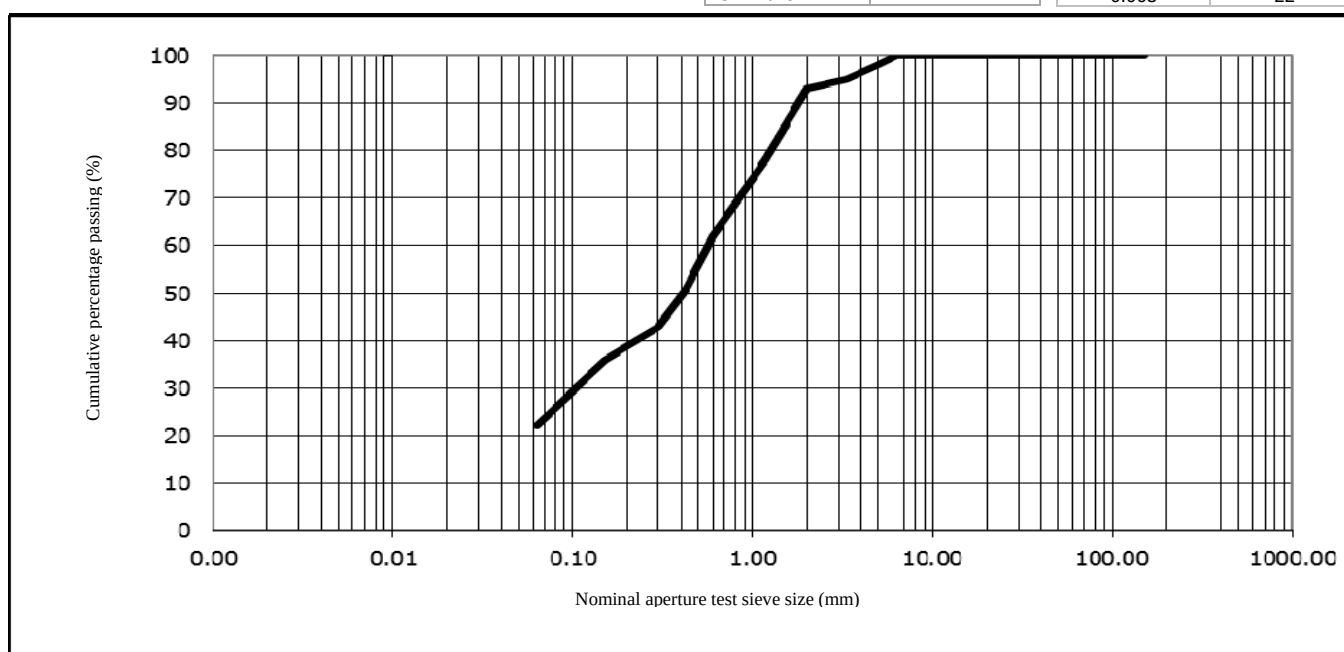
Date Sampled: N/A
Sampled from: -

Material Specification: N/A
Sample Description: Orange brown slightly gravelly slightly silty clayey SAND
Sample Type: Disturbed
Sampled by: Client
Date Sampled: N/A

Remarks: -

BS Test Sieve (mm)	% Material Passing
100	100
90	100
75	100
63	100
50	100
40	100
37.5	100
28	100
20	100
14	100
10	100
6.3	100
5	98
3.35	95
2	93
1.18	78
0.6	62
0.425	51
0.3	43
0.15	36
0.063	22

Soil Fraction	Total Percentage
COBBLES	-
GRAVEL	7
SAND	71
SILT / CLAY	22



Sample Preparation: In accordance with BS 1377-1 & 2:1990

Certification:-

Certified that the Particle Size Distribution was determined in accordance with BS 1377-2: 1990 Method 9.3

Test results reported herein do not apply to samples other than those supplied. GSSL Ltd neither accepts responsibility for nor makes claim as to the final use & purpose of the materials(s)

Approved Signatory:

Date Reported: 05/07/13



Determination of Particle Size Distribution (Dry Sieving)

Report Ref. No: GS-20436

GSSL Sample ID A2

Client ID WS02 @ 1.50-1.70m

Client: REC Ltd
Site: 20436 – St James Lane

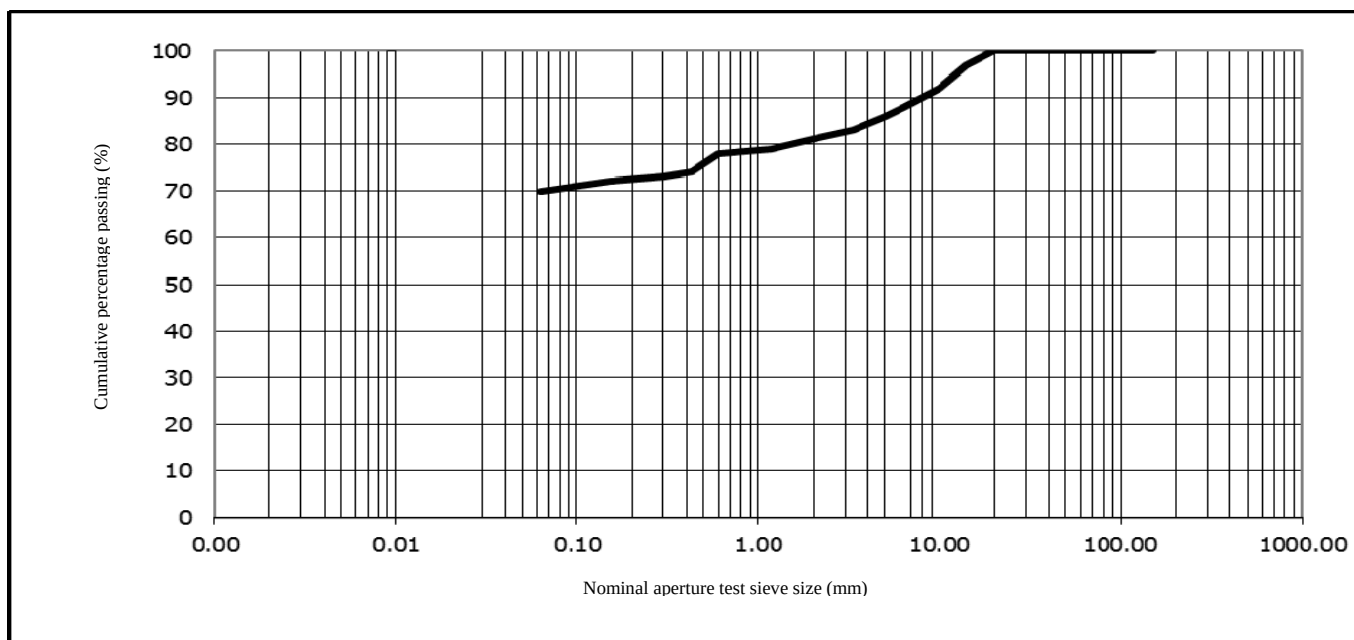
Date Sampled: N/A
Sampled from: -

Material Specification: N/A
Sample Description: Orange brown gravelly slightly sandy silty CLAY
Sample Type: Disturbed
Sampled by: Client
Date Sampled: N/A

Remarks: -

BS Test Sieve (mm)	% Material Passing
100	100
90	100
75	100
63	100
50	100
40	100
37.5	100
28	100
20	100
14	97
10	92
6.3	88
5	86
3.35	83
2	81
1.18	79
0.6	78
0.425	74
0.3	73
0.15	72
0.063	70

Soil Fraction	Total Percentage
COBBLES	-
GRAVEL	19
SAND	11
SILT / CLAY	70



Sample Preparation: In accordance with BS 1377-1 & 2:1990

Certification:-

Certified that the Particle Size Distribution was determined in accordance with BS 1377-2: 1990 Method 9.3

Test results reported herein do not apply to samples other than those supplied. GSSL Ltd neither accepts responsibility for nor makes claim as to the final use & purpose of the materials(s)

Approved Signatory:

Date Reported: 05/07/13



Determination of Particle Size Distribution (Dry Sieving)

Report Ref. No: GS-20436

GSSL Sample ID A3

Client ID WS03 @ 1.40-1.70m

Client: REC Ltd
Site: 20436 – St James Lane

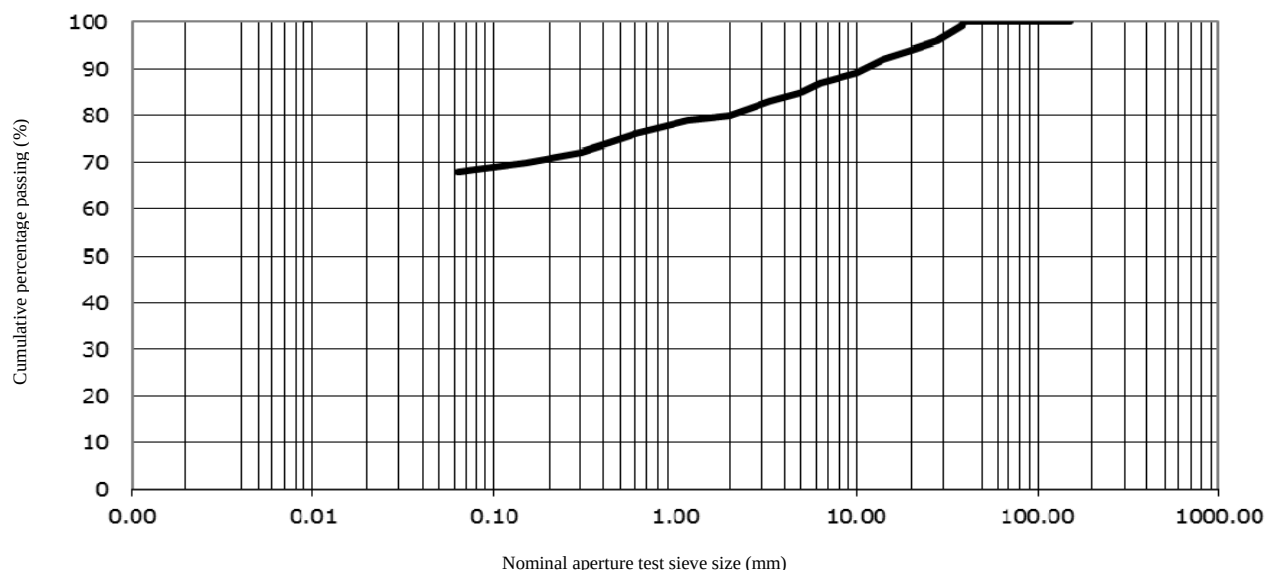
Date Sampled: N/A
Sampled from: -

Material Specification: N/A
Sample Description: Orange brown gravelly slightly sandy silty CLAY
Sample Type: Disturbed
Sampled by: Client
Date Sampled: N/A

Remarks: -

BS Test Sieve (mm)	% Material Passing
100	100
90	100
75	100
63	100
50	100
40	100
37.5	99
28	96
20	94
14	92
10	89
6.3	87
5	85
3.35	83
2	80
1.18	79
0.6	76
0.425	74
0.3	72
0.15	70
0.063	68

Soil Fraction	Total Percentage
COBBLES	-
GRAVEL	20
SAND	12
SILT / CLAY	68



Sample Preparation: In accordance with BS 1377-1 & 2:1990

Certification:-

Certified that the Particle Size Distribution was determined in accordance with BS 1377-2: 1990 Method 9.3

Test results reported herein do not apply to samples other than those supplied. GSSL Ltd neither accepts responsibility for nor makes claim as to the final use & purpose of the materials(s)

Approved Signatory:

Date Reported: 05/07/13



Determination of Particle Size Distribution (Dry Sieving)

Report Ref. No: GS-20436

GSSL Sample ID A4

Client ID HP03 @ 1.20-1.40m

Client: REC Ltd
Site: 20436 – St James Lane

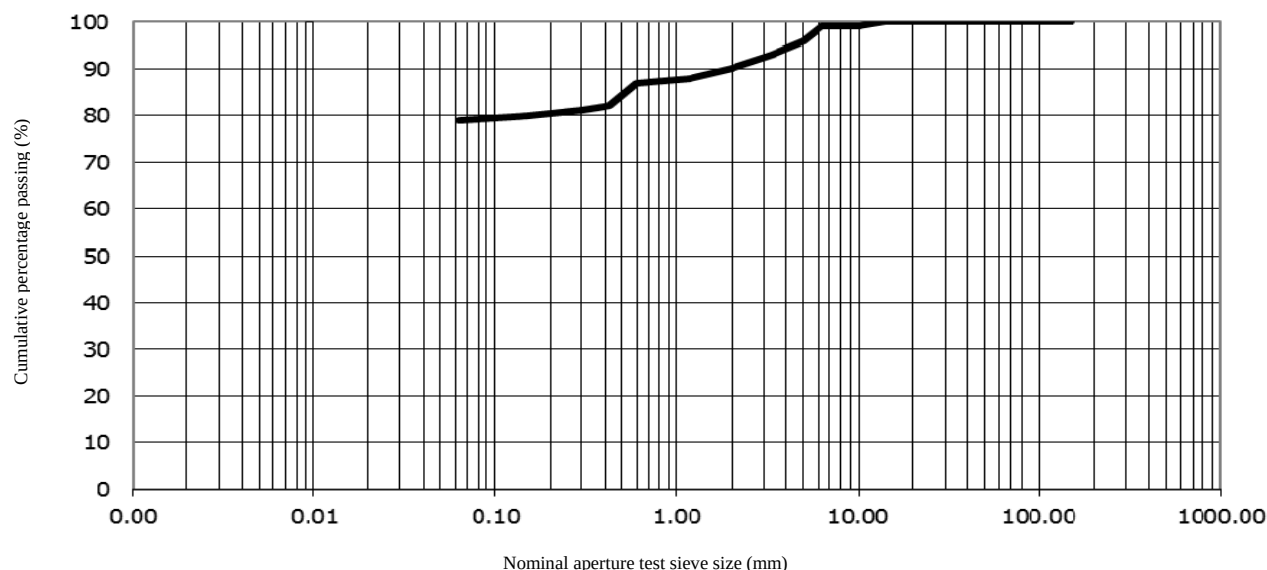
Date Sampled: N/A
Sampled from: -

Material Specification: N/A
Sample Description: Brown slightly gravelly slightly sandy silty CLAY
Sample Type: Disturbed
Sampled by: Client
Date Sampled: N/A

Remarks: -

BS Test Sieve (mm)	% Material Passing
100	100
90	100
75	100
63	100
50	100
40	100
37.5	100
28	100
20	100
14	100
10	99
6.3	99
5	96
3.35	93
2	90
1.18	88
0.6	87
0.425	82
0.3	81
0.15	80
0.063	79

Soil Fraction	Total Percentage
COBBLES	-
GRAVEL	10
SAND	11
SILT / CLAY	79



Sample Preparation: In accordance with BS 1377-1 & 2:1990

Certification:-

Certified that the Particle Size Distribution was determined in accordance with BS 1377-2: 1990 Method 9.3

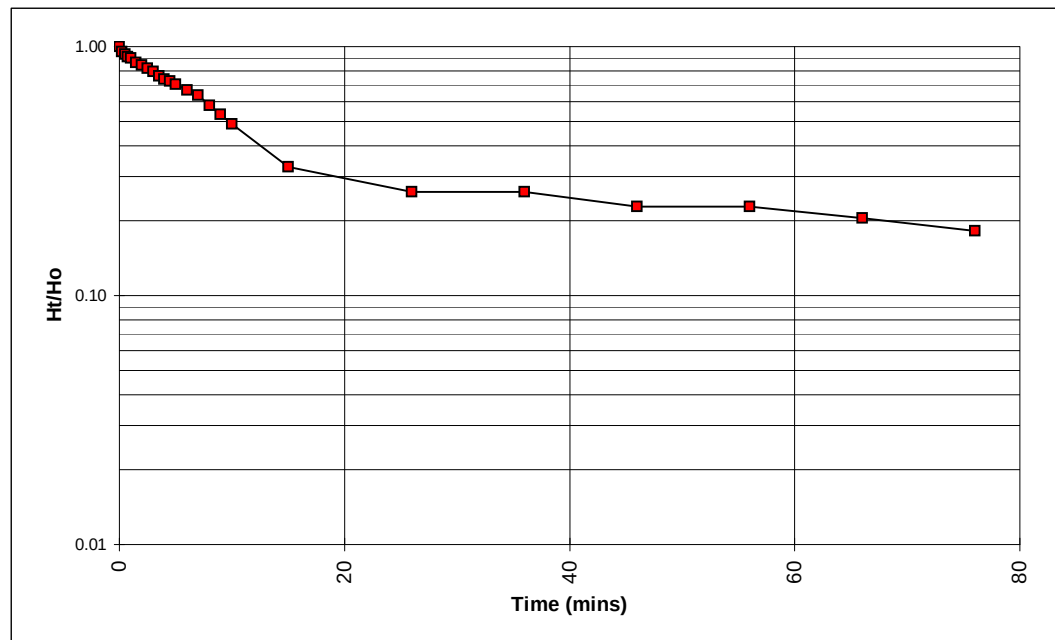
Test results reported herein do not apply to samples other than those supplied. GSSL Ltd neither accepts responsibility for nor makes claim as to the final use & purpose of the materials(s)

Approved Signatory:

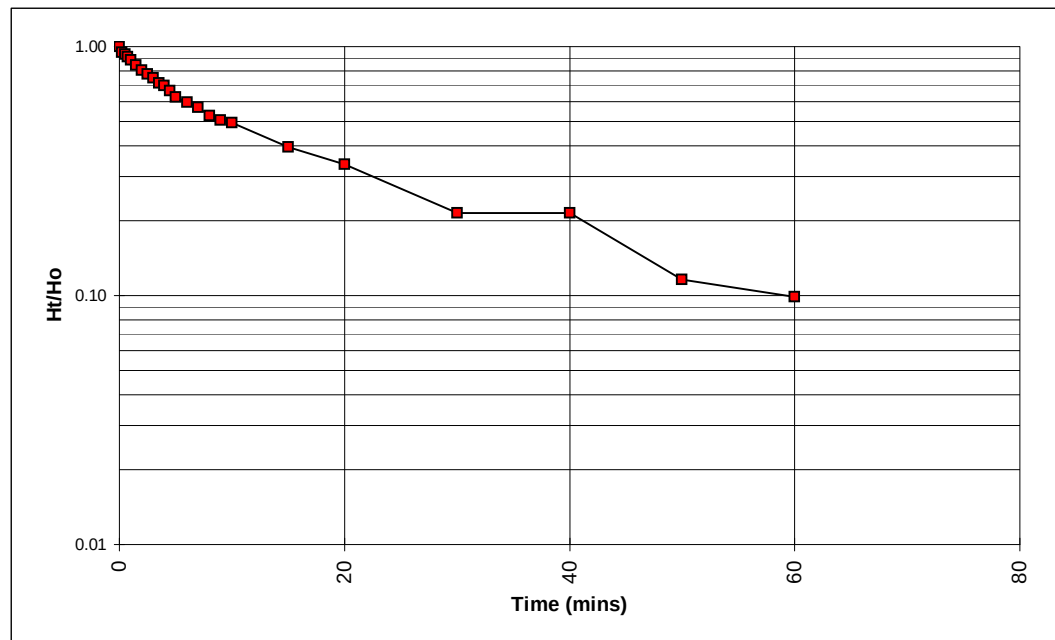
Date Reported: 05/07/13

APPENDIX X
SOIL INFILTRATION TESTING RESULTS

INSITU PIEZOMETER PERMEABILITY TEST		Site Name St James' Lane			
See BS 5930:1999 Para. 25.4		Job No. 20436			
REC Ltd					
Borehole number.....	WS 02	TIME	DEPTH	Ht	Ht/Ho
Date.....	28/06/2013	(min)	(m)	(m)	
Was this a (R)ising or (F)alling test.....	R	0	0.63	-0.88	1.00
Diameter of borehole.....	0.115 [m]	0.25	0.67	-0.84	0.95
Depth to top of filter.....	0.50 [m]	0.5	0.69	-0.82	0.93
Depth to bottom of filter.....	3.80 [m]	0.75	0.71	-0.80	0.91
Internal diameter of piezometer.....	0.05 [m]	1	0.72	-0.79	0.90
Ground water level.....	1.51 [m]	1.5	0.75	-0.76	0.86
Water level at start of test.....	0.63 [m]	2	0.77	-0.74	0.84
Initial head of water (Ho).....	-0.88 [m]	2.5	0.79	-0.72	0.82
		3	0.81	-0.70	0.80
Time lag of test (Ht/Ho = 0.37)	12.50 [mins]	3.5	0.84	-0.67	0.76
Intake factor F (Case d - BS 5930:1999 page 50)	5.84	4	0.86	-0.65	0.74
		4.5	0.87	-0.64	0.73
PERMEABILITY k	2.37E-06 [m/s]	5	0.89	-0.62	0.70
	28.70	6	0.92	-0.59	0.67
		7	0.95	-0.56	0.64
		8	1.00	-0.51	0.58
Notes: All depths measured from ground level		9	1.04	-0.47	0.53
		10	1.08	-0.43	0.49
		15	1.22	-0.29	0.33
		26	1.28	-0.23	0.26
		36	1.28	-0.23	0.26
		46	1.31	-0.20	0.23
		56	1.31	-0.20	0.23
		66	1.33	-0.18	0.20
		76	1.35	-0.16	0.18



INSITU PIEZOMETER PERMEABILITY TEST		Site Name St James' Lane			
See BS 5930:1999 Para. 25.4		Job No. 20436			
REC Ltd					
Borehole number.....	WS 03	TIME	DEPTH	Ht	Ht/Ho
Date.....	28/06/2013	(min)	(m)	(m)	
Was this a (R)ising or (F)alling test.....	R	0	0.58	-1.72	1.00
Diameter of borehole.....	0.115 [m]	0.25	0.67	-1.63	0.95
Depth to top of filter.....	0.50 [m]	0.5	0.70	-1.60	0.93
Depth to bottom of filter.....	4.20 [m]	0.75	0.74	-1.56	0.91
Internal diameter of piezometer.....	0.05 [m]	1	0.78	-1.52	0.88
Ground water level.....	2.30 [m]	1.5	0.85	-1.45	0.84
Water level at start of test.....	0.58 [m]	2	0.92	-1.38	0.80
Initial head of water (Ho).....	-1.72 [m]	2.5	0.97	-1.33	0.77
		3	1.01	-1.29	0.75
Time lag of test (Ht/Ho = 0.37)	17.50 [mins]	3.5	1.07	-1.23	0.72
Intake factor F (Case d - BS 5930:1999 page 50)	6.37	4	1.10	-1.20	0.70
		4.5	1.16	-1.14	0.66
PERMEABILITY k	1.55E-06 [m/s]	5	1.22	-1.08	0.63
	32.17	6	1.27	-1.03	0.60
Notes: All depths measured from ground level		7	1.32	-0.98	0.57
		8	1.39	-0.91	0.53
		9	1.43	-0.87	0.51
		10	1.45	-0.85	0.49
		15	1.62	-0.68	0.40
		20	1.72	-0.58	0.34
		30	1.93	-0.37	0.22
		40	1.93	-0.37	0.22
		50	2.10	-0.20	0.12
		60	2.13	-0.17	0.10



**CD CONTAINING
ENVIRONMENTAL & GEOLOGICAL DATA
HISTORICAL MAPPING
COMPLETE PDF COPY OF REC REPORT**

REC are a multi-disciplinary health, safety, environmental and energy consultancy. Our national coverage enables our local experts to provide cost effective and pragmatic consultancy services in an efficient and sustainable manner.

REC CHSS Corporate Health & Safety Services

- NEBOSH Accredited Training Courses
- IOSH Accredited Training Courses
- IEMA Accredited Training Courses
- Asbestos Training
- Health & Safety Training
- CDM Training
- Health & Safety Consultancy

REC Renewable Energy

- Feasibility Studies
- Ground Source Heat Pumps Installation
- Air Source Heat Pump Installation
- System Design and Maintenance
- Solar Photovoltaic (PV) Systems
- Combined Heat and Power Systems

REC Acoustics

- Sound Insulation Testing
- Noise at Work Assessment
- Development Related Noise
- Environmental Noise

REC Environmental Management

- Environmental Management
- Divestment Services
- Environmental Management Systems
- CDM Co-Ordination
- Environment Permit Application

REC Asbestos & Legionella

- Asbestos Management Surveys
- Demolition/Refurbishment Surveys
- Analysis of Asbestos in Soils and Bulk Samples
- Air Testing for Clearances and Reassurance
- Legionella Risk Assessment

REC Air Quality

- Air Quality Impact
- Odour Assessment
- Dispersion Modelling
- Stack Emission Testing
- Pollution Monitoring

REC Geoenvironmental

- Geotechnical Investigation & Assessment
- Contaminated Land Investigation & Assessment
- Waste Management
- Groundwater Testing
- Environmental Impact Assessment

REC Flood Risk

- Flood Risk & Consequence Assessment
- Strategic Flood Risk Assessment (SFRA)
- EIA Technical Chapters
- Assessment of Flood Levels
- Hydrology & Hydrogeology
- Flood Defence Structures
- Drainage Systems (SUDS) Design
- Mitigation Measures
- Soakaway Tests

REC Ecology

- Phase 1 Habitat Surveys
- Invasive Species
- Legally Protected Species Surveys
- Mitigation Schemes
- Ecological Impact Assessment (EcIA)
- BREEAM & Code 4 Sustainable Homes
- Habitat Management Plans
- Management planning and targeted Biodiversity Action Plan survey
- Environmental Impact Assessment