

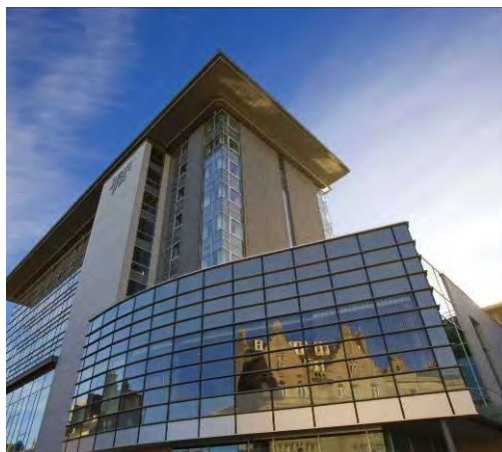
Cairn Hotel Group

**Proposed Development at
2 Little Lever Street, Manchester**

**Geo Environmental Site
Investigation Report**

116341/01A

July 2018



FAIRHURST

CONTROL SHEET**CLIENT:** Cairn Hotel Group**PROJECT TITLE:** Proposed Development at 2 Little Lever Street, Manchester**REPORT TITLE:** Geo Environmental Site Investigation Report**PROJECT REFERENCE:** 116341**DOCUMENT NUMBER:** D/I/L/116341/01A

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Executive Summary of Site Conditions, Page 1 of 3

Developer and Funded		Cairn Hotel Group	
Current Site Status		The site is split into two distinct areas as follows; <u>Main Site - Little Lever Street</u> The main site currently consists of vacant, stripped ground, following demolition of the existing building, basement retaining walls and a site level that is generally flat and approximately 2.5m below surrounding ground levels. <u>Gardens Hotel - Basement</u> A secondary site is located in the basement of the Gardens Hotel	
Development Proposals		The proposed development is to comprise a seven storey building for use as a hotel, with a link bridge at level three connecting the development to the rear of the Gardens Hotel.	
Site Conditions	Location		The main site is located, at National Grid Reference 384540, 398320, is located at 2 Little Lever Street, Manchester. A secondary site is located in the basement of the Gardens Hotel, which is accessed via a fire exit off of Back Piccadilly. The site is bound by Back Piccadilly, Little Lever Street and Cavell Street to the south-west, north-west and north-east of the site, respectively. The south-east boundary comprises an adjoining multi storey building. Buildings overlooking the site comprise both commercial and residential usage.
	Site History	Onsite	From 1892 to 1933 two buildings that were demolished in the early 2000's. Anecdotal account of former mill building on site.
	Site History	Offsite	Adjacent land has been used for residential, commercial and industrial purposes.
	Geology		During the site investigation the following soil profiles were identified; <u>Main Site - Little Lever Street - External Investigation</u> • Made Ground as a mix of cohesive and granular fill to approximately 0.6m bgl. • Firm becoming stiff Clay to 9.4m bgl • Dense Sand proven to 11.8mbgl <u>Gardens Hotel - Basement - Internal Investigation</u> • Concrete to between to 0.1m bgl • Made ground to 1.7m bgl • Stiff Clay proven to 5.45m bgl
	Surface Water		The following surface water conditions were identified onsite; • The existing built developments adjacent assumed to discharge to the river or public sewer. • A CCTV survey is recommended to inspect the condition of potential existing drainage.
	Groundwater		The following groundwater conditions were identified • Superficial deposits as a Secondary (Undifferentiated) Aquifer • bedrock as a Principle A Aquifer • No.3 potable abstraction points within 1km of the site • No groundwater was identified during the site investigation and monitoring visits
	Flood Risk		• Environment Agency Flood Zone 1
	Landfill		• No recorded landfills on site • Made ground as construction material (locally) to 2.45m depth

Executive Summary of Site Conditions, Page 2 of 3

Geotechnical Constraints	The following geotechnical constraints have been identified; • Localised concrete hardstanding across parts of the site • Variable made ground within the Little Lever Street site footprint with thicknesses of up to 2mbgl • Obstructions encountered in the made ground • Party wall of 15 No Newton Street forms the eastern boundary • The site slopes by approximately 1.5m from Little Lever Street towards the party wall of 15 No Newton Street • Basement of adjacent building along the eastern boundary • Historical foundations and substructures anticipated • Foundation and obstructions expected associated with the existing building • Obstructions and substructures associated with historical buildings on site • Services beneath the existing basement and possible historical floor slabs • Services beneath the adjacent buildings
Earthworks	The following materials are likely to be generated during general earthworks, foundation arisings and drainage arisings; • Hard materials associated with existing buildings and concrete slabs. Once crushed and reprocessed this material is suitable for re use on site • Made ground as granular and cohesive fill – suitable for reuse as low quality fill beneath car park. • Superficial deposits as clay suitable for reuse as general fill. • In view of the historical development and made ground on site, asbestos fibres may be present within the soils and appropriate mitigation measures and PPE should be adopted during redevelopment works to mitigate risks
Foundation and Slab Design	Based on the ground conditions identified and subject to confirmation of proposed development and final floor levels the following preliminary foundation design is considered viable; • Due to the depth of made ground identified piled foundations are required to found on firm to stiff clay with an allowable bearing capacity of 150kN/m² • The use of precast suspended floors are assumed for development
Retention	Based on the conditions on site identified the following preliminary retention design should be considered; • The proposed development includes a basement construction which is expected to require construction of a contiguous board pile wall
Services	The following services are present: • Services beneath the existing basement and possible historical floor slabs • Services beneath the adjacent buildings

Executive Summary of Site Conditions, Page 3 of 3

Contamination Issues	• No Asbestos identified from site investigation and lab testing • In view of the historic development on site, asbestos fibres cannot be discounted within the made ground • Localised elevated concentrations of heavy metals (lead) and organics (PAH) identified within the made ground on site
Remediation Options	The following measures are recommended to ensure a low risk to receptors is maintained in the development; • Asbestos survey has been undertaken and asbestos has been identified. Asbestos removal by a specialist contractor will be required prior to demolition. • Asbestos fibres identified within the made ground the presence of further asbestos debris and contamination to any made ground cannot be discounted. If encountered this material may require removal. Construction workers should be made aware and shall adopt appropriate health and safety measures during earthworks. • Dust suppression measures should be adopted during all earthworks. • Construction workers should undertake soil gas and VOC monitoring prior to and during man entry of below ground voids. • Surface water control measures should be adopted during construction to limit runoff and infiltration through exposed made ground horizons and to limit siltation of the surface drainage system. • Validation testing on a grid should be undertaken as a precautionary approach to confirm the absence of significant contamination. • Soil gas protection measures are not required as the site classifies as Characteristic Situation No. 1 • Aggressive Chemical Environment for Concrete measures as DS-2, ACEC Class AC-2

1.0 INTRODUCTION

Fairhurst have been instructed by the Cairn Hotel Group to carry out a Desk Study and Geo-Environmental Site Investigation Report for a proposed development at 2 Little Lever Street, Manchester at Grid Ref: 384540, 398320, as shown on the Architect's Site Location Plan, **Appendix B**. The proposed development is to comprise a seven storey building for use as a hotel, with a link bridge at level three connecting the development to the rear of the Gardens Hotel. The site is split into a main site located off Little Lever Street and a secondary site situated in the basement of the Gardens Hotel, which is accessed via a fire exit off of Back Piccadilly.

The aim of the Desk Study and Site Investigation was to provide geotechnical and environmental information on the site to provide advice on contamination and geotechnical design of the proposed development including;

- Foundation design
- To identify development abnormal costs
- To develop a Conceptual Site Model for the site
- To develop an environmental risk assessment and update the preliminary Risk Assessment included in the Desk Study Report
- To establish whether contamination is present and requires remedial action

This was carried out via an intrusive ground investigation with chemical and geotechnical testing.

The design of the site investigation was informed by a review of the Desk Study information, presented in **Appendix A**.

1.1 Development Proposals

The proposed development is to comprise a seven storey building for use as a hotel, with a link bridge at level three connecting the development to the rear of the Gardens Hotel. In order to facilitate the development a site clearance will be required.

Indicative layouts are shown on the Architect's Drawings in **Appendix B**.

1.2 Sources of Information

Information has been obtained from the following sources:

- Soiltechnics Ground Investigation Report, 2005 (Ref. 1)
- Ian Farmer Associates Factual Report (Ref. 11)

2.0 THE SITE

2.1 Site Location

The site, at National Grid Reference 384540, 398320, is located at 2 Little Lever Street, Manchester, as shown on the Site Location Plan, **Appendix B**.

The main site currently consists of hardground with limited vegetation cover, following demolition of the existing building. Retaining walls remain, such that levels across the site are approximately 2.5m below surrounding ground levels. The site is generally level, with a very gentle slope from north-west to south-east where the existing basement has been removed.

A secondary site is located in the basement of the Gardens Hotel, which is accessed via a fire exit off of Back Piccadilly. The site is bound by Back Piccadilly, Little Lever Street and Cavell Street to the south-west, north-west and north-east of the site, respectively. The south-east boundary comprises an adjoining multi storey building. Buildings overlooking the site comprise both commercial and residential usage.

2.2 Site History

The site's historical land uses have been identified based on a review in Soiltechnics 2005 Ground Investigation Report (Ref. 1). The data was originally collated following a review of OS Maps. Significant features, changes, and associated dates are summarised in Table 1 and 2.

Table 1: Existing Development

Date	On Site	Adjacent Land
Present	Hardground with limited vegetation cover.	Back Piccadilly, Little Lever Street and Cavell Street to the south-west, north-west and north-east of the site, respectively. The south-east boundary comprises a multi storey building.

Table 2: Historical Land Use

Date	On Site	Adjacent Land
1892 to 1933	Two buildings, concurrent with the layout of the buildings that were demolished in the early 2000's	- Cotton mill 350m to the south - Tree covered open ground is indicated some 150m to the south-west, recorded as Manchester Royal Infirmary in 1908 and a library in 1922 - A canal wharf and associated buildings 300m east - Victoria, London Road and Central railway stations are all located within 1km of the site

1948 to 1982	No significant change	- Paint works, machine tool works and printing works approx. 300m to the east and north - Series of warehouses within 400m - Ground formerly occupied by the library is now Piccadilly Gardens - Land formerly occupied by Dale Street Wharf is recorded as a car park after 1971 - Builders yard 300m east - Central station is disused after 1972 and London Road station becomes Piccadilly Station
1999	No significant change	Bus station indicated to the south of Piccadilly Gardens

Since 1892 two buildings existed on site which is concurrent with the layout of the buildings that were demolished in the early 2000's. Although it is not indicated upon the historical maps, it is understood from Ashgate Developments Limited that part of the site may have been formerly occupied by a mill.

Adjacent land has been used for residential, commercial and industrial purposes.

2.3 Geology

The geological profile of the site has been identified based on a review in Soiltechnics 2005 Ground Investigation Report (Ref. 1).

2.3.1 Made Ground: The site has undergone historical development, with two buildings on site. As such, made ground would be expected to be present across the site. The made ground is likely to predominantly comprise construction and fill material used to level the ground prior following demolition of the previous buildings.

2.3.2 Superficial Deposits: BGS map sheet

The site is shown to be underlain by alluvium as clay, sands and gravels

2.3.3 Solid Geology: BGS map sheet.

The superficial deposits are underlain by Triassic Sandstone.

2.4 Mining and Mineral Extraction

A review of a historical Coal Authority Report presented in Soiltechnics 2005 Report is presented below.

2.4.1 Mining

The Coal Authority indicates that the property is not within a zone of likely physical presence of underground coal workings. The report does however state that reserves of coal exist in the locality of the site, which could be worked at some time in the future, subject to feasibility, licenses and planning consents.

2.4.2 Mineral Extraction

A review of historical plans did not identify activities associated with mineral extraction on site.

2.5 Landfilling and Soil Gas

2.5.1 Onsite

The following information is provided on landfilling and soil gas onsite:

- No recorded landfills on site.
- The site has undergone historical development with two buildings on site. As such, made ground as construction material is expected to be present across the site.

2.5.2 Adjacent Land

The following information is provided on landfilling and soil gas on adjacent land:

- The nearest historical landfill was located 79m north east of site at Spen Lane. Deposited waste included commercial waste.

2.6 Controlled Waters

2.6.1 Surface Water

The following information is provided on surface waters;

- The existing built developments that surround the site has roofline and surface water drainage systems which are assumed to discharge to the river or public sewer. A CCTV survey is recommended to inspect the condition of existing drainage.
- Historical utility plans included in Soiltechnics 2005 Report indicates a 406x300mm diameter public sewer runs below Little Lever Street and Back Piccadilly, which runs into a 900x600mm diameter public sewer along Lever Street to the north. Furthermore, a public sewer runs southwards along Cavell Street into a 1500mm diameter sewer on Newton Street

2.6.2 Groundwater

The following information on groundwater is identified;

- The site is expected to be underlain by made ground and superficial soils over bedrock. As such, perched and superficial waters would only be expected to be present locally within the soil profile.
- Environment Agency maps classify the superficial deposits beneath the site as a Secondary (Undifferentiated) Aquifer
- Environment Agency maps classify the bedrock beneath the site as a Secondary (Undifferentiated) Aquifer
- There are three potable abstraction points within 1km of the site, with the nearest located 530m to the south-west

2.6.3 Flood Risk

The following information on flood risk is available;

- Environment Agency maps classify the site as within Flood Zone 1 which means having less than a 1 in 1,000 annual probability of river flooding (<0.1%).

2.7 Radon

According to BRE 211 Radon Report presented by Soiltechnics 2005 Report, the property is in a lower to intermediate probability radon area, and therefore no radon protective measures are necessary in the construction of new dwellings or extensions.

2.8 Regulatory Review

2.8.1 Permits Consents and Authorisations

The factors that could influence the environmental status of the site are described below in Table 4. A full listing of these factors including discharge consents, pollution incidents and other environmental information was included in the EnviroCheck Report in Soiltechnics 2005 Ground Investigation Report.

Table 4 – Regulatory Review

Feature	No. within 1km	Closest to site	Details about closest to site
Local Authority Pollution Prevention Controls	8	434m NE	Express Printers, authorisation revoked
Pollution Incidents to Controlled Waters	31	268m SE	Pollution source not determined. Chemical paints/dyes pollutant. Category 3 – Minor Incident.
Contemporary Trade Directory Entries	261	36m N	Clothing and fabric manufacturers

Feature	No. within 1km	Closest to site	Details about closest to site
Registered Fuel Stations	3	310m NE	Blossom Motor Company. Status obsolete

2.8.2 Landfilling and Waste Management

Details of the landfill sites and waste management facilities located within 1km of the site are summarised in Table 5.

Table 5 – Landfill and Waste Management Sites

Feature	No. within 1km	Closest to site	Details about closest to site(s)
Historical Landfill Sites	0	N/A	N/A
Licensed Waste Management Facilities	3	559m NE	End of life vehicles
Local Authority Recorded Landfill Sites	0	N/A	N/A
Registered Landfill Sites	1	919m E	Large landfill. Authorised waste included ceramics, construction waste, glass, metals, soil
Registered Waste Transfer sites	1	883m N	British Gas site, exempt from license

2.8.3 Summary

All consents and permits discussed are considered not to have a detrimental impact on the site.

2.9 Ecological Receptors

No ecological receptors have been identified onsite or the immediate adjacent land.

2.10 Invasive Species

Japanese Knotweed has not been identified on the site.

2.11 Site Inspection

A site walkover was undertaken and photographs from the walkover are included in **Appendix D**, and are summarised below:

Main Site - Little Lever Street

- Site boundary secured with 2m high wooden fence
- Access via Back Piccadilly
- The site slopes from north-west to south-east, from street level down to approximately 2.5m below street level, as a result of excavation and removal of basement
- Basement retaining walls remain along the site boundary
- An existing building bounds the site to the south-east
- Site cover is hardground with sparse vegetation of grass and small shrubs
- Construction debris has been left sparsely across the site with brick fragments, rubble, wood, metal and plastic
- No signs of surface water flooding or ponding
- No visual or olfactory signs of contamination identified
- Party wall of 15 No Newton Street forms the eastern boundary
- The site slopes by approximately 1.5m from Little lever Street towards the party wall of 15 No Newton Street

Gardens Hotel - Basement

- Access via fire exit off of Back Piccadilly down several flights of stairs
- Basement floor consists of concrete, brick and tiles
- Previously excavated pits all identified. Most are covered with boards
- Material within the basement includes piles of rubble from previous excavations, tables, shelving and disused office equipment
- Concern over ventilation of basement for site investigation works

3.0 PRELIMINARY ENVIRONMENTAL RISK ASSESSMENT

3.1 Qualitative Risk Assessment Methodology

Land contamination is a material consideration under the planning regime and a local planning authority has a duty to consider the potential implications of contamination under the following circumstances;

- when it is developing a Local Development Frameworks
- when it is considering applications for planning permission

The National Planning Policy Framework (NPPF) paragraph 122 states that planning policies and decisions should ensure that;

- The site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation;
- after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990

In order to establish whether there are potentially unacceptable risks associated with contaminant sources a conceptual Site Model has been developed and a Qualitative Risk Assessment has been undertaken in accordance with the requirements of the 'Model Procedures for the management of land contaminated' – CLR11 (Ref. 4). The assessment has been undertaken with regard to the following proposed land use;

- Commercial Development as a hotel and associated elevated foot bridge

The following sections discuss the identified potential on and off site contamination sources, migration pathways and environmental receptors in the context of the proposed development. The plausible pollutant linkages, which may represent a risk to receptors, such as human health and controlled waters, are identified via the conceptual site model and risk assessment based on the data collected during the desk study.

3.2 Potential Sources of Contamination

3.2.1 Historical Land Uses

The historical plans indicate that the site has been developed as two buildings that existed on site since 1892 which is concurrent with the layout of the buildings that were demolished in the early 2000's. Although it is not indicated upon the historical maps, it is understood from Ashgate Developments Limited that part of the site may have been formerly occupied by a mill. A number of potentially contaminative land uses have been located within proximity of the site.

The following potential contaminant hazards may be present based on site history, industry profiles, and available site investigation data.

Onsite

General Made Ground; Widespread and significant contamination is unlikely, however, localised contaminants associated with made ground may include Heavy Metals, Inorganics, Organics, Asbestos, and Soil Gas.

Made Ground associated with historical land use; Localised contaminants associated with the historical land use may include Heavy Metals, Inorganics, Organics (TPH, PAH) within the soils and groundwater, Asbestos fibres within the made ground and soil gas.

Asbestos debris in made ground; The site has undergone a number of phases of construction and demolition. Therefore, the presence of asbestos fibres within the made ground cannot be discounted.

Adjacent Land

General Made Ground; Localised contaminants associated with made ground may include Heavy Metals, Inorganics, Organics, Asbestos, and Soil Gas.

Historical land use as a mills, gas works, chemical works; widespread contamination at significant levels is unlikely; however localised contaminant hotspots of Heavy Metals, Inorganics, Organics (TPH and PAH), and Asbestos.

3.3 Pathways

A pathway is defined as a mechanism or route by which a contaminant comes into contact with, or otherwise affects a receptor. Pathways by which the identified receptors may be impacted on in the context of the proposed development are identified as follows;

- Ingestion
- Skin contact
- Inhalation
- Surface run-off
- Leaching of soluble contamination into groundwater
- Saturated zone flow through Aquifer
- Construction pathways.
- Direct contact by buried structures
- Accumulation of potentially explosive gases within confined spaces

3.4 Receptors

3.4.1 Human Health

Human receptors that are potentially at risk from identified sources include;

- Human health end users
- Human health construction workers
- Human health adjacent site users

3.4.2 Controlled Waters

Controlled waters that are potentially at risk from identified sources include;

- Rochdale Canal approximately 225m east of the site
- Bedrock - Principle Aquifer
- Superficial deposits (undifferentiated) Aquifer
- Three abstraction points within 1km

3.4.3 Structures

Migration of potential pollutants on site may present a risk to the following structures:

- Buried concrete foundations
- Services

3.5 *Qualitative Risk Assessment*

Based on the preliminary Conceptual Site Model (CSM) an Environmental Risk Assessment (ERA) was undertaken. The Environmental Risk Assessment was based on a simple matrix taken from CIRIA C552 (Rudland et al., 2001) 'Contaminated Land Risk Assessment – A Guide to Good Practice' which provides a consistent basis for decision-making. The probability and consequences of complete pollution pathways are defined according to parameters relevant to the situation and risk assessment.

The following Pollution Linkages Tables (Table 3 and 4) indicate the level of risk associated with the identified contaminant sources and is based on the combination of consequence and probability. Tables 9, 10, 11, and 12 in **Appendix B** provide a Risk Matrix, together with a Classification of Consequence, Probability, and Risk.

Table 6 – Summary of plausible source – pathway – receptor pollutant linkage – Onsite sources

Source	Pathway	Receptor	Con.	Prob.	Risk
General Made Ground	Ingestion, Inhalation, Dermal Contact	Future Site Users	Md	UI	L
		Construction Workers	Md	UI	L
		Adjacent Land Users	Md	UI	L
	Leaching, Migration, and Surface run-off	Principal A Aquifer	Md	UI	L
		Rochdale Canal	Md	UI	L
	Direct Contact	Buried Concrete	Mi	UI	L
		Underground Services	Mi	UI	L
Historical use of the site as two buildings	Ingestion, Inhalation, Dermal Contact	Future Site Users	Md	UI	L
		Construction Workers	Md	Lw	M/L
		Adjacent Land Users	Md	UI	L
	Leaching, Migration, and Surface run-off	Principal A Aquifer	Md	Lw	M
		Rochdale Canal	Md	Lw	L
	Direct Contact	Buried Concrete	Mi	UI	L
		Underground Services	Mi	UI	L
Asbestos Debris within the made ground	Inhalation	Future Site Users	Md	UI	L
		Construction Workers	Md	Lw	M/L

After CIRIA Report C552, Contaminated Land Risk Assessment A Guide to Good Practice, 2001.

Where Con = Consequence and Prob = Probability. **Consequence:** Sv = Severe, Md = Medium, Mi = Mild, Mr = Minor. **Probability:** Hi = High likelihood, Li = Likely, Lw = Low Likelihood, UI = Unlikely. **Risk:** VH = Very High, H = High, M = Moderate, M/L = Moderate/Low, L = Low, VL = Very Low.

Table 7 – Summary of plausible source - pathway – receptor pollutant linkage – Offsite sources

Source	Pathway	Receptor	Con.	Prob.	Risk
Historical and Present land use as a cotton mill, infirmary, paint works, machine test works, builders yard.	Ingestion, Inhalation, Dermal Contact	Future Site Users	Md	UI	L
		Construction Workers	Md	UI	L
	Leaching, Migration and Surface run-off	Principal A Aquifer	Md	Lw	M
		Rochdale Canal	Md	Lw	L
	Direct Contact	Buried Concrete	Mi	UI	L
		Underground Services	Mi	UI	L

After CIRIA Report C552, Contaminated Land Risk Assessment A Guide to Good Practice, 2001.

Where Con = Consequence and Prob = Probability. **Consequence:** Sv = Severe, Md = Medium, Mi = Mild, Mr = Minor. **Probability:** Hi = High likelihood, Li = Likely, Lw = Low Likelihood, UI = Unlikely. **Risk:** VH = Very High, H = High, M = Moderate, M/L = Moderate/Low, L = Low, VL = Very Low

Based on the known site history, the pollution linkage assessment, and the geological setting of the site, the risk assessment has indicated the following;

- Potentially contaminated made ground on site represents a **Low** risk to human health and a **Moderate to Low** risk to Construction Workers. However, with the use of appropriate PPE the risk is to construction workers is **Low**.
- Potential soil gas beneath the site represents a **Low** risk to future site users and a **Moderate to Low** risk to Construction Workers. However, with the use of appropriate PPE the risk is to construction workers is **Low**.
- The site represents a **Moderate** risk to the Principle A Aquifer and a **Low** risk to the Rochdale Canal.
- Asbestos is present within the existing built development and represents a **Moderate** to **Low** risk to construction workers.

4.0 GROUND CONDITIONS

4.1 Site Investigation

4.1.1 Objectives

A detailed site investigation was designed and implemented by Fairhurst. The overall aim of the investigation was to:

- Identify and confirm the general soil profile.
- Identify suitable founding strata and assist in foundation design.
- To investigate and identify potential contamination and therefore refine the environmental site conceptual model.
- Establish any potential development abnormalities prior to site development.
- Provide information to assist in the characterisation of the site in order to satisfy regulators that environmental risks have been adequately identified and mitigated.

4.1.2 Exploratory Works

The site investigation was undertaken between 25th and 28th of October 2016 and comprised the following:

- 3 No. boreholes to a maximum depth of 13.38m
- 2 No. window samples to a maximum depth of 5.45m
- 3 No. Trial pits to a maximum depth of 3.5mbgl
- 2 No. hand pits

Location and borehole records shown in the Factual Report, **Appendix E**

4.1.3 *Monitoring*

3 No. monitoring wells were installed and monitored on November the 9th, 23rd and 30th in 2016 for;

- O₂ , CO₂ , CH₄ , CO, H₂S , VOC and LEL
- Gas flow rate, and atmospheric pressure
- Water level
- Ground water contamination from BH02

4.1.4 *Chemical Testing*

Disturbed and Jar samples were taken throughout the exploratory holes and chosen for testing to target specific strata and areas of visual or olfactory evidence of contamination.

Determinands selected as part of the chemical analysis are detailed below;

- Heavy Metals - Arsenic, Boron (Water Soluble), Cadmium, Chromium, Copper, Lead, Mercury, Magnesium (Water Soluble), Nickel, Selenium, Zinc.
- Organics - PAH, TPH, Phenol (total)
- Inorganics - Sulphur, Sulphate (Total / 2:1 water-soil extract), Sulphide, Chloride, Ammonium, Cyanide (free/complex/total), Thiocyanate.
- Miscellaneous – pH & Asbestos. Where asbestos fibres were identified asbestos quantification was undertaken.

Groundwater samples collected post site investigation monitoring were tested for the following;

- Heavy Metals - Arsenic, Boron (Water Soluble), Cadmium, Chromium (III/VI), Copper, Lead, Mercury, Magnesium (Water Soluble), Nickel, Selenium, Zinc.
- Organics - PAH, TPH, TOC, Phenol (total)
- Inorganics - Sulphur, Sulphate (Total / 2:1 water-soil extract), Sulphide, Chloride, Nitrate, Ammonium, Cyanide (free/complex/total), Thiocyanate
- pH

4.1.5 *Geotechnical Testing*

The following Geotechnical Testing was undertaken as part of the Site Investigation:

- Moisture content
- Atterberg limit tests
- Undrained single stage triaxial tests
- One dimensional consolidation test

4.2 **Soil Profile**

Detailed descriptions of the materials encountered, together with groundwater observations and the results of in situ tests are given in the Factual Report (Ref. 1). A summary of the soil profile is detailed below;

Main Site - Little Lever Street - External Investigation

- **Made Ground** as a mix of cohesive and granular fill to approximately 0.6m bgl.
- Firm becoming stiff **Clay** to 9.4m bgl
- Dense **Sand** proven to 11.8mbgl

Note: BH01 terminated at 2.45m bgl within the made ground.

Gardens Hotel - Basement - Internal Investigation

The following soil profile was identified within the basement of Gardens Hotel;

- Concrete to between to 0.1m bgl
- **Made ground** to 1.7m bgl
- Stiff **Clay** proven to 5.45m bgl

4.3 Groundwater Profile

The following water profile was recorded during the site investigation;

- No groundwater was identified during the site investigation. Groundwater was encountered during at monitoring visits at 1.35m bgl

4.4 Geotechnical Properties

In the following sections a summary of the geotechnical properties, based on physical description and in-situ testing, for each strata encountered is presented. The results of the geotechnical laboratory tests are included in Factual Report (Ref. 12).

4.4.1 Made Ground

Main Site - Little Lever Street - External Investigation

Thin made ground was identified across the site to between 0.6m and 2.45m. BH01 terminated at 2.45m bgl within the made ground.

Gardens Hotel - Basement - Internal Investigation

Thin made ground was identified across the site to 0.5m.

4.4.2 Superficial Deposits

In-situ geotechnical and laboratory tests were carried out on samples of the clay to assess the moisture content, index properties, shear strength and consolidation properties of the clay.

Little Lever Street - External Investigation

Superficial deposits as firm **Clay** were encountered, respectively, across the sites to 9.4m m bgl and 11.8m bgl

External investigation gave moisture values of between 17.8 and 25.3%, plastic limit test results of between 19 - 20%, liquid limits of between 31-42% and a plasticity index of between 14 and 23% defining the clays as firm.

SPT's taken in-situ within superficial deposits were between 15 to 50 (locally) indicating compaction of firm to stiffer clays with increasing depth.

Gardens Hotel - Internal Investigation

Superficial deposits as stiff **Clay** were encountered across the sites to 5m bgl

Internal investigation on No.1 sample from WS04 gave moisture values of 19.5%, plastic limit test results of 19 %, liquid limits of between 40% and a plasticity index of 21 defining the clays as stiff.

SPT tests taken in-situ within the superficial deposits had values of 11 to 45 indicating compaction and stiffing of the clays with increasing depth.

4.4.3 Bedrock

No bedrock was encountered on site during the Site Investigation works.

4.5 Existing Foundations

Main Site - Little Lever Street - External Investigation

2 No. hand pit were excavated along the party wall along the eastern boundary. The following foundations were identified;

- Corbelled brick foundation encountered found on firm CLAY at between 0.49m and 0.6mbgl
- Foundation width assumed to be between 480mm and 640mm
- Founding strata as firm CLAY

Gardens Hotel - Basement - Internal Investigation

3 No hand pits were excavated within the basement to confirm existing foundations. Due to a backed up sewer pipe it was not possible to log HP2 as foul water was present on the floor of the basement at this location. The following foundations were identified;

- HP01 – Corbelled brick foundations found on firm CLAY at 0.5mbgl. A broken pipe was encountered within the base of the excavation. Foundation width assumed to be 300mm.
- HP05/WS05 – A brick floor was identified across the base of the foundation excavation at 1.5m – possibly a former basement floor
- Founding strata as firm CLAY

4.6 Relic Structures

Based on the site investigation, walk over and review of historical plans the following obstructions have been identified;

- Localised concrete hardstanding across parts of the site
- Variable made ground within the Little Lever Street site footprint with thicknesses of up to 2mbgl
- Obstructions encountered in the made ground BH01
- Party wall of 15 No Newton Street forms the eastern boundary

- The site slopes by approximately 1.5m from Little lever Street towards the party wall of 15 No Newton Street
- Basement of adjacent building along the eastern boundary

The following obstructions are anticipated;

- Foundation and obstructions expected associated with the existing building
- Obstructions and substructures associated with historical buildings on site
- Services beneath the existing basement and possible historical floor slabs
- Services beneath the adjacent buildings

4.7 Evidence of Contamination

No visual or olfactory signs of contamination were identified during the site investigation undertaken in 2016.

The site has been subject to historical development and although not encountered during the site investigations, the presence of asbestos debris in the made ground cannot be discounted.

4.7.1 Contamination Test Results

Soil samples of the made ground, in addition to water sample, were analysed for contamination during the site investigation covering both sites. The results of the site investigation are detailed in the factual report (Ref. 11) and summarised below.

Made Ground

A total of no. 5 Soil samples of made ground were analysed for contamination and the results are summarised below:

- All samples were below their respective assessment in **Appendix C** criteria apart from;
- Localised elevated of benzo(a)pyrene and lead, respectively, in BH01 and TP04

Asbestos

A total of no. 5 samples were analysed for Asbestos.

- No asbestos fibres were detected

Water Sample

A total of no. 1 sample was analysed for contamination.

- Sample below its respective assessment criteria in **Appendix C**

4.7.2 Soil Gas Monitoring

The following soil gas monitoring has been undertaken on site;

- A total of 3 No. monitoring visits were undertaken over the period 9th November 2016 to 30th November 2016;

The gas monitoring results are in the factual report (Ref. 11) and summarised below:

- Methane concentrations negligible
- Maximum recorded concentration of carbon dioxide = 0.4%
- Oxygen concentrations from 21% to 21.3%

- A maximum recorded flow rate of -0.1l/hr

5.0 GEOTECHNICAL ASSESSMENT

5.1 Geotechnical Hazards/Constraints

The following geotechnical constraints have been identified on the sites;

- Localised concrete hardstanding across parts of the site
- Variable made ground within the Little Lever Street site footprint with thicknesses of up to 2mbgl
- Obstructions encountered in the made ground BH01
- Party wall of 15 No Newton Street forms the eastern boundary
- The site slopes by approximately 1.5m from Little Lever Street towards the party wall of 15 No Newton Street
- Basement of adjacent building along the eastern boundary
- Historical foundations and substructures anticipated
- Foundation and obstructions expected associated with the existing building
- Obstructions and substructures associated with historical buildings on site
- Services beneath the existing basement and possible historical floor slabs
- Services beneath the adjacent buildings

5.2 Demolitions

Demolition of the existing building is required to facilitate the development. An asbestos survey is required to identify any potential asbestos materials prior to demolition.

5.3 Earthworks

The main site on Little Lever Street slopes by approximately 1.5m towards the party wall of 15 No Newton Street. As such, earthworks are likely to be required in order to provide a development platform for the hotel development. This is expected to comprise re-grading by following construction of boundary retentions.

The following materials are likely to be generated during general earthworks, foundation and drainage excavations;

- Hard materials associated with existing buildings and areas of concrete hardstanding - Once crushed and reprocessed this material is suitable for re use on site.
- Made ground as granular and cohesive fill – suitable for reuse as low quality fill
- Superficial deposits as clay suitable for reuse as general fill

Earthworks material may be subject to water and handling damage. The reuse of earthworks material should be undertaken in accordance with an approved specification in order to ensure materials are suitable for reuse. The use of lime/cement may be required to improve material handling.

Although not encountered during the site investigations, In view of the historical nature the presence of asbestos debris in the made ground cannot be discounted within the soils and appropriate mitigation measures and PPE is to be employed during redevelopment works to mitigate risks.

5.4 Foundation Design and Floor Slab Consideration

The main site on Little Lever Street is underlain by made ground between approximately 0.5m and 2.5m, firm to stiff clay between 2.0m to 9.4m bgl over dense Sand proven to 11.8m bgl

Based on the ground conditions identified and subject to confirmation of proposed development and final floor levels the following preliminary foundation design is considered viable;

- The use of traditional foundations in made ground or shallow superficial soils is not viable
- Due to the depth of made ground identified piled foundations are required

Preliminary advice has been obtained for a specialist contractor (**Appendix G**) which indicates that;

- 300mm section Driven Pre-Cast Concrete piles are expected to refuse in the granular till at say 15m
- A grid of 4 by 3 caps, giving 60 piles total
- At the time of the enquiry 5/06/2018 Aarsleff offered a guide price of approximately £40k for the work above using with a standard large piling rig

The basement of the Garden Hotel is underlain by made ground to approximately 1.7m and then stiff clay proven to 5.45m bgl.

- The existing Gardens Hotel I shaving additional floors added an these will increase the load to the existing foundations

5.5 Retention

The proposed development includes a basement construction which is expected to require construction of a contiguous board pile wall.

5.6 Pavement Design

Based on the available information the following sub-grades and indicative design CBR values are considered appropriate;

<u>Subgrade</u>	<u>Design CBR</u>
Existing Made ground	3%
Natural clay	<2.0%

Prior to development all subgrades should be proof rolled and visually inspected. Any soft or loose materials identified should be removed and replaced with a compacted granular fill.

Where adoptable roads are proposed the pavement construction should be approved by the adopting authority.

5.7 Drainage

Based on the ground conditions identified as made ground and impermeable clay the use of infiltration drainage is not considered viable.

5.8 Utilities

Utility plans have not been supplied by the client. However, utilities are expected beneath the existing basement, possible historical floor slabs and the adjacent buildings.

5.9 Temporary Works

The following temporary works are anticipated for the proposed development;

- Pneumatic breakers will be necessary for the relic slab and foundations of the previous on site development and possibly for bedrock excavation
- Dewatering may be required during excavation
- Subscan for expected services on site

6.0 ENVIRONMENTAL RISK ASSESSMENT

6.1 General

6.1.1 Human Health

A Generic Quantitative Risk Assessment for Human Health has been undertaken in accordance with the Environment Agency's guidance 'Using Soil Guideline Values' (Ref. 3). The Tier 1 assessment for the site has been undertaken using the Environment Agency's Soil Guideline Values (SGV's) for commercial development where available. In the absence of any published SGV's Atkins Soil Screening Values (SSV's) based on Soil Organic Matter (SOM) of 1% have been used.

6.1.2 Controlled Waters

A Tier One assessment has been undertaken in accordance with the EA Remedial Targets Methodology (Ref. 4) to assess the risk to controlled waters (groundwater and surface water).

The groundwater chemical results have been assessed against UK Drinking Water Standards (2000) (DWS) where available or UK Environmental Quality Standards for Fresh Water (EQS). In the absence of DWS or EQS values DW2 class threshold values specified in the Surface Water (Abstraction for Drinking Water) (Classification) Regulations (1996) (Ref. 5) have been used.

6.1.3 Ground Gas

A ground gas risk assessment has been undertaken in accordance with advice provided in the Ground Gas Handbook (Ref. 6) and CIRIA 665 'Assessing risks posed by hazardous ground gases to buildings' (Ref. 7). The level of gas protection measures required for the development is based on the calculated "Characteristic Situations" for the site.

The results of soil, groundwater and ground gas testing are presented in Factual Report (Ref. 3). The assessment criteria for the site, including the sources used for individual determinands, is included in **Appendix C** and is discussed in the following sections.

6.2 Statistical Analysis in the Assessment of Soil Contamination Data

6.2.1 General

The statistical analysis techniques have been jointly produced by CIEH and CL: AIRE and are drafted on the perspective of either the Planning System or part 2A of the Environmental Protection Act 1990. In this instance the statistical analysis has been undertaken on the perspective of the planning process.

The following statistical approach is based on two Hypotheses, the Null Hypothesis and the Alternative Hypothesis. These hypotheses have been structured to show (with a defined level of confidence) which of the two hypotheses is most likely to be true in any particular case.

6.2.2 Null and Alternative Hypothesis- Under the Land Use Planning System

The Null Hypothesis is that the level of contamination (in the land of interest) is the same as, or higher than, the critical concentration.

If the statistical test shows that the Null Hypothesis should be rejected, the assessor can conclude that the Alternative Hypothesis is more likely to be true i.e. that contaminant concentrations are low relative to the critical concentration and that, potentially, the land is suitable for use.

If the test shows that the Null Hypothesis should not be rejected the assessor should conclude that contaminant concentration may be the same as, or higher than the critical concentration and further assessment may be needed.

6.2.3 Null and Alternative Hypothesis- Under Part IIA

The Null Hypothesis is that the level of contamination in the land of interest is the same as or lower than the critical concentration and the Alternative Hypothesis is that the level of contamination is higher than the critical concentration.

In this case if the Null Hypothesis is rejected the assessor can conclude that contaminant concentrations are high relative to the critical concentration (and a basis for intervention under the regime potentially exists). If the Null Hypothesis is not rejected, contamination levels may be the same as, or lower than, the critical concentration and a basis for regulatory input is unlikely to be available.

6.3 Human Health Risk Assessment - Assessment Criteria: Residential End Use

Comparison of the analysis results with the relevant assessment criteria is shown on **Appendix C**. The results of the chemical analyses of the samples recovered from the investigatory works at the site have revealed the site to be free of significant soil contamination (based on soil samples analysed at 1.0mbgl). The following sections summarise the categories of chemicals tested and the analysis results.

6.3.1 *Inorganic compounds, metals, non-metals*

Contaminant assessment from the site investigation has been made against the Atkins Contamination Assessment Criteria in **Appendix C** and the results are summarised below;

- Localised elevated lead

The proposed development will comprise hard and soft covers, therefore no direct pathway exists between the made ground and the end user. Therefore the risk to human health is considered to be **Low**.

6.3.2 *Organic Compounds*

Contaminant assessment from the site investigation has been made against the Atkins Contamination Assessment Criteria in **Appendix C** and the results are summarised below;

- Localised Elevated of benzo(a)pyrene

The proposed development will comprise hard and soft covers, therefore no direct pathway exists between the made ground and the end user. Therefore the risk to human health is considered to be **Low**.

6.3.3 *Asbestos*

No asbestos fibres were detected in the soil samples tested. Although not encountered during the site investigations, in view of the historical development on site the presence of asbestos debris in the made ground cannot be discounted.

The proposed development will comprise hard and soft covers, therefore no direct pathway exists between the made ground and the end user. Therefore the risk to human health is considered to be **Low**.

However, the risk to construction workers is considered to be **Low to Moderate**. Appropriate health and safety measures should be implemented during construction and all soils should be dampened down during any earthworks.

6.4 **Controlled Waters**

The site is located in an area where Superficial Deposits and bedrock are designated by the Environment Agency as being a Secondary A Aquifer. There are three potable abstraction points within 1km of the site, with the nearest located 530m to the south-west.

The results of the controlled waters are summarised below;

- Controlled waters were below the WSVs assessment criteria in **Appendix C**

6.5 **Ground Gas**

6.5.1 *Methane and Carbon Dioxide*

Based on the site investigation the following potential sources of soil gas have been identified;

- Made Ground as a concrete and brick fill - **Very Low** soil gas generating potential
- Alluvial deposits with low degradable content – **Very Low** soil gas generating potential
- Coal Measures – **Very Low** soil gas generating potential

3 rounds of monitoring have been undertaken on site.

CIRIA Report 665 "Assessing Risks Posed by Hazardous ground gases to Buildings" (Ref. 9) presents current best practice on the assessment of ground gases. The report presents a risk based approach based on gas screening levels which depend on both the concentration and emission rate of gas from the ground. Gas screening levels are calculated as follows:

Gas screening value (l/hr) = gas concentration (%) x measured borehole flow rate (l/h)

Maximum CO₂ recorded = 0.4% v/v

Maximum Gas flow rate = -0.1l/h

GSV = Worst case GSV 0.4%v/v x -0.1l/h = 0.0004

A Maximum GSV of 0.0004 l/hr has been recorded giving Characteristic Situation 1.

6.6 Aggressive Ground

6.6.1 Concrete

Chemical test results have been assessed in accordance with BRE Special Digest 1 (Ref. 5) to identify how aggressive the site conditions are to buried concrete.

Based on the results from initial site investigation and the supplementary site investigation the site is classified as DS-2, ACEC Class AC-2, in accordance with the guidance given in BRE Special Digest 1, Table C2 Aggressive Chemical Environment for Concrete (ACEC) classification for Brownfield locations.

6.6.2 Services

The advice of service providers should be obtained to ensure that appropriate measures are taken to protect services from contamination and aggressive ground conditions.

6.7 Refined Pollution Linkages and Conceptual Model

6.7.1 Introduction

The potential implication of contamination on the subject site has been considered in terms of the planning process.

The statutory guidance sets out the definition of contaminated land within the context of Government Policy including the 'suitability of use' approach. Action is necessary only where there are unacceptable risks to human health or the environment, taking into account the current land and its environmental setting.

In the context of land contamination, there are three essential elements to any risk;

- **Source:** Substances that are potential contaminants or pollutants that may cause harm.
- **Pathway:** A potential route by which contaminants can move from the source to the receptor.
- **Receptor** or target: A receptor that may be harmed (for example the water environment, humans, flora and fauna).

Each of these elements can exist independently. They create a risk only where they are linked together, so that a particular contaminant affects a particular receptor via one of more

pathways. This kind of linked combination of source - pathway - receptor is described as a pollutant linkage.

In order to assess the contamination risk at the subject site an assessment of pollutant linkages has been undertaken and is discussed in the following sections.

6.7.2 Sources

The following sources have been identified on site;

- Localised elevated PAH within the made ground
- Localised elevated lead within the made ground

6.7.3 Pathways

The following potential pathways have been identified:

- Inhalation
- Ingestion
- Dermal Contact
- Leaching and Lateral Migration
- Surface Run-off
- Direct Contact
- Root Uptake
- Accumulation in confined spaces

6.7.4 Receptors

The following receptors have been identified;

- Site end users
- Construction Workers
- Adjacent Land Users
- Groundwater
- Buried Concrete
- Services

6.7.5 Refined Pollution Linkages

Pollution linkages based on the identified soil and ground gas hazards have been undertaken with respect to the pathways and receptors. A summary table of the expected level of risk from the identified hazards is presented in Table 8 (On Site Sources) and Table 9 (Off Site Sources).

Risk classifications used are detailed in Tables 12 - 15 contained within **Appendix C**.

Table 8 – Refined On Site Pollution Linkages

Source	Pathway	Receptor	Con.	Prob.	Risk	Are Mitigation Measures required?
General Made Ground	Ingestion, Inhalation and Dermal Contact	Future Site Users	Md	UI	L	No
		Construction Workers	Md	Lw	M/L	Yes - Construction workers should adopt appropriate health and safety measures and use of appropriate PPE during any earthworks operations.
		Adjacent Land Users	Md	UI	L	Yes - Dust suppression measures required to prevent fugitive dusts migrating to the adjacent land during construction phase.
	Leaching and Lateral Migration	Principle A Aquifer	Md	UI	L	No. Made ground will be confined beneath hardcovers.
	Direct Contact	Buried Concrete	Mi	Lw	L	Yes - Buried concrete should be designed in accordance with BRE special publication as DS-2, ACEC Class AC-2
		Services	Mi	Lw	L	No.
	Direct contact & Root Uptake	Landscaping	Mi	Lw	L	No. Made ground will be confined beneath hardcovers.
Asbestos fibres in made ground	Inhalation	Future Site User	Md	UI	L	No. Made ground will be confined beneath hardcovers.
		Construction Worker	Md	Lw	M/L	Yes. Construction workers should adopt appropriate health and safety measures and these should be used during construction and all soils should be dampened down during any earthworks.
		Off site land Users	Md	UI	L	Yes. Damping down to be undertaken during earthworks to prevent dust migration. Covered lorries to be used to remove material from site.
Ground gases associated with made ground	Inhalation	Future Site Users	Md	UI	L	No - the site is classified as Characteristic Situation 1.
		Construction Workers	Md	Lw	M/L	Yes - Ground gas monitoring should be undertaken before man entry into void spaces.
Historical land use as two buildings	Ingestion, Inhalation, Dermal	Future Site Users	Md	UI	L	No. Made ground to be confined beneath hard covers.
		Construction Workers	Md	Lw	M/L	Yes. Construction workers should adopt appropriate health and

	Contact					safety measures and use of appropriate PPE during any earthworks operations
		Adjacent Land Users	Md	UI	L	No.
	Leaching, Migration, and Surface run-off	Groundwaters	Md	UI	L	No. Made ground will be confined beneath hardcovers.

Table 9 - Refined Off Site Pollution Linkages

Source	Pathway	Receptor	Con.	Prob.	Risk	Are Mitigation Measures required?
Historical and present land use	Ingestion, Inhalation, Dermal Contact	Future Site Users	Md	UI	L	No
		Construction Workers	Md	UI	L	No
	Leaching, Migration and Surface run-off	Secondary A Aquifer	Md	UI	L	No

After CIRIA Report C552, Contaminated Land Risk Assessment A Guide To Good Practice, 2001

KEY: **Consequence:** Sv = Severe, Md = Medium, Mi = Mild, Mr = Minor

Probability: Hi = High likelihood, Li = Likely, Lw = Low Likelihood, UI = Unlikely

Risk: VH = Very High, H = High, M = Moderate, M/L = Moderate/Low, L = Low, VL = Very Low

Based on the results of the site investigation, the revised risk assessment has indicated the following;

- Elevated concentrations of heavy metals (lead) and organics (PAH) identified within the made ground on site. The proposed development will be under hardcovers, therefore the risk to human health and groundwater will be **Low**. However, the risk to construction workers is considered to be **Moderate to Low** risk. With the use of appropriate PPE the risk to construction workers is **Low**.
- No asbestos fibres were identified within the made ground across the site and the proposed development will be under hardcovers. Therefore, the risk to human health is considered to be **Low**. However, in view of the historical nature the presence of asbestos cannot be discounted. Therefore, the risk to construction workers is considered to be **Moderate to Low**. Damping down will be required during any earthworks to mitigate the risk.
- Localised marginally elevated concentrations of Carbon Dioxide identified with negligible flow rate represent a **Low** risk to future site users and a **Moderate to Low** risk to Construction Workers. However, with the use of appropriate PPE the risk is to construction workers is **Low**.

6.8 Recommendations for Site Remediation

6.8.1 General

In view of the results from laboratory analysis, contamination hazards are present on this site.

In order to ensure that risks to identified receptors from the proposed development are maintained at a **Low** level, specific mitigation and validation precautionary measures should be incorporated.

The remediation and mitigation measures summarised in the following sections are recommended for the proposed development.

6.8.2 Site Wide Preparatory Earthworks

The following mitigation measures should be undertaken during the general preparatory earthworks.

General Measures Implemented During Construction

- No asbestos fibres were identified within the made ground during the site investigation. However, in view of the historical development on site the presence of asbestos cannot be discounted. As such, construction workers should adopt appropriate health and safety measures - including damping of materials - when working with made ground deposits. The site has undergone a number of phases of construction and demolition. Therefore, the presence of asbestos fibres within the made ground cannot be discounted. If any asbestos containing materials are identified they should be removed and disposed of to landfill by a specialist contractor.
- Construction workers should undertake ground gas and VOC monitoring prior to and during man entry of below ground voids.
- Construction workers should adopt appropriate health and safety measures.
- Dust suppression measures should be adopted during all earthworks to mitigate associated risks.

Minimum Measures to Mitigate Risk to Human Health-End Users

No pollutant linkages were identified which have the potential to impact human end users of the site. As such, the risk to end-users posed by contamination is considered to be **Low** and no remedial measures are currently required during preparatory earthworks with respect to end users.

Minimum Measures to Mitigate Risk to Controlled Waters

The following additional precautionary minimum measures should be implemented during the preparatory earthworks;

- On completion of the site strip, a visual inspection and validation testing should be undertaken on a grid pattern to confirm the absence of any further areas of unknown contamination.
- Additional contaminated materials, if encountered, during construction works and proven to represent an unacceptable risk should be removed and disposed of to an appropriate landfill. After completion of these works validation testing and auditing should be undertaken to confirm the successful removal of contaminants.
- Validation testing to be carried out on site won material and imported bulk fill.

6.8.3 Mitigation Measures within the Built Development

It is recommended that the following mitigation measures should be incorporated into the built development;

- Buried concrete and services should be designed in accordance with the guidance given in BRE Special publication No. 1 (Ref. 10). Based on sulphate conditions the use of Design sulphate DS-2 and ACEC Class AC-2 is considered appropriate.
- The advice of service providers should be obtained to ensure that appropriate measures are taken to protect services from contamination and aggressive ground conditions.
- Soil gas monitoring indicates areas of the site to classify as Characteristic Situation 1. Therefore, no specific soil gas protection measures are required.

6.8.4 Validation and Reporting

All Environmental works should be validated by suitable validation testing and reporting to prove the of the applied mitigation strategy and to assess any residual risks to the development.

6.9 Waste Regulations

The development of the site will require the excavation and handling of made ground materials and potentially contaminated materials associated with the former land use. These materials could classify as waste and, if this is the case, their excavation and handling would be subject to Waste Management Licensing and Regulations (Ref. 11)

Earthworks materials, which are not a risk to human health or the wider environment can cease to be waste for a particular use by following the current voluntary industry definition of waste: Development Industry Code of Practise (COP) (Ref. 12).

This requires registration of the site under the waste COP and presentation of a materials management plan and earthworks validation report to confirm compliance.

Site won waste material which is designated for off site disposal must comply with the following criteria;

- Waste should be characterised prior to disposal
- It is the waste producer's responsibility to ensure compliance with the requirements of Landfill Directive/Transfer notes

Based on the results it is anticipated that made ground waste generated on site could have enhanced disposal costs.

All laboratory results should be issued to the selected landfill to establish if they will accept the waste and to confirm the classification.

REFERENCES

1. Soiltechnics Ground Investigation for a proposed development at 35 Back Piccadilly, Manchester (2005)
2. Model Procedures for Contaminated Land – CLR11
3. Environment Agency, 'Using Soil Guideline Values', SC050021/SGV
4. Environment Agency, 2004, Remedial Targets Methodology
5. Surface Waters (Abstraction for Drinking Water)(Classification) Regulations (1996)
6. Ground Gas Handbook
7. CIRIA C665 Assessing risks posed by hazardous ground gases to buildings (2007)
8. Building Research Management. Concrete in Aggressive Ground Special Digest 1 (2005)
9. Waste Management Licensing Regulations
10. CL:AIRE Waste Code of Practice
11. Asbestos Survey Report
12. Ian Farmer Associates Factual Report, Gardens Hotel, Manchester (2016)

Appendix A

Desk Study Information

2/4 Little Lever Street, Manchester

APPENDIX B;



**Proposed Residential Development
35, Back Piccadilly
Manchester**

GROUND INVESTIGATION REPORT

EXECUTIVE SUMMARY

GENERAL

We recommend the following executive summary is not read in isolation to the main report which follows.

SITE DESCRIPTION, HISTORY AND PROPOSALS

We understand the site formerly comprised two, adjoining multi-storey buildings with basements. At the time of investigation these had been demolished.

We understand the project will comprise the construction of a nine storey building which will include two levels of car parking. No garden/landscaped areas are proposed at the site.

GROUND CONDITIONS ENCOUNTERED

Each exploratory excavation encountered a similar profile of soils considered to be, in order of superposition; Made Ground, Glacial Till and Permian and Triassic Sandstone. Made Ground deposits were encountered to a maximum depth of 1.45m, and the Glacial Till extended to depths of between 19.5m and 21.0m below existing basement level.

FOUNDATION SOLUTION

Based on site development proposals and ground conditions encountered at the site, we recommend that a pile foundation solution is adopted at the site.

CHEMICAL/GASEOUS CONTAMINATION

Elevated concentrations of lead and sulphate were recorded within some of the Made Ground samples taken from the site. Based development proposals and ground conditions at the site however, no remedial requirements are considered necessary at the site.

Should site development proposals change, then we recommend that this report is referred back to Soiltechnics for reassessment.

A registered landfill site is recorded some 900m east of the site. The cohesive glacial soils underlying the site in our opinion however, are effectively impermeable to landfill type gas migration. The site in our opinion therefore, poses a low risk of potential landfill gas contamination.

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- STB0620D-01 Site location plan
- STB0620D-02 Plan showing existing site features and location of exploratory points.
- STB0620D-03 Graphical summary of standard penetration testing

APPENDICES

- A1 Definitions of geotechnical terms used in this report.
- A2 Definitions of geo-environmental terms used in this report.
- B Trial pit records.
- C Photographic record of trial pit excavations.
- D Borehole records (cable and tool percussion drilling).
- E Copies of laboratory test result certificates – classification testing.
- F Copies of laboratory test result certificates – concentrations of chemical contaminants.
- G Statistical analysis of test data in relation to concentrations of chemical contaminants.
- H Copies of Statutory Undertakers replies.
- I Copy of correspondence received from the Coal Authority
- J Copy of desk study information produced by Envirocheck

1.0 INTRODUCTION**1.1 Objectives**

1.1.1 This report describes a ground investigation carried out for the redevelopment of a site at 35 Back Piccadilly, Manchester.

1.1.2 The principal objective of the ground investigation was to establish ground conditions at the site, sufficient to identify possible foundation solutions for the development and provide parameters necessary for the design and construction of foundations.

1.1.3 The investigation included an evaluation of potential chemical and gaseous contamination of the site leading to the production of a risk assessment in relation to contamination.

1.1.4 Our brief also included investigations and testing to allow classification of soils at the site to dispose to landfill. Our report on this aspect is separately presented.

1.2 Client Instructions and Confidentiality

1.2.1 The investigation was carried out in October 2005 and reported in January 2006, acting on instructions received from Ashgate Developments Limited acting on behalf of Mount Services Limited.

1.2.2 This report has been prepared for the sole benefit of our client, Mount Services Limited, but this report, and its contents, remains the property of Soiltechnics Limited until payment in full of our invoices in connection with production of this report.

1.2.3 Our original investigation proposals were outlined in our letter to Ashgate Developments Limited. The investigation generally followed our original investigation proposals. The investigation process was also determined to maintain as far as possible the original investigation budget costs.

1.3 Site Location and Development Proposals

1.3.1 The National Grid reference for the site is 384540 398320. A plan showing the location of the site is presented on Drawing STB0620D-02.

1.3.2 We have not received a proposed layout of the development, but we understand that it will comprise the construction of a nine storey building which will include two levels of car parking. We understand the existing basement void will not be utilised and no garden/landscaped areas are proposed at the site.

1.4 Report Format and Investigation Standards

1.4.1 Sections 1 to 5 of this report describe the factual aspects of the investigation with Section 6 presenting an engineering assessment of the investigatory data. Section 7 provides a risk assessment of chemical and gaseous contamination based on readily available historic records, inspection of the soils and laboratory testing.

1.4.2 This investigation integrates both contamination and geotechnical aspects. The investigation was carried out generally, and where practical following the recommendations of BS5930: 1999 '*Code of Practice for Site Investigations*'. The investigation process also followed the principles of BS10175: 2001 '*Investigation of potentially Contaminated Sites - Code of Practice*'. In view of the client's requirement for rapid implementation of the investigation, the following elements, defined in BS10175, have been completed and incorporated in this report.

- a) Phase I Preliminary investigation (desk study and site reconnaissance)
- b) Phase II Exploratory and main (intrusive) investigations

The extent and result of the preliminary investigation (desk study) is reported in Section 2. Fieldwork combined the exploratory investigation and main investigation stages into one phase with the extent of these works described in Sections 3 and 5 of this report. Any supplementary investigations deemed necessary as a result of deficient information obtained by investigations, completed to date, are identified in Section 8.

1.4.3 Our investigations included testing to allow classification of soils at the site to be disposed of to landfill. Our report on this aspect is separately presented.

1.5 Status of this Report

1.5.1 This report is final based on our current instructions.

1.5.2 This investigation has been carried out and reported based on our understanding of best practice. Improved practices, technology, new information and changes in legislation may necessitate an alteration to the report in whole or part after publication. Hence, should the development commence after expiry of one year from the publication date of this report then we would recommend the report be referred back to Soiltechnics for reassessment. Equally, if the nature of the development changes, Soiltechnics should be advised and a reassessment carried out if considered appropriate.

2.0 DESK STUDY INFORMATION

2.1 General

2.1.1 We have carried out a desk study which was limited to the collection of readily available information. This included:

- a) Retrieval of published Ordnance Survey maps dating back to 1892 at 1:2500 and 1:10000 scales where applicable.
- b) Inspection of geological maps produced by the British Geological Survey together with relevant geological memoirs.
- c) Consultation with;
 - i) Statutory Undertakers
 - iii) The Coal Authority
- d) Site reconnaissance
- e) Other relevant published documents

Section a) was carried out by Envirocheck. The report prepared by Envirocheck is presented in Appendix J. In addition to retrieval of historical and current Ordnance Survey data, Envirocheck provide information compiled from outside agencies including: -

Environment Agency
Institute of Hydrology
British Geological Survey
Countryside Council for Wales
Scottish National Heritage
English Nature

The study did not extend to research of meteorological information or consultation with other interested parties such as English Heritage (ancient monuments), Ordnance Survey (survey control points), Planning Authorities or Archaeological Units.

2.2 Description of the Site

2.2.1 We understand from Ashgate Developments Limited the site formerly comprised two, multi-storey buildings with basements. At the time of the investigation, the buildings which formerly occupied the site had been demolished. The basement retaining walls remained, such that levels across the site were approximately 2.5m below surrounding ground levels. A ramp enabled access to the site, which was comprised of demolition rubble.

- 2.2.2 The site is bounded by Back Piccadilly, Little Lever Street, and Cavell Street to the southwest, northwest and northeast of the site respectively, whilst the southeastern boundary comprises an adjoining multi storey building. Buildings overlooking the site comprise both commercial and residential usage.
- 2.2.3 No vegetation was present at the site, and levels, with the exception of the ramped access, were generally consistent.
- 2.2.4 A plan showing the observed site features and location of exploratory points is presented on Drawing STB0620D-02.

2.3 History of the Site

- 2.3.1 An attempt to trace the history of the site has been carried out by obtaining copies of old Ordnance Survey maps provided by Envirocheck. These maps are presented in Appendix J, but have been reduced from A3 size to A4 (70%) for ease of presentation. This size reduction affects the scale recorded on the maps. We can provide A3 copies if required. Soiltechnics Limited holds a limited copyright licence to reproduce the enclosed Ordnance Survey material and has to pay royalties on copies. Should you wish to obtain further copies of the Ordnance Survey maps included in this report an appropriate licence is required. We will be pleased to provide additional reports at an appropriate fee.
- 2.3.2 The recent history of the site based on published Ordnance Survey maps is summarised on the following table: -

Dates	Historical Usage	Comments
1892-1933	Two buildings, suspected to be concurrent with the layout of the buildings that have recently been demolished.	The layout of the site and the surrounding buildings are suspected to be concurrent with the recently demolished buildings. A number of the surrounding buildings are recorded as being hotels. A cotton mill is recorded some 350m to the south of the site. Tree covered open ground is indicated some 150m to the southwest of the site, which is recorded as Manchester Royal Infirmary in 1908 and a library in 1922. A canal wharf, and associated buildings are indicated some 300m east of the site. Victoria Station (and Exchange Station), London Road Station and Central Station, are all located within 1km of the site to the northwest, southeast and southwest of the site respectively.
1948-1992	As above	A paint works, machine tool works and printing works are indicated some 300m to the east and north of the site. A series of warehouses are indicated within 400m of the site. Ground formerly occupied by the library is now recorded as Piccadilly Gardens. The land formerly occupied by Dale Street Wharf is recorded as a car park after 1971, at which time a builders yard is recorded some 300m east of the site. Central Station is disused after 1972 and London Road Station becomes Piccadilly Station.
1999	As above	Bus station indicated to the south of Piccadilly Gardens.

Table reference 2.3.2

- 2.3.3 Although it is not indicated upon the historical maps, we understand from Ashgate Developments Limited that part of the site may have been formerly occupied by a mill.

2.4 Geology and Geohydrology of the Area

2.4.1 Geology of the Area

- 2.4.1.1 Inspection of the geological map of the area (at 1: 50000 scale) published by the British Geological Survey indicates the topography local to the site (based on borehole/observations recorded on the map) is formed in the following sequence of soils.

Strata	Approximate thickness (m)	Typical soil type	Likely permeability
Glacial Till	>5m	Clay, sands and gravels	Low
Triassic Sandstone	>20m	Sand	High

Table reference 2.4.1

The soil types and assessment of permeability's are based on geological memoirs.

2.4.2 Geohydrology – aquifer designation and groundwater vulnerability

- 2.4.2.1 Envirocheck reports the site is located in an area designated a major aquifer probably reflecting the underlying geology comprising Triassic Sandstone, which are likely to be reasonably permeable deposits. A major aquifer is defined by the Environment Agency in their publication 'policy and practice for the protection of groundwater' on highly permeable formations. They are highly productive and able to support large abstractions for public water supply and other purposes. In addition, Envirocheck provide an extract of the groundwater vulnerability map recording the soils containing the aquifer is a high leaching potential. These soils have little ability to attenuate diffuse source pollutants. Non-absorbed diffuse source pollutants and liquid discharges will percolate rapidly through them. The groundwater vulnerability map also records a sub class of soil type U, (undifferentiated). In such a case there is insufficient information to classify the soils accurately and generally a default class of H1 is adopted. A sub class of H1 is defined as a soil which readily transmits liquid discharges because they are either shallow or susceptible to rapid by-pass flow directly to rock, gravel or groundwater.

2.4.3 Geohydrology – water abstractions

- 2.4.3.1 Envirocheck report three abstraction points within 1km of the site, with the nearest located some 530m to the southwest. One of these licences has been revoked, whilst permit end dates are not available for the remaining two licenses which are abstracted for general cooling purposes.

2.4.4 *Geohydrology – source protection zone*

- 2.4.4.1 Envirocheck does not record the site is located within a zone protecting a potable water supply abstracting from a major aquifer (i.e. a source protection zone).

2.5 Environmental Study

2.5.1 We have instructed Envirocheck to carry out a search of their records and report on the following aspects: -

Agency and Hydrological

Air Pollution Controls ("APC")
 Discharge Consents to Controlled Waters
 Enforcement and Prohibition Notices
 Integrated Pollution Controls ("IPC")
 Nearest Surface Water Feature
 Pollution Incidents to Controlled Waters
 Prosecutions relating to Authorised Processes
 Prosecutions to Controlled Waters
 Red List Discharge Consents
 Radioactive Substance Authorisations ("RSA")

River Quality Data
 Water Abstractions
 Groundwater Vulnerability
 Drift Deposits
 Fluvial Indicative Flood Plain
 Tidal Indicative Flood Plain
 Source Protection Zones

Waste

BGS Recorded Landfill Sites
 Integrated Pollution Control registered Waste Sites
 Registered Waste Transfer Sites

Registered Waste Treatment or Disposal Sites
 Registered Landfill Sites

Hazardous Substances

Planning Hazardous Substance Consents
 Planning Hazardous Substance Enforcements

COMAH Sites
 Explosive Sites
 NIHHS Sites

Geological

BGS Boreholes
 BGS Recorded Mineral Sites
 BGS 1:625,000 Surface Geology
 Coal Mining Affected Areas

Shallow Mining Hazards
 Natural Subsidence Hazard
 Radon Affected Area
 Radon Protection Measures

Industrial Land Use

Contemporary Trade Directory Entries
 (of possible contaminative use)
 Fuel Station Entries
 Post 1995 Planning Applications
 (of possible contaminative use)
 Potentially Contaminative Uses (Past Use)

Potentially Contaminative Uses
 (Non-Water Related)
 Potentially Contaminative Uses
 (Water Related)
 Nearest Overhead Transmission Line

Sensitive Land Use

Adopted Green Belt
 Unadopted Green Belt
 Areas of Outstanding Natural Beauty
 Environmentally Sensitive Areas
 Forest Parks
 Local Nature Reserves
 Marine Nature Reserves
 National Nature Reserves

National Parks
 National Scenic Areas
 Nitrate Sensitive Areas
 Nitrate Vulnerable Zones
 RAMSAR Sites
 Sites of Special Scientific Interest
 ("SSSI")
 Special Areas of Conservation
 Special Protection Areas

2.5.2 A copy of records produced by Envirocheck is presented in Appendix J.

2.5.3 Envirocheck produce a wealth of factual database information. Although we can provide a discussion on each of the database topics, this would produce a very lengthy document, but some of these discussions would not be relevant to the aims of this report. As a consequence we have extracted some of the relevant geotechnical topics (including flood risk) and discussed them in this section of the report. Key environmental issues from the Envirocheck database are discussed in Section 7.

2.6 Coal Mining Records

2.6.1 We have instructed The Coal Authority to carry out a search of their records centred on the development site. A copy of their report is presented in Appendix 1. They have indicated that the property is not within a zone of likely physical influence from past or present underground coal workings. The report does however state that reserves of coal exist in the locality of the site, which could be worked at some time in the future, subject to feasibility, licences and planning consents.

2.7 Radon

2.7.1 With reference to the Building Research Establishment (BRE) publication *"Radon: guidance on protective measures for new dwellings"*, (1999) the site is located where **no protection** is considered necessary. Envirocheck use the British Geological Survey database to review reported radon levels in an area in which the site is located to establish recommended radon protection levels for new dwellings. The database confirms the BRE recommendations.

2.7.2 It is noteworthy that the BRE and BGS information is based on statistical analysis of measurements made on houses in combination with geological units, which are known to emit radon. Therefore there is a risk for actual radon levels at the site to exceed the levels assessed by the BGS / BRE. Currently, the only true method of checking actual radon levels is by measurement within a house on the site over a 3 month period.

2.8 Enquiries with Statutory Undertakers

2.8.1 We have contacted the following Statutory Undertakers (SUs) to obtain copies of their records in order to avoid damaging their apparatus during our fieldwork activities: -

- a) British Telecommunications plc
- b) Transco
- c) United Utilities North West

- 2.8.2 Copies of responses received prior to publication of this report are presented in Appendix H. These records have been obtained solely for the purposes described above. Some of these records have been obtained from the Internet and from our database without contacting the statutory undertaker direct. Occasionally, SU information is recorded on drawings larger than A3, and thus cannot be easily presented in this report. In such cases we will copy the correspondence but not incorporate the drawing in this report, and maintain the records on our office file.
- 2.8.3 Normally Statutory Undertakers drawings record the approximate location of their services. We recommend further on site investigations be undertaken to confirm the position of the apparatus and thus establish the effect on the proposed development and the necessity or otherwise for the permanent or temporary diversion of the service to allow the construction of the development to safely and successfully proceed.
- 2.8.4 It should be noted that statutory undertakers' records normally exclude private services.
- 2.9 **Flood Risk**
- 2.9.1 The Envirocheck report indicates the site is not located within a Fluvial or Tidal flood plain, though areas designated at risk from flooding and extreme flooding are indicated within 1km of the site. We would recommend, therefore, that clarification of flood risk and the implications of flooding be sought within the Environment Agency.
- 2.10 **Shallow mining and natural subsidence hazards**
- 2.10.1 Envirocheck use the British Geological Survey database to establish hazard ratings for shallow minings and natural subsidence hazards. The database indicates the following ratings for the site.
- | | |
|---|-----------|
| a) Shallow mining hazard rating: | No hazard |
| b) Landslide ground stability hazard rating: | Very Low |
| c) Ground dissolution stability hazard rating: | No hazard |
| d) Collapsible ground stability hazard rating: | No hazard |
| e) Compressible ground stability hazard rating: | No hazard |
| f) Running sand ground stability hazard rating: | Very Low |
| g) Shrinking or swelling clay ground stability hazards: | Very Low |

2.11 Borehole Records

2.11.1 The British Geological Survey (BGS) retain records of boreholes formed from ground investigations carried out on a nationwide basis. A listing of borehole records within 1000m of the site is produced in the Envirocheck Report presented in Appendix J.

2.11.2 We do not normally obtain copies of these records but can do on further instructions. There is normally a charge made by the BGS for retrieving and copying these records.

2.12 Mining and dissolution hazards

2.12.1 Envirocheck's database indicates the subject site is not within a zone of conclusive rock mining based upon the findings of a report completed by Ove Arup and Partners in December 1991, commissioned by the Department of the Environment ("DoE"). It forms part of the Geology and Mining Planning Research Programme of the DoE, aimed at assessing the significance of environmental hazards and their influence on planning and control of development. The main objective of the data is to indicate where mining should be borne in mind when considered planning and development of land.

3.0 FIELDWORK**3.1 General**

- 3.1.1 Fieldwork comprised the excavation of three trial pits and two boreholes. Fieldwork was carried out between 24th and 25th October 2005.
- 3.1.2 A plan of the site showing observed/existing site features (including site reconnaissance notes) and position of exploratory points is presented on Drawing STB0620D-02. The position of exploratory points shown on these plans is approximate only and confirmation of these positions is subject to dimensional surveys, which is considered outside our brief.
- 3.1.3 The extent of fieldwork activities and position of exploratory points were defined by Soiltechnics Ltd in conjunction with Ashgate Developments Limited.
- 3.1.4 Exploratory points were positioned to avoid known locations of underground services, and to provide a reasonable coverage of the site.
- 3.1.5 Prior to commencement of exploratory excavations an electronic cable locating tool was used to scan the area of the excavation. If we received a response to this equipment then the excavation would be relocated.
- 3.1.6 All soils/rocks exposed in excavations were described in accordance with BS5930: 1999 "*Code of Practice for Site Investigations*".

3.2 Site Restrictions

- 3.2.1 The demolition rubble-access ramp, prevented intrusive investigations toward the northwest of the site and due to surface softening of the soils, winching was required to move the cable and tool percussive rig to each borehole location. A groundwater entry restricted the depth of our hand excavated trial pit, TP01.

3.3 Exploratory Trial Pits

- 3.3.1 The trial pits were excavated using hand tools to a maximum depth of 1.55 metres, below surface levels at the site (3.45m below surrounding ground surface levels).
- 3.3.2 Trial pits TP01 and TP02 were undertaken in an attempt to expose the foundation arrangements along the northeastern boundary of the site. Trial pit TP03 was undertaken to retrieve near surface samples for subsequent laboratory analysis. The trial pit excavations were backfilled with excavated material, which was compacted using hand held ramming tools. The surface was reinstated to match the original surroundings. A Geotechnical Engineer supervised the excavations.

- 3.3.3 Sampling and logging was carried out as trial pit excavations proceeded but were not entered at depths exceeding 1.2 metres, or where trial pit sides were deemed unstable. The density of granular soils encountered in excavations was gauged by the ease of excavation.
- 3.3.4 Soil samples for subsequent laboratory determination of concentration of chemical contaminants were taken from the sides of trial pits using clean stainless steel equipment and stored in new plastic containers, which were labelled and sealed. The stainless steel sampling equipment was cleaned with deionised water between sampling points. If as a consequence of visual or olfactory evidence, a sample was suspected to be contaminated by organic material, the sample was stored in an amber glass jar with a PTFE sealing washer.
- 3.3.5 Soil samples for subsequent 'physical' laboratory testing were taken from the side of trial pits. The sample was placed in a plastic bag and subsequently sealed and labelled.
- 3.3.6 Soil samples were taken to meet the requirements of class 3, 4 or 5 as described in BS5930: 1999 (table 2) with the sample sizes in accordance with Table 3 of the same standard. Sample sizes were appropriate for the laboratory test being considered.
- 3.3.7 Where possible, a pocket penetrometer was used in the cohesive soils encountered. This tool is deemed to measure the apparent ultimate bearing capacity of the soil under test. The pocket penetrometer is calibrated in kg/cm^2 . The reading can be approximately converted to equivalent undrained shear strength by multiplying the results by a factor of 50. Tests were carried out in the sides of trial pits when access can be safely achieved otherwise testing was carried out on excavated intact clods. The results are reported in columns to the right of trial pit results. The pocket penetrometer is not covered by British Standards. This tool has the advantage that it can be used to determine the approximate insitu undrained shear strength of stony cohesive soils.
- 3.3.8 Trial pit records are presented in Appendix B. Photographic records of trial pits are presented in Appendix C.

3.4 Light Cable and Tool Percussion Boring

- 3.4.1 Boreholes BH01 and BH02 were excavated using light cable percussion boring techniques as described in BS5930: 1999 forming 150mm diameter holes. Temporary casing was advanced within the borehole excavation to maintain the stability of the hole. When groundwater was encountered the excavation was temporarily halted to allow for groundwater observations to be made. Following groundwater observations the casing was advanced within the hole and the locations of the water strikes recorded. The casing was subsequently advanced to maintain the stability of the borehole and seal off the water to prevent further ingress. Additional records were taken when (and if) the casing produced a seal against water ingress. When obstructions were encountered a chisel was employed to break through the obstruction. Time taken to progress the excavation using the chisel is recorded on the borehole logs.
- 3.4.2 On completion of excavations the boreholes were backfilled with excavated soils and compacted using drilling tools.
- 3.4.3 Soil samples for subsequent laboratory determination of concentration of chemical contaminants were taken from 'intact' bulk disturbed samples obtained in the cutting shoe of the drilling rig. A sub sample was obtained discarding soil, which would have been in contact with the drilling rig cutting shoe with the subsamples taken using clean stainless steel equipment. In all cases the stainless steel equipment was cleaned with deionised water between sampling with samples stored in new plastic containers, which were labelled and sealed. If as a consequence of visual or olfactory evidence, a sample was suspected to be contaminated by organic material, the sample was stored in an amber glass jar with a PTFE sealing washer.
- 3.4.4 Bulk soil samples for identification or subsequent 'physical' laboratory testing were taken from borehole cutting equipment. The sample were placed in a plastic bag and subsequently sealed and labelled. Bulk soil samples were taken to meet the requirements of class 3, 4 or 5 as described in BS5930: 1999 with the sample sizes in accordance with Table 1 of the same standard. Sample sizes were appropriate for the laboratory test being considered.
- 3.4.5 'Undisturbed' 100mm diameter samples were taken in cohesive soils when considered appropriate using a general-purpose open tube sampler. Every attempt was made to obtain class 1 sample to BS5930 (1999) but class 2 samples were more likely (refer BS5930: 1999 for an explanation). The undisturbed sample was obtained in a plastic liner and sealed with wax prior to labelling. The number of blows of the standard driving hammer is required to obtain the sample is recorded on borehole records.

3.4.6 Standard Penetration Testing (SPT) was carried out at regular frequencies in the borehole. The test was carried out in accordance with BS1377: 1990 Part 9 'Method of Test for soils for Civil Engineering Purposes' (method 3.3). Details of the test, as required by BS1377: 1990 are recorded in borehole records. The drive rods were type AW up to 20m depth and type BW for depths in excess of 20m. Samples taken from the open sampler (SPT) were placed in a plastic bag, sealed and labelled. In coarse granular soils, a solid 60° cone may have been used to replace the SPT cutting shoe. This test is reported as SPT(C). A graphical summary of standard penetration testing is presented on Drawing STB0620D-03.

3.4.7 The borehole excavations were formed by drillers accredited by the British Drilling Association with samples re-logged by an experienced Geotechnical Engineer.

3.4.8 Records of boreholes formed by light cable and tool percussion drilling techniques are presented in Appendix D.

3.5 Sampling Strategy

3.5.1 In general we adopted a judgemental sampling strategy in relation to potential chemical contamination. The location and frequency of sampling was carried out in consideration of the following:-

- i) Location of potential contamination sources
- ii) Topography
- iii) Geology (Including Made Ground)
- iv) Nature of development proposals

Sampling for classification testing was also judgemental with the frequency and location of sampling relating to: -

- i) Geology
- ii) Topography
- iii) Nature of development proposals

3.5.2 Samples are stored for a period of one month following issue of this report unless otherwise required.

4.0 GROUND CONDITIONS ENCOUNTERED**4.1 Soils / Rocks**

4.1.1 Each exploratory excavation encountered a similar profile of soils considered to be, in order of superposition: -

- Made Ground
- Glacial Till
- Permian and Triassic Sandstone

4.1.2 Made Ground comprised firm dark brown slightly sandy, gravelly clay with occasional cobbles of brick. Gravels comprised brick, flint and quartz.

4.1.3 Glacial deposits comprised both cohesive and granular soils. The near surface glacial material comprised firm and stiff brown sandy slightly gravelly clay, with occasional cobbles at depth. Gravels and cobbles comprised flint and quartz. The cohesive, glacial deposits extended to depths of 9.5m and 11.0m below the existing basement level within boreholes BH01 and BH02 respectively.

4.1.4 The underlying glacial deposits comprised banded cohesive and granular deposits. The more granular deposits comprised medium dense, dense and very dense brown sands and gravels with many cobbles. The gravel and cobbles comprised quartz and flint. The banded cohesive soils comprised stiff and very stiff dark brown sandy clay with occasional cobbles of flint and quartz. Glacial Till was encountered to depths of 21.0m and 19.7m, below existing basement level, within borehole BH01 and BH02 respectively.

4.1.5 The Permian and Triassic Sandstone comprised very weak, poorly cemented, highly friable, red brown sandstone. Boreholes met with refusal within the sandstone at depths of 21.7 and 20.5m within boreholes BH01 and BH02 respectively.

4.1.6 The investigation confirmed published geological records.

4.2 Groundwater

4.2.1 Groundwater inflows were observed in some / many of the exploratory excavations. A summary of our observations is tabulated below:

Exploratory point	Depth (m) below existing basement level	Observations
TP01	0.75	Standing level
BH01	18m	Rising to 17.2m in 10 mins
BH01	21m	Rising to 15.0m in 10 mins
BH02	11m	Rising to 10.4m in 10 mins
BH02	19m	Rising to 15.0m in 10 mins
Table reference 4.3.1		

4.2.2

It should be noted that water levels will vary depending generally on recent weather conditions and only long term monitoring of levels in piezometers will provide a measure of seasonal variations in groundwater levels.

5.0 LABORATORY TESTING

5.1 Laboratory testing was carried out as deemed necessary and limited to the following: -

- In accordance with BS1377: 1990 *"Methods of Test for Soils for Civil Engineering Purposes"*.

a) Classification tests: (to part 2)

- i) Determination of moisture content (method 3)
- ii) Determination of the liquid limit – one point cone penetrometer method (method 4.4)
- iii) Determination of the plastic limit and plasticity index (method 5)

b) Chemical and electro chemical tests (to part 3)

- i) Determination of sulphate content of soil and groundwater (method 5)
- ii) Determination of the pH value (method 9)

- Following methods based on and incorporating procedures published in HMSO Series *'Methods for the Examinations of Water and Associated Materials'*.

a) Determination of concentration of chemical contaminants on soil, and where applicable water samples

b) Determination of soluble sulphate content.

- Determination of concentration of leachable contaminants

5.2 Laboratory testing was carried out by independent specialist testing houses, which operate quality assurance schemes.

5.3 Copies of laboratory test result certificates are presented in Appendices E and F.

6.0 ENGINEERING ASSESSMENT

6.1 General Description of the Development

6.1.1 The following assessments are made on the investigatory data presented in the preceding sections of this report and are made with reference to specific nature of the development. A brief description of the development is provided in Section 1.

6.1.2 Should the development proposals change then it may be necessary to review the investigation and report.

6.2 Building Foundation, Design and Construction

6.2.1 Definitions of geotechnical terms used in the following paragraphs are provided in Appendix A1.

6.2.2 Based on site development proposals and ground conditions encountered at the site, we recommend that a piled foundation solution is adopted.

6.2.3 *Piled Foundations*

6.2.3.1 It is possible that the new building will be supported off a piled raft with possible retaining walls (if the existing basement is not infilled) and underpinned existing foundations.

6.2.3.2 Two hand excavated trial pits were undertaken to assess the existing foundations along the northeastern boundary. The trial pits encountered corbelled brick foundations extending to depths of 0.3m and 0.6m below existing site basement level in trial pits TP01 and TP02 respectively. It is suspected that these shallow foundations may correspond to the former buildings which occupied the site. Although groundwater entries hampered our excavations, at trial pit TP01 location a second section of foundations was encountered at approximately 1.52m depth below existing basement level. It is anticipated that the deeper foundations may correspond to the existing adjoining building (possibly representing a deeper adjoining basement). The foundation formations were recorded directly on the upper horizons of the Glacial Till soils. We recommend, should these foundations remain then they are suitably underpinned to avoid the potential risk of total and/or differential settlement.

6.2.3.3 A piled foundation solution would transmit superstructural loads down through the Made Ground and into the Glacial Till and possibly the Permian and Triassic Sandstone at depth to obtain end bearing and shaft adhesion support. The difficulty of boring piles through the dense, glacial gravels and cobbles at the site with potential groundwater entries along with the proximity to underground structures (e.g. existing foundations and possible deep basements) and stresses induced on existing/proposed foundations would have to be considered by any specialist piling company and will affect the method of pile installation.

6.2.3.4 We recommend this report be provided to a specialist piling company to allow the selection of the most appropriate pile type for the development and ground conditions. The contents of this report will also assist in the design of the pile.

6.2.3.5 We recommend piling be carried out following the "Specification for Piling and Embedded Retaining Walls" produced by the Institution of Civil Engineers.

6.2.4 ***Basement retaining walls***

6.2.4.1 We understand the proposed building completely covers the site boundaries and the existing basement opening will not be utilised and will either be infilled or capped. The existing retaining walls may be utilised in the short term however dependant upon the vertical load carrying requirements it may be necessary to underpin or install a new permanent retaining wall around the perimeter of the basement. Consideration should be given to the potential risk of overbreak/instability particularly in the Made Ground deposits. In addition, potential high rainfall events and potential perched groundwater pockets may promote progressive instability.

6.3 **Influence of Trees and Hedges**

6.3.1 Major vegetation was not identified and we understand is not proposed at the site and hence in our opinion the development proposals will not be influenced by vegetation.

6.4 **Ground Floor Construction**

6.4.1 If a piled foundation is selected then the floor slab can also be piled thus minimising levels of settlement.

6.5 **Service Trench Excavations**

6.5.1 It is difficult to predict the stability of trench sides from borehole investigations. Generally we would anticipate a risk of some overbreak/instability in the Made Ground deposits however we consider the underlying cohesive Glacial Till deposits will remain stable in the short term.

6.5.2 We anticipate there may be perched groundwater pockets within the near surface Made Ground soils. Such inflows may promote progressive instability in trench sides requiring continuous trench sheet piling to maintain an open excavation. We anticipate water will be controlled with nominal pumping techniques.

- 6.5.3 We recommend any trench excavation requiring human entry is shored as necessary to conform with current best practice, and accepted by the Health and Safety Executive (HSE) and in particular, following guidance provided in the HSE construction information sheet No 8 (revision 1) "Safety in excavations".
- 6.6 **Soakaway Potential**
- 6.6.1 The near surface Glacial Till deposits are, in our opinion, effectively impermeable and would not be able to dispose of water using soakaway systems.
- 6.7 **Effect of Ground Conditions on Concrete**
- 6.7.1 **Assessment Standards**
- 6.7.1.1 We have adopted procedures described in the Building Research Establishment (BRE) Special Digest 1 'Concrete in Aggressive Ground' (Parts 1 and 2) to assess the Aggressive Chemical Environment for Concrete (ACEC) and establish a Design Sulfate class (DS Class).
- 6.7.2 **Assessment Criteria**
- 6.7.2.1 Laboratory test data indicates the soluble sulfate content of near surface soils are less than 2.0g/l. As these results are less than 3.7g/l (refer BRE Digest) then we have not measured the concentration of Magnesium.
- 6.7.2.2 The pH of soil samples tested range from 7.9 to 8.3. Following the BRE Digest, the characteristic pH is 7.9 (based on the mean of the lowest 20% of test results) which is greater than 5.5 thus the concentration of chloride and nitrate have not been measured.
- 6.7.2.3 In our opinion water is likely to be static in the near surface soils to and around foundation levels.
- 6.7.3 **Assessment of Aggressive Chemical Environment**
- 6.7.3.1 Based on the above information, and with reference to Table 2 of Special Digest 1 (part2), we are of the opinion that the Made Ground deposits are classified as Design Sulfate Class DS-2 and Aggressive Chemical Environment for Concrete (ACEC) AC-1.
- 6.7.3.2 The near surface glacial soils are classified as Design Sulfate Class DS-1 and Aggressive Chemical Environment for Concrete (ACEC) AC-1.
- 6.7.3.3 We recommend therefore that the Design Sulfate Class DS-2 is adopted at the site where Made Ground deposits are present however within the natural soils DS-1 may be used.

7.0 CHEMICAL AND GASEOUS CONTAMINATION AND LANDFILL ISSUES

7.1 Current statute on contaminated land, regulation and liabilities.

7.1.1 Statute

7.1.1.1 Part IIA of the Environment Protection Act 1990 became statute in April 2000. The principal feature of this legislation is that the hazards associated with contaminated land should be evaluated in the context of a site-specific risk based framework. More specifically contaminated land is defined as:

"any land which appears to the local authority in whose area it is situated to be in such a condition, by reasons of substances in, on or under the land, that:

- a) significant harm is being caused or there is a significant possibility of such harm being caused; or*
- b) pollution of controlled waters is being or is likely to be caused".*

7.1.1.2 Central to the investigation of contaminated land and the assessment of risks posed by this land is that:

- i) there must be contaminants(s) at concentrations capable of causing health effects (*Sources*).
- ii) there must be a human or environmental receptor present, or one which makes use of the site periodically (*Receptor*); and
- iii) there must be an exposure pathway by which the receptor comes into contact with the environmental contaminant (*Pathway*).

7.1.2 Regulation of the Act

7.1.2.1 In most cases the Act is regulated by Borough or District Councils and their role is as follows

- i) Inspect their area to identify contaminated land
- ii) Establish responsibilities for remediation of the land
- iii) See that appropriate remediation takes place
 - through agreement with those responsible, or if not possible
 - by serving a remediation notice, or
 - in certain cases carrying out the works themselves, or
 - in certain cases by other powers
- iv) keep a public register detailing the regulatory action which they have taken

7.1.2.2 For "special" sites the Environment Agency will take over from the Council as regulator. Special sites typically include:-

- Contaminated land which affects controlled water and their quality
- Oil refineries
- Nuclear sites
- Waste management sites

7.1.3 ***Liabilities under the Act***

7.1.3.1 Liability for remediation of contaminated land would be assigned to persons, organisations or businesses if they caused, or knowingly permitted contamination, or if they own or occupy contaminated land in a case where no polluter can be found.

7.1.4 ***Further Information***

7.1.4.1 The above provides a brief outline as regards current statute. Further information can be obtained from the Department for the Environment, Food and Rural Affairs (DEFRA) and their Web site www.defra.gov.uk.

7.2 **General**

7.2.1 This report section discusses chemical and gaseous contamination issues relating to the site. As stated in section 1.4.2, the investigation process followed the principles of BS10175: 2001 '*Investigation of potentially contaminated sites – Code of Practice*', with the investigation combining a desk study (preliminary investigation) together with the exploratory and main investigations (refer BS10175: 2001 for an explanation).

7.2.2 The objectives of this section of the report are to produce a '*Conceptual model*' based on investigatory data obtained to date. The conceptual model is produced by identification of *contaminants* and establishment of feasible *pathways* and *receptors*. The conceptual model allows a *risk assessment* to be derived. Depending upon the outcome of the risk assessment it may be necessary to carry out remediation and/or further investigations with a view to eliminating, reducing or refining the risk of damage to identified receptors. If appropriate, our report will provide recommendations in this respect.

7.2.3 Definition of terms used in the preceding paragraph and subsequent parts of this section of the report are presented in Appendix A2.

7.2.4

Chemical Contamination

7.2.4.1

For the purposes of presenting this section of this report, we have adopted the following sequence in relation to chemical contamination.

Conceptual model element	Contributory Information	Outcome
Receptor	Development categorisation	- identification of receptors at risk of being harmed - method of analysing test data - criteria for risk assessment modelling
Pathways	- geology and ground conditions - development proposals	- identification of critical pathways from source to receptor
Source	- previous site history - desk study information - site reconnaissance - fieldwork observations	- testing regime - identification of a chemical source - by-analysis of test data and other evidence

The above information will construct a conceptual model of the site/project. Initially, test data is compared with relevant guideline values, recognising feasible pathways to identical receptors. If the risks to human health and water receptors are considered greater than low, then measures to eliminate or minimise the risk of a contaminative source harming receptors must be identified and actioned or possibly further investigations may allow the risk to be refined to acceptable levels.

7.2.5

Gaseous Contamination

7.2.5.1

A similar risk assessment process in respect to gaseous contamination is carried out.

7.3

Development Categorisation and Identified Receptors

7.3.1

Identified receptors

7.3.1.1

The principal receptors subject to harm caused by contamination of the proposed development site are as follows.

- a) End users of the developed site (Humans)
- b) Construction operatives (Humans)
- c) Groundwater and surface water resources

7.3.2

Human Receptors – End Users of the Site

7.3.2.1

The critical human 'receptor' used in the analysis of test data (refer CLR publications listed in 7.6.2 below) is a child under the age of 6 years. This takes into account the inquisitive nature of children (i.e. an amenable means of direct soil ingestion) and their relative body mass.

7.3.2.2 Such a receptor is critical for residential developments particularly those including gardens where both direct (hand to mouth and breathable soil dusts) and indirect ingestion (via consumption of home grown vegetables) of contaminated soils is feasible. For industrial/commercial developments, the adult becomes the critical receptor, exposed in the long term, where applicable, to breathable airborne contaminated soil dusts. These pathways (inhalation/ingestion) for source contamination to reach the human receptor can be eliminated, depending upon the development proposals, or by remediation, or indeed if the source is not evident then the source-pathway-receptor model is not relevant. Further, more detailed information on the exposure assessment model for human receptors is described in CLR 10 (refer report Section 7.6.2 for references).

7.3.3 ***Human Receptors – Construction Operatives***

7.3.3.1 Typically, construction operatives will be exposed to the development site for relatively short timescales. Operatives however, are subject to contaminated soils/waters through the ingestion/inhalation pathway route. Exposure rates can be substantially reduced by various means described in the recommendations Section 7.7.4 of this report.

7.3.4 ***Groundwater and Surface Water Receptors***

7.3.4.1 Water resources can be harmed by migration of chemical contamination of the site via migration pathways described in subsequent report sections.

7.3.5 ***Development Categorisation***

7.3.5.1 It is understood that the site will be redeveloped for residential use and will be substantially covered by the proposed building. This criterion has been used in the evaluation of test data (refer following report section) and used in the construction of the conceptual model.

7.4 Identification of Pathways

7.4.1 Pathways to Human Receptors (end users)

7.4.1.1 CLR10 (refer report Section 7.6.2 for references), provides a very detailed assessment of pathways and assessment and human exposure rates to source contaminants. In summary, the principal pathways of contamination to the human receptor are as follows:-

- Ingestion of contaminated soil dusts
- Ingestion by incidental or deliberate hand to mouth contact
- Ingestion of contaminated fruit/vegetables
- Skin contact with soils (working or at play)
- Inhalation of vapours

Clearly some of these pathways can be eliminated depending upon the end use of the site, for instance ingestion of fruit/vegetables sourced from an industrial development is unlikely, and child receptors would not be considered for an industrial development.

7.4.2 Pathways to Human Receptors (end users) - Elemental Risk Assessment

7.4.2.1 Based on our understanding of development proposals, which does not incorporate any soft landscaping/garden areas (as described in 7.3.5. above), we can provide the following elemental risk assessment for end users of the site, which is summarised in the following table and contributes to a collective risk assessment on Section 7.7.

Elemental risk assessment carried forward to collective risk assessment in Section 7.7		
Element	Type (position in conceptual model)	Assessed risk
End users (children)	Pathway – Ingestion of contaminated soils	Low
End users (children)	Pathway – Inhalation of contaminated soil dusts	Low
End users (adults)	Pathway – Ingestion of contaminated soils	Low
End users (adults)	Pathway – Inhalation of contaminated soil dusts	Low
Table reference 7.4.2		

7.4.3 Pathways to Water Receptors

7.4.3.1 Pathways of any chemical contaminations at the site to water receptors is a function of the geological conditions at the site and the feasibility of such pollutants to migrate laterally or vertically through soils to groundwater resources or indeed surface water resources.

7.4.3.2

Based on published geological records, supplemented by actual investigatory data, the topography local to the site is formed in the following sequence of soils.

Strata	Approx thickness	Typical soil type	Likely permeability	Aquifer potential	Pathway feasibility
Made Ground	0.5-1.0m (from existing basement level)	Clay	Low	-	Low
Glacial Till	20m	Clay with sand and gravel	Low	Non	Low
Permian and Triassic Sandstone	>10m	Sandstone	High	Major aquifer	High

Table reference 7.4.3.2

7.4.3.3

Based on the above, near surface soils are considered to be effectively impermeable, and thus the risk of any chemical contaminants at the site migrating to adjacent sites (and indeed chemical contaminants from adjacent sites migrating to the subject site) is considered low. Similarly, the risk of chemical contaminants at this site and adjacent sites migrating vertically to groundwater resources, is considered low. The following table summarises this elemental risk assessment, which contributes to a collective risk assessment in Section 7.7.

Elemental risk assessment carried forward to collective risk assessment in Section 7.7		
Element	Type (Position in conceptual model)	Assessed risk
Geology	Pathway – lateral migration to/from adjacent sites and watercourses	Low
Geology	Pathway – vertical migration to groundwater resources.	Low

Table reference 7.4.3.3

7.5 Assessment of Sources of Chemical Contamination

7.5.1 Initially, potential sources of contamination are assessed using the following elements of the investigation process.

- History of the site
- Desk study information
- Site reconnaissance
- Fieldwork observations

These elements will dictate a relevant soil/water testing regime to quantify possible risks of any identified contaminative processes/events which may harm identified receptors.

7.5.2 Source Assessment – History of the Site

7.5.2.1 The history of the site and its immediate surroundings based on published Ordnance Survey maps is described in Section 2.

7.5.2.2 Based on published historical maps, there is no evidence to indicate the site, or its immediate surroundings, has been subject to activities, which could produce a source of chemical contamination. We understand however that the site may have been occupied by a former mill. On this evidence, in isolation, the risk of a source of chemical contamination is considered moderate. The following table summarises this elemental risk assessment, which contributes to a collective risk assessment in Section 7.7.

Elemental risk assessment carried forward to collective risk assessment in Section 7.7		
Element	Type (Position in conceptual model)	Assessed Risk
Historical (on site)	Source	Moderate
Historical (adjacent site)	Source	Low
Table reference 7.5.2		

7.5.3 Source Assessment – Desk Study Information

7.5.3.1 Envirocheck presents a detailed database of environmental information in relation to the site including;

- Pollution incidents
- Landfill sites
- Trading activities

Based on the Envirocheck data (refer Appendix J) the site has no recorded history of any existing pollution events, or trading activities which could generate a source of contamination, or is located in close proximity to a landfill site. The following table summarises this elemental risk assessment which contributes to a collective risk assessment in Section 7.7

Elemental risk assessment carried forward to collective risk assessment in Section 7.7		
Element	Type (Position in conceptual model)	Assessed Risk
Desk Study information (on site)	Source	Low
Desk Study information (adjacent site)	Source	Low
Table reference 7.5.2		

7.5.4 Source Assessment – Site Reconnaissance

7.5.4.1 A full description of the site and observed adjacent land uses is provided in Section 2 of this report. A plan summarising observations made on site during our site reconnaissance visit is presented on Drawing STB0620D-02.

7.5.4.2 As a result of our site reconnaissance visit, we did not observe any obvious evidence of any current or recent activities on site or adjacent sites, which provide a potential source of chemical contamination. On this evidence, in isolation, the risk of a source of chemical contamination is considered low. The following table summarises this elemental risk assessment, which contributes to a collective risk assessment in Section 7.7.

Elemental risk assessment carried forward to collective risk assessment in Section 7.7		
Element	Type (Position in conceptual model)	Assessed risk
Site reconnaissance (on site observations)	Source	Low
Site reconnaissance (off site observations)	Source	Low
Table reference 7.5.4		

7.5.5 Source Assessment - Fieldwork Activities

7.5.5.1 None of the exploratory excavations exposed soils or water, which provides visual or olfactory evidence, which would indicate the soils on site are chemically contaminated on this basis, and in isolation the risk of a source of on site chemical contamination is considered low. The following table summarises this elemental risk assessments, which contributes to a collective risk assessment in Section 7.7.

Elemental risk assessment carried forward to collective risk assessment in Section 7.7		
Element	Type (position in conceptual model)	Assessed risk
Intrusive on site investigation	Source	Low
Table reference 7.5.5		

7.6 Laboratory Testing

7.6.1 Testing Regime – Human receptors

7.6.1.1 Although historical records do not identify any past or recent uses of the site which may have generated specific contamination, we understand that the site may have been occupied by a mill. Such usage is highlighted in Tables 2.2 and 2.3 of the Contaminated Land Report (CLR) no. 8 'Potential Contaminants for the Food and Rural Affairs (DEFRA) in conjunction with the Environment Agency (EA). As a result we have scheduled testing to measure concentrations of the following contaminants.

- Cadmium
- Chromium
- Copper
- Mercury
- Boron
- Nitrate
- Sulfate
- Phenol
- Acetone
- Chlorinated Aliphatic Hydrocarbons
- Dieldrin
- Volatile Organic Compounds (VOCs)
- Semi Volatile Organic Compounds (SVOCs)
- Polychlorinated biphenyl's (PCBs)

7.6.1.2 Again, with reference to CLR 8, we have scheduled testing to include inorganic contaminants listed in Table 2.1 of CLR 8 (if not listed above) when they are considered a risk to human receptors. In addition, we have also scheduled testing to measure the concentration of the more common organic compounds forming polycyclic hydrocarbons (PAH), typically derived from a variety of combustion and pyrolytic sources.

7.6.1.3 Seven samples were submitted for measurement of inorganic and organic contaminants described in the preceding paragraph. The overall testing strategy and quantity (described above) is considered an absolute minimum to allow a risk assessment to be made. Obviously additional testing (quantity and type) would allow a more accurate risk assessment to be made.

7.6.1.4 The results of laboratory determination of concentration of chemical contaminants are presented in Appendix F.

7.6.2 *Criteria for assessment of test data – Human receptors*

7.6.2.1 Assessment of laboratory test data has been carried out using the following documents published by the DEFRA in conjunction with the EA.

- ♦ *Assessment of Risks to Human Health from Land Contamination: An overview of the development of soil guideline values and related research* (R & D Publication, Contaminated Land Report (CLR)7).
- ♦ *'Contaminants of Soil: Collation of Toxicological Data and Intake Values for Humans'* (R & D Publication, Contaminated Land Report (CLR)9).
- ♦ *'The Contaminated Land Exposure Assessment Model' (CLEA): Technical basis and algorithms* (R & D Publication, Contaminated Land Report (CLR)10).
- ♦ *Model Procedures for the Management of Land Contamination* (Contaminated Land Report (CLR)11)
- ♦ *'Contaminants in Soil: Collection of Toxicological data and intake values for Human Values'* (R & D Publications Tox 1, 2, 3, 4, 5, 6, 7, 8, & 10).
- ♦ *'Soil Guideline Values for Contamination'* (R & D Publication SGV1, 3, 4, 5, 7, 9, & 10).

These documents form part of the Contaminated Land Report (CLR) some of which remains unpublished. The above publications do provide soil guideline values (SGV's) in relation to the following chemical contaminants.

Arsenic
Cadmium (total)
Chromium (total)
Lead

Mercury
Selenium
Nickel
Ethylbenzene
Toluene

- 7.6.2.2 Soil guideline values (SGV's) referred to in Contaminated Land Reports (CLR) are used as a screening tool to assess the risks posed to health of humans from exposure to soil contamination in relation to land uses. They represent 'intervention values'; indications to an assessor that soil concentrations above these levels might present an unacceptable risk to the health of site users. These soil guideline values have been produced using conceptual exposure models, which use assumptions and are applied to differing end uses of land. If the SGV's are exceeded it does not necessarily imply there is an actual risk to health and site-specific circumstances should be taken into account. Conversely, where a critical pathway or chemical form of the contaminant has not been evaluated by the CLR then, potentially, a significant risk may be present even if the SGV has not been exceeded.
- 7.6.2.3 Where published soil guidelines are not available for a contaminant, it may be necessary to derive a site-specific assessment criteria (SSAC). This is carried out following procedures described in the following document produced by Land Quality Management Limited on behalf of the Scotland and Northern Ireland Forum for Environmental Research (SNIFFER) '*Method for deriving site specific human health assessment criteria for contaminants in soil*' (April 2003). Publicly available toxicity reports, produced by nationally and internationally recognised bodies, have been used in production of the site-specific assessment criteria. Individual reports have been prepared for contaminants under consideration (where considered appropriate), which are maintained at our office and are available to governmental authorities, who may be scrutinising this report, but will only be issued as '*commercial in confidence*' if and when requested.
- 7.6.2.4 For assessment of polycyclic aromatic hydrocarbons (PAH) we have selected Benzo(a)pyrene and Naphthalene as indicators of prevalence of such contamination. This indicator has been chosen in view of available toxicity data produced and published by DEFRA. Again, we have utilised our SSACs for evaluation of these contaminants as indicator.
- 7.6.3 ***Statistical analysis of test data – Human Receptors***
- 7.6.3.1 Following CLR7, we have carried out a statistical analysis of test data for each chemical contaminant considered in this investigation. Initially, the maximum value test is carried out to provide an indication of results, which could be considered 'statistical outliers', and thus not part of the general population of results. The maximum test value is described in detail in CLR7. If outliers are clearly identified, then these may represent an area of contamination considered worthy of further investigation.

- 7.6.3.2 Following completion of the maximum value test procedure, then the mean value test is carried out on test data. If a "statistical outlier" is identified as part of the maximum value test, then the outlier result is ignored in the subsequent mean value test, to avoid distortion of the general population of results. The mean value test determines the 95th percentile value for appropriate test data for individual contaminants, which is also related to the number of test values under consideration. The resulting 95th percentile values are then compared with soil guideline values or site specific assessment criteria.
- 7.6.3.3 The above statistical analysis of test data is tabulated in Appendix G.
- 7.6.3.4 As always, statistical tests are an aid to decision making, but are not a substitute for professional judgement.
- 7.6.4 *Evaluation of test data (inorganic contaminants) - Human Receptors*
- 7.6.4.1 In consideration of the results of the maximum value test (refer Appendix G), statistical analysis highlighted an outlier potentially suggesting further investigation for cadmium. The outlier concentration associated with cadmium however falls well below soil guideline values for the end use of the site.
- 7.6.4.2 In consideration of the mean value test (95th Percentile values – refer Appendix G) compared with published soil guideline values and site-specific assessment criteria values, our analysis indicated none of the results exceed these guideline values with the exception of concentrations of lead. The elevated concentrations of lead were detected within the Made Ground deposits at the site.
- 7.6.4.3 In the absence of published soil guidelines values, as a practice, we are in the process of producing our own site-specific assessment criteria (SSAC) but at this stage we have not produced values for cyanides or sulphur, but test data produced values below detectable levels for these contaminants, and as such, they are not considered to present a significant risk to end users at the site.
- 7.6.4.4 Based on the above evaluation in isolation, the Made Ground soils at the site exhibit a degree of lead contamination. Based on site development proposals however, which incorporate a fully surfaced site, the pathway for contamination to reach end users at the site is effectively severed and as such the potential risk of contamination causing significant harm to end users is considered to be low, and as such no remedial action is considered necessary. It is possible that the concentrations of lead could leach to groundwater resources, but this is discussed further in following paragraphs

7.6.5 Evaluation of test data (organic contaminants) – Human Receptors

7.6.5.1 For evaluation of test data in relation to polycyclic aromatic hydrocarbon (PAH) contamination we have adopted benzo(a)pyrene and naphthalene as indicators of prevalent organic contamination. In consideration of the maximum value test, (refer Appendix G) the results for naphthalene have produced two statistical outliers, with measured concentrations of 0.15 and 0.11mg/kg. These values do not however exceed our site specific assessment criteria of 60mg/kg and in our opinion are not considered worthy of further investigation.

7.6.5.2 In consideration of the mean value test (95th percentile values – refer Appendix G) for benzo(a)pyrene and naphthalene; compared with our site specific assessment criteria; indicates none of the results exceed out site specific assessment criteria values.

7.6.5.3 Measured concentrations of Polychlorinated Biphenyl's (PCBs) were all recorded below detectable limits, and as such, are not considered to present a significant risk of causing significant harm to either end-users or water receptors at the site.

7.6.5.4 Measured concentrations of contaminants within the Dieldrin suite of analysis (organochlorine pesticides) produced measured results below detectable limits, and as such are not considered to present a risk to human end users or water receptors at the site.

7.6.5.5 Measured concentrations of contaminants within the Volatile Organic Compounds (VOCs) suite of analysis were all recorded below detectable limits, and as such are not considered to present a significant risk to end-users or water receptors at the site.

7.6.6 Testing regime – Water Receptors

7.6.6.1 With reference to Paragraph 7.6.1.1 our testing schedule included measurement of leachability / concentration of the following contaminants associated with current/historical site uses.

- Cadmium
- Chromium
- Copper
- Mercury
- Boron
- Nitrate
- Sulfate

7.6.6.2 In addition, and again, with reference to CLR8, we have scheduled testing to measure the leachability / concentration of inorganic contaminants listed in Table 2.1 (of CLR8) where they are considered a risk to water resources. In addition, we have also scheduled testing to include the more common organic compounds forming polycyclic aromatic hydrocarbons.

- 7.6.6.3 It should be noted that we have only scheduled two samples for laboratory determination of leachability / concentrations of contaminants described above. This in our opinion is an absolute minimum to assist in the risk assessment. Further laboratory testing will increase the accuracy of the risk assessment.

7.6.7 Assessment Criteria - Water Receptors

- 7.6.7.1 For interpretation of test data in relation to water receptors we have directly compared measured values with the Environment Agency publication 'Environment Agency technical advice to third parties on Pollution of Controlled Waters for Part II a of the Environmental Protection Act 1990' Appendix A (selected water quality standards for use in assessing the presence of pollution of controlled waters) (release 2.0 May 2002).

7.6.8 Evaluation test data – Water Receptors

- 7.6.8.1 None of the test results provide values above concentrations defined for Environmental Quality Standards (EQS) (freshwater) included in Appendix A of the publication described in Paragraph 7.6.7.1 above, with the exception of one marginally elevated concentration of sulphate within the near surface Made Ground deposits. This contaminant is compared with EQS values in the following table.

Contaminant	Sample origin (excavation ref)	EQS for freshwater (mg/l)	Measured Values (mg/l)
Sulphate	TP03 0.3m	400	440

- 7.6.8.2 The cohesive nature of the shallow Glacial Till deposits at the site and the development proposals (which will completely occupy the site) will in our opinion effectively restrict the pathway by which sulphates could reach either groundwater resources at depth or adjacent receptors. As such, no remedial action is considered necessary with regard to the isolated sulphate leachate concentration encountered at the site.

- 7.6.8.3 It should also be noted that sulphate can have an impact upon construction materials which is further discussed in Section 6.7.

7.6.9

Laboratory Test Data – Risk Assessment

7.6.9.1

Based on our evaluation of laboratory test data described above, the following table summarises this elemental risk assessment which contributes to a collective risk assessment in Section 7.7.

Elemental risk assessment carried forward to collective risk assessments in Section 7.7			
Element	Type	(position in conceptual model)	Assessed risk
Laboratory testing	Source		Low
Table reference 7.6.9			

7.7

Chemical Contamination – cumulative risk assessment, conceptual model and summary

7.7.1

From elemental risk assessments developed in preceding report sections, we can now produce the following cumulative risk assessment based on the source-pathway-receptor model. The first stage is to confirm a source of chemical contamination, which could harm identified receptors. Should the assessed risk of harm be greater than 'low', then the second stage of potential pathways of contaminants to receptors will need examination. The following table summarises elemental risk assessments.

Table summarising elemental risk assessments for sources of chemical contamination which could harm identified receptors				
Elemental investigations / observations	Reference table	Assessed risk		
		low	moderate	high
Historical maps (on site)	7.5.2		✓	
Historical maps (adjacent site)	7.5.2	✓		
Reconnaissance	7.5.4	✓		
Desk study information (on site)	7.5.3	✓		
Desk study information (adjacent site)	7.5.3	✓		
Exploratory holes	7.5.5	✓		
Laboratory testing	7.6.9	✓		
Table reference 7.7.1				

- 7.7.2. We understand from Ashgate Developments Limited that the site will be fully surfaced with hardstanding, and that no soft landscaped areas are proposed at the site. Based on current development proposals, in our opinion, the risk to end users, water resources and off site receptors, created from ground conditions encountered at the site, is considered low, and no remedial action is considered necessary. Should development proposals change however, then we recommend that the report is referred back to Soiltechnics Ltd for reassessment.
- 7.8 **Landfill Gas Contamination**
- 7.8.1 Waste Management Paper 27 (1991) produced by the Department of the Environment '*Control of Landfill Gases*' contains the strong recommendation to avoid building within 50m of a new landfill site and to carry out site investigations within a zone 250m beyond the boundary of a landfill site. No distinction is made between sites of differing ground conditions, but the paper does not advocate the site is safe beyond the 250m zone.
- 7.8.2 The principal gases produced by landfills accepting biodegradable waste are methane and carbon dioxide. Methane, in appropriate concentrations, can be explosive and carbon dioxide can cause asphyxiation.
- 7.8.3 An assessment of the risk of the site being affected by landfill gases is based on the following aspects.
- a) Source of the gas
 - b) Investigation Information
 - c) Migration feasibility
 - d) Sensitivity of the development and its location relative to the source
- 7.8.4 A registered landfill site is located some 900m to the east of the site. This landfill is recorded as being large (equal to or greater than 75,000 and less than 250,000 tonnes per year), and authorised to accept the following list of waste materials; ceramic, construction industrial wastes, glass, metals, similar non-leachate forming materials, soil, clay, sand, stone, brick, concrete and slate. The site has not been active since 1986.
- 7.8.5 The cohesive, near surface glacial soils at the site, in our opinion would be relatively impermeable to landfill type gas migration. The risk therefore of the site being affected by potential landfill gas contamination is considered to be low.
- 7.9 **Disposal of Soils off Site**
- 7.9.1 Using available investigatory data we have produced a separate report to classify soils likely to be excavated at the site for off site disposal.

7.10 Landfill tax

- 7.10.1 Disposal of soils to landfill sites is normally subject to landfill tax with rates varying from year to year based on government policy. Current information on rates of landfill tax can be obtained from H M Customs and Excise (HMCE) Office (leaflet notice LFT 1) with a lower rate applied to inactive (or inert) wastes and the standard rate to all other taxable wastes.
- 7.10.2 Landfill tax exemption can be obtained providing the following conditions can be satisfied.
- a) Reclamation must involve clearing the land of pollutants that are causing harm or have the potential to cause harm, demonstrating that the pollutants are or potentially:
 - i) Polluting ground or surface water or
 - ii) Harming the health of people or animals or plants on
 - iii) Damaging the fabric of structures or services
 - b) The cause of the pollution must have ceased
 - c) The land is not subject to the works or remediation notice
 - d) The reclamation constitutes or includes clearing the land of pollutants which would (unless cleared) prevent the land being put to intended use
- 7.10.3 Details of the above are produced in the HMCE Leaflet LFT2. Applications for landfill tax exemption must be submitted to HMCE at least 30 days before the intention to start removing waste to landfill.
- 7.10.4 In our opinion it may be possible to obtain landfill tax exemption based on the development proposals and ground conditions determined at this site. We would be pleased to assist on this aspect on further instructions.
- 7.11 On Site Monitoring**
- 7.11.1 We have attempted to identify the potential for chemical contamination on the site, however, areas, which have not been investigated at this stage, may exhibit higher levels of contamination. We would consider the risk of this to be low. If such areas are exposed at any time during construction we recommend investigation and testing be carried out accordingly.

SOI/

7

Proposed development at 35 Back Piccadilly, Manchester

HER INVESTIGATIONS

in our opinion, no further investigations are considered necessary at this time.

Sarah Drage

Sarah Drage BSc, (Hons)
Geo-environmental Engineer for Soiltechnics Limited

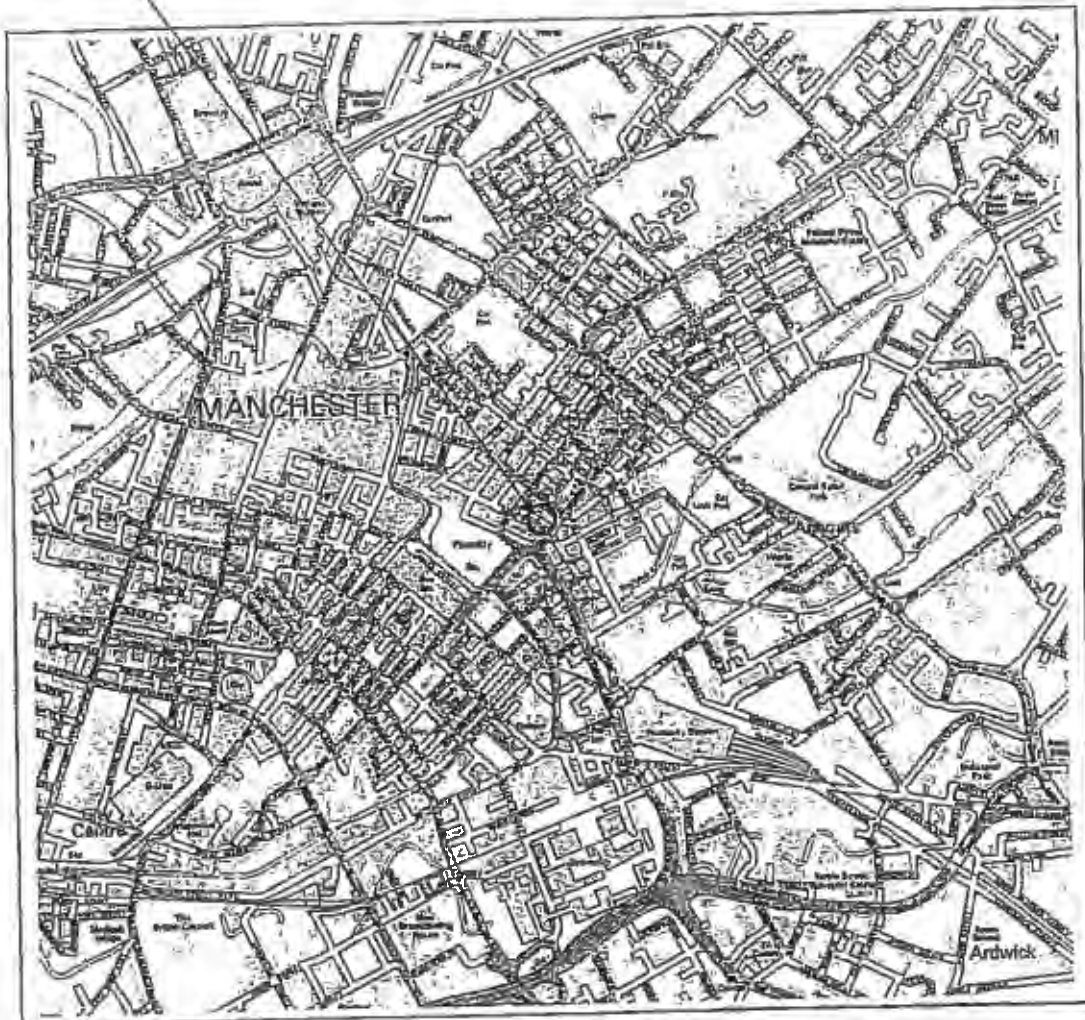
I. Evetts

Ian Evetts HNC,
Associate Director for Soiltechnics Limited

DRAWING STB0620D-01

Site Location Plan

The Site,



SOILTECHNICS

GEOTECHNICAL ENGINEERS, ENVIRONMENTAL CONSULTANTS

Castle Baro, White Lodge, Wilmslow, Northampton, NN6 7PY.
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Project

Proposed redevelopment at
35 Back Piccadilly, Manchester

Title

Site Location Plan

scale

NTS

date

04.01.06

drawn by

SD

checked by

project ref

STB0620D

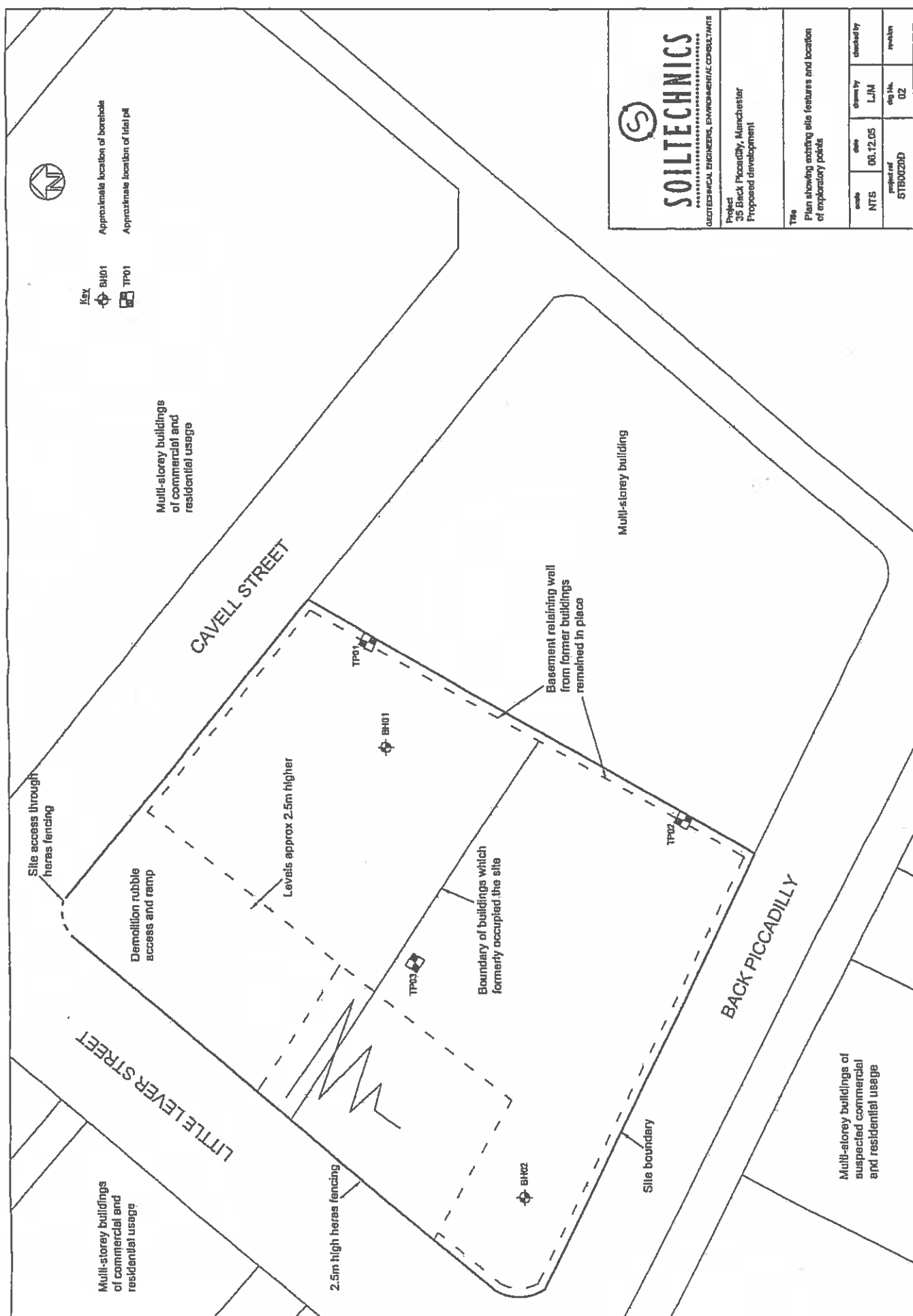
drw no

01

revision

DRAWING STB0620D-02

**Plan showing existing site features and location of
exploratory points**



SOLITECHNICS

IDENTIFYING ENVIRONMENTAL CONSTRAINTS

Project
35 Back Picoality, Manchester
Proposed development

type

Plan showing existing site features and location of exploratory points

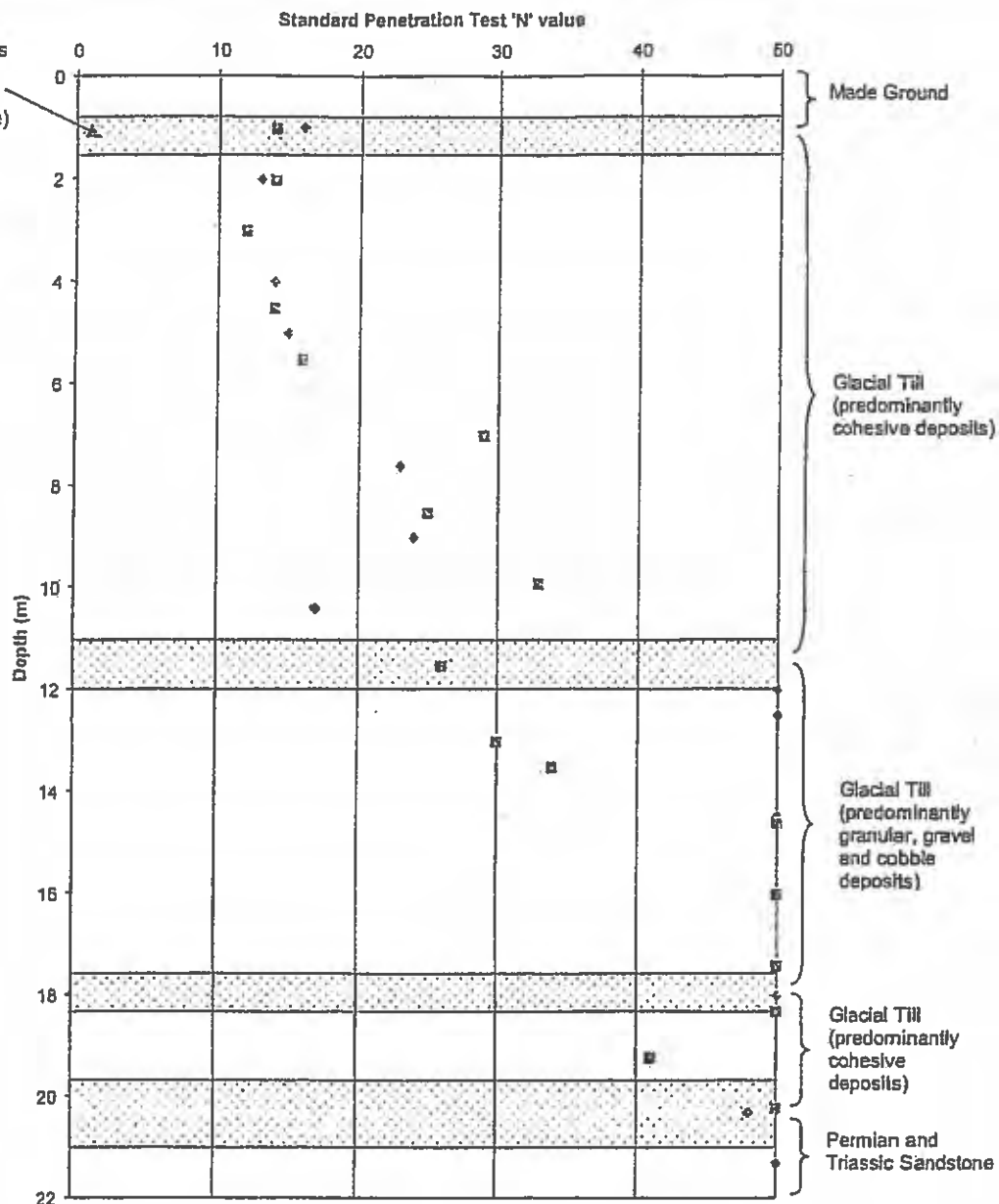
scale	date	drawn by	checked by
NTS	08.12.05	LJM	

DRAWING STB0620D-03

Graphical summary of Standard Penetration Testing

Geological interface
The blue and red lines
indicate the interface
encountered within
boreholes BH01 (blue)
and BH02 (red).

◆ BH01
■ BH02



Notes

1. All SPT 'N' values recorded at or above 50 blows are indicated here as 50. Precise measures, indicating SPT value and associated penetration depth (if less than 300mm) is indicated on borehole logs (ref Appendix D).
2. The depths (m) indicated on the y-axis are all measured from below the existing basement level.



SOILTECHNICS

GEOTECHNICAL ENGINEERS, ENVIRONMENTAL CONSULTANTS

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Project

Proposed development
35 Back Piccadilly, Manchester

Title

Graphical summary of
Standard Penetration Testing

scale

NTS

date

06.12.05

drawn by

SD

checked by

project ref

STB0620D

drg no

03

revision

APPENDIX A1

Definitions of geotechnical terms used in this report.

APPENDIX A1

Definition of geotechnical terms used in this report. (Sheet 1 of 2)

Bearing pressures.

Ultimate bearing capacity. The value of the gross loading intensity for a particular foundation at which the resistance of the soil to displacement of the foundation is fully mobilised.

Presumed bearing value. The net loading intensity considered appropriate to the particular type of ground for preliminary design purposes. The particular value is based on calculation from shear strength tests or other field tests incorporating a factor of safety against shear failure.

Allowable bearing pressure. The maximum allowable net loading intensity at the base of the foundation, taking into account the ultimate bearing capacity, the amount and kind of settlement expected and our estimate of ability of the structure to accommodate this settlement.

Factor of safety. The ratio of the ultimate bearing capacity to the intensity of the applied bearing pressure or the ratio of the ultimate load to the applied load.

Foundations

Strip foundations. A foundation providing a continuous longitudinal ground bearing.

Trench fill concrete foundation. A trench filled with mass concrete providing a continuous longitudinal ground bearing.

Pad foundation. An isolated foundation to spread a concentrated load.

Raft foundation. A foundation continuous in two directions, usually covering an area equal to or greater than the base area of the structure.

Substructure. That part of any structure (including building, road, runway or earthwork) which is below natural or artificial ground level. In a bridge this includes piers and abutments (and wing walls), whether below ground level or not, which support the superstructure.

Piled foundations and end bearing piles. A pile driven or formed in the ground for transmitting the weight of a structure to the soil by the resistance developed at the pile point or base and the friction along its surface. If the pile supports the load mainly by the resistance developed at its point or base, it is referred to as an end-bearing pile; if mainly by friction along its surface, as a friction pile.

Bored cast in place pile. A pile formed with or without a casing by excavating or boring a hole in the ground and subsequently filling it with plain or reinforced concrete.

Driven pile. A pile driven into the ground by the blows of a hammer or a vibrator.

Precast pile. A reinforced or prestressed concrete pile cast before driving.

APPENDIX A1

Definition of geotechnical terms used in this report. (Sheet 2 of 2)

Driven cast in place pile. A pile installed by driving a permanent or temporary casing, and filling the hole so formed with plain or reinforced concrete.

Displacement piles. Piles formed by displacement of the soil or ground through which they are driven.

Skin friction. The frictional resistance of the surrounding soil on the surface of cofferdam or caisson walls, and pile shafts.

Downdrag or negative skin friction. A downwards frictional force applied to the shaft of a pile caused by the consolidation of compressible strata, e.g. under recently placed fill. Downdrag has the effect of adding load to the pile and reducing the factor of safety.

Road Pavements.

The following definitions are based on Transport and Road Research Laboratory (TRRL) Report LR1132.

Equilibrium CBR values. A prediction of the CBR value, which will be attained under the completed pavement.

Thin pavement. A thin pavement (which includes both bound and unbound pavement construction materials 1 in 300mm thick and a thick pavement is 1200mm thick (typical of motorway construction).

APPENDIX A2

Definitions of geo-environmental terms used in this report.

APPENDIX A2

Definition of geo-environmental terms used in this report (Sheet 1 of 2)

Conceptual model

Textual and/or schematic hypothesis of the nature and sources of contamination, potential migration pathways (including description of the ground and groundwater) and potential receptors, developed on the basis of the information obtained from the investigatory process.

Contamination

Presence of a substance which is in, on or under land, and which has the potential to cause harm or to cause pollution of controlled water.

Controlled water

Inland freshwater (any lake, pond or watercourse above the freshwater limit), water contained in underground strata and any coastal water between the limit of highest tide or the freshwater line to the three mile limit of territorial waters.

Harm

Adverse effect on the health of living organisms, or other interference with ecological systems of which they form part, and, in the case of humans, including property.

Pathway

Mechanism or route by which a contaminant comes into contact with, or otherwise affects, a receptor.

Receptor

Persons, living organisms, ecological systems, controlled waters, atmosphere, structures and utilities that could be adversely affected by the contaminant(s).

Risk

Probability of the occurrence of, and magnitude of the consequences of, an unwanted adverse effect on a receptor.

Risk Assessment

Process of establishing, to the extent possible, the existence, nature and significance of risk.

APPENDIX A2

Definition of geo-environmental terms used in this report (Sheet 2 of 2)

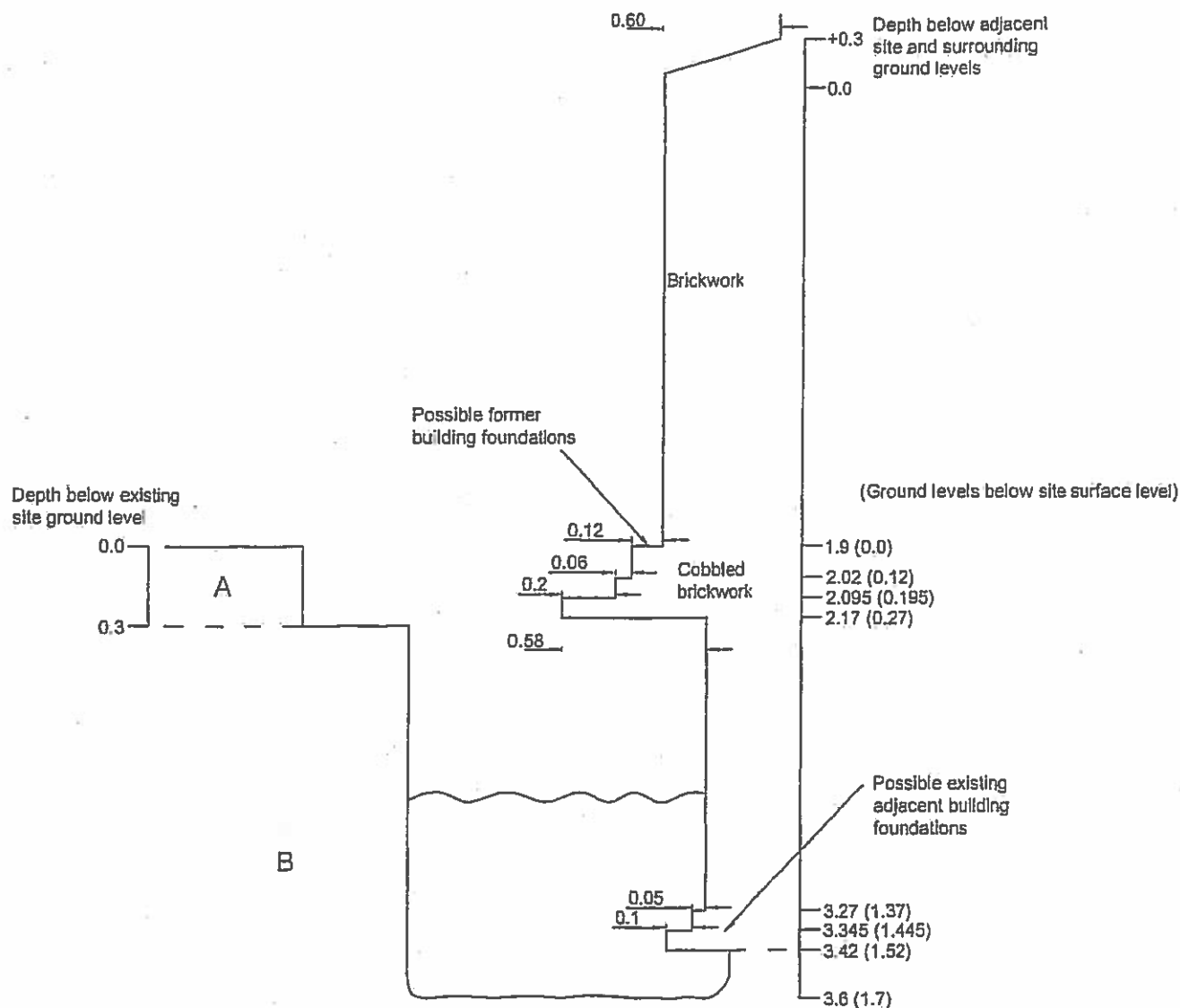
Risk Terminology

In accordance with Department of the Environment guidance, the following categorisation of risk has been developed:

<u>Term</u>	<u>Description</u>
Very high risk	There is a <i>high probability</i> that <i>severe harm</i> could arise to a designated receptor from an identified hazard at the site without appropriate remedial action.
High risk	<i>Harm is likely to arise</i> to a designated receptor from an identified hazard at the site without appropriate remedial action.
Medium risk	<i>It is possible</i> that without appropriate remedial action <i>harm could arise</i> to a designated receptor. It is relatively <i>unlikely</i> that any such harm would be <i>severe</i> , and if any harm were to occur it is <i>more likely</i> that such harm would be <i>relatively mild</i> .
Low risk	<i>It is possible</i> that <i>harm could arise</i> to a designated receptor from an identified hazard. <i>It is likely</i> that, at worst if any harm was realised any effects would be <i>mild</i> .
Negligible risk	The presence of an identified hazard does not give rise to the potential to cause harm to a designated receptor.

APPENDIX B

Trial pit records



Key

- A Loose and medium dense brown and dark grey very clayey gravelly SAND with many cobbles. Gravel and cobbles consist of brick, concrete and clinker. (MADE GROUND)
- B Stiff red brown and grey sandy CLAY. (GLACIAL TILL)

Notes

- 1.) Water standing at 0.75m below existing basement ground level.
- 2.) All measurements shown in metres
- 3.) Trial pit excavated using hand tools
- 4.) Pocket penetrometer testing undertaken:
0.4m - 2.0/2.75/2.5
1.0m - 3.0/3.0/3.25
- 5.) Disturbed samples taken at 0.1m and 0.3m



SOILTECHNICS

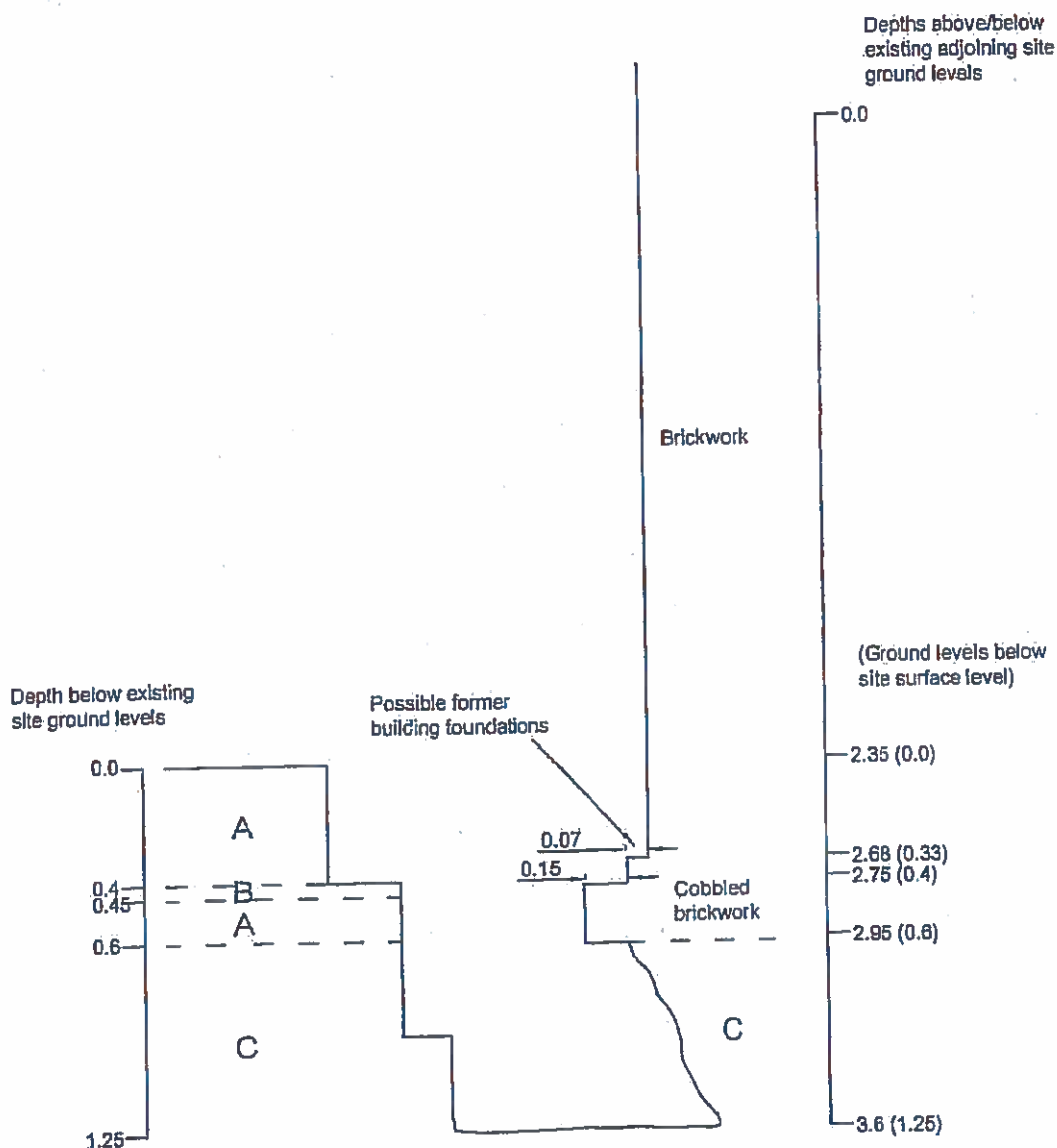
GEOTECHNICAL ENGINEERS, ENVIRONMENTAL CONSULTANTS

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Project
Proposed development
35 Back Picadilly, Manchester

Title
Cross section through Trial Pit TP01

scale	date	drawn by	checked by
NTS	11.11.05	LJM	
project ref	drg No.	revision	
STB0620D	TP01		



Key

- A Loose grey brown clayey very gravelly SAND with many cobbles of brick and concrete. Gravel consists of brick, concrete and ceramic. (MADE GROUND)
- B Dense grey CONCRETE. (MADE GROUND)
- C Stiff becoming very stiff brown and grey CLAY. (GLACIAL TILL)

Notes

- 1.) No groundwater encountered in trial pit
- 2.) All measurements shown in metres
- 3.) Trial pit excavated using hand tools
- 4.) Pocket penetrometer testing undertaken:
0.6m - 2.0/2.5/2.5
1.0m - 3.5/3.25/3.25
- 5.) Disturbed samples taken at 0.1m and 0.9m



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Project

Proposed development
35 Back Piccadilly, Manchester

Title

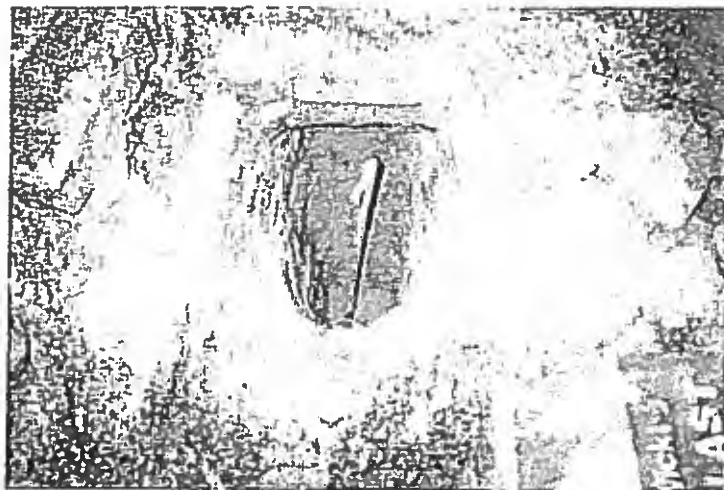
Cross section through Trial Pit TP02

scale	date	drawn by	checked by
NTS	11.11.05	LJM	
project ref		drg No.	revision
STB0620D		TP02	

APPENDIX C

Photographic record of trial pit excavations

Trial pit TP01



Trial pit TP02



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Project

**Proposed Residential Development
35 Back Piccadilly, Manchester**

Title

**Photographic Record of hand dug trial pits TP01
and TP02.**

scale	date	drawn by	checked by
NA	06.12.05	SD	
project ref		appendix	revision
STB0620D		C	

APPENDIX D

Borehole records (cable and tool percussion drilling)

CASING DEPTH (m)	WATER (m)	STRATA DESCRIPTION	LEGEND	DEPTH (m)	TEST RESULTS		SAMPLING		
					TYPE AND DEPTH	RESULT	FROM (m)	TO (m)	TYPE
1.0		Firm dark brown slightly sandy gravelly CLAY with occasional cobbles of brick. Gravel consists of brick, flint and quartz. (MADE GROUND)		0.0			0.0	0.7	B
		Firm dark brown sandy slightly gravelly CLAY. Gravel consists of brick. (MADE GROUND)		0.7	SPT	(4) 16	1.0	1.5	B
				1.45	1.0-1.45m		1.45		J
2.0		Firm dark brown sandy CLAY. (GLACIAL TILL)			SPT	(4) 13			J
					2.0-2.45m		2.45		J
							3.0	3.4	U100
4.0					SPT	(4) 14			J
					4.0-4.45m		4.45		J
							4.5	5.0	B
5.0					SPT	(4) 15			J
					5.0-5.45m		5.45		J

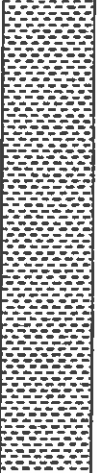
DRILLING			GROUNDWATER					
TYPE (DIAMETER)	FROM	TO	DEPTH STRUCK	BEHAVIOUR	DEPTH SEALED	DATE	DEPTH OF CASING	
	0.0m	21.0m	0.4m 9.5m 18.0m 21.0m	Standing at 0.4m Rising to 8.6m in 10 minutes Rising to 17.2m in 10 minutes Rising to 15.0m in 10 minutes	1.0m 13.0m 18.4m			

REFER TO KEY AT BEGINNING OF THIS APPENDIX FOR EXPLANATION OF SYMBOLS

BOREHOLE RECORD SHEET 1 OF 4

 SOILTECHNICS GEOTECHNICAL ENGINEERS, ENVIRONMENTAL CONSULTANTS Cedar Barn, White Lodge, Walgrave, Northampton, NN6 9PY. Tel: (01604) 781877 Fax: (01604) 781007 E-mail: mail@soiltechnics.net	GROUND LEVEL	CO-ORDINATES
	LOCATION PLAN ON DRAWING No STB0620D-02	DATE OF EXCAVATION 24.10.05
	PROJECT 35 Back Piccadilly, Manchester Proposed development	
	PROJECT REF. STB0620D	BOREHOLE No BH01

CASING DEPTH (m)	WATER (m)	STRATA DESCRIPTION	LEGEND	DEPTH (m)	TEST RESULTS		SAMPLING			
					TYPE AND DEPTH	RESULT	FROM (m)	TO (m)	TYPE	
7.6		Firm becoming stiff dark brown sandy CLAY. (GLACIAL TILL)		6.8						
					SPT 7.6-8.05m	(7) 23	7.6	8.1	B	
							8.1	8.4	B	
9.0						SPT 9.0-9.45m	(4) 24	9.0	9.5	B
								9.6	J	
		Medium dense dark brown mottled light brown gravelly SAND with occasional cobbles of flint. Gravel consists of flint and quartz. (GLACIAL TILL)		9.5						
10.4					10.0					
		Medium dense light brown very gravelly SAND with occasional cobbles of flint. Gravel consists of flint and quartz. (GLACIAL TILL)			SPT 10.4-10.85m	(6) 17	10.4	10.9	B	
								11.0	J	
		Very dense dark brown mottled light brown GRAVEL AND COBBLES of flint and quartz. (GLACIAL TILL)		12.0						
12.0										
					12.0	SPT 12.0m	80 for 150mm penetration			
		Very dense dark brown clayey sandy GRAVEL with occasional cobbles of flint and quartz. Gravel consists of flint and quartz. (GLACIAL TILL)								
12.5					12.5	SPT 12.5-12.95m	(17) 64	12.5	13.0	B
DRILLING		GROUNDWATER								
TYPE (DIAMETER)	FROM	TO	DEPTH STRUCK	BEHAVIOUR	DEPTH SEALED	DATE	DEPTH OF CASING			
	0.0m	21.0m	0.4m 9.5m 18.0m 21.0m	Standing at 0.4m Rising to 8.5m in 10 minutes Rising to 17.2m in 10 minutes Rising to 18.0m in 10 minutes	1.0m 13.0m 18.4m					
REFER TO KEY AT BEGINNING OF THIS APPENDIX FOR EXPLANATION OF SYMBOLS										
BOREHOLE RECORD SHEET 2 OF 4										
 SOILTECHNICS GEOTECHNICAL ENGINEERS, ENVIRONMENTAL CONSULTANTS Cedar Barn, White Lodge, Walgrave, Northampton. NN8 8PY. Tel: (01604) 781877 Fax: (01604) 781007 E-mail: mail@soiltechnics.net				GROUND LEVEL		CO-ORDINATES				
				LOCATION PLAN ON DRAWING No STB0620D-02		DATE OF EXCAVATION 24.10.05				
				PROJECT 35 Back Piccadilly, Manchester Proposed development						
				PROJECT REF. STB0620D		BOREHOLE No BH01				

CASING DEPTH (m)	WATER (m)	STRATA DESCRIPTION	LEGEND	DEPTH (m)	TEST RESULTS		SAMPLING		
					TYPE AND DEPTH	RESULT	FROM (m)	TO (m)	TYPE
				13.6	SPT	(16) 85	14.0	14.5	B
				14.6					
		Very dense dark brown mottled light brown GRAVEL and COBBLES of flint and quartz. (GLACIAL TILL)		15.4			15.4	15.9	B
		Very dense dark brown mottled brown slightly sandy GRAVEL with occasional cobbles of flint. Gravel consists of flint and quartz. (GLACIAL TILL)		17.6			17.0	17.5	B
		Very stiff dark brown slightly sandy CLAY with occasional cobbles of flint. (GLACIAL TILL)			SPT @ 18.0m	50 for 75mm penetration	19.0	19.5	B
					SPT @ 20.3-20.75m	(13) 48	20.3	20.8	B

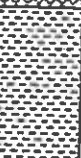
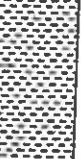
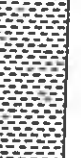
DRILLING			GROUNDWATER				
TYPE (DIAMETER)	FROM	TO	DEPTH STRUCK	BEHAVIOUR	DEPTH SEALED	DATE	DEPTH OF CASING
	0.0m	21.0m	0.4m 9.5m 18.0m	Standing at 0.4m Rising to 8.5m in 10 minutes Rising to 17.2m in 10 minutes Rising to 15.0m in 10 minutes	1.0m 13.0m 18.4m		

REFER TO KEY AT BEGINNING OF THIS APPENDIX FOR EXPLANATION OF SYMBOLS

BOREHOLE RECORD SHEET 3 OF 4

 SOILTECHNICS GEOTECHNICAL ENGINEERS, ENVIRONMENTAL CONSULTANTS Cedar Barn, White Lodge, Walgrave, Northampton. NN6 9PY. Tel: (01604) 781877 Fax: (01604) 781007 E-mail: mail@soiltechnics.net	GROUND LEVEL		CO-ORDINATES	
	LOCATION PLAN ON DRAWING No STB0620D-02		DATE OF EXCAVATION 24-25.10.05	
	PROJECT 35 Back Piccadilly, Manchester Proposed development			
	PROJECT REF. STB0620D		BOREHOLE No BH01	

CASING DEPTH (m)	WATER (m)	STRATA DESCRIPTION	LEGEND	DEPTH (m)	TEST RESULTS		SAMPLING		
					TYPE AND DEPTH	RESULT	FROM (m)	TO (m)	TYPE
				21.0					
		Red SANDSTONE. (PERMIAN AND TRIASSIC SANDSTONE)		21.3m	SPT @ 21.3m	(30) 50 for 150mm penetration	21.3		J
		BOREHOLE TERMINATED AT 21.7m		21.7					
		Notes 1.) Chiselling from 12.0-12.5m and 14.5- 15.0m for a total of 2 hours.							
DRILLING		GROUNDWATER							
TYPE (DIAMETER)	FROM	TO	DEPTH STRUCK	BEHAVIOUR	DEPTH SEALED	DATE	DEPTH OF CASING		
	0.0m	21.0m	0.4m 9.5m 16.0m 21.0m	Standing at 0.4m Rising to 6.9m in 10 minutes Rising to 17.2m in 10 minutes Rising to 18.4m in 10 minutes	1.0m 13.0m 18.4m				
REFER TO KEY AT BEGINNING OF THIS APPENDIX FOR EXPLANATION OF SYMBOLS									
BOREHOLE RECORD SHEET 4 OF 4									
 SOILTECHNICS GEOTECHNICAL ENGINEERS, ENVIRONMENTAL CONSULTANTS Cedar Barn, White Lodge, Walgrave, Northampton. NN8 9PY. Tel: (01604) 781877 Fax: (01604) 781007 E-mail: mail@soiltechnics.net				GROUND LEVEL		CO-ORDINATES			
				LOCATION PLAN ON DRAWING No STB0620D-02		DATE OF EXCAVATION 24-25.10.05			
				PROJECT 35 Back Piccadilly, Manchester Proposed development					
				PROJECT REF. STB0620D		BOREHOLE No BH01			

CASING DEPTH (m)	WATER (m)	STRATA DESCRIPTION	LEGEND	DEPTH (m)	TEST RESULTS		SAMPLING		
					TYPE AND DEPTH	RESULT	FROM (m)	TO (m)	TYPE
1.0		Firm dark brown slightly sandy gravelly CLAY with occasional cobbles of brick. Gravel consists of brick, flint and quartz. (MADE GROUND)		0.0			0.0	0.7	B
				0.7	SPT 1.0-1.45m	(4) 14	1.45		J
2.0		Firm becoming stiff dark brown slightly sandy CLAY. (GLACIAL TILL)					1.5	2.0	B
					SPT 2.0-2.45m	(4) 14	2.0	2.5	B
3.0									
					SPT 3.0-3.45m	(3) 12	3.0	3.5	B
4.5							3.45		J
					SPT 4.5-4.95m	(3) 14	4.5		J
5.5									
					SPT 5.5-5.95m	(5) 18	5.5		J

DRILLING			GROUNDWATER					
TYPE (DIAMETER)	FROM	TO	DEPTH STRUCK	BEHAVIOUR	DEPTH SEALED	DATE	DEPTH OF CASING	
	0.0m	20.5m	11.0m 19.0m	Rising to 10.4m in 10 minutes Rising to 15.0m in 10 minutes	13.5m			

REFER TO KEY AT BEGINNING OF THIS APPENDIX FOR EXPLANATION OF SYMBOLS

BOREHOLE RECORD SHEET 1 OF 4

 SOILTECHNICS GEOTECHNICAL ENGINEERS, ENVIRONMENTAL CONSULTANTS Cedar Barn, White Lodge, Walgrave, Northampton, NN6 9PY. Tel: (01604) 781877 Fax: (01604) 781007 E-mail: mail@soiltechnics.net	GROUND LEVEL	CO-ORDINATES
	LOCATION PLAN ON DRAWING No STB620D-02	DATE OF EXCAVATION 25-26.10.05
	PROJECT 35 Back Piccadilly, Manchester Proposed development	
	PROJECT REF. STB620D	BOREHOLE No BH02

CASING DEPTH (m)	WATER (m)	STRATA DESCRIPTION	LEGEND	DEPTH (m)	TEST RESULTS		SAMPLING		
					TYPE AND DEPTH	RESULT	FROM (m)	TO (m)	TYPE
7.0		Firm becoming stiff dark brown slightly sandy CLAY. (GLACIAL TILL)			SPT 7.0-7.45m	(6) 29	7.0	7.5	B
							7.45		J
8.5					SPT 8.5-8.95m	(4) 25		8.95	J
9.9		Stiff brown slightly sandy slightly gravelly CLAY with occasional cobbles. Occasional of flint and quartz. (GLACIAL TILL)		9.6	SPT @ 9.9-10.35m	(8) 33	9.9	10.4	B
11.5		Medium dense brown very sandy GRAVEL with occasional flint cobbles. Gravel consists of flint and quartz. (GLACIAL TILL)		11.0	SPT 11.5-11.95m	(6) 26	11.5	12.0	B
13.0					SPT 13.0-13.45m	(6) 30	13.0	13.5	B

DRILLING			GROUNDWATER				
TYPE (DIAMETER)	FROM	TO	DEPTH STRUCK	BEHAVIOUR	DEPTH SEALED	DATE	DEPTH OF CASING
	0.0m	20.5m	11.0m 19.0m	Rising to 10.4m in 10 minutes Rising to 15.0m in 10 minutes	13.5m		

REFER TO KEY AT BEGINNING OF THIS APPENDIX FOR EXPLANATION OF SYMBOLS

BOREHOLE RECORD SHEET 2 OF 4

 SOILTECHNICS GEOTECHNICAL ENGINEERS, ENVIRONMENTAL CONSULTANTS Cedar Barn, White Lodge, Welgrave, Northampton. NN8 9PY. Tel: (01804) 781877 Fax: (01804) 781007 E-mail: mail@soiltechnics.net	GROUND LEVEL	CO-ORDINATES
	LOCATION PLAN ON DRAWING No STB620D-02	DATE OF EXCAVATION 26.10.05
	PROJECT 35 Back Piccadilly, Manchester Proposed development	
	PROJECT REF. STB620D	BOREHOLE No BH02

CASING DEPTH (m)	WATER (m)	STRATA DESCRIPTION	LEGEND	DEPTH (m)	TEST RESULTS		SAMPLING		
					TYPE AND DEPTH	RESULT	FROM (m)	TO (m)	TYPE
13.5		Stiff dark brown slightly sandy CLAY with occasional cobbles of flint. (GLACIAL TILL)		13.5	SPT @ 13.5-13.95m	(10) 34	13.5	14.0	B
14.6		Very dense light brown mottled yellow brown very sandy GRAVEL with some cobbles of flint. (GLACIAL TILL)		14.6	SPT @ 14.6m	(51) 50 for 150mm penetration	14.6	15.1	B
16.0					SPT @ 16.0-16.45m	(16) 59	16.0	16.5	B
17.4		Very stiff dark brown sandy CLAY with occasional cobbles of flint. (GLACIAL TILL)			SPT @ 17.4-17.85m	(12) 58	17.4	17.9	B
18.3		Dense brown and pink-brown SAND and GRAVEL with cobbles of flint and quartz. (GLACIAL TILL)		18.3	SPT @ 18.3-18.75m	(10) 54	18.3	18.8	B
19.2		Weak red brown poorly cemented highly friable SANDSTONE.		19.0	SPT @ 19.2-19.65m	(7) 41	19.2	19.7	
20.2		(PERMIAN AND TRIASSIC SANDSTONE)		19.7	SPT @ 20.2-20.65m	(50)	19.7		J
DRILLING		GROUNDWATER							
TYPE (DIAMETER)	FROM	TO	DEPTH STRUCK	BEHAVIOUR	DEPTH SEALED	DATE	DEPTH OF CASING		
	0.0m	20.5m	11.0m 19.0m	Rising to 10.4m in 10 minutes Rising to 15.0m in 10 minutes	13.5m				
REFER TO KEY AT BEGINNING OF THIS APPENDIX FOR EXPLANATION OF SYMBOLS									
BOREHOLE RECORD SHEET 3 OF 4									
 SOILTECHNICS GEOTECHNICAL ENGINEERS, ENVIRONMENTAL CONSULTANTS Cedar Barn, White Lodge, Walgrave, Northampton. NN6 9PY. Tel: (01804) 781877 Fax: (01804) 781007 E-mail: mail@soiltechnics.net					GROUND LEVEL		CO-ORDINATES		
					LOCATION PLAN ON DRAWING No STB620D-02		DATE OF EXCAVATION 26.10.05		
					PROJECT 35 Back Piccadilly, Manchester Proposed development				
					PROJECT REF. STB620D		BOREHOLE No BH02		

CASING DEPTH (m)	WATER (m)	STRATA DESCRIPTION	LEGEND	DEPTH (m)	TEST RESULTS		SAMPLING		
					TYPE AND DEPTH	RESULT	FROM (m)	TO (m)	TYPE
		Weak red brown poorly cemented highly friable SANDSTONE. (PERMIAN AND TRIASSIC SANDSTONE) BOREHOLE TERMINATED AT 20.5m Notes 1.) Chiselling from 9.6-9.9m, 14.1-14.3m, 14.7-15.0m, 16.5-16.9m and 20.2-20.5m for a total time of 3 hours 15 minutes. 2.) Water added to assist drilling at 14.6-18.3m		20.5			20.5		J
DRILLING		GROUNDWATER							
TYPE (DIAMETER)	FROM	TO	DEPTH STRUCK	BEHAVIOUR	DEPTH SEALED		DATE	DEPTH OF CASING	
	0.0m	20.5m	11.0m 19.0m	Rising to 10.4m in 10 minutes Rising to 15.0m in 10 minutes	13.5m				
REFER TO KEY AT BEGINNING OF THIS APPENDIX FOR EXPLANATION OF SYMBOLS									
BOREHOLE RECORD SHEET 4 OF 4									
 SOILTECHNICS GEOTECHNICAL ENGINEERS, ENVIRONMENTAL CONSULTANTS Cedar Barn, White Lodge, Welgrave, Northampton. NN6 9PY. Tel: (01804) 781877 Fax: (01804) 781007 E-mail: mail@soiltechnics.net					GROUND LEVEL		CO-ORDINATES		
					LOCATION PLAN ON DRAWING No STB620D-02		DATE OF EXCAVATION 26.10.05		
					PROJECT 35 Back Piccadilly, Manchester Proposed development				
					PROJECT REF. STB620D		BOREHOLE No BH02		

APPENDIX E

Copies of laboratory test result certificates – classification testing

APPENDIX F

Copies of laboratory results certificates – concentrations of chemical contaminants



ALcontrol Technichem

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Langley,
Slough SL3 8XP
tel: 01753 212500
fax: 01753 212501
email: langley@alcontrol.co.uk

Page 1 of 19

Brian Thomson
Soiltechnics
Cedar Barn
White Lodge
Walgrave
Northampton
NN6 9PY

24 November 2005

TEST REPORT

Our Report Number: 05-08849

Your Order Reference: 5386

10 soil samples submitted for analysis on 31/10/2005

Project Name: 35 Back Picadilly, Manchester

Project Code: STB0620D

Laboratory analysis started on 31/10/2005

All laboratory analysis completed by 24 November 2005

Rexona Rahman
Analytical Reporting Manager
ALCONTROL TECHNICHEM

Leigh Barker
Project Co-ordinator
ALCONTROL TECHNICHEM

Test methods are documented in house procedures or where appropriate standard methods. Non accredited tests (if applicable) are identified on each page. Procedures for sampling are outside the scope of the laboratory UKAS accreditation. Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation. All samples connected with this report, including any 'on hold', will be stored and disposed of according to company policy. A copy of this policy is available on request.



1141

Matrix: Soil
Project Name: 35 Back Picadilly, Manchester

Matrix: Soil
Project Name: 35 Back Picadilly, Manchester

Matrix: Soil
Project Name: 35 Back Picadilly, Manchester

ALcontrol Technichem Table Of Results

Project Name: 35 Back Picadilly, Manchester
Client : Soiltechnics

Job Number : 05-08849
Matrix : Soil
Project Code: STB0620D

Sample Reference	TP01	TP02	TP02	TP03	BH01	BH01	Method No	Units
Sample Depth (m)	0.1	0.1	0.9	0.3	0.7	4.0		
Date Sampled	24/10/05	24/10/05	24/10/05	24/10/05	24/10/05	24/10/05		
Date Scheduled	31/10/05	31/10/05	31/10/05	31/10/05	31/10/05	31/10/05		
Laboratory Reference No	105151	105152	105153	105154	105155	105156		
Analysis								
Moisture Content (Dry Weight)	28.8	28.3	17.7	26.9	29.3	22.1		%
Moisture Content (Wet Weight)	22.4	22.0	15.1	21.2	22.6	18.1		%
Arsenic	16	31	6.5	38	14	6.5	069 TM	mg/kg
Beryllium	1.8	2.1	1.6	2.3	2.1	1.4	069 TM	mg/kg
Cadmium	1.9	2.4	1.6	2.7	5.2	2.5	069 TM	mg/kg
Chromium	30	46	34	27	43	28	069 TM	mg/kg
Lead	550	890	25	1000	450	33	069 TM	mg/kg
Mercury	0.6	1.3	<0.3	1.9	0.6	<0.3	069 TM	mg/kg
Nickel	32	31	34	31	59	32	069 TM	mg/kg
Selenium	1.9	2.5	3.3	1.5	4.7	2.8	069 TM	mg/kg
W/S Sulphate as SO4	1.6	1.6	0.12	1.6	0.58	0.17	074 TM	g/l
Vanadium	38	38	33	40	57	29	069 TM	mg/kg
Free Cyanide	<5	<5	<5	<5	<5	<5	061 ^T	mg/kg
Complex Cyanide	<5	<5	<5	<5	<5	<5	061 TM	mg/kg
Total Cyanide	<5	<5	<5	<5	<5	<5	061 TM	mg/kg
Organic Matter	2.6	2.7	0.84	4.8	2.3	1.6	026 ^T	%
pH	8.0	8.0	8.2	8.3	8.1	8.3	009 TM	pH Units
Elemental Sulphur	<100	<100	<100	<100	<100	<100	032 TM	mg/kg
PCB SUITE								
PCB Congener 28	<0.03	-	<0.03	-	-	-	039S ^T	mg/kg
PCB Congener 52	<0.02	-	<0.02	-	-	-	039S ^T	mg/kg
PCB Congener 101	<0.03	-	<0.03	-	-	-	039S TM	mg/kg
PCB Congener 118	<0.035	-	<0.035	-	-	-	039S TM	mg/kg
PCB Congener 138	<0.05	-	<0.05	-	-	-	039S TM	mg/kg
PCB Congener 153	<0.035	-	<0.035	-	-	-	039S TM	mg/kg
PCB Congener 180	<0.055	-	<0.055	-	-	-	039S TM	mg/kg
PCB's (Sum of ICES Congeners)	ND	-	ND	-	-	-	039S ^T	mg/kg

^T Determination is Accredited to ISO 17025

TM Determination is Accredited to MCERTS.

ALcontrol Technichem Table Of Results

Project Name: 35 Back Picadilly, Manchester
Client : Soiltechnics

Job Number : 05-08849
Matrix : Soil
Project Code: STB0620D

Sample Reference	TP01	TP02	TP02	TP03	BH01	BH01	Method No	Date
Sample Depth (m)	0.1	0.1	0.9	0.3	0.7	4.0		
Date Sampled	24/10/05	24/10/05	24/10/05	24/10/05	24/10/05	24/10/05		
Date Scheduled	31/10/05	31/10/05	31/10/05	31/10/05	31/10/05	31/10/05		
Laboratory Reference No	105151	105152	105153	105154	105155	105156		
Analysis								
Perchloroethane	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
Hexachloroethane	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
1,3,5-trichlorobenzene	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
1,2,4-trichlorobenzene	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
1,2,3-trichlorobenzene	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
Hexachlorobutadiene	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
1,2,4,5-tetrachlorobenzene	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
Dichlobenil	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
Pentachlorobenzene	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
Tecnazene	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
Trifluralin	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
alpha-HCH	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
Hexachlorobenzene	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
beta-HCH	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
gamma-HCH (lindane)	<0.1	-	<0.1	-	-	-	076	mg/kg
Quintozene	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
Propyzamide	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
delta-HCH	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
Chlorothalonil	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
Triallate	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
Heptachlor	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
Aldrin	<0.1	-	<0.1	-	-	-	076	mg/kg
Triadimefon	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
Isodrin	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
Pendimethalin	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
Cis-Heptachlor Epoxide	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
gamma-Chlordane (trans)	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg
o,p-ODE	<0.1	-	<0.1	-	-	-	076 ¹	mg/kg

¹ Determination is Accredited to ISO 17025.
² Determination is Accredited to MCERTS.

ALcontrol Technichem Table Of Results

Project Name: 35 Back Picadilly, Manchester
Client : Soiltechnics

Job Number : 05-08849
Matrix : Soil
Project Code: STB0620D

[illegible]

[†] Determination is Accredited to ISO 17025.
^{*} Determination is Accredited to MCERTS.

ALcontrol Technichem Table Of Results

Project Name: 35 Back Picadilly, Manchester
Client : Soiltechnics

Job Number : 05-08849
Matrix : Soil
Project Code: STB0620D

Sample Reference	BH01							Method/No	Units
Sample Depth (m)	10.4								
Date Sampled	24/10/05								
Date Scheduled	31/10/05								
Laboratory Reference No	105157								
Analysis									
									%
Moisture Content (Dry Weight)	17.7								%
Moisture Content (Wet Weight)	15.0							069 TH	mg/kg
Arsenic	2.9							069 TH	mg/kg
Beryllium	0.8							069 TH	mg/kg
Cadmium	0.9							069 TH	mg/kg
Chromium	23							069 TH	mg/kg
Lead	9.7							069 TH	mg/kg
Mercury	< 0.3							069 TH	mg/kg
Nickel	12							069 TH	mg/kg
Selenium	1.6							074 TH	g/l
W/S Sulphate as SO4	0.11							069 TH	mg/kg
Variadium	10							061 ^T	mg/kg
Free Cyanide	<5							061 ^T	mg/kg
Complex Cyanide	<5							061 TH	mg/kg
Total Cyanide	<5							026 ^T	%
Organic Matter	<0.1							009 TH	pH Units
pH	8.2							032 TH	mg/kg
Elemental Sulphur	<100								
PCB SUITE									
PCB Congener 28	-							039S ^T	mg/kg
PCB Congener 52	-							039S ^T	mg/kg
PCB Congener 101	-							039S TH	mg/kg
PCB Congener 118	-							039S TH	mg/kg
PCB Congener 138	-							039S TH	mg/kg
PCB Congener 153	-							039S TH	mg/kg
PCB Congener 180	-							039S TH	mg/kg
PCB's (Sum of ICES Congeners)	-							039S ^T	mg/kg

ALcontrol Technichem Table Of Results

Project Name: 35 Back Picadilly, Manchester
Client : Soiltechnics

Job Number : 05-08849
Matrix : Soil
Project Code: STB0620D

Sample Reference	BH01								
Sample Depth (m)	10.4								
Date Sampled	24/10/05								
Date Scheduled	31/10/05								
Laboratory Reference No	105157								
Analysis Reference									
Pentachloroethane	-							076 ¹	mg/kg
Hexachloroethane	-							076 ¹	mg/kg
1,3,5-trichlorobenzene	-							076 ¹	mg/kg
1,2,4-trichlorobenzene	-							076 ¹	mg/kg
1,2,3-trichlorobenzene	-							076 ¹	mg/kg
Hexachlorobutadiene	-							076 ¹	mg/kg
1,2,4,5-tetrachlorobenzene	-							076 ¹	mg/kg
Dichlobenil	-							076 ¹	mg/kg
Pentachlorobenzene	-							076 ¹	mg/kg
Tecnazene	-							076 ¹	mg/kg
Trifluralin	-							076 ¹	mg/kg
alpha-HCH	-							076 ¹	mg/kg
Hexachlorobenzene	-							076 ¹	mg/kg
beta-HCH	-							076 ¹	mg/kg
gamma-HCH (lindane)	-							076 ¹	mg/kg
Quintozene	-							076 ¹	mg/kg
Propyzamide	-							076 ¹	mg/kg
delta-HCH	-							076 ¹	mg/kg
Chlorothalonil	-							076 ¹	mg/kg
Triallate	-							076 ¹	mg/kg
Heptachlor	-							076 ¹	mg/kg
Aldrin	-							076 ¹	mg/kg
Triadimefon	-							076 ¹	mg/kg
Isodrin	-							076 ¹	mg/kg
Pendimethalin	-							076 ¹	mg/kg
Cis-Heptachlor Epoxide	-							076 ¹	mg/kg
gamma-Chlordane (trans)	-							076 ¹	mg/kg
o,p-DDE	-							076 ¹	mg/kg

¹ Determination is Accredited to ISO 17025.

² Determination is Accredited to MCERTS.

ALcontrol Technichem Table Of Results

Project Name: 35 Back Picadilly, Manchester
Client : Soiltechnics

Job Number : 05-08849
Matrix : Soil
Project Code: STB0620D

[illegible]

[†] Determination is Accredited to ISO 17025.
^h Determination is Accredited to MCERTS.

Project Name: 35 Back Picadilly, Manchester
Client : Solltechnics

Project Name: 35 Back Picadilly, Manchester
Client : Solltechnics

¹ Determination is Accredited to ISO 17025.
² Determination is Accredited to MCERTS.

Project Name: 35 Back Picadilly, Manchester
Client : Soiltechnics

[illegible]

ALcontrol Technichem Table Of Results

Project Name: 35 Back Picadilly, Manchester
Client : Soiltechnics

Job Number : 05-08849
Matrix : Soil
Project Code: STB0620D

Sample Reference	TP01	TP02							
Sample Depth (m)	0.1	0.9							
Date Sampled	24/10/05	24/10/05							
Date Scheduled	31/10/05	31/10/05							
Laboratory Reference No	105151	105153							
Analysis:									
SVOO SUITE									
Naphthalene	540	< 150						053S TM	µg/kg
2-Chloronaphthalene	< 150	< 150						053S TM	µg/kg
Acenaphthylene	610	< 150						053S TM	µg/kg
Acenaphthene	260	< 150						053S TM	µg/kg
Fluorene	710	< 150						053S TM	µg/kg
Phenanthrene	2500	< 150						053S TM	µg/kg
Anthracene	820	< 150						053S TM	µg/kg
Fluoranthene	2500	< 150						053S TM	µg/kg
Pyrene	2600	< 150						053S TM	µg/kg
Benz(a)anthracene	2000	< 150						053S TM	µg/kg
Chrysene	1700	< 150						053S TM	µg/kg
Benzo(b)fluoranthene	2800	< 150						053S TM	µg/kg
Benzo(k)fluoranthene	1400	< 150						053S TM	µg/kg
Benzo(a)pyrene	2300	< 150						053S TM	µg/kg
Dibenzo(a,h)anthracene	510	< 150						053S TM	µg/kg
Indeno(1,2,3-cd)pyrene	1400	< 150						053S TM	µg/kg
Benzo(g,h,i)perylene	1800	< 150						053S TM	µg/kg
Phenol	< 150	< 150						053S TM	µg/kg
2-Chlorophenol	< 150	< 150						053S TM	µg/kg
2-Methylphenol	< 200	< 200						053S TM	µg/kg
4-Methylphenol	< 200	< 200						053S TM	µg/kg
2-Nitrophenol	< 300	< 300						053S TM	µg/kg
2,4-Dimethylphenol	< 250	< 250						053S TM	µg/kg
2,4-Dichlorophenol	< 200	< 200						053S TM	µg/kg
2,6-Dichlorophenol	< 200	< 200						053S TM	µg/kg
4-Chloro-3-methyl phenol	< 150	< 150						053S TM	µg/kg
2,4,6-Trichlorophenol	< 150	< 150						053S TM	µg/kg
2,4,5-Trichlorophenol	< 200	< 200						053S TM	µg/kg
4-Nitrophenol	< 300	< 300						053S TM	µg/kg

¹ Determination is Accredited to ISO 17025.

TM Determination is Accredited to MCERTS.

ALcontrol Technichem Table Of Results

Job Number : 05-08849
Matrix : Soil
Project Code: STB0620D

Project Name: 35 Back Picadilly, Manchester
Client : Soiltechnics

Sample Reference	TP01	TP02					Method	Unit
Sample Depth (m)	0.1	0.9						
Date Sampled	24/10/05	24/10/05						
Date Scheduled	31/10/05	31/10/05						
Laboratory Reference No	105151	105153						
Analysis								
SVOC SUITE Cont:								
2,3,4,6-Tetrachlorophenol	< 250	< 250					053S	µg/kg
Pentachlorophenol	< 250	< 250					053S	µg/kg
Dimethyl Phthalate	< 200	< 200					053S TM	µg/kg
Diethyl Phthalate	< 200	< 200					053S TM	µg/kg
Di-n-butyl phthalate	< 150	< 150					053S TM	µg/kg
Butyl benzyl phthalate	< 150	< 150					053S TM	µg/kg
Bis(2-chloroethyl)ether	< 150	< 150					053S TM	µg/kg
Bis(2-chloroisopropyl)ether	< 200	< 200					053S TM	µg/kg
4-Chlorophenyl phenyl ether	< 150	< 150					053S TM	µg/kg
Bromo phenyl phenyl ether	< 200	< 200					053S TM	µg/kg
1,3-Dichlorobenzene	< 200	< 200					053S TM	µg/kg
1,2-Dichlorobenzene	< 150	< 150					053S TM	µg/kg
1,4-Dichlorobenzene	< 200	< 200					053S TM	µg/kg
Nitrobenzene	< 150	< 150					053S TM	µg/kg
1,2,4-Trichlorobenzene	< 200	< 200					053S TM	µg/kg
2,6-Dinitrotoluene	< 200	< 200					053S TM	µg/kg
2,4-Dinitrotoluene	< 200	< 200					053S TM	µg/kg
Azobenzene	< 200	< 200					053S TM	µg/kg
Hexachlorobenzene	< 200	< 200					053S TM	µg/kg
Hexachloroethane	< 150	< 150					053S TM	µg/kg
n-Nitro-n-propyl-1-propanamine	< 200	< 200					053S TM	µg/kg
Isophorone	< 200	< 200					053S TM	µg/kg
Bis(2-chloroethoxy)methane	< 150	< 150					053S TM	µg/kg
Hexachlorobutadiene	< 150	< 150					053S TM	µg/kg
Anthraquinone	210	< 150					053S TM	µg/kg
Aniline	< 100	< 100					053S ¹	µg/kg

¹ Determination is Accredited to ISO 17025.

TM Determination is Accredited to MCERTS.

Project Name: 35 Back Picadilly, Manchester
Client : Soiltechnics

Project Name: 35 Back Picadilly, Manchester
Client : Soiltechnics

2

ALcontrol Technichem Table Of Results

Project Name: 35 Back Picadilly, Manchester
Client : Soiltechnics

Job Number : 05-08849
Matrix : Soil
Project Code: STB0620D

Sample Reference	TP01	TP02					Method No	Units
Sample Depth (m)	0.1	0.9						
Date Sampled	24/10/05	24/10/05						
Date Scheduled	31/10/05	31/10/05						
Laboratory Reference No	105151	105153						
Analysis								
VOC SUITE Cont								
Dibromochloromethane	< 20	< 20					071S TM	µg/kg
1,2-Dibromoethane	< 20	< 20					071S TM	µg/kg
Tetrachloroethene	< 20	< 20					071S	µg/kg
1,1,1,2-Tetrachloroethane	< 10	< 10					071S	µg/kg
Chlorobenzene	< 20	< 20					071S TM	µg/kg
Ethyl Benzene	< 20	< 20					071S	µg/kg
m,p-Xylenes	< 30	< 30					071S	µg/kg
Bromoform	< 10	< 10					071S TM	µg/kg
Styrene	< 20	< 20					071S TM	µg/kg
o-Xylene	< 20	< 20					071S	µg/kg
1,1,1,2 Tetrachloroethane	< 10	< 10					071S TM	µg/kg
1,2,3-Trichloropropane	< 20	< 20					071S TM	µg/kg
Isopropylbenzene	< 20	< 20					071S TM	µg/kg
Bromobenzene	< 10	< 10					071S TM	µg/kg
n-propylbenzene	< 20	< 20					071S TM	µg/kg
2-Chlorotoluene	< 20	< 20					071S TM	µg/kg
4-Chlorotoluene	< 20	< 20					071S	µg/kg
1,3,5 Trimethylbenzene	< 20	< 20					071S TM	µg/kg
tert-butylbenzene	< 20	< 20					071S TM	µg/kg
1,2,4 Trimethylbenzene	< 20	< 20					071S	µg/kg
sec-butylbenzene	< 20	< 20					071S	µg/kg
1,3 Dichlorobenzene	< 20	< 20					071S	µg/kg
1,4 Dichlorobenzene	< 20	< 20					071S TM	µg/kg
4-Isopropyltoluene	< 20	< 20					071S	µg/kg
1,2 Dichlorobenzene	< 20	< 20					071S	µg/kg
n-butylbenzene	< 20	< 20					071S	µg/kg
1,2,4-Trichlorobenzene	< 20	< 20					071S	µg/kg
1,2-Dibromo-3-Chloropropane	< 20	< 20					071S	µg/kg
Hexachlorobutadiene	< 20	< 20					071S	µg/kg
1,2,3-Trichlorobenzene	< 20	< 20					071S	µg/kg

¹ Determination is Accredited to ISO 17025.
TM Determination is Accredited to MCERTS.

Table Of Results

Client : Soiltechnics

Project Code: STB0620D

[illegible]

² Determination is Accredited to ISO 17025.

^h Determination is Accredited to MCERTS.

ALcontrol Technichem Table Of Results

Job Number : 05-08849
Matrix : Leachate
Project Code: STB0620D

Project Name: 35 Back Picadilly, Manchester
Client : Soiltechnics

[illegible]

¹ Determination is Accredited to ISO 17025.

^H Determination is Accredited to MCERTS.

ALcontrol Technichem

Table Of Results - Appendix

Summary of methods contained within report :

Method No.	Reference	Description	ISO 17025 Accredited	MGERTS Accredited	Wet/Dry Analysis
053S	In-house method	Determination of semi-volatile organic compounds in soil samples by dichloromethane extraction and GC-MS detection	Y	Y	W
022S	In-house method	Determination of PAH compounds in soil samples by hexane / acetone extraction followed by GC-MS detection	Y	Y	W
009	In-house method referencing BS1377: Part 3: 1990 and Second Site Property: Environmental Assessment Guidance Version 3: March 2003	Determination of pH by addition of water followed by electrometric measurement	Y	Y	W
084	In-house method	Determination of pH in aqueous samples by direct electrometric measurement	N	N	W
080	In-house method based on MEWAM "Inductively Coupled Plasma Spectrometry", HMSO, 1996	Determination of metals in aqueous samples by nitric acid digestion followed by Inductively Coupled Plasma - Mass Spectrometry detection (ICP-MS)	N	N	W
076	In-house method	Determination of organochlorine pesticides in soil samples by hexane/acetone extraction followed by GC-MS detection	Y	N	W
071S	In-house method	Determination of volatile organic compounds in soil samples by headspace GC-MS analysis	N	N	W
065	In-house method	Determination of total petroleum hydrocarbons in soil samples using hexane:acetone extraction followed by silica-alumina "clean-up" and GC-FID detection	N	N	W

ALcontrol Technichem

Table Of Results - Appendix

Summary of methods contained within report :

Method No.	Reference	Description	ISO 17025 Accredited	MCERTS Accredited	Wet/Dry Analysis
062	In-house method based on MEWAM "Inductively Coupled Plasma Spectrometry", HMSO, 1996	Determination of metals in aqueous samples by nitric digestion followed by ICP-OES detection	Y	N	W
061	In-house method based on Method 4500-CN, "Standard Methods for the Examination of Water and Waste Water", APHA AWWA WEF, Edition 18, 1992	Determination of cyanides and thiocyanate in aqueous samples by continuous flow colorimetry (Skalar)	Y	N	W
055	In-house method based on MEWAM "Sulphide in Waters and Effluents", HMSO, 1983	Determination of sulphide in aqueous samples by direct colourimetry	Y	N	W
029	In-house method based on MEWAM "Suspended, Settleable and Total Dissolved Solids in Waters and Effluents", HMSO, 1980	Determination of total, settleable and suspended solids in aqueous samples by filtration and gravimetry	N	N	W
028	In-house method	Determination of mercury in aqueous samples by bromine digestion and atomic fluorescence detection	Y	N	W
022L	In-house method	Determination of PAH compounds in aqueous samples by pentane extraction followed by GC-MS detection	Y	N	W
016	In-house method based on MEWAM "Inductively Coupled Plasma Spectrometry", HMSO, 1996	Determination of metals in aqueous samples by nitric digestion followed by ICP-OES detection	Y	N	W
011	In-house method	Determination of anion content in aqueous samples using ion chromatographic determination with electrical conductivity detector	N	N	W

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Table Of Results - Appendix

Summary of methods contained within report :

Method No	Reference	Description	ISO 17025 Accredited	MCERTS Accredited	Wet/Dry Analysis
074	In-house method based on BS1377 Part 3, "Chemical and Electrochemical Tests", 1990	Determination of 2:1 water soluble sulphate in soil samples by Inductively Coupled Plasma - Optical Emission Spectrometry (ICP-OES)	Y	Y	D
069	In-house method based on MEWAM "Methods for the Determination of Metals in Soil", HMSO, 1986	Determination of metals in soil samples by aqua-regia digestion followed by ICP-OES detection	Y	Y	D
032	In-house method	Determination of elemental sulphur (with simultaneous PAH screening) by dichloromethane extraction followed by HPLC-UV detection	Y	Y	D
026	In-house method based on BS1377 Part 3, "Chemical and Electrochemical Tests", 1990	Determination of organic matter in soil samples by oxidation (Walkley & Black method) followed by titration	Y	N	D

Soil results are expressed on a dry weight basis. Where the test uses as-received sample, a moisture correction factor is applied to the wet weight result to convert it. This factor is determined gravimetrically using loss of moisture on drying at 30 (+/-5) degrees C.