Former Lombard Service Station, Bristol

Interpretive Report on Ground Investigation

Project No: 733272

Client: Sandy Lane Construction Ltd.

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STRUCTURAL SOILS LTD

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Author	[redacted]	J Evans MSci MSc FGS
Technical Reviewer		A Watts BSc (Hons) FGS
Approved by		S Pond BSc CChem MRSC
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STRUCTURAL SOILS LIMITED
The Old School
Stillhouse Lane
Bedminster
BRISTOL
BS3 4EB
Tel: 0117 947 1000
Email: ask@soils.co.uk
www.soils.co.uk

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1 INTRODUCTION

This investigation was carried out by Structural Soils Ltd (SSL) on the instructions of and on behalf of Sandy Lane Construction Ltd (the Client) at the site of the Former Lombard Service Station on Brook Road in Southville, Bristol. The purpose of the work was to obtain geoenvironmental information to advance the clearance of anticipated land contamination conditions regarding the demolition of a vehicle garage and the construction of residential dwellings.

The scope of the investigation comprised cable percussion drilling, window sampling, laboratory testing and the preparation of this report. The report contains a description of the site and the works carried out, the exploratory hole logs, in-situ and laboratory testing results.

The ground investigation has been carried out in accordance with the general requirements of BS 5930:2015, BS 10175:2011+A2:2017, BS EN 1997-2 (2007), BS EN ISO 22475-1 (2006) and other relevant standards as identified below.

This report presents the factual records of the fieldwork and laboratory testing together with an interpretation of the findings with respect to the proposed development. The report presents an appraisal of geoenvironmental aspects such as soil contamination and gives recommendations on risk reduction. It should not be assumed that these would meet the requirements of the local authority, whose advice should be sought regarding planning permission.

All information, comments and opinions given in this report are based on the ground conditions encountered during the site work, and on the results of laboratory and field tests performed during the investigation. Whilst every attempt is made to record full details of the strata encountered in the exploratory holes, techniques of hole formation and sampling will inevitably lead to disturbance, mixing or loss of material in some soils and rocks. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata, contaminant concentrations and water conditions between or below exploratory holes.

All information, comments and opinions given in the desk study in this report are based on the information obtained. The information search cannot be exhaustive and there may be records that have not come to light. There may also be circumstances at the site that are not documented.

This report was prepared by SSL for the sole and exclusive use of Sandy Lane Developments Ltd. in response to particular instructions. Any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded. No liability will be accepted after a period of 6 years from the date of the report.

1.1 Information Sources

The following sources of information have been used in the preparation of this report.

- Extracts of available historical Ordnance Survey (OS) maps covering the period from 1886 to 2018 which are presented in Appendix G.
- An Envirocheck report produced by Envirocheck for an area up to 1 km from the centre of the site which is reproduced in Appendix G. The report is compiled from the database of information maintained by various statutory bodies listed within Appendix G.
- The MAGIC website (DEFRA and Environment Agency data)
- British Geological Survey (BGS) website.
- Structural Soils Report 80856 of 1988 – St Johns Road Bedminster
- Services Information Sources.
- Know Your Place Bristol Mapping Service, available at: http://maps.bristol.gov.uk/kyp/?edition

2 SITE DESCRIPTION

2.1 Location and Topography

The site is located on the corner of Brook Road and St Paul's Road in Bedminster, approximately 1.3 km south west of Bristol Temple Meads Railway Station. (see Site Location Map in Appendix A). The British National Grid Reference of the site is ST 586 717. Access to the site is gained via a set of steel gates off Brook Road.

The L-shaped site is approximately 30 m by 20 m in size with its long axis orientated from north to south parallel with St Pauls Road (see Existing Site Layout Plan in Appendix A). The site is occupied by an active vehicle service and repair garage building in the north with an approximately square car sales and parking yard area to the south.

The yard is a former petrol sales forecourt and is surfaced by uneven, cracked concrete slabs with two steel covers at its centre indicating the position of possibly a pair of tanks or possible a single twin compartment tank. The inspection chambers beneath the covers have been filled with a sand and cement slurry. It is certain that the tank(s) remain in-situ and considered very likely that they have been slurry filled as a part of decommissioning. An area of scarred concrete approximately 1 m to the south of the covers indicates the location of a former pump island and potentially the supports for a canopy.

No evidence of vent pipes or a petroleum interceptor was evident on the forecourt.

The garage building comprises a single storey front constructed with multi-tiered concrete floor slabs connected by ramps. Walls are generally constructed from a mixture of brick masonry and concrete blocks, whilst the roof is corrugated metal sheeting over steel trusses. A shallow 0.15 m deep service pit is present at the centre of the garage and straddled by one of a pair of car lifts. Used lubricants were collected and stored within 205 lt steel drums for later disposal, and surface staining of the floor was generally limited.

Some storage of used car parts and material is undertaken within the garage, including small volumes of paints in the form of spray cans, and 25 lt drums of lubricating oils.

The site is located in a residential area with dwellings located immediately to the north, east and west and on the far side of Brook Road to the south. In the wider area the nearest non-residential land use is a construction site and an ASDA superstore located 30m to the east on the far side of St John's Road.

The site is set at an elevation of approximately 8 m above Ordnance Datum (AOD), similar to the surrounding ground in the near vicinity of the site, however to the north ground levels rise at around 5 degrees from the line of Dean Crescent to the line of Lucky Lane 130 m from the site. East of St John's Road, the ground elevation quickly returns to around 8 m in the area of the superstore car park.

Buried electricity, water and overhead telecommunications services were identified to enter the site from the west whilst a buried gas pipe enters the site from the south and runs along the east margin.

2.2 History of Site and Surrounding Area

2.2.1 Historic Mapping

A search of Ordnance Survey maps was undertaken to establish the land-use history of the site and surroundings. Extracts of the maps that are discussed below can be found in Appendix G of this report, except for the pre-1886 mapping and 1946 aerial photography which can be viewed on the Know Your Place website. Unless otherwise stated, all quoted distances are measured from the site boundary that is marked on the maps.

TABLE 1 :SUMMARY OF HISTORICAL MAP DATA

Dates	Scale	Significant features, changes and developments:	
		On site	In surroundings [distance(m)]
1828	Not Given	Undeveloped – part of an open field	*Tan Yard* 75m E
1840	Not Given	No significant changes	No significant changes
1886 – 1896	1:10,560 & 1:2,500	Site occupied by 7 terraced houses with back gardens/yards.	*Timber yard* 100 m NE, *Bedminster Tannery* 50 – 100 m E, *Coal Yard* 100 m SE, *Tannery* 250 m SE, *Bedminster Smelting Works* 300 m SE, *Dean lane Colliery* including 3 shafts 300 m SW. *Tannery* 300 m W. *Malago Vale Iron Works* 500 m S
1903 - 1905	1:10,560 & 1:2,500	No significant changes	*Bedminster Tannery* now *Tobacco Factory*
1918 – 1921	1:10,560 & 1:2,500	No significant changes	*Dean Lane Colliery* now appears closed. *Coal Yard* appears no longer in use. *Timber Yard* appears no longer in use.
1930 – 1938	1:10,560	No significant changes	No significant changes

TABLE 1 :SUMMARY OF HISTORICAL MAP DATA			
Dates	Scale	Significant features, changes and developments:	
		On site	In surroundings [distance(m)]
1946	Aerial Photographs	5 of the 7 houses have been demolished leaving only the two in the SE of the site (No.s 10 and 11 *Brook Road*)	*Builders Yard* immediately NE.
1953 - 1969	1:10,560 & 1:2,500	Current garage building apparently present but unlabelled until 1964 by which time No.11 and 12 have been demolished.	*Oil Tanks* now present 95 m to NE
1972 – 1989	1:10,000 & 1:2,500	No significant changes	*Oil Tanks* no longer shown. Iron works no longer shown. Terrace properties to north and builders yard no longer recorded.
1990 - 1991	1:10,000 & 1:2,500	No significant changes	Factory adjacent to site now *Superstore*. Tannery 75 m from site now redeveloped.
1991 – 2006	1:10,000	No significant changes	Residences to N recorded from 2003.
2018	1:10,000	No significant changes	Petrol Station now present within *Superstore* car park 240 m NE.

Note: N = north, S = south, E = east, W = west.

2.2.2 Planning History

A search of the records available via a search of the Bristol City Council (BCC) online planning search identifies that outline permission was granted for the erection of a petrol filling and service station together with a vehicular access to St John's Square in 1960, with further permission for alternations to (the) existing workshop and lay-out of (the) petrol filling station in 1961.

2.2.3 Site History from Other Sources

Preliminary discussions with the Contaminated Land Officer at BCC indicates that the council suspect that the site may have been subjected to bomb damage in the

Second World War resulting in the missing buildings observed in 1946 aerial photography.

A Petroleum Licensing Search undertaken with BCC, the relevant Petroleum Licensing Authority, has returned no records. The search response is presented in Appendix G. Unfortunately historic data within Bristol is not always complete and some historic records are known to have been lost through damage in storage.

Previous discussions with the former site owners (Ms Kim Marchant) suggested that petrol sales at the site ceased in the late 1980's.

2.2.4 Summary of Site History

Save for the temporary presence of a Builders Yard to the north east of the site for a period post Second World War, the site has been set within a mainly residential area.

Tanneries, timber yards and tobacco factories have been present to the east of the site, on the flat low-lands associated with the now culverted Malago river. Many of these historic industrial sites have been redeveloped.

The site itself may have been subject to bomb damage during the war, with the first garage buildings appearing shortly after. The full forecourt area was associated with the site by the mid-1960s when it is assumed that petrol sales would have commenced, before ceasing in the late 1980s.

3 PHYSICAL SETTING

3.1 Geology

Information on the geology of the site was obtained from the following sources published by the British Geological Survey (BGS):

- BGS map (sheet 264, scale 1:50,000 published 2004).
- The BGS digital geology map, which utilises the most up to date names for geological units (www.bgs.ac.uk/data).
- The BGS Lexicon of Named Rock Units, which provides typical descriptions for most geological units (www.bgs.ac.uk/lexicon).

The site is shown to be underlain by the following descending sequence of strata:

TABLE 2 : SUMMARY OF EXPECTED SITE GEOLOGY	
Geological Unit Name	**Description**
ANTHROPOGENIC GROUND	
Artificial Ground shown	Yes
SUPERFICIAL DEPOSITS	
Alluvium	Clay, Silt and Gravel
SOLID GEOLOGY	
Redcliffe Sandstone Member (Previously called Redcliffe Sandstone Formation)	*'Fine- to medium-grained, deep red, calcareous and ferruginous sandstone'*
Mercia Mudstone Group	*'Dominantly red, less commonly green-grey, mudstones and subordinate siltstones. Sandstone horizons are also present'*

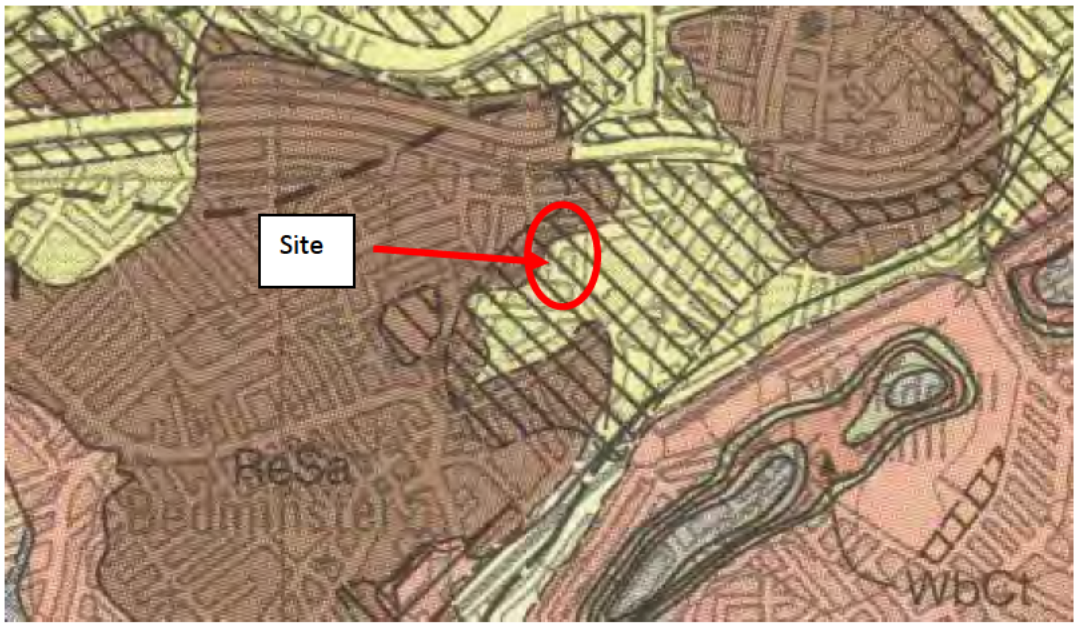
Note: Information obtained from BGS digital records © NERC.

The BGS geological map shows the site to be underlain by Made Ground over superficial Alluvium deposits and then the Redcliffe Sandstone Member of the Mercia Mudstone Group at depth.

Borehole logs from a ground investigation conducted by SSL in 1988 (Ref: 80856) for the construction of housing immediately to the north of the site indicate the Alluvium to be present to a depth between 8.5 m to 9.0 m below ground level, and that there may locally be present a thin basal gravel which could represent a terrace deposit of the River Avon.

The mapped Alluvium below the site is associated with an embayment at the mouth of the channel of the Malago river where it would have joined the former tidal channel of the Avon between the high grounds of Southville/Bedminster and Redcliffe.

The BGS online maps portal provides access to scans of almost all maps produced by the BGS since 1932. An extract of the most recent available scanned map for the site is included below:



Note: Above images contain British Geological Survey materials ©NERC [2018].

3.2 Hydrogeology and Hydrology

3.2.1 Aquifer Designation

The Environment Agency (EA) website (http://apps.environment-agency.gov.uk/wiyby/default.aspx) has classified the geological units underlying the site as follows:

- Alluvium as Unproductive Strata
- Redcliffe Sandstone Formation as a Secondary 'A' Aquifer (variably permeable)

'Unproductive Strata' are rock layers or superficial deposits with low permeability that have negligible significance for water supply or river base flow.

'Secondary' aquifers include a wide range of rock layers or superficial deposits with an equally wide range of water permeability and storage. Secondary 'A' Aquifers are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

3.2.2 Groundwater Vulnerability Zones

Information on the leaching potential of the soils directly under the site is given on the Environment Agency (EA) groundwater vulnerability map - Southern Cotswolds (sheet 37, scale 1:100,000).

The soils on this site have been classified as having a high (urban) leaching potential (HU), as soil information for restored mineral workings and urban areas is based on fewer observations than elsewhere. A worst-case vulnerability (HU) classification is assumed for these areas and for current mineral workings until proved otherwise.

3.2.3 Source Protection Zones

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

3.2.4 Anticipated Groundwater flow / direction

Groundwater beneath the site is expected to be present within the Alluvium and present within 2 m or so of the ground surface. Based on the geological mapping this is expected to be an unconfined aquifer and it is expected to be recharged by precipitation which infiltrates at the site. Groundwater flow within this unit is expected to be dominated by intergranular flow, and is expected to be very slow north-eastwards towards the River Avon which flows east to west through a man-made channel (the New Cut) 200 m north of the site.

The culverted course of the Malago is present 180 m east of the site which flows northwards to empty into the River Avon.

Groundwater movements in the Mercia Mudstone is expected to be very limited, except for within the sandstone units of the Redcliffe Sandstone Member, which are

exposed in the side of the New Cut. Flow in this formation is expected to be towards the north or northwest.

3.3 Ground Gas

3.3.1 Radon

According to the Envirocheck the estimated proportion of homes near the site that are above the radon action level is 1 %. Therefore no radon protection measures are considered necessary in the construction of new buildings (including extensions, conversions and refurbishment projects).

3.3.2 Coal Measures

Coal Measures strata are considered likely to be too deep to pose a plausible risk of ground gas migration to the site.

3.3.3 Made Ground

Made ground present at the site is likely to comprise of building materials associated with the previous buildings at the site and any construction that has subsequently taken place. Should the site have been subjected to bomb damage, there may be ash and other organic material such as timber in the ground, as well as any other material used to subsequently level the site. These may generate methane and carbon dioxide at very low rates as they decay.

3.3.4 Natural Soils

The SSL ground investigation undertaken to the north of the site in 1988 recorded the presence of peat inclusions and layers of peat rich clay within the Alluvium. These deposits can be expected to contain elevated concentrations of methane and carbon dioxide, but actual generation rates for such deposits are low, with the low permeability ground containing historically generated gas.

3.4 Archaeology / Ecology

No archaeological or ecological consultation has been undertaken for this study.

3.5 Utilities

The site and surrounding area are likely to contain underground services; a copy of utility data has been provided by the Client at the time of writing this report:

- Bristol Water
- Wessex Water
- Wales & West Utilities
- Western Power Distribution

- BT Openreach
- Virgin Media

Other utilities not included in this data may be present.

4 ENVIRONMENTAL SETTING

4.1 Environmental Data

Environmental features such as landfills, groundwater abstraction points, etc, are detailed in the Landmark Envirocheck report that can be found in Appendix G of this report. 'Notable' features in these data sets are listed below.

TABLE 3 : SUMMARY OF SIGNIFICANT ENVIRONMENTAL DATA

Data Types Showing Notable Issues	No. of Notable Listings (or Yes/No) and Distance (m) from Site				Details of Notable Listings
	On site	0-250	250-500	>500	
AGENCY AND HYDROLOGICAL					
BGS Flooding Susceptibility	-	Yes	Yes	-	Limited potential for groundwater flooding to occur.
Discharge Consents	-	11	13	31	Nearest: *Asda Superstore*, 71 m to NE.
Local Authority Pollution Prevention and Controls (and enforcements)	-	1	5	10	Nearest: *Johnson Cleaners UK Ltd.*, 148 m to E.
Nearest Surface Waters	-	1	N/A	N/A	*The Malago*, 186 m to SE. (Culverted)
Prosecutions Relating to Authorised Processes	-	-	-	1	*Sheene Road*, (Illegal dumping of waste) - 613 m to S.
Registered Radioactive Substances	-	-	13	-	Nearest: *Bristol General Hospital*, 380 m to NE.
River Quality	-	-	1	1	Nearest: *Floating Harbour* (River Quality B), 487 m to N.
Substantiated Pollution Incidents	-	-	-	1	Category 1 – Major water impact incident, 741 m to S.

TABLE 3 : SUMMARY OF SIGNIFICANT ENVIRONMENTAL DATA					
Data Types Showing Notable Issues	No. of Notable Listings (or Yes/No) and Distance (m) from Site				Details of Notable Listings
	On site	0-250	250-500	>500	
Water Abstractions (Licensed)	-	-	-	19	Nearest: *Lloyds Bank Plc.*, surface water abstraction for cooling, 513 m to NW.
Risk of Flooding/Flood Storage Areas	Yes	-	-	-	At risk from an extreme flood event (Zone 2).
WASTE					
Management and Transfer Sites	-	-	-	7	Nearest: *11 Whitehouse Place* (End of life vehicles), 598 m to E.
Potentially Infilled Land	-	1	1	6	Nearest: Infilled Pit / Quarry mapped in 1887, 187 m to W.
Treatment and Disposal Sites	-	-	-	2	Nearest: *Atex Breakers* (Scrapyard), 594 m to E.
HAZARDOUS SUBSTANCES					
Hazardous Substances (Installations, Consents & Enforcements)	-	-	-	2	Nearest: *British Gas Plc.*, 848 to NW.
INDUSTRIAL LAND USE					
Fuel Station Entries	-	-	2	4	Nearest: *Asda*, 275 m to NE.
Contemporary Trade Directory Entries	2	33	81	183	On site: *Lombard Service Station*, Garage Services - Inactive. Nearest: *Done & Dusted*, Commercial cleaning services – 99 m to NW.
SENSITIVE LAND USE					
No entries within 2000 m					

Note: N = north, S = south, E = east, W = west.

4.1.1 Summary of Environmental Data

The datasheets indicate that industrial occupation of the site has principally been limited to Lombard Service Station, with a general absence of potentially contaminative land uses in the records for nearby land.

5 GEOENVIRONMENTAL ASSESSMENT

5.1 Initial Conceptual Model

The information presented in Sections 2, 3 and 4 have been used to compile an initial conceptual model. The identified potential sources of contamination, associated contaminants and receptors have been considered with plausible pathways that may link them. The resulting potential pollutant linkages are considered in Section 5.2. The risk classification has been estimated in accordance with information in Appendix D.

5.1.1 Summary of Potential Contamination Sources

Potential sources and their associated contaminants of concern are summarised in the table below.

TABLE 4 :SUMMARY OF POTENTIAL SOURCES AND CONTAMINANTS	
On Site (Historical)	**Contaminants of Concern**
Made Ground	Heavy metals, asbestos, hydrocarbons (PAH)
On Site (Current)	**Contaminants of Concern**
Buried fuel tanks	Fuel hydrocarbons (petrol and diesel)
Vehicle Garage	Lubricating oils, fuel hydrocarbons (petrol and diesel) degreasers (VOCs), asbestos
Peat / Alluvium beneath site	Ground gas – methane, carbon dioxide

The potential sources of contamination at the site are primarily associated with the previous commercial activities that have taken place and the demolition of three properties on the site prior to the development of the garage. The alluvium underlying the site is expected to contain deposits of peat which may generate natural ground gas.

5.1.2 Summary of Potential Receptors

Details of the proposed scheme of development have not been provided by the client at the time of writing. However, it is understood that the development will be flats, potentially with some small areas of communal landscaping if space allows. Accordingly, sensitive receptors are considered to include:

- future site occupants
- adjacent site users
- potable water supply pipes
- groundwater beneath the site

Please note that construction workers have not been identified in the conceptual model as receptors because risks are considered to be managed through health and safety procedures including CDM regulations.

5.1.3 Pathways

Pathways that could results in a potentially complete contaminant linkage include:

- direct contact (soil and dust ingestion, dust inhalation and dermal contact)
- inhalation of ground gas
- inhalation of vapour
- permeation of plastic water supply pipes
- leaching
- lateral and vertical migration of gas, vapour or dissolved phase contamination
- preferential pathways including permeable pipe surrounds
- dissolution of non-aqueous phase liquids

5.1.4 Data Gaps and Uncertainty

Although attempts have been made to identify potential sources of contamination, there may be sources or incidents, such as pollution events, that have not been recorded in the historical and environmental records consulted as part of this investigation.

5.1.5 Potentially Complete Contaminant Linkages

The potentially complete contaminant linkages identified for the proposed end use are:

1. Direct contact by future site residents with soil that may be impacted by heavy metals and hydrocarbons.
2. Direct contact by future site residents with soil that may be impacted by asbestos.
3. Ingress of hydrocarbon vapours into structures and inhalation by future site residents.
4. Direct contact of potable water supply pipes with contaminated soils leading to ingress of contaminants or degradation of the pipe.
5. Leaching of soil contaminants into the Secondary A Aquifer beneath the site.
6. Migration and accumulation of ground gas in properties potentially resulting in asphyxiation or explosion.

5.2 Preliminary Risk Assessment

5.2.1 Risk Estimation for Potentially Complete Contaminant Linkages

The potentially complete contaminant linkages are detailed above with the estimated risk associated with each being detailed in Table 5 below. The risk classification has been undertaken in accordance with CIRIA C552, with a summary of the relevant section being included in Appendix D.

TABLE 5 :RISK ESTIMATION FOR POTENTIALLY COMPLETE CONTAMINANT LINKAGES			
Contaminant Linkage	**Probability**	**Consequence**	**Risk and justification**
1. Direct contact by future site residents with soil that may be impacted by heavy metals and hydrocarbons.	Low Liklihood	Medium	Moderate/Low – The proposed development may include limited soft landscaping areas where residents may be exposed to contaminated soils, but no existing topsoil is likely to be present and contact would be minimised through the use of clean imported topsoil. Growth and consumption of produce on site is unlikely.
2. Direct contact by future site residents with soil that may be impacted by asbestos.	Low Likelihood	Medium	Moderate/Low –The proposed development may include limited soft landscaping areas where residents may be exposed to contaminated soils.
3. Ingress of hydrocarbon vapours into structures and inhalation by future site residents.	Likely	Medium	Moderate– Hydrocarbon contamination is likely to be found on the site within the former forecourt area and potentially beneath the garage building. Vapour generation is a possibility and ingress into the new structure which will cover these areas is plausible.
4. Direct contact of potable water supply pipes with contaminated soils leading to ingress of contaminants or degradation of the pipe.	Likely	Medium	Moderate – Hydrocarbon contaminants within the Made Ground and Alluvium might contact water supply pipes, and thresholds for acceptable contamination are very low for standard water supply pipes.
5. Leaching of soil contaminants into the Secondary A Aquifer beneath the site.	Low likelihood	Medium	Moderate / Low – Groundwater expected to be present within the Alluvium at the site. However, the low expected permeability of this unit may limit the potential for contaminants to leach down into the Secondary 'A' Aquifer. Additionally

TABLE 5 :RISK ESTIMATION FOR POTENTIALLY COMPLETE CONTAMINANT LINKAGES			
Contaminant Linkage	**Probability**	**Consequence**	**Risk and justification**
			the Mercia Mudstone beneath the site is likely to be dominated by mudstone rather than the sandstone units of the Redcliffe Sandstone Member.
6. Migration and accumulation of ground gas in properties potentially resulting in asphyxiation or explosion.	Low Likelihood	Severe	Moderate – Potential sources of ground gas have been identified below the site and gas generation rates are expected to be low, however absolute concentrations may be sufficiently elevated to warrant the inclusion of gas protection measures within future buildings.

The review of the available information and the production of the initial conceptual model and risk assessment has identified risks associated with potentially complete pollutant linkages that vary from Low to Moderate.

Linkages with risk estimations of Moderate/Low or above would typically require further investigation. To further investigate these linkages we have undertaken a ground investigation to collect information on the completeness of these linkages.

6 FIELDWORK

6.1 General

The ground investigation was carried out by SSL between 15 and 18 October 2018. The investigation was supervised by an engineer from SSL. The scope of works and positions were selected, set out and adjusted where necessary by SSL to take account of buried or overhead services, or other restrictions. The exploratory hole and in-situ test locations are shown on the Exploratory Hole Location Plan presented in Appendix A.

6.2 Exploratory Holes

The exploratory holes are listed in the following table.

TABLE 6 :SCOPE OF INTRUSIVE WORKS			
Quantity	**Exploratory Hole Type**	**Maximum depth (m)**	**Hole / Test Numbers**
3	Cable Percussion Boreholes.	9.30	BH1-BH3
3	Window Sample Boreholes	6.00	WS1, WS3 & WS4

The exploratory hole logs are presented in Appendix B. These provide information including the equipment and methods used, samples taken, tests carried out, water observations and descriptions of the strata encountered. Explanation of the terms and abbreviations used on the logs is given in the Key to Exploratory Hole Records in Appendix B, together with other explanatory information.

The holes were logged by an engineer in general accordance with the recommendations of BS 5930:2015 (which incorporates the requirements of BS EN ISO 14688-1, 14688-2 and 14689-1). Detailed descriptions, together with relevant comments, are given on the logs.

Prior to the commencement of any exploratory hole or intrusive test all positions were checked for buried services by a specialist utility surveyor using a cable avoidance tool (CAT), signal generator ('genny'), and ground penetrating radar (GPR).

Inspection pits were hand dug at exploratory locations where noted on the relevant exploratory hole logs or in-situ test results.

The surveying of exploratory hole positions relative to the British National Grid and ground levels relative to Ordnance Datum has not been requested or undertaken as part of this investigation.

6.3 Instrumentation

On completion 50 mm and 40 mm diameter gas/groundwater monitoring wells were installed in selected exploratory holes the design having been decided by SSL. The installation details are shown on the exploratory hole logs and on a summary table presented within Appendix B.

6.4 In-Situ Testing

The in-situ tests are listed in the following table.

TABLE 7 :SCOPE OF IN-SITU TESTING		
Quantity	**In-situ Test**	**Remarks**
12	Standard Penetration Tests (SPT).	Carried out in boreholes; test results included on exploratory hole logs presented in Appendix B.
47	Hand Penetrometer (HP).	Set of three readings for each test.

6.5 Monitoring and Post Fieldwork Environmental Sampling

Groundwater levels were recorded in the monitoring wells on 1, 7 and 16 November and 13 December 2018 by SSL engineers. The results together with the temporal (weather) conditions are tabulated in Appendix E.

Ground gas monitoring was carried out over the same period. An infrared gas meter was used to measure concentrations of carbon dioxide (CO2), methane (CH4) and oxygen (O2) in percentage by volume, whilst hydrogen sulphide (H2S) and carbon monoxide (CO) were recorded in parts per million. Initial and steady state concentrations were recorded. An integral flow meter was used to measure borehole flow rates (initial and steady state) in litres per hour (l/hr). In addition the atmospheric pressure before and during monitoring.

It should be noted that groundwater levels, gas concentrations and gas flows usually vary due to seasonal, atmospheric and/or other effects and may at times differ to those measured during the investigation.

The calibration certificate for the gas analyser and PID used are contained in Appendix F.

The wells were purged on the first monitoring visit. Sampling was then undertaken on the second monitoring visit using low-flow sampling techniques to minimise sample disturbance and the effects of sediment mobilisation into the samples.

7 LABORATORY TESTING

Samples for potential geoenvironmental testing were sent to a sister company Envirolab Limited, a MCERTS and UKAS accredited testing laboratory. Laboratory tests were scheduled by SSL. Tests carried out in accordance with MCERTS/UKAS standards where noted on the results sheets.

7.1 Geoenvironmental Laboratory Testing

The geoenvironmental testing carried out is summarised in the following table. The results are included as Appendix C of this report, and include details of the test method.

TABLE 8 : SUMMARY OF GEOENVIRONMENTAL LABORATORY TESTING

Numbers of tests	Description	Notes
	SOIL	
6	SSL contamination screening suite	Comprises arsenic, cadmium, chromium (total), lead, mercury, selenium, copper, nickel, zinc, speciated polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH banded 1 with ID), soluble organic matter, soluble sulphate and pH.
3	TPHCWG	VPH and EPH with CWG banding, plus BTEX and MTBE. (C5-C35)
3	Volatile organic compounds (VOC).	
10	Asbestos presence screen.	Identification was undertaken if/where asbestos fibres were detected.
	WATER	
3	SSL GWS Groundwater Screening suite.	Comprises arsenic, cadmium, chromium (total), lead, mercury, selenium, copper, nickel, zinc, speciated polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPHCWG (speciated) with CWG bandings), sulphate, hardness and pH.
6	VOC	Volatile organic compounds
3	DOC	Dissolved organic carbon
3	Calcium	
9	TPHCWG	Comprises VPH and EPH with CWG banding, plus BTEX and MTBE. (C5-C35)

8 GROUND CONDITIONS

8.1 General

Descriptions of the strata encountered are given on the exploratory holes logs presented in Appendix B. The downward succession encountered is broadly consistent with the published geology. This sequence is summarised in Table 9 below:

TABLE 9 : SUMMARY OF GROUND CONDITIONS

Strata Encountered	Depth to top of stratum (m bgl)	Range of Thicknesses (m)	Exploratory holes encountered in
Made Ground	0.00	1.25 - >2.00	BH1-BH3, WS1, WS3 & WS4
Alluvium	1.25 – 1.80	6.00 - 6.45	BH1-BH3, WS1 & WS3
Mercia Mudstone Group	7.50 - 8.00	Not proved	BH1-BH3

Further description of the ground conditions is present below.

8.2 Made Ground

Below the concrete surfaces the Made Ground comprised a variable mixture of sands gravels and clays in differing proportions but most typically as slightly sandy gravelly clays and very sandy very clayey gravels. The gravel clasts were typical of demolition rubble and included brick, concrete, ceramics, clinker and lime mortar with rare inclusions of glass and coal. Natural clasts were limited to the occasional presence of mudstone.

The thickness of the made ground does not appear to vary systematically across the site, and ranges from 1.25 m in BH3 to greater than 2.00 m in WS4. WS4 was intentionally drilled in the near vicinity of the underground storage tanks, and met refusal at 2.00m depth. This may be related to material in the ground relating to the tanks, such as a concrete base on which they may be sat.

8.3 Alluvium

Alluvium was encountered at all locations except for WS4 which was terminated on an obstruction in the made ground.

The Alluvium was typically firm organic silty clays which decreased in strength with depth, to become soft and very soft below 3.0 to 4.0 metres. These deposits contained frequent decaying organic remains, which were particularly prevalent and becoming abundant from around 5.0 m depth, with the clays being interbedded with

fibrous and psuedofibrous peats. A band of predominately fibrous and pseudo fibrous peat subordinately interbedded with a soft or very soft grey clay was identified in BH2 and BH3 from 6.0 m to 6.5 m. Whilst not recorded in BH1, it is very likely to have been present also.

Below 6.5 m depth the organic content of the Alluvium reduces again and the clays pass into slightly sandy gravelly or slightly gravelly clays between 7.1 m (BH3) and 7.7 m (BH1). This coarse material includes mudstone, sandstone and chert, and represents the base of the Alluvium, being underlain by deposits of the Mercia Mudstone between 7.5 m and 8.0 m depth.

8.4 Mercia Mudstone Group

Partially weathered mudstones of the Mercia Mudstone Group were encountered beneath the Alluvium in all three boreholes. Depths ranged from 7.5 m in BH2 to 8.0 m in BH1. The mudstones are reported to be extremely to very weak and were frequently recovered as a gravel. Sandstone was only encountered within BH3 at the base of the hole at 9.25 m depth.

8.5 Groundwater

No perched water was encountered within the made ground during the field works, and no notable water strikes were encountered within the Alluvium. Slow groundwater strikes were recorded within the Mercia Mudstone with water continuing to enter the bores even with the drill casing advanced into the mudstone. Rises to between 7.5 m and 8.1 m below ground level were recorded.

Monitoring undertaken has indicated slow entry of groundwater from the Alluvium and variable groundwater elevations across the site from 0.91 m to 3.12 m depth. Groundwater elevations within the deep wells are typically around 3 m below ground level, with those in the Alluvium being slightly shallower. Some perched water is anticipated in the made ground from around 1 m below ground level.

8.6 Indications of Contamination

No perched water was encountered within the made ground during the field works, and no indications of contamination were noted during the fieldwork beyond the presence of fragments of coal and clinker within the made ground.

PID headspace screening results for soil samples recovered from the exploratory holes ranged up to 0.3 ppm isobutylene equivalent.

9 GEOENVIRONMENTAL ASSESSMENT

9.1 Purpose of Investigation

The purpose of the work was to obtain geoenvironmental information to support the clearance of anticipated land contamination conditions regarding the demolition of a vehicle garage and the construction of residential dwellings.

9.2 General

In line with CLR11 (EA, 2014), there are two stages of quantitative risk assessment, generic and detailed. The Generic Quantitative Risk Assessment (GQRA) comprises the comparison of soil, groundwater, soil gas and ground gas results with generic assessment criteria (GAC) that are appropriate to the linkage being assessed. This comparison can be undertaken directly against the laboratory results or following statistical analysis depending upon the sampling procedure that was adopted.

9.3 Linkages for assessment

The linkages that required assessment after the findings of the ground investigation had been considered are detailed below together with the method of assessment.

TABLE 10 : LINKAGES FOR GENERIC QUANTITATIVE RISK ASSESSMENT

Relevant pollutant linkage	Assessment method
1. Direct contact by future site residents with soil that may be impacted by heavy metals and hydrocarbons,	Human health GAC in Appendix D for residential land use without consumption of home-grown produce.
2. Direct contact by future site residents with soil that may be impacted by asbestos.	Qualitative assessment of the type, form and quantity of asbestos present in consideration of the prosed land use.
3. Ingress of hydrocarbon vapours into structures and inhalation by future site residents.	Human health GAC in Appendix D include the vapour pathway.
4. Direct contact of potable water supply pipes with contaminated soils leading to ingress of contaminants or degradation of the pipe.	Comparison of soil data to GAC in Appendix D for plastic water supply pipes using UKWIR (2010) guidance.
5. Leaching of soil contaminants into the Secondary A Aquifer beneath the site.	Comparison of groundwater data to Controlled Waters GAC in Appendix D to inform on whether this contamination is already occurring.

6. Migration and accumulation of ground gas in properties potentially resulting in asphyxiation or explosion.	Gas Screening Values compared to the Revised Wilson and Card Classification (residential) presented within CIRIA Report 665 and BS:8485 2015.

9.3.1 Linkage 1 – Direct contact by future site residents with soil that may be impacted by heavy metals and hydrocarbons

9.3.1.1 General

To determine whether contaminants are present at levels that may be deemed to pose a significant hazard to human health, measured contamination levels in soil at the site are compared against derived guideline values ('Tier 2' soil screening), either directly or following statistical analysis. Where contaminants are present above the screening values it is probable that site-specific information will be required to further examine the potential risk of harm arising from such contamination.

The background to the assessment is contained in Appendix D and the findings are summarised in the following pages.

The proposed use of the site is flats potentially with small areas of soft landscaping if space allows, and thus residential land use without consumption of homegrown produce generic assessment criteria (GAC) have been used to assess the results.

Due to the limited number of samples tested we have compared the results directly to the residential land use without consumption of homegrown produce GAC without the use of the statistics.

9.3.1.2 Results

Except as follows the results did not exceed the residential without consumption of home-grown produce GACs. A summary of the assessment is presented in Appendix C.

TABLE 11 : RESULTS ABOVE GUIDELINES

Land Use – Residential without consumption of home-grown produce

Exploratory hole	Depth m	Contaminant	Result mg/kg	GAC Limit mg/kg
BH1	0.70	Lead	839	310
BH3	1.00		442	
WS3	0.60		862	

The investigation has identified elevated level of lead in the made ground across the site at concentrations which could pose a risk to end user of the site if such material was to remain in the near surface beneath future areas of soft landscaping or unmade surfaces.

9.3.2 Linkage 2 - Direct contact by future site residents with soil that may be impacted by asbestos

No suspected asbestos was observed in the soils on the site during the site investigation and none of the 10 asbestos-in-soil screens undertaken returned positive results. Accordingly, on the basis of the available information, the risk from asbestos in the soils on the site to future site users appears low, and this linkage is considered to be incomplete.

9.3.3 Linkage 3 - Ingress of hydrocarbon vapours into structures and inhalation by future site residents

The vapour inhalation pathway from soils to indoor air is included within the land use generic assessment criteria discussed above in section in 9.3.1.

No exceedances were found for volatile contaminants in the tested soils. This accords with the general absence of indications of hydrocarbon contamination within the soils recovered as a part of this investigation.

Furthermore, comparison of the groundwater chemical analysis results with the GrAC, which considers the generation potential for vapour generation from dissolved phase contamination in groundwater also identifies no exceedances.

This linkage is considered to be incomplete.

9.3.4 Linkage 4 - Direct contact of potable water supply pipes with contaminated soils leading to ingress of contaminants or degradation of the pipe.

9.3.4.1 General

It should be noted that at the time of this investigation the future routes of water supply pipes had not been established, hence the investigation and sampling strategy may not be fully compliant with UKWIR recommendations. Consequently, a targeted investigation and specific sampling/analytical strategy may be required at a later date once the route of the supply pipes is known.

For possible pollutant linkages to proposed water supply pipes, the laboratory test results have been subject to initial assessment against the GAC presented in Appendix D (reproduced from the Table 3.1 of UKWIR).

Full testing has not been undertaken to determine the suitability of metallic pipe materials.

9.3.4.2 Results

The soil test results showed several exceedances of the UKWIR guidelines for polythene pipe in the made ground soils as shown in the table below.

TABLE 12: RESULTS ABOVE GUIDELINES				
Exploratory hole	**Depth m**	**Contaminant**	**Result mg/kg**	**Guideline mg/kg**
BH3	1.00	Benzo(a)pyrene	0.57	0.50 for PE pipes.
BH2	0.30	TPH C_{11}-C_{20}	13	10 for PE pipes.
BH3	1.00		18	
WS1	0.30		37	
WS4	1.10		14	
WS1	0.30	TPH C_{21}-C_{40}	993	500 for PE pipes.

Note: PE – Polyethylene (also known as Alkathene or MDPE)

The investigation has identified a number of exceedances of the UKWIR guidelines for standard polyethylene pipes in the made ground soils. This linkage is considered to be potentially complete.

9.3.5 Linkage 5 - Leaching of soil contaminants into the Secondary A Aquifer beneath the site

9.3.5.1 General

The site lies over Unproductive Strata (the Alluvium) with a concealed Secondary A Aquifer (the Mercia Mudstone Group) at depth. Future groundwater abstractions from the mudstones of the Mercia Mudstone Group are implausible, and accordingly the most sensitive receptor in the vicinity of the site is considered to be surface water of the River Avon present in the New Cut 200 m north of the site, or the culverted channel of the Malago 180m east of the site.

The chemical analysis results for the groundwater have been compared to available Environmental Quality Standards for freshwater, presented in Appendix D which is considered to be protective surface water courses discussed above. In line with the Environment Agency's Remedial Targets Methodology, the GAC for controlled waters are termed 'Target Concentrations' (TC).

9.3.5.2 Results

None of the freshwater EQS values were exceeded for metals, semi metals, BTEX compounds or VOCs. There are no EQS values published for speciated total petroleum hydrocarbons and the results have been compared to the World Health Organisation limits for petroleum hydrocarbons in drinking water as presented in Table 21.

TABLE 13: SUMMARY OF TARGET CONCENTRATION EXCEEDANCES – HYDROCARBONS					
Determinant	**Maximum Concentration (µg/l)**	**Location**	**Aqueous Solubility (µg/l)**	**Drinking Water Assessment Criteria**	**Freshwater EQS**
TPH Aromatic <C8-C10	472	BH1	65000	300	-
TPH Aromatic <C10-C12	169	BH1	25000	90	-
TPH Aromatic <C12-C16	132	BH1	5800	90	-

This screening identified limited exceedances for a small number of aromatic hydrocarbon bands. It is noted that the results returned are significantly lower than the aqueous solubilities of each fraction by a least an order of magnitude. There is no evidence from the fieldwork, monitoring or analysis that free product has been encountered at the site. Accordingly, this limited contamination appears to be already present in the water in the dissolved phase.

No basal gravels have been encountered at the base of the Alluvium, and the Mercia Mudstone was found to be represented by stiff clays and mudstone which are expected to have very limited hydraulic conductivities. Inspection of the water monitoring data indicates variable groundwater levels across the site, with no clear indication of gradient of the piezometric surface in either the shallow or deeper well arrays.

It is considered that mobilisation from the site via groundwater to impact on the identified surface water receptors is implausible. Consequently, this linkage is considered to be incomplete.

It should be noted that the constituents of petrol and diesel are considered to be hazardous substances, and the historic tanks and pipework represent potentially significant sources of these contaminants that under the guise of the EU Water Framework Directive should be prevented from entering groundwater. Whist there is no evidence that significant contamination is currently occurring we would recommend the removal of theses feature as a part of the development to guard against potential future contamination of soils and groundwater from deterioration of the remaining infrastructure.

9.3.6 Linkage 6 - Migration and accumulation of ground gas in properties potentially resulting in asphyxiation or explosion

9.3.6.1 General

In order to assess the significance of ground gases at the site, measured concentrations (by volume in air) and flow rates have been used to generate Gas Screening Values (GSVs). These have then been compared to the Revised Wilson and Card Classification presented within CIRIA Report 665. BS8485 has also been referenced.

It is recommended that the gas risk should be assessed by the consideration of pathways to human receptors as follows:

- Gas entering the building through the substructure and building up to hazardous levels; and
- Subsequent householder exposure through potential areas of soft landscaping.

9.3.6.2 Results

The following ground gas parameters have been recorded over the 4 no. gas monitoring rounds conducted on 1, 7 and 16 November and 13 December 2018. This included a visit undertaken at low pressure (<995 mb). Measured flow rates during

the monitoring campaign across the site were found to be below the limit of measurement except for in BH1 during the third monitoring visit when groundwater had risen beyond the response zone of the installation causing pressurisation of the well headspace resulting in short term flow readings up to -0.5 l/hr. This result is not considered to be representative of the flow of gas from the ground.

Maximum gas concentrations by position are recorded in Table 14 below:

TABLE 14: SUMMARY OF MAXIMUM GAS CONCENTRATIONS

Exploratory Position	Methane (%)	Carbon Dioxide (%)
BH1	0.9	0.7
BH2	1.3	0.2
BH3	12.6	4.2
WS1	0.0	0.7
WS3	0.0	0.7
WS4	0.0	1.7

Levels of methane and carbon dioxide have been found to be elevated within the deep boreholes which intercept bands of peat between 6.00 m and 6.50 m below ground level.

Ground gases present in peat and very organic alluvium are generated over very long periods of time and trapped or adsorbed within the deposits, accordingly there is very limited scope for lateral or vertical migration of the gas through the saturated natural soil profile. Actual generation rates within these deposits is expected to be very low.

The shallower window sample holes show no methane and significantly lower concentrations of carbon dioxide in the near surface beneath the existing concrete slabs which cover the site. This is considered to be an additional line of evidence that a significant flux of ground gas is not occurring from the deep alluvium to the near surface.

It is considered that there is currently no viable pathway from the identified source to impact on the future residents of the proposed flats, and that as long as the construction works do not increase the risk, this linkage will remain incomplete.

The proposed building is likely to make use of deep piled foundations to transmit foundation loads down into the stiff clays of the Mercia Mudstone Group at depth. Piles

Given the thickness and low strength of the alluvial soils it is considered highly likely that they would form a good seal around any pile type which may be adopted (displacement or replacement) and that use of these techniques will generate preferential pathways for ground gas migration which could impact the requirement for gas protection measures.

Ground improvement techniques however, such as installation of vibro-stone columns, wick drains or similar, may create pathways for ground gas migration and we would advise against their use in this circumstance.

9.3.6.3 Conclusion

This linkage is considered to be incomplete and the ground gas regime at the site is considered to fall into Characteristic Situation 1 of BS 8485:2015. Table 8.6 of CIRIA 665 indicates that no special protection measures are required in the new buildings.

The designer of the foundations for the development should consider the presence of a plausible source of ground gas at depth beneath the site and note that whilst the use of piles would not increase the risk of ground gas migration, techniques such as the installation of vibro stone columns or wick drains should be avoided.

9.4 Contamination Conclusions

Soil contamination has been identified at the site resulting in complete pollutant linkages. The linkages are summarised below:

- Direct contact by future site users with soil that may be impacted by lead.
- Direct contact of potable water supply pipes with contaminated soils leading to ingress of contaminants or degradation of the pipe.

9.5 Outline Remediation and Risk Reduction Recommendations

As a part of the planning process it is anticipated that Bristol City Council will place conditions relating to land contamination requiring the submission of a remedial strategy for the development of the site, and then validation of the implementation of that strategy.

The following may be taken as indicative of the remedial measures that would be required as a part of the development of the site with flats.

9.5.1 General Considerations

9.5.1.1 Discovery of Unexpected Contamination

Given the existence of made ground on the site and the site's past use, vigilance should be maintained during site clearance and construction, in case any areas of suspected contamination are encountered (e.g. suspicious in appearance or odour, etc).

When any such contamination is found then the Principal Contractor should stop all work in that area and they or the Client should contact a suitably qualified person such as Structural Soils Ltd to assess the situation. Appropriate sampling, testing and further risk assessment may be required.

Given the potential for volatile contamination on the site we consider that the developer should ensure that Structural Soils Ltd or alternative suitably qualified person visit site and inspect each set of foundation trenches for signs of contamination, before the foundations are constructed. Structural Soils Ltd should inspect each set of excavations for visual signs or odours of contamination. A photo-

ionisation detector (PID) should also be used as an additional line of evidence to assess the excavations for the presence of volatile hydrocarbons.

The site manager for the Principal Contractor at the site should provide a written statement regarding any visual or olfactory evidence of contamination observed (or lack of) whilst groundwork, service laying or landscaping is underway. Such a statement will form part of the final validation reporting

9.5.1.2 Forecourt Area Decommissioning

The presence of the tanks and associated pipework represent a significant risk of future contamination to the site and the wider environment. Accordingly we would recommend an approach of primary source removal of the tanks and associated infrastructure, with a limited over-dig of the excavations to remove any soils that contain visible mobile free-product.

We recommend that all of the underground tanks, their vent pipes, filling pipes, and the oil/water interceptor etc, be properly removed in line with recognised procedures, using a specialist contractor having sufficient and suitable experience in such work. The contractor selected for this work should provide a risk assessment and Safety Method Statement identifying the proposed decommissioning procedures prior to commencement of work on site.

This should include proposals on how the tanks will be 'inerted' or certified gas free if they are in fact found not to be filled with concrete, and whether they will be transported off site, or dismantled on site.

The removal of the tanks should include the excavation of any concrete, brick or sand surrounds to allow inspection of the surrounding soils. As a part of this any excavations should be over-dug to remove any soils or materials noted to contain mobile free phase product, such that it would enter and collect on the face of an excavation. This is not intended to include product within micro-fissures within the soil and any excavation would necessarily be limited by the land ownership constraints and the requirement not to cause instability to any adjacent properties of the pavement.

Care should be taken on the storage of any excavated arisings that it does not cause contamination of the underlying soils. As such is should be stored on concrete hard standing, or areas that have been prepared with a high quality virgin polymer DPM type membrane. Stockpiles should be sheeted over during periods of rain to prevent the generation of potentially contaminated leachate or runoff.

Care should be taken to avoid excessive rainwater accumulation in any open excavations as this may drive migration of contamination. Any water pumped from excavation should be appropriately disposed off site, or to foul sewer subject to obtaining appropriate discharge consents.

Any excavations should be infilled with an acceptable, adequately compacted, low permeability fill, to limit future infiltration, and to minimise the potential for hydrocarbon vapour posing a potential odour nuisance.

Particular care should be taken to protect the existing array of groundwater and shallow vapour monitoring wells present on the garage until such a time as it is agreed with the environmental regulators that they may be decommissioned. Loss of these before this time may require additional works to reinstate these wells.

9.5.1.3 Monitoring Well Decommissioning

Once agreement has been received from the environmental regulators that the existing monitoring wells are no longer required, the deep monitoring wells present in BH1, BH2 and BH3 should be decommissioned in accordance with the latest guidance from the Environment Agency as the wells form potential migration pathways for migration of contamination vertically within the soil profile.

We anticipate that the most appropriate form of decommissioning is likely to be by pressure grouting.

9.5.1.4 Imported Topsoil

Currently few of the soils seen on the site would be considered as suitable topsoil and thus imported soils will have to be sourced to complete the gardens and soft landscaping areas.

The imported soil should meet the requirements of BS3882:2015 Specification for topsoil with regards to the presence of physical and chemical contaminants so that it poses no health risks to the future residents or maintenance workers. The assessment of chemical contamination will be undertaken by comparison against the RSK generic assessment presented in Appendix G.

Imported soils should be sourced from a reputable supplier and must be accompanied by the supplier's certificates. Additionally, following import the soils should be independently sampled and verified for quality and chemical contamination compliance. Chemical contamination testing should be undertaken at a UKAS and MCERTS accredited laboratory using the following suite of contamination analysis.

TABLE 15: TOPSOIL CONTAMINATION SCREENING SUITE
Determinant
Arsenic
Cadmium
Chromium III
Chromium VI
Copper
Lead
Mercury
Nickel
Selenium
Zinc
pH
Soil Organic Matter
Speciated Polycyclic Aromatic Hydrocarbons
Total Petroleum Hydrocarbons (total, banded or speciated)
Asbestos Screen

Testing frequencies for topsoil quality and chemical contamination should reflect the confidence in the provenance and suitability of the topsoil. For BS3882 topsoil quality this should meet a minimum of 1 no. sample per site. For chemical contamination the following is recommended:

- For natural soils the frequency should not fall below a minimum of 3 no. tests per source, or 1 no. test per 250 m3 of imported soil, whichever is the greater.
- For manufactured or recycled topsoil the frequency should not fall below a minimum of 3 no. tests per source or 1 no. test per 50 m3, whichever is the greater.

Prospective sources of topsoil should be discussed with Structural Soils Ltd prior to import, as failure to meet the required standard will result in the need to replace the affected soil. This data will be required for inclusion in the validation report for the site.

Validation of the topsoil quality is best undertaken by random sampling once the soil has been imported.

9.5.2 Specific Pathway Breaks

9.5.2.1 Linkage 1 – Direct contact by future site residents with soil that may be impacted by lead

A practical solution to the presence of soil contaminants that pose a risk to humans is often to provide a clean cover layer in any garden or landscaped areas above any contamination (e.g. made ground) that will remain in place.

It is recommended that in any proposed soft landscaping areas all made ground within 300 mm of finished level is removed and replaced with clean subsoil and topsoil.

The type of soil should be adequate for plant cultivation. The proposed imported soils should be tested to confirm that they are uncontaminated and the final thickness of the cover will require validating.

Site, landscape and maintenance workers should wear gloves, boots and overalls and wash their hands before eating, drinking and smoking. Excessive dust generation should be avoided.

9.5.2.2 Linkage 4 -Direct contact of potable water supply pipes with contaminated soils leading to ingress of contaminants or degradation of the pipe.

The investigation has shown hydrocarbon exceedances in the shallow made ground across the site.

Therefore, we anticipate that Bristol Water will require the use of barrier pipeworks and fittings (Protecta-line, Puriton or similar) to be used throughout the development for water supply pipes in the ground. It is recommended that this report be presented to Bristol Water to confirm their requirements for pipe materials.

Correspondence with the water company and photographs of the pipe work being installed should be kept for inclusion in a remediation validation report which can be submitted to the planning authority.

10 OFF-SITE DISPOSAL OF SPOIL

10.1.1 General

All excavated material and excess spoil must be classified for waste disposal purposes prior to disposal at landfill. Under the Landfill (England and Wales) Regulations 2002 (as amended), prior to disposal all wastes must be classified as:

- 'inert', or
- 'non-hazardous', or
- 'hazardous'.

The Environment Agency's *Guidance on the Assessment and Classification of Waste*, Environment Agency, WM3, First Edition May 2015 document outlines the methodology for classifying wastes. Currently all wastes may require pre-treatment prior to disposal at landfill.

10.1.2 Initial Waste Characterisation

Envirolab have produced an assessment tool, 'Haswaste', that characterises contaminated waste soil by following the guidance within WM3. The 'total solid testing' results from this investigation have been run through this assessment tool to aid potential future off-site disposal of materials. This assessment produces an 'initial' characterisation of the waste which determines if it is hazardous or not (if it is 'not' hazardous, then it may be either inert (insoluble and inorganic) or non-hazardous. However, due to complications with the terminology of 'inert waste' it is best not to refer to it as such until after Waste Acceptance Criteria testing).

The assessment is included in Appendix E. Any samples that are classed as hazardous will have yellow cells with bold text, in the respective sample columns. The majority of the samples would be classified as non-hazardous waste with one exception, WS4 at 1.10 m depth has a corrosive pH of 13.4, which is classified as hazardous waste.

It is important to note that whilst we believe our in-house assessment tool to be an accurate interpretation of the requirements of WM3, thereby producing initial classifications in accordance with it, landfill operators often have their own assessment tools and can often come to a different conclusion. As a result, some landfill operators could even refuse to take apparently suitable waste.

11 SUMMARY

11.1 The purpose of the work was to obtain geoenvironmental information to advance the clearance of anticipated land contamination conditions regarding the demolition of a vehicle garage and the construction of residential dwellings.

11.2 The site is located on the corner of Brook Road and St Paul's Road in Bedminster, approximately 1.3 km south west of Bristol Temple Meads Railway Station. The British National Grid Reference of the site is ST 585 717.

11.3 The L-shaped site is approximately 30 m by 20 m in size and is occupied by an active vehicle service and repair garage building with a car sales and parking yard area. Two steel covers at the centre of the yard indicate the position of possibly a pair of tanks or possible a single twin compartment tank. The inspection chambers beneath the covers have been filled with a sand and cement slurry. No evidence of vent pipes or a petroleum interceptor was evident on the forecourt.

11.4 A desk study has been carried out. Early maps show the site to have initially been occupied by several residential properties which may have been subject to bomb damage in the Second World War. The first garage buildings appearing shortly after 1946 with a forecourt area by the mid-1960s when it is assumed that petrol sales would have commenced. Anecdotal sources indicate that fuel sales ceased in the late 1980s.

11.5 The geological map shows the site to be underlain by Made Ground over superficial Alluvium deposits and then the Redcliffe Sandstone Member of the Mercia Mudstone Group at depth

11.6 A ground investigation was carried out by SSL between 15 and 18 October 2018 that comprised three cable percussion boreholes and three window sample boreholes with associated geoenvironmental testing.

11.7 The ground investigation identified the site to be covered by 1.25 m - >2.00 m of made ground overlying superficial alluvium which extended to a depth between 7.50 m and 8.00 m. The superficial deposits were underlain by the Mercia Mudstone Group which was confirmed to a depth of 9.30 m.

11.8 No perched water was encountered within the made ground during the field works, and no notable water strikes were encountered within the Alluvium. Slow groundwater strikes were recorded within the Mercia Mudstone with rises to between 7.50 m and 8.10 m below ground level. Groundwater monitoring undertaken identified variable groundwater elevations across the site from 0.91 m to 3.12 m depth.

11.9 The investigation has identified elevated level of lead in the made ground across the site at concentrations which pose a risk to end user of the site if such material was to remain in the near surface beneath future areas of soft landscaping or unmade surfaces. It is recommended that in any proposed soft landscaping areas all made ground within 300 mm of finished level is removed and replaced with clean subsoil and topsoil.

11.10 The investigation has shown several hydrocarbon results that exceedance the thresholds for standard polyethylene pipes in the made ground across the site. Consequently, we anticipate that Bristol Water will require the use of barrier pipe for

all water supply pipe and fittings lain in the ground on the scheme. It is recommended that this report be presented to Bristol Water to confirm their requirements for pipe materials.

11.11 Levels of methane and/or carbon dioxide have been found to be elevated within the deep boreholes where bands of peat are present. No complete linkage exists between the peat ground gas source and the shallow soils on the site. Piled foundations are not likely to increase the mobility and risk of ground gas thus should not drive a need to incorporate ground gas protection measures. Techniques which may create a pathway for ground gas migrations such as vibro-stone columns or wick drains should be avoided.

11.12 The Initial Waste Characterisation indicates that the majority of the samples would be classified as non-hazardous waste with one exception, WS4 at 1.10 m depth has a corrosive pH of 13.4, which is classified as hazardous waste.

11.13 No radon protection measures are considered necessary in the construction of new buildings.

11.14 Outline remedial measures anticipated to be required in the development of the site are presented in Section 9.5 and are expected to include decommissioning of the forecourt area infrastructure, specific decommissioning of the monitoring well arrays, use of specific barrier pipe and fittings for new water supply pipes and provision of certified clean cover soils in future areas of soft landscaping.

12 REFERENCES

12.1 BS 5930:2015 *Code of practice for ground investigations*

12.2 BS 10175:2011 *Investigation of potentially contaminated sites: Code of practice*, including amendment A2 2017

12.3 BS EN 1997-2:2007 Eurocode 7 — *Geotechnical design Part 2: Ground Investigation and testing*

12.4 BS EN ISO 22475-1:2006 *Geotechnical Investigation and Testing – Sampling methods and groundwater measurements, Part 1 Technical principals for execution*

12.5 Structural Soils, 1988. Report Ref 80856 Report on Site Investigation at St Johns Road, Bedminster, Bristol

12.6 http://maps.bristol.gov.uk/kyp/?edition

12.7 British Geological Survey sheet 264 scale 1:50,000, published 2004

12.8 British Geological Survey online digital geological map, www.bgs.ac.uk/data

12.9 British Geological Survey Lexicon of Named Rock Units, www.bgs.ac.uk/lexicon

12.10 Environment Agency website, www.environment–agency.gov.uk

12.11 Environment Agency Groundwater Vulnerability Map: Southern Cotswolds, sheet 37, scale 1:100,000

12.12 CIRIA Report C552 (2001), Contaminated Land Risk Management; A Guide to Good Practice

12.13 BS EN ISO 14688-1:2018 Geotechnical investigation and testing – Identification and classification of soil: Part 1: Identification and description

12.14 BS EN ISO 14688-2:2018 *Geotechnical investigation and testing – Identification and classification of soil: Part 2: Principles for a classification*

12.15 BS EN ISO 14689-1:2018 *Geotechnical investigation and testing – Identification and classification of rock: Part 1: Identification and description*

12.16 R & D Publication CLR 11 (September 2004). Model Procedures for the Management of Contaminated Land. Contaminated Land. Environment Agency

12.17 UK Water Industry Research (2010) UKWIR Report 10/WM/03/21. Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites (London: UKWIR).

12.18 CIRIA Report C665 Assessing risks posed by hazardous ground gases to buildings, London, 2007

12.19 BS 8485:2015 Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings

12.20 Landfill (England & Wales) Regulations 2002

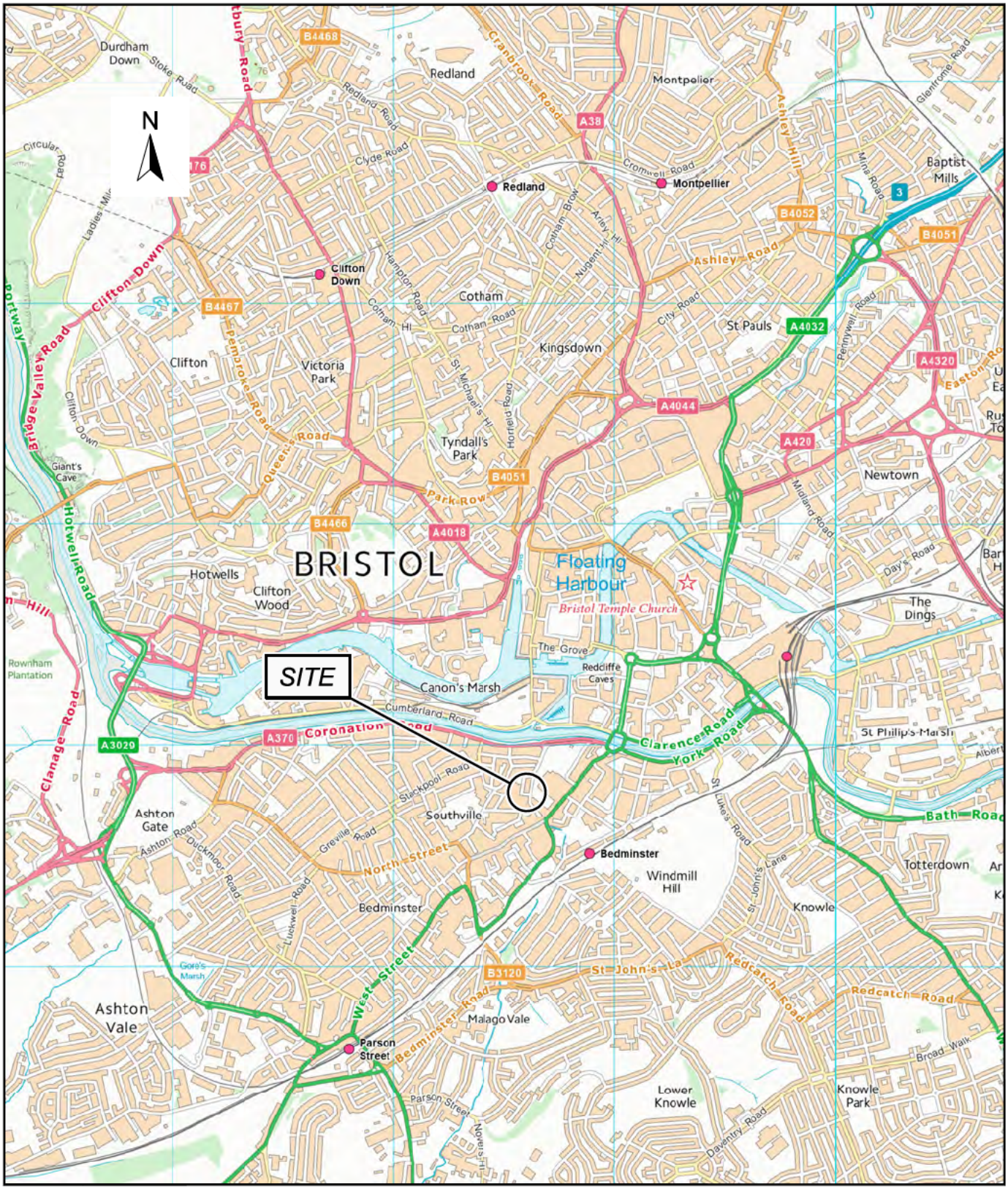
12.21 Guidance on the Assessment and Classification of Waste, Environment Agency, WM3, First Edition May 2015

12.22 Wilson S and Mortimer S, Piled Foundations and pathways for ground gas migration in the UK. Environmental Geotechnics, ICE, 2017

APPENDIX A -
PLANS AND DRAWINGS

(i) Site Location Plan

(ii) Exploratory Hole Location Plan



STRUCTURAL SOILS
The Old School
Stillhouse Lane
Bedminster
Bristol BS3 4EB
Tel: 0117 947 1000
ask@soils.co.uk
www.soils.co.uk

CLIENT: Sandy Lane Construction Ltd.

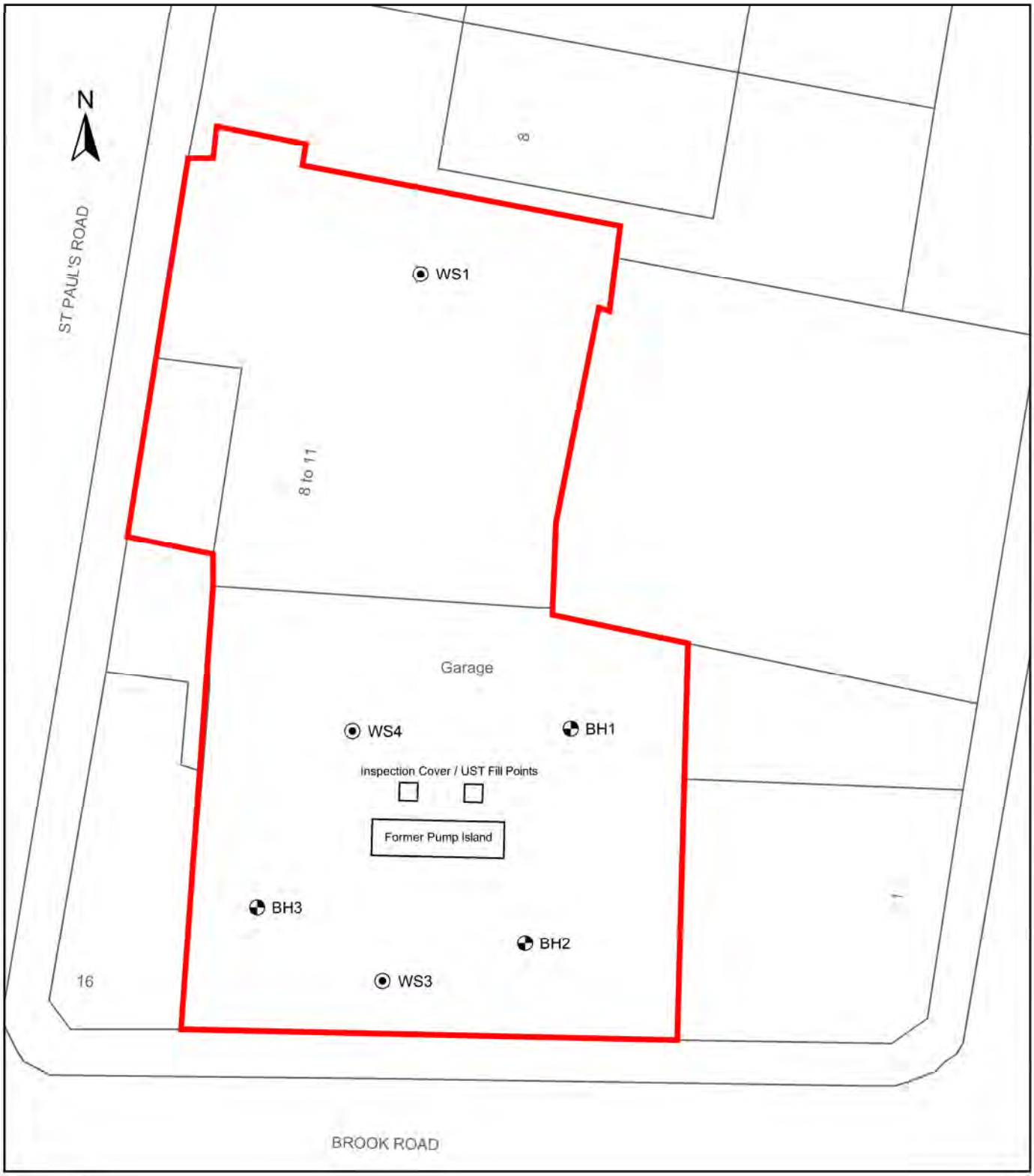
PROJECT: Former Lombard Service Station, Bristol

TITLE: SITE LOCATION MAP

REV.	DATE	DESCRIPTION	BY	CHD.	APR.
00	733272	-	NP	JE	-

DIMENSION	SCALE	DRAWING STATUS
m	1:25,000	-

JOB NO	GRID REF	SCALE BAR	ORIGIN SIZE	FIGURE
733272	ST 586 717	0 250 500 750 1,000m	A4	1



LEGEND

Borehole Location

Window Sample Location

STRUCTURAL SOILS
The Old School
Stillhouse Lane
Bedminster
Bristol BS3 4EB
Tel: 0117 947 1000
ask@soils.co.uk
www.soils.co.uk

CLIENT: Sandy Land Construction Ltd

PROJECT: Former Lombard Service Station, Bristol

TITLE: EXPLORATORY HOLE LOCATION PLAN

REV	DATE	DESCRIPTION	BY	CHD	APR
00	26.10.2018	-	NP	JE	-

DIMENSION	SCALE	DRAWING STATUS
m	1:200	-

JOB NO	SCALE BAR	ORIGIN SIZE	FIGURE
733272	0 2 4 6 8 10m	A4	2

APPENDIX B -
EXPLORATORY HOLE RECORDS

(i) Key to Exploratory Hole Logs

(ii) Borehole Logs

(iii) Window Sample Logs

(iv) Standpipe Summary Table

KEY TO EXPLORATORY HOLE LOGS - SUMMARY OF ABBREVIATIONS

SAMPLING

Sample type codes

B	=	Bulk disturbed sample.
DSPT	=	Small disturbed sample originating from SPT test.
ES	=	Soil sample for environmental testing.

IN-SITU TESTING

$SPT_{(c)}$	=	Standard Penetration Test using a solid 60 degree cone.
SPT	=	Standard Penetration Test using split spoon sampler. ($_{(NR)}$ indicates 'No Sample Recovery').
	=	* denotes extrapolated N value. NP denotes 'No Penetration'.
HP	=	Hand Penetrometer Test. Value given as shear strength c_u, in kPa.
PID	=	Photo Ionisation Detector Results, in ppm.

ADDITIONAL NOTES

1. All soil and rock descriptions and legends in general accordance with BS EN ISO 14688-1, 14688-2, 14689-1, and BS5930:2015.
2. Material types divided by a broken line (- - -) indicates an unclear boundary.
3. The data on any sheet within the report showing the AGS icon is available in the AGS format.

GINT_LIBRARY_V8_07.GLB|GrfcText G - LEGEND - 1 OF 2 | 733272_FORMER_LOMBARD_SERVICE_STATION_BRISTOL.GPJ - v8_06 | 15/01/19 - 14:04 | JE4.
Structural Soils Ltd, Head Office - Bristol: The Old School, Stillhouse Lane, Bedminster, Bristol, BS3 4EB. Tel: 0117-947-1000, Fax: 0117-947-1004, Web: www.soils.co.uk, Email:admin@soils.co.uk.

STRUCTURAL SOILS

Contract Reference: **733272**

KEY TO EXPLORATORY HOLE LOGS - SUMMARY OF GRAPHIC SYMBOLS

WATER COLUMN SYMBOLS

First water strike, second water strike etc.

Standing water level following first strike, standing water level following second strike etc.

Seepage.

Standing water level recorded at documented date.

MATERIAL GRAPHIC LEGENDS


CLAY


Gravelly silty CLAY


MADE GROUND


Mudstone


PEAT


Sandy silty CLAY


Sandy gravelly CLAY


Silty CLAY


SANDSTONE

INSTRUMENTATION SYMBOLS


Clay


Bentonite cement grout


Bentonite seal


Gravel filter


Flush cover


Plain pipe


Slotted pipe

STRUCTURAL SOILS

BOREHOLE LOG

Contract:	Client:	Borehole:
Former Lombard Service Station, Bristol	**Sandy Lane Construction Ltd.**	**BH1**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
733272	**15.10.18** End: **15.10.18**	**---**	**---**	**1** of **2**

Samples and In-situ Tests				Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
						MADE GROUND: CONCRETE slab.	0.20	
						MADE GROUND: Brown very gravelly clayey fine to coarse SAND with medium a cobble content. Gravel is angular to subangular fine to coarse of brick, concrete and clinker. Cobbles are angular of brick.	0.35	
						MADE GROUND: CONCRETE slab.	0.45	
0.50-0.80	1	B				MADE GROUND: Soft brown slightly sandy gravelly CLAY with low a cobble content. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of brick, concrete, clinker and coal. Cobbles are angular of concrete.	(0.35)	
0.70	101	ES					0.80	
0.70		PID	0.0ppm					
0.80-1.20	2	B				MADE GROUND: Soft dark brown mottled black slightly sandy gravelly CLAY with a low cobble content. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of brick, concrete, coal and ceramic tile fragments. Cobbles are angular of concrete.	(0.40)	
1.00	102	ES					1.20	
1.00		PID	0.0ppm					
1.20-1.60	3	B				MADE GROUND: Dark brown mottled black very sandy clayey angular to subangular fine to coarse GRAVEL of brick, concrete, ceramic tile fragments, coal and clinker.	(0.40)	
1.40	103	ES					1.60	
1.40		PID	0.0ppm					
1.60-2.00	4	B				MADE GROUND: Firm dark brown slightly sandy CLAY. Sand is fine to medium. Mild organic odour.	1.80	
1.70		HP	c_u=70/85/60					
1.80	104	ES				Stiff greyish brown CLAY with abundant black speckling. Moderate organic odour. (ALLUVIUM)	2.00	
1.80		PID	0.0ppm					
1.90		HP	c_u=100/90/100					
2.00-2.50	5	B				Stiff light grey mottled light brown CLAY with occasional greyish brown silt laminations. Mild organic odour. (ALLUVIUM)	(1.00)	
2.20	105	ES					3.00	
2.20		PID	0.0ppm					
2.40		HP	c_u=110/120/110					
2.50-3.00	6	B						
2.70	106	ES						
2.70		PID	0.0ppm					
2.90		HP	c_u=75/70/70					
3.00-3.50	7	B				Firm bluish grey mottled light brown CLAY with occasional greyish brown silt laminations. (ALLUVIUM)	(0.40)	
3.20		HP	c_u=60/60/65				3.40	
3.50-4.00	8	B				Firm to soft bluish grey mottled greyish brown silty CLAY with occasional dark brown and yellow f brous organic material. (ALLUVIUM)	(1.10)	
3.70		HP	c_u=35/35/35					
4.00-4.50	9	B					4.50	
4.30		HP	c_u=20/20/15					
4.50-5.00	10	B				Very soft bluish grey mottled greyish brown and dark grey silty CLAY with occasional dark brown and yellow fibrous material. Mild organic odour. (ALLUVIUM)	(1.00)	
4.70		HP	c_u=10/10/15					

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
15/10/18	12:00	9.00	7.70	150	9.00
15/10/18	13:15	9.00	7.70	150	7.50

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

1. GPR and CAT & Genny service scan prior to commencement.
2. Break out concrete slab.
3. Inspection pit dug to 0.35m depth.
4. Break out buried concrete slab.
5. Inspection pit dug to 1.20m depth.
6. Borehole stable. Groundwater strike present

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Dando 2000**	**M. Gofmonas & M. Zgrzebnicki**	**JDEvans**	

STRUCTURAL SOILS

BOREHOLE LOG

Contract:	Client:	Borehole:
Former Lombard Service Station, Bristol	**Sandy Lane Construction Ltd.**	**BH1**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
733272	**15.10.18** End: **15.10.18**	**---**	**---**	**2** of **2**

Samples and In-situ Tests				Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
5.00-5.50	11	B				Very soft bluish grey mottled greyish brown and dark grey silty CLAY with occasional dark brown and yellow fibrous material. Mild organic odour. (ALLUVIUM) *(stratum copied from 4 50m from previous sheet)*	5.50	
5.20		HP	c_u=5/5/0					
5.50-6.00	12	B				Very soft light grey mottled light brown CLAY containing abundant brown and dark brown pockets of fibrous and pseudofibrous peat. Strong organic odour. (ALLUVIUM)	(1.00)	
5.60		HP	c_u=5/0/5					
6.00-6.50	13	B					6.50	
6.20		HP	c_u=10/0/0					
6.50-7.00	14	B				Soft to firm light grey mottled light brown slightly gravelly silty CLAY with rare dark brown fibrous material. Gravel is subrounded fine of carbonate nodules. Mild organic odour. (ALLUVIUM)	(0.50)	
6.80		HP	c_u=60/50/50				7.00	
7.00-7.50	15	B				Soft light grey and grey silty CLAY containing brown lenses of silt with light brown and dark brown fibrous and pseudofibrous peat. Strong organic odour. (ALLUVIUM)	(0.70)	
7.20		HP	c_u=20/10/25				7.70	
7.70-8.00	16	B				Very soft light grey mottled reddish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine of mudstone and sandstone. (ALLUVIUM)	(0.30)	
7.80		HP	c_u=15/5/5				8.00	
8.00-8.50	17	B				Extremely weak to very weak reddish brown MUDSTONE. Partially weathered. (MERCIA MUDSTONE GROUP)	(0.70)	
8.20		HP	c_u=225/225/225					
8.50-9.00	18	B					8.70	
8.70		HP	c_u=25/35/40			Extremely weak reddish brown MUDSTONE recovered as soft to firm slightly sandy gravelly clay. Sand is fine to coarse. Gravel is angular to subangular fine to medium of mudstone and sandstone. Partially weathered. (MERCIA MUDSTONE GROUP)	(0.30)	
						Borehole terminated at 9.00m depth.	9.00	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

in borehole with water observed to rise from 9.00m to 7.50m depth on completion.

7. Groundwater and gas installation comprising 2.00m of 50mm plain and 5.70m of 50mm slotted pipe with flush cover.

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Dando 2000**	**M. Gofmonas & M. Zgrzebnicki**	**JDEvans**	

STRUCTURAL SOILS

BOREHOLE LOG

Contract:	Client:	Borehole:
Former Lombard Service Station, Bristol	**Sandy Lane Construction Ltd.**	**BH2**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
733272	**15.10.18** End: **15.10.18**	**---**	**---**	**1** of **2**

Samples and In-situ Tests				Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
						MADE GROUND: CONCRETE slab.	0.20	
0.20-0.40	1	B				MADE GROUND: Brown very sandy very clayey angular to subangular fine to coarse GRAVEL of brick, concrete, clinker and coal. Sand is fine to coarse.	0.40	
0.30	101	ES						
0.30		PID	0.0ppm					
0.50-0.90	2	B				MADE GROUND: Soft dark brown mottled grey slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of brick, concrete, ceramic tile fragments, clinker and coal.	(0.50)	
0.70	102	ES					0.90	
0.70		PID	0.0ppm					
1.00-1.20	3	B				MADE GROUND: Soft orangish brown mottled light brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of mudstone, coal, clinker and concrete.	(0.30)	
1.10	103	ES					1.20	
1.10		HP	c_u=30/30/20					
1.10		PID	0.0ppm			MADE GROUND: Soft to firm dark brown slightly sandy slightly gravelly CLAY with abundant black speckling. Sand is coarse. Gravel is subangular fine to medium of coal, roof tile and brick. Moderate organic odour.	(0.30)	
1.20-1.50	4	B					1.50	
1.40	104	ES						
1.40		HP	c_u=35/40/40					
1.40		PID	0.1ppm					
1.50-2.00	5	B				Stiff greyish brown slightly gravelly silty CLAY with occassional rootlets. Gravel is angular to subangular fine. Mild organic odour. (ALLUVIUM)	(0.50)	
1.70	105	ES					2.00	
1.70		PID	0.1ppm					
1.80		HP	c_u=90/75/85					
2.00-2.50	6	B				Stiff light grey mottled light brown silty CLAY. Mild organic odour. (ALLUVIUM)	(0.50)	
2.20		HP	c_u=100/85/90					
2.30	106	ES					2.50	
2.30		PID	0.0ppm					
2.50-3.00	7	B				Stiff to firm bluish grey mottled light brown silty CLAY with occasional lenses of dark brown organic matter. Mild to moderate organic odour. (ALLUVIUM)	(1.00)	
2.70		HP	c_u=55/40/50					
3.00-3.50	8	B					3.50	
3.20		HP	c_u=35/40/50					
3.50-4.00	9	B				Soft to very soft bluish grey mottled greyish brown silty CLAY with occasional dark brown organic material. (ALLUVIUM)	(1.00)	
3.80		HP	c_u=20/10/25					
4.00-4.50	10	B					4.50	
4.20		HP	c_u=10/20/20					
4.50-5.00	11	B				Very soft light grey mottled greyish brown silty CLAY with occasional brown and dark brown fibrous organic material. (ALLUVIUM)	(0.50)	
4.80		HP	c_u=5/10/10				5.00	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
15/10/18	16:45	9.00	7.70	150	9.00
15/10/18	17:15	9.00	7.70	150	8.10

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

1. GPR and CAT & Genny service scan prior to commencement.
2. Break out concrete slab.
3. Inspection pit dug to 1.20m depth.
4. Borehole stable. Groundwater seepage present in borehole with water observed to rise from 9.00m to 8.10m depth on

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Dando 2000**	**M. Gofmonas & M. Zgrzebnicki**	**JDEvans**	

STRUCTURAL SOILS

BOREHOLE LOG

Contract:	Client:	Borehole:
Former Lombard Service Station, Bristol	**Sandy Lane Construction Ltd.**	**BH2**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
733272	**15.10.18** End: **15.10.18**	**---**	**---**	**2** of **2**

Samples and In-situ Tests				Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
5.00-5.50	12	B				Very soft light grey mottled greyish brown silty CLAY containing pockets of brown and dark brown fibrous and pseudofibrous peat. Strong organic odour. (ALLUVIUM)	(0.50)	
5.20		HP	c_u=0/0/0				5.50	
5.50-6.00	13	B				Very soft light grey mottled greyish brown silty CLAY interbedded with f brous and pseudofibrous peat. Strong organic odour. (ALLUVIUM)	(0.50)	
5.80		HP	c_u=0/5/0				6.00	
6.00-6.50	14	B				Brown and dark brown fibrous and pseudofibrous PEAT interbedded with soft greyish brown silty clay. Strong organic odour. (ALLUVIUM)	(0.50)	
6.20		HP	c_u=20/15/15				6.50	
6.50-7.00	15	B				Very soft to soft bluish grey CLAY with occasional yellowish brown and dark brown f brous organic material. (ALLUVIUM)	(0.75)	
6.70		HP	c_u=15/30/30				7.25	
7.30-7.50	16	B				Very soft brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of sandstone, mudstone, flint and limestone. (ALLUVIUM)	7.50	
7.60-8.00	17	B				Extremely weak to very weak reddish brown with rare light grey mottling MUDSTONE. Partially weathered. (MERCIA MUDSTONE GROUP)	(1.00)	
7.70		HP	c_u=>225/>225/>225					
8.00-8.50	18	B		1				
8.40		HP	c_u=>225/>225/>225				8.50	
8.50-9.00	19	B				Extremely weak reddish brown MUDSTONE. Partially weathered. (MERCIA MUDSTONE GROUP)	(0.50)	
8.80		HP	c_u=>225/>225/205				9.00	
						Borehole terminated at 9.00m depth.		

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

completion.
5. Groundwater and gas installation comprising 2.30m of 50mm plain and 5.00m of 50mm slotted pipe with flush cover.

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Dando 2000**	**M. Gofmonas & M. Zgrzebnicki**	**JDEvans**	

STRUCTURAL SOILS

BOREHOLE LOG

Contract:	Client:	Borehole:
Former Lombard Service Station, Bristol	**Sandy Lane Construction Ltd.**	**BH3**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
733272	**16.10.18** End: **16.10.18**	**---**	**---**	**1** of **2**

Samples and In-situ Tests				Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
						MADE GROUND: CONCRETE slab.	0.20	
						MADE GROUND: Dark brown sandy slightly clayey angular to subangular fine to coarse GRAVEL of brick, concrete, clinker and coal with medium cobble content. Cobbles are angular of brick.	0.30	
0.30-0.70	1	B						
0.50	101	ES				MADE GROUND: Very soft to soft dark brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of brick, coal, clinker, concrete and mudstone.	(0.60)	
0.50		PID	0.0ppm				0.90	
0.90-1.20	2	B				MADE GROUND: Dark brown very gravelly clayey fine to coarse SAND. Gravel is angular to subangular fine to coarse of brick, concrete, ceramic tile fragments and clinker. Occasional glass fragments.	(0.35)	
1.00	102	ES					1.25	
1.00		PID	0.1ppm					
1.20-1.50	3	B						
1.30		HP	c_u=80/100/95			Stiff greyish brown silty CLAY with occasional rootlet structures. Mild organic odour. (ALLUVIUM)	1.50	
1.35	103	ES						
1.35		PID	0.0ppm					
1.50-2.00	4	B				Stiff light grey mottled light brown silty CLAY with rare rootlet structures. (ALLUVIUM)	(1.00)	
1.70		HP	c_u=110/100/115					
1.75	104	ES						
1.75		PID	0.0ppm					
2.00-2.50	5	B						
2.30		HP	c_u=130/120/120				2.50	
2.50-3.00	6	B				Soft to firm bluish grey mottled light brown silty CLAY with occasional yellowish brown organic material. Mild to moderate organic odour. (ALLUVIUM)	(1.00)	
2.60		HP	c_u=50/50/45					
3.00-3.50	7	B						
3.30		HP	c_u=35/35/35				3.50	
3.50-4.00	8	B				Very soft to soft bluish grey with rare light brown mottling CLAY containing occasional black and yellow fibrous organic material. (ALLUVIUM)	(0.50)	
3.60		HP	c_u=10/10/20				4.00	
4.00-4.50	9	B				Very soft light grey mottled greyish brown silty CLAY with rare yellowish brown f brous organic material. (ALLUVIUM)	(1.00)	
4.20		HP	c_u=10/5/10					
4.50-5.00	10	B						
4.80		HP	c_u=0/0/0				5.00	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
16/10/18	12:00	9.00	7.70	150	9.00
16/10/18	13:00	9.30	9.00	150	7.90

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

1. GPR and CAT & Genny service scan prior to commencement.
2. Break out concrete slab.
3. Inspection pit dug to 1.20m depth.
4. Borehole stable. Groundwater strike present in borehole with water observed to rise from 9.30m to 7.59m depth on completion.

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Dando 2000**	**M. Gofmonas & M. Zgrzebnicki**	**JDEvans**	

STRUCTURAL SOILS

BOREHOLE LOG

Contract:	Client:	Borehole:
Former Lombard Service Station, Bristol	**Sandy Lane Construction Ltd.**	**BH3**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
733272	**16.10.18** End: **16.10.18**	**---**	**---**	**2** of **2**

Samples and In-situ Tests				Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
5.00-5.50	11	B				Very soft light grey mottled greyish brown silty CLAY with occasional brown pockets of fibrous and pseudofibrous peat. Mild organic odour. (ALLUVIUM)	(0.30)	
5.30		HP	c_u=5/0/5				5.30	
5.50-6.00	12	B				Very soft to soft light grey mottled greyish brown silty CLAY with interbedded brown fibrous and pseudofibrous peat. Strong organic odour. (ALLUVIUM)	(0.70)	
5.80		HP	c_u=20/10/20				6.00	
6.00-6.50	13	B				Brown and dark brown fibrous and pseudofibrous PEAT with interbedded very soft light grey clay. Strong organic odour. (ALLUVIUM)	(0.50)	
6.30		HP	c_u=5/10/10				6.50	
6.50-7.00	14	B				Soft bluish grey CLAY with occasional light brown fibrous organic material. Moderate organic odour. (ALLUVIUM)	(0.60)	
6.80		HP	c_u=25/30/20				7.10	
7.00-7.50	15	B				Very soft brown mottled light grey slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of sandstone, mudstone and flint. (ALLUVIUM)	(0.60)	
7.40		HP	c_u=0/5/0				7.70	
7.50-8.00	16	B		1		Extremely weak to very weak reddish brown mottled light grey MUDSTONE. Partially weathered. (MERCIA MUDSTONE GROUP)	(0.60)	
7.80		HP	c_u=>225/>225/>225				8.30	
8.00-8.50	17	B				Extremely weak to very weak reddish brown MUDSTONE. Partially weathered. (MERCIA MUDSTONE GROUP)	(0.95)	
8.30		HP	c_u=>225/>225/>225					
8.50-9.00	18	B						
8.70		HP	c_u=>225/>225/>225					
9.00-9.30	1	SPT	5,7/8,10,32 for 0mm				9.25	
						Very weak yellowish brown fine to medium SANDSTONE. (MERCIA MUDSTONE GROUP)	9.30	
						Borehole terminated at 9.30m depth.		

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

5. Groundwater and gas installation comprising 1.50m of 50mm plain and 6.20m of 50mm slotted pipe with flush cover.
6. SPT hammer EQU085-2018 (E_r = 75.30%) used.

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Dando 2000**	**M. Gofmonas & M. Zgrzebnicki**	**JDEvans**	

STRUCTURAL SOILS

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Former Lombard Service Station, Bristol	**Sandy Lane Construction Ltd.**	**WS1**

Contract Ref:	Start: **16.10.18**	Ground Level:	Co-ordinates:	Sheet:
733272	End: **16.10.18**	**---**	**---**	**1** of **2**

Progress	Samples / Tests				Water	Backfill & Instru-mentation	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
							MADE GROUND: CONCRETE slab.	0.20	
							. . . at 0.19m 2mm wire mesh.		
	0.30	101	ES				MADE GROUND: Light brown very sandy angular to subangular fine to coarse GRAVEL of brick, concrete, coal and clinker with a medium cobble content. Cobbles are angular of brick.	0.45	
	0.30		PID	0.0ppm				0.55	
							MADE GROUND: CONCRETE slab.		
	0.80	102	ES				MADE GROUND: Soft dark brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of brick, concrete, clinker and lime.	(0.65)	
	0.80		PID	0.0ppm				1.20	
	1.20-1.65	1	SPT(c)	N=3			MADE GROUND: Soft to firm light grey slightly sandy slightly gravelly CLAY with occasional rootlets. Sand is fine to coarse. Gravel is subangular fine of brick and lime.	1.35	
	1.25	103	ES						
	1.25		PID	0.0ppm				(0.35)	
	1.30		HP	c_u=35/20/45					
1.20 - 2.00 (98mm dia) 90% rec	1.50	104	ES				Firm light brown slightly sandy silty CLAY with occasional shell fragments and abundant rootlets. Sand is fine to medium. (ALLUVIUM)	1.70	
	1.50		HP	c_u=60/60/100					
	1.50		PID	0.0ppm					
	1.90		HP	c_u=90/70/85					
	2.00-2.45	2	SPT(c)	N=10			Firm to stiff light grey mottled light brown CLAY with greyish brown lenses of silt and occasional rootlet structures. (ALLUVIUM)	(0.95)	
2.00 - 3.00 (85mm dia) 100% rec	2.40	105	ES						
	2.40		PID	0.0ppm				2.65	
	2.70		HP	c_u=45/50/55			Firm bluish grey CLAY. (ALLUVIUM)	2.80	
	2.90	106	ES				Firm bluish grey mottled light brown CLAY. (ALLUVIUM)	(0.50)	
	2.90		HP	c_u=45/50/50					
	2.90		PID	0.0ppm					
	3.00-3.45	3	SPT(c)	N=13				3.30	
3.00 - 4.00 (75mm dia) 100% rec	3.50		HP	c_u=20/20/15			Soft becoming very soft bluish grey mottled greyish brown silty CLAY containing rare black and brown fibrous material. (ALLUVIUM)		
	3.70	107	ES						
	3.70		PID	0.0ppm				(1.50)	
	4.00-4.45	4	SPT(c)	N=10					
4.00 - 5.00 (75mm dia) 100% rec	4.50	108	ES						
	4.50		HP	c_u=5/5/5					
	4.50		PID	0.0ppm				4.80	
	4.80		HP	c_u=50/50/50			*Description on next sheet*		
	4.90	109	ES						

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
16/10/18	14:00	6.45	-	50	Dry

General Remarks

1. GPR and CAT & Genny service scan prior to commencement.
2. Break out concrete slab.
3. Inspection pit dug to 0.45m depth.
4. Break out buried concrete floor slab.
5. Inspection dug to 1.20 m depth.
6. Window sample hole dry but clays swelling to close hole.
7. Groundwater and gas installation comprising 1.50m of 40mm plain and 4.50m

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Dando Terrier**	**P. Guinness & J. Evans**	**JDEvans**	

STRUCTURAL SOILS

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Former Lombard Service Station, Bristol	**Sandy Lane Construction Ltd.**	**WS1**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
733272	**16.10.18**	**---**	**---**	**2** of **2**
	End: **16.10.18**			

Progress	Samples / Tests				Water	Backfill & Instru-mentation	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
5.00 - 6.00 (65mm dia) 100% rec	4.90		PID	0.0ppm			Firm becoming soft bluish grey silty CLAY containing occasional light brown fibrous material. (ALLUVIUM)	(0.45)	
	5.00-5.45	5	SPT(c)	N=9				5.25	
	5.20		HP	c_u=20/15/20/5/0/5			*(stratum copied from 4 80m from previous sheet)*		
							Very soft dark grey silty CLAY containing yellowish brown and dark brown fibrous material. (ALLUVIUM)	5.50	
	5.70	110	ES				Very soft to soft greyish brown silty CLAY containing dark brown lenses of fibrous and pseudofibrous peat. Moderate organic odour. (ALLUVIUM)	(0.95)	
	5.70		PID	0.3ppm					
	5.80		HP	c_u=20/10/10					
	6.00-6.45	6	SPT(c)	N=7				6.45	
							Window sample hole terminated at 6.45m depth.		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

of 40 mm slotted pipe with flush cover.

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Dando Terrier**	**P. Guinness & J. Evans**	**JDEvans**	

STRUCTURAL SOILS

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Former Lombard Service Station, Bristol	**Sandy Lane Construction Ltd.**	**WS3**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
733272	**16.10.18**	**---**	**---**	**1** of **1**
	End: **16.10.18**			

Progress	Samples / Tests				Water	Backfill & Instru-mentation	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
							MADE GROUND: CONCRETE slab.	0.10	
	0.20	101	ES				MADE GROUND: Greyish brown very gravelly clayey fine to coarse SAND. Gravel is angular to subangular fine to coarse of brick, concrete and clinker.	(0.30)	
	0.20		PID	0.1ppm				0.40	
	0.60	102	ES				MADE GROUND: Soft brown mottled black slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of brick, concrete, clinker, coal and ceramic tile fragments.	(0.40)	
	0.60		PID	0.0ppm				0.80	
	1.00	103	ES				MADE GROUND: Reddish brown very gravelly clayey fine to coarse SAND with medium cobble content. Gravel is angular to subangular fine to coarse of brick, clinker, concrete and coal.	(0.35)	
	1.00		PID	0.0ppm				1.15	
	1.20-1.65	1	SPT(c)	N=5			MADE GROUND: Very soft to soft dark greyish brown slightly sandy slightly gravelly CLAY with rare rootlets. Sand is fine to coarse. Gravel is angular to subangular fine to medium of clinker and brick.	(0.30)	
	1.30	104	ES					1.45	
	1.30		PID	0.3ppm					
1.20 - 2.00 (98mm dia) 90% rec	1.40		HP	c_u=5/10/15				1.55	
	1.50	105	ES				MADE GROUND: Firm light grey mottled orange slightly sandy silty CLAY. Sand is fine to coarse. Gravel is angular to subangular fine of clinker and metal fragments.		
	1.50		HP	c_u=60/60/70				1.80	
	1.50		PID	0.0ppm			Stiff light brown mottled light grey silty CLAY with occasional rootlet structures. (ALLUVIUM)	(0.50)	
	1.70	106	ES					2.30	
	1.70		HP	c_u=90/100/90			Stiff light grey mottled light brown silty CLAY with rare rootlet structures. (ALLUVIUM)	2.40	
	1.70		PID	0.0ppm					
	1.90		HP	c_u=80/95/100			Stiff bluish grey silty CLAY with rare brown fibrous material. (ALLUVIUM)		
	2.00-2.45	2	SPT(c)	N=7					
	2.00	107	ES						
	2.00		PID	0.0ppm					
2.00 - 3.00 (85mm dia) 100% rec	2.35		HP	c_u=80/90/75					
	2.60		HP	c_u=60/60/50					
							Firm bluish grey mottled light brown CLAY containing occasional pockets of greyish brown silt. (ALLUVIUM)	(1.00)	
	2.90	108	ES						
	2.90		PID	0.0ppm					
	3.00-3.45	3	SPT(c)	N=7				3.40	
3.00 - 4.00 (75mm dia) 100% rec							Soft bluish grey mottled greyish brown silty CLAY. (ALLUVIUM)		
	3.60	109	ES						
	3.60		PID	0.0ppm					
	3.80		HP	c_u=20/30/20				(1.05)	
	4.00-4.45	4	SPT(c)	N=10					
								4.45	
							Window sample hole terminated at 4.45m depth.		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
16/10/18	16:15	4.45	-	50	Dry

General Remarks

1. GPR and CAT & Genny service scan prior to commencement.
2. Break out concrete slab.
3. Inspection pit dug to 1.20m depth.
4. Window sample hole dry but clays swelling to close hole.
5. Groundwater and gas installation comprising 0.50m of 40mm plain and 3.50m of 40 mm slotted pipe with flush cover.

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Dando Terrier**	**P. Guinness & J. Evans**	**JDEvans**	

STRUCTURAL SOILS

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Former Lombard Service Station, Bristol	**Sandy Lane Construction Ltd.**	**WS4**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
733272	**16.10.18**	**---**	**---**	**1** of **1**
	End: **16.10.18**			

Progress	Samples / Tests				Water	Backfill & Instru-mentation	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.10	101	ES				MADE GROUND: CONCRETE slab.	0.08	
	0.10		PID	0.0ppm			MADE GROUND: Dark brown mottled red very gravelly clayey fine to coarse SAND with a medium cobble content. Gravel is angular to subangular fine to coarse of brick, concrete, clinker, coal and occasional glass fragments.	0.15 0.40	
	0.50	102	ES					0.60	
	0.50		HP	c_u=35/40/25			MADE GROUND: Reddish brown very sandy angular to subangular fine to coarse GRAVEL of brick and concrete with a high cobble content. Sand is fine to coarse. Cobbles are angular of concrete.	0.80	
	0.50		PID	0.0ppm					
	0.70	103	ES					1.00	
	0.70		PID	0.0ppm			MADE GROUND: Soft to firm reddish brown mottled light grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of mudstone.	(0.50)	
	0.90	104	ES					1.50	
	0.90		HP	c_u=0/5/0			MADE GROUND: Soft blackish brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of brick, concrete and clinker.	(0.50)	
	0.90		PID	0.0ppm					
	1.10	105	ES				MADE GROUND: Very soft to soft greyish brown mottled black slightly gravelly sandy SILT. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of brick, concrete, coal and clinker.	2.00	
	1.10		PID	0.1ppm					
1.20 - 2.00 (98mm dia) 80% rec	1.20-1.65	1	SPT	N=4			MADE GROUND: Whitish grey slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of lime and concrete.		
	1.60	106	ES				MADE GROUND: Firm dark greyish brown slightly gravelly silty CLAY. Gravel is angular to subangular fine of sandstone and flint. Mild organic odour.		
	1.60		HP	c_u=65/60/50					
	1.60		PID	0.0ppm			Window sample hole terminated at 2.00m depth on obstruction.		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
16/10/18	15:10	2.00	-	98	Dry

General Remarks

1. GPR and CAT & Genny service scan prior to commencement.
2. Break out concrete slab.
3. Inspection pit dug to 1.20m depth.
4. Window sample hole dry and relatively stable.
5. Groundwater and gas installation comprising 0.50m of 40mm plain and 1.50m of 40 mm slotted pipe with flush cover.

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Dando Terrier**	**P. Guinness & J. Evans**	**JDEvans**	

STANDPIPE SUMMARY TABLE

Exploratory Position ID	Pipe ref/ Caption	Ground Level	Length of Pipe (m)	Response Zone Top (m)	Response Zone Base (m)	Slotted Pipe Top (m)	Slotted Pipe Base (m)	Pipe Internal Diameter (mm)	Remarks
BH1	1	---	7.70	2.00	7.70	2.00	7.70	50	
BH2	1	---	7.30	2.30	7.30	2.30	7.30	50	
BH3	1	---	7.70	1.50	7.70	1.50	7.70	50	
WS1	1	---	6.00	1.50	6.00	1.50	6.00	40	
WS3	1	---	4.00	0.50	4.00	0.50	4.00	40	
WS4	1	---	2.00	0.50	2.00	0.50	2.00	40	

STRUCTURAL SOILS
The Old School
Stillhouse Lane
Bedminster
Bristol BS3 4EB

Compiled By		Date	Contract Ref:
J. Evans	JONATHANEVANS	15.01.19	733272
Contract: Former Lombard Service Station, Bristol			Page: 1 of 1

APPENDIX C - GEOENVIRONMENTAL TESTING

(i) Laboratory Test Results

(ii) Initial Waste Characterisation (Haswaste)

(iii) Laboratory UKAS Accreditation Certificate

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

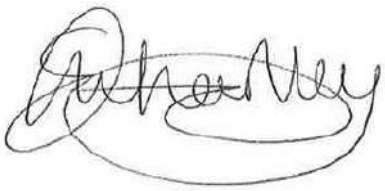
FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/08822
Issue Number: 1 **Date:** 02 November, 2018

Client:
Structural Soils Limited (Bristol)
The Old School
Stillhouse Lane
Bedminster
Bristol
UK
BS3 4EB

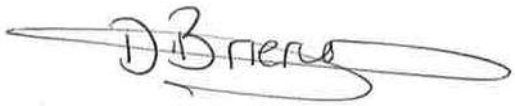
Project Manager: Adam Watts/enviro@soils.co.uk/Jonathan Evans
Project Name: Former Lombard Service Station
Project Ref: 733272
Order No: N/A
Date Samples Received: 22/10/18
Date Instructions Received: 22/10/18
Date Analysis Completed: 02/11/18

Prepared by:



Elisha Hartley
Admin Assistant

Approved by:



Danielle Brierley
Client Manager

Envirolab Job Number: 18/08822

Client Project Name: Former Lombard Service Station

Client Project Ref: 733272

Lab Sample ID	18/08822/1	18/08822/3	18/08822/6	18/08822/7	18/08822/13	18/08822/14	18/08822/17	18/08822/18	Units	Method ref
Client Sample No	101	103	106	101	101	102	101	102		
Client Sample ID	BH1	BH1	BH1	BH2	BH3	BH3	WS1	WS1		
Depth to Top	0.70	1.40	2.70	0.30	0.50	1.00	0.30	0.80		
Depth To Bottom										
Date Sampled	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	4AB	4A	3	4AB		4A	4A			
% Moisture at <40C$_A$	16.7	-	-	14.0	-	22.8	13.1	-	% w/w	A T 044
% Stones >10mm$_A$	28.2	32.1	<0.1	31.5	-	7.6	34.8	-	% w/w	A T 044
pH$_D^{M\#}$	9.47	-	-	10.05	-	9.31	10.25	-	pH	A T 031s
Sulphate (water sol 2 1)$_D^{M\#}$	0.06	-	-	0.06	-	0.06	0.15	-	g/l	A T 026s
Organic matter$_D^{M\#}$	9.7	-	-	5.8	-	12.2	5.5	-	% w/w	A T 032 OM
Arsenic$_D^{M\#}$	18	-	-	16	-	27	16	-	mg/kg	A T 024s
Cadmium$_D^{M\#}$	0.9	-	-	2.1	-	7.9	3.0	-	mg/kg	A T 024s
Copper$_D^{M\#}$	65	-	-	61	-	89	48	-	mg/kg	A T 024s
Chromium$_D^{M\#}$	19	-	-	17	-	19	19	-	mg/kg	A T 024s
Lead$_D^{M\#}$	839	-	-	290	-	442	221	-	mg/kg	A T 024s
Mercury$_D$	1.58	-	-	1.05	-	2.46	1.07	-	mg/kg	A T 024s
Nickel$_D^{M\#}$	25	-	-	23	-	34	17	-	mg/kg	A T 024s
Selenium$_D^{\#}$	<1	-	-	<1	-	<1	<1	-	mg/kg	A T 024s
Zinc$_D^{M\#}$	207	-	-	229	-	210	202	-	mg/kg	A T 024s

Envirolab Job Number: 18/08822

Client Project Name: Former Lombard Service Station

Client Project Ref: 733272

Lab Sample ID	18/08822/1	18/08822/3	18/08822/6	18/08822/7	18/08822/13	18/08822/14	18/08822/17	18/08822/18	Units	Method ref
Client Sample No	101	103	106	101	101	102	101	102		
Client Sample ID	BH1	BH1	BH1	BH2	BH3	BH3	WS1	WS1		
Depth to Top	0.70	1.40	2.70	0.30	0.50	1.00	0.30	0.80		
Depth To Bottom										
Date Sampled	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	4AB	4A	3	4AB		4A	4A			
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_A^{\#}$	NAD	NAD	-	NAD	NAD	NAD	NAD	NAD		A T 045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	-	N/A	N/A	N/A	N/A	N/A		

Envirolab Job Number: 18/08822

Client Project Name: Former Lombard Service Station

Client Project Ref: 733272

Lab Sample ID	18/08822/1	18/08822/3	18/08822/6	18/08822/7	18/08822/13	18/08822/14	18/08822/17	18/08822/18	Units	Method ref
Client Sample No	101	103	106	101	101	102	101	102		
Client Sample ID	BH1	BH1	BH1	BH2	BH3	BH3	WS1	WS1		
Depth to Top	0.70	1.40	2.70	0.30	0.50	1.00	0.30	0.80		
Depth To Bottom										
Date Sampled	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	4AB	4A	3	4AB		4A	4A			
PAH-16MS										
Acenaphthene$_A^{M\#}$	<0.01	-	-	<0.01	-	0.02	0.02	-	mg/kg	A T 019s
Acenaphthylene$_A^{M\#}$	<0.01	-	-	0.02	-	0.01	0.03	-	mg/kg	A T 019s
Anthracene$_A^{M\#}$	<0.02	-	-	0.04	-	0.08	0.06	-	mg/kg	A T 019s
Benzo(a)anthracene$_A^{M\#}$	0.08	-	-	0.33	-	0.50	0.31	-	mg/kg	A T 019s
Benzo(a)pyrene$_A^{M\#}$	0.09	-	-	0.44	-	0.57	0.38	-	mg/kg	A T 019s
Benzo(b)fluoranthene$_A^{M\#}$	0.11	-	-	0.54	-	0.68	0.46	-	mg/kg	A T 019s
Benzo(ghi perylene$_A^{M\#}$	0.05	-	-	0.31	-	0.29	0.31	-	mg/kg	A T 019s
Benzo(k)fluoranthene$_A^{M\#}$	<0.07	-	-	0.18	-	0.19	0.14	-	mg/kg	A T 019s
Chrysene$_A^{M\#}$	0.09	-	-	0.38	-	0.54	0.40	-	mg/kg	A T 019s
Dibenzo(ah)anthracene$_A^{M\#}$	<0.04	-	-	0.07	-	0.08	0.05	-	mg/kg	A T 019s
Fluoranthene$_A^{M\#}$	0.11	-	-	0.53	-	0.86	0.72	-	mg/kg	A T 019s
Fluorene$_A^{M\#}$	<0.01	-	-	<0.01	-	0.02	0.02	-	mg/kg	A T 019s
Indeno(123-cd)pyrene$_A^{M\#}$	0.06	-	-	0.39	-	0.37	0.28	-	mg/kg	A T 019s
Naphthalene$_A^{M\#}$	<0.03	-	-	<0.03	-	<0.03	0.03	-	mg/kg	A T 019s
Phenanthrene$_A^{M\#}$	0.05	-	-	0.20	-	0.41	0.43	-	mg/kg	A T 019s
Pyrene$_A^{M\#}$	0.09	-	-	0.46	-	0.74	0.61	-	mg/kg	A T 019s
Total PAH-16MS$_A^{M\#}$	0.73	-	-	3.89	-	5.36	4.25	-	mg/kg	A T 019s
TPH Banded 1 with ID										
>C6-C8$_A^{M\#}$	<5	-	-	<5	-	<5	<5	-	mg/kg	A T 007s
>C8-C10$_A^{M\#}$	<1	-	-	2	-	<1	2	-	mg/kg	A T 007s
>C10-C12$_A^{M\#}$	<1	-	-	<1	-	<1	<1	-	mg/kg	A T 007s
>C12-C16$_A^{M\#}$	<2	-	-	<2	-	4	5	-	mg/kg	A T 007s
>C16-C21$_A^{M\#}$	7	-	-	11	-	14	32	-	mg/kg	A T 007s
>C21-C40$_A^{\#}$	45	-	-	116	-	115	993	-	mg/kg	A T 007s
TPH ID (for FID characterisations)$_A$	Possible PAHs + other unknown heavier hydrocarbons	-	-	Possible PAHs + other unknown heavier hydrocarbons	-	Possible PAHs + other unknown heavier hydrocarbons	Possible PAHs + other unknown heavier hydrocarbons	-		A T 007s
Total TPH Banded 1 with ID$_A$	52	-	-	129	-	133	1030	-	mg/kg	A T 007s

Lab Sample ID	18/08822/1	18/08822/3	18/08822/6	18/08822/7	18/08822/13	18/08822/14	18/08822/17	18/08822/18	Units	Method ref
Client Sample No	101	103	106	101	101	102	101	102		
Client Sample ID	BH1	BH1	BH1	BH2	BH3	BH3	WS1	WS1		
Depth to Top	0.70	1.40	2.70	0.30	0.50	1.00	0.30	0.80		
Depth To Bottom										
Date Sampled	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	4AB	4A	3	4AB		4A	4A			
VOC										
Dichlorodifluoromethane$_{A}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
Chloromethane$_{A}$	-	<10	-	-	-	-	-	-	µg/kg	A T 006s
Vinyl Chloride$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
Bromomethane$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
Chloroethane$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
Trichlorofluoromethane$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
1,1-Dichloroethene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
Carbon Disulphide$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
Dichloromethane$_{A}$	-	<5	-	-	-	-	-	-	µg/kg	A T 006s
trans 1,2-Dichloroethene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
1,1-Dichloroethane$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
cis 1,2-Dichloroethene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
2,2-Dichloropropane$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
Bromochloromethane$_{A}^{\#}$	-	<5	-	-	-	-	-	-	µg/kg	A T 006s
Chloroform$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
1,1,1-Trichloroethane$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
1,1-Dichloropropene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
Carbon Tetrachloride$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
1,2-Dichloroethane$_{A}^{\#}$	-	<2	-	-	-	-	-	-	µg/kg	A T 006s
Benzene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
Trichloroethene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
1,2-Dichloropropane$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
Dibromomethane$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
Bromodichloromethane$_{A}^{\#}$	-	<10	-	-	-	-	-	-	µg/kg	A T 006s
cis 1,3-Dichloropropene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
Toluene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
trans 1,3-Dichloropropene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
1,1,2-Trichloroethane$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
1,3-Dichloropropane$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
Tetrachloroethene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
Dibromochloromethane$_{A}^{\#}$	-	<3	-	-	-	-	-	-	µg/kg	A T 006s
1,2-Dibromoethane$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s

Lab Sample ID	18/08822/1	18/08822/3	18/08822/6	18/08822/7	18/08822/13	18/08822/14	18/08822/17	18/08822/18	Units	Method ref
Client Sample No	101	103	106	101	101	102	101	102		
Client Sample ID	BH1	BH1	BH1	BH2	BH3	BH3	WS1	WS1		
Depth to Top	0.70	1.40	2.70	0.30	0.50	1.00	0.30	0.80		
Depth To Bottom										
Date Sampled	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	4AB	4A	3	4AB		4A	4A			
Chlorobenzene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
1,1,1,2-Tetrachloroethane$_{A}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
Ethylbenzene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
m & p Xylene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
o-Xylene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
Styrene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
Bromoform$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
Isopropylbenzene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
1,1,2,2-Tetrachloroethane$_{A}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
1,2,3-Trichloropropane$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
Bromobenzene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
n-Propylbenzene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
2-Chlorotoluene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
1,3,5-Trimethylbenzene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
4-Chlorotoluene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
tert-Butylbenzene$_{A}^{\#}$	-	<2	-	-	-	-	-	-	µg/kg	A T 006s
1,2,4-Trimethylbenzene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
sec-Butylbenzene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
4-Isopropyltoluene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
1,3-Dichlorobenzene$_{A}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
1,4-Dichlorobenzene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
n-Butylbenzene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
1,2-Dichlorobenzene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
1,2-Dibromo-3-chloropropane$_{A}$	-	<2	-	-	-	-	-	-	µg/kg	A T 006s
1,2,4-Trichlorobenzene$_{A}$	-	<3	-	-	-	-	-	-	µg/kg	A T 006s
Hexachlorobutadiene$_{A}^{\#}$	-	<1	-	-	-	-	-	-	µg/kg	A T 006s
1,2,3-Trichlorobenzene$_{A}$	-	<3	-	-	-	-	-	-	µg/kg	A T 006s

Envirolab Job Number: 18/08822

Client Project Name: Former Lombard Service Station

Client Project Ref: 733272

Lab Sample ID	18/08822/1	18/08822/3	18/08822/6	18/08822/7	18/08822/13	18/08822/14	18/08822/17	18/08822/18	Units	Method ref
Client Sample No	101	103	106	101	101	102	101	102		
Client Sample ID	BH1	BH1	BH1	BH2	BH3	BH3	WS1	WS1		
Depth to Top	0.70	1.40	2.70	0.30	0.50	1.00	0.30	0.80		
Depth To Bottom										
Date Sampled	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	4AB	4A	3	4AB		4A	4A			
TPH CWG										
Ali >C5-C6$_A^{\#}$	-	-	<0.01	-	-	-	-	-	mg/kg	A T 022s
Ali >C6-C8$_A^{\#}$	-	-	0.01	-	-	-	-	-	mg/kg	A T 022s
Ali >C8-C10$_A^{M\#}$	-	-	<1	-	-	-	-	-	mg/kg	A T 055s
Ali >C10-C12$_A^{M\#}$	-	-	<1	-	-	-	-	-	mg/kg	A T 055s
Ali >C12-C16$_A^{M\#}$	-	-	<1	-	-	-	-	-	mg/kg	A T 055s
Ali >C16-C21$_A^{M\#}$	-	-	<1	-	-	-	-	-	mg/kg	A T 055s
Ali >C21-C35$_A$	-	-	<1	-	-	-	-	-	mg/kg	A T 055s
Total Aliphatics >C5-C35$_A$	-	-	<1	-	-	-	-	-	mg/kg	A T 055s
Aro >C5-C7$_A^{\#}$	-	-	<0.01	-	-	-	-	-	mg/kg	A T 022s
Aro >C7-C8$_A^{\#}$	-	-	<0.01	-	-	-	-	-	mg/kg	A T 022s
Aro >C8-C10$_A^{M\#}$	-	-	<1	-	-	-	-	-	mg/kg	A T 055s
Aro >C10-C12$_A^{M\#}$	-	-	<1	-	-	-	-	-	mg/kg	A T 055s
Aro >C12-C16$_A$	-	-	<1	-	-	-	-	-	mg/kg	A T 055s
Aro >C16-C21$_A^{M\#}$	-	-	<1	-	-	-	-	-	mg/kg	A T 055s
Aro >C21-C35$_A^{M\#}$	-	-	1	-	-	-	-	-	mg/kg	A T 055s
Total Aromatics >C5-C35$_A$	-	-	1	-	-	-	-	-	mg/kg	A T 055s
TPH (Ali & Aro >C5-C35)$_A$	-	-	1	-	-	-	-	-	mg/kg	A T 055s
BTEX - Benzene$_A^{\#}$	-	-	<0.01	-	-	-	-	-	mg/kg	A T 022s
BTEX - Toluene$_A^{\#}$	-	-	<0.01	-	-	-	-	-	mg/kg	A T 022s
BTEX - Ethyl Benzene$_A^{\#}$	-	-	<0.01	-	-	-	-	-	mg/kg	A T 022s
BTEX - m & p Xylene$_A^{\#}$	-	-	<0.01	-	-	-	-	-	mg/kg	A T 022s
BTEX - o Xylene$_A^{\#}$	-	-	<0.01	-	-	-	-	-	mg/kg	A T 022s
MTBE$_A^{\#}$	-	-	<0.01	-	-	-	-	-	mg/kg	A T 022s

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Lab Sample ID	18/08822/22	18/08822/27	18/08822/28	18/08822/30	18/08822/35	18/08822/39	18/08822/40		Units	Method ref
Client Sample No	106	101	102	104	109	104	105			
Client Sample ID	WS1	WS3	WS3	WS3	WS3	WS4	WS4			
Depth to Top	2.90	0.20	0.60	1.30	3.60	0.90	1.10			
Depth To Bottom										
Date Sampled	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18			
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES			
Sample Matrix Code	3		4AB	5	3	4A	4A			
% Moisture at <40C$_A$	-	-	20.3	-	-	-	25.3		% w/w	A T 044
% Stones >10mm$_A$	<0.1	-	6.3	<0.1	<0.1	1.2	4.3		% w/w	A T 044
pH$_D^{M\#}$	-	-	9.49	-	-	-	13.40		pH	A T 031s
Sulphate (water sol 2 1)$_D^{M\#}$	-	-	0.07	-	-	-	0.03		g/l	A T 026s
Organic matter$_D^{M\#}$	-	-	8.2	-	-	-	2.7		% w/w	A T 032 OM
Arsenic$_D^{M\#}$	-	-	17	-	-	-	13		mg/kg	A T 024s
Cadmium$_D^{M\#}$	-	-	<0.5	-	-	-	1.6		mg/kg	A T 024s
Copper$_D^{M\#}$	-	-	141	-	-	-	22		mg/kg	A T 024s
Chromium$_D^{M\#}$	-	-	14	-	-	-	8		mg/kg	A T 024s
Lead$_D^{M\#}$	-	-	862	-	-	-	199		mg/kg	A T 024s
Mercury$_D$	-	-	42.7	-	-	-	1.27		mg/kg	A T 024s
Nickel$_D^{M\#}$	-	-	16	-	-	-	4		mg/kg	A T 024s
Selenium$_D^{\#}$	-	-	<1	-	-	-	<1		mg/kg	A T 024s
Zinc$_D^{M\#}$	-	-	182	-	-	-	56		mg/kg	A T 024s

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Lab Sample ID	18/08822/22	18/08822/27	18/08822/28	18/08822/30	18/08822/35	18/08822/39	18/08822/40		Units	Method ref
Client Sample No	106	101	102	104	109	104	105			
Client Sample ID	WS1	WS3	WS3	WS3	WS3	WS4	WS4			
Depth to Top	2.90	0.20	0.60	1.30	3.60	0.90	1.10			
Depth To Bottom										
Date Sampled	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18			
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES			
Sample Matrix Code	3		4AB	5	3	4A	4A			
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_A^{\#}$	-	NAD	NAD	-	-	-	NAD			A T 045
Asbestos ACM - Suitable for Water Absorption Test?	-	N/A	N/A	-	-	-	N/A			