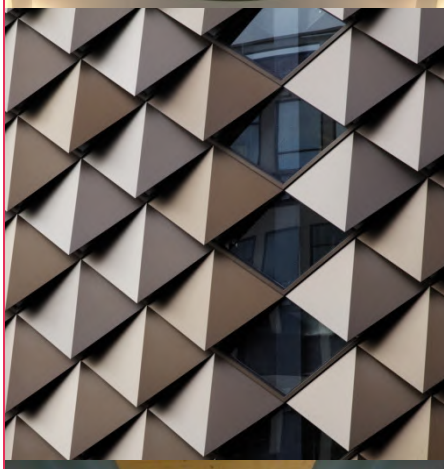








London Road Fire Station, Manchester

Phase 2 Intrusive Investigation

Curtins Ref: B061230/JB/8131

Revision: A

Issue Date: 27 January 2017

Client Name: Allied London

Client Address: 33 Cork Street, London, W1S 3NQ

Site Address: London Road Fire Station, London Road, Manchester, M1

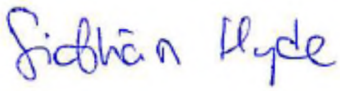
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-	Phase 2 Intrusive Investigation	JB	SH	27 January 2017
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Executive Summary

Heading	Description
Site Details	National Grid Reference 384670, 397820 with the site covering an area of approximately 0.62Ha.
Current Setting	The site is occupied by a Grade II* Listed historic fire station, currently in disuse. The building comprises of four storeys with basements under the west corner, north, east and south of the building onsite. There is a large courtyard in the centre and a tower on the southern flank.
Development Proposals	It is understood that development proposals comprise refurbishment of the existing structure, construction of a single storey structure in the courtyard The development is planned to include a hotel, restaurants, bars and retail units, and, from the second floor upwards, residential apartments.
Site History	Historical Ordnance Survey plans indicate the site in the 1850s-90s was developed with high density terraced houses with a road intersecting the site. In the early 20th Century the terraced houses were removed and a single building, named as Chief Fire Station, was constructed with a courtyard in the centre. Later the site is sub-divided into police station and ambulance station, gas meter test station, coroner's court and bank with the rest of the site remaining a fire station and yard. In the 1940s a control room was constructed in the south-east and in the 1950-60s the northwest of the site is used for a motor repairs workshop. By 1992 the additional building in the southeast of the central courtyard has been demolished with the site then remaining relatively unchanged and unoccupied until the present day.
Fieldworks	The intrusive investigation was undertaken between 22nd August and 5th September 2016 and comprised one window sample borehole to 5.00m bgl (WS03); three cable percussive boreholes (BH1-BH3) to 10m bgl, with BH2 being extended by rotary drilling to 15m bgl; four machine-excavated trial pits (TP01-TP04), to a maximum depth of 5m bgl; and six hand-excavated trial pits (HP01, HP03, HP04, HP06-HP09) to a maximum depth of 2.5m bgl.
Ground Conditions	Strata encountered comprised surface covering of concrete and/ or brick paving overlying Made Ground to depths of 0.30-2.70m bgl. Anthropogenic fragments within the Made Ground included brick concrete, ash, plastic bags, metal, wood and glass. Directly beneath the Made Ground, Cohesive Glacial Till of firm-stiff, brown, sandy, slightly gravelly clay and Granular Glacial Till / Residual Soil of red, brown, sandy, silty gravel and red, brown, slightly silty, very clayey, fine-coarse sand, with occasional clay bands was present. The underlying sandstone bedrock was partially weathered and recovered as red, brown, slightly gravelly sand. The bedrock was identified at depths of 5.60m, 8.60m and 5.90m bgl, in BH01, BH02 and BH03 respectively. Existing Foundations (Basement Level) - HP01 and HP03 encountered foundations which comprised iron columns on concrete pads. HP04, HP06, HP07 and HP09 encountered foundations comprised of stepped brick wall upon concrete. At the base of the foundations HP06 and HP08 encountered Sand, and HP04 and HP07 encountered Sandstone. Existing Foundations (Courtyard Level) - Existing foundations, of stepped brick wall, were present in TP02-TP04, with TP02 and TP04 encountering concrete below the stepped brick wall. TP01 did not encounter any foundations. Additional investigations of existing foundations will need to be carried out to confirm the details of existing foundations, for structural design and to avoid clashes. This will require foundation inspection pits to be dug.
Contamination	Given that the proposed end use of the site is commercial use on the lower floors and residential apartments on the upper floors, the report compares the chemistry analysis results from soil samples collected from each exploratory hole against 'Commercial' end-use GAC thresholds. No Tier 1 Threshold exceedances were recorded in the Made Ground and natural soils. Therefore, any potential exposure to contamination, is considered Unlikely to end-users and the associated risks considered as **Low**. As only limited contamination has been identified within the Made Ground soils onsite, with clayey Glacial Till underlying it and the bedrock containing the Principal Aquifer significantly deeper, the risks to groundwater and surface water receptors (controlled waters) are therefore considered to be **Low** and **Very Low**, respectively.
Ground Gas	Three gas monitoring visits have been undertaken to date, with barometric pressure recorded at 1010-1017mb. Maximum readings of 2ppm for hydrogen sulphide (H_2S), 3ppm for carbon monoxide (CO) and peak concentrations of 0.5-1.6% for Carbon Dioxide were recorded. Methane (CH_4) and gas flow were recorded below the instrument's detection limit within all of the monitoring wells throughout the monitoring period. In accordance with an assessment by CIRIA C665 the GSV indicates a Characteristic Situation 1 (CS1) gas regime which does not require any gas protection measures. It is considered that the risk posed to site end users from ground gases is **Low**. Upon the completion of the six gas monitoring visits, the results and subsequent recommendations will be issued

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Heading	Description
	as an addendum to this report. The site is at a **Low** risk from Radon, however as the new development incorporates a basement the advice of a specialist Radon assessor must be obtained to fully assess the risk posed to end-users of the site.
Foundations	It is recommended that structural loads are transferred to partially weathered sandstone below basement floor level. The nature of the foundations will depend on construction sequence with regards to underpinning and support of existing structures, and the excavation sequence for basements beneath existing structures and across the basement footprint. The following foundation types may be considered: - Spread Foundations beneath the basement floor assuming very dense sand and extremely weak sandstone is present at the base of the excavation, an allowable bearing pressure about 250kN/m^2 is considered appropriate for square pad foundations up to 3m by 3m. - Piled Foundations may be used to transfer structural loads to the underlying sandstone. The carrying capacity of piles depends, not only on their size and the ground conditions, but also on their method of installation. Pile design and installation are continuously evolving processes and state-of-the-art methods are often employed before they reach the public domain, perhaps several years ahead. It is recommended that specialist Piling Contractors be consulted as to the suitability and carrying capacity of their piles in the ground conditions found onsite.
Excavation and Support	Excavations <1.00m should stand unsupported in the short term when battered back to a suitable angle of repose. Side support for safety purposes should of course be provided to all excavations which appear unstable. Those >1.20m deep, should be undertaken in accordance with the Health and Safety Regulations. Excavations for basements should be fully supported, and be designed and constructed in accordance with Health and Safety Regulations. Support systems should be designed with due consideration to the current buildings. Conventional mechanical plant should be suitable for excavations through Made Ground, Clay and Sand. Concrete and obstructions within the Made Ground and the excavation of Sandstone may necessitate the use of hydraulic breakers or similar. Groundwater should not be expected in shallow excavations for foundations or services, however it is possible that Perched Groundwater could be present in the Made Ground overlying the natural strata. It is considered that this could be dealt with by localised pumping.
Concrete Design	For overall design purposes, it is recommended that a Design Sulphate Class of DS-1 and ACEC Class of AC-1 be adopted for the site.
Preliminary Waste Classification	The initial assessment revealed that of the twelve soil samples tested, nine samples have indicated to be non-hazardous waste for offsite disposal. However, three samples have indicated to be hazardous waste for offsite disposal owing to the concentrations of Boron classed as hazard property HP6. The Contractors should satisfy themselves regarding the classification of any waste arisings. Confirmation of acceptability should be sought from receiving landfill or treatment facility via the issue of laboratory chemical testing results.

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Appendix A1 - Drawings

Appendix A2 - Exploratory Hole Logs, Photographs & Foundation Dimensions

Appendix A3 - Laboratory Testing & Monitoring Results

Appendix A4 - Tier 1 Thresholds

Appendix A5 - Qualitative/Quantitative Risk Assessment Rationale

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1.0 Introduction

1.1 Project Background

In August 2016 Curtins were instructed by Allied London, to undertake a Phase 2 Ground Investigation at the site of the London Road Fire Station building, London Road, Manchester.

The site is approximately centred on National Grid Reference 384670, 397820 and is currently occupied by a Grade II* Listed historic fire station, currently in disuse. There is a large courtyard in the centre and tower on the southern flank.

It is understood that development proposals comprise refurbishment of the existing structure, construction of a new single storey structure in the courtyard and extension of existing basements under the building to extend across the whole development footprint. The development is planned to include a hotel, restaurants, bars and retail units, and from the second floor upwards, residential apartments.

The Phase 2 Ground Investigation has been undertaken in support of the redevelopment of the site with mixed retail, commercial and residential use. The current development plans are included within *Appendix A1* of this report.

1.2 Scope of Works

The Phase 2 Ground Investigation was undertaken in order to provide an assessment of the ground conditions on the subject site with respect to any potential contamination in the underlying soils and or groundwater.

Specifically, the Phase 2 report is intended to determine;

a) If there is a risk of the proposed end user being adversely impacted upon by potential contamination in shallow site soils that may be present on the site due to its known current, recent and historical use;
b) If there is a risk of groundwater and/or surface water being adversely impacted upon by potential contamination that may be present on the site due to its known current, recent and historical use;
c) If there is a risk to the end user from soil gases including methane, carbon dioxide, oxygen and hydrogen sulphide;
d) Recommendations for the design of foundations and building ground floor slabs; and
e) Recommendations for the specification of sub-structure concrete and water supply pipes.

At the time of writing this report, some ground gas monitoring results remain outstanding. Upon receipt of these results, this report will be updated as a revised version or addendum report, along with any changes in recommendations for this development.

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2.0 Site Setting and Existing Reporting

This section of the report presents a summary of the site setting with reference to the Curtins Phase 1 Preliminary Site Assessment (Ref.1) conducted (report ID: B060270.001/APA/6737 Rev A), dated May 2016.

2.1 Current Setting

The development area covers approximately 0.62Ha within the city centre region of Manchester. It is occupied by a Grade II* Listed historic fire station, currently in disuse. It comprises of a four storey building, with basements under the west corner, north, east and south of the building onsite. There is a large courtyard in the centre, tower on the southern flank and potentially an underground tank in the centre-north of the courtyard.

The site is bounded by Minshull Street South to the west, Whitworth Street (A6) to the north and east and Fairfield Street (B6469) to the south). The immediate surrounding area compromises of office, residential and commercial use with Manchester Piccadilly Station to the east of the site.

2.2 Previous Site Uses

Historical Ordnance Survey plans indicate the site in 1850s-90s was developed with a high density terraced houses with a road intersecting the site. By 1908 the terraced houses have been removed and a single building, named as Chief Fire Station, is present with a courtyard in the centre. In 1922 the building is sub-divided into police station and ambulance station in the west, gas meter test station in the north, coroner's court and bank in the east with the rest of the site remaining a fire station and yard. In the 1940s a control room was constructed in the south-east and a chimney is present in the west of the site. By 1950s-60s the ambulance station and gas meter test station are no longer present and motor repairs workshop is located in the northwest of the site. By 1992 the additional building in the southeast of the central courtyard has been demolished.

The surrounding land, in the late 19th century, was predominantly developed for residential and industrial use. By Early 20th Century, a tramway is constructed adjacent to the south of the site and demolition of residential buildings surrounding the site. and used for agriculture. Rochdale Canal is located to the north of the site. By Late 20th Century there is wider urban development across the area.

2.3 Published Geology

A study of the Envirocheck recorded and British Geological Survey (BGS) 1:50,000 mapping recorded (Bedrock and Superficial Editions) for Manchester (Sheet 085) indicates the following geological succession underlying the site:

- **Made Ground – (**Undivided) of *Holocene Age*.

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- **Superficial** – Glacial Till (Diamicton) of *Devensian Age*.
- **Bedrock** – Chester Pebble Beds Formation (sandstone) of *Early Triassic Age*.

Five BGS fault lines, trending northwest-southeast are found within 1000m of the site; the closest are 200m northeast and southwest of the site.

There are a number BGS historical borehole records available within the surrounding area from Corporation Sewer Shafts, approximately 10m north of the site (BGS ID: SJ89NW1 at grid location 384628, 397838). They record Made Ground depth is 3.35-8.84m bgl, the Glacial Till is not always present underlying the Made Ground, and the Bedrock was encountered at 8.84-10.06m bgl.

2.3.1 Mining

The site is situated within an area which may be affected by coal mining. The Coal Authority's online interactive mapping suggests a number of mine entry locations >1000m east of the site. The tool outlines the presence of a development high risk area approximately 600m east of the site. No evidence of mining was noted within the historical mapping within the site, or the area immediately surrounding the site.

Based on the foregoing commentary the likelihood of encountering relic mining features on site is considered to be unlikely and therefore has not been considered further.

2.3.2 Radon

The BGS Radon Mapping confirms part of the site is situated in a low probability radon area as less than 1% of homes are above the action level. On this basis, radon protection measures are not considered necessary within the proposed development and have not been considered further.

As this development incorporates a basement the advice of a specialist Radon assessor must be obtained.

2.4 Hydrogeology and Hydrology

2.4.1 Hydrogeology

The Groundwater Vulnerability Map presented within the Envirocheck report indicates that the site is underlain by a Principal Aquifer situated within the bedrock. *Principle Aquifers are layers of rock of drift deposits that have high intergranular and/or fracture permeability – usually providing a high level of water storage.*

The southern proportion of the site is located within a Secondary Undifferentiated Aquifer within the superficial deposits. *Secondary Undifferentiated Aquifers are that that have been assigned*

in cases where it is not possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

The Envirocheck Report notes low permeability drift deposits occurring at the surface and overlying Major and Minor Aquifers are head, clay-with-flints, brickenearth, peat, river terrace deposits and marine and estuarine deposits.

The site is located within an area of High Groundwater Vulnerability but with Limited Potential for Groundwater flooding to occur.

There are two groundwater abstraction sites recorded 252m west of the site for a borehole for non-evaporative cooling, operated by West Contracting since January 2009.

The site is not situated within a designated groundwater Source Protection Zone (SPZ).

2.4.2 Hydrology

The Envirocheck Report identifies a surface water feature 42m north of the site. There are a number of additional watercourses, such as canals and streams identified within the wider region.

The site is not situated in an area that is known to be at risk from extreme flooding or flooding from rivers or sea.

A small portion of the north and southeast of the courtyard, south, north and northeast boundaries of the site are at low risk (1000 year return period) to flooding from surface water. The north corner of the site is at high (30 year return period) to medium (100 year return period) risk from surface water flooding.

There are seventy-two discharge consents within 1000m of the site; the closest is 53m northwest of the site, operated by United Utilities Ltd on Minshull Street, Manchester for storm Sewage Overflow.

There are twenty-six Pollution Incidents to Controlled Waters noted within 1000m of the site; the closest is 39m north from private sewage system in March 1991.

2.5 Landfill

According to the Envirocheck report there are no recorded Historic or Currently Operational Landfills onsite or within 250m of the site.

There are a number of locations of Potentially Infilled Land within 1000m of the site location; the nearest, located 45m west of the site is described as unknown filled ground (pond, marsh, river, stream, dock etc.) dated 1956.

2.6 Unexploded Ordnance (UXO) Risk Assessment

During WWII, the site was located in an area of Moderate bombing density, as confirmed by official statistics and mapping. UXO risk mapping indicates the site to be in close proximity to areas of Manchester suggested as being of high risk and locations of >1000 bomb tonnage.

Analysis of known bomb drop locations, presented during war years, indicates that a number of positions in close proximity to the western boundary of the site. As such, it stands to reason that UXO existence may be prevalent in locations which were known to be affected by bombing activity during this period.

The nature of the ambient land use; incorporating works, engineering works, emergency service facilities and train stations, suggests the possibility to targeted bombing raids across the region thereby accounting for previously suggested damage and, with regards to future works, the possibility of UXO presence across the region. Limited development across the site during post-war years may suggest limited chance for UXO disturbance or discovery.

The exact nature of the site geology (Till) is not known however is considered likely to comprise fine grained (clay) soils resulting in a large range of potential UXO penetration depths from around 0.50m up to 14.00m below ground level.

At this stage the proposed development works are likely to entail; ground investigations, shallow excavations for earthworks and the emplacement of spread foundations (subject to ground conditions revealed) with localised deep excavations possible, e.g. drainage alignments. In general, the shallow nature or very small footprint (boreholes) of these activities will further reduce the likelihood of UXO being encountered. The consequence of a UXO strike is invariably severe.

Based on the foregoing commentary, as the building was occupied throughout prior to, during and after WWII, and no ammunitions or bomb damage were noted on the site, there is deemed very low risk of UXO being discovered on the site.

2.7 Significant Features Potentially Affecting Re-Development

The site maintains the presence of a Grade II* Listed Building.

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3.0 Preliminary Conceptual Model

The following sub-sections present assessments of the potential sources, pathways and receptors that exist within the site conceptual model.

Potential source-pathway-receptor linkages that may arise are identified in the following section, the Qualitative Risk Assessment.

3.1 Potential Sources

- **Made-Ground soils onsite -** may be some localised spillage/leakage of fuels, oils, chemicals, industry related products, ash and clinker deposition associated with coal combustion, and uncontrolled deposition of Made Ground arising from construction/ demolition processes.

  The nature and type of general contamination may include, amongst others; ash and clinker, hydrocarbons (e.g. fuel oils), non-metals, heavy metals and asbestos.

- **Made-Ground soils offsite -** deemed the result of periods of construction/ demolition and the industrial history of the surrounding area.
  Potential contaminants could arise due to construction activities, atmospheric deposition and land management. The nature and type of general contamination may include, amongst others; ash and fill, hydrocarbons (e.g. fuel oils), industrial chemicals, non-metals, heavy metals and asbestos.
- **Ground Gas generating** - sources may be present within Made Ground deposits surrounding the site anticipated from historical developments and land use. There are no records of organic rich drift deposits (e.g. peat) being present. Noxious and asphyxiate gases may therefore include, but not be limited to; carbon dioxide, carbon monoxide, methane and hydrogen sulphide.

3.2 Potential Pathways

- **Direct contact, ingestion and inhalation (dust and vapours)** - may occur where the end user is exposed to; solid, dust or volatile components of soils on site.
- **Vertical migration -** may occur within the possible natural deposits on site both upwards, due to processes including; capillary action, burrowing animals inducing soil mixing and downwards into the natural deposits due to processes including; infiltration. Vertical migration of soil gases is identified as a specific pathway. Soils of high leaching potential are indicated as being present on the site, leaving potential for downward migration to controlled waters.
- **Lateral migration -** may occur within the natural deposits due to processes including; the influence of perched or natural groundwater flow patterns and natural or man-made high

permeability zones, e.g. sand lenses or drainage runs or pores/voids within natural and made-ground soils for soil and mine gases.

3.3 Potential Receptors

- **End users -** including residents, general public, construction workers and site maintenance staff.
- **Controlled waters (groundwater) -** corresponding with the underlying geology, the site is underlain by a Principal Aquifer. There are two groundwater abstraction points located within 500m of the site.
- **Controlled waters (surface water) - t**he nearest surface water feature is located 42m north of the site.
- **Construction workers during development of the site -** construction workers will be exposed to potential sources however, wearing the correct personal protective equipment and adoption of suitable working practices will reduce this risk.
- **Construction materials buried concrete and water supply pipes** - may be compromised by the potential presence of aggressive ground conditions or contamination.
- **Local ecology -** protected species onsite and within local habitats; e.g. woodland, hedgerow, grassland and water.

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4.0 Phase 2 Investigation Proposals

A number of potential sources of onsite contamination were identified as detailed in Section 3.1 and the risks presented by ground gases also warrant further investigation.

Potential contaminants of concern associated with the onsite sources include, amongst others; organic compounds including hydrocarbons, polycyclic aromatic hydrocarbons arising from incomplete combustion and inorganic compounds including metals, non-metals and asbestos.

Noxious and asphyxiate ground/mine gases may include, but not be limited to; carbon dioxide, carbon monoxide, methane and hydrogen sulphide.

The Desk Study concluded that there could be a risk of the site end user being adversely impacted upon by material potentially present on the site. A strategy for the initial Phase 2 Ground Investigation was derived accordingly and is detailed in Section 5.0.

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5.0 Fieldwork

5.1 General

The site investigation fieldworks were undertaken by Ian Farmers Associates Ltd (IFA) between Monday 22nd August and Monday 5th September 2016.

The scope of the ground investigation was designed in general accordance with current UK guidance including CLR11 (Ref.2), British Standard (BS) 10175 (Ref.3), BS5930:2010 (Ref.4) and Eurocode 7 (Ref.5). A summary of the scope and rationale are summarised in Table 5.1 below.

Table 5.1 Scope and Rationale of Fieldwork Undertaken

Activity	Rationale
One window sample borehole to a maximum depth of 5.00m bgl (WS03).	To determine the shallow ground conditions beneath the development footprint.
Three cable percussive boreholes (BH1-BH3) to 10m bgl with BH2 being extended by rotary drilling techniques to 15m bgl.	To determine the deep ground conditions beneath the development footprint.
Four machine-excavated trial pits (TP01-TP04) to a maximum depth of 5m bgl.	To determine the in-situ condition of the ground to be examined both laterally and vertically, and to allow discontinuities to be recorded, beneath the development footprint.
Six hand-excavated trial pits (HP01, HP03, HP04, HP06-HP08) to a maximum depth of 2.5m bgl.	To determine the in-situ condition of the ground to be examined both laterally and vertically; often to examine existing foundations beneath the development footprint.
Description and logging of soil arisings from exploratory holes.	To provide a characterisation of ground conditions and inform sample selection for laboratory analysis.
Collection of representative soil samples from exploratory hole arisings.	To enable laboratory Environmental and Geotechnical analysis of recovered soil samples.
Installation of monitoring wells in four exploratory holes.	To enable a ground gas and groundwater monitoring to be undertaken.
In-situ testing.	To determine geotechnical properties of the strata revealed.

Curtin's drawings ref. B061230/L001 Rev C and B061230/L002 Rev C records the locations of the exploratory holes at the site, copies of which are contained within *Appendix A1*. Due to site constraints, WS01, WS02 and WS04 were not advanced.

5.2 Soil Logging and Sampling

Exploratory arisings were logged on site by a qualified Engineer. All exploratory holes were logged in accordance with the requirements of BS5930 (Ref.4**Error! Bookmark not defined.**), including recording observed visual and olfactory indications of contamination. Exploratory hole logs are provided in *Appendix A2*.

Representative soil samples were selected for laboratory chemical analysis, based on field observations and to provide a characterisation of the Made Ground and natural strata encountered. Selected soil samples were placed in laboratory provided containers and stored in cool boxes prior to being transported to the nominated laboratory under the laboratory's chain of custody documentation. The laboratory selected by Curtins for chemical analysis was Scientific Analysis Laboratories Ltd, a UKAS and MCERTS accredited laboratory.

5.3 Monitoring Well Installations

Gas and groundwater monitoring installations (50mm diameter) were installed within four of the exploratory holes (BH01, BH02, BH03 and WS03). A bentonite seal was placed above and below the screened section of the borehole to minimise potential for downward migration of contaminants and the creation of a preferential migratory pathway. A gravel surround was installed in the annulus between the sides of the borehole and the slotted sections of pipe.

A summary of the response zones is presented in Table 3.2 below.

Table 5.3 *Monitoring Well Response Zones*

Borehole Reference	Response Zone(s) (m bgl)	Strata Description(s) (Principal strata in capitals)
BH01	3.00 – 5.00	SUPERFICIAL DEPOSITS (clays and gravels)
BH02	9.00 – 12.00	SANDSTONE (weathered)
BH03	1.00 - 6.00	MADE GROUND (clay) & SUPERFICIAL DEPOSITS (clay & sand)
WS03	1.00 – 3.50	SUPERFICIAL DEPOSITS (clay)

Copies of borehole logs can be referred to in *Appendix A2* of this report.

5.4 Post-Investigation Monitoring

5.4.1 Ground Gas Monitoring

As previously highlighted, it is considered that the predominant feature associated with ground gas generation and migration across the site is from suspected Made Ground features;

potentially infilled ground within the surrounding region. An initial programme of six ground gas monitoring visits, over three months, was proposed.

Due to the establishment of an ice rick within the site's courtyard area over the Christmas period, ground gas monitoring was put on hold throughout November and December 2016, with monitoring due to recommence late January 2017.

5.4.2 Groundwater Sampling

If adequate groundwater is available for allow sufficient sample collection, groundwater samples will be collected from three borehole locations across the site and tested by a broad environmental testing suite.

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6.0 Laboratory Testing

A programme of environmental chemistry testing was scheduled, with analytical suites developed reflecting the findings of the summary desk study and onsite observations.

Given the potential site wide source of contamination (Made Ground and natural soils) the sampling positions (boreholes) were generally located in a non-targeted, systematic array to give adequate and representative coverage of the site accounting for the historical site use, proposed end use and the immediate environmental setting.

6.1 Soil Analysis

The contaminants of concern potentially present on the site were considered to include, amongst others; organic matter, ash and fill, hydrocarbons (e.g. fuel/oils), heavy metals and asbestos, the extent of which is captured by the broad environmental testing suite listed in Table 6.1a and 6.1b below.

Table 6.1a *Environmental Chemistry Analysis Suite : Soils*

Suite Ref.	Analysis	LOD
Suite A	Asbestos Screen	-
	pH	-
	Soil Organic Matter	0.1 mg/kg
	Arsenic	5 mg/kg
	Boron (water soluble)	1 mg/kg
	Cadmium	0.5 mg/kg
	Chromium	5 mg/kg
	Chromium VI	5 mg/kg
	Copper	5 mg/kg
	Lead	5 mg/kg
	Mercury	0.1 mg/kg
	Nickel	5 mg/kg
	Selenium	5 mg/kg
	Zinc	5 mg/kg
	Cyanide (total)	10 mg/kg
	Sulphate (total)	200 mg/kg
	Sulphide	2 mg/kg
	Sulphur (elemental)	20 mg/kg
	Phenols (screen)	1 mg/kg
	PAH's (USEPA16)	0.1 mg/kg
	TPH (Aro/Ali Split)	0.01 mg/kg to 0.1 mg/kg

Table 6.1b *Environmental Chemistry Analysis Suite : Soils*

Suite Ref.	Analysis	LOD
Suite B	pH	-
	Soil Organic Matter	0.1 mg/kg
	Arsenic	5 mg/kg
	Boron (water soluble)	1 mg/kg
	Cadmium	0.5 mg/kg
	Chromium	5 mg/kg
	Chromium VI	5 mg/kg
	Copper	5 mg/kg
	Lead	5 mg/kg
	Mercury	0.1 mg/kg
	Nickel	5 mg/kg
	Selenium	5 mg/kg
	Zinc	5 mg/kg
	Cyanide (total)	10 mg/kg
	Sulphate (total)	200 mg/kg
	Sulphide	2 mg/kg
	Sulphur (elemental)	20 mg/kg
	Phenols (screen)	1 mg/kg
	PAH's (USEPA16)	0.1 mg/kg
	TPH Banded (C10-C40)	10 mg/kg

Eight Made Ground samples were tested for Suite A and four natural soil samples from across the site were tested for Suite B. Copies of the environmental chemistry testing certificates presented in *Appendix A3*.

6.2 Geotechnical Analysis

Soil samples for testing were prepared in accordance with BS1377: Part One: 1990 and representative sub-samples were taken for testing. The following tests were carried out:

No. Tested	Description
3	Moisture Content
3	Plasticity Indicies
3	Particle Size Distribution (wet)
3	Undrained shear strength
3	Oedometer consolidation
6	Water soluble sulphate
6	pH value

Copies of the testing certificates are presented in *Appendix A3*.

Rock samples for geotechnical testing were prepared and tested in accordance with ISRM Suggested Methods (Ref.6) and 4 Point Load Index Test (PLT) was carried out. Copies of the rock test results are presented in *Appendix A3*.

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7.0 Ground Conditions

The strata encountered during the investigation is generally in agreement with the expected geology from BGS geology mapping. The strata generally comprised of Made Ground overlying clay and sand, underlain by sandstone bedrock.

Curtin's drawings ref. B061230/L001 Rev C and B061230/L002 Rev C record the locations of the exploratory holes on the site, copies of which are contained within *Appendix A1*.

7.1 Made Ground

Made Ground was encountered at all locations from ground level to depths of 0.30-2.70m bgl. Concrete was present in all locations, apart from BH02 and BH03, from ground level to a depth of 0.27m bgl. Brick paving was present in WS03 to 0.05m bgl. BH02 encountered brick paving to 0.10m bgl with concrete directly underlying it to 0.20m bgl.

Beneath the ground covering, varying Made Ground was present comprising coarse soils of sand and gravel with localised clay. A coarse soil, of dark brown, sandy, angular-subangular gravel with localised sand, was present in all locations except TP02, at depths from ground level and 0.27m bgl. Within HP04 and TP01 a Made Ground, of brown, very gravelly, fine-coarse sand, was encountered at depths of 0.05-1.10m bgl.

The coarse soils extended to 0.30-2.65m bgl. Underlying that in BH01, BH03, and TP01-TP03, was Made Ground comprising of very soft-firm, dark brown, sandy, slightly gravelly clay, to depths of 0.25-1.30m bgl. The base of the clay was encountered at 1.53-2.70m bgl.

Low to medium cobble content and anthropogenic fragments, including brick concrete, ash, plastic bags, metal, wood and glass, were present throughout the Made Ground. Made Ground was present to depths of 0.30-2.70m bgl, except in HP01, TP01, TP02 and TP04 where the base of the Made Ground was not proven as they terminated at depths of 1.76-2.65m bgl.

Laboratory analysis of Made Ground recorded pH values of 8.4-8.8 and soluble SO_4 contents of 44-150mg/l.

7.2 Cohesive Glacial Till

Cohesive Glacial Till was recorded underlying Made Ground comprising of firm to stiff, brown, sandy, slightly gravelly clay, in BH01-BH03, HP03, HP07 and WS03 at depths of 0.30-2.10m bgl with a thickness ranging between 0.40m-3.00m. The base of the clay was proven to a maximum depth of 4.00m bgl in BH03.

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The consistencies of the clay were determined by logging, laboratory tests and derivation from in-situ tests (reported in Section 10.1). Laboratory analysis of the clay recorded pH values of 8.3-8.6 and soluble SO_4 contents of 49-350mg/l.

7.3 Granular Glacial Till / Residual Soils from Completely Weathered Bedrock

Within BH01-BH03, HP02, HP06, HP08 and WS03 coarse soil, of sand and gravel, was encountered at depths in range of 0.33-4.00m bgl, and may represent more granular soils of Glacial Till or residual soil derived from completely weathered sandstone. The proven base of the coarse soils was encountered in BH01-BH03 at depths of 5.60-8.60m bgl.

Red, brown, sandy, silty gravel was present in BH01 and BH02 at 3.70m bgl and 3.60m bgl, respectively. Red, brown, slightly silty, very clayey, fine-coarse sand, with occasional clay bands, at depths of 0.33-4.00m was present in BH03, HP02, HP06, HP08 and WS03.

Laboratory analysis of the coarse soil has given pH values of 8.4 and soluble SO_4 contents of 120mg/l.

7.4 Bedrock

Sandstone bedrock was encountered beneath the Glacial till / Residual soils and recovered as partially weathered red, brown, slightly gravelly sand at depths of 5.60m, 8.60m and 5.90m bgl, in BH01, BH02 and BH03 respectively. HP04 and HP07 were advanced from the floor of the basements and encountered sandstone bedrock at depths of 1.40m and 0.77m bgl respectively. The base of the bedrock was not proven as BH01, BH02 and BH03 were terminated at depths of 8.00m, 17.00m and 8.00m bgl in the sandstone.

7.5 Existing Foundations – Basement Level

Existing foundations were present in HP01, HP03, HP04, and HP06-HP08. Due to service restrictions HP02, HP05 and HP09 were cancelled.

HP01 and HP03 encountered foundations which comprised iron columns on concrete pads; the top of the concrete pads were at 0.75m and 0.30m bgl respectively, and bases at 0.79m and 1.55m bgl respectively. A second layer of concrete in HP01 was encountered at 0.79m bgl. Overall the base of the foundations in HP01 and HP03 were at 1.90m in Made Ground and 1.37m bgl in Sand, respectively.

HP04, HP06, HP07 and HP09 encountered foundations comprised of stepped brick wall upon concrete at depths of 0.12-0.62m bgl, with the base of the concrete at 0.94-1.65m bgl. HP06 and HP07 had foundation step out of 0.20m and 0.05m respectively, and HP08 had multiple step outs of 0.05-0.50m giving an overall length of 0.85m. No step out was present in HP04. At the base of the foundations HP06 and HP08 encountered Sand, and HP04 and HP07 encountered Sandstone.

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The dimensions of the foundations in HP01, HP03, HP04 and HP06-HP08 are shown in *Appendix A2*.

Additional investigations of existing foundations will need to be carried out to confirm the details of existing foundations, for structural design and to avoid clashes.

7.6 Existing Foundations – Courtyard Level

Existing foundations, of stepped brick wall, were present in TP02-TP04, with TP02 and TP04 encountering concrete below the stepped brick wall. TP01 did not encounter any foundations.

TP02 and TP04 have an approximate step out of 0.50m and total step out of 0.20-0.36m, upon concrete at depth of 1.46m and 1.42m bgl respectively. TP02 had a concrete step out of 0.18m and encountered a clay pipe at 0.50m bgl. The base of the foundations were not proven; TP02 was terminated in Made Ground at 2.00m bgl and TP04 was terminated due to an obstruction in Made Ground at 1.76m bgl.

TP03 has an approximate step out of 0.05m on each step, with a total step out of 0.45m, and the base of the brick at 1.15m bgl within Clay.

The dimensions of the foundations in TP02-TP04 are shown in *Appendix A2*.

Additional investigations of existing foundations will need to be carried out to confirm the details of existing foundations, for structural design and to avoid clashes.

7.7 Groundwater

Groundwater was not encountered in any of the exploratory holes during site investigation, however it was encountered in one exploratory hole during subsequent site visits. The observed groundwater depths recorded shown in Table 7.7 below. Information recorded to date during monitoring may be referenced within Curtins Gas Monitoring Sheets contained within *Appendix A3*.

Table 7.7 *Groundwater Gauging Data*

Exploratory Hole Reference ID	Depth to groundwater to date (m bgl)		
	Visit 1: 27/09/2016	Visit 2: 12/10/2016	Visit 3: 25/10/2016
BH01	Dry	Dry	Dry
BH02	Dry	11.74	11.78
BH03	Dry	Dry	Dry
WS03	Dry	Dry	Obstructed by parked car

8.0 Geochemical Ground and Groundwater Assessment

This section of the report includes the assessment of the potential contamination, solid, liquid and gas, identified on the subject site which may present a risk to the proposed end users, associated utilities and the wider environment.

In guidance published by the Environment Agency, the risk to human health or controlled waters is determined through an assessment of pollutant linkages between a source of contamination (within the ground or groundwater either on or off site) and a sensitive receptor such as end users of the site, building materials, edible plants grown in gardens or groundwater abstracted for drinking. This is termed a source-pathway-receptor relationship. The same model is applied to the assessment of risk arising from ground gases as detailed within BS8576:2013 (Ref.7).

These models have a common approach, which is one of a tiered assessment. At each stage of the assessment further detail can be applied to the conceptual site model to provide a detailed interpretation on a site by site basis. As part of the planning process this approach is adopted in order to establish either if the site is 'suitable for use' or whether additional work or else remedial work is required in order for the site to be deemed so.

The sub-sections hereafter therefore incorporate the first tier (Tier 1) of this approach otherwise referred to as the Generic Quantitative Risk Assessment (GQRA). The GQRA builds on the observations made during the ground investigation and is based solely on the results of the chemical and other testing data obtained as part of Curtins ground investigation. The GQRA is used to build/refine the Conceptual Site Model (CSM) for the site as detailed and presented in Section 8.0 of this report.

The following sections present more detail on the risk assessment methodology rationale for the main receptors.

8.1 Generic Quantitative Risk Assessment – Human Health

Detailed guidance on human health risk assessment is available within a number of documents, published by both the Environment Agency and Defra. Guidance includes Contaminated Land Exposure Assessment (CLEA) v1.06 model (Ref.8).

A generic quantitative risk assessment (GQRA) has been carried out for the Potential Contaminant Linkages (PCLs) investigated by screening of soil contamination data against relevant Generic Assessment Criteria (GAC) where available, including:

i) **Soil Guideline Values (SGVs):** These have been published by the Environment Agency and are trigger values for screening out low risk areas of land contamination. SGV's give an indication of representative average concentrations of chemicals in soil, below which long-term health risks are likely to be minimal. SGVs have been published for a number of contaminants including arsenic, cadmium, mercury, nickel, selenium, BTEX, phenols and dioxins, furans and

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dioxin-like PCB substances for land uses including residential, allotments and commercial. The SGVs have been developed for a sandy loam soil with 6% soil organic matter (SOM) content;

ii) **Supplementary Screening Values:** In addition to the SGVs developed by the EA other third party organisations have derived GACs for a wider range of contaminants and land uses using the CLEA Model. Curtins have adopted these numbers where applicable, including those developed by Atkins AtriskSoil™, the LQM/CIEH Suitable for Use Levels (S4UL) and EIC/AGS/CL:AIRE published thresholds.

iii) **Category 4 Screening Levels (C4SLs):** In March 2014 Defra published C4SLs for arsenic, benzene, benzo(a)pyrene, cadmium, hexavalent chromium and lead. These values were derived to support the revised Part 2A Statutory Guidance issued in 2012 (Ref.9) in which four categories of contaminated land are included, ranging from Category 1 (significant/high risk) to Category 4 (low risk). C4SLs are not representative of significant possibility of significant harm (SPoSH) and are low risk levels which, and therefore where the C4SLs are not exceeded, land can be demonstrated to be in Category 4 and cannot be determined as contaminated land.

The proposed end use of the site is for mixed commercial and residential use with basement under the building footprint and courtyard. The basement, ground and first floors are proposed to be for commercial use, with residential accommodation on the second and third floors. Therefore, this site is considered to be most analogous with a *Commercial* end-use scenario and so assessment has been undertaken against this criteria.

Details of the GAC's adopted for the GQRA are provided in *Appendix A4*.

8.1.1 Site Soils

Representative samples from shallow site soils were taken from twelve exploratory sample holes across the site with Made Ground samples tested for Suite A and natural strata samples tested for Suite B respectively, as previously described in Section 6.1. The samples were collected at variable depths in accordance with observed ground conditions noted during the drilling process.

As discussed within the previous section, comparison of the soil analysis results has been undertaken against Generic Assessment Criteria (GAC) for a *Commercial* end-use scenario.

The results of the environmental testing can be referred to in *Appendix A3*. Copies of the adopted Tier 1 thresholds are contained within *Appendix A4*.

Soil organic matter (SOM) has a strong bearing on the availability of potential contaminants and therefore influences the Tier 1 thresholds. Soil organic matter (SOM) values for the site soils ranged 1.8-24.0%.

With consideration for a calculated geometric average, shallow soil samples features determine an SOM of 6.66% while the deeper soils maintain a lower valuation of 2.07%. As such, a comparison against Tier 1 thresholds for a conservative SOM of 1.0% for a *Commercial* end-use has been adopted for all soil samples analysed.

With respect to the proposed end-use of the site, and the implementation of previously discussed thresholds, no contaminant exceedances have been recorded within the investigated soil samples. Consequently, the risk from Made Ground and natural soils to the end-user is considered **Low**.

Asbestos was not detected in any of the samples analysed as part of this investigation.

8.2 Generic Quantitative Risk Assessment – Controlled Water

Insufficient groundwater is available within the exploratory holes to allow groundwater sampling. Groundwater was found within BH02 at 11.74-11.78m bgl within bedrock strata.

As limited soil contamination has been recorded in the Made Ground soils, with clayey Glacial Till underlying it and the bedrock containing the Principal Aquifer significantly deeper, the risks to groundwater and surface water receptors (controlled waters) are therefore considered to be **Low** and **Very Low**, respectively.

8.3 Generic Quantitative Risk Assessment – Ground Gas

The assessment of risk presented by ground gases is assessed with reference to guidance published by CIRIA (Assessing Risks Posed by Hazardous Ground Gases to Buildings, C665 (Ref.10), BSI Publication (Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings BS8485:2015 (Ref.11) and other broadly accepted references such as the Ground Gas Handbook 2009 (Ref.12).

The gas risk assessment adopts a tiered approach. In the first instance this involves a re-evaluation of the Conceptual Site Model described within the Phase 1 Preliminary Site Assessment Desk Study (Ref.1) and thereafter validating this conceptual model with the ground gas data, the semi-quantitative risk assessment.

8.3.1 Land Gas Monitoring Results

The ground investigation revealed a ground model predominantly consistent with the preliminary conceptual site model. Generally, the strata encountered was Made Ground deposits, Glacial Till superficial deposits (Clay, Gravel and Sand) and bedrock deposits (Sandstone).

In order to characterise the site's gas regime and validate the qualitative assessment of ground gas risk, standpipe installations were incorporated within four exploratory borehole locations as detailed in Section 5.3 and the logs contained within *Appendix A2* of this report.

An initial programme of six gas monitoring visits over three months was proposed. At the time of writing this report, three visits have been undertaken (27th September 2016, 12th October 2016 and 25th October 2016), with barometric pressure recorded at 1010-1017mb.

Due to the establishment of an ice rick within the site's courtyard area over the Christmas period, ground gas monitoring was put on hold throughout November and December 2016, with monitoring due to recommence early February 2017.

A summary of the soil gas monitoring results to date is presented in Tables 8.3.1 below and copies of the log sheets presented in *Appendix A3*.

Table 8.3.1 *Summary of Soil Gas Monitoring Results*

Borehole Reference	Maximum Gas Flow (l/hr)	Maximum CO_2 Concentration (% $^{vol}/_{vol}$)	Maximum CH_4 Concentration (% $^{vol}/_{vol}$)	Minimum Steady O_2 Reading	Response Zone
BH01	<0.1	0.6	<0.1	20.1	Open (2m)
BH02	<0.1	1.1	<0.1	14.6	Open (3m)
BH03	<0.1	1.6	<0.1	19.9	Open (5m)
WS03	<0.1	0.5	<0.1	13.9	Open (3.5m)

Maximum reading of 2ppm for hydrogen sulphide (H_2S) and 3ppm for carbon monoxide (CO) were recorded. Methane (CH_4) and gas flow were recorded below the instrument's detection limit within all of the monitoring wells throughout the monitoring period. Carbon Dioxide was recorded in peak concentrations between 0.5-1.6%.

8.3.2 Land Gas Assessment

The Conceptual Site Model presented within the Phase I Preliminary Site Assessment identified possible Made Ground deposits as a potential source of Ground Gas generation both onsite and offsite resulting from historical development and land use. The report suggests no records of organic rich drift deposits (e.g. peat) being present. Additionally, coal deposits are noted to not underlie the site. Noxious and asphyxiate gases were attributed to include, but not limited to, carbon dioxide, carbon monoxide, methane and hydrogen sulphide. The consequence was evaluated as a High risk.

The ground investigation revealed a ground model generally consistent with the preliminary conceptual site model. Made Ground soils were encountered to depths of between 0.30m to

2.70m bgl but with limited putrescible content generally, and natural deposits were generally clay, sand and gravel with no significant putrescible/organic content.

Consideration of the recorded soil gas flow rates, presented above, enables hazardous gas flow rates to be evaluated. Q_{hg} can be derived for both 'worst credible' and 'worst possible' scenarios and a comparison made in support of an appropriate assessment of ground gas risk. For a 'worst credible' scenario steady state flow rates are adopted, whilst for a 'worst possible' scenario peak flows are adopted.

Evaluation of the 'worst credible scenario' (highest hazardous gas flow rate that is realistically possible, i.e. in a single borehole) and 'worst possible scenario' (highest Q_{hg} across the entire dataset irrespective of location and discrete monitoring events) records a maximum Q_{hg} of 0.0016 l/hr for carbon dioxide.

This worst possible scenario has been adopted as the sites Gas Screening Value (GSV) and in accordance with an assessment by CIRIA C665 the GSV indicates a Characteristic Situation 1 (CS1) gas regime which does not require any gas protection measures. It is considered that the risk posed to sites end users from ground gases is **Low** risk.

This recommendation is however subject to the results of the outstanding gas monitoring visits, the results of which together with any recommendations will be issued within an addendum or revised version of this report.

The potential risks from ground gases to the excavations are to be dealt with by the Contractor, in accordance with the Confined Space Regulations, during construction. Appropriate ground gas monitoring and safety measures should be in place during the works, as the potential presence of ground gases could pose a risk in any confined spaces of deep excavations.

8.4 Materials Management

8.4.1 Re-use of Site Soils

Based on the geochemical testing results presented as part of this investigation it is considered that there is no specific requirement to remove soils from site as a result of them presenting an unacceptable risk to human health or the environment.

The re-use of site-won soils may therefore be undertaken if the following principles are met:

i) the geotechnical suitability of the material needs to be confirmed;
ii) the re-use of the material needs to be covered as part of the planning approval, e.g. site levels maintained within agreed limits;
iii) the volume of the material being re-used needs to be confirmed and traceable; and
iv) regulatory approval from the relevant authorities has been sought.

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These principles are outlined within the CL:AIRE Development Industry Code of Practice (v2) (Ref.13) and if and where the re-use of site-won soils is proposed as part of the development works it is recommended that a Materials Management Plan is produced in line with the Code of Practice to detail and document the process.

8.4.2 Preliminary Waste Classification

Where any site soils are to be disposed of offsite guidance on the disposal of contaminated soils is provided within the following document published by the Environment Agency, the Guidance on the classification and Assessment of Waste Technical Guidance WM3 (1st Edition 2015) (Ref.14).

Guidance states that the Principal Contractor (or any other sub-contractor undertaking excavations) should, in conjunction with the proposed disposal facility, use where possible the relevant environmental chemistry analysis results to classify any surplus material identified for offsite disposal. However, it should be noted that this information is for guidance only and material identified for disposal will have to be tested and assessed in accordance with WM3 to enable classification during the works.

An initial assessment for the waste classification of the shallow site soils encountered on site has been undertaken through a comparison of the soil testing results against the Tier 1 Thresholds and using the Waste Soils Characterisation Assessment Tool, Cat-WasteSoil, developed by McArdle and Atkins. This online tool gives a rapid assessment of contaminated soils and their classification as either hazardous or non-hazardous (stable non-reactive hazardous waste) waste, it should be noted that this tool does not classify inert waste.

The initial assessment revealed that of the twelve soil samples tested, nine samples have indicated to be non-hazardous waste for offsite disposal. However, three samples have indicated to be hazardous waste for offsite disposal owing to the concentrations of Boron in borehole BH02, TP02 and WS03 at depths of 2.70m, 0.5m and 0.80m bgl respectively, classed as hazard property HP6.

As discussed, preliminary waste classification is undertaken to offer indicative advice with respect to disposal requirements. Landfill operators are not obliged to accept waste and, if they were to do so, may have specific requirements beyond those outlined above prior to acceptance. The Contractors should satisfy themselves regarding the classification of any waste arisings. Confirmation of acceptability should be sought from receiving landfill or treatment facility via the issue of laboratory chemical testing results.

9.0 Revised Conceptual Site Model

The Preliminary Conceptual Site Model (PCSM) discussed in Section 3.0 of this report has been revised following the GQRA in Section 8.0 above. The Conceptual Site Model (CSM) is presented in the table on the following page and a Diagrammatic Conceptual Site Model is presented in *Appendix A1*.

The CSM details the source-pathway-receptor linkages or potential pollutant linkages (PPL) that have been identified for the site. The GQRA details the associated level of risk relating to these potential pollutant linkages.

The CSM concerns risk to human health and Water Environment with additional, more specific risk assessment protocols contained within the main body of this reporting, as detailed below.

The CSM follows the framework outlined within CIRIA C552 which is summarised within *Appendix A5*.

The 'risk rating' within the CSM refers to the risk that the source, pathway, receptor linkage or PPL is complete. Unless specifically stated it does not necessarily refer to an immediate risk and is intended to be used as a tool to assess the necessity for further assessment/investigation.

9.1 Additional Risk Assessments

The following risk assessments, listed below, are not included within the main CSM and GQRA but none-the-less can be of critical importance to the onward development of the site.

- The risk presented by Mining is discussed and assessed in Section 2.3.1.
- The risk presented by Radon is discussed and assessed in Section 2.3.3.
- The risk presented by UXO is discussed and assessed in Section 2.6.

Under current health and safety legislation, employers are required to carry out their own appropriate risk assessments and mitigation to protect themselves and their employees, other human receptors and the environment from potential contamination. Such risks must be adequately mitigated by law, specifically the Construction Design Management (CDM) Regulations, 2015 which require that potential risks to human health and the environment from construction activities are appropriately identified and all necessary steps taken to eliminate / manage that risk. It has been assumed that any future construction works on site will be undertaken in compliance with these requirements and therefore construction workers involved in the building works at the site have been discounted as a human receptor in the conceptual site model. Reference should be given to the environmental testing results discussed within Section 8.0 and presented within *Appendix A3*.

Qualitative Risk Assessment → Generic Quantitative Risk Assessment → Detailed Quantitative Risk Assessment or; Remedial Action

- The table below represents the Second stage in the land quality risk assessment process; the Revised Conceptual Site Model following the Quantitative Risk Assessment.
- In order for a development site to be deemed 'suitable for use' the level of risk needs to be brought down to acceptable levels, i.e. low to negligible risk. The purpose of each stage of risk assessment is ultimately to establish if there is a requirement for additional levels of assessment to be made in order to have sufficient confidence to support a risk characterisation or management decision, e.g. remedial action.

Conceptual Site Model			Quantitative Risk Assessment			Action
Identified Sources	**Pathway(s)**	**Receptor(s)**	**Consequence (Potential Severity)**	**Likelihood of Occurrence**	**Risk Rating**	
Onsite Sources of Potential Contamination: Made Ground was encountered in all exploratory holes across the site beneath a surface covering of concrete and/or brick paving, with a maximum depth of 2.70m bgl encountered in BH03.	**Direct contact, ingestion, inhalation (dust and vapours)**	**End users of site** Residents, employees and general public	**Medium** Chronic health risk	**Unlikely** Limited soil contamination, not exceeding relevant thresholds, was recorded within the site soils. Furthermore, the redevelopment of the site will involve the removal of much of the Made Ground for basements, therefore, any potential exposure to contamination, although unlikely given the isolated nature, will be mitigated.	**Low**	**No further action recommended**
	Vertical migration through the superficial deposits (soils) May occur due to processes including; capillary action, burrowing animals inducing soil mixing and downwards into the natural deposits through infiltration.	**Groundwater** Principal Aquifer. No groundwater abstractions identified within 500m of the site. The site is not within a Source Protection Zone.	**Medium** Pollution of sensitive water resources	**Unlikely** Due to limited soil contamination, with clayey Glacial Till underlying the Made Ground and the bedrock containing the Principal Aquifer significantly deeper, there is limited potential for impact to underlying groundwater body.	**Low**	**No further action recommended**
	Horizontal migration over and through the superficial deposits (soils) May occur due to the influence of perched or natural groundwater flow patterns and natural or man-made high permeability zones, e.g. sand lenses or drainage runs.	**Surface Water Environment** There is a surface water feature noted 41m northwest of the site.	**Low** Pollution of non-sensitive water resources	**Unlikely** Due to limited soil contamination and clayey Glacial Till underlying the Made Ground, there is limited potential for impact for contaminants to migrate into surface water bodies.	**Very Low**	**No further action recommended**
Potential on and offsite soils with the potential to generate ground gases include: Made Ground soils on & off site.	**Vertical and horizontal migration through the superficial and bedrock deposits**	**End user of site** Residents, employees and general public	**Medium** Human health risk	**Unlikely** No significant onsite sources of ground gas noted in the Made Ground or natural soils, in the monitoring visits carried out so far.	**Low**	**Gas monitoring visits to be completed and risk assessment updated with final results and any recommendations**

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10.0 Geotechnical Assessment

10.1 Structural Design Details

It is understood that the proposed development comprises of:

- The excavation of a new basement across the existing courtyard area and into areas underneath the existing building where there isn't existing basement, and
- The construction of one storey new building in the courtyard.

The current development plans are presented within *Appendix A1*.

The comments and discussion below do not fall within the requirement of EC7 (Ref.5) and are offered for guidance. The comments and recommendations below should be reviewed as development details become available.

10.2 Geotechnical Testing Results

Copies of the geotechnical testing certificates are presented in *Appendix A3*.

10.2.1 Standard Penetration Test Results

Made Ground - Four SPT 'N' values in the range of 1-20 were attained, indicating variable strength within the Made Ground.

Cohesive Glacial Till - Six SPT 'N' values in the range of 11-40 were attained within the clay. The SPT 'N' values have been used to obtain approximate Cu values in clay. The derived Cu values, excluding the highest value, in the range of 55-200N/m^2 have been determined where full penetration was achieved and have been based on an f_1 value of about 5. The derived values indicate medium, high and very high strength material.

Granular Glacial Till/Residual soils – Seven SPT 'N' values in the range of 14-50 blows with a penetration of 130-220mm were obtained, indicating relative densities of medium dense to dense and very dense. The three highest SPT values of 50 blows for 220mm, 180mm and 130mm were recorded at 5.00m bgl (BH01), 6.00m and 7.50m bgl (BH02); these values may signify sandstone bedrock. The outstanding four SPT 'N' values range from 14-48 representative of a medium dense and dense strata.

Sandstone Bedrock – Six SPT 'N' values recorded >50 blows with penetration of 60-147mm. Extrapolation of those values to 300m penetration results in 'N' values of 102-250.

The strength of the bedrock may be approximately based on: $\sigma_c > 10N$ (kN/m^2) [where σ_c – unconfined compressive strength (UCS), and N – SPT 'N' value] (approach based on CIRIA

Report 143 (1995) represents a lower bound value of UCS). On this basis lower bound strengths are 1.02-2.5MN/m^2 for the sandstone; indicating a very weak material.

10.2.2 Cohesive Glacial Till

Geotechnical Testing Results - The Atterberg Limit and moisture content determination tests were undertaken on three clay soil samples from the Glacial Till. The results are summarised in Table 10.2.2a below:

Table 10.2.2a Atterberg Limits and Moisture Contents

Description	Results
Moisture Content	15-18.3%
Plastic Limit	18-20%
Plasticity Index[1]	18-20
Material passing through 425µm sieve	83-93%

[1] Corrected in accordance with NHBC Chapter 4.2

Based on the above results the Glacial Till maybe classified as Intermediate Plasticity Clay. From on the measured plastic index values the Glacial Till is classified as low volume change.

Consolidation - Three samples of Glacial Till were assessed for consolidation and recorded coefficient of compressibility (mv) of 0.11m2/MN, 0.18m2/MN and 0.12m2/MN at pressure stages rising from overburden. The values indicate medium compressibility.

Unconsolidated Undrained Triaxial Compression - Three samples of the Glacial Till were tested for undrained shear strength (Cu) and the results are detailed in Table 10.2.2b below:

Table 10.2.2b Unconsolidated Undrained Triaxial Compression Results

Sample	Depth (m)	Cu (kN/m^2)
BH01	3.00	303
BH02	2.00	310
BH03	3.00	184

These values indicate very high and extremely high strength material.

10.2.3 Granular Glacial Till / Residual Soils - Particle Size Distribution (PSD)

Six samples of the coarse soil were recovered and the results recorded a coarse constituent of 23-40% and fine (silt and clay) component of 7-18%. Therefore, the material is medium and fine gravel with secondary sand content.

10.3 Foundations

The investigation in the courtyard proved Made Ground to depths of 0.60-2.70m bgl underlain by Glacial Till and residual soils with weathered sandstone bedrock present at depths of 5.60m, 8.60m and 5.90m bgl. It is recommended that structural loads are transferred to weathered sandstone below basement floor level.

The nature of the foundations will depend on construction sequence with regards to underpinning and support of existing structures, and the excavation sequence for basements beneath existing structures and across the basement footprint.

The following foundation types may be considered:

- **Spread Foundations** beneath the basement floor - assuming very dense sand and extremely weak sandstone is present at the base of the excavation, an allowable bearing pressure about 250kN/m^2 is considered appropriate for square pad foundations up to 3m by 3m.
- **Piled Foundations** – may be used to transfer structural loads to the underlying sandstone. The carrying capacity of piles depends, not only on their size and the ground conditions, but also on their method of installation. Pile design and installation are continuously evolving processes and state-of-the-art methods are often employed before they reach the public domain, perhaps several years ahead. It is recommended that specialist Piling Contractors be consulted as to the suitability and carrying capacity of their piles in the ground conditions found onsite.

10.4 Floor Slabs

It is expected that the weathered sandstone bedrock will be encountered below the basement floor level. Based on this assumption, a Ground Bearing Floor Slab may be utilised for the basement floor. Ground floor slabs will be suspended on columns extending to both pad foundations of pile caps.

10.5 Excavations

Based on onsite observations, and the results of in-situ and laboratory tests, it is considered that excavations to <1.00m should stand unsupported in the short term. Side support for safety purposes should, of course, be provided to all excavations which appear unstable, and those >1.20m deep in accordance with Health and Safety Regulations.

Excavations for basements should be fully supported, and be designed and constructed in accordance with Health and Safety Regulations. Support systems should be designed with due consideration to the current buildings.

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Conventional mechanical plant should be suitable for excavations through Made Ground, Clay and Sand. Concrete and obstructions within the Made Ground and the excavation of Sandstone may necessitate the use of hydraulic breakers or similar.

Groundwater should not be expected in shallow excavations for foundations or services, however it is possible that Perched Groundwater could be present in the Made Ground overlying the natural strata. It is considered that this could be dealt with by localised pumping.

10.5.1 Bedrock

Point Load Tests (PLT) – four PLT tests were carried out on sandstone recovered from rotary cores and gave PLT $Is_{(50)}$ values ranging <0.04-<0.09MPa. The Unconfined Compressive Strength (UCS) can be derived from PLT $Is_{(50)}$ x 20 = UCS. This indicates UCS values of 0.8-1.8MN/m^2 and signifies extremely weak and very weak materials.

10.6 Buried Concrete

The site has been classified in accordance with BRE Special Digest 1 (Ref.15), as Greenfield without the presence of pyrite, and laboratory testing undertaken accordingly. It is recommended that the guidelines given in BRE Special Digest 1 be implemented, and that the groundwater should be regarded as mobile.

The following table shows the results of laboratory sulphate concentration testing as 2:1 water/soil extract, and the concrete class based on the laboratory results.

Table 10.6 *Sulphate Concentration Results and Recommended Concrete Class*

Strata	Sulphate Concentration (mg/l)	pH	Design Sulphate Class	ACEC Class
Made Ground	44 – 150	8.4 – 8.8	DS-1	-
Natural Strata	49 – 350	8.3 – 8.6	DS-1	AC-1

For overall design purposes, it is recommended that a Design Sulphate Class of DS-1 and ACEC Class of AC-1 be adopted for the site.

10.7 Additional Structural Investigation Works

Additional investigations of existing foundations will need to be carried out to confirm the details of existing foundations, for structural design and to avoid clashes. This will require foundation inspection pits to be dug.

11.0 Conclusions & Recommendations

11.1 Conclusions

A revised tabulated revised Conceptual Site Model has been derived following the findings on the Generic Quantitative Risk Assessment risk assessment and is presented in Section 9.0.

11.1.1 Ground Model

Made Ground - was encountered at all locations from ground level to depths of 0.30-2.70m bgl. Concrete and/ or brick paving was present in all locations. Beneath the ground covering, varying Made Ground was present comprising coarse soils of sand and gravel with localised clay. The coarse soil comprised dark brown, sandy, angular-subangular gravel with localised sand, or brown, very gravelly, fine-coarse sand, or very soft-firm, dark brown, sandy, slightly gravelly clay. Low to medium cobble content and anthropogenic fragments, including brick concrete, ash, plastic bags, metal, wood and glass, were present throughout the Made Ground.

Glacial Till / **Residual Soil** - directly beneath the Made Ground a Cohesive Glacial Till, of firm-stiff, brown, sandy, slightly gravelly clay (in BH01-BH03, HP03, HP07 and WS03), underlain by Granular Glacial Till / Residual Soil of red, brown, sandy, silty gravel (in BH01 and BH02 at 3.70m bgl and 3.60m bgl, respectively) and red, brown, slightly silty, very clayey, fine-coarse sand, with occasional clay bands (at depths of 0.33-4.00m in BH03, HP02, HP06, HP08 and WS03).

Bedrock - the sandstone bedrock was partially weathered and recovered as red, brown, slightly gravelly sand. The bedrock was present at depths of 5.60m, 8.60m and 5.90m bgl, in BH01, BH02 and BH03 respectively.

Existing Foundations (Basement Level) - HP01 and HP03 encountered foundations which comprised iron columns on concrete pads; the top of the concrete pads were at 0.75m and 0.30m bgl respectively, and bases at 0.79m and 1.55m bgl respectively. Overall the base of the foundations in HP01 and HP03 were at 1.90m in Made Ground and 1.37m bgl in Sand, respectively. HP04, HP06, HP07 and HP09 encountered foundations comprised of stepped brick wall upon concrete at depths of 0.12-0.62m bgl, with the base of the concrete at 0.94-1.65m bgl. HP06 and HP07 had foundation step out of 0.20m and 0.05m respectively, and HP08 had multiple step outs of 0.05-0.50m giving an overall length of 0.85m. No step out was present in HP04. At the base of the foundations HP06 and HP08 encountered Sand, and HP04 and HP07 encountered Sandstone.

Existing Foundations (Courtyard Level) - Existing foundations, of stepped brick wall, were present in TP02-TP04, with TP02 and TP04 encountering concrete below the stepped brick

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wall. TP02 and TP04 have an approximate step out of 0.50m and total step out of 0.20-0.36m, upon concrete at depth of 1.46m and 1.42m bgl respectively. TP02 had a concrete step out of 0.18m and encountered a clay pipe at 0.50m bgl. The base of the foundations were not proven; TP02 was terminated in Made Ground at 2.00m bgl and TP04 was terminated due to an obstruction in Made Ground at 1.76m bgl. TP03 has an approximate step out of 0.05m on each step, with a total step out of 0.45m, and the base of the brick at 1.15m bgl within Clay. TP01 did not encounter any foundations.

11.1.2 Risk Assessments

The environmental chemistry soil results have been compared with the Tier 1 criteria for soils with respect to human health against '*Commercial'* thresholds.

With respect to the proposed end use of the site, no Tier 1 Threshold exceedances were recorded. As part of the redevelopment of the site, the Made Ground is being excavated for basements across the site. Therefore, the source of any potential contamination is being removed and so exposure to contamination to the end-user is considered Low.

As only limited contamination has been identified within the Made Ground soils onsite, with clayey Glacial Till underlying it and the bedrock containing the Principal Aquifer significantly deeper, the risks to groundwater and surface water receptors (controlled waters) are therefore considered to be **Low** and **Very Low**, respectively.

Three rounds of gas monitoring have been completed to date, with three visits yet to be undertaken. Evaluation of the 'worst credible scenario' and 'worst possible scenario' records a maximum Q_{hg} of 0.0016 l/hr for carbon dioxide. This worst possible scenario has been adopted as the sites Gas Screening Value (GSV) and in accordance with an assessment by CIRIA C665 the GSV indicates a Characteristic Situation 1 (CS1) gas regime which does not require any gas protection measures. It is considered that the risk posed to sites end users from ground gases is **Low** risk.

The BGS Radon Mapping confirms the site is situated in an area where less than 1% of homes are above the radon action level. Radon protection measures are therefore not considered necessary within the proposed development. It is considered that the risk posed to sites end users from radon is **Low** risk. However, as the new development incorporates a basement the advice of a specialist Radon assessor must be obtained.

No evidence of shallow coal mining or intact coal was encountered beneath the site and therefore the probability of shallow coal mining posing a risk to the proposed development is considered to be **Unlikely**.

11.2 Recommendations

Based on the findings of the ground investigation, the following recommendations are made:

1) In general, it is recommended that construction workers are provided with appropriate PPE and sanitary facilities with reference to the environmental testing results presented herein and within *Appendix A3*.

2) Gas monitoring to date has classified the site in line with Characteristic Situation 1 (CS1) gas regime and therefore no gas protection measures are required. Upon the completion of the three remaining gas monitoring visits, the results and subsequent recommendations will be issued as an addendum to this report.

3) As the new development incorporates new foundations, advice of a specialist Radon assessor must be obtained to fully assess the risk posed to end-users of the site.

4) Additional investigations of existing foundations will need to be carried out to confirm the details of existing foundations, for structural design and to avoid clashes. This will require foundation inspection pits to be dug.

12.0 References

1 Curtins Consulting, Phase 1 Preliminary Site Assessment for London Road Fire Station, May 2016 (report ID: B060270.001 Rev A/APA/6737).

2 Environment Agency (2004) Model Procedures for the management of land Contamination Contaminated Land Report 11 (CLR11).

3 British Standards Institution (2011) Investigation of Potentially Contaminated Sites (report no. BS10175).

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5 British Standards Institution (2006) Eurocode 7: Geotechnical Design (report no. BS EN 1997).

6 Brown, E. T. (1981) Rock Characterization, Testing and Monitoring: ISRM Suggested Methods.

7 British Standards Institution (2013) Guidance on Investigations for Ground Gas, Permanent Gas and Volatile Organic Compounds (VOCs) (report no.BS8576:2013).

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9 Department of Environment Food and Rural Affairs (DEFRA) (2012) Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance (report no. PB13735).

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11 British Standards Institution (2015) Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings (report no.BS8485).

12 S Wilson, G Card, S Haines (2009) Ground Gas Handbook Cathness, Scotland, Whittles Publishing.

13 CL:AIRE (2011) Development Industry Code of Practice (Version 2).

14 Environment Agency (2015) Guidance on the Classification and Assessment of Waste Technical Guidance WM3 (1st Edition 2015).

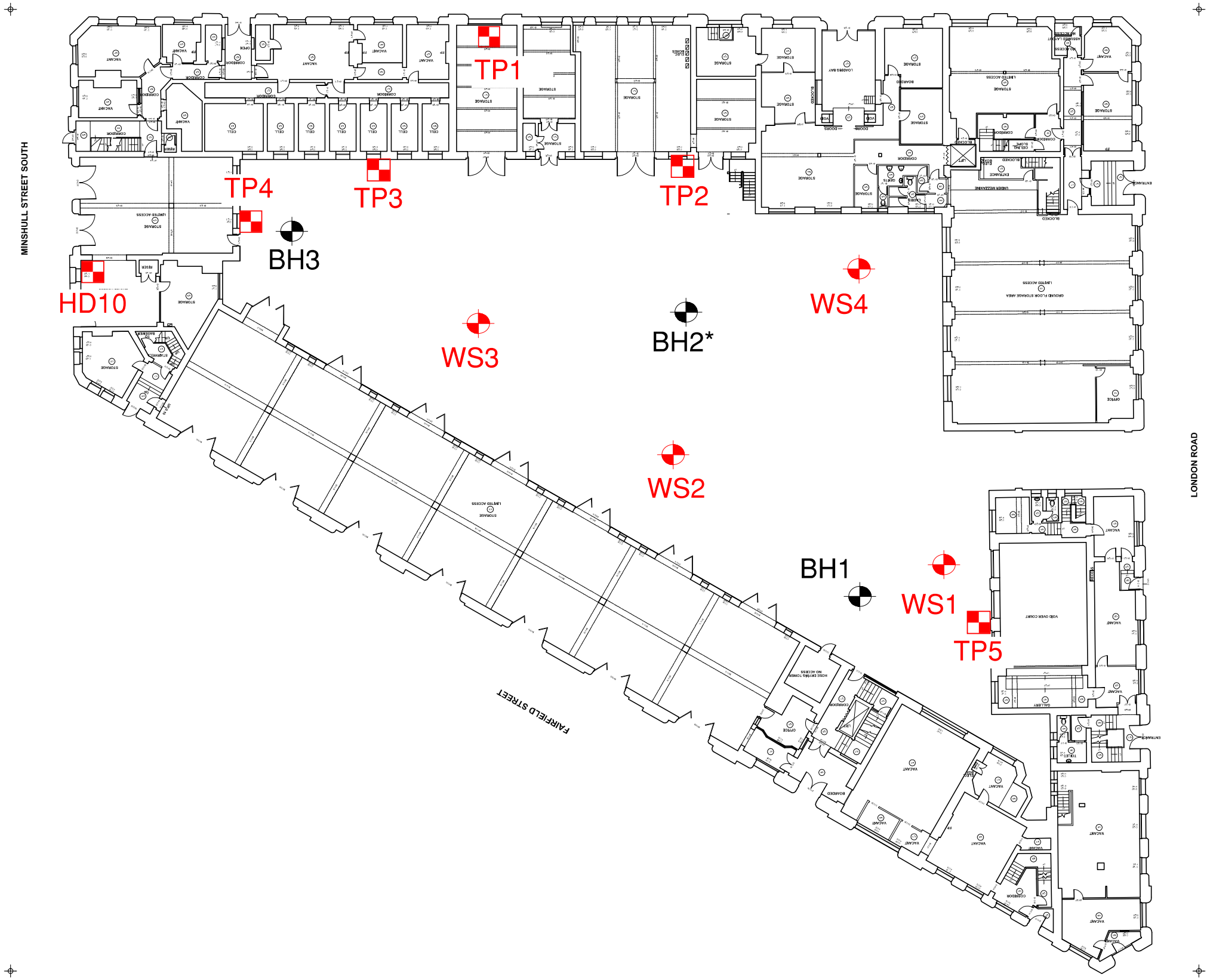
15 Building Research Establishment (2005) Special Digest 1, ‘Concrete in Aggressive Ground’.

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Appendix A1 – Drawings

- Curtins Proposed Borehole Location Plans for London Road Fire Station:
  - Ground Floor, drawing ref. B061230/L001 Rev C, dated May 2016.
  - Basement Floor, drawing ref. B061230/L002 Rev C, dated May 2016.
- Levitt Bernstein Architects Ltd drawings:
  - **Proposed Basement Plan** Rev P15, drawing no. 3336 - D109, dated August 2016.
  - **Proposed Ground Floor Plan** Rev P14, drawing no. 3336 - D110, dated August 2016.
- Diagrammatic Conceptual Site Model (CSM)

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TP1 - TP4 - Machine excavated trial pits to determine the size, depth+construction of foundations. All pits to be extended to base of wall (foundation for inspection by Engineer)

BH1 and BH3 - Cable Percussion borehole to maximum 10m

BH2* Cable Percussion borehole to maximum 10m with 5m rotary core

WS1 - WS4 - Window Sample boreholes to maximum 5m

Rev:	Description:	Date:	By:	Chkd:

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Birmingham - Bristol - Cardiff - Douglas - Edinburgh - Kendal - Leeds - Liverpool - London - Manchester - Nottingham

Status:

INFORMATION

Project:

London Rd. Fire & Police Station

Drg Title:

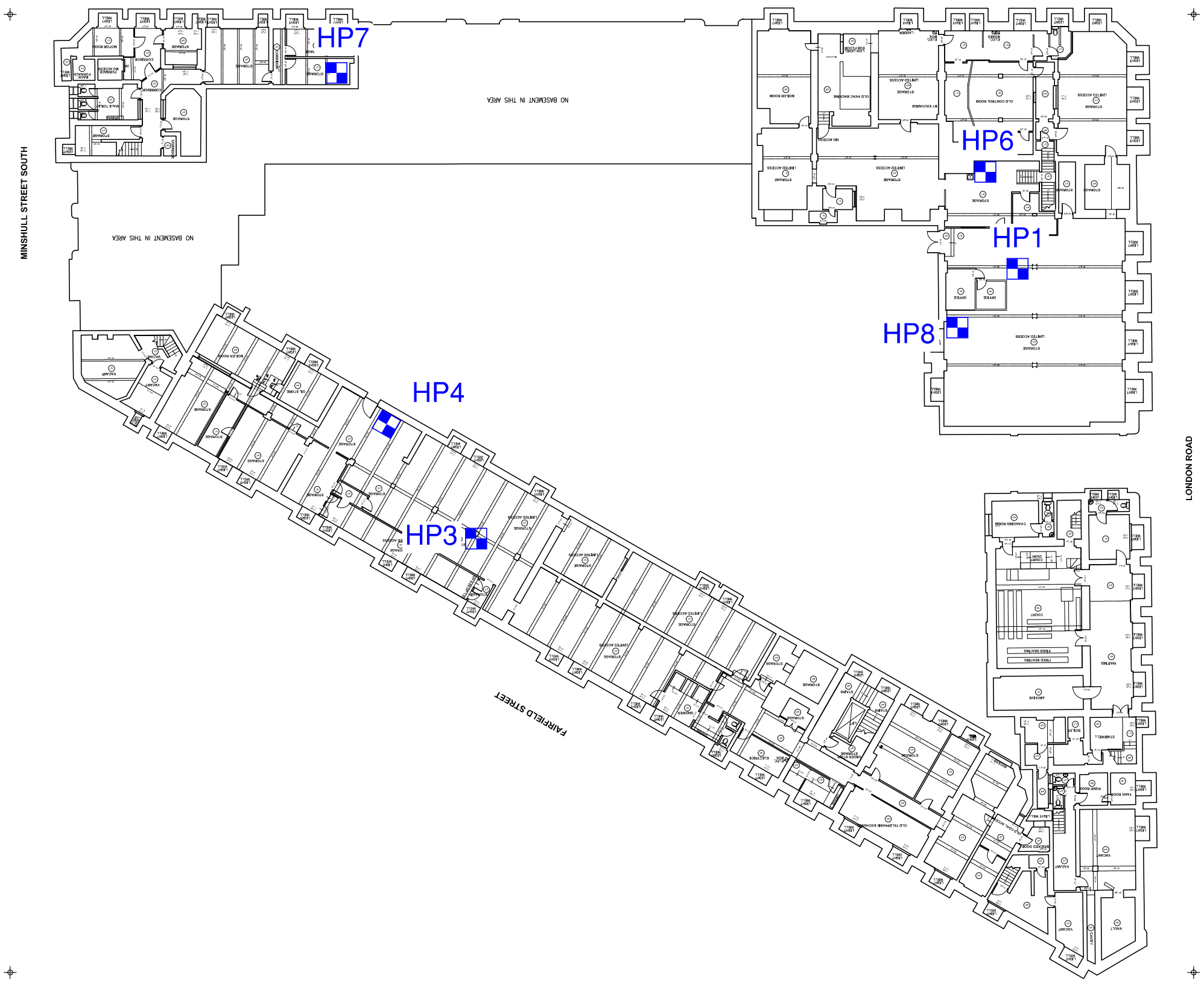
Proposed Exploratory Hole Location Plan- Ground Floor

Scale:	Size:	First Issue:	Drawn:	Checked:
	A3	17.05.2016	LR	SH

Drg No: B061230/L001

Rev: C

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HP 1- HP 9 - Hand excavated trial pits to determine the size, depth+construction of foundations. All pits in basement require breakout of existing slab.

Rev:	Description:	Date:	By:	Chkd:

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Structures - Civils - Environmental - Infrastructure - Transport Planning - Sustainability - Expert Advisory Services
Birmingham - Bristol - Cardiff - Douglas - Edinburgh - Kendal - Leeds - Liverpool - London - Manchester - Nottingham

Status:

INFORMATION

Project:

London Rd. Fire & Police Station

Drg Title:

Proposed Exploratory Hole Location Plan- Basement Floor

Scale:	Size:	First Issue:	Drawn:	Checked:
	A3	17.05.2016	LR	SH

Drg No:	Rev:
B061230/L002	C

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I 2003 **00 Ground Floor GA**

1 : 200

0 2m 4m 6m 8m 10m 20m

N

Notes:

Drawings are based on survey data and may not accurately represent what is physically present.

Do not scale from this drawing. All dimensions are to be verified on site before proceeding with the work.

All dimensions are in millimeters unless noted otherwise.

Purcell shall be notified in writing of any discrepancies.

Key Plan

not to scale

- Coroner's Court (Sui generis)
- Hotel (C1)
- Unit A (A1, A3, A4)
- Unit D (B1, A3, A4, D2, C1)
- Unit E (A1, A3, A4)
- Unit F (A1, A3, A4, D2)
- Unit G (A1, A3, A4)
- Unit H (A1, A3, A4)
- Courtyard (A1, A3, A4, D2)
- Courtyard External (A1, A3, A4, D2)
- Landlord Areas

All furniture is shown indicatively

Hotel (C1)	598 m²
Landlord Areas	127 m²
Live & Work (B1, C3)	827 m²
Live & Work External (B1, C3)	85 m²
Unit L (B1, A3, A4)	149 m²
Workspace (B1)	576 m²
Workspace External (B1)	69 m²
Grand total: 92	2430 m²

Existing

Proposed

REV	DATE	DESCRIPTION
1	02/12/19	For planning
2	03/12/19	For Planning
3	06/12/19	For Planning

CLIENT

Allied London

PROJECT

London Road Fire Station

JOB NUMBER

240242

PURCELL

TITLE

Proposed Ground Floor Plan

SIZE	SCALE	LAST REVISED	DRAWN	CHECKED
A1L	As indicated	06/12/2019 11:39:09	SA	

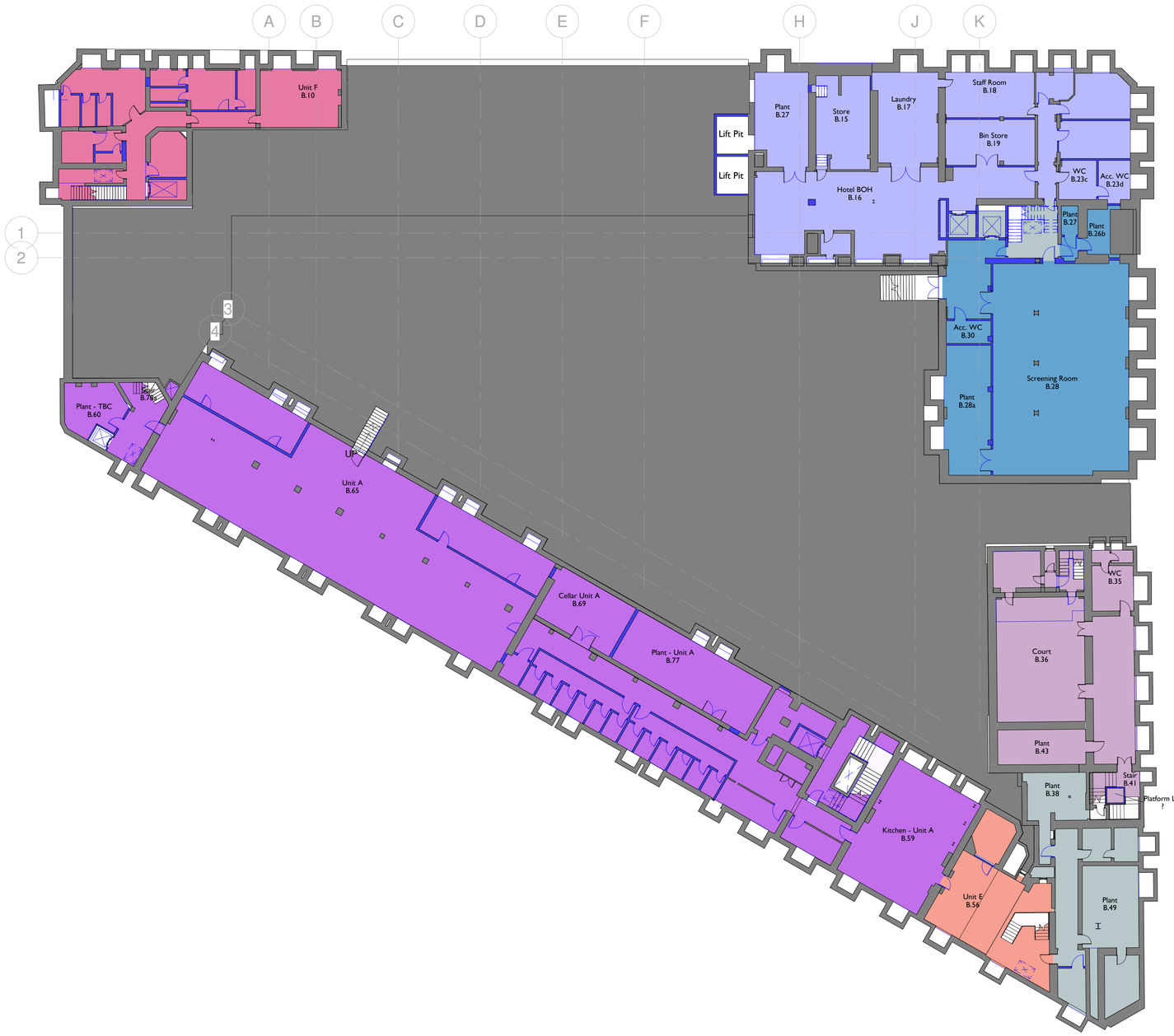
REV 3 **SUITABILITY/REASON FOR ISSUE** **S2 FOR PLANNING**

DRAWING NUMBER

240242-PUR-FS-00-DR-A-2003

St James', 79 Oxford Street, Manchester, M1 6FQ

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1 / 2002 **-01 Basement GA**

1 : 200

0 2m 4m 6m 8m 10m 20m

N

Notes:

Drawings are based on survey data and may not accurately represent what is physically present.

Do not scale from this drawing. All dimensions are to be verified on site before proceeding with the work.

All dimensions are in millimeters unless noted otherwise.

Purcell shall be notified in writing of any discrepancies.

Key Plan
not to scale

- Coroner's Court (Sui generis)
- Hotel (C1)
- Screening Room (B1, A3, A4, D2, C1)
- Unit A (A1, A3, A4)
- Unit E (A1, A3, A4)
- Unit F (A1, A3, A4, D2)
- Landlord Areas

All furniture is shown indicatively

Coroner's Court (Sui generis)	178 m²
Hotel (C1)	340 m²
Landlord Areas	157 m²
Screening Room (B1, A3, A4, D2, C1)	266 m²
Unit A (A1, A3, A4)	694 m²
Unit E (A1, A3, A4)	74 m²
Unit F (A1, A3, A4, D2)	141 m²
Grand total: 94	1851 m²

Existing

Proposed

REV	DATE	DESCRIPTION
1	02/12/19	For planning
2	03/12/19	For Planning
3	06/12/19	For Planning

CLIENT
Allied London

PROJECT
London Road Fire Station

JOB NUMBER
240242

PURCELL

TITLE
Proposed Basement Plan

SIZE	SCALE	LAST REVISED	DRAWN	CHECKED
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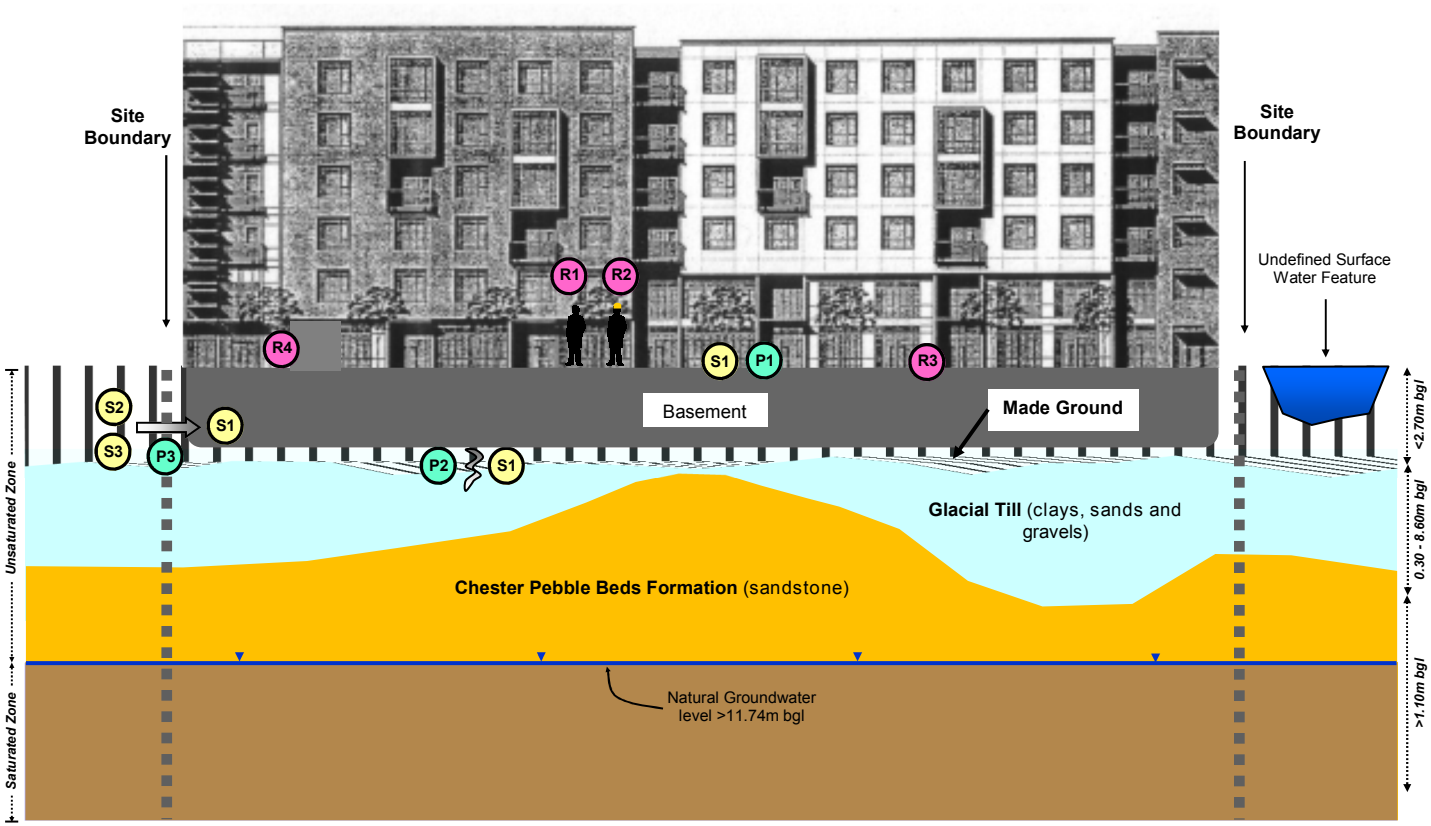
REV **3**
SUITABILITY/REASON FOR ISSUE **S2 FOR PLANNING**

DRAWING NUMBER
240242-PUR-FS-B1-DR-A-2002

St James', 79 Oxford Street, Manchester, M1 6FQ

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London Road Fire Station, Manchester (M1)



Sources

- S1 Made-ground (On site)
- S2 Made-ground (Off site)
- S3 Natural soils (On & off site)
- S4 Ground gas sources

Pathways

- P1 Direct contact, ingestion and or inhalation
- P2 Vertical migration
- P3 Horizontal migration

Receptors

- R1 End users
- R2 Construction workers
- R3 Construction materials
- R4 Local ecology

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Tel: 0161 236 2394

Project	Job Reference	Author	Client
London Road Fire Station	B061230	JB	Allied London
Drawing Title	**Date**	**Checked**	**Scale**
Diagrammatic Conceptual Model	09/01/2017	SH	Not to scale

Appendix A2 – Exploratory Hole Logs, Section, Photos & Drawings

- Window Sample Borehole Logs, WS03
- Borehole Logs, BH01-BH03
- Hand Dug Pit Logs, HP01, HP03, HP04, and HP06-HP09
- Trial Pit Logs, TP01-TP04
- Nominal Section: Strata from Ground Level (BH01-BH03 and WS03)
- Hand Pit Photographs, HP01, HP03, HP04, and HP06-HP08
- Hand Pit Drawings, HP01, HP03, HP04, HP06 and HP08
- Trial Pit Photographs, TP02-TP04
- Trial Pit Drawings, TP02-TP04
- Borehole Core Photographs, BH02

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Contract Name:		Client:			Borehole ID:
London Road Fire Station, Manchester		Allied London			WS03
Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
41953	31/08/2016	JM	HH	DRAFT	
Dynamic Sample Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Print Date: 02/11/2016
					Scale: 1:50

Weather: | Termination: | SPT Hammer: N/R, Energy Ratio: N/R

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
				0.05		MADEGROUND: Brick.		
				0.24		MADE GROUND: Concrete.		
0.40	D7			(0.36)		MADE GROUND: Brown, dark brown, sandy, angular to subrounded, fine to coarse GRAVEL including brick, ash, coal and concrete.		
0.40	ES9			0.60				
0.80	D6					Stiff, brown, mottled grey, slightly sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to coarse including sandstone, siltstone, limestone, quartzite and occasional coal.		
0.80	ES8							
1.00		SPT(S) N=22 (3,4/5,5,6,6)						
1.50	D5							
2.00		SPT(S) N=27 (4,6/6,6,7,8)		(3.00)				
2.50	D4							
3.00		SPT(S) N=40 (6,6/10,7,11,12)						
3.50	D3							
3.60		SPT(S) 50 (27 for 135mm/50 for 115mm)		3.60		Dense, reddish brown, fine to coarse SAND (Possible weathered sandstone).		
3.80 - 4.05	D2			(0.45)				
				4.05		End of Borehole at 4.05m		

Borehole Diameter		Installation			
Depth (m)	Dia (m)	Depth Top	Base (m)	Diameter	Pipe Type
		0.00	0.20		PLAIN
		0.20	1.00		PLAIN
		1.00	3.50		SLOTTED

Water Strikes					
Depth Strike	Depth Casing	Depth Sealed	Time (mins)	Rose to (m)	Remarks

Remarks:

Service inspection pit hand excavated from GL to 1.20m.

IAN FARMER ASSOCIATES

Contract Name:	Client:	Borehole ID:
London Road Fire Station, Manchester	Allied London	BH01

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
41953	26/08/2016	JM	HH	DRAFT	

Cable Percussion Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Print Date: 02/11/2016	Scale: 1:50

Weather: | Termination: | SPT Hammer: N/R, Energy Ratio: N/R

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.20	D2			0.20		MADE GROUND: Concrete.		
0.20	ES1					MADE GROUND: Dark brown grey, sandy, angular to subrounded, fine to coarse GRAVEL with medium cobble content. Including brick, concrete and sandstone.		
0.50 - 1.00	B3			(1.10)				
1.00	D5							
1.00	ES4							
1.20		SPT(S) N=14 (2,3/3,4,3,4)		1.30		MADE GROUND: Firm, dark brown, sandy, very gravelly CLAY. Gravel is angular to subrounded, fine to coarse including brick, ash, concrete, sandstone and occasional wood.		
1.20 - 1.65	B6							
1.70	D8			(0.80)				
1.70	ES7							
2.00		SPT(S) N=13 (2,3/3,3,4,3)		2.10		Firm, brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine and medium including sandstone, siltstone, limestone, occasional quartzite and coal.		
2.00 - 2.45	B9							
2.70	ES10							
3.00 - 3.45	U12	115 blows. 100% recovery		(1.60)		*Below 3.00m: stiff and very high strength.*		
3.50	D13							
3.70	D14			3.70		Dense, reddish brown, silty, sandy, subangular to rounded, fine and coarse GRAVEL including sandstone, siltstone, limestone, occasional quartzite and coal.		
4.00		SPT(S) N=48 (7,7/7,9,13,19)						
4.00 - 4.45	B15							
4.00 - 4.45	D16			(1.90)				
5.00		SPT(S) 50 (10,11/50 for 220mm)						
5.00 - 5.45	B17							
5.00 - 5.45	D19							
5.60	D18			5.60		Weathered SANDSTONE recovered as, dense red brown, slightly gravelly, fine to coarse sand. Gravel is subangular to subrounded, fine to coarse including sandstone.		
6.00		SPT(S) 50 (25 for 87mm/50 for 147mm)						
6.00 - 6.45	B20							
6.00 - 6.45	D21			(2.40)				
7.00	D22							
7.50		SPT(S) 50 (25 for 85mm/50 for 85mm)						
7.50 - 7.67	B23							
7.50 - 7.67	D24			8.00		End of Borehole at 8.00m		

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter

Depth (m)	Dia (mm)
8.00	150

Casing Diameter

Depth (m)	Dia (mm)
7.50	150

Chiselling

From (m)	To (m)	Duration	Remarks
5.00	5.00	00:30	
7.70	8.00	01:00	

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	3.00	PLAIN	
3.00	5.00	SLOTTED	

Remarks:

Service inspection pit hand excavated from GL to 1.20m.

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0		

IAN FARMER ASSOCIATES

Contract Name:	Client:	Borehole ID:
London Road Fire Station, Manchester	Allied London	BH02

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 2
41953	30/08/2016	JM	HH	DRAFT	

Cable Percussion Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Print Date: 02/11/2016	Scale: 1:50

Weather: | Termination: | SPT Hammer: N/R, Energy Ratio: N/R

Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
				0.07		MADE GROUND: Brick paving.		
0.20	ES1			0.20		MADE GROUND: Concrete.		
0.50 - 1.00	B2					MADE GROUND: Dark brown, slightly clayey, sandy, angular to subrounded fine to coarse GRAVEL with medium cobble content., including brick, ash, concrete, sandstone and occasional wood.		
0.70	ES3							
				(1.60)				
1.20		SPT(S) N=20 (3,5/5,4,5,6)						
1.20 - 1.65	B4							
1.70	ES5							
1.80	D6			1.80				
2.00 - 2.45	U7	120 blows. 100% recovery				Stiff, brown, slightly mottled grey, slightly sandy, slightly gravelly CLAY with medium cobble content. Gravel is subangular to rounded, fine and medium including sandstone. siltstone, limestone, occasional wood.		
						At 2.00m: very high strength		
2.50	D8							
2.70	ES9			(1.80)				
3.00		SPT(S) N=34 (4,5/6,8,10,10)						
3.00 - 3.45	B10							
3.00 - 3.45	D11							
3.60	D12			3.60		Dense, reddish brown, silty, sandy, subangular to rounded, fine and coarse GRAVEL with clay bands including sandstone, siltstone, limestone, occasional quartzite and coal.		
4.00		SPT(S) N=39 (5,8/8,9,10,12)						
4.00 - 4.45	B13							
5.00		SPT(S) N=43 (6,7/9,10,11,13)						
5.00 - 5.45	B14							
6.00		SPT(S) 53 (8,11/53 for 180mm)		(5.00)				
6.00 - 6.33	B15							
6.00 - 6.33	D16							
6.80	D17							
7.50		SPT(C) 50 (25 for 95mm/50 for 130mm)						
7.50 - 7.91	B18							
8.60	D19			8.60		Weathered SANDSTONE recovered as very dense, reddish brown, slightly gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse including sandstone.		
9.00		SPT(S) 50 (25 for 35mm/50 for 60mm)						
9.00 - 9.10	D20			(1.40)				
				10.00				

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter

Depth (m)	Dia (mm)
10.00	150

Casing Diameter

Depth (m)	Dia (mm)
9.00	150

Chiselling

From (m)	To (m)	Duration	Remarks
6.20	6.50	01:15	
6.90	7.20	01:00	
7.60	7.00	01:30	

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	9.00	PLAIN	
9.00	12.00	SLOTTED	

Remarks:

Service inspection pit hand excavated from GL to 1.20m.
Chiselling: 9.70m to 10.00m = 1hr

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

IAN FARMER ASSOCIATES	Contract Name: London Road Fire Station, Manchester			Client: Allied London		Borehole ID: BH02
	Contract Number: 41953	Date Started: 30/08/2016	Loggged By: JM	Checked By: HH	Status: DRAFT	Sheet 2 of 2
Rotary Core Drilling Log	Easting:	Northing:	Ground Level:	Plant Used:	Print Date: 02/11/2016	Scale: 1:50
Weather:		Termination:		SPT Hammer: N/R, Energy Ratio: N/R		

Coring Details					Strata Details				Groundwater	
Depth	TCR	SCR	RQD	Fracture Spacing	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
10.00 - 11.50	67	41	0	10		(1.00)		Extremely weak, thinly bedded, reddish brown, medium and coarse grained SANDSTONE. Distinctly weathered. Subhorizonal (80 to 85 degrees), very closely spaced, undulating, rough, moderately open to open, sand infilled discontinuities. At 10.15m, 10.16m, 10.42m, 10.75m and 10.80m, drilling induced fractures.		
11.50 - 13.00	53	15	8	NR NI 18		11.00		Extremely weak, thinly bedded, reddish brown, medium and coarse grained SANDSTONE. Distinctly weathered. Horizonal to subhorizonal (80 to 90 degrees), closely spaced, undulating, rough, moderately open to open, sand infilled discontinuities. Between 11.00m to 12.20m: assumed zone of core loss. At 12.20m: non intact recovered as gravel.		
13.00 - 14.50	89	25	0	12 26 NI 15 NI 12		(6.00)		At 13.48m: non intact recovered as gravel. At 14.07m: non intact recovered as gravel. Between 14.33m and 16.15m: assumed zone of core loss.		
14.50 - 16.00	0	0	0	NR				At 16.15m: non intact recovered as gravel.		
16.00 - 17.00	85	31	11	NI 18 6 NI 20		17.00		At 16.81m: very weak At 16.91m: non intact recovered as gravel. End of Borehole at 10.000m		

Start & End of Shift Observations				
Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter	
Depth (m)	Dia (mm)
10.00	150

Casing Diameter	
Depth (m)	Dia (mm)
9.00	150

Remarks:

Service inspection pit hand excavated from GL to 1.20m.
Chiselling: 9.70m to 10.00m = 1hr

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Flush Information				
Top (m)	Base (m)	Flush Type	Return	Flush Colour

Installation			
Top (m)	Base (m)	Type	Dia (mm)
0.00	9.00	PLAIN	
9.00	12.00	SLOTTED	

Fracture spacing as FI or Min, Average and Max in mm. TCR, SCR and RQD reported in %

IAN FARMER ASSOCIATES

Contract Name:		Client:			Borehole ID:
London Road Fire Station, Manchester		Allied London			BH03
Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
41953	25/08/2016	JM	HH	DRAFT	
Cable Percussion Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Print Date: 02/11/2016
					Scale: 1:50

Weather: | Termination: | SPT Hammer: N/R, Energy Ratio: N/R

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.20	ES1			(0.30)		MADE GROUND: Brown, sandy, angular to subrounded, fine to coarse GRAVEL including brick, concrete, occasional sandstone and wood with medium cobble content.		
0.20 - 0.70	B2			0.30		MADE GROUND: Very soft, dark brown, sandy, very gravelly CLAY with low cobble content. Gravel is angular to subrounded, fine to coarse including brick, ash, occasional concrete, sandstone and wood.		
0.70	ES3							
1.20		SPT(S) N=1 (1,0/0,0,1,0)						
1.20 - 1.65	B4			(2.40)				
1.70	ES5							
2.00		SPT(S) N=2 (1,0/1,0,0,1)						
2.00 - 2.45	B6							
2.70	D8			2.70		Firm, brown, slightly mottled grey, slightly sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine and medium including sandstone, siltstone, limestone, occasional quartzite and coal.		
2.70	ES7					*At 3.00m: very high strength*		
3.00 - 3.45	U9	63 blows. 100% recovery						
3.50	D10			(1.30)				
4.00		SPT(S) N=11 (2,2/3,3,3,2)		4.00		Medium dense, reddish brown, silty, fine and medium SAND with clay bands.		
4.00 - 4.45	B11							
4.00 - 4.45	D12							
5.00		SPT(S) N=14 (2,3/3,4,4,3)		(1.90)				
5.00 - 5.45	B13							
5.00 - 5.45	D14							
6.00		SPT(S) 50 (25 for 100mm/50 for 100mm)		5.90		Weathered SANDSTONE recovered as, dense, reddish brown yellow, slightly gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse including sandstone.		
6.00 - 6.20	B15							
6.00 - 6.20	D16							
7.00	D17			(2.10)				
7.50		SPT(S) 50 (25 for 100mm/50 for 100mm)						
7.50 - 7.70	B18							
7.50 - 7.70	D19			8.00		End of Borehole at 8.00m		

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
					8.00	150	7.50	150

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

Chiselling			
From (m)	To (m)	Duration	Remarks
7.70	8.00	01:00	

Installation			
Top (m)	Base (m)	Type	Dia (mm)
0.00	0.20	PLAIN	
0.20	1.00	PLAIN	
1.00	6.00	SLOTTED	

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

IAN FARMER ASSOCIATES

Contract Name:		Client:			Trial Pit ID:
London Road Fire Station, Manchester		Allied London			HP01
Contract Number:	Date:	Logged By:	Checked By:	Status:	Sheet 1 of 1
41953	22/08/2016	JM	HH	DRAFT	
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used:	Date Printed: / Scale:
				Hand excavated	02/11/2016 / 1:40

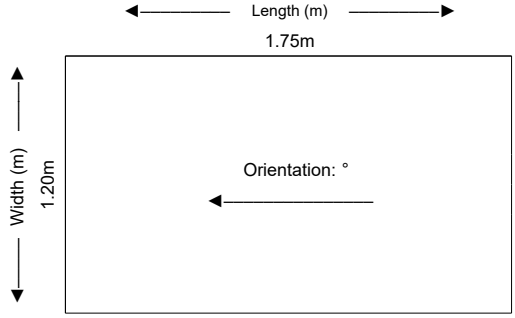
Weather: | Hole Termination: | Stability: Hand pit remained dry and stable during excavation

Samples & In Situ Testing			Strata Details				Water
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description	
				0.20		MADE GROUND: Concrete.	
0.20 - 1.00	B2					MADE GROUND: Brown, very sandy, angular to subrounded, fine to coarse GRAVEL with high cobble contents. Including concrete, brick, sandstone, siltstone and occasional wood.	
0.50	ES1						
				(2.45)			
1.50	D5						
1.50	ES3						
1.50 - 2.50	D4						
				2.65		End of Trial Pit at 2.65m	

1 2 3 4 5 6

Dimensions:

Final Depth: 2.65m



General Remarks:

Refer to sketch for further details.

Water Strikes

Strike (m)	Time (mins)	Rose to (m)	Remarks

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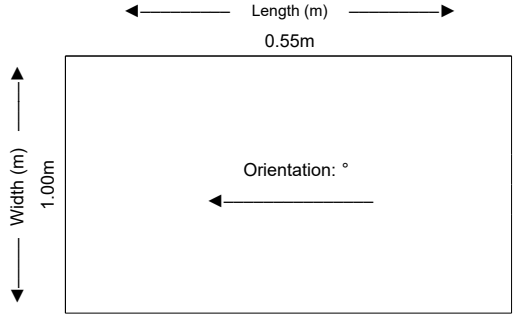
Contract Name:		Client:			Trial Pit ID:
London Road Fire Station, Manchester		Allied London			HP03
Contract Number:	Date:	Logged By:	Checked By:	Status:	Sheet 1 of 1
41953	24/08/2016	JM	HH	DRAFT	
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used:	Date Printed: 02/11/2016
					Scale: 1:40
Weather:	Hole Termination:		Stability: Hand excavated.		

Samples & In Situ Testing			Strata Details				Water
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description	
0.13 - 0.30	D3			0.13		MADE GROUND: Concrete.	
0.30 - 0.70	B2			0.30		MADE GROUND: Orangish brown, sandy, angular to subrounded, fine to coarse GRAVEL with low cobble content. including brick, concrete .	
				(0.40)		Stiff, greyish brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to coarse including sandstone, siltstone and quartzite.	
0.70 - 1.46	B1			0.70		Dense, brown, clayey, gravelly, fine to coarse SAND. Gravel is subangular to rounded, fine to coarse including sandstone, siltstone and quartzite.	
				(0.76)			
				1.46		End of Trial Pit at 1.46m	

1 2 3 4 5 6

Dimensions:

Final Depth: 1.46m



General Remarks:

Refer to sketch for further details.

Water Strikes

Strike (m)	Time (mins)	Rose to (m)	Remarks

IAN FARMER ASSOCIATES

Contract Name:		Client:			Trial Pit ID:
London Road Fire Station, Manchester		Allied London			HP04
Contract Number:	Date:	Logged By:	Checked By:	Status:	Sheet 1 of 1
41953	24/08/2016	JM	HH	DRAFT	
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used:	Date Printed: / Scale:
				Hand excavated	02/11/2016 / 1:40

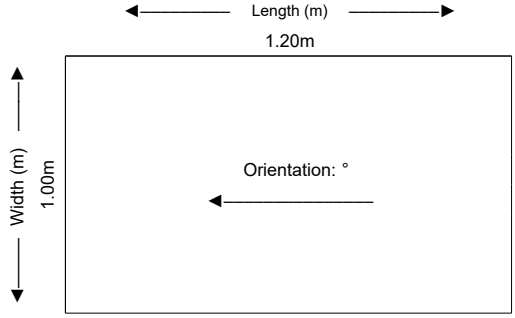
Weather: | Hole Termination: | Stability: Hand pit remained dry and stable during excavation.

Samples & In Situ Testing			Strata Details				Water
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description	
0.10 - 1.10	B1			0.10		MADE GROUND: Concrete.	
				(1.00)		MADE GROUND: Brown, very gravelly, fine to coarse SAND with low cobble content. Gravel is angular to subrounded, fine to coarse including brick, concrete, sandstone, plastic, occasional wood, plastic bags, cans and glass.	
1.10 - 1.40	B2			1.10			
				(0.30)		Extremely weathered SANDSTONE recovered as, reddish brown, slightly gravelly, fine to coarse sand. Gravel is subangular to subrounded, fine to coarse including sandstone.	
				1.40		End of Trial Pit at 1.40m	

1 2 3 4 5 6

Dimensions:

Final Depth: 1.40m



General Remarks:

Refer to sketch for further details.

Water Strikes

Strike (m)	Time (mins)	Rose to (m)	Remarks

IAN FARMER ASSOCIATES

Contract Name:		Client:			Trial Pit ID:
London Road Fire Station, Manchester		Allied London			HP06
Contract Number:	Date:	Logged By:	Checked By:	Status:	Sheet 1 of 1
41953	23/08/2016	JM	HH	DRAFT	
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used:	Date Printed: / Scale:
				Hand excavated	02/11/2016 / 1:40

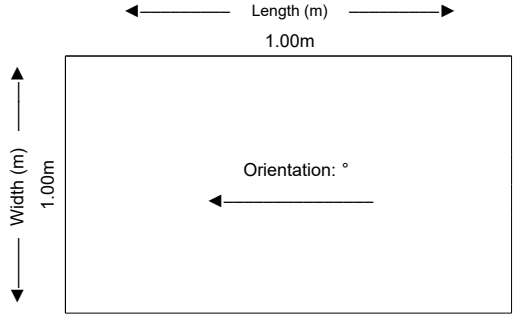
Weather: | Hole Termination: | Stability: Hand pit remained dry and stable during excavation.

Samples & In Situ Testing			Strata Details				Water
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description	
0.10 - 0.33	B2			0.10		MADE GROUND: Concrete.	
0.33 - 1.00	B1			0.33		MADE GROUND: Grey, slightly sandy, angular to subrounded, fine to coarse GRAVEL with medium cobble content, including brick, concrete and sandstone.	
				(0.87)		Reddish brown, slightly gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse including sandstone.	
				1.20		End of Trial Pit at 1.20m	

1 2 3 4 5 6

Dimensions:

Final Depth: 1.20m



General Remarks:

Refer to sketch for further details.

Water Strikes

Strike (m)	Time (mins)	Rose to (m)	Remarks

IAN FARMER ASSOCIATES

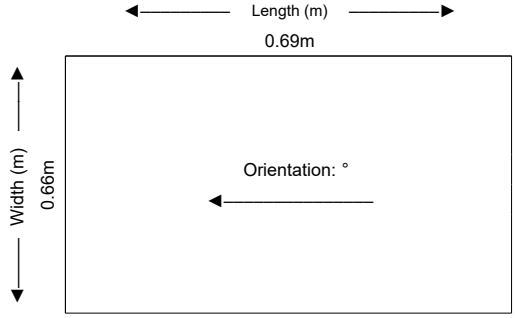
Contract Name:		Client:			Trial Pit ID:
London Road Fire Station, Manchester		Allied London			HP07
Contract Number:	Date:	Logged By:	Checked By:	Status:	Sheet 1 of 1
41953	25/08/2016	JM	HH	DRAFT	
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used:	Date Printed: / Scale:
				Hand excavated	02/11/2016 / 1:40
Weather:	Hole Termination:			Stability: Hand pit remained dry and stable during excavation	

Samples & In Situ Testing			Strata Details				Water
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description	
0.10 - 0.33	D3			0.10		MADE GROUND: Concrete.	
0.33 - 0.77	B2			0.33		MADE GROUND: Dark brown grey, sandy, angular to subrounded, fine to coarse GRAVEL with low cobble content. Including brick, concrete and occasional wood.	
				(0.44)		Stiff, greyish brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to coarse including siltstone, sandstone and quartzite.	
0.77 - 1.20	D1			0.77			
				(0.43)		Reddish brown, slightly gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse including sandstone and extremely weathered sandstone (Weathered sandstone).	
				1.20		End of Trial Pit at 1.20m	

1 2 3 4 5 6

Dimensions:

Final Depth: 1.20m



General Remarks:

Refer to sketch for further details.

Water Strikes

Strike (m)	Time (mins)	Rose to (m)	Remarks

IAN FARMER ASSOCIATES

Contract Name:		Client:			Trial Pit ID:
London Road Fire Station, Manchester		Allied London			HP08
Contract Number:	Date:	Logged By:	Checked By:	Status:	Sheet 1 of 1
41953	22/08/2016	JM	HH	DRAFT	
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used:	Date Printed: / Scale:
				Hand excavated	02/11/2016 / 1:40

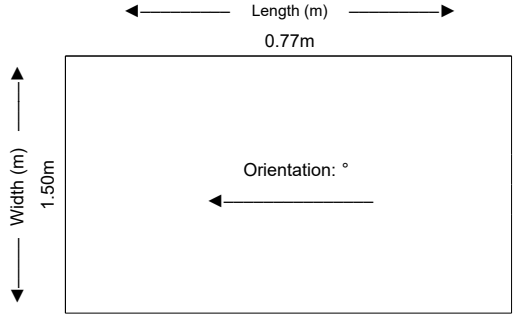
Weather: | Hole Termination: | Stability: Hand pit remained dry and stable during excavation.

Samples & In Situ Testing			Strata Details				Water
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description	
0.20 - 0.30	B1			0.12		MADE GROUND: Concrete.	
0.40 - 0.70	B2			0.35		MADE GROUND: Brown, slightly clayey, sandy, angular to subrounded, fine to coarse GRAVEL with medium cobble content. Including concrete, brick, occasional wood and ash.	
0.70 - 1.50	B3			(0.35)		Firm, brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to coarse including sandstone and siltstone.	
				0.70		Brown, slightly gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine and medium including sandstone.	
				(1.20)			
				1.90		End of Trial Pit at 1.90m	

1 2 3 4 5 6

Dimensions:

Final Depth: 1.90m



General Remarks:

Refer to sketch for further details.

Water Strikes

Strike (m)	Time (mins)	Rose to (m)	Remarks

IAN FARMER ASSOCIATES

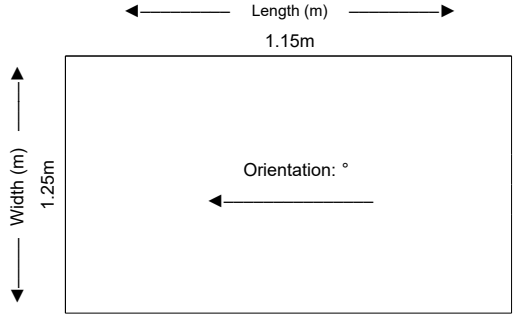
Contract Name:		Client:			Trial Pit ID:
London Road Fire Station, Manchester		Allied London			TP01
Contract Number:	Date:	Logged By:	Checked By:	Status:	Sheet 1 of 1
41953	05/09/2016	JM	HH	DRAFT	
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used: 1 ton tracked excavator	Date Printed: 02/11/2016	Scale: 1:40

Weather: | Hole Termination: | Stability: Trial pit remained dry and stable during excavating

Samples & In Situ Testing			Strata Details				Water
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description	
				0.05		MADE GROUND: Concrete.	
				0.25		MADE GROUND: Brown, slightly clayey, gravelly, fine to coarse SAND with low cobble content. Gravel is angular to subangular, fine to coarse including brick, concrete, mudstone and coal.	
0.50	D2					MADE GROUND: Firm, brown, mottled blackish red, sandy, gravelly CLAY. With low cobble content. Gravel is angular to subangular, fine to coarse including brick, concrete, mudstone, ceramic and coal.	
0.50	ES1						
0.70	B3						
1.00	ES4			(1.75)			1
1.70	B5						
2.00	D7			2.00			2
2.00	ES6					End of Trial Pit at 2.00m	
							3
							4
							5
							6

Dimensions:

Final Depth: 2.00m



General Remarks:

No foundations encountered.

Water Strikes			
Strike (m)	Time (mins)	Rose to (m)	Remarks

IAN FARMER ASSOCIATES

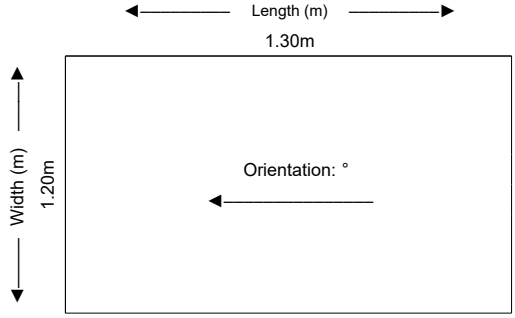
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London Road Fire Station, Manchester		Allied London			TP02
Contract Number:	Date:	Logged By:	Checked By:	Status:	Sheet 1 of 1
41953	01/09/2016	JM	HH	DRAFT	
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used: 1 ton tracked excavator	Date Printed: 02/11/2016	Scale: 1:40
Weather:	Hole Termination:		Stability:		

Samples & In Situ Testing			Strata Details				Water
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description	
0.18 - 1.00	B1			0.18		MADE GROUND: Concrete with rebar.	
0.50	ES2			(1.30)		MADE GROUND: Firm, dark brown, sandy, gravelly CLAY with medium cobble content. Gravel is angular to subrounded, fine to coarse including brick, ash, concrete, slab and sandstone.	
1.48 - 2.00	B3			1.48		MADE GROUND: Stiff, brown, mottled grey, slightly sandy, slightly gravelly CLAY. Gravel is angular to rounded, fine and medium including sandstone, siltstone, limestone, brick, concrete and coal (Reworked natural).	
1.50	ES4			(0.52)			
				2.00		End of Trial Pit at 2.00m	

1 2 3 4 5 6

Dimensions:

Final Depth: 2.00m



General Remarks:

Refer to sketch for further details.

Water Strikes

Strike (m)	Time (mins)	Rose to (m)	Remarks

IAN FARMER ASSOCIATES

Contract Name:		Client:			Trial Pit ID:
London Road Fire Station, Manchester		Allied London			TP03
Contract Number:	Date:	Logged By:	Checked By:	Status:	Sheet 1 of 1
41953	01/09/2016	JM	HH	DRAFT	
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used: 1 ton tracked excavator.	Date Printed: 02/11/2016	Scale: 1:40

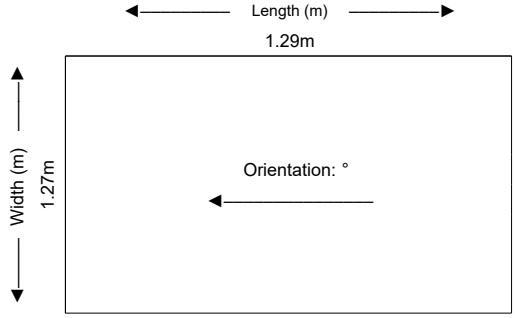
Weather: | Hole Termination: | Stability: Trial pit remained dry and stable during excavation

Samples & In Situ Testing			Strata Details				Water
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description	
				0.23		MADE GROUND: Concrete with rebar.	
0.50	D1			(0.37)		MADE GROUND: Dark grey, dark brown, slightly clayey, very sandy, angular to subrounded, fine to coarse GRAVEL with medium cobble content. Including brick, concrete, ash and slate.	
0.60	ES2			0.60		MADE GROUND: Dark brown, soft, sandy, gravelly CLAY with low cobble content. Gravel is angular to subrounded, fine to coarse including brick, concrete, ash and slate.	
1.00	B3			(0.93)			
1.60	B4			1.53		Stiff, brown mottled grey, slightly sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine and medium including limestone, siltstone, sandstone, occasional quartzite and coal.	
1.60	ES5			1.70		End of Trial Pit at 1.70m	

1 2 3 4 5 6

Dimensions:

Final Depth: 1.70m



General Remarks:

Refer to sketch for further details.

Water Strikes

Strike (m)	Time (mins)	Rose to (m)	Remarks

IAN FARMER ASSOCIATES

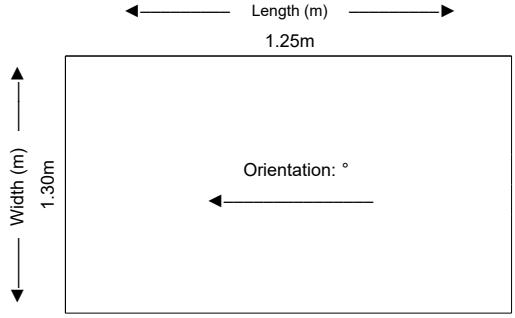
Contract Name:		Client:			Trial Pit ID:
London Road Fire Station, Manchester		Allied London			TP04
Contract Number:	Date:	Logged By:	Checked By:	Status:	Sheet 1 of 1
41953	30/08/2016	JM	HH	DRAFT	
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used: 1 ton tracked excavator	Date Printed: 02/11/2016
					Scale: 1:40
Weather:		Hole Termination:		Stability:	

Samples & In Situ Testing			Strata Details				Water
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description	
				0.27		MADE GROUND: Concrete.	
0.27 - 1.76	B1					MADE GROUND: Orangish brown, sandy, angular to subrounded, fine to coarse GRAVEL including brick, concrete, occasional wood and clinker.	
				(1.49)			
1.50	D2						
				1.76		End of Trial Pit at 1.76m	

1
2
3
4
5
6

Dimensions:

Final Depth: 1.76m

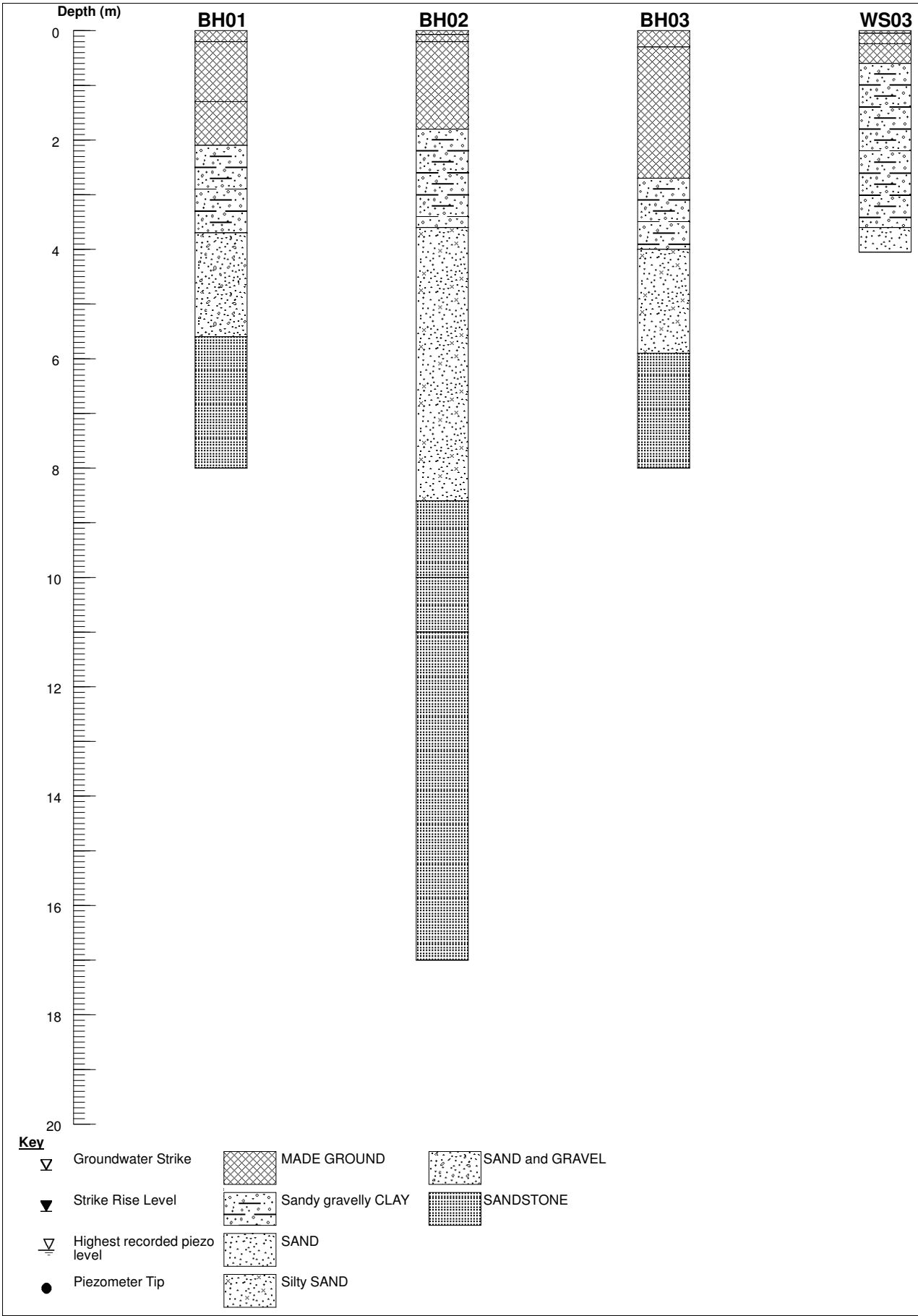


General Remarks:

Concrete encountered at 1.76m.
Refer to sketch for further details.

Water Strikes

Strike (m)	Time (mins)	Rose to (m)	Remarks



IAN FARMER ASSOCIATES

Nominal Section: Strata from Ground Level

Site	Date Drawn	Date Checked	Sheet	Job Number
London Road Fire Station, Manchester	08/11/2016		1/1	41953
Client	**Drawn By**	**Checked By**	**Scale**	**Figure No.**
Allied London			1:100[V]	Figure A1.3

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Hand pit Photographs
HP01





Hand pit Photographs
HP01



Hand pit Photographs
HP03





Hand pit Photographs
HP03



Hand pit Photographs
HP04





Hand pit Photographs
HP04



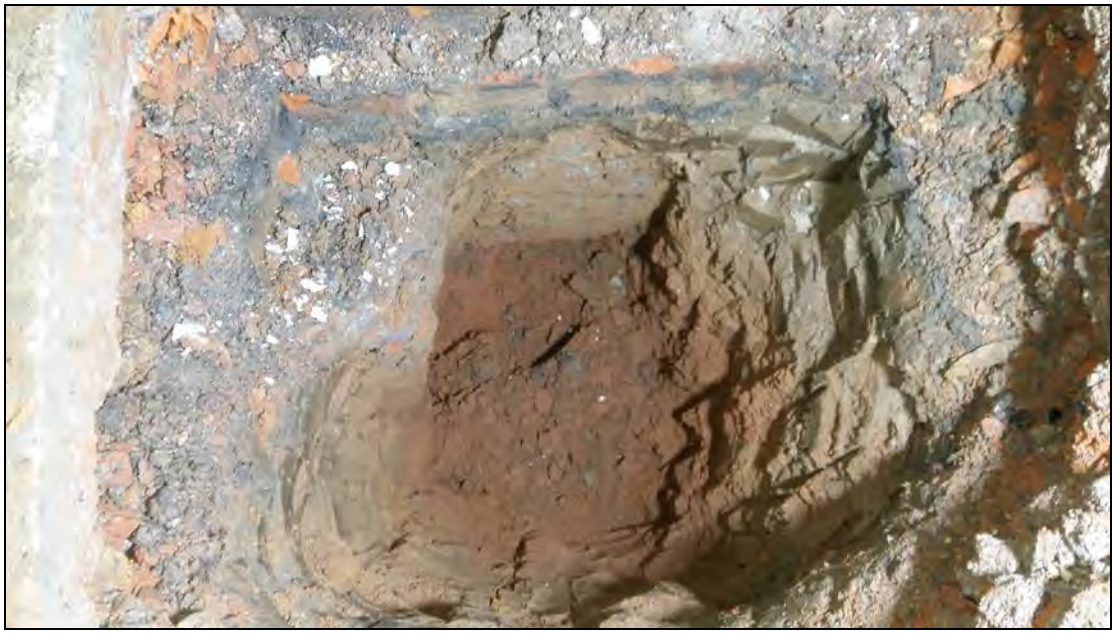
Hand pit Photographs
HP06





Hand pit Photographs
HP07





Hand pit Photographs
HP07



Hand pit Photographs
HP08

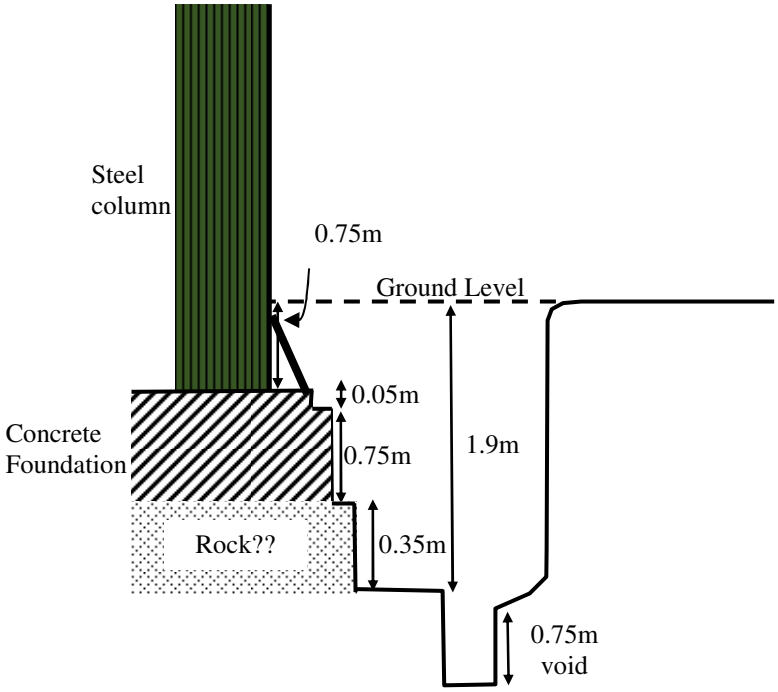


Hand pit Photographs
HP08

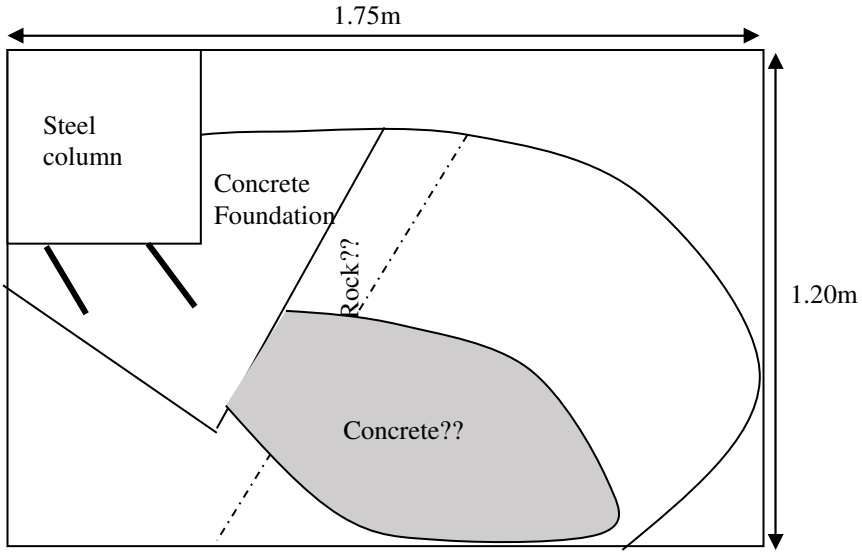


Hand Pit Drawings
HP01

Cross Section

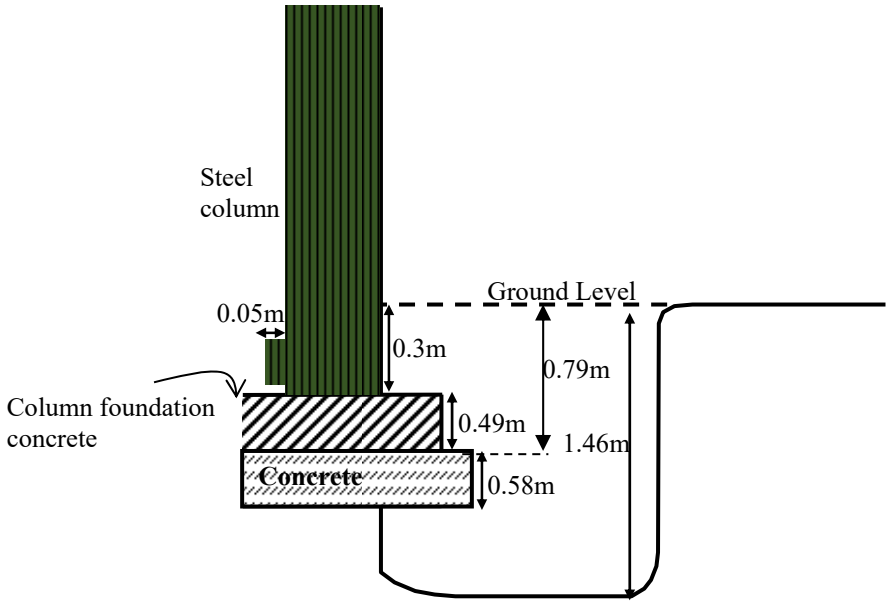


Plan View

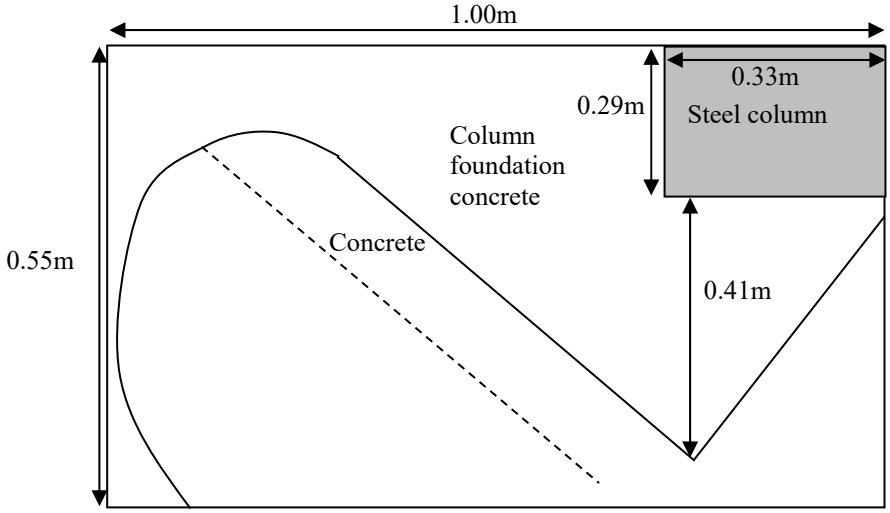


Foundation Pit Drawings
HP03

Cross Section

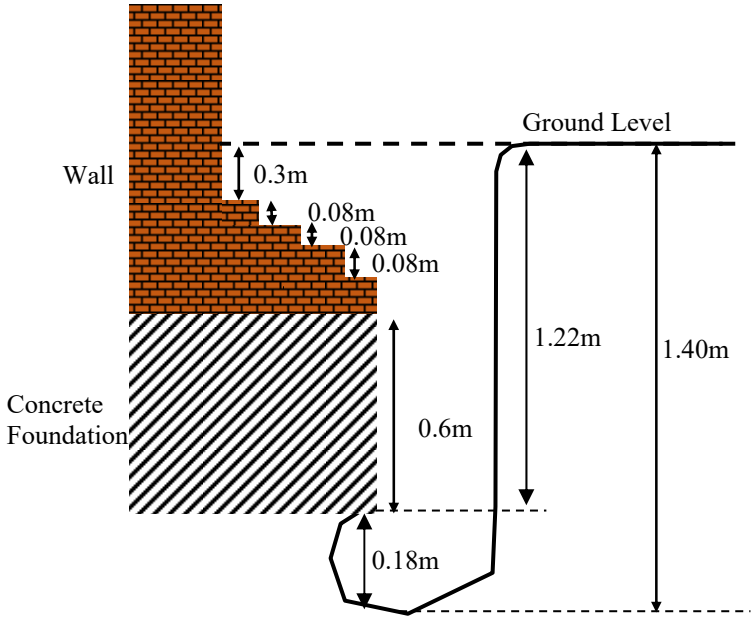


Plan View

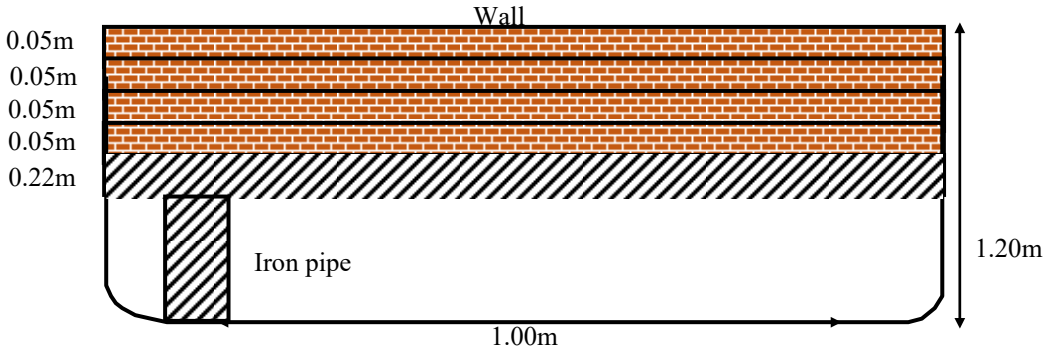


Hand Pit Drawings
HP04

Cross Section

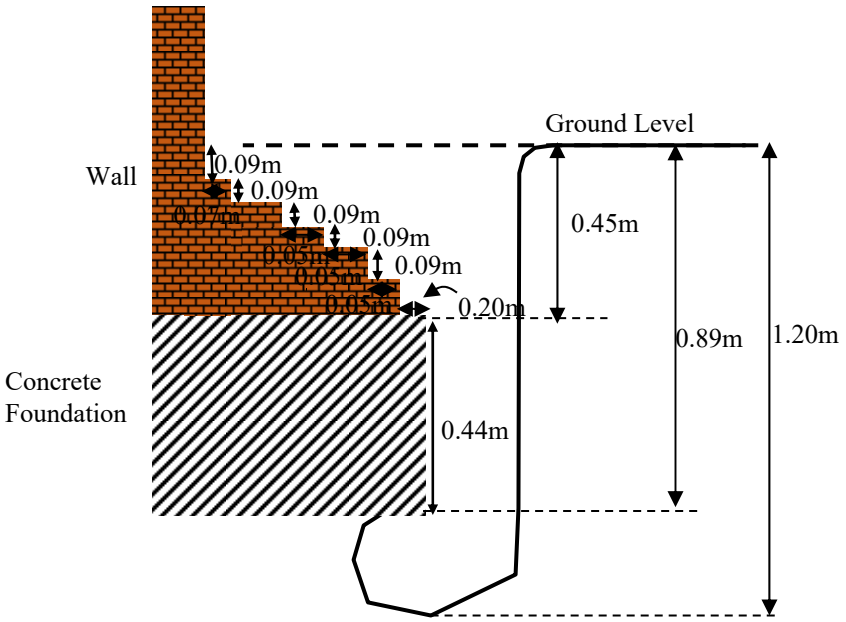


Plan View

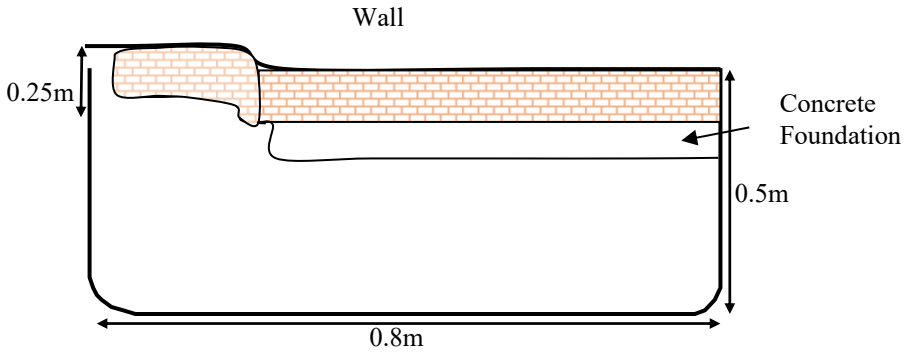


Hand Pit Drawings
HP06

Cross Section

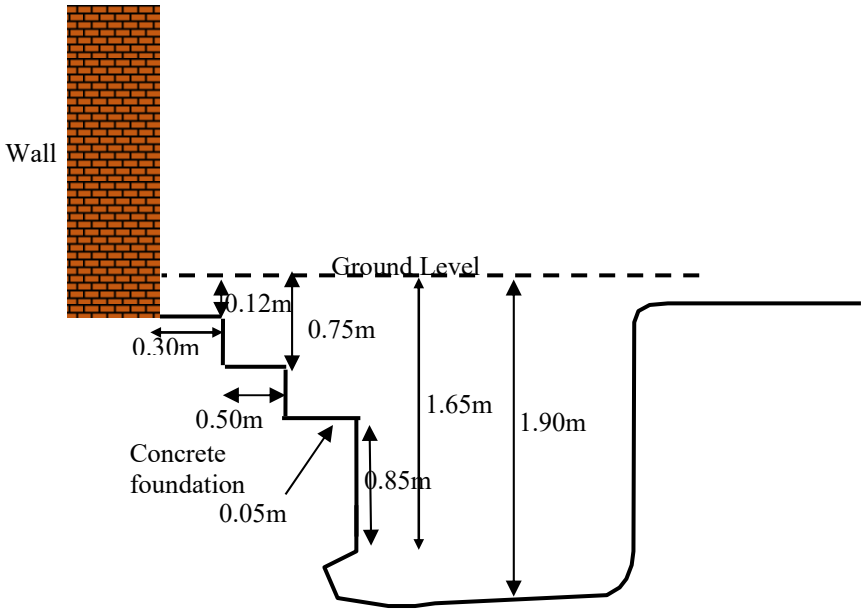


Plan View

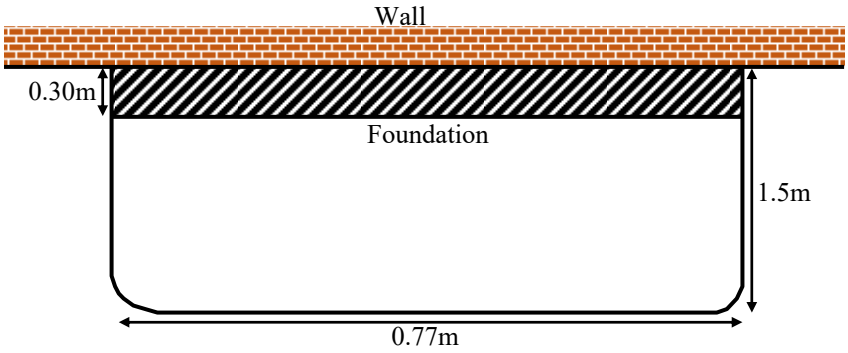


Hand Pit Drawings
HP08

Cross Section



Plan View



Trial pit Photographs
TP02



Trial pit Photographs
TP02





Trial pit Photographs
TP03





Trial pit Photographs
TP03



Trial pit Photographs
TP04



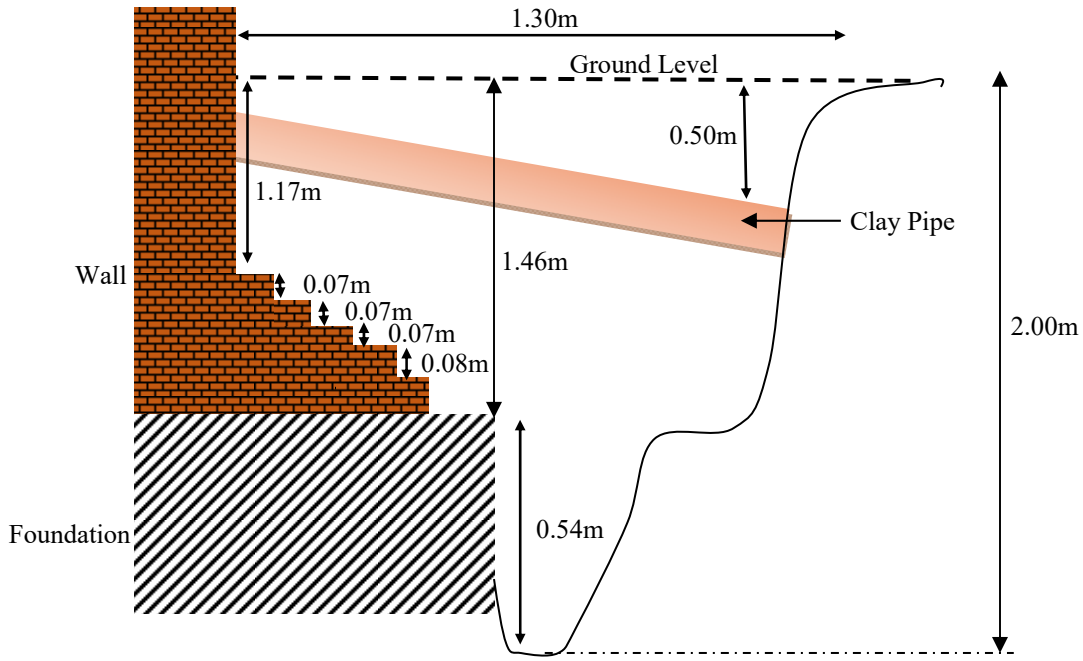


Trial pit Photographs
TP04

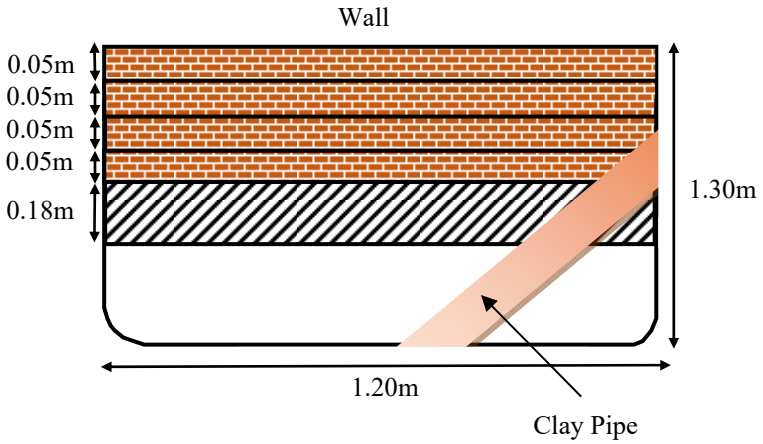


Trial Pit Drawings
TP02

Cross Section

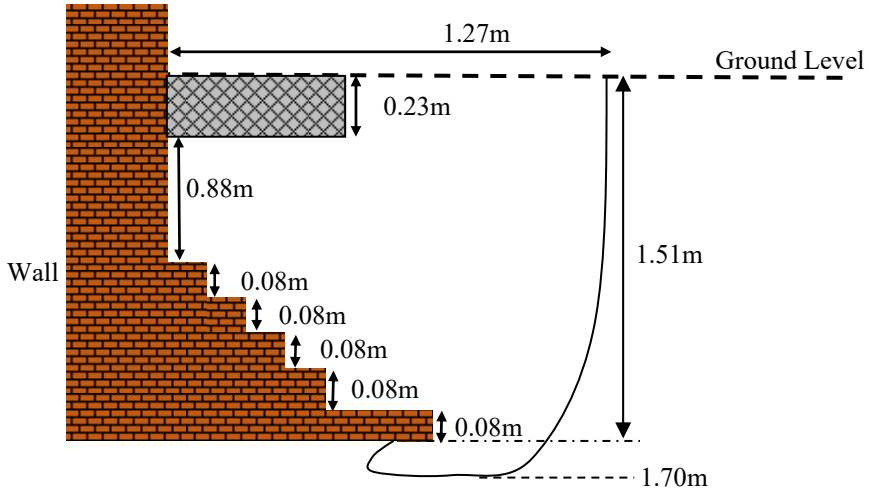


Plan View

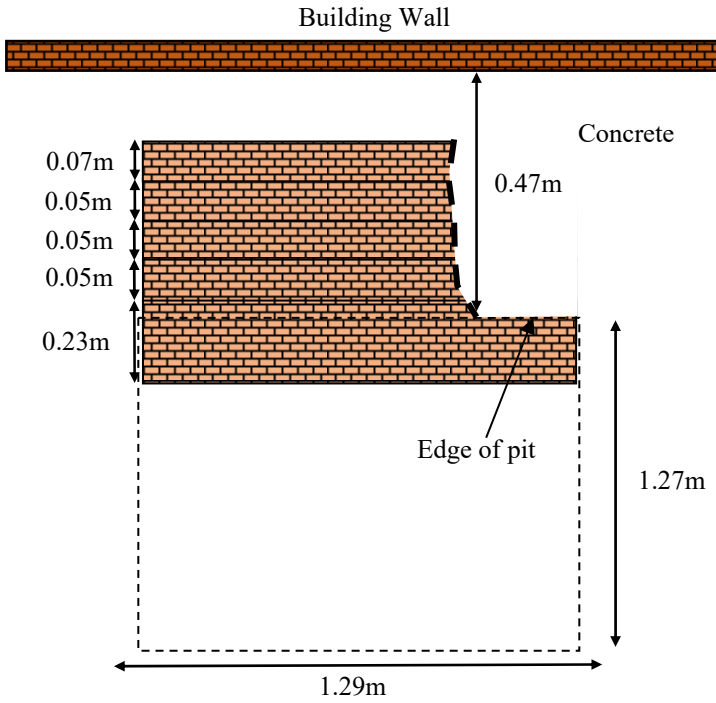


Trial Pit Drawings
TP03

Cross Section

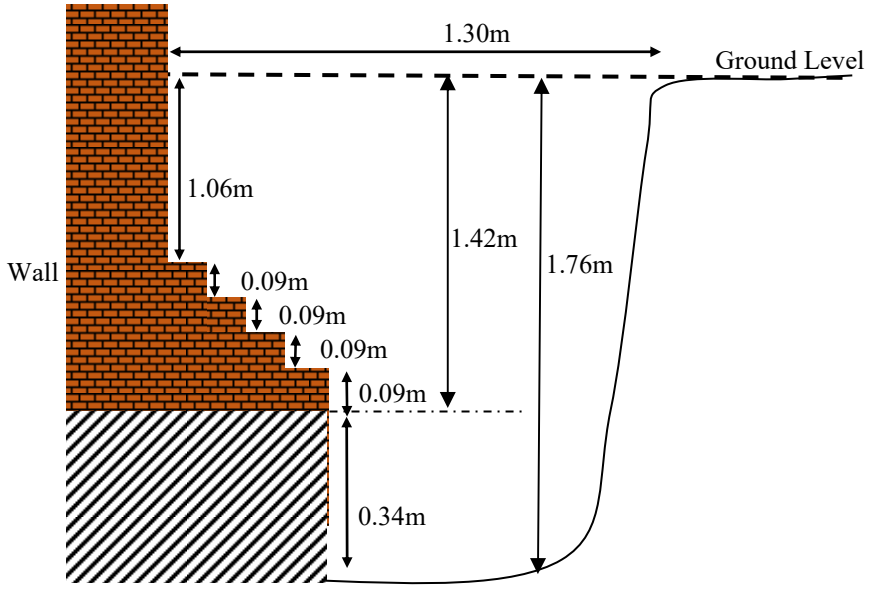


Plan View

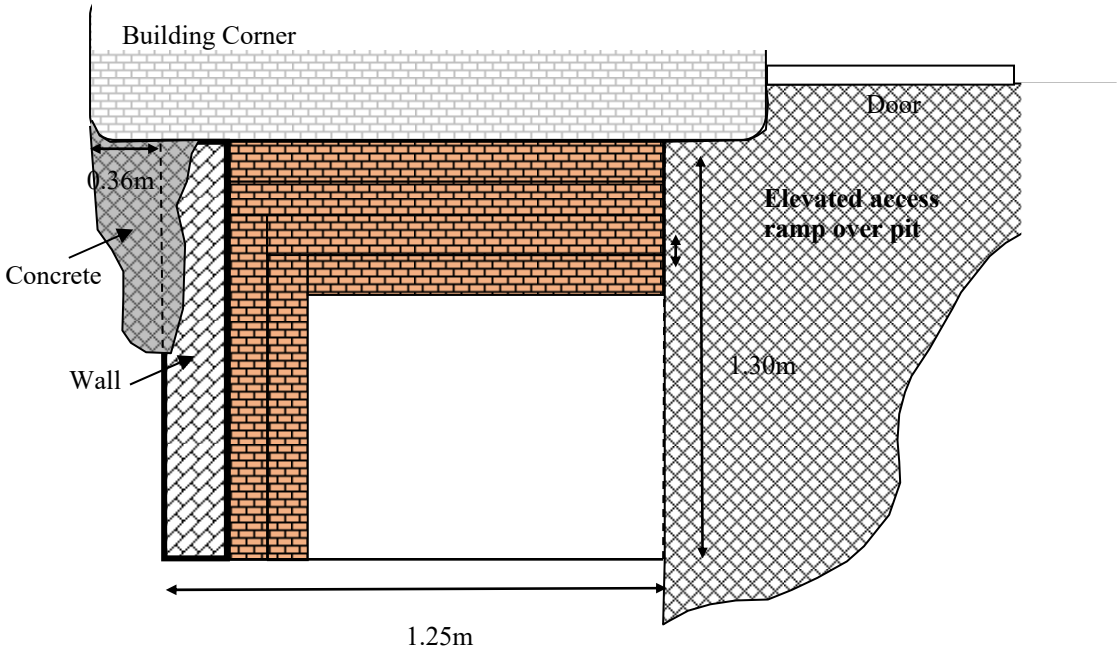


Trial Pit Drawings
TP04

Cross Section



Plan View



Core Photographs
BH 102

Runs 1, 2 & 3 10.00m – 14.50m



Core Photographs
BH 102

Runs 3 & 4 14.50m – 17.00m



Appendix A3 – Laboratory Testing & Monitoring Results

- Scientific Analysis Laboratories Ltd, Environmental Chemistry Analysis Results (Soil), Certificate No. 597753 (14/10/2016).
- Dets Ltd Environmental Chemistry Analysis Results (Soil), Certificate No. 16-78192 (14/09/2016).
- Geotechnical Analysis Results:
  - Archway Engineering (UK) Ltd, SPT Hammer Energy Test Report, Ref. AR1181 (12/01/2016)
  - SPT 'N' Value versus Depth graph
  - Dynamic Sampling UK Ltd, Hammer Energy Test Report, Ref. 110.45.LT (27/06/2016)
  - Ian Farmers Ltd Test Report, Ref. 41953/1 (29/09/2016)
  - Ian Farmers Ltd Point Load Strength Index Test Results, Ref. 41953R/1 (21/09/2016)
- Gas Monitoring Visit 1-3 Results

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SCIENTIFIC ANALYSIS LABORATORIES
DELIVERING SCIENCE

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

Scientific Analysis Laboratories Ltd

Certificate of Analysis

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

Report Number: Supplemental to 597753-1

Date of Report: 14-Oct-2016

Customer: Curtins Consulting Ltd.
Rose Wharf
Ground Floor
East Street Leeds
LS9 8EE

Customer Contact: Niall Farnworth

Customer Job Reference: B061230
Customer Purchase Order: EBMA260
Customer Site Reference: London Road Fire Station
Date Job Received at SAL: 26-Aug-2016
Date Analysis Started: 06-Sep-2016
Date Analysis Completed: 16-Sep-2016

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
Tests covered by this certificate were conducted in accordance with SAL SOPs
All results have been reviewed in accordance with Section 25 of the SAL Quality Manual

UKAS TESTING
1549

mCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

Report checked and authorised by :
Bianca Prince
Customer Service Manager

Issued by :
Bianca Prince
Customer Service Manager

SAL Reference: 597753
Project Site: London Road Fire Station
Customer Reference: B061230

Soil Analysed as Soil
Heavy Metals(9)

				SAL Reference	**597753 001**	**597753 002**	**597753 003**	**597753 004**	**597753 005**
				Customer Sample Reference	**BH01 ES1**	**BH01 ES5**	**BH01 ES7**	**BH02 ES1**	**BH02 ES9**
				Depth	**0.2**	**1.7**	**2.7**	**0.2**	**2.7**
				Date Sampled	**26-AUG-2016**	**26-AUG-2016**	**26-AUG-2016**	**30-AUG-2016**	**30-AUG-2016**
				Type	**Clay**	**Sandy Soil**	**Clay**	**Sandy Soil**	**Clay**
Determinand	**Method**	**Test Sample**	**LOD**	**Units**					
Arsenic	T6	M40	2	mg/kg	**12**	**9**	**8**	**17**	**9**
Cadmium	T6	M40	1	mg/kg	**1**	<1	<1	<1	<1
Chromium	T6	M40	1	mg/kg	**16**	**15**	**22**	**14**	**27**
Copper	T6	M40	1	mg/kg	**46**	**39**	**33**	**280**	**27**
Lead	T6	M40	1	mg/kg	**350**	**110**	**56**	**110**	**27**
Mercury	T6	M40	1	mg/kg	**2**	**17**	**8**	**1**	**1**
Nickel	T6	M40	1	mg/kg	**16**	**19**	**25**	**17**	**30**
Selenium	T6	M40	3	mg/kg	<3	<3	<3	<3	<3
Zinc	T6	M40	1	mg/kg	**400**	**260**	**100**	**160**	**83**

SAL Reference: 597753
Project Site: London Road Fire Station
Customer Reference: B061230

Soil Analysed as Soil
Heavy Metals(9)

				SAL Reference	**597753 006**	**597753 007**	**597753 008**	**597753 009**	**597753 010**
				Customer Sample Reference	**BH03 ES1**	**BH03 ES3**	**BH03 ES7**	**TP02**	**TP03**
				Depth	**0.2**	**0.7**	**2.7**	**0.5**	**0.6**
				Date Sampled	**25-AUG-2016**	**25-AUG-2016**	**25-AUG-2016**	**01-SEP-2016**	**01-SEP-2016**
				Type	**Sandy Soil**	**Sandy Soil**	**Clay**	**Clay**	**Clay**
Determinand	**Method**	**Test Sample**	**LOD**	**Units**					
Arsenic	T6	M40	2	mg/kg	**16**	**21**	**8**	**21**	**19**
Cadmium	T6	M40	1	mg/kg	<1	<1	<1	<1	<1
Chromium	T6	M40	1	mg/kg	**20**	**22**	**26**	**22**	**25**
Copper	T6	M40	1	mg/kg	**69**	**68**	**26**	**56**	**67**
Lead	T6	M40	1	mg/kg	**410**	**450**	**24**	**120**	**160**
Mercury	T6	M40	1	mg/kg	**2**	**3**	**1**	**1**	**2**
Nickel	T6	M40	1	mg/kg	**20**	**24**	**33**	**30**	**32**
Selenium	T6	M40	3	mg/kg	<3	<3	<3	<3	<3
Zinc	T6	M40	1	mg/kg	**300**	**170**	**64**	**110**	**160**

SAL Reference: 597753
Project Site: London Road Fire Station
Customer Reference: B061230

Soil Analysed as Soil
Heavy Metals(9)

				SAL Reference	**597753 011**	**597753 012**
				Customer Sample Reference	**WS03**	**WS03**
				Depth	**0.4**	**0.8**
				Date Sampled	**31-AUG-2016**	**31-AUG-2016**
				Type	**Sandy Soil**	**Clay**
Determinand	**Method**	**Test Sample**	**LOD**	**Units**		
Arsenic	T6	M40	2	mg/kg	**26**	**10**
Cadmium	T6	M40	1	mg/kg	<1	<1
Chromium	T6	M40	1	mg/kg	**16**	**32**
Copper	T6	M40	1	mg/kg	**110**	**29**
Lead	T6	M40	1	mg/kg	**360**	**22**
Mercury	T6	M40	1	mg/kg	**1**	**1**
Nickel	T6	M40	1	mg/kg	**27**	**38**
Selenium	T6	M40	3	mg/kg	<3	<3
Zinc	T6	M40	1	mg/kg	**200**	**67**

SAL Reference: 597753
Project Site: London Road Fire Station
Customer Reference: B061230

Soil Analysed as Soil
Curtins Suite A

SAL Reference				**597753 001**	**597753 002**	**597753 004**	**597753 006**	**597753 007**
Customer Sample Reference				**BH01 ES1**	**BH01 ES5**	**BH02 ES1**	**BH03 ES1**	**BH03 ES3**
Depth				**0.2**	**1.7**	**0.2**	**0.2**	**0.7**
Date Sampled				**26-AUG-2016**	**26-AUG-2016**	**30-AUG-2016**	**25-AUG-2016**	**25-AUG-2016**
Type				**Clay**	**Sandy Soil**	**Sandy Soil**	**Sandy Soil**	**Sandy Soil**
Determinand	**Method**	**Test Sample**	**LOD**	**Units**					
Asbestos ID	T27	AR			N.D.	N.D.	N.D.	N.D.	N.D.
Boron (water-soluble)	T6	AR	1	mg/kg	<1	<1	<1	<1	<1
Chromium VI	T6	AR	1	mg/kg	<1	<1	<1	<1	<1
Cyanide(Total)	T546	AR	1	mg/kg	<1	<1	<1	<1	<1
pH	T7	AR			**10.6**	**9.1**	**8.5**	**8.4**	**8.2**
Phenols(Mono)	T546	AR	1	mg/kg	<1	<1	<1	<1	<1
Retained on 10mm sieve	T2	M40	0.1	%	<0.1	<0.1	<0.1	<0.1	<0.1
Soil Organic Matter	T287	M40	0.1	%	**3.1**	**2.9**	**11**	**5.2**	**6.2**
SO4(Total)	T6	M40	0.01	%	**0.37**	**0.07**	**0.17**	**0.24**	**0.13**
Sulphide	T4	AR	10	mg/kg	<10	<10	<10	<10	<10
Sulphur (total)	T6	M40	0.01	%	**0.12**	**0.02**	**0.06**	**0.06**	**0.04**

SAL Reference: 597753
Project Site: London Road Fire Station
Customer Reference: B061230

Soil Analysed as Soil
Curtins Suite A

SAL Reference				**597753 009**	**597753 010**	**597753 011**
Customer Sample Reference				**TP02**	**TP03**	**WS03**
Depth				**0.5**	**0.6**	**0.4**
Date Sampled				**01-SEP-2016**	**01-SEP-2016**	**31-AUG-2016**
Type				**Clay**	**Clay**	**Sandy Soil**
Determinand	**Method**	**Test Sample**	**LOD**	**Units**			
Asbestos ID	T27	AR			N.D.	N.D.	N.D.
Boron (water-soluble)	T6	AR	1	mg/kg	<1	<1	<1
Chromium VI	T6	AR	1	mg/kg	<1	<1	<1
Cyanide(Total)	T546	AR	1	mg/kg	<1	<1	<1
pH	T7	AR			**8.1**	**8.2**	**8.9**
Phenols(Mono)	T546	AR	1	mg/kg	<1	<1	<1
Retained on 10mm sieve	T2	M40	0.1	%	<0.1	<0.1	<0.1
Soil Organic Matter	T287	M40	0.1	%	**7.7**	**6.6**	**24**
SO4(Total)	T6	M40	0.01	%	**0.18**	**0.08**	**0.38**
Sulphide	T4	AR	10	mg/kg	<10	<10	<10
Sulphur (total)	T6	M40	0.01	%	**0.05**	**0.03**	**0.12**

SAL Reference: 597753
Project Site: London Road Fire Station
Customer Reference: B061230

Soil Analysed as Soil
Curtins Suite B

SAL Reference	**597753 003**	**597753 005**	**597753 008**	**597753 012**
Customer Sample Reference	**BH01 ES7**	**BH02 ES9**	**BH03 ES7**	**WS03**
Depth	**2.7**	**2.7**	**2.7**	**0.8**
Date Sampled	**26-AUG-2016**	**30-AUG-2016**	**25-AUG-2016**	**31-AUG-2016**
Type	**Clay**	**Clay**	**Clay**	**Clay**

Determinand	Method	Test Sample	LOD	Units				
Boron (water-soluble)	T6	AR	1	mg/kg	<1	**2**	<1	<1
Chromium VI	T6	AR	1	mg/kg	<1	<1	<1	<1
Cyanide(Total)	T546	AR	1	mg/kg	<1	<1	<1	<1
pH	T7	AR			**8.4**	**8.1**	**7.9**	**8.1**
Phenols(Mono)	T546	AR	1	mg/kg	<1	<1	<1	<1
Retained on 10mm sieve	T2	M40	0.1	%	<0.1	<0.1	<0.1	<0.1
Soil Organic Matter	T287	M40	0.1	%	**1.7**	**3.0**	**2.0**	**1.8**
SO4(Total)	T6	M40	0.01	%	**0.06**	**0.12**	**0.04**	**0.06**
Sulphide	T4	AR	10	mg/kg	<10	<10	<10	<10
Sulphur (total)	T6	M40	0.01	%	**0.02**	**0.04**	**0.02**	**0.02**
TPH (C8-C10)	T8	M105	1	mg/kg	(13) <1	(13) <1	(13) <1	(13) <1
TPH (C10-C12)	T206	M105	1	mg/kg	(13) <1	(13) <1	(13) <1	(13) <1
TPH (C12-C16)	T206	M105	1	mg/kg	(13) <1	(13) <1	(13) <1	(13) <1
TPH (C16-C21)	T206	M105	1	mg/kg	**(13) 1**	**(13) 3**	**(13) 2**	(13) <1
TPH (C21-C35)	T206	M105	1	mg/kg	**(13) 1**	**(13) 85**	**(13) 13**	**(13) 1**

SAL Reference: 597753
Project Site: London Road Fire Station
Customer Reference: B061230

Soil Analysed as Soil
TPH (CWG)

SAL Reference					**597753 001**	**597753 002**	**597753 004**	**597753 006**	**597753 007**
Customer Sample Reference					**BH01 ES1**	**BH01 ES5**	**BH02 ES1**	**BH03 ES1**	**BH03 ES3**
Depth					**0.2**	**1.7**	**0.2**	**0.2**	**0.7**
Date Sampled					**26-AUG-2016**	**26-AUG-2016**	**30-AUG-2016**	**25-AUG-2016**	**25-AUG-2016**
Type					**Clay**	**Sandy Soil**	**Sandy Soil**	**Sandy Soil**	**Sandy Soil**
Determinand	**Method**	**Test Sample**	**LOD**	**Units**					
Benzene	T54	AR	1	µg/kg	(13) <1	(13) <1	(13,110) <2	(13) <1	(13) <1
Toluene	T54	AR	1	µg/kg	(13) <1	(13) <1	(13,110) <2	(13) <1	(13) <1
EthylBenzene	T54	AR	1	µg/kg	<1	<1	(110) <2	<1	<1
M/P Xylene	T54	AR	1	µg/kg	<1	<1	(110) <2	<1	<1
O Xylene	T54	AR	1	µg/kg	<1	<1	(110) <2	<1	**1**
Methyl tert-Butyl Ether	T54	AR	1	µg/kg	<1	<1	(110) <2	<1	<1
TPH (C5-C6 aliphatic)	T54	AR	0.010	mg/kg	<0.010	<0.010	(110) <0.020	<0.010	<0.010
TPH (C6-C8 aliphatic)	T54	AR	0.010	mg/kg	<0.010	<0.010	(110) <0.020	<0.010	<0.010
TPH (C8-C10 aliphatic)	T54	AR	0.010	mg/kg	<0.010	<0.010	(110) <0.020	<0.010	<0.010
TPH (C10-C12 aliphatic)	T8	M105	1	mg/kg	(13) <1	(13) <1	(13) <1	(13) <1	(13) <1
TPH (C12-C16 aliphatic)	T8	M105	1	mg/kg	(13) <1	(13) <1	(13) <1	(13) <1	(13) <1
TPH (C16-C21 aliphatic)	T8	M105	1	mg/kg	(13) <1	(13) <1	**(13) 6**	(13) <1	(13) <1
TPH (C21-C35 aliphatic)	T8	M105	1	mg/kg	**(13) 3**	**(13) 3**	**(13) 39**	**(13) 4**	**(13) 3**
TPH (C6-C7 aromatic)	T54	AR	0.010	mg/kg	<0.010	<0.010	(110) <0.020	<0.010	<0.010
TPH (C7-C8 aromatic)	T54	AR	0.010	mg/kg	<0.010	<0.010	(110) <0.020	<0.010	<0.010
TPH (C8-C10 aromatic)	T54	AR	0.010	mg/kg	<0.010	<0.010	(110) <0.020	<0.010	<0.010
TPH (C10-C12 aromatic)	T8	M105	1	mg/kg	(13) <1	(13) <1	**(13) 1**	(13) <1	(13) <1
TPH (C12-C16 aromatic)	T8	M105	1	mg/kg	(13) <1	(13) <1	**(13) 8**	**(13) 6**	**(13) 4**
TPH (C16-C21 aromatic)	T8	M105	1	mg/kg	**(13) 4**	**(13) 2**	**(13) 34**	**(13) 25**	**(13) 18**
TPH (C21-C35 aromatic)	T8	M105	1	mg/kg	**(13) 7**	**(13) 2**	**(13) 55**	**(13) 43**	**(13) 29**

SAL Reference: 597753
Project Site: London Road Fire Station
Customer Reference: B061230

Soil Analysed as Soil
TPH (CWG)

SAL Reference	597753 009	597753 010	597753 011
Customer Sample Reference	TP02	TP03	WS03
Depth	0.5	0.6	0.4
Date Sampled	01-SEP-2016	01-SEP-2016	31-AUG-2016
Type	Clay	Clay	Sandy Soil

Determinand	Method	Test Sample	LOD	Units			
Benzene	T54	AR	1	µg/kg	(13) <1	(13) <1	(13) <1
Toluene	T54	AR	1	µg/kg	**(13) 2**	(13) <1	**(13) 2**
EthylBenzene	T54	AR	1	µg/kg	<1	<1	<1
M/P Xylene	T54	AR	1	µg/kg	<1	<1	<1
O Xylene	T54	AR	1	µg/kg	<1	<1	<1
Methyl tert-Butyl Ether	T54	AR	1	µg/kg	<1	<1	<1
TPH (C5-C6 aliphatic)	T54	AR	0.010	mg/kg	<0.010	<0.010	<0.010
TPH (C6-C8 aliphatic)	T54	AR	0.010	mg/kg	<0.010	<0.010	<0.010
TPH (C8-C10 aliphatic)	T54	AR	0.010	mg/kg	<0.010	<0.010	**0.61**
TPH (C10-C12 aliphatic)	T8	M105	1	mg/kg	(13) <1	(13) <1	(13) <1
TPH (C12-C16 aliphatic)	T8	M105	1	mg/kg	(13) <1	(13) <1	(13) <1
TPH (C16-C21 aliphatic)	T8	M105	1	mg/kg	(13) <1	(13) <1	**(13) 1**
TPH (C21-C35 aliphatic)	T8	M105	1	mg/kg	**(13) 4**	**(13) 2**	**(13) 11**
TPH (C6-C7 aromatic)	T54	AR	0.010	mg/kg	<0.010	<0.010	<0.010
TPH (C7-C8 aromatic)	T54	AR	0.010	mg/kg	<0.010	<0.010	<0.010
TPH (C8-C10 aromatic)	T54	AR	0.010	mg/kg	<0.010	<0.010	<0.010
TPH (C10-C12 aromatic)	T8	M105	1	mg/kg	(13) <1	(13) <1	(13) <1
TPH (C12-C16 aromatic)	T8	M105	1	mg/kg	**(13) 3**	**(13) 2**	**(13) 7**
TPH (C16-C21 aromatic)	T8	M105	1	mg/kg	**(13) 7**	**(13) 6**	**(13) 31**
TPH (C21-C35 aromatic)	T8	M105	1	mg/kg	**(13) 15**	**(13) 9**	**(13) 55**

SAL Reference: 597753
Project Site: London Road Fire Station
Customer Reference: B061230

Soil Analysed as Soil
MCERTS Preparation

SAL Reference	597753 001	597753 002	597753 003	597753 004	597753 005
Customer Sample Reference	BH01 ES1	BH01 ES5	BH01 ES7	BH02 ES1	BH02 ES9
Depth	0.2	1.7	2.7	0.2	2.7
Date Sampled	26-AUG-2016	26-AUG-2016	26-AUG-2016	30-AUG-2016	30-AUG-2016
Type	Clay	Sandy Soil	Clay	Sandy Soil	Clay

Determinand	Method	Test Sample	LOD	Units					
Moisture @105C	T162	AR	0.1	%	**23**	**15**	**17**	**16**	**16**

SAL Reference: 597753
Project Site: London Road Fire Station
Customer Reference: B061230

Soil Analysed as Soil
MCERTS Preparation

SAL Reference	597753 006	597753 007	597753 008	597753 009	597753 010
Customer Sample Reference	BH03 ES1	BH03 ES3	BH03 ES7	TP02	TP03
Depth	0.2	0.7	2.7	0.5	0.6
Date Sampled	25-AUG-2016	25-AUG-2016	25-AUG-2016	01-SEP-2016	01-SEP-2016
Type	Sandy Soil	Sandy Soil	Clay	Clay	Clay

Determinand	Method	Test Sample	LOD	Units					
Moisture @105C	T162	AR	0.1	%	**18**	**20**	**14**	**21**	**25**

SAL Reference: 597753
Project Site: London Road Fire Station
Customer Reference: B061230

Soil Analysed as Soil
MCERTS Preparation

				SAL Reference	**597753 011**	**597753 012**
				Customer Sample Reference	**WS03**	**WS03**
				Depth	**0.4**	**0.8**
				Date Sampled	**31-AUG-2016**	**31-AUG-2016**
				Type	**Sandy Soil**	**Clay**
Determinand	**Method**	**Test Sample**	**LOD**	**Units**		
Moisture @105C	T162	AR	0.1	%	**13**	**15**

SAL Reference: 597753
Project Site: London Road Fire Station
Customer Reference: B061230

Soil Analysed as Soil
Total and Speciated USEPA16 PAH

				SAL Reference	**597753 001**	**597753 002**	**597753 003**	**597753 004**	**597753 005**
				Customer Sample Reference	**BH01 ES1**	**BH01 ES5**	**BH01 ES7**	**BH02 ES1**	**BH02 ES9**
				Depth	**0.2**	**1.7**	**2.7**	**0.2**	**2.7**
				Date Sampled	**26-AUG-2016**	**26-AUG-2016**	**26-AUG-2016**	**30-AUG-2016**	**30-AUG-2016**
				Type	**Clay**	**Sandy Soil**	**Clay**	**Sandy Soil**	**Clay**
Determinand	**Method**	**Test Sample**	**LOD**	**Units**					
Naphthalene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	**2.2**	<0.1
Acenaphthylene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	**0.5**	<0.1
Acenaphthene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	**1.8**	<0.1
Fluorene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	**1.7**	<0.1
Phenanthrene	T207	M105	0.1	mg/kg	**0.2**	**0.2**	<0.1	**11**	<0.1
Anthracene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	**4.0**	<0.1
Fluoranthene	T207	M105	0.1	mg/kg	**0.3**	**0.3**	<0.1	**9.6**	<0.1
Pyrene	T207	M105	0.1	mg/kg	**0.3**	**0.3**	<0.1	**9.3**	<0.1
Benzo(a)Anthracene	T207	M105	0.1	mg/kg	**0.2**	**0.1**	<0.1	**6.5**	<0.1
Chrysene	T207	M105	0.1	mg/kg	**0.2**	**0.1**	<0.1	**7.5**	<0.1
Benzo(b/k)Fluoranthene	T207	M105	0.1	mg/kg	**0.2**	**0.2**	<0.1	**11**	<0.1
Benzo(a)Pyrene	T207	M105	0.1	mg/kg	**0.2**	<0.1	<0.1	**6.7**	<0.1
Indeno(123-cd)Pyrene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	**4.2**	<0.1
Dibenzo(ah)Anthracene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	**1.2**	<0.1
Benzo(ghi)Perylene	T207	M105	0.1	mg/kg	**0.1**	<0.1	<0.1	**5.0**	<0.1
PAH(total)	T207	M105	0.1	mg/kg	**1.7**	**1.2**	<0.1	**82**	<0.1

SAL Reference: 597753
Project Site: London Road Fire Station
Customer Reference: B061230

Soil Analysed as Soil
Total and Speciated USEPA16 PAH

				SAL Reference	**597753 006**	**597753 007**	**597753 008**	**597753 009**	**597753 010**
				Customer Sample Reference	**BH03 ES1**	**BH03 ES3**	**BH03 ES7**	**TP02**	**TP03**
				Depth	**0.2**	**0.7**	**2.7**	**0.5**	**0.6**
				Date Sampled	**25-AUG-2016**	**25-AUG-2016**	**25-AUG-2016**	**01-SEP-2016**	**01-SEP-2016**
				Type	**Sandy Soil**	**Sandy Soil**	**Clay**	**Clay**	**Clay**
Determinand	**Method**	**Test Sample**	**LOD**	**Units**					
Naphthalene	T207	M105	0.1	mg/kg	**1.1**	**0.4**	<0.1	<0.1	<0.1
Acenaphthylene	T207	M105	0.1	mg/kg	**0.7**	**0.3**	<0.1	<0.1	<0.1
Acenaphthene	T207	M105	0.1	mg/kg	**1.0**	**0.4**	<0.1	**0.1**	**0.1**
Fluorene	T207	M105	0.1	mg/kg	**1.4**	**0.7**	<0.1	<0.1	**0.1**
Phenanthrene	T207	M105	0.1	mg/kg	**7.7**	**4.0**	<0.1	**1.3**	**1.3**
Anthracene	T207	M105	0.1	mg/kg	**2.2**	**1.0**	<0.1	**0.3**	**0.3**
Fluoranthene	T207	M105	0.1	mg/kg	**8.6**	**3.6**	<0.1	**1.7**	**1.7**
Pyrene	T207	M105	0.1	mg/kg	**8.4**	**3.5**	<0.1	**1.8**	**1.8**
Benzo(a)Anthracene	T207	M105	0.1	mg/kg	**5.2**	**1.8**	<0.1	**0.8**	**0.9**
Chrysene	T207	M105	0.1	mg/kg	**6.0**	**2.1**	<0.1	**0.9**	**0.9**
Benzo(b/k)Fluoranthene	T207	M105	0.1	mg/kg	**8.5**	**2.5**	<0.1	**1.2**	**1.1**
Benzo(a)Pyrene	T207	M105	0.1	mg/kg	**5.1**	**1.5**	<0.1	**0.7**	**0.6**
Indeno(123-cd)Pyrene	T207	M105	0.1	mg/kg	**2.6**	**0.7**	<0.1	**0.4**	**0.3**
Dibenzo(ah)Anthracene	T207	M105	0.1	mg/kg	**0.8**	**0.2**	<0.1	<0.1	<0.1
Benzo(ghi)Perylene	T207	M105	0.1	mg/kg	**2.9**	**0.9**	<0.1	**0.4**	**0.3**
PAH(total)	T207	M105	0.1	mg/kg	**62**	**24**	<0.1	**9.6**	**9.5**

SAL Reference: 597753
Project Site: London Road Fire Station
Customer Reference: B061230

Soil Analysed as Soil
Total and Speciated USEPA16 PAH

				SAL Reference	**597753 011**	**597753 012**
				Customer Sample Reference	**WS03**	**WS03**
				Depth	**0.4**	**0.8**
				Date Sampled	**31-AUG-2016**	**31-AUG-2016**
				Type	**Sandy Soil**	**Clay**
Determinand	**Method**	**Test Sample**	**LOD**	**Units**		
Naphthalene	T207	M105	0.1	mg/kg	**0.3**	<0.1
Acenaphthylene	T207	M105	0.1	mg/kg	**0.1**	<0.1
Acenaphthene	T207	M105	0.1	mg/kg	**0.1**	<0.1
Fluorene	T207	M105	0.1	mg/kg	**0.2**	<0.1
Phenanthrene	T207	M105	0.1	mg/kg	**2.1**	<0.1
Anthracene	T207	M105	0.1	mg/kg	**0.6**	<0.1
Fluoranthene	T207	M105	0.1	mg/kg	**2.7**	<0.1
Pyrene	T207	M105	0.1	mg/kg	**2.9**	<0.1
Benzo(a)Anthracene	T207	M105	0.1	mg/kg	**2.3**	<0.1
Chrysene	T207	M105	0.1	mg/kg	**2.6**	<0.1
Benzo(b/k)Fluoranthene	T207	M105	0.1	mg/kg	**4.5**	<0.1
Benzo(a)Pyrene	T207	M105	0.1	mg/kg	**3.5**	<0.1
Indeno(123-cd)Pyrene	T207	M105	0.1	mg/kg	**2.3**	<0.1
Dibenzo(ah)Anthracene	T207	M105	0.1	mg/kg	**0.6**	<0.1
Benzo(ghi)Perylene	T207	M105	0.1	mg/kg	**4.2**	<0.1
PAH(total)	T207	M105	0.1	mg/kg	**29**	<0.1

Index to symbols used in Supplemental to 597753-1

Value	Description
AR	As Received
M105	Analysis conducted on an "as received" aliquot. Results are reported on a dry weight basis where moisture content was determined by assisted drying of sample at 105C

M40	Analysis conducted on sample assisted dried at no more than 40C. Results are reported on a dry weight basis.
N.D.	Not Detected
13	Results have been blank corrected.
110	LOD raised due to low internal standard recovery.
S	Analysis was subcontracted
M	Analysis is MCERTS accredited
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Notes

Asbestos was subcontracted to REC Asbestos
Supplemental report to include updated Boron results

Method Index

Value	Description
T8	GC/FID
T27	PLM
T287	Calc TOC/0.58
T4	Colorimetry
T54	GC/MS (Headspace)
T162	Grav (1 Dec) (105 C)
T546	Colorimetry (CF)
T206	GC/FID (MCERTS)
T7	Probe
T2	Grav
T6	ICP/OES
T207	GC/MS (MCERTS)

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Asbestos ID	T27	AR			SU	001-002,004,006-007,009-011
Boron (water-soluble)	T6	AR	1	mg/kg	N	001-012
Chromium VI	T6	AR	1	mg/kg	N	001-012
Cyanide(Total)	T546	AR	1	mg/kg	M	001-012
pH	T7	AR			M	001-012
Phenols(Mono)	T546	AR	1	mg/kg	M	001-012
Retained on 10mm sieve	T2	M40	0.1	%	N	001-012
Soil Organic Matter	T287	M40	0.1	%	N	001-012
SO4(Total)	T6	M40	0.01	%	N	001-012
Sulphide	T4	AR	10	mg/kg	N	001-012
Sulphur (total)	T6	M40	0.01	%	N	001-012
Arsenic	T6	M40	2	mg/kg	M	001-012
Cadmium	T6	M40	1	mg/kg	M	001-012
Chromium	T6	M40	1	mg/kg	M	001-012
Copper	T6	M40	1	mg/kg	M	001-012
Lead	T6	M40	1	mg/kg	M	001-012
Mercury	T6	M40	1	mg/kg	M	001-012
Nickel	T6	M40	1	mg/kg	M	001-012
Selenium	T6	M40	3	mg/kg	M	001-012
Zinc	T6	M40	1	mg/kg	M	001-012
Naphthalene	T207	M105	0.1	mg/kg	M	001-012
Acenaphthylene	T207	M105	0.1	mg/kg	U	001-012
Acenaphthene	T207	M105	0.1	mg/kg	M	001-012
Fluorene	T207	M105	0.1	mg/kg	M	001-012
Phenanthrene	T207	M105	0.1	mg/kg	M	001-012
Anthracene	T207	M105	0.1	mg/kg	U	001-012
Fluoranthene	T207	M105	0.1	mg/kg	M	001-012
Pyrene	T207	M105	0.1	mg/kg	M	001-012
Benzo(a)Anthracene	T207	M105	0.1	mg/kg	M	001-012
Chrysene	T207	M105	0.1	mg/kg	M	001-012
Benzo(b/k)Fluoranthene	T207	M105	0.1	mg/kg	M	001-012
Benzo(a)Pyrene	T207	M105	0.1	mg/kg	M	001-012
Indeno(123-cd)Pyrene	T207	M105	0.1	mg/kg	M	001-012
Dibenzo(ah)Anthracene	T207	M105	0.1	mg/kg	M	001-012

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Benzo(ghi)Perylene	T207	M105	0.1	mg/kg	M	001-012
PAH(total)	T207	M105	0.1	mg/kg	U	001-012
Benzene	T54	AR	1	µg/kg	U	001-002,004,006-007,009-011
Toluene	T54	AR	1	µg/kg	U	001-002,004,006-007,009-011
EthylBenzene	T54	AR	1	µg/kg	U	001-002,004,006-007,009-011
M/P Xylene	T54	AR	1	µg/kg	U	001-002,004,006-007,009-011
O Xylene	T54	AR	1	µg/kg	U	001-002,004,006-007,009-011
Methyl tert-Butyl Ether	T54	AR	1	µg/kg	U	001-002,004,006-007,009-011
TPH (C5-C6 aliphatic)	T54	AR	0.010	mg/kg	N	001-002,004,006-007,009-011
TPH (C6-C8 aliphatic)	T54	AR	0.010	mg/kg	N	001-002,004,006-007,009-011
TPH (C8-C10 aliphatic)	T54	AR	0.010	mg/kg	N	001-002,004,006-007,009-011
TPH (C10-C12 aliphatic)	T8	M105	1	mg/kg	N	001-002,004,006-007,009-011
TPH (C12-C16 aliphatic)	T8	M105	1	mg/kg	N	001-002,004,006-007,009-011
TPH (C16-C21 aliphatic)	T8	M105	1	mg/kg	N	001-002,004,006-007,009-011
TPH (C21-C35 aliphatic)	T8	M105	1	mg/kg	N	001-002,004,006-007,009-011
TPH (C6-C7 aromatic)	T54	AR	0.010	mg/kg	N	001-002,004,006-007,009-011
TPH (C7-C8 aromatic)	T54	AR	0.010	mg/kg	N	001-002,004,006-007,009-011
TPH (C8-C10 aromatic)	T54	AR	0.010	mg/kg	N	001-002,004,006-007,009-011
TPH (C10-C12 aromatic)	T8	M105	1	mg/kg	N	001-002,004,006-007,009-011
TPH (C12-C16 aromatic)	T8	M105	1	mg/kg	N	001-002,004,006-007,009-011
TPH (C16-C21 aromatic)	T8	M105	1	mg/kg	N	001-002,004,006-007,009-011
TPH (C21-C35 aromatic)	T8	M105	1	mg/kg	N	001-002,004,006-007,009-011
TPH (C8-C10)	T8	M105	1	mg/kg	U	003,005,008,012
TPH (C10-C12)	T206	M105	1	mg/kg	M	003,005,008,012
TPH (C12-C16)	T206	M105	1	mg/kg	M	003,005,008,012
TPH (C16-C21)	T206	M105	1	mg/kg	M	003,005,008,012
TPH (C21-C35)	T206	M105	1	mg/kg	M	003,005,008,012
Moisture @105C	T162	AR	0.1	%	N	001-012

Derwentside Environmental Testing Services

Certificate of Analysis

Certificate Number 16-78192

14-Sep-16

Client	Ian Farmer Associates 14-15 Rufford Court Hardwick Grange Woolston Warrington Cheshire WA1 4RF
Our Reference	16-78192
Client Reference	41953
Order No	41331
Contract Title	London Road Fire Station, Manchester
Description	6 Soil samples.
Date Received	10-Sep-16
Date Started	10-Sep-16
Date Completed	14-Sep-16
Test Procedures	Identified by prefix DETSn (details on request).
Notes	Opinions and interpretations are outside the scope of UKAS accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. Observations and interpretations are outside the scope of ISO 17025. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Rob Brown
Business Manager

UKAS TESTING
2139

Summary of Chemical Analysis
Soil Samples

Our Ref 16-78192
Client Ref 41953
Contract Title London Road Fire Station, Manchester

			Lab No	1050366	1050367	1050368	1050369	1050370	1050371
			Sample ID	BH01	BH02	BH02	BH02	BH03	BH03
			Depth	1.20-1.65	1.80	1.20-1.65	3.60	1.20-1.65	3.50
			Other ID	6	16	19	9	6	14
			Sample Type	B	D	B	D	B	D
			Sampling Date	26/08/16	30/08/16	30/08/16	30/08/16	31/08/16	31/08/16
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Inorganics									
pH	DETSC 2008#			8.8	8.6	8.5	8.4	8.4	8.3
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	100	350	150	120	44	49

Key: # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Information in Support of the Analytical Results

Our Ref 16-78192
Client Ref 41953
Contract London Road Fire Station, Manchester

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1050366	BH01 1.20-1.65 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
1050367	BH02 1.80 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
1050368	BH02 1.20-1.65 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
1050369	BH02 3.60 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
1050370	BH03 1.20-1.65 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
1050371	BH03 3.50 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	

Key: P-Plastic T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

ARCHWAY ENGINEERING (UK) LTD
AINLEYS INDUSTRIAL ESTATE
ELLAND
WEST YORKSHIRE
HX5 9JP

SPT Hammer Ref:	AR1181
Test Date:	12/01/2016
Report Date:	12/01/2016
File Name:	AR1181.spt
Test Operator:	SH

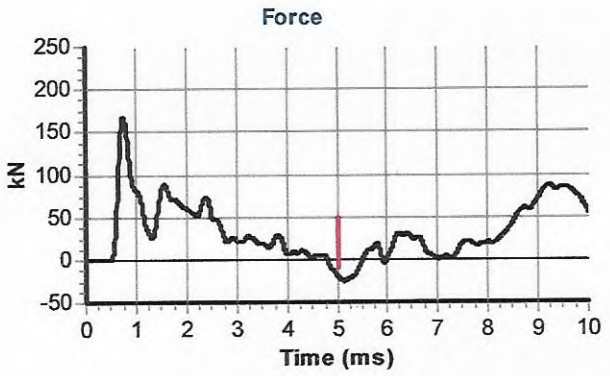
Instrumented Rod Data

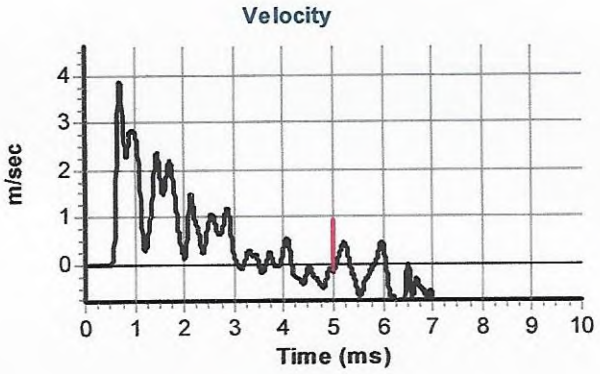
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.1
Assumed Modulus E_a (GPa):	200
Accelerometer No.1:	7079
Accelerometer No.2:	7080

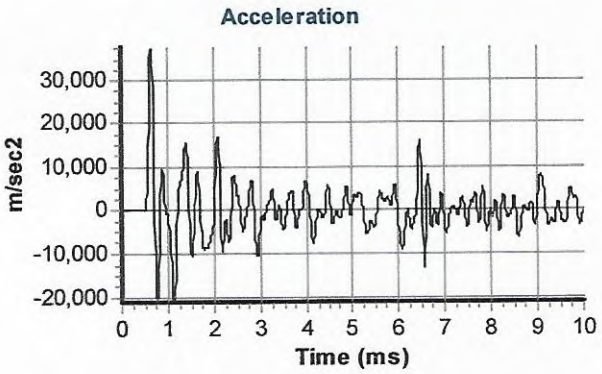
SPT Hammer Information

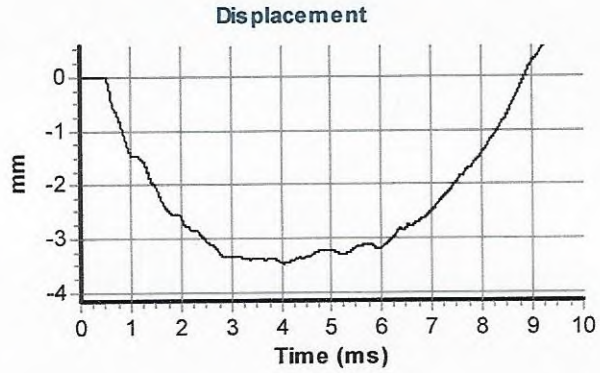
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	10.0

Comments / Location
CALIBRATION









Calculations

Area of Rod A (mm2):	918
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	267

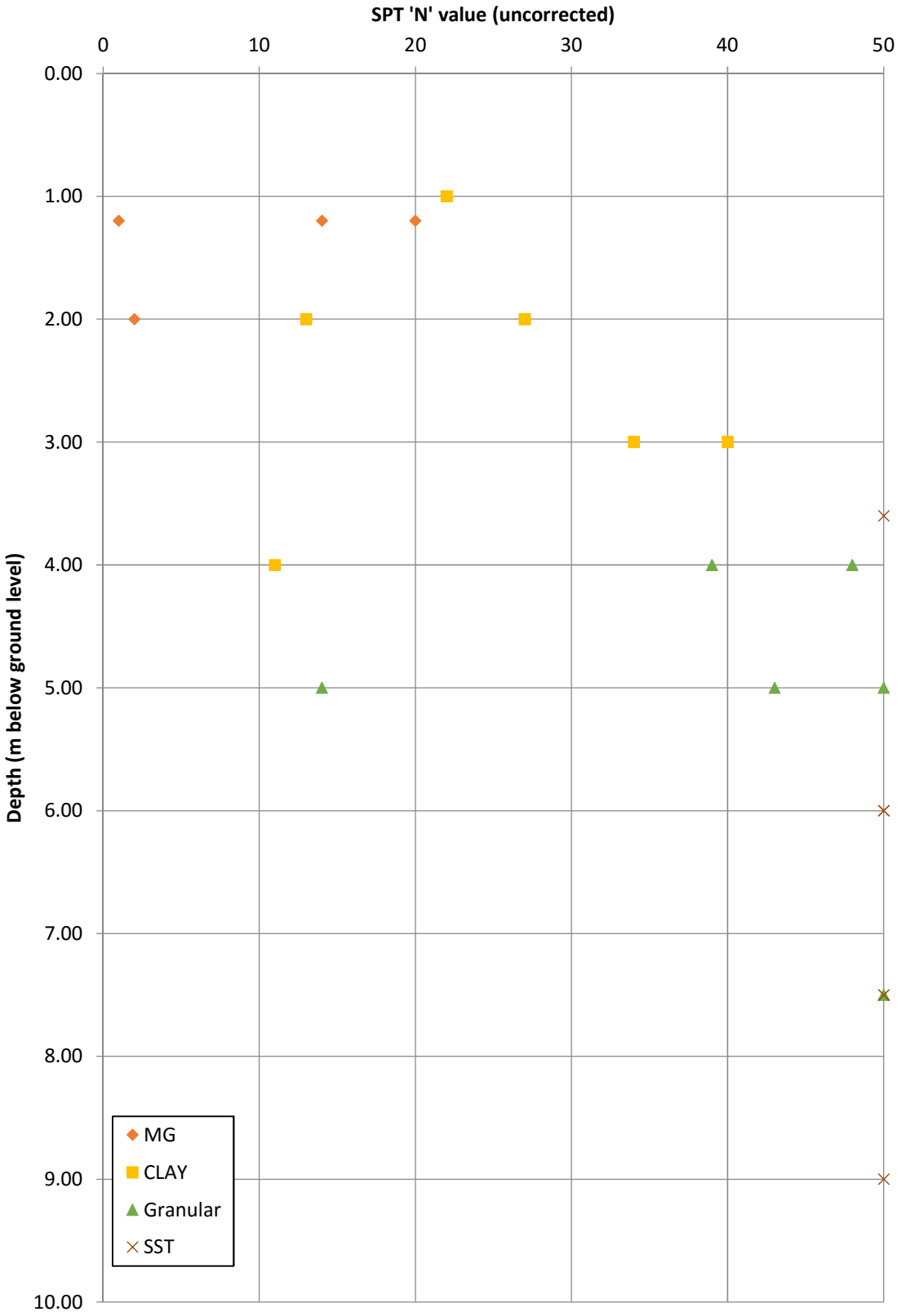
Energy Ratio E_r (%): **56**

Signed: M.GARDNER
Title: FITTER

The recommended calibration interval is 12 months

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Figure A1.4 London Road Fire Station
SPT 'N' value versus depth





Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Dynamic sampling uk ltd
6-8 victory parkway
victory road
Derby
DE24 8ZF

Hammer Ref:	110.45.LT
Test Date:	27/06/2016
Report Date:	
File Name:	110.45.LT.spt
Test Operator:	TP

Instrumented Rod Data

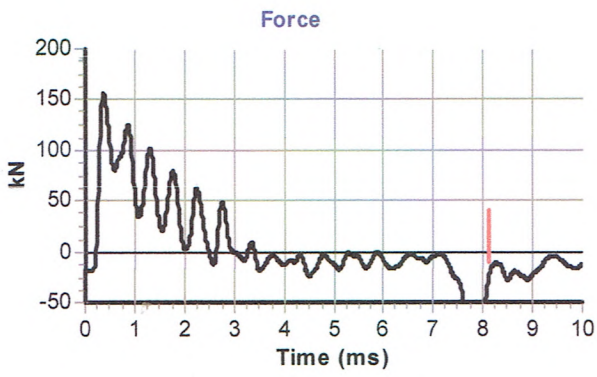
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.9
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	6455
Accelerometer No.2:	6457

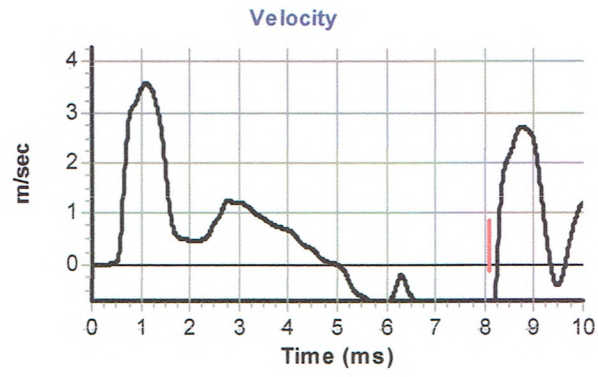
Hammer Information

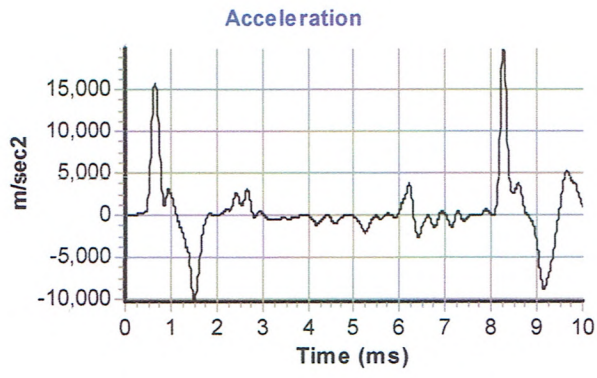
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
String Length L (m):	15.0

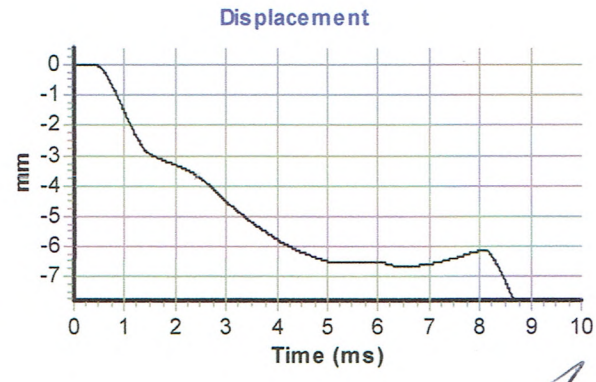
Comments / Location

Hammer tested at Dynamic samplings yard.





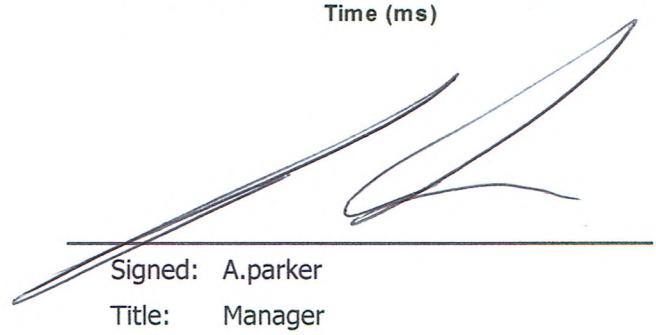




Calculations

Area of Rod A (mm2):	1021
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	346

Energy Ratio E_r (%): **73**



Signed: A.parker

Title: Manager

The recommended calibration interval is 12 months

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IAN FARMER ASSOCIATES

Unit 4 Faraday Close, Pattinson North Industrial Estate, Washington, Tyne & Wear, NE38 8QJ
Tel. 0191 482 8500 Fax. 0191 482 8520 Email. washington@ianfarmer.co.uk Internet. www.ianfarmer.co.uk

Merchant Exchange
17-19 Whitworth Street West
Manchester
M1 5WG

F.A.O.

Test Report - 41953 /1

Site:	London Road Fire Station, Manchester
Job Number:	41953
Originating Client:	Curtins
Originating Reference:	41953
Date Sampled:	Not Given
Date Scheduled:	12/09/2016
Date Testing Started:	14/09/2016
Date Testing Finished:	29/09/2016

Remarks:

Authorised By: 

Daniel Smith
Laboratory Supervisor

Date: 29/09/2016

constructionline

Ian Farmer Associates (1998) Limited. Registered in England and Wales No. 3661447
Registered Office: Unit 4 Faraday Close, Pattinson North Industrial Estate, Washington, NE38 8QJ
Offices in: Coventry (024) 7630 3422. Harpenden, Herts. (01582) 460 018. Llanelli (01554) 566 566.
Motherwell (01698) 230 231. Newcastle upon Tyne (0191) 482 8500. Truro (01827) 261 775.
Warrington (01925) 855 440.

AGS ASSOCIATION OF GEOTECHNICAL & GEOENVIRONMENTAL SPECIALISTS

UKAS TESTING
1464

IAN FARMER ASSOCIATES

Laboratory Test Report 41953 / 1

Site: London Road Fire Station, Manchester **Job Number:** 41953

Client: Curtins **Page:** 2

Determination of Water Content, Liquid Limit and Plastic Limit and Derivation of Plasticity and Liquidity Index

Borehole / Trial Pit	Depth (m)	Sample	Natural / Sieved	Natural Water Content %	Sample Passing 425 µm Sieve		Liquid Limit %	Plastic Limit %	Plasticity Index %	Liquidity Index	Class	Description / Remarks
					Percentage %	Water Content %						
BH01	3.00	U12	Natural	16.2	90	17.0	36	18	18	-0.03	CI	Brown slightly sandy, gravelly CLAY
BH02	2.00	U15	Natural	15	83	17.0	38	18	20	-0.04	CI	Brown slightly sandy, gravelly CLAY
BH03	3.00	U13	Natural	18.3	93	19.0	40	20	20	-0.03	CI	Brown slightly gravelly CLAY

Method of Preparation: BS EN ISO 17892 : Part 1 : 2014 : Clause 5.1 Water content test preparation
BS 1377 : Part 1 : 2016 : Clause 8.4.3 Preparation of samples for plasticity tests
BS 1377 : Part 2 : 1990 : Clause 4.2 Preparation of samples for plastic limit tests

Method of Test: BS EN ISO 17892 : Part 1 : 2014 : Clause 5.2 Water content test execution
BS 1377 : Part 2 : 1990 : Clause 4.3 or 4.4 Determination of the liquid limit
BS 1377 : Part 2 : 1990 : Clause 5.3 Determination of the plastic limit and plasticity index

UKAS TESTING 1464

IAN FARMER ASSOCIATES

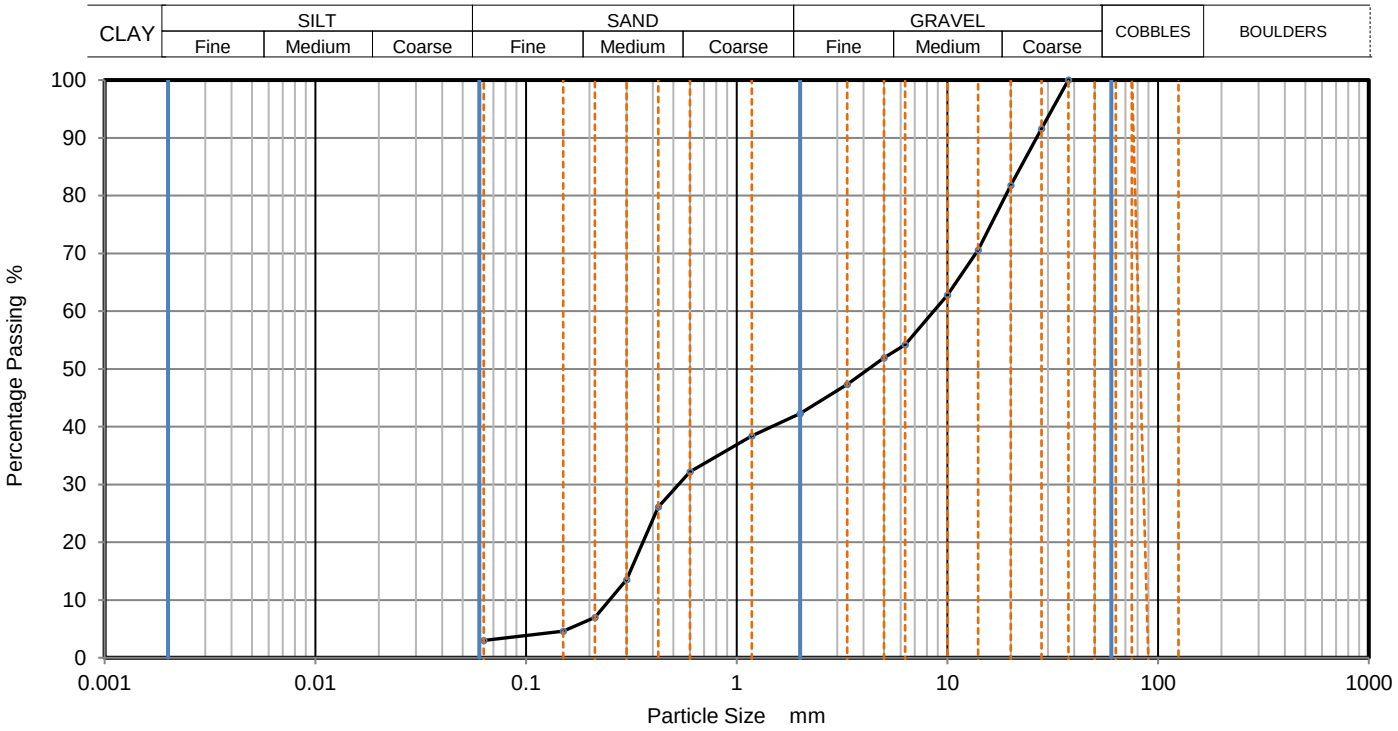
Laboratory Test Report | 41953 / 1

Site: London Road Fire Station, Manchester **Job Number:** 41953

Client: Curtins **Page:** 3

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH01	4.00	B15	Wet Sieve	Brown very gravelly SAND



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
37.5	100		
28	92		
20	82		
14	71		
10	63		
6.3	54		
5	52		
3.35	47		
2	42		
1.18	38		
0.6	32		
0.425	26		
0.3	14		
0.212	7		
0.15	5		
0.063	3		

Dry Mass of sample, g: 5245

Sample Proportions	% dry mass
Very coarse	0
Gravel	58
Sand	39
Fines <0.063mm	3

Grading Analysis		
D100	mm	37.5
D60	mm	8.58
D30	mm	0.53
D10	mm	0.249
Uniformity Coefficient		34
Curvature Coefficient		0.13

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7 3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method

UKAS TESTING
1464

IAN FARMER ASSOCIATES

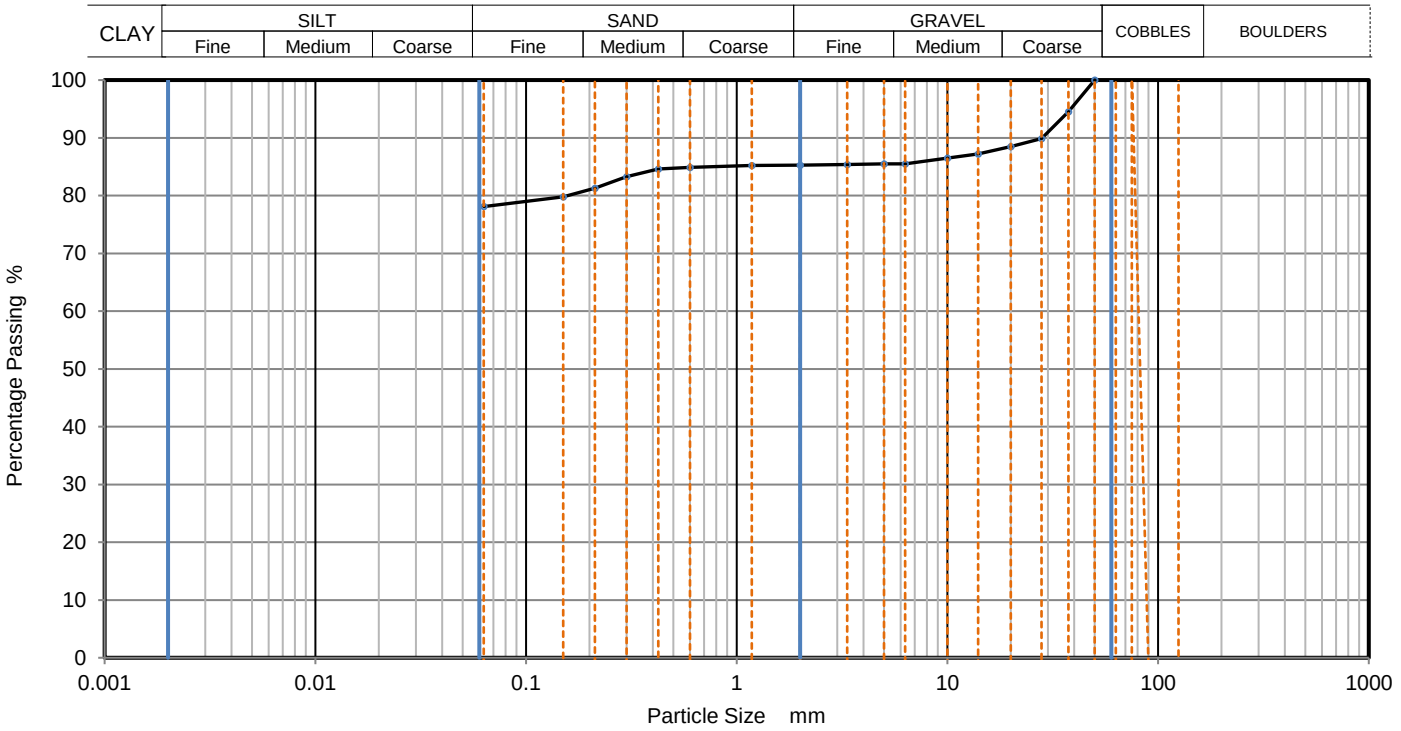
Laboratory Test Report | 41953 / 1

Site: London Road Fire Station, Manchester **Job Number:** 41953

Client: Curtins **Page:** 4

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH02	4.00	B8	Wet Sieve	Brown slightly gravelly, slightly clayey SAND



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
50	100		
37.5	95		
28	90		
20	89		
14	87		
10	87		
6.3	86		
5	86		
3.35	85		
2	85		
1.18	85		
0.6	85		
0.425	85		
0.3	83		
0.212	81		
0.15	80		
0.063	78		

Dry Mass of sample, g: 2179

Sample Proportions	% dry mass
Very coarse	0
Gravel	15
Sand	7
Fines <0.063mm	78

Grading Analysis		
D100	mm	50
D60	mm	
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7 3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method

UKAS TESTING
1464

IAN FARMER ASSOCIATES

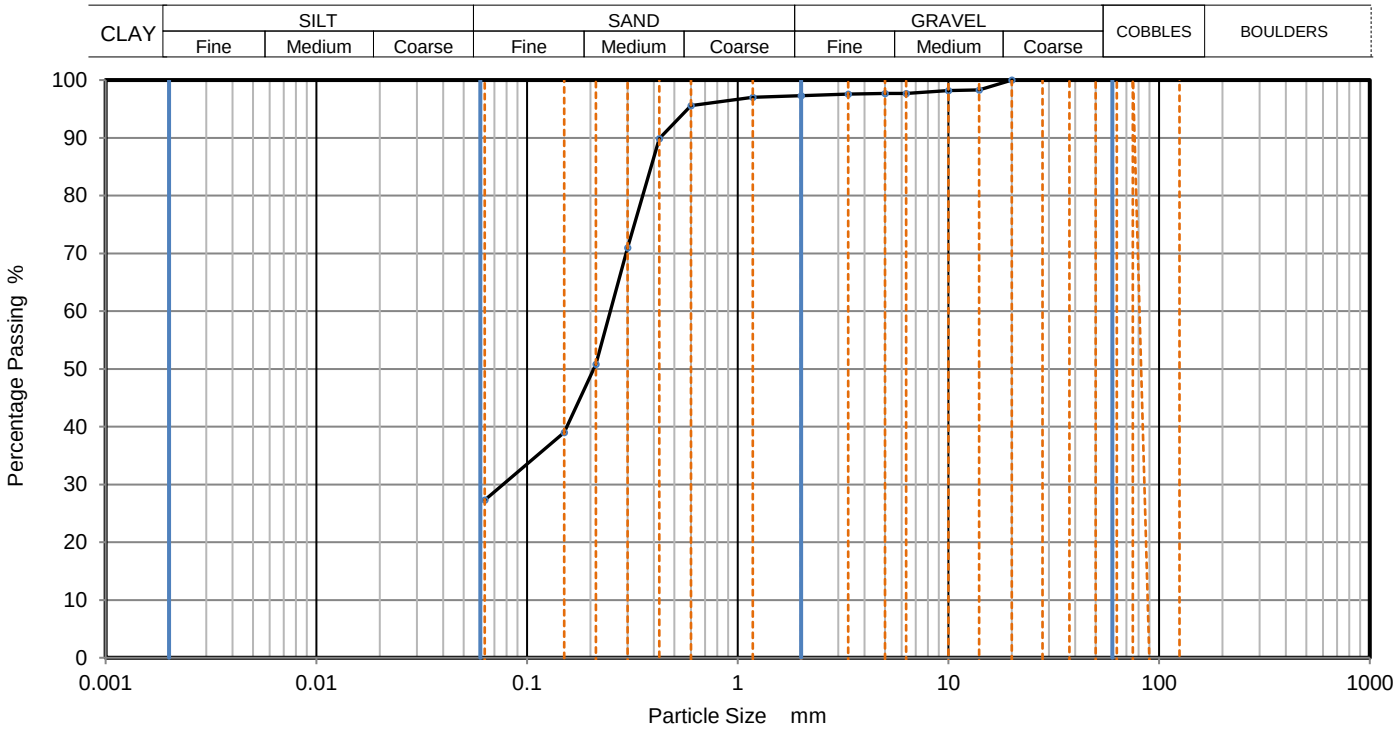
Laboratory Test Report | 41953 / 1

Site: London Road Fire Station, Manchester **Job Number:** 41953

Client: Curtins **Page:** 5

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH03	5.00	B17	Wet Sieve	Brown clayey SAND



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
20	100		
14	98		
10	98		
6.3	98		
5	98		
3.35	98		
2	97		
1.18	97		
0.6	96		
0.425	90		
0.3	71		
0.212	51		
0.15	39		
0.063	27		

Dry Mass of sample, g: 1451

Sample Proportions	% dry mass
Very coarse	0
Gravel	3
Sand	70
Fines <0.063mm	27

Grading Analysis		
D100	mm	20
D60	mm	0.248
D30	mm	0.0772
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7 3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method

UKAS TESTING
1464

IAN FARMER ASSOCIATES	Laboratory Test Report	41953 / 1

Site: London Road Fire Station, Manchester **Job Number:** 41953

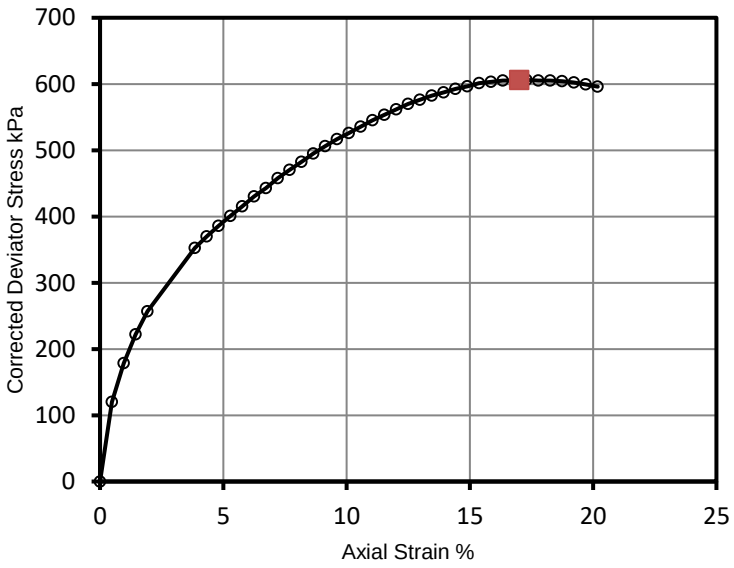
Client: Curtins **Page:** 6

Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen (Definitive Method)

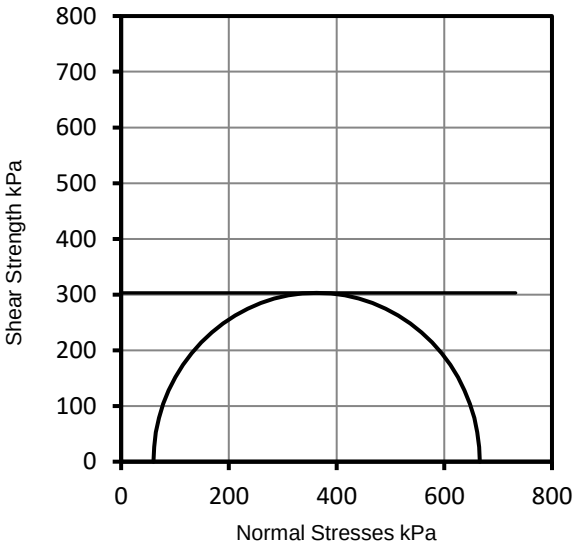
Borehole / Trial Pit	Depth (m)	Sample	Description
BH01	3.00	U12	**Brown slightly sandy, gravelly CLAY**

Initial Sample	Test Number	1
	Original Length (mm)	410.00
	Depth from Top (mm)	15.00
	Condition	Undisturbed
	Orientation	Vertical
Length (mm)		208.06
Diameter (mm)		102.16
Moisture Content (%)		15.30
Bulk Density (Mg/m3)		2.18
Dry Density (Mg/m3)		1.89
Membrane Thickness (mm)		0.44
Membrane Type		Latex
Rate of Strain (%/min)		1.9
Test Results	Cell Pressure (kPa)	60
	Axial Strain (%)	17
	Membrane Corr. (kPa)	1.47
	Deviator Stress, (σ1 - σ3)f (kPa)	606
	Undrained Shear Strength, cu = ½(σ1 - σ3)f (kPa)	303
	Mode of Failure	Plastic

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377.
This is provided for information only.

Method of Preparation: BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or
BS 1377:PT1:1990:7.7.5.2 Preparation of disturbed samples for testing

Method of Test: BS 1377:PT2:1990:7.2 Determination of density by linear measurement.
BS 1377:PT7:1990:8.4 Determination of undrained shear strength in triaxial compression without measurement of pore pressure (Definitive method)

UKAS TESTING
1464

IAN FARMER ASSOCIATES	Laboratory Test Report	41953 / 1

Site: London Road Fire Station, Manchester **Job Number:** 41953

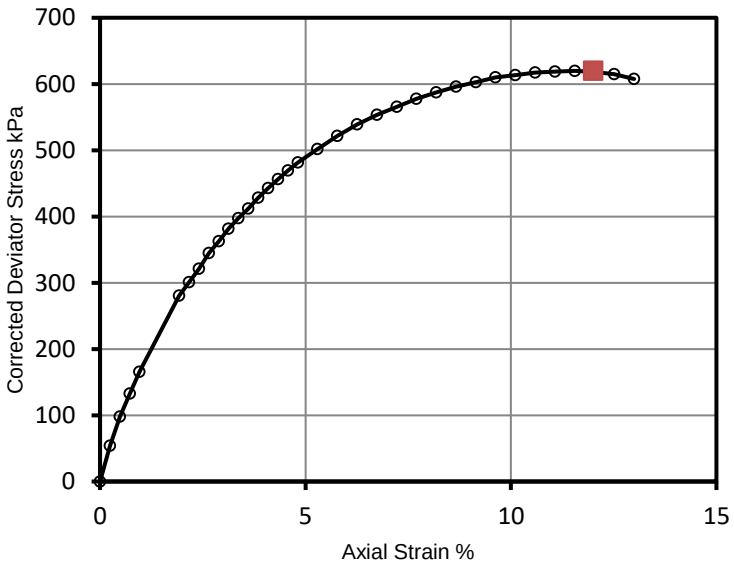
Client: Curtins **Page:** 7

Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen (Definitive Method)

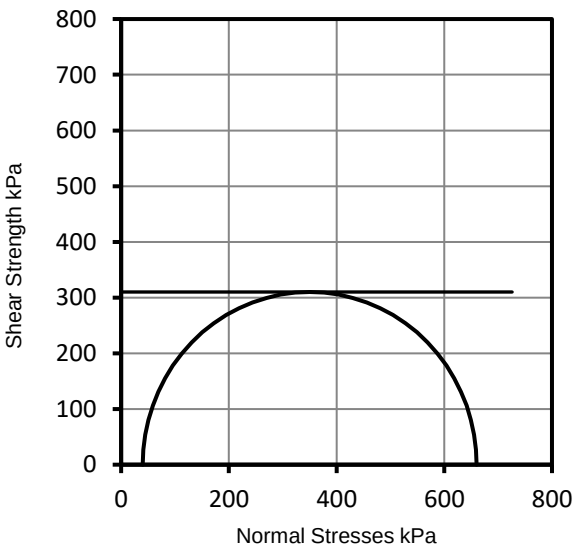
Borehole / Trial Pit	Depth (m)	Sample	Description
BH02	2.00	U15	**Brown slightly sandy, gravelly CLAY**

Initial Sample	Test Number	1
	Original Length (mm)	370.00
	Depth from Top (mm)	7.00
	Condition	Undisturbed
	Orientation	Vertical
Length (mm)		207.76
Diameter (mm)		102.11
Moisture Content (%)		21.70
Bulk Density (Mg/m3)		2.17
Dry Density (Mg/m3)		1.78
Membrane Thickness (mm)		0.47
Membrane Type		Latex
Rate of Strain (%/min)		1.9
Test Results	Cell Pressure (kPa)	40
	Axial Strain (%)	12
	Membrane Corr. (kPa)	1.14
	Deviator Stress, (σ1 - σ3)f (kPa)	620
	Undrained Shear Strength, cu = ½(σ1 - σ3)f (kPa)	310
	Mode of Failure	Compound

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377.
This is provided for information only.

Method of Preparation: BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or
BS 1377:PT1:1990:7.7.5.2 Preparation of disturbed samples for testing

Method of Test: BS 1377:PT2:1990:7.2 Determination of density by linear measurement.
BS 1377:PT7:1990:8.4 Determination of undrained shear strength in triaxial compression without measurement of pore pressure (Definitive method)

UKAS TESTING
1464

IAN FARMER ASSOCIATES	Laboratory Test Report	41953 / 1

Site: London Road Fire Station, Manchester **Job Number:** 41953

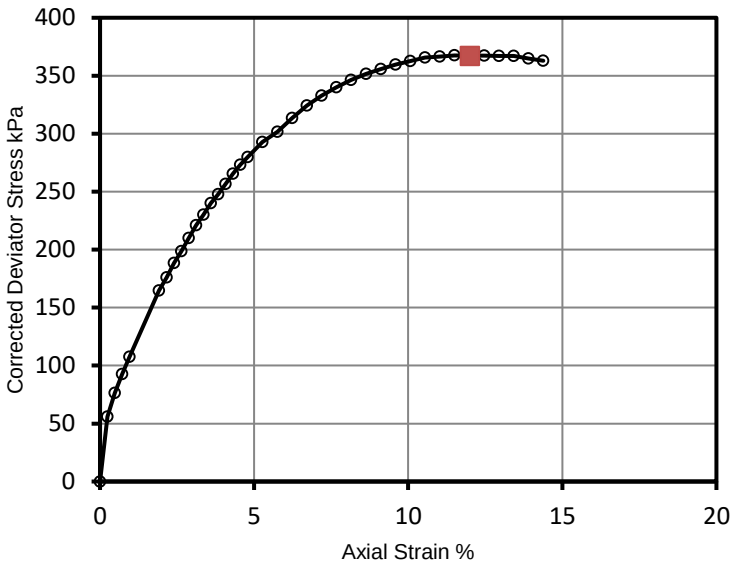
Client: Curtins **Page:** 8

Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen (Definitive Method)

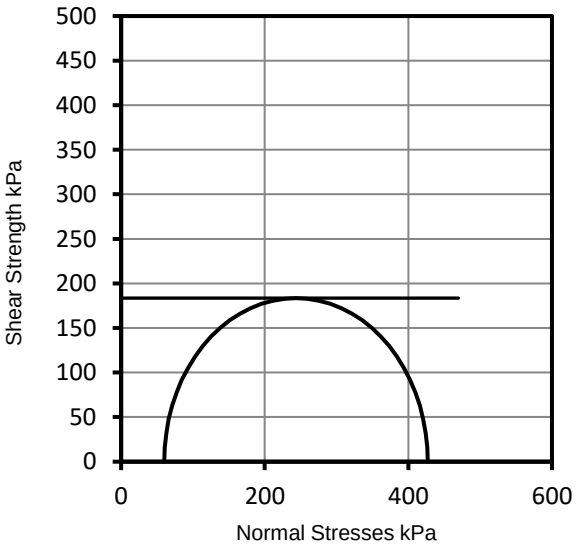
Borehole / Trial Pit	Depth (m)	Sample	Description
BH03	3.00	U13	**Brown slightly gravelly CLAY**

Initial Sample	Test Number	1
	Original Length (mm)	356.42
	Depth from Top (mm)	22.91
	Condition	Undisturbed
	Orientation	Vertical
Length (mm)		208.59
Diameter (mm)		101.25
Moisture Content (%)		17.80
Bulk Density (Mg/m3)		2.19
Dry Density (Mg/m3)		1.85
Membrane Thickness (mm)		0.39
Membrane Type		Latex
Rate of Strain (%/min)		1.9
Test Results	Cell Pressure (kPa)	60
	Axial Strain (%)	12
	Membrane Corr. (kPa)	0.95
	Deviator Stress, (σ1 - σ3)f (kPa)	367
	Undrained Shear Strength, cu = ½(σ1 - σ3)f (kPa)	184
	Mode of Failure	Compound

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377.
This is provided for information only.

Method of Preparation: BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or
BS 1377:PT1:1990:7.7.5.2 Preparation of disturbed samples for testing

Method of Test: BS 1377:PT2:1990:7.2 Determination of density by linear measurement.
BS 1377:PT7:1990:8.4 Determination of undrained shear strength in triaxial compression without measurement of pore pressure (Definitive method)

UKAS TESTING
1464

IAN FARMER ASSOCIATES

Laboratory Test Report | 41953 / 1

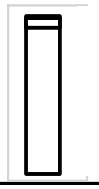
Site: London Road Fire Station, Manchester | **Job Number:** 41953

Client: Curtins | **Page:** 9

DETERMINATION OF THE ONE-DIMENSIONAL CONSOLIDATION PROPERTIES

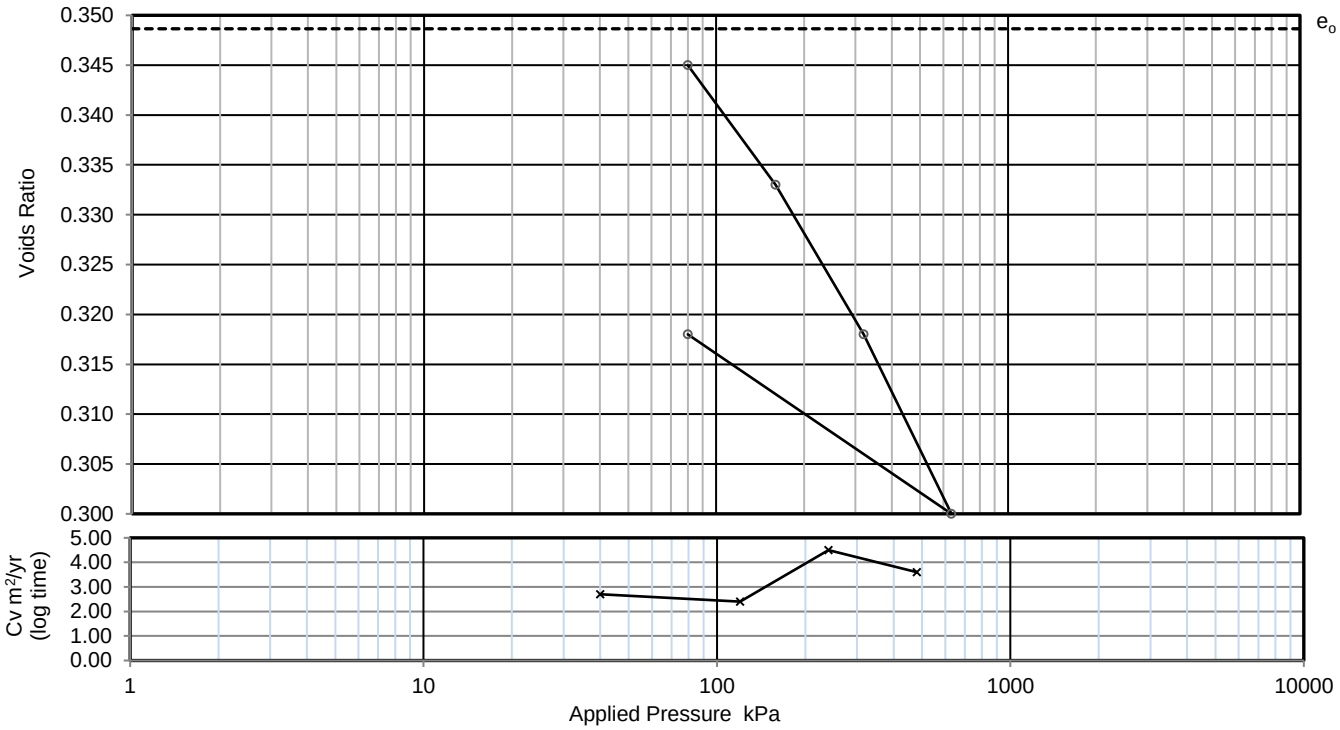
Borehole / Trial Pit	Depth (m)	Sample	Description
BH01	3	U12	Brown slightly sandy, gravelly CLAY

Initial Specimen



Length of Sample (mm)	410.00
Depth from top of specimen (mm)	5.00
Condition of Sample:	Undisturbed
Orientation:	Vertical

Diameter (mm)	74.92
Particle density (Mg/m³)	2.65 assumed
Swelling Pressure (kPa)	40
Lab Temp. (°C)	22



Applied Pressure kPa	Mv m2/MN	Cv (t50, log) m2/yr	Cv (t90, root) m2/yr	Csec	Voids ratio
40.0	-	-	-	-	0.349
80	0.032	2.7	4.1	0.00045	0.345
160	0.11	2.4	10	0.00031	0.333
320	0.071	4.5	34	0.00079	0.318
640	0.043	3.6	31	0.00062	0.300
80	0.043				0.318

	Initial	Final
Height (mm)	18.71	18.28
Water Content (%)	13.9	15.0
Bulk density (Mg/m³)	2.24	2.31
Dry density (Mg/m³)	1.96	2.01
Voids Ratio	0.349	0.318
Degree of Saturation (%)	105	125

Method of Preparation: BS 1377:Part 5:1990, clause 3.3 Preparation of specimen
BS 1377:Part 5:1990, clause 3.4 Preparation and assembly of apparatus

Method of Test: BS 1377:Part 5:1990, clause 4.3 Measurement of swelling presure
BS 1377:Part 5:1990, clause 3.5 Determination of the one-dimensional consolidation properties

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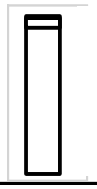
Site: London Road Fire Station, Manchester **Job Number:** 41953

Client: Curtins **Page:** 10

DETERMINATION OF THE ONE-DIMENSIONAL CONSOLIDATION PROPERTIES

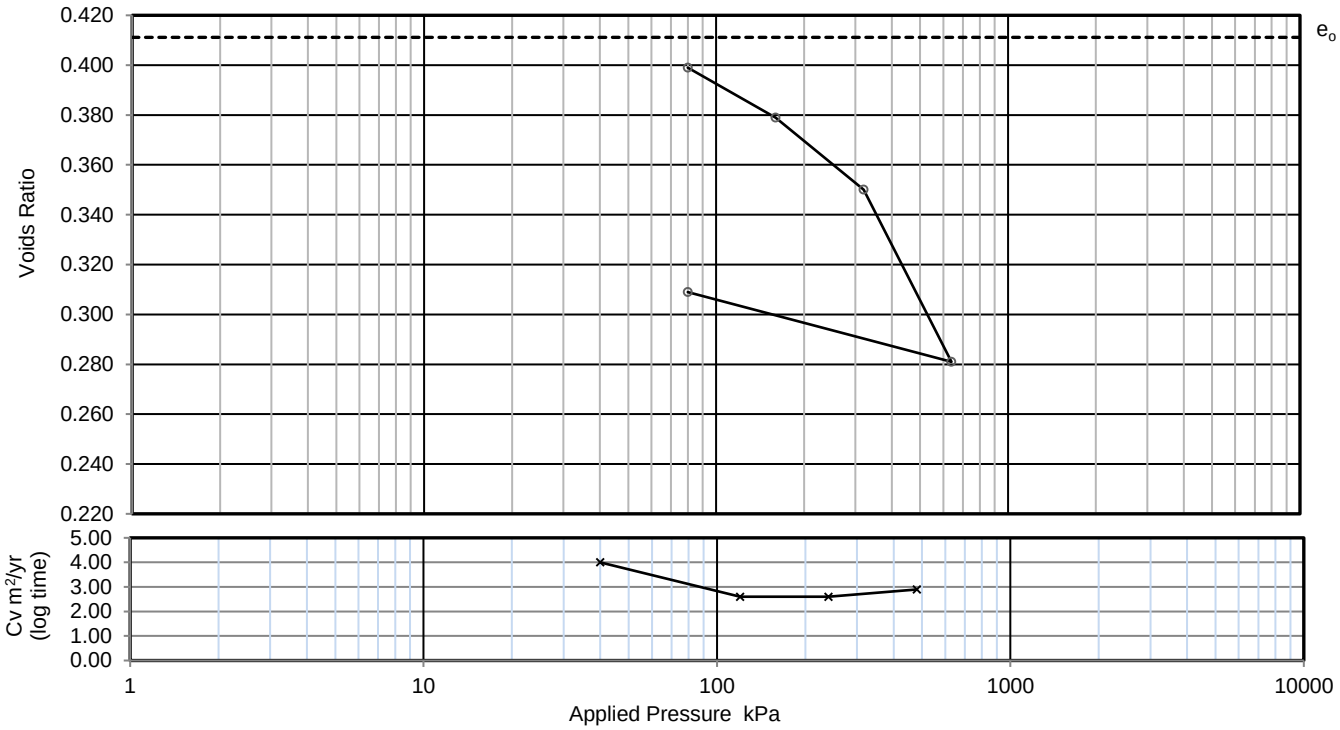
Borehole / Trial Pit	Depth (m)	Sample	Description
BH02	2	U15	Brown slightly sandy, gravelly CLAY

Initial Specimen



Length of Sample (mm)	370.00
Depth from top of specimen (mm)	0.00
Condition of Sample:	Undisturbed
Orientation:	Vertical

Diameter (mm)	74.97
Particle density (Mg/m³)	2.65 assumed
Swelling Pressure (kPa)	40
Lab Temp. (°C)	22



Applied Pressure kPa	Mv m2/MN	Cv (t50, log) m2/yr	Cv (t90, root) m2/yr	Csec	Voids ratio
40.0	-	-	-	-	0.411
80	0.1	4	17	0.00069	0.399
160	0.18	2.6	12	0.00066	0.379
320	0.13	2.6	33	0.00089	0.350
640	0.16	2.9	6.6	0.0013	0.281
80	0.039				0.309

	Initial	Final
Height (mm)	18.87	17.51
Water Content (%)	16.3	17.3
Bulk density (Mg/m³)	2.18	2.37
Dry density (Mg/m³)	1.88	2.02
Voids Ratio	0.411	0.309
Degree of Saturation (%)	105	148

Method of Preparation: BS 1377:Part 5:1990, clause 3.3 Preparation of specimen
BS 1377:Part 5:1990, clause 3.4 Preparation and assembly of apparatus

Method of Test: BS 1377:Part 5:1990, clause 4.3 Measurement of swelling presure
BS 1377:Part 5:1990, clause 3.5 Determination of the one-dimensional consolidation properties

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Site: London Road Fire Station, Manchester **Job Number:** 41953

Client: Curtins **Page:** 11

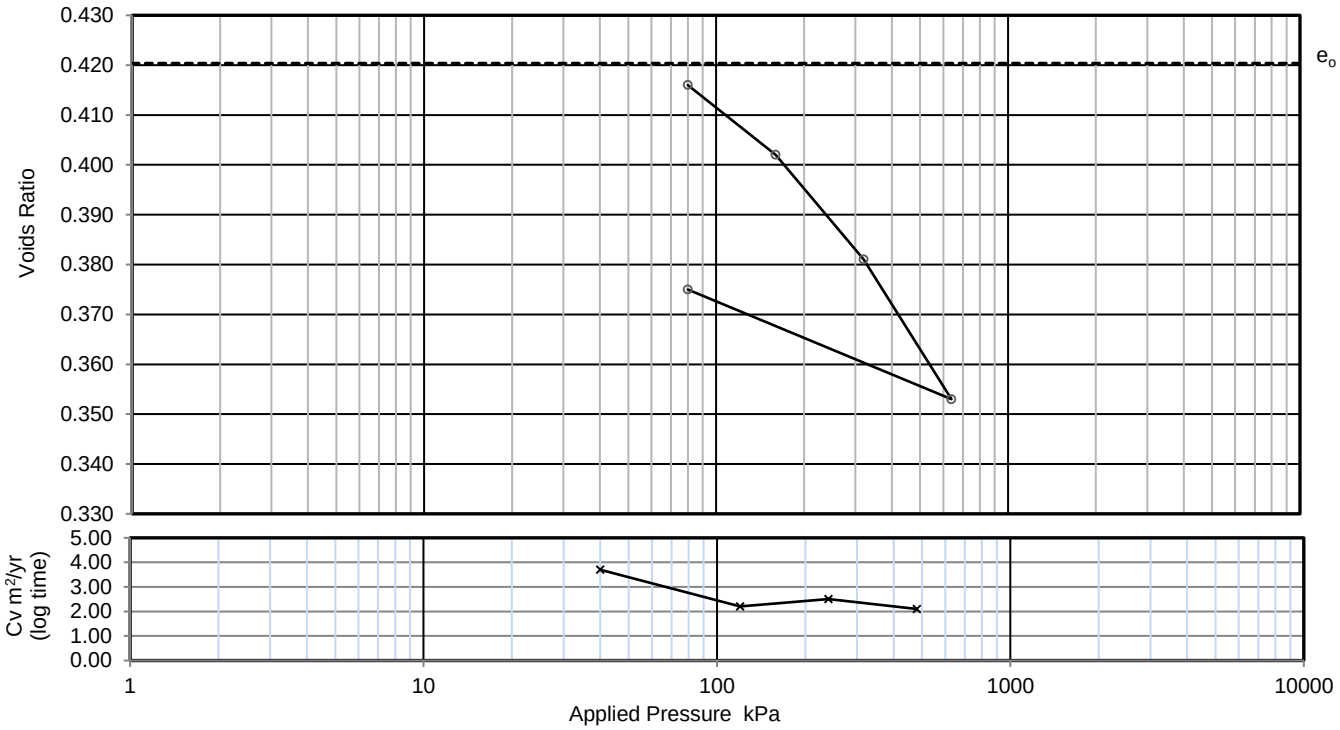
DETERMINATION OF THE ONE-DIMENSIONAL CONSOLIDATION PROPERTIES

Borehole / Trial Pit	Depth (m)	Sample	Description
BH03	3	U13	Brown slightly gravelly CLAY

Initial Specimen

Length of Sample (mm)	356.00
Depth from top of specimen (mm)	10.00
Condition of Sample:	Undisturbed
Orientation:	Vertical

Diameter (mm)	74.90
Particle density (Mg/m³)	2.65 assumed
Swelling Pressure (kPa)	
Lab Temp. (°C)	22



Applied Pressure kPa	Mv m2/MN	Cv (t50, log) m2/yr	Cv (t90, root) m2/yr	Csec	Voids ratio
0.0	-	-	-	-	0.420
80	0.041	3.7	18	0.00045	0.416
160	0.12	2.2	7.8	0.00049	0.402
320	0.094	2.5	6.8	0.00085	0.381
640	0.063	2.1	4.2	0.00092	0.353
80	0.033				0.375

	Initial	Final
Height (mm)	19.71	19.08
Water Content (%)	16.6	16.6
Bulk density (Mg/m³)	2.18	2.25
Dry density (Mg/m³)	1.87	1.93
Voids Ratio	0.420	0.375
Degree of Saturation (%)	105	117

Method of Preparation: BS 1377:Part 5:1990, clause 3.3 Preparation of specimen
BS 1377:Part 5:1990, clause 3.4 Preparation and assembly of apparatus

Method of Test: BS 1377:Part 5:1990, clause 3.5 Determination of the one-dimensional consolidation properties

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F.A.O.

Test Report - 41953R /1

Site:	London Road Fire Station, Manchester
Job Number:	41953R
Originating Client:	Curtins
Originating Reference:	41953R
Date Sampled:	Not Given
Date Scheduled:	19/09/2016
Date Testing Started:	20/09/2016
Date Testing Finished:	21/09/2016

Remarks:

Authorised By:

Daniel Smith
Laboratory Supervisor

Date: 22/09/2016

constructionline

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Laboratory Test Report 41953R / 1

Site: London Road Fire Station, Manchester **Job Number:** 41953R

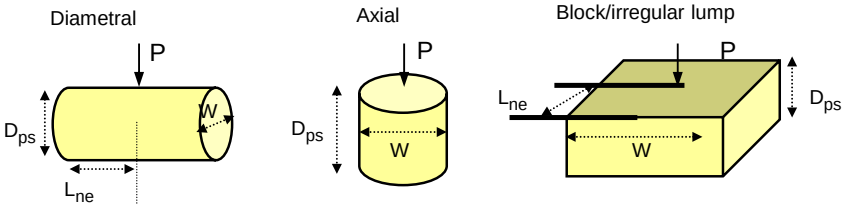
Client: Curtins **Page:** 2

Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P kN	Equivalent diameter, De mm	Point Load Strength Index		Remarks (including water content if measured)
				Type (D, A, I, B)	Direction (L, P or U)		Lne mm	W mm	Dps mm	Dps' mm			Is . MPa	Is (50) MPa	
BH02	10.15	C24	Brown SANDSTONE As received	A	U	YES		85.9	70.0	72.0	<0.3	88.7	<0.04	<0.05	
BH02	12.56	C25	Brown SANDSTONE As received	A	U	YES		83.6	45.0	48.0	<0.3	71.5	<0.04	<0.05	
BH02	14.12	C26	Brown SANDSTONE As received	A	U	YES		85.2	82.0	84.0	<0.3	95.5	<0.03	<0.04	
BH02	16.81	C27	Brown SANDSTONE As received	A	U	YES		86.3	28.0	32.0	<0.3	59.3	<0.09	<0.09	

Test Type
D - Diametral, A - Axial, I - Irregular Lump, B - Block
Direction
L - parallel to planes of weakness
P - perpendicular to planes of weakness
U - unknown or random
Dimensions
Dps - Distance between platens (platen separation)
Dps' - at failure (see ISRM note 6)
Lne - Length from platens to nearest free end
W - Width of shortest dimension perpendicular to load, P
Size factor, F = (De/50)0.45 for all tests.

Detailed legend for test and dimensions, based on ISRM



Method of Preparation: ISRM 2007 Suggested method for point load strength index (pages 125 - 132)

Method of Test: ISRM 2007 Suggested method for point load strength index (pages 125 - 132)

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GAS MONITORING LOG SHEET

Project:	London Road Fire Station	**Date:**	27/09/16
Job Number:	B061230	**Visit:**	1
Client:	Allied London	**Weather:**	Overcast
Barometric State:	Rising	**Ground Conditions:**	Damp

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Note
		Max	SS	Max	SS	Max	SS					
BH01	1012	0.0	0.0	0.0	0.0	0.3	0.3	20.1	0	0	n/a	
BH02	1012	0.0	0.0	0.0	0.0	0.0	0.0	15.8	1	0	n/a	
WS03	1010	0.0	0.0	0.0	0.0	1.6	1.6	13.9	0	0	n/a	
BH03	1010	0.0	0.0	0.0	0.0	0.5	0.5	19.9	0	0	n/a	

Notes

Logged by

1% gas volume = 10,000 ppm
Flow rate, methane and cabon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated

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GAS MONITORING LOG SHEET

Project:	London Road Fire Station	**Date:**	12/10/16
Job Number:	B061230	**Visit:**	2
Client:	Allied London	**Weather:**	Dry
Barometric State:	Falling	**Ground Conditions:**	Dry

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Note
		Max	SS	Max	SS	Max	SS					
BH01	1017	0.0	0.0	0.0	0.0	0.6	0.3	20.6	0	3	Dry	
BH02	1017	0.0	0.0	0.0	0.0	0.8	0.8	14.8	1	3	11.74	
WS03	1017	0.0	0.0	0.0	0.0	1.6	1.5	17.6	1	3	Dry	
BH03	1017	0.0	0.0	0.0	0.0	0.1	0.1	20.3	1	1	Dry	

Notes

Logged by

JB

1% gas volume = 10,000 ppm
Flow rate, methane and cabon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated

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GAS MONITORING LOG SHEET

Project:	London Road Fire Station	**Date:**	25/10/16
Job Number:	B061230	**Visit:**	3
Client:	Allied London	**Weather:**	Dry
Barometric State:	Rising	**Ground Conditions:**	Dry

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Note
		Max	SS	Max	SS	Max	SS					
BH01	1016	0.0	0.0	0.0	0.0	0.0	0.0	20.7	0	0	Dry	
BH02	1016	0.0	0.0	0.0	0.0	1.1	1.1	14.6	2	0	11.78	
WS03	-	-	-	-	-	-	-	-	-	-	-	1
BH03	1015	0.0	0.0	0.0	0.0	0.0	0.0	19.9	1	0	Dry	

Notes

1 Unable to access monitoring well.

Logged by

JB

1% gas volume = 10,000 ppm
Flow rate, methane and cabon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated

Appendix A4 – Tier 1 Thresholds

- Generic Assessment Criteria (GAC) for a '*Commercial*' end-use, 1% SOM

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Tier 1 Thresholds

Soil Contaminants: Initial Assessment of Risk

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The following tables can be used for the initial assessment with regard to the potential for the identified contaminants within a sandy matrix with an average Soil Organic Matter (SOM) content of 1% to present a risk of significant harm to the **'Commercial'** end user.

The list of determinands is non-industry specific and it should be recognised that additional site specific determinands may need to be accounted for.

Table 1.0 Inorganic Species and Phenols

Contaminants	Threshold Trigger Concentration For Planned End Use	
	Source (ref. 1)	Value (mg/kg)
Antimony	ATRISK^{soil} Soil Screening Value	4830
Arsenic	CLEA SGV for commercial end use published May 09	640
Beryllium	ATRISK^{soil} Soil Screening Value	1010
Boron	Recognised threshold to prevent phytotoxic affects	3
Cadmium	CLEA SGV for commercial end use published July 09	230
Chromium (VI)	ATRISK^{soil} Soil Screening Value	330
Copper	ATRISK^{soil} Soil Screening Value	109000
Cyanide (Free)	ATRISK^{soil} Soil Screening Value	34
Lead	ATRISK^{soil} Soil Screening Value	6490
Mercury	ATRISK^{soil} Soil Screening Value (ref. 2)	4.3 ; 3600 ; 66.4
Nickel	CLEA SGV for commercial end use published May 09	1800
Selenium	CLEA SGV for commercial end use published March 09	13000
Sulphate	Recognised threshold for protection of sub-surface concrete	2400
Sulphur (Free)	Recognised threshold for all end uses	5000
Sulphide	Recognised threshold for all end uses	250
Vanadium	ATRISK^{soil} Soil Screening Value	7530
Zinc	ATRISK^{soil} Soil Screening Value	≤1,000,000
pH	Typical value in uncontaminated soils	6-8
Phenols	Recognised threshold for protection of services (ref. 3)	5

1. The tables are for guidance only and must be read in conjunction with relevant source documentation.
2. Three values correspond to: elemental mercury (Hg); inorganic mercury (Hg^{2+}) and methyl mercury (Hg^{+4}).
3. For human health consider using ATRISK^{soil} Soil Screening Value of 686mg/kg.

Table 1.1 BTEX Species

Contaminants	Threshold Trigger Concentration For Planned End Use	
	Source	Value (mg/kg)
Benzene	ATRISK^{soil} Soil Screening Value	13.1
Toluene	ATRISK^{soil} Soil Screening Value (ref. 4)	414000
Ethylbenzene	ATRISK^{soil} Soil Screening Value (ref. 4)	180000
m-Xylene	ATRISK^{soil} Soil Screening Value (ref. 4)	276000
o-Xylene	ATRISK^{soil} Soil Screening Value (ref. 4)	296000
p-Xylene	ATRISK^{soil} Soil Screening Value (ref. 4)	279000

Tier 1 Thresholds

Soil Contaminants: Initial Assessment of Risk

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Table 1.2 PAH Species

Contaminants	Threshold Trigger Concentration For Planned End Use	
	Source	Value (mg/kg)
Acenaphthene	ATRISK^{soil} Soil Screening Value (ref. 4)	109000
Anthracene	ATRISK^{soil} Soil Screening Value (ref. 4)	536000
Benz(a)anthracene	ATRISK^{soil} Soil Screening Value (ref. 4)	131
Benzo(a)pyrene	ATRISK^{soil} Soil Screening Value (ref. 4)	14.3
Benzo(b)fluoranthene	ATRISK^{soil} Soil Screening Value (ref. 4)	142
Benzo(ghi)perylene	ATRISK^{soil} Soil Screening Value (ref. 4)	1440
Benzo(k)fluoranthene	ATRISK^{soil} Soil Screening Value (ref. 4)	1430
Chrysene	ATRISK^{soil} Soil Screening Value (ref. 4)	14000
Dibenz(ah)anthracene	ATRISK^{soil} Soil Screening Value (ref. 4)	14.3
Fluoranthene	ATRISK^{soil} Soil Screening Value (ref. 4)	72300
Fluorene	ATRISK^{soil} Soil Screening Value (ref. 4)	66800
Indeno(123cd)pyrene	ATRISK^{soil} Soil Screening Value (ref. 4)	142
Naphthalene	ATRISK^{soil} Soil Screening Value (ref. 4)	8180
Pyrene	ATRISK^{soil} Soil Screening Value (ref. 4)	54200

4. Where free product is not observed, otherwise consider revising.

Table 1.3 Total Petroleum Hydrocarbon (TPH) Bandings (All values in mg/kg)

Carbon Range	Threshold Trigger Concentration For Planned End Use		
	Source	Aromatic	Aliphatic
C5 – C6	ATRISK^{soil} Soil Screening Value (ref. 5)	13.1 (C5-C7)	327 (ref. 9)
C6 – C8	ATRISK^{soil} Soil Screening Value (ref. 6)	414000 (C7-C8)	158 (ref. 9)
C8 – C10	ATRISK^{soil} Soil Screening Value (ref. 7)	58600	167000
C10 – C12	ATRISK^{soil} Soil Screening Value (ref. 7)	68300	171000
C12 – C16	ATRISK^{soil} Soil Screening Value (ref. 7)	68400	171000
C16 – C21	ATRISK^{soil} Soil Screening Value	28400	≤1,000,000
C21 – C35	ATRISK^{soil} Soil Screening Value	28400	

5. Based on total benzene concentration in the soil.
6. Based on total toluene concentration in the soil.
8. Aliphatic & Aromatic: where free product is not observed, otherwise consider revising.
9. Modelled threshold <1kg/kg; lowest of either aqueous or vapour saturation limits presented.

ATRISK^{soil} Soil Screening Values are published by Atkins Limited

Appendix A5 – Qualitative/Quantitative Risk Assessment Rationale

The site-specific qualitative/quantitative risk assessment of environmental harm, as detailed in Sections 3.0 and 9.0 of this reporting, is summarised in Table A5.1 hereafter; the principle being to establish whether connecting links exist between a hazardous source to a potential receptor via an exposure pathway.

The qualitative/quantitative risk assessment corresponds with the total site area and incorporates both descriptive (qualitative) and, where available, numerical (quantitative) lines of evidence.

Risk assessment is the process of collating known information on a hazard or set of hazards in order to estimate actual or potential risk to receptors. The receptor may be humans, a water resource, a sensitive local ecosystem or future construction materials. Receptors can be connected to the hazardous source by one or several exposure pathways such as direct contact for example. Risks are generally managed by isolating the receptor or intercepting the exposure pathway or by isolating or removing the hazard.

Without the three essential components of a source, pathway and receptor there can be no risk. Therefore the presence of hazard on a site does not necessarily mean there is a risk.

By considering where a viable pathway exists which connects a source with a receptor the risk assessment in Section 3.0 and Table A5.1 identifies where pollutant linkage exists. If there is no pollutant linkage there is no risk and only where a pollutant linkage is established does the risk assessment consider the level of risk.

The risk assessment considers the likelihood of a particular event taking place (accounting for the presence of the hazard and receptor and the integrity of the exposure pathway) in conjunction with the severity of the potential consequence (accounting for the potential severity of the hazard and the sensitivity of the receptor).

In the risk assessment the consequence of the hazard has been classified as severe or medium or mild or minor and the probability (likelihood) of the circumstances actually occurring classified as high likelihood or likely or low likelihood or unlikely.

The consequences and probabilities are subsequently cross-correlated to give a qualitative estimation of the risk using Department of the Environment risk classifications as detailed in the table below and as referenced in CIRIA C552.

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability (Likelihood)	**High Likelihood**	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	Likely	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/Low Risk	Low Risk	Very Low Risk	Very Low Risk

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In accordance with DoE guidance, the following categorisation of **consequence** has been developed.

Classification	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resource. Catastrophic damage to buildings/property. A short-term risk to a particular ecosystem or organisation forming part of such ecosystem.	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied).
Medium	Chronic damage to Human Health. Pollution of sensitive water resources. A significant change in a particular ecosystem or organism forming part of such ecosystem.	Concentration of a contaminant from site exceeds the generic or site-specific assessment criteria. Leaching of contaminants from a site to a Principal or Secondary A aquifer. Death of a species within a designated nature reserve. Lesser toxic and asphyxiate effects
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services. Damage to sensitive buildings/structures/services or the environment.	Pollution of non-classified groundwater (inc. Secondary B aquifers). Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing, etc). Easily repairable effects of damage to buildings, structures and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discoloration of concrete.

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In accordance with DoE guidance, the following categorisation of **probability** has been developed.

Classification	Definition
High Likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low Likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

In accordance with DoE guidance, the following categorisation of **risk** has been developed.

Classification	Definition
Very High Risk	There is a *high probability* that *severe harm* could arise to a designated receptor from an identified hazard at the site without appropriate further action.
High Risk	*Harm* is *likely to arise* to a designated receptor from an identified hazard at the site without appropriate further action.
Moderate Risk	*It is possible* that without appropriate further action *harm could arise* to a designated receptor. It is relatively *unlikely* that any such harm would be *severe,* and if any harm were to occur it is *more likely* that such harm would be *relatively mild.*
Low Risk	*It is possible* that *harm could arise* to a designated receptor from an identified hazard. It is *likely* that, at worst, if any harm was realised any effects would be *mild.*
Negligible Risk	The presence of an identified hazard does not give rise to the potential to cause harm to a designated receptor.

The term 'risk' in this instance refers to the risk that the source, pathway, receptor linkage for a given source of contamination is complete. It does not refer to immediate risk to individuals or features present on the site from potential contaminants and is intended to be used as a tool to assess the necessity of further investigation.

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