Camley Street Natural Park
12 Camley Street
London
N1C 4PW

Combined Geotechnical, Preliminary and Quantitative Contamination Risk Assessment and Waste Classification Report

Report No. R17-12131

June 2017

Report prepared for the benefit of:

London Wildlife Trust
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The risk assessment presented in this report follows 'source-pathway-receptor' techniques for the determination of whether a site is contaminated. This is standard practice in the UK, being intrinsic to Part 2A of the Environmental Protection Act 1990 as amended.

The report considers the proposed end users as the most sensitive human health receptors. If significant risks to construction workers are identified by the preliminary assessment attention is drawn to this, although it is noted that no assessment of risk from acute exposure has been undertaken in this connection.

This report is not intended to be either an ecological, archaeological or flood risk assessment. An appropriate specialist should be consulted about any concerns that may arise in this regard.

EXECUTIVE SUMMARY

The following presents a summary of the main findings of the ground investigation. It is emphasised that no reliance should be placed on any individual point until the whole of the report has been read as other sections of the report may put into context the information contained herein.

It is proposed to demolish and rebuild the visitor centre at Camley Street Natural Park, Camley Street, London.

The site currently contains a prefabricated wooden building used as a visitor centre for the Camley Street Natural Park.

The site formerly comprised part of a larger area of Coal Shoots. These were demolished by the time of the 1968 map and the site was referred to as a nature park by the 1987 map review.

Reference to geological datasets indicates that the site is expected to be underlain by the London Clay Formation. The ground investigation confirmed the underlying soils to comprise a significant thickness of made ground, overlying the undisturbed soils of the London Clay Formation.

The London Clay Formation is classed as an Unproductive Stratum. The site does not lie within an Environment Agency Source Protection Zone with regard to the protection of the quality of groundwater that is abstracted for potable supply.

The preliminary contamination risk assessment identified potential complete pollutant linkages relating to the proposed end users due to the historical use of the site.

The ground investigation identified the presence of asbestos materials within the made ground soils present beneath the site. The depth of made ground recorded also represents a potential source of ground gas generation.

Further works are recommended to allow a more detailed assessment of the risk posed to the proposed development.

Precautions against shrinkage and heave for any new foundation system (pile caps and ground beams etc.) should assume a low volume change potential for the fine grained made ground soils and a high volume change potential for the London Clay Formation soils.

Given the significant thickness of made ground encountered and the depth to the competent soils of the London Clay Formation, present at a depth of around 3.5m, it is recommended that piled foundations should be adopted. Indicative pile capacities are included in the body of the report.

A DS-4 Design Sulfate Class and an AC-3s ACEC classification should be assumed as a minimum for the design of concrete in contact with the ground.

In view of the significant thickness of made ground, it is recommended that ground floors should be suspended.

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1. INTRODUCTION

It is proposed to demolish and rebuild the visitor centre at Camley Natural Park, 12 Camley Street, London.

Ashdown Site Investigation Limited was requested to provide an estimate for carrying out a combined geotechnical and ground contamination risk assessment of the area of proposed redevelopment by Ian Jupp of Huntley Cartwright. The scope of the works allowed for and the terms and conditions under which the works were to be undertaken were set out within the offer letter Q17-5880, dated 7th April 2017. The instruction to proceed was received on behalf of the client, London Wildlife Trust, Dean Bradley House, Horseferry Road, London, SW1P 2AF by means of a signed order, dated 18th April 2017.

The objectives of the works were to:

a) Establish the expected geology, hydrogeology and hydrology at the site;
b) Ascertain the development history and current site use;
c) Develop a preliminary conceptual model of the site identifying potential complete pollutant linkages relating to end users of the proposed development works, to controlled waters beneath and in the vicinity of the site, or to other off-site sensitive receptors, if identified;
d) Investigate the ground and groundwater conditions in the area of the proposed development;
e) Investigate the form of foundations to existing structures;
f) Provide advice to assist others in undertaking design of foundations and ground floors;
g) Test for the presence of contaminants identified by the preliminary conceptual model; and
h) Develop a quantitative conceptual model of the site, refining the preliminary model to identify any remaining pollutant linkages.

The preliminary conceptual model has been based on the findings of a walkover survey and reference to historical Ordnance Survey maps and published geological and environmental information obtained from various sources.

Copies of the historical maps and geo-environmental data referred to in this report are included in a separate volume[1].

[1] Geo-Environmental Data and Historical Maps (Ashdown Site Investigation Limited, Report Number R17-12131/map, dated May 2017.

2. WALKOVER SURVEY

The site under assessment comprises an irregular shaped plot of land located within the north western part of the wider Camley Street Natural Park. The extent of the area within which the assessment was requested to be carried out is shown on the plan presented as Appendix A. It is noted that the site boundary shown within the accompanying maps and data encompasses the entire park.

This area is centred on the approximate Ordnance Survey national grid reference TQ 2995 8351. A site location plan and site plan are presented as Figure 1 and Figure 2, respectively. Photographs taken during the walkover survey are included in Appendix A.

Access to the site is off Camley Street to the southwest. The park extends further to the southeast and the Grand Union Canal lies to its northeast. The north western part of the assessment area was hoarded off and inaccessible due to construction works being carried out on a new bridge spanning the canal.

The site contains a wooden prefabricated building used as a visitor centre for the park. A number of mature trees were present near the building and the ground around was surfaced with a mixture of woodchip, brick paviors and paving slabs.

3. ENVIRONMENTAL AND GEO-ENVIRONMENTAL DATA REVIEW

3.1 Geological and Hydrogeological Information

3.1.1 Expected Geology, Aquifer Designation & Groundwater Vulnerability

The stratigraphic unit that may be expected to underlie the site is presented in the following table.

Table 1. Expected Strata, Aquifer Designation and Description

Type	Stratum	Aquifer Designation	Source Protection Zone
Bedrock	London Clay Formation	Unproductive Stratum	The site does not lie within an Environment Agency Source Protection Zone with regard to the protection of the quality of groundwater that is abstracted for potable supply.

3.1.1.1 London Clay Formation

The London Clay Formation comprises a blue grey silty clay, which tends to weather to brown near to the upper surface. With depth, the clay becomes very stiff/hard, is frequently fissured and can contain some inclusions and beds of weak mudstone and siltstone.

3.1.2 Groundwater and Surface Water Abstraction Licences

The closest groundwater abstraction licence is recorded to lie 336m to the east of the site and is recorded as being for a heat pump.

The closest surface water abstraction licence is recorded to lie 177m to the north west of the site but refers to water use within the Camley Street Nature Park.

3.1.3 Surface Water Features

The nearest recorded significant surface water feature is the Grand Union Canal located adjacent to site to the northeast.

The data states that the canal is reported to be "River Quality C".

3.1.4 Flooding

The site does not lie within an Environment Agency Flood Zone.

The site does not lie within an area where the British Geological Survey report a risk from groundwater flooding to be present.

3.1.5 Mining, Natural Ground Subsidence & Radon

Table 2. Natural Ground Subsidence Hazards

Section	Risk Assessment
Coal Mining Affected Areas	In an area that might not be affected by coal mining
Non-Coal Mining Areas of Great Britain	No Hazard
Potential for Collapsible Ground Stability Hazards	Very Low
Potential for Compressible Ground Stability Hazards	No Hazard
Potential for Ground Dissolution Stability Hazards	No Hazard
Potential for Landslide Ground Stability Hazards	Very Low
Potential for Running Sand Ground Stability Hazards	No Hazard
Potential for Shrinking or Swelling Clay Ground Stability Hazards	Moderate
Radon Affected Areas	The site is reported to be within an area where less than 1% of properties are at or above the action level requiring radon gas protection measures to be installed in new buildings.
Radon Protection Measures	No radon protection measures are reported by the British Geological Survey to be necessary in the construction of new dwellings or extensions.

It should be noted that the assessment provided within the data represents a generic assessment only.

Detailed assessment of the geotechnical characteristics of the soils encountered at the site is presented in Section 8 of this report.

3.2 Agency & Hydrological Data

The data has been reviewed and any entries referring to locations on, or in close proximity to, the site that may pose a potential risk are discussed within the following table.

Table 3. Agency & Hydrogeological Data

Section	Discussion
Pollution Incidents to Controlled Waters	A category 3 – minor incident is recorded within the canal, but no details as to when this occurred or what pollutants were involved is provided.

Following a review of the data, none of the other entries within this section are considered to pose a significant risk to the site.

3.3 Waste

The data has been reviewed and any entries referring to locations on, or in close proximity to, the site that may pose a potential risk are discussed within the following table.

Table 4. Waste Data

Section	Discussion
Licensed Waste Management Facilities	Two sites are listed on the opposite side of Camley Road to the south west. Both were licensed as waste transfer stations from around 1992 to 2001. These appear to relate to the redevelopment works around the Kings Cross/St Pancras area that took place around that time. This area has since been developed as part of the railway line.
Registered Waste Transfer Sites	The two sites referred to above are also identified here.

Following a review of the data, none of the other entries within this section are considered to pose a significant risk to the site.

3.4 Hazardous Substance

The data has been reviewed and none of the entries within this section are considered to pose a significant risk to the site.

3.5 Industrial Land Use

The data has been reviewed and none of the entries within this section are considered to pose a significant risk to the site.

3.6 Sensitive Land Use

The data has been reviewed and no sensitive land uses relevant to the proposed development have been identified within 500m of the site.

4. HISTORICAL MAP REVIEW

Historical Ordnance Survey maps covering the area of the site have been reviewed and are summarised in the following table.

It is noted that each map presents information applicable at the time of the survey (or revision date) and is subject to surveying and cartographic errors and/or advances. Revisions to maps are made at irregular intervals and it is possible that significant developments may have taken place on or within the vicinity of the site that are not shown on the maps.

'In the Vicinity of the Site' generally refers to features of relevance within approximately 250m of the site boundary, but may also include more distant features if considered to be pertinent to the assessment of the development history.

Table 5. Summary of Significant Features Identified on Historical Maps

Map Details	On-Site	In the Vicinity of the Site
1873 1:1,056	The site is occupied by part of a large Coal Shoot.	The Coal Shoot occupies the whole of the footprint of what is now the park. The "Imperial Gas Works" which includes a large number of gasometers and several retort houses, is present some 175m to the south east of the assessment site. The road to the south west is labelled as Cambridge Street. Further coal shoots are present on the opposite side of the road. The canal is shown to the north east.
1968 1:1,250	The coal shoots are no longer shown and the site is clear of structures.	The coal shoots on the opposite side of what is now labelled as Camley Street are also no longer shown.
1987 1:1,250	A structure is now shown on the footprint of the existing visitor centre building and the site is labelled as part of a "nature park".	

5. PRELIMINARY CONTAMINATION RISK ASSESSMENT

5.1 Introduction

A preliminary risk assessment considers the potential sources of contamination identified, the receptors that may be present in view of the development proposals and the contaminant pathways by which these may be linked. A complete pollutant linkage is only deemed to exist where all three are present and a site is considered suitable for use where no complete pollutant linkages are identified.

Where a complete pollutant linkage is deemed to be present, an assessment of the level of risk associated with the pollutant linkage has been carried out in line with published guidance[2].

The level of risk is determined using the risk matrix presented in the following table. Classifications of probability, consequence and risk are presented in Appendix E.

Table 6. Risk Assessment Matrix

		Probability			
		Very Low	**Low**	**Moderate**	**High**
Consequence	**Very Minor**	Negligible	Very Low	Low	Low/Moderate
	Minor	Very Low	Low	Low/Moderate	Moderate
	Moderate	Low	Low/Moderate	Moderate	High
	Severe	Low/Moderate	Moderate	High	Very High

5.2 Basis of Assessment

The assessment of risk has been made on the basis that the site will remain as part of a publicly accessible park, with a new visitor centre.

Should the proposed development plans be altered, a revised risk assessment may be required.

It is noted that an asbestos survey of the existing structure and infrastructure[3] was beyond the brief of this report. The risk assessment has been undertaken on the basis that should asbestos be identified within buildings or infrastructure these materials will be removed appropriately by licensed contractors and asbestos materials disposed of in accordance with legal requirements prior to demolition or other works in order to avoid contaminating soils at the site.

The findings of the preliminary contamination assessment have been used to inform the ground investigation works which are discussed in the following section of the report.

[2] Contaminated Land Risk Assessment: A guide to good practice, CIRIA C552, 2001.
[3] As defined under Section 5(a) of the Control of Asbestos Regulations, 2012.

5.3 Potential Contamination Sources Identified

The following potential sources of contamination have been identified by the preliminary contamination risk assessment:

- Historical use of the site as a Coal Shoot
- Historical demolition works

The Category 3 pollution incident is not considered to pose a significant risk to the site given the expected dispersion and flow of any contaminants away from the site.

The licensed waste management facilities and waste transfer sites are not considered to pose a significant risk to the site given that activities were likely to have been controlled under the terms of the licences and that the area has since been redeveloped.

5.4 Preliminary Conceptual Model

The preliminary conceptual model for the proposed development is presented in the following table.

Table 7. Preliminary Conceptual Model

Potential Sources Identified	Potential Contaminants	Receptor	Potential Pathways	Pathway Present?	Probability	Consequence	Overall Assessment of Risk	Pollutant Linkage Present?
Historical use of the site as a coal shoot	Heavy metals PAH compounds Petroleum Hydrocarbons Asbestos	Human Health (End Users)	Dermal contact with soil and dust (indoor & outdoor)	Yes	High	Moderate	High	Yes
			Ingestion of soil and indoor dust	Yes	High	Moderate	High	Yes
			Consumption of home-grown produce and attached soil	No	Pathway not present			No
			Inhalation of soil dust (indoor and outdoor)	Yes	High	Moderate	High	Yes
			Contamination of incoming services	Yes	Low	Minor	Low/Moderate	Yes
			Inhalation of soil vapours	Yes	Low	Minor	Low/Moderate	Yes
			Inhalation of soil gases/Risk of explosion	No	Contaminants do not pose a risk via this pathway			No
		Groundwater	Migration to groundwater	Yes	Very Low	Very Minor	Negligible	No
Historical Demolition Works	Heavy metals PAH compounds Asbestos	Human Health (End Users)	Dermal contact with soil and dust (indoor & outdoor)	Yes	Moderate	Moderate	Moderate	Yes
			Ingestion of soil and indoor dust	Yes	Moderate	Moderate	Moderate	Yes
			Consumption of home-grown produce and attached soil	No	Pathway not present			No
			Inhalation of soil dust (indoor and outdoor)	Yes	Moderate	Moderate	Moderate	Yes
			Contamination of incoming services	No	Contaminants do not pose a risk via these pathways			No
			Inhalation of soil vapours	No				No
			Inhalation of soil gases/Risk of explosion	No				No
		Groundwater	Migration to groundwater	Yes	Very Low	Very Minor	Negligible	No

6. GROUND INVESTIGATION

6.1 Introduction

The ground investigation comprised the excavation of two hand dug foundation inspection pits and the drilling of a dynamic sampler borehole. In view of the significant depth of made ground encountered at the site, a single gas monitoring standpipe was installed to enable future monitoring if required. The fieldwork was carried out on 9th May 2017. The exploratory hole locations are shown on Figure 2.

The locations of the exploratory holes were provided within the specification provided by Ian Jupp of Huntley Cartwright and indicated on the plan included in Appendix A. It is noted that at the time of the intrusive works the northern most part of the development area was hoarded/fenced off and being utilised as a compound for the construction of a new bridge over the Union Canal. Given that access was not permitted to this part of the site, the exploratory holes prescribed as TP01 and BH01 could not be excavated. However it is understood that a ground investigation, including the boring of a deep borehole, was undertaken within this northern part of the site as part of the bridge redevelopment works.

Descriptions of the strata encountered and comments on groundwater conditions are shown in the exploratory hole records given in Appendix C, together with notes to assist in their interpretation.

6.2 Exploratory Holes

6.2.1 Dynamic Sampler Borehole

A single borehole (designated BH02) was drilled to a depth of 10m below ground level.

The borehole was formed by a series of 1.0m long, open ended, hollow steel tubes of up to 100mm diameter, each containing a removable plastic liner. The tubes, progressively reducing in diameter, were driven into the ground by means of a track-mounted drop weight. Each tube was extracted from the ground using a hydraulically operated jack and the enclosed sample was recovered in its plastic liner.

The system enables sub-samples to be taken for detailed examination and laboratory testing.

6.2.2 Foundation Inspection Pits

Two pits (designated TP02 and TP03) were excavated using hand-tools to depths of 0.34m and 0.55m below ground level, respectively, to enable inspection of the foundations to the existing building.

6.3 Sampling

Disturbed samples of soil were taken at the depths shown in the exploratory hole records and were collected in plastic liners, plastic bags, plastic tubs or amber jars fitted with gas tight lids.

On collection the amber jars were stored in cool boxes with cooling blocks to maintain temperatures below 4°C until transferred to refrigerators upon return to the office and subsequently forwarded to the external accredited chemical testing laboratory.

6.4 In Situ Testing

The depths of in situ testing, together with the test results, are either given on the exploratory hole records or are summarised separately in Appendix C. Notes providing additional information on the tests performed are included in the appendix.

6.4.1 DPSH Dynamic Probe (Super Heavy) Testing

Continuous dynamic probe testing was undertaken adjacent to borehole BH02. The test was conducted to a depth of 10m below ground level using a super heavy DPSH-B[4] probing geometry.

The DPSH-B configuration is similar to that of the standard penetration test (SPT); the main differences being that the tip comprises a 90° cone, the driving rods are lighter than those used for SPT testing and the blow counts are recorded over 100mm increments rather than 300mm, as is the case for the SPT.

The blow counts recorded and the calculated dynamic point resistances, which account for inertia of the anvil and driving rods, are presented on the borehole records and separately in Appendix C.

6.4.2 Undrained Shear Strength

Undrained shear strength determinations were made in situ within the fine-grained soils using a Geonor hand shear vane. Additionally, undrained shear strength determinations were made within samples of the fine grained soils held in the dynamic sampler liners using a hand penetrometer.

6.5 Installations

In view of the significant depth of made ground encountered a gas monitoring standpipe was installed within borehole BH02 to a depth of 3.5m to enable future monitoring if required. A description of the installation is shown on the exploratory hole record in Appendix C.

6.6 Laboratory Testing

Laboratory testing was scheduled by Ashdown Site Investigation Ltd. Results from the laboratory tests are provided in Appendix D.

[4] As defined by BS EN ISO 22476-2:2005.

6.6.1 Geotechnical Testing

Geotechnical testing was undertaken by Ashdown Site Investigation Ltd in accordance with the methods given in BS1377[5]. Chemical testing to enable classification of the chemical environment of soils in accordance with BRE SD1[6] was undertaken by an external UKAS accredited laboratory. Notes to assist with the interpretation of the tests are contained within Appendix D.

6.6.2 Chemical Testing

Chemical testing of selected samples was undertaken by a laboratory with recognised (UKAS and MCERTS) accreditation for quality control.

[5] BS1377:1990 Parts 1 to 8, Methods of test for soils for civil engineering purposes.
[6] BRE Special Digest 1:2005 Concrete in Aggressive Ground.

7. GROUND CONDITIONS

7.1 Stratigraphy

7.1.1 Surface Covering

Each of the exploratory holes was excavated through a surface cover of wood chippings some 50mm to 150mm in thickness.

7.1.2 Made Ground

Made ground, generally comprising gravelly sandy clay was recorded to the full depth of TP02 and TP03, and to a depth of 3.5m below ground level within borehole BH02. The gravel fraction comprised variable quantities of brick, concrete, slate, chalk, clay tile, ceramic tile, metal, glass, shell, flint and clinker-like material.

Underlying the existing timber structure a layer of sandy gravel of crushed concrete, brick and flint material was encountered to a depth of 0.30m and 0.35m in trial pits TP02 and TP03, respectively.

7.1.3 London Clay Formation

Beneath the made ground the dynamic sampler borehole encountered generally stiff to very stiff clay soils which continued to the full depth of the investigation.

These soils are considered to be representative of the London Clay Formation soils indicated on the published geology map.

7.2 Stability

Borehole BH02 collapsed to a depth of 8.0m on completion of drilling. The shallow hand dug pits were recorded to be stable during excavation.

7.3 Groundwater Conditions

Each of the exploratory holes was recorded to be dry during the short period of the intrusive works.

7.4 Existing Foundations

Details of the foundations exposed within the foundation inspection pits are included as Figure 3 of this report.

The existing timber structure appears to be supported on a layer of crushed material, possibly compacted when placed, recorded to be some 300mm and 250mm thick at the locations of TP02 and TP03, respectively. Beneath the crushed material layer, made ground soils were encountered.

8. GEOTECHNICAL ASSESSMENT

At the time of preparation of this report no specific development proposal for the site had been finalised, although it is understood that the development proposals will comprise the construction of a new single storey building to replace the existing building. No specific details were available concerning the specific loads likely to be applied to the foundations.

8.1 Foundations

8.1.1 Soil Shrinkage/Heave Potential

The fine-grained soils of the made ground and London Clay Formation have been classified as clays of intermediate and high plasticity and with modified plasticity indices of 11% and 43% the soils may be expected to exhibit a low and high volume change potential, respectively.

It is recommended that the design of precautions against shrinkage and heave for any new foundation system (pile caps and ground beams etc.) should assume a low volume change potential for the fine grained made ground and a high volume change potential for the London Clay Formation soils and take into account current guidance such as that given by the Building Research Establishment (BRE)[7] or the National House Builders Council (NHBC)[8].

Whilst this report has been prepared to provide advice to assist designers in undertaking detailed design, the report itself does not represent a detailed design statement. It is recommended that an arboricultural survey of the site should be conducted to establish the species and maturity of the existing trees in the areas of the proposed new buildings. The survey should be extended to include a review of historical photographs and detailed site plans (if available) to establish the species and location of any felled trees that may affect foundation design. The information obtained from the arboricultural survey, information on proposed planting schemes and the findings of this report should be provided to the structural engineer responsible for the detailed design of foundation systems, including assessment of requirements for sleeving or reinforcing of piled foundations and requirements for placement of void formers et cetera.

8.1.2 Spread Foundations

All made ground and any soils disturbed by the construction or removal of any previously existing foundations or services should be regarded as being variable in nature and state of compaction and, as such, unsuitable as a founding medium for shallow footings.

Given the significant thickness of made ground encountered and the depth to the competent soils of the London Clay Formation, encountered at some 3.5m depth, the construction of conventional spread foundations at this site is unlikely to be a viable option.

[7] www.bre.co.uk : BRE Digests 40, 241 and 242, Low rise buildings on shrinkable clay soils, parts 1, 2 and 3; and BRE Digest 298 , The influence of trees on house foundations in clay soils and BRE Digest 412, Desiccation in clay soils.

[8] http://www.nhbc.co.uk/ : NHBC Standards, Chapter 4.2.

8.1.3 Piled Foundations

In view of the depth of made ground beneath the site it is recommended that a piled foundation should be adopted, with the underlying London Clay Formation deposits providing support to piled foundations by a combination of side adhesion (skin friction) and end bearing.

The proven ground conditions would indicate that bored piles could be employed to provide a suitable foundation solution. However, the method of installation would have to accommodate the presence of potential relict structural obstructions and/or naturally occurring hard strata that were recorded within the borehole/dynamic probe undertaken. In addition, the selection of piling techniques should consider access constraints applicable to particular plant and potential vibration effects on existing services, structures, roadways and the canal bank.

Depending on the method employed it is considered likely that driving displacement (driven) piles through the very stiff soils and claystone layers would prove difficult and could be disruptive to nearby structures and services.

For the purpose of this initial discussion and for reasons given above, consideration has been given to the adoption of bored piles, the use of which would prove beneficial as, this method enables temporary steel casing to be installed to stabilise the pile bore and a range of boring tools, including chisels, can be employed to progress pile bores through difficult ground. The use of bentonite slurry may be required where high groundwater pressures are encountered within sand horizons in order to avoid sand rising within the pile bore.

Calculations to determine illustrative working loads for axially loaded piles have been undertaken; each calculation assuming a single pile acting in compression. Indicative capacities are presented in the following table. Available capacities may vary for piles acting in tension.

The soil profile assumed for these calculations has been based on examination of the recovered samples and the results of in situ and laboratory testing. A modelled ground profile comprising made ground to a depth of 3.5m overlying stiff to very stiff clays has been adopted. Groundwater has been assumed to be present below the base of the piles.

In consideration of the presence of made ground, which may be highly variable and compressible, the benefit of shaft resistance within the upper 3.5m has been discounted.

Table 8. Indicative Axially Loaded Pile Working Capacities

Working Loads of Piles (kN)			
	Size (mm)		
Length (m)	**250**	**300**	**450**
8	150	185	320
10	205	255	425

Notes:
The structural strength of the concrete used in construction may limit the available working loads of the piles. Indicated pile lengths are from existing ground level. A factor of safety of 3.0 has been applied. The benefit of shaft resistance within the upper 3.5m has been discounted.

Working capacities for pile groups should be assessed when final design details are known, although for preliminary design purposes it is likely that piles spaced at least 3 x pile diameter from other piles in any group will behave as single piles.

Where preliminary and working pile load tests are undertaken it may be appropriate to reduce Safety Factors, although 2.5 may be a minimum local authority requirement. Should testing not be undertaken it is suggested that a factor of safety of at least 3.0 should be adopted.

For all piling options it is recommended that the advice of specialist foundation contractors should be sought at the earliest opportunity and that piling specifications should be obtained with reference to their particular products as this may affect the calculated pile capacity. The piling contractor is likely to require ground investigation data to a depth at least 5m below the base of piles, which given the depth of made ground encountered may necessitate further ground investigation works.

8.1.4 Alternative Foundation Systems

Various specialist foundation systems, including stone and concrete columns, are marketed by specialist foundation contractors, some of which may be suitable for use at this site. Specialist contractors should be consulted about the applicability of their specific foundation systems to this site.

8.2 Groundwater

Whilst groundwater was not encountered during the short period of the intrusive works the potential for perched groundwater to be present, for example within the made ground, should not be overlooked. It is also possible that heavy precipitation during construction could lead to the ingress of perched groundwater or surface water run-off into excavations. In such circumstances it would be expected that water entering into excavations would be adequately managed by pumping from sumps.

8.3 Stability of Excavations

All made ground soils exposed in excavations should be assumed to be unstable, even in the short term. Where stable excavations are required, excavations should either be suitably supported or side slopes should be battered back to a safe angle of repose.

All excavations requiring human entry must be shored or battered as necessary to conform to current best practice, as accepted by the Health and Safety Executive (HSE)[9]. Current legislation requires that where personnel access is required into any excavation a competent person must inspect excavation supports or battering of slopes at the start of the working shift and at other specified times. No work should take place until the excavation is safe. Excavations should also be inspected after any event that may have affected their stability, such as a significant weather event, changes in surcharge loadings imposed by temporary storage of materials or changes in site traffic plans or alteration of support systems. Inspections should be formally recorded and any faults that are found should be corrected immediately.

Particular attention must be paid to ensuring the stability of nearby structures, services and neighbouring sites as well as the road frontages/canal.

[9] Relevant guidance is given on the HSE website, www.hse.gov.uk

8.4 Aggressivity to Concrete

The aggressivity of the soils to concrete has been assessed in accordance with guidance published by the BRE[10].

In consideration of the soils encountered beneath the site and its historical usage it is recommended that 'brown field conditions' should be assumed for the purpose of assessing the aggressivity of the chemical environment for concrete classification (ACEC class). Given that groundwater was not encountered, 'static groundwater' conditions may be assumed.

Assessment of the chemical analysis of the soil indicates a sulphate content falling into Design Sulfate Classes DS-2 and DS-5 of Table C2. The results of the pH tests indicate that the underlying soils are alkaline.

In accordance with the digest, a DS-4 Design Sulfate Class and an AC-3s ACEC classification should be assumed as a minimum for the design of concrete in contact with the ground.

8.5 Ground Floors

In view of the significant thickness of made ground, it is recommended that ground floors should be suspended.

[10] BRE Special Digest 1:2005 Concrete in Aggressive Ground.

9. QUANTITATIVE CONTAMINATION ASSESSMENT

9.1 Assessment Strategy

The design of the ground investigation was specified by the client. As discussed in section 6, due to bridge construction works taking place in the northern part of the assessment site, no intrusive works were permitted to be carried out in this area.

The potential sources identified by the preliminary risk assessment could result in contamination being present anywhere on the site. The limited number of non-targeted sampling positions completed is considered sufficient to enable an initial quantitative contamination assessment of risk posed to end users of the site but further works would be required to inform a more detailed assessment of risk.

9.2 Analysis of Contamination Test Results

The results of the testing carried out on the made ground soils encountered beneath the site have been compared with generic soil screening values (SSVs) comprising the 'Suitable For Use Levels' (S4ULs) calculated as a joint project between LQM and CIEH[11]. In lieu of an S4UL screening value for lead, the Category 4 Screening Level (C4SL) was used, as published within SP1010[12].

In view of the proposed development the assessment has been made against SSVs calculated for the generic 'Public Park' (POS_{park}) land use[13]. The POS_{park} land use is intended to be representative of an open space provided for recreational use. In modelling this land use it has been assumed to be a relatively large area of predominately grassed open space with no more than 25% of exposed soil. The critical receptor for this land use is considered to be a young female child using the site on a regular basis from birth to age 6.

It is noted that given that the soft covered areas present around the visitor centre are generally raised and fenced off, and are therefore not directly accessible by end users, the assumptions made for the generic land use are considered to be relatively conservative.

9.2.1 Heavy Metals and PAH compounds

The following table summarises the soil screening values along with the maximum and minimum concentrations for the heavy metals and PAH compounds tested for.

[11] The LQM/CIEH Suitable 4 Use Levels, 2015.

[12] SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. Final Project Report, published by DEFRA, 2014.

[13] SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. Final Project Report, published by DEFRA, 2014.

Table 9. Summary of Test Results and Statistical Analysis for Heavy Metals and PAH Compounds

Contaminant	SSV (mg/kg)	No. of Samples	Minimum Concentration (mg/kg)	Maximum concentration (mg/kg)	Limit of Detection (mg/kg)	No of exceedances
Arsenic	170	5	13	22	< 2	0
Water Soluble Boron	46000	5	<LOD	2.4	< 1	0
Cadmium	555	5	<LOD	0.5	< 0.2	0
Chromium	33000	5	12	41	< 2	0
Hexavalent Chromium	220	5	<LOD	<LOD	< 2	0
Copper	44000	5	20	70	< 4	0
Lead	1300	5	25	423	< 3	0
Mercury	240	5	<LOD	2.9	< 1	0
Nickel	3400	5	12	46	< 3	0
Selenium	1800	5	<LOD	<LOD	< 3	0
Zinc	170000	5	70	278	< 3	0
Naphthalene	1200	5	<LOD	0.13	< 0.1	0
Acenaphthylene	29000	5	<LOD	<LOD	< 0.1	0
Acenaphthene	29000	5	<LOD	<LOD	< 0.1	0
Fluorene	20000	5	<LOD	<LOD	< 0.1	0
Phenanthrene	6200	5	<LOD	1.07	< 0.1	0
Anthracene	150000	5	<LOD	0.21	< 0.1	0
Fluoranthene	6300	5	<LOD	2.15	< 0.1	0
Pyrene	15000	5	<LOD	1.84	< 0.1	0
Benz(a)anthracene	49	5	<LOD	1.01	< 0.1	0
Chrysene	93	5	<LOD	0.98	< 0.1	0
Benzo(b)fluoranthene	13	5	<LOD	1.5	< 0.1	0
Benzo(k)fluoranthene	370	5	<LOD	0.46	< 0.1	0
Benzo(a)pyrene	11	5	<LOD	0.92	< 0.1	0
Indeno(123-cd)pyrene	150	5	<LOD	0.58	< 0.1	0
Dibenz(ah)anthracene	1.1	5	<LOD	<LOD	< 0.1	0
Benzo(ghi)perylene	1400	5	<LOD	0.39	< 0.1	0
Arsenic	170	5	13	22	< 2	0

None of the concentrations of heavy metals or PAH compounds recorded exceeded the generic screening values.

9.2.2 Asbestos

Shallow samples of the made ground from the three intrusive positions carried out were screened for the presence of asbestos. The two samples taken from the foundation inspection pits recorded the presence of chrysotile and amosite fibres within the soil matrix.

9.2.3 Petroleum Hydrocarbons and BTEX compounds

Two samples of the made ground and one of the undisturbed London Clay Formation were tested for total concentrations of petroleum hydrocarbons within the results speciated by

aromatic and aliphatic equivalent carbon weight fractions. The samples were also tested for concentrations of BTEX compounds.

Samples of made ground taken from trial pits TP02 and TP03 were tested for total concentrations of petroleum hydrocarbons with the results speciated only by equivalent carbon weight fractions. Although full speciation of these results was not undertaken, the results of the testing undertaken can still be compared with the more stringent of the screening values for the respective equivalent carbon weight fraction and, where the concentration recorded is found to be lower, then it can be concluded that no significant risk is present.

The following table lists the screening values for petroleum hydrocarbon equivalent carbon weight fractions calculated for 1% organic content.

Table 10. Soil Screening Values for petroleum hydrocarbon equivalent carbon weight fractions

Petroleum Hydrocarbon Fraction	SSV (mg/kg)	Petroleum Hydrocarbon Fraction	SSV (mg/kg)
Aliphatic EC 5-6	95000	Aromatic EC 5-7	76000
Aliphatic EC >6-8	150000	Aromatic EC >7-8	87000
Aliphatic EC >8-10	14000	Aromatic EC >8-10	7200
Aliphatic EC >10-12	21000	Aromatic EC >10-12	9200
Aliphatic EC >12-16	25000	Aromatic EC >12-16	10000
Aliphatic EC >16-35	450000	Aromatic EC >16-21	7600
Aliphatic EC >35-44	450000	Aromatic EC >21-35	7800
		Aromatic EC >35-44	7800

Table 11. Soil Screening Values for BTEX Compounds

BTEX Compound	SSV (mg/kg)
Benzene	87000
Toluene	17000
Ethylbenzene	17000
p-Xylene[1]	17000

[1] Xylene has three structural isomers, the SSV presented is for *p*-Xylene, which has the most conservative SSV.

None of the samples recorded any concentrations of petroleum hydrocarbons or BTEX compounds above the generic SSV. No visual or olfactory evidence of suspected contamination was noted within the intrusive positions.

9.2.4 Ground Gases

No potential sources of ground gas were identified by the preliminary risk assessment. However, the intrusive investigation recorded the presence of a significant depth of made ground beneath the site. Reworked and fill materials, such as those encountered within the borehole, have the potential to act as a source of gas generation. A gas monitoring well was installed within borehole BH02, but monitoring of the well was beyond the scope of this investigation.

9.3 Quantitative Contamination Risk Assessment

9.3.1 Quantitative Conceptual Model

The quantitative conceptual model for the proposed development is presented in the following table.

Table 12. Quantitative Conceptual Model

Sources Identified	Contaminants	Receptor	Potential Pathways	Pathway Present?	Probability	Consequence	Overall Assessment of Risk	Pollutant Linkage Present?
Made Ground beneath the site	Asbestos Potential ground gases	Human Health (End Users)	Dermal contact with soil and dust (indoor & outdoor).	No	Contaminants do not pose a risk via these pathways			No
			Ingestion of soil and indoor dust.	No				No
			Consumption of home-grown produce and attached soil.	No				No
			Inhalation of soil dust (indoor and outdoor).	Yes	Low	Moderate	Low/ Moderate	Yes
			Contamination of incoming services.	No	Contaminants do not pose a risk via these pathways			No
			Inhalation of soil vapours.	No				No
			Inhalation of soil gases/Risk of explosion.	Yes	Low	Minor	Low	Yes
		Groundwater	Migration to groundwater.	No	Contaminants do not pose a risk via this pathway			No

9.4 Risks to Other Potential Receptors

The following general guidance is given with regard to other potential on site receptors, which may not necessarily be statutory drivers for remedial works.

As a minimum and in accordance with industry best practice all ground-workers should be issued with the appropriate PPE and should be instructed in safe working methods, particularly in view of the potential for asbestos to be encountered within the made ground soils.

As a precautionary measure instructions should be given in the recognition of potentially hazardous materials, including oily and odorous soil and water and discoloured or fibrous substances. Any oil-like substances contacting the skin must be washed off immediately using an appropriate cleanser. Operatives should be warned to avoid contact between hands and mouth before washing. The consumption of food and smoking must be confined to designated clean areas. Suitable welfare (washing) facilities should be provided. These precautions should be taken in addition to anything highlighted by a site specific risk assessment which should be undertaken by any contractor prior to commencing work.

A comparison of the test results from the made ground from across the site has been made against the screening criteria[14] and indicates that the protection of water supply services is unlikely to be required. However it is noted that the testing undertaken to date does not encompass all of the contaminants that may be required by water supply companies for assessment purposes. Notwithstanding the above it is strongly recommended that designers consult with the proposed water supply company to ascertain whether they require further laboratory testing and assessment specific to proposed routes of services.

All site personnel should be appropriately briefed on what actions to take in the event that evidence of significant contamination is identified or suspected.

9.5 Recommendations

Complete and potentially complete pollutant linkages have been identified to be present at the site.

Given the source identified further works are recommended to allow a more detailed assessment of the risk to be made.

To assess the risk from ground gases, it is recommended that additional standpipes be installed and a programme of gas monitoring carried out to determine whether or not a significant risk from ground gases is present that would require some form of protection to be incorporated into the proposed building.

Given the presence of asbestos fibres within two of the three shallow samples of made ground tested, further assessment should be carried out to determine whether widespread asbestos contamination is present, or whether the contamination is limited to the made ground soils beneath the existing building where the two samples which recorded asbestos were taken from.

[14] Set out within Table 3.1 of the Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites, UK Water Industry Research, 2010.

This additional testing would also assist with the waste classification as discussed in the following section.

9.6 Handling and Disposal of Waste

Soils and other materials taken for disposal should be handled, transferred and disposed of as controlled waste in accordance with current waste management and duty of care regulations and comply with current codes of practice[15]. Waste transfer notes detailing the site address, the waste type, details of the haulage contractor and full details of the disposal site must be kept.

Specifically, the disposal of any asbestos containing materials should be undertaken by appropriately trained personnel. The disposal of such material should be undertaken in accordance with the Hazardous Waste Regulations 2005, as amended.

Asbestos has been recorded within two of the three samples of made ground analysed. Quantitative analysis of the percentage of asbestos present by mass within the sample was beyond the scope of the assessment and therefore at this stage it should be assumed that any made ground soils to be disposed of will need to be classified as hazardous waste with a code from the list of wastes (LoW) of 17 05 03 due to the presence of asbestos within the soil matrix.

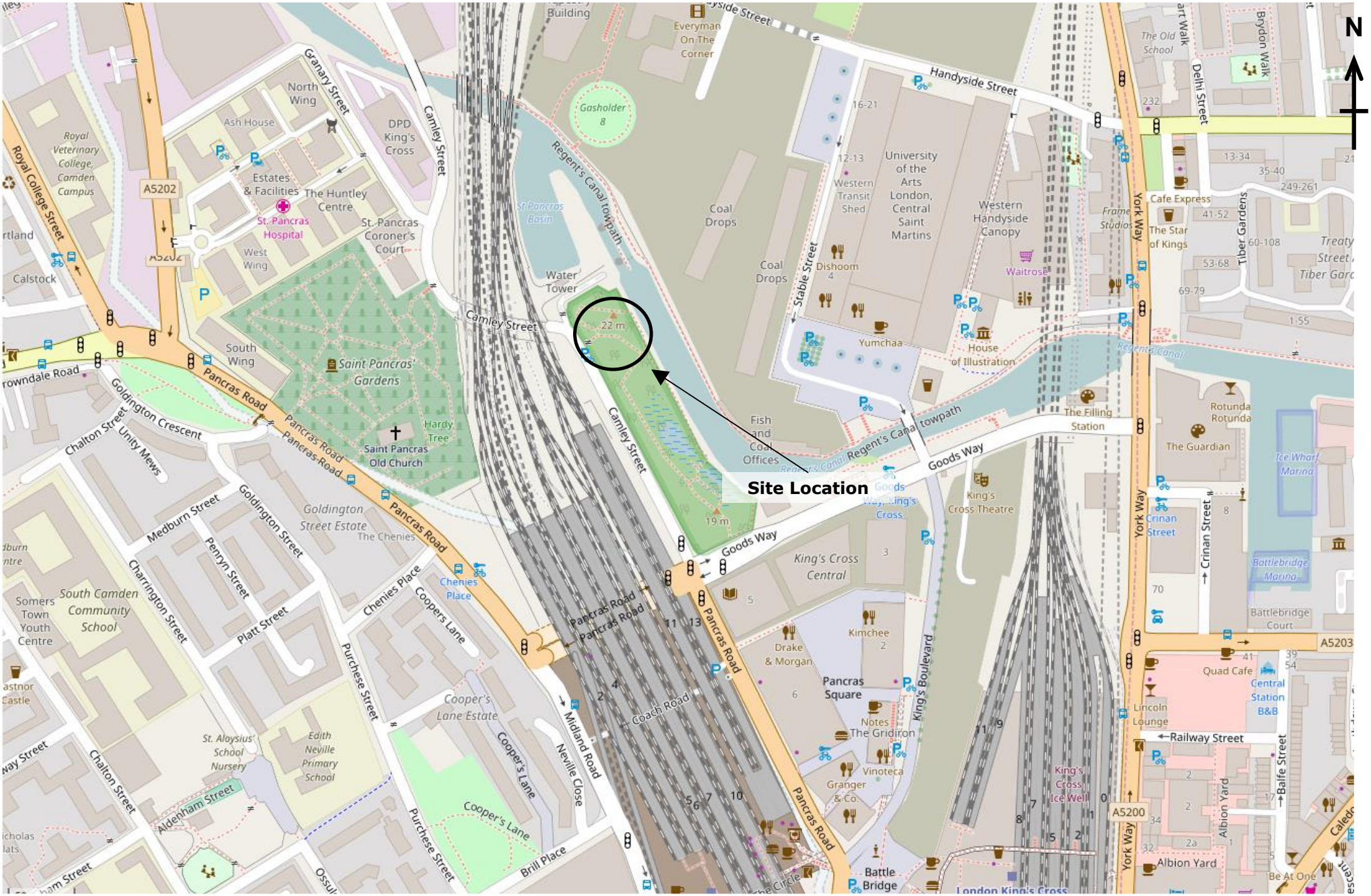
Further testing, as recommended within Section 9.5, could include quantitative analysis to determine the percentage of asbestos by mass within the made ground. If it can be shown that the percentage present is less than 0.1%, or that asbestos is only present at some locations, then it may be possible to demonstrate that the made ground soils could be classified as non-hazardous waste, or specific areas may be able to be delineated for disposal as hazardous waste.

WAC testing was carried out on the sample taken from borehole BH02. This sample did not meet the criteria for inert waste.

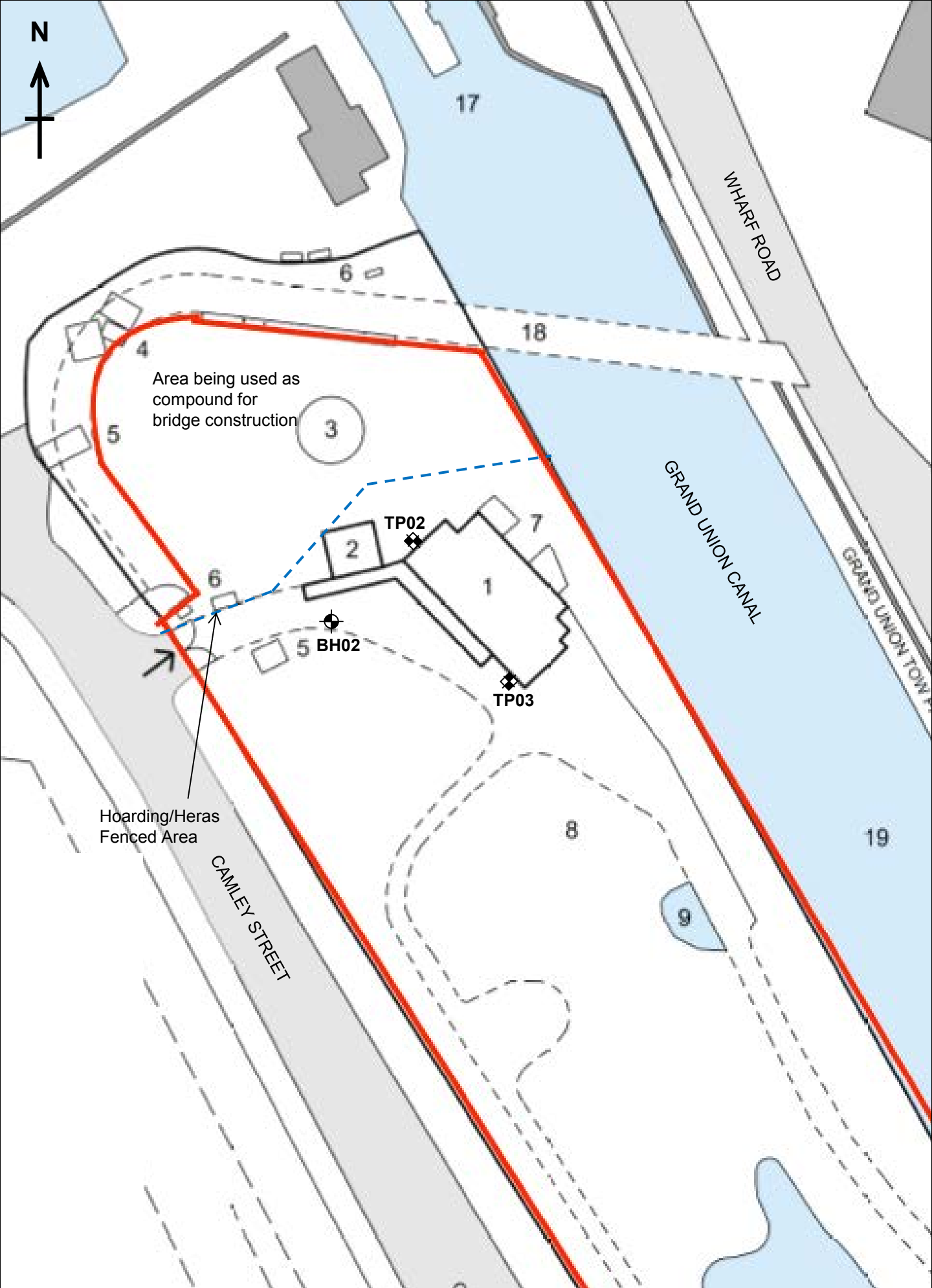
Ashdown Site Investigation Ltd.
June 2017

[15] Waste Duty of Care Code of Practice, Dept. for Environment Food & Rural Affairs.

FIGURES

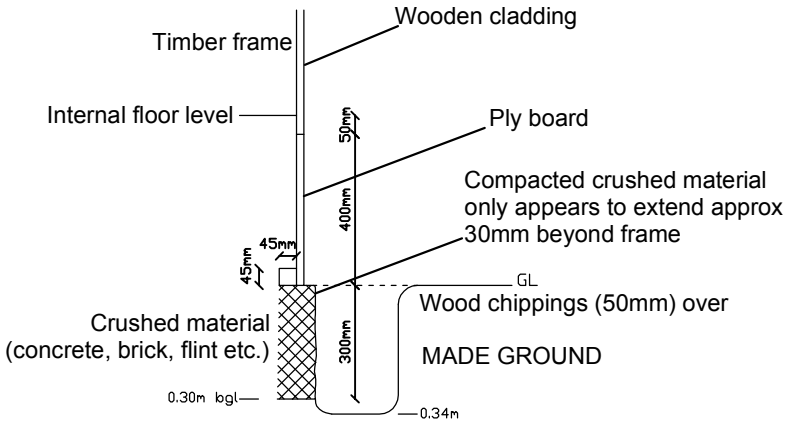


ASHDOWN SITE INVESTIGATION LIMITED	Site: Camley Street Natural Park, 12 Camley Street, London	Site Location Plan. Not To Scale	Figure 1 R17-12131

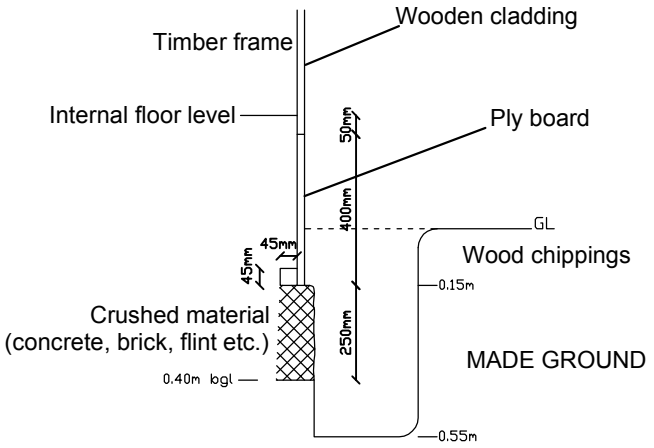


ASHDOWN SITE INVESTIGATION LIMITED	Site: Camley Street Natural Park, 12 Camley Street, London	Exploratory Hole Location Plan Not To Scale	Figure 2 R17-12131

TP02



TP03



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TSH	May 2017	1:20

SITE:
Camley Street Natural Park
12 Camley Street
London

REPORT REF.:	FIGURE NO.:
R17-12131	3

DRAWING TITLE:
Foundation Details

APPENDIX A

Assessment Area

ENTUITIVE

CAMLEY STREET NATURAL PARK

BH = BOREHOLE TO 10M
TP = TRIAL PIT TO 1.2M

SHEDS
CONTAINERS
'TENT'
'VOLUNTEERS ROOM'
STORAGE BOXES
TP01
TP02
TP03
BH01
BH02
POSSIBLE SITE OF NEW SINGLE STOREY BUILDING
EXISTING BUILDING
GRAND UNION CANAL
GRAND UNION TOW PATH
WHARF ROAD
CAMLEY STREET
1
2
3
4
5
6
7
8
9
18
19
20

4521/SK-SI-01

SITE INVESTIGATION

TMM 04/17

APPENDIX B

Site Walkover Photographs


PLEASE DO NOT
PUT RUBBISH IN
THE WATER BUTTS

APPENDIX C

Exploratory Hole Notes
In Situ Testing Notes
Exploratory Hole Records
DPSH-B Dynamic Probe Records

NOTES FOR THE INTERPRETATION OF EXPLORATORY HOLE RECORDS

1 Symbols and abbreviations

Samples

U 'Undisturbed' Sample: - also known as 'U100' or 'U4' - 100mm diameter by 450mm long. The number of blows to drive in the sampling tube is shown after the test index letter in the SPT column.
Uo Sample not obtained.
U* Full penetration of sample not obtained.
Pi Piston Sample: 'Undisturbed' sample 100mm diameter by 600mm long.
D Disturbed Sample.
R Root Sample.
B Bulk Disturbed Sample.
W Water Sample.
J Jar Sample (sample taken in amber glass jar fitted with gas tight lid)
T Tub Sample
Vi Vial Sample

In situ Testing

S Standard penetration test (SPT): In the borehole record the depth of the test is that at the start of the normal 450mm penetration. The number of blows per 75mm penetration is recorded, with the initial 150mm for seating blows being recorded followed by the blows recorded for the remaining 300mm of the test. The total blows to achieve the standard penetration of 300mm, discounting the seating blows, is noted as the N value on the log. Where the full penetration of the test cannot be achieved (a refusal) the number of blows achieved and the penetration achieved will be reported.

C Standard Penetration Test (SPT) conducted usually in coarse grained soils or weak rocks using the same procedure as for the SPT but with a 50mm diameter, 60º apex solid cone fitted in place of the sampler. Variations in test results are indicated by the same symbols as for the SPT (above).

V Shear Vane Test: Undrained shear strength (cohesion) (kN/m^2) shown within the Vane/Pen Test and N Value column.

H Hand penetrometer Test: Undrained shear strength (cohesion) (kN/m^2) shown within the Vane/Pen Test and N Value column.

P Perth Penetrometer Test: See "In Situ Testing Notes" for full description. Number of blows for 300mm penetration shown under Vane/Pen Test and N Value column. In sand the number of blows is approximately equivalent to the SPT "N" value.

Excavation Method

CP Cable Percussion Borehole
WLS Dynamic Sampler Borehole using windowless sampler tubes
WS Dynamic Sampler Borehole using window sampler tubes
TP Trial Pit excavated using mechanic excavator
HDP Trial Pit excavated using hand tools

2 Soil Description

Description and classification of soils has been carried out using as a general basis the British Standard Geotechnical investigation and testing – Identification and classification of soil, Part 1 Identification and description (BS EN ISO 14688-1:2002+A1:2013) and Part 2 Principles of classification (BS EN 14688-2:2004+A1:2013) as well as the BS5930:2015 code of Practice for Ground Investigations.

Fine Grained Soils

The consistency of fine grained soils given in the report is based on visual inspection of the samples and the strength is based on results of in situ and/or laboratory undrained shear strength tests when carried out.

The consistency is determined on the following basis:

Consistency	**Manual Test**
Very Soft	Soil exudes between fingers when squeezed in hand
Soft	Soils can be moulded by light finger pressure
Firm	Cannot be moulded by finger but rolled to 3mm threads without breaking/crumbling
Stiff	Crumbles/breaks when rolled to 3mm thick threads but can be moulded into a lump again
Very Stiff	Cannot be moulded and crumbles under pressure, can be indented by thumbnail

The terms used for the designation of the undrained shear strength are as follows:

Undrained Shear Strength	
Extremely to Very Low	<20 kPa
Low	20-40 kPa
Medium	40-75 kPa
High	75-150 kPa
Very High	150-300 kPa
Extremely high	300-600 kPa

Note: The undrained shear strength of the soils is measured either by laboratory testing or in the field using hand shear vane.

It is recognised that any coarse grained soil that has in excess of approximately 35% fine grained soil (clay and silt) can often be expected to behave as a fine grained soil despite the dominance of coarse grained material within the soil mass. To reflect this, it is the soil type that dominates the behaviour of the soil mass that appears on the exploratory hole records.

Coarse Grained Soils

The relative densities of coarse grained soils (sand and gravel) given in the report are based on field estimations and the results of the Standard Penetration Test (SPT) and equivalent correlation from other testing. The classification in terms of "N" Values is as follows:

SPT 'N' Value	**Relative Density**
0-4	Very Loose
4-10	Loose
10-30	Medium Dense
30-50	Dense
Greater than 50	Very Dense

3 Rock Description

Description and classification of rocks has been carried out using as a general basis the British Standard Geotechnical investigation and testing – Identification and classification of rock, Part 1 Identification and classification (BS EN ISO 14689-1:2003) as well as the BS5930:2015 code of Practice for Ground Investigations.

The description of rock mass includes the type of rock, structure, discontinuities and weathering.

The unconfined compressive strength of rock material is determined on the following basis:

Term	**Field Identification**	**Unconfined Compressive Strength (MPa)**
Extremely Weak	Indented by thumbnail	Less than 1
Very Weak	Crumbles under firm blows with point of geological hammer, peeled by pocket knife	1 to 5
Weak	Peeled by pocket knife with difficulty, shallow indentations made by firm blow with geological hammer	5 to 25
Medium Strong	Cannot be peeled or scraped with knife, can be fractured with single firm blow of geological hammer	25 to 50
Strong	Requires more than one blow of geological hammer to fracture	50 to 100
Very Strong	Requires may blows of geological hammer to fracture it	100 to 250
Extremely Strong	Can only be chipped with geological hammer	Greater and 250

The terms describing discontinuity and bedding spacing are as follows:

Bedding Thickness	
Very Thick	>2000mm
Thick	2000-600mm
Medium	600-200mm
Thin	200-60mm
Very Thin	60-20mm
Thickly Laminated	20-6mm
Thinly Laminated	<6mm

Discontinuity Spacing	
Very Wide	>2000mm
Wide	2000-600mm
Medium	600-200mm
Close	200-60mm
Very Close	60-20mm
Extremely Close	<20mm

Chalk

Chalk description is based on BS EN ISO 14688, BS EN ISO 14689 and BS5930. The classification of chalk generally follows the guidance offered by the Construction Industry Research and Information Association (CIRIA) C574, 'Engineering in Chalk'. This is based on assessment of chalk density, discontinuity and aperture spacing, and the proportion of intact chalk to silt of chalk. See additional chalk classification notes.

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Site Name: Camley Street Natural Park, 12 Camley Street, London

Job Number: R17-12131

Start Date: 09/05/2017

End Date: 09/05/2017

Borehole Number: **BH02**

Standpipe	Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Dynamic Probe Blows/100mm 0 5 10 15 20 25 30	Legend	Depth	Stratum Description
							0.00	Wood Chippings
	J T	0.20					0.10	MADE GROUND: Brown gravelly sandy clay. Gravel is angular to subangular, fine to coarse brick, clay tile, ceramic tile, metal, glass, shell, clinker-like material and flint.
	D	0.25						
	J T	1.10						
	D	1.30					1.50	MADE GROUND: Black/grey gravelly silty clay, with a slight organic odour. Gravel is angular to subangular, fine to coarse, brick, flint, chalk, and occasional slate.
	J T	1.70						
	D	1.80						
	J T	2.70						
	D	2.80						
	J T	3.60					3.50	Very stiff orange brown mottled grey slightly sandy silty CLAY. (London Clay Formation)
	D	3.65						
	H	3.80		170				
	V	4.00		>130				
							4.30	Very stiff grey mottled orange slightly gravelly silty CLAY. Gravel is angular to subangular, fine to coarse claystone. (London Clay Formation) with nodules of claystone between 4.50m and 5.0m
	H	4.60		250				
	J T	4.60						
	D	4.65						
	V	5.00		>130			5.00	Continued on next sheet

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole collapsed to 8.00m on completion

Notes: Standpipe installed to 3.50m depth; 3.50m to 1.50m slotted pipe with gravel surround; 1.50m to ground level plain pipe with bentonite seal; completed with gas tap/end cap and security cover concreted flush with the ground surface.

Excavation Method: WLS

Borehole Diameter: Various

Made By: PM

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Job Number: R17-12131

Start Date: 09/05/2017

End Date: 09/05/2017

Borehole Number: **BH02**

Standpipe	Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Dynamic Probe Blows/100mm 0 5 10 15 20 25 30	Legend	Depth	Stratum Description
								Very stiff orange brown mottled grey silty CLAY. (London Clay Formation
	H	5.50		>250				
								becoming brown and grey mottled and fissured below 5.60m depth.
	D	5.80						
	D	6.25						
	J T	6.30						with selenite crystals and occasional shell fragments below 6.30m depth.
	H	6.50		>251				
	D	6.80						
	H	6.80		>251				
								with a thin layer of weak orange claystone at 7.30m depth.
	D	7.50						
	H	7.60		>251				
	J T	7.80						
	H	8.70		>251				
	D	8.80						
	D	9.30						becoming grey below 9.20m
	H	9.50		>251				
	D	9.80						
	H	9.80		>251				
							10.00	End of borehole at 10.00m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole collapsed to 8.00m on completion

Notes: Standpipe installed to 3.50m depth; 3.50m to 1.50m slotted pipe with gravel surround; 1.50m to ground level plain pipe with bentonite seal; completed with gas tap/end cap and security cover concreted flush with the ground surface.

Excavation Method: WLS

Borehole Diameter: Various

Made By: PM

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Site Name: Camley Street Natural Park, 12 Camley Street, London

Job Number: R17-12131

Start Date: 09/05/2017

End Date: 09/05/2017

Trial Pit Number: **TP02**

Samples and In Situ Testing				Legend	Depth/ Reduced Level	Stratum Description
Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result			
					0.00	Woodchippings
D*	0.20				0.05	MADE GROUND: firm brown gravelly silty sandy clay. Gravel is angular to sub angular, fine to coarse brick, clay tile, ceramic tile, metal, glass, shell, clinker-like material and flint.
J T	0.20					
D	0.32				0.34	with crushed concrete, brick and flint material existing beneath structure to a depth of 0.30m.
J T	0.32					
						End of trial pit at 0.34m

Remarks

Groundwater: Trial pit dry on completion.

Stability: Trial pit stable on completion.

Notes: * Samples taken of crushed material beneath structure.

Excavation Method:	HDP
Pit Length:	n/a
Pit Width:	n/a
Made By:	PM

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Site Name: Camley Street Natural Park, 12 Camley Street, London

Job Number: R17-12131

Start Date: 09/05/2017

End Date: 09/05/2017

Trial Pit Number: **TP03**

Samples and In Situ Testing				Legend	Depth/ Reduced Level	Stratum Description
Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result			
					0.00	Woodchippings.
D*	0.15					MADE GROUND: Brown firm gravelly silty sandy clay. Gravel is angular to sub angular, fine to coarse brick, clay tile, ceramic tile, metal, glass, shell, clinker-like material and flint.
J T	0.15				0.25	
D	0.35				0.40	with crushed brick, concrete and flint material beneath existing structure to a depth of 0.40m.
J T	0.35					
						End of trial pit at 0.40m

Remarks

Groundwater: Trial pit dry on completion.

Stability: Trial pit stable on completion.

Notes: * Samples taken of crushed material beneath structure.

Excavation Method:	HDP
Pit Length:	n/a
Pit Width:	n/a
Made By:	PM

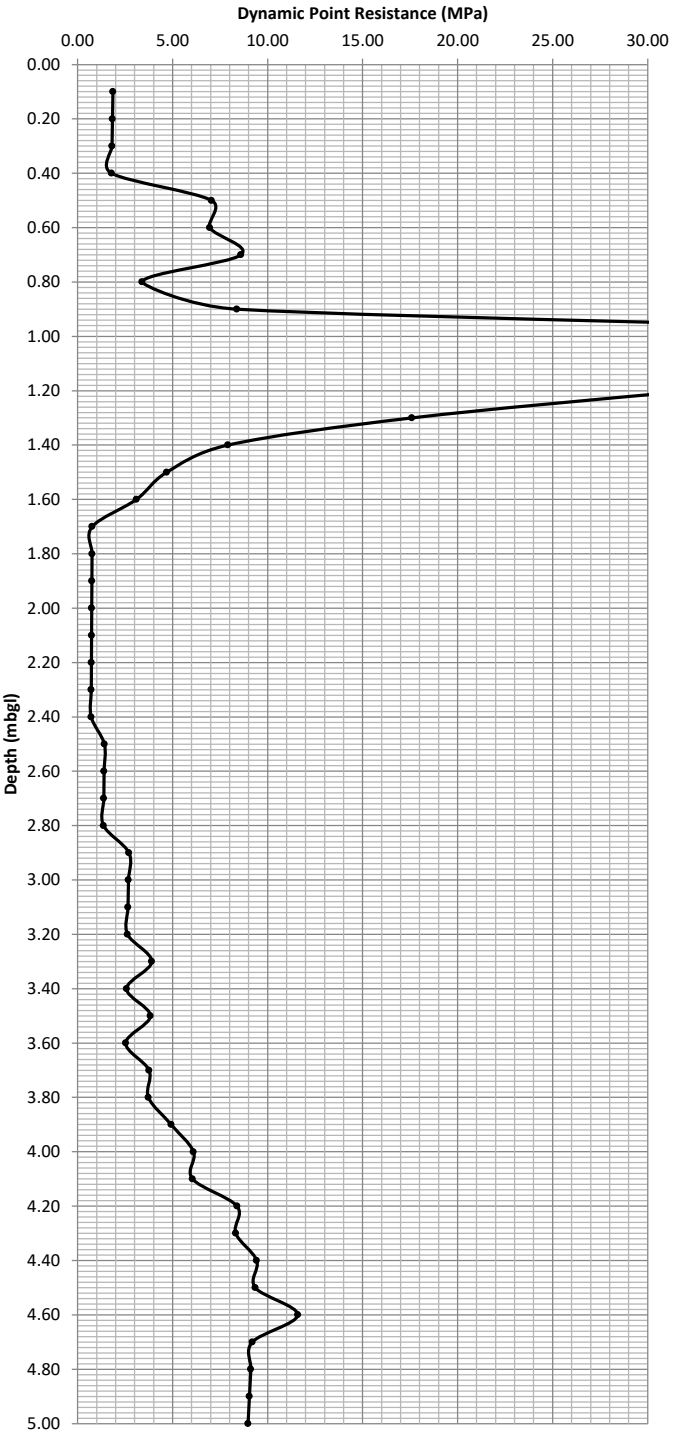
ASHDOWN SITE INVESTIGATION LTD

Dynamic Probe Record

SITE Camley Street Natural Park, 12 Camely Street, London **Report Ref.** R17-12131

Test Location Reference	BH02

Depth (mbgl)	Blows (per 100mm)	Average Penetration per Blow (m)	Unit Point Resistance (MPa)	Dynamic Point Resistance (MPa)
0.10	1	0.10	1.92	1.86
0.20	1	0.10	1.92	1.83
0.30	1	0.10	1.92	1.81
0.40	1	0.10	1.92	1.78
0.50	4	0.03	7.67	7.05
0.60	4	0.03	7.67	6.96
0.70	5	0.02	9.59	8.59
0.80	2	0.05	3.84	3.39
0.90	5	0.02	9.59	8.38
1.00	32	0.00	61.40	53.02
1.10	30	0.00	57.56	49.12
1.20	20	0.01	38.37	32.36
1.30	11	0.01	21.11	17.59
1.40	5	0.02	9.59	7.91
1.50	3	0.03	5.76	4.69
1.60	2	0.05	3.84	3.09
1.70	0.5	0.20	0.96	0.76
1.80	0.5	0.20	0.96	0.76
1.90	0.5	0.20	0.96	0.75
2.00	0.5	0.20	0.96	0.74
2.10	0.5	0.20	0.96	0.73
2.20	0.5	0.20	0.96	0.72
2.30	0.5	0.20	0.96	0.72
2.40	0.5	0.20	0.96	0.71
2.50	1	0.10	1.92	1.41
2.60	1	0.10	1.92	1.39
2.70	1	0.10	1.92	1.38
2.80	1	0.10	1.92	1.36
2.90	2	0.05	3.84	2.70
3.00	2	0.05	3.84	2.67
3.10	2	0.05	3.84	2.65
3.20	2	0.05	3.84	2.62
3.30	3	0.03	5.76	3.90
3.40	2	0.05	3.84	2.58
3.50	3	0.03	5.76	3.83
3.60	2	0.05	3.84	2.53
3.70	3	0.03	5.76	3.76
3.80	3	0.03	5.76	3.72
3.90	4	0.03	7.67	4.92
4.00	5	0.02	9.59	6.10
4.10	5	0.02	9.59	6.05
4.20	7	0.01	13.43	8.39
4.30	7	0.01	13.43	8.32
4.40	8	0.01	15.35	9.43
4.50	8	0.01	15.35	9.35
4.60	10	0.01	19.19	11.59
4.70	8	0.01	15.35	9.19
4.80	8	0.01	15.35	9.12
4.90	8	0.01	15.35	9.04
5.00	8	0.01	15.35	8.97



Notes:

Hammer Mass	63.5 kg
Fall Height	0.76 m
Cone Area	0.0019 m^2
E_{theor}	473 J
Energy Ratio	0.77
Anvil Mass	1.25 kg
Rod Mass	8.79 kg/m

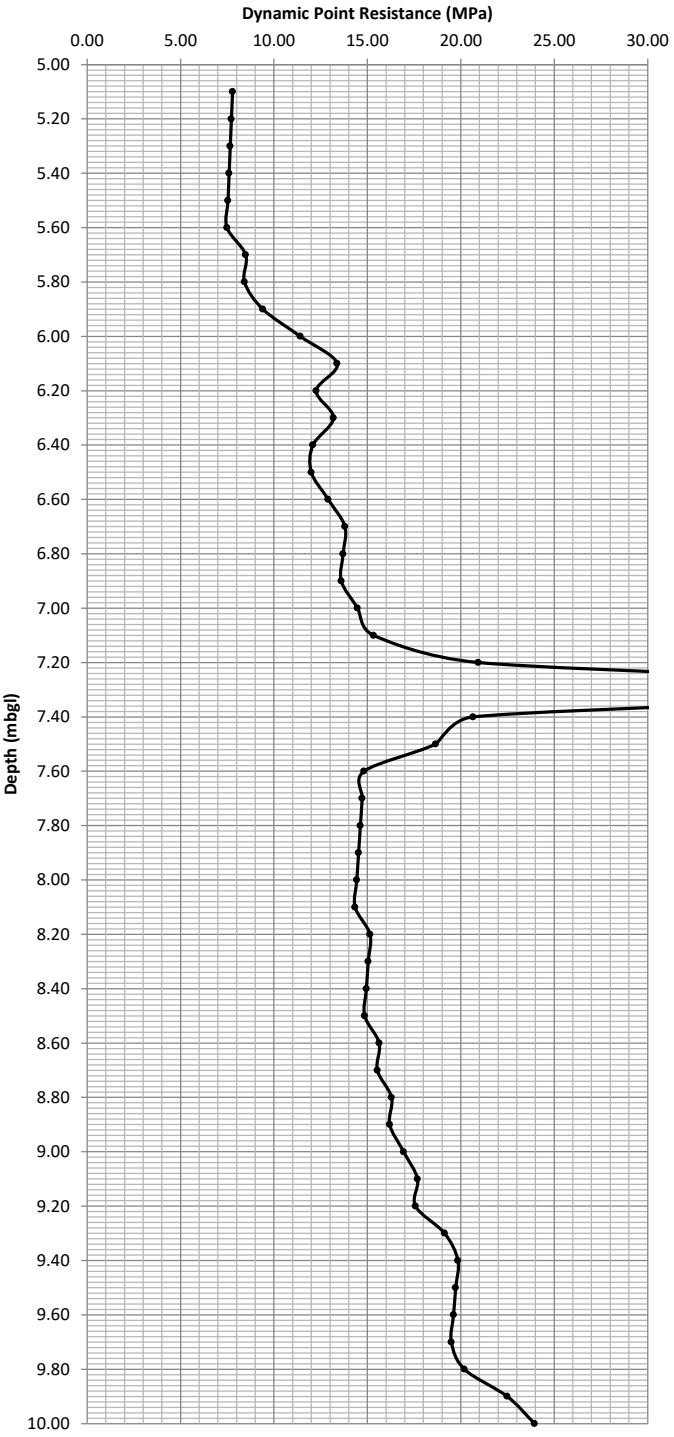
ASHDOWN SITE INVESTIGATION LTD

Dynamic Probe Record

SITE Camley Street Natural Park, 12 Camely Street, London **Report Ref.** R17-12131

Test Location Reference	BH02

Depth (mbgl)	Blows (per 100mm)	Average Penetration per Blow (m)	Unit Point Resistance (MPa)	Dynamic Point Resistance (MPa)
5.10	7	0.01	13.43	7.78
5.20	7	0.01	13.43	7.72
5.30	7	0.01	13.43	7.66
5.40	7	0.01	13.43	7.60
5.50	7	0.01	13.43	7.54
5.60	7	0.01	13.43	7.48
5.70	8	0.01	15.35	8.49
5.80	8	0.01	15.35	8.42
5.90	9	0.01	17.27	9.41
6.00	11	0.01	21.11	11.41
6.10	13	0.01	24.94	13.38
6.20	12	0.01	23.02	12.26
6.30	13	0.01	24.94	13.19
6.40	12	0.01	23.02	12.09
6.50	12	0.01	23.02	12.00
6.60	13	0.01	24.94	12.90
6.70	14	0.01	26.86	13.80
6.80	14	0.01	26.86	13.70
6.90	14	0.01	26.86	13.61
7.00	15	0.01	28.78	14.48
7.10	16	0.01	30.70	15.33
7.20	22	0.00	42.21	20.94
7.30	50	0.00	95.93	47.27
7.40	22	0.00	42.21	20.66
7.50	20	0.01	38.37	18.65
7.60	16	0.01	30.70	14.82
7.70	16	0.01	30.70	14.72
7.80	16	0.01	30.70	14.63
7.90	16	0.01	30.70	14.53
8.00	16	0.01	30.70	14.44
8.10	16	0.01	30.70	14.34
8.20	17	0.01	32.62	15.14
8.30	17	0.01	32.62	15.04
8.40	17	0.01	32.62	14.95
8.50	17	0.01	32.62	14.86
8.60	18	0.01	34.54	15.63
8.70	18	0.01	34.54	15.53
8.80	19	0.01	36.45	16.30
8.90	19	0.01	36.45	16.19
9.00	20	0.01	38.37	16.94
9.10	21	0.00	40.29	17.68
9.20	21	0.00	40.29	17.58
9.30	23	0.00	44.13	19.13
9.40	24	0.00	46.05	19.85
9.50	24	0.00	46.05	19.73
9.60	24	0.00	46.05	19.61
9.70	24	0.00	46.05	19.50
9.80	25	0.00	47.97	20.19
9.90	28	0.00	53.72	22.48
10.00	30	0.00	57.56	23.95



Notes:

Hammer Mass	63.5 kg
Fall Height	0.76 m
Cone Area	0.0019 m^2
E_{theor}	473 J
Energy Ratio	0.77
Anvil Mass	1.25 kg
Rod Mass	8.79 kg/m

APPENDIX D

Geotechnical Laboratory Testing Notes
Geotechnical Test Results
Contamination Test Results

GEOTECHNICAL LABORATORY TESTING NOTES

1 Soil Description

Description and classification of soils has been carried out using as a general basis the British Standard Geotechnical investigation and testing – Identification and classification of soil, Part 1 Identification and description (BS EN ISO 14688-1:2002+A1:2013) and Part 2 Principles of classification (BS EN 14688-2:2004 +A1:2013) as well as the BS5930:2015 code of Practice for Ground Investigations.

2 Index Tests

Index (Atterberg Limit) tests are undertaken on samples of fine grained soils provide the primary information for the classification of fine grained soils.

Fine grained soil is tested to determine its liquid and plastic limits, which are moisture contents that define boundaries between material consistency states. These tests are used to evaluate indices used for soil identification and to help determine the shrinkage and swelling characteristics of the soil under conditions of changing moisture content. The tests are carried out in accordance with BS1377: Part 2: 1990 + A1:1996 Classification tests.

The consistency index is derived from the Index Tests and is summarized in the following table. These divisions may be approximate, particularly for low plasticity soils. The consistency recorded on the soil classification summary is derived from the consistency index.

Consistency	Consistency Index
Very Soft	<0.25
Soft	0.25 to 0.50
Firm	0.50 to 0.75
Stiff	0.75 to 1.00
Very Stiff	>1.00

3 Particle Size Distribution Tests

Sieve analyses are carried out soil samples to establish their particle size distribution that can assist in the assessment of the permeability and classification of granular soils.

The tests are carried out in accordance with BS1377: Part 2: 1990 + A1:1996 Classification tests.

4 Natural Moisture/ Saturated Moisture Content Determination of Chalk

The results of natural moisture or saturated moisture content tests of disturbed samples of chalk are used to assist in the classification of the chalk to determine key geotechnical parameters of strength, density and crushing properties.

The tests are carried out in accordance with BS1377: Part 2: 1990 + A1:1996 Classification tests.

5 Soil Suction Testing

Soil suction tests are undertaken for the determination of the state of desiccation in clay soils.

The testing is carried out in accordance with the Building Research Establishment Information Paper IP4/93, dated February 1993.

6 Triaxial Compression Tests

Undrained triaxial compression tests are carried out on undisturbed samples of cohesive soil in order to assist in the determination of the undrained shear strength of the soil. The results of moisture content and density determinations are also included.

The tests are carried out in accordance with BS1377: Part 7: 1990 + A1:1994 Shear strength tests (total stress).

7 Shear Vane and Hand Penetrometer Testing

Undisturbed samples are tested in the laboratory using a Geonor Hand Shear Vane for the determination of their undrained shear strength.

The vane tests are carried out in general accordance with BS1377: Part 7: 1990 + A1:1994 Shear strength tests (total stress).

8 One Dimensional Consolidation Tests

One-dimensional consolidation tests are performed on undisturbed soil samples to ascertain their settlement characteristics.

The tests are carried out in accordance with BS1377: Part 5: 1990 + A1:1994 Compressibility, Permeability and Durability tests.

9 Dry Density / Moisture Content Relationship (Compaction) Testing

Compaction testing for the determination of the dry density / moisture content relationship is carried out on using either a 2.5kg, 4.5kg hammer or a vibrating hammer.

The tests are carried out in accordance with the British Standard BS1377: Part 4: 1990 + A1 & A2:2002 Compaction-related tests.

10 California Bearing Ratio

The soil is usually compacted at the as dug “natural” moisture content and often at moisture contents around the natural moisture content.

The California bearing ratio is determined in accordance with the British Standard BS1377: Part 4: 1990 + A1 & A2:2002 Compaction related tests.

11 Chemical Testing

Soil samples are tested for their concentration of water soluble sulphate and pH for use in concrete mix design.

Water samples are tested for total sulphate concentration and pH value.

Where a water soluble sulphate content in soils or a total sulphate content in groundwater exceeds 3000mg/l SO_4 the magnesium sulphate content of the samples is required to be determined (BRE Special Digest 1:2005).

ASHDOWN SITE INVESTIGATION LIMITED

Soil Classification Summary

Site Name:	Camley Street Natural Park, 12 Camley Street, London	Job No:	R17-12131

BH/TP No.	Depth (m)	Nat. Moist. Cont. (w %)	Equiv. Moist. Cont. (wa %)	Atterberg Limits			Class'n	Cons. Index (Ic)	% passing 425 µm sieve	Visual Description of Sample
				Wl %	Wp %	Ip %				
BH02	1.80	23		48	24	24	CI		47	MADE GROUND: Dark brown slightly sandy slightly gravelly clay. Gravel is fine to coarse flint, brick, glass and wood.
BH02	3.65	28		65	22	43	CH	0.86*	99	Stiff dark grey and orange grey mottled black speckled CLAY with rare fine to medium flint gravel.

Test Method: Classification Tests BS1377: Part 2: 1990: Method 4.4, 5.3 and 5.4

* Consistency index based on natural moisture content and not the equivalent moisture content.

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QTS Environmental Report No: 17-59114

Site Reference:	Camley Street Natural Park, 12 Camley Street, London
Project / Job Ref:	R17-12131
Order No:	P17-4821
Sample Receipt Date:	17/05/2017
Sample Scheduled Date:	18/05/2017
Report Issue Number:	1
Reporting Date:	24/05/2017

Authorised by:

Kevin Old
Associate Director of Laboratory

Authorised by:

Russell Jarvis
Associate Director of Client Services

QTSE is the trading name of DETS Ltd, company registration number 03705645

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate						
QTS Environmental Report No: 17-59114	Date Sampled	09/05/17	09/05/17	09/05/17	09/05/17	
Ashdown Site Investigations Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	
Site Reference: Camley Street Natural Park, 12 Camley Street, London	TP / BH No	BH02	BH02	BH02	BH02	
Project / Job Ref: R17-12131	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	
Order No: P17-4821	Depth (m)	1.30	2.80	4.65	9.80	
Reporting Date: 24/05/2017	QTSE Sample No	269255	269256	269257	269258	

Determinand	Unit	RL	Accreditation					
pH	pH Units	N/a	MCERTS	7.9	7.9	7.9	7.7	
Total Sulphate as SO_4	mg/kg	< 200	NONE	4281	2648	1195	3006	
Total Sulphate as SO_4	%	< 0.02	NONE	0.43	0.26	0.12	0.30	
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	473	501	229	957	
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	0.47	0.50	0.23	0.96	
Total Sulphur	%	< 0.02	NONE	1.25	0.84	0.04	0.85	

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C
Analysis carried out on the dried sample is corrected for the stone content
Subcontracted analysis (S)

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Lenham Heath
Maidstone
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Soil Analysis Certificate - Sample Descriptions	
QTS Environmental Report No: 17-59114	
Ashdown Site Investigations Ltd	
Site Reference: Camley Street Natural Park, 12 Camley Street, London	
Project / Job Ref: R17-12131	
Order No: P17-4821	
Reporting Date: 24/05/2017	

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
269255	BH02	None Supplied	1.30	19.6	Black sandy clay
269256	BH02	None Supplied	2.80	26.8	Brown clayey sand
269257	BH02	None Supplied	4.65	17.5	Brown sandy clay
269258	BH02	None Supplied	9.80	17.4	Brown clay

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample I/S

Unsuitable Sample U/S

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Soil Analysis Certificate - Methodology & Miscellaneous Information
QTS Environmental Report No: 17-59114
Ashdown Site Investigations Ltd
Site Reference: Camley Street Natural Park, 12 Camley Street, London
Project / Job Ref: R17-12131
Order No: P17-4821
Reporting Date: 24/05/2017

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

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QTS Environmental Report No: 17-58872

Site Reference:	Camley Street Natural Park, 12 Camley Street, London
Project / Job Ref:	R17-12131
Order No:	P17-4817
Sample Receipt Date:	12/05/2017
Sample Scheduled Date:	12/05/2017
Report Issue Number:	1
Reporting Date:	18/05/2017

Authorised by:

Kevin Old
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Authorised by:

Russell Jarvis
Associate Director of Client Services

QTSE is the trading name of DETS Ltd, company registration number 03705645

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Soil Analysis Certificate						
QTS Environmental Report No: 17-58872	Date Sampled	09/05/17	09/05/17	09/05/17	09/05/17	09/05/17
Ashdown Site Investigations Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Camley Street Natural Park, 12 Camley Street, London	TP / BH No	BH02	BH02	BH02	TP02	TP03
Project / Job Ref: R17-12131	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: P17-4817	Depth (m)	0.10	1.70	3.60	0.20	0.15
Reporting Date: 18/05/2017	QTSE Sample No	268367	268368	268369	268370	268371

Determinand	Unit	RL	Accreditation					
Asbestos Screen [S]	N/a	N/a	ISO17025	Not Detected			Detected	Detected
Sample Matrix [S]	Material Type	N/a	NONE				Fibre bundles present	Fibre bundles present
Asbestos Type [S]	PLM Result	N/a	ISO17025				Chrysotile	Chrysotile Amosite
pH	pH Units	N/a	MCERTS	7.3	7.8	7.7	7.2	7.4
Total Sulphate as SO_4	mg/kg	< 200	NONE				6739	7895
Total Sulphate as SO_4	%	< 0.02	NONE				0.67	0.79
Organic Matter	%	< 0.1	MCERTS	5.8	1.3	0.1	3.6	5.2
Arsenic (As)	mg/kg	< 2	MCERTS	22	13	14	16	15
W/S Boron	mg/kg	< 1	NONE	2.2	2	< 1	< 1	2.4
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	0.5	0.2	< 0.2	0.4	0.4
Chromium (Cr)	mg/kg	< 2	MCERTS	27	12	41	31	27
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Copper (Cu)	mg/kg	< 4	MCERTS	60	67	20	63	70
Lead (Pb)	mg/kg	< 3	MCERTS	336	423	25	156	211
Mercury (Hg)	mg/kg	< 1	NONE	< 1	2.9	< 1	< 1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS	21	12	46	16	15
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3	< 3	< 3
Zinc (Zn)	mg/kg	< 3	MCERTS	268	70	72	226	278

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C
Analysis carried out on the dried sample is corrected for the stone content

The samples have been examined to identify the presence of asbestiform minerals by polarising light microscopy and dispersion staining technique to In-House Procedures QTSE600 Determination of Asbestos in Bulk Materials; Asbestos in Soils/Sediments (fibre screening and identification)

This report refers to samples as received, and QTS Environmental Ltd, takes no responsibility for the accuracy or competence of sampling by others.

The material description shall be regarded as tentative and is not included in our scope of UKAS Accreditation.

Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation.

Asbestos Analyst: Javeed Malik

RL: Reporting Limit

Pinch Test: Where pinch test is positive it is reported "Loose Fibres - PT" with type(s).

Subcontracted analysis [S]

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Soil Analysis Certificate - Speciated PAHs							
QTS Environmental Report No: 17-58872	Date Sampled	09/05/17	09/05/17	09/05/17	09/05/17	09/05/17
Ashdown Site Investigations Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Camley Street Natural Park, 12 Camley Street, London	TP / BH No	BH02	BH02	BH02	TP02	TP03
Project / Job Ref: R17-12131	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: P17-4817	Depth (m)	0.10	1.70	3.60	0.20	0.15
Reporting Date: 18/05/2017	QTSE Sample No	268367	268368	268369	268370	268371

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	0.13	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	1.07	< 0.1	< 0.1	0.60	0.50
Anthracene	mg/kg	< 0.1	MCERTS	0.21	< 0.1	< 0.1	0.15	0.12
Fluoranthene	mg/kg	< 0.1	MCERTS	2.15	< 0.1	< 0.1	1.26	1.17
Pyrene	mg/kg	< 0.1	MCERTS	1.84	< 0.1	< 0.1	1.17	1.07
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	1.01	< 0.1	< 0.1	0.60	0.65
Chrysene	mg/kg	< 0.1	MCERTS	0.98	< 0.1	< 0.1	0.66	0.68
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	1.50	< 0.1	< 0.1	0.81	0.92
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	0.46	< 0.1	< 0.1	0.31	0.36
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.92	< 0.1	< 0.1	0.51	0.63
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	0.58	< 0.1	< 0.1	0.34	0.41
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	0.35	< 0.1	< 0.1	0.31	0.39
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	11.2	< 1.6	< 1.6	6.7	6.9

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{o}C

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Soil Analysis Certificate - EPH Banded (Type F)						
QTS Environmental Report No: 17-58872	Date Sampled	09/05/17	09/05/17			
Ashdown Site Investigations Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: Camley Street Natural Park, 12 Camley Street, London	TP / BH No	TP02	TP03			
Project / Job Ref: R17-12131	Additional Refs	None Supplied	None Supplied			
Order No: P17-4817	Depth (m)	0.20	0.15			
Reporting Date: 18/05/2017	QTSE Sample No	268370	268371			

Determinand	Unit	RL	Accreditation					
EPH (>C8 - C10)	mg/kg	< 1	MCERTS	< 1	< 1			
EPH (>C10 - C12)	mg/kg	< 1	MCERTS	< 1	< 1			
EPH (>C12 - C16)	mg/kg	< 1	MCERTS	< 1	< 1			
EPH (>C16 - C21)	mg/kg	< 1	MCERTS	13	8			
EPH (>C21 - C40)	mg/kg	< 6	MCERTS	242	114			
EPH (C8 - C40)	mg/kg	< 6	MCERTS	255	122			

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C

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Soil Analysis Certificate - TPH CWG Banded						
QTS Environmental Report No: 17-58872	Date Sampled	09/05/17	09/05/17	09/05/17		
Ashdown Site Investigations Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Camley Street Natural Park, 12 Camley Street, London	TP / BH No	BH02	BH02	BH02		
Project / Job Ref: R17-12131	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: P17-4817	Depth (m)	0.10	1.70	3.60		
Reporting Date: 18/05/2017	QTSE Sample No	268367	268368	268369		

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Aliphatic >C6 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05		
Aliphatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Aliphatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Aliphatic >C12 - C16	mg/kg	< 3	MCERTS	< 3	< 3	< 3		
Aliphatic >C16 - C21	mg/kg	< 3	MCERTS	< 3	< 3	< 3		
Aliphatic >C21 - C34	mg/kg	< 10	MCERTS	< 10	< 10	< 10		
Aliphatic (C5 - C34)	mg/kg	< 21	NONE	< 21	< 21	< 21		
Aromatic >C5 - C7	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Aromatic >C7 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05		
Aromatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Aromatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Aromatic >C12 - C16	mg/kg	< 2	MCERTS	2	< 2	< 2		
Aromatic >C16 - C21	mg/kg	< 3	MCERTS	11	< 3	< 3		
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	49	< 10	< 10		
Aromatic (C5 - C35)	mg/kg	< 21	NONE	62	< 21	< 21		
Total >C5 - C35	mg/kg	< 42	NONE	62	< 42	< 42		

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C

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Soil Analysis Certificate - BTEX / MTBE						
QTS Environmental Report No: 17-58872	Date Sampled	09/05/17	09/05/17	09/05/17		
Ashdown Site Investigations Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Camley Street Natural Park, 12 Camley Street, London	TP / BH No	BH02	BH02	BH02		
Project / Job Ref: R17-12131	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: P17-4817	Depth (m)	0.10	1.70	3.60		
Reporting Date: 18/05/2017	QTSE Sample No	268367	268368	268369		

Determinand	Unit	RL	Accreditation					
Benzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
Toluene	ug/kg	< 5	MCERTS	9	< 5	< 5		
Ethylbenzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
p & m-xylene	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
o-xylene	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
MTBE	ug/kg	< 5	MCERTS	< 5	< 5	< 5		

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C

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4480

Waste Acceptance Criteria Analytical Certificate - BS EN 12457/2

QTS Environmental Report No: 17-58872	Date Sampled	09/05/17	
Ashdown Site Investigations Ltd	Time Sampled	None Supplied	
Site Reference: Camley Street Natural Park, 12 Camley Street, London	TP / BH No	BH02	
Project / Job Ref: R17-12131	Additional Refs	None Supplied	
Order No: P17-4817	Depth (m)	0.10	
Reporting Date: 18/05/2017	QTSE Sample No	268367	

Determinand	Unit	MDL		Landfill Waste Acceptance Criteria Limits: Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
TOC[MU]	%	< 0.1	3.4	3%	5%	6%
Loss on Ignition	%	< 0.01	12.90	--	--	10%
BTEX[MU]	mg/kg	< 0.05	< 0.05	6	--	--
Sum of PCBs	mg/kg	< 0.1	< 0.1	1	--	--
Mineral Oil[MU]	mg/kg	< 10	< 10	500	--	--
Total PAH[MU]	mg/kg	< 1.7	11.2	100	--	--
pH[MU]	pH Units	N/a	7.3	--	>6	--
Acid Neutralisation Capacity	mol/kg (+/-)	< 1	1.9	--	To be evaluated	To be evaluated

Eluate Analysis	10:1 mg/l			Cumulative 10:1 mg/kg	Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)		
Arsenic[U]	0.01			0.1	0.5	2	25
Barium[U]	0.03			0.3	20	100	300
Cadmium[U]	< 0.0005			< 0.005	0.04	1	5
Chromium[U]	< 0.005			< 0.05	0.5	10	70
Copper[U]	0.02			0.2	2	50	100
Mercury[U]	< 0.0005			< 0.01	0.01	0.2	2
Molybdenum[U]	0.006			0.06	0.5	10	30
Nickel[U]	< 0.007			< 0.07	0.4	10	40
Lead[U]	0.036			0.36	0.5	10	50
Antimony[U]	< 0.005			< 0.05	0.06	0.7	5
Selenium[U]	< 0.005			< 0.05	0.1	0.5	7
Zinc[U]	0.020			0.20	4	50	200
Chloride[U]	11			108	800	15000	25000
Fluoride[U]	< 0.5			< 5	10	150	500
Sulphate[U]	32			322	1000	20000	50000
TDS	179			1789	4000	60000	100000
Phenol Index	< 0.01			< 0.1	1	-	-
DOC	18.5			185	500	800	1000
Leach Test Information							
Sample Mass (kg)	0.11						
Dry Matter (%)	82.9						
Moisture (%)	20.6						
Stage 1							
Volume Eluate L10 (litres)	0.88						

Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and QTS Environmental cannot be held responsible for any discrepencies with current legislation
M Denotes MCERTS accredited test
U Denotes ISO17025 accredited test

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Soil Analysis Certificate - Sample Descriptions
QTS Environmental Report No: 17-58872
Ashdown Site Investigations Ltd
Site Reference: Camley Street Natural Park, 12 Camley Street, London
Project / Job Ref: R17-12131
Order No: P17-4817
Reporting Date: 18/05/2017

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
268367	BH02	None Supplied	0.10	17.1	Brown sandy clay with stones and brick
268368	BH02	None Supplied	1.70	13.6	Black sandy clay with brick
268369	BH02	None Supplied	3.60	19	Brown clay
268370	TP02	None Supplied	0.20	6.2	Grey sandy gravel with stones and concrete
268371	TP03	None Supplied	0.15	7.8	Grey sandy gravel with stones and concrete

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample I/S

Unsuitable Sample U/S

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Soil Analysis Certificate - Methodology & Miscellaneous Information
QTS Environmental Report No: 17-58872
Ashdown Site Investigations Ltd
Site Reference: Camley Street Natural Park, 12 Camley Street, London
Project / Job Ref: R17-12131
Order No: P17-4817
Reporting Date: 18/05/2017

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

APPENDIX E

Classification of Probability, Consequence and Risk

Probability of risk being realised	
Classification	Definition
High	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.
Moderate	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	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.
Very Low	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

Consequence of risk being realised		
Classification	Category	Definition
Severe	Human Health	Short term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA.
	Controlled Waters	Short term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource.
	Property	Catastrophic damage to buildings/property.
	Ecological Systems	A short term risk to a particular ecosystem or organisation forming part of such ecosystem.
Moderate	Human Health	Chronic damage to Human Health.
	Controlled Waters	Pollution of sensitive water resources (note: Water Resources Act contains no scope for considering significance of pollution).
	Ecological System	A significant change in a particular ecosystem or organism forming part of such ecosystem.
Minor	Controlled Waters	Pollution of non-sensitive water resources.
	Property	Significant damage to crops, buildings, structures and services.
	Ecological Systems	Damage to sensitive buildings/structures/services or the environment.
Very Minor	Human Health	Non-permanent health effects to human health (easily prevented by means such as personal protective clothing, etc).
	Property	Easily repairable effects of damage to buildings, structures and services.
	Project	Harm, although not necessarily significant harm, which may result in a financial loss or expenditure to resolve.

Risk classification definitions	
Very High	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the long term.
Moderate	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.
Low	It is possible that harm could arise to a designated receptor from an identified hazard, but there is a low likelihood of this hazard occurring and if realised, harm would at worst normally be mild.
Very Low	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised, it is not likely to be severe.