

# **CONTENTS**

1.0	INTRODUCTION & SCOPE OF WORKS
2.0	WALKOVER SURVEY
3.0	PHASE 1 ENVIRONMENTAL RISK ASSESSMENT
4.0	HISTORICAL MAPS
5.0	FIELDWORK
6.0	GROUND CONDITIONS
7.0	LABORATORY TESTING
8.0	DISCUSSION

## **APPENDICES**

- *EnviroCheck Report*
- *EnviroCheck Plans*
- *Historical Maps (11 Sheets)*
- *Plates 1-3 - General Site Photographs*
- *Cable Percussion Borehole Records (BH1-BH2)*
- *Drive-in-Sampler Borehole Records (DIS1-DIS4)*
- *Falling Head Permeability Test Record Sheets (SA1-SA3)*
- *SPT versus Depth Profile*
- *Laboratory Test Results*
- *C<sub>u</sub> Versus Depth Profile*
- *Gas/Groundwater Monitoring Test Results*
- *Proposed Site Plan, Messrs. TZG Partnership Limited Contract No. 6373 Drg. No. S800.*
- *Sketch Fieldwork Location Plan, Drawing No. RML 6698/1*

## **1.0 INTRODUCTION & SCOPE OF WORKS**

- 1.1 This report has been prepared by Risk Management Limited for the Client, Messrs. Camden Lifestyle (UK) Limited, under cover of Messrs. G L Hearn Limited's e-mailed instructions to proceed, dated 16<sup>th</sup> April 2018.
- 1.2 The Consulting Engineers for the project are Messrs. TZG Partnership Limited.
- 1.3 The site under consideration was a central courtyard area, with several single-storey and double-storey buildings surrounding, located at Nos. 7 A,B,C Bayham Street, London, NW1 0EY.
- 1.4 The approximate six-figure grid reference for the centre of the site is 529230 E, 183460 N.
- 1.5 It is understood that the proposed description of the development is as follows;
- “Full Planning Application for the demolition of existing buildings (B1a Use Class) and erection of a 5 storey building, comprising co-working office floorspace (B1a Use Class), hotel accommodation (C1 Use Class) and an ancillary café/bar and gym/fitness facilities; and works to the existing access.”*
- 1.6 The development also includes a proposed two-storey basement. The currently proposed plan layout sequence of the development is indicated on the appended Messrs. TZG Partnership Limited Contract No. 6373 Drawing No. S800.
- 1.7 Risk Management Limited have now been commissioned to carry out an investigation into the site comprising both a Phase I, *Non-Intrusive*, Desk Study and a Phase II, *Intrusive*, Site Investigation.
- 1.8 The Desk Study comprises a Walkover Survey, an Environmental Disclosure Report, and a Historical Map Search and covers the whole of the site.
- 1.9 It should be noted that the current Desk Study is designed for geo-environmental purposes only and does not include a Structural Survey, Ecological Survey, above ground or building Asbestos Survey or an Invasive Plant Survey for Japanese Knotweed, Giant Hogweed etc.
- 1.10 The *Intrusive* site investigation provides information on the sub-soil conditions at this site, together with laboratory testing and includes a land-borne gas monitoring survey.
- 1.11 This report presents the work carried out and discusses the findings.

## **2.0 WALKOVER SURVEY**

- 2.1 A Walkover Survey of the site under investigation, and that of the immediate surrounding area, was carried out by Risk Management Limited on the 19<sup>th</sup> May 2018.
- 2.2 The majority of the site was formed of a concrete hardstanding area used for car parking and entrances to various small office buildings surrounding and in parts forming the boundaries to the current site.
- 2.3 The local topography was relatively flat with the eastern portion, by the metal car entrance gate, sloping down towards Bayham Street to the east.
- 2.4 The northern boundary to the current site was formed, in the eastern portion, by a two-storey, brick-built, flat roofed building, whilst the western portion comprised a brick wall. Further mainly residential buildings lay beyond to the north.
- 2.5 The eastern boundary to the current site comprised a brick wall in the northern portion with a metal pedestrian gate. The southern portion of the eastern boundary comprised a large metal car entrance gate. Bayham Street and a large six-storey residential building, named "Westerham", lay further beyond.
- 2.6 The southern boundary to the current site comprised a single-storey, brick built, pitched roof building in the eastern portion. A small alleyway with a brick wall formed a small portion of the southern boundary with a further building in the western portion. A new, high-rise, residential property was being constructed beyond the southern boundary to the west and an existing mixed-use building was located to the south-east, fronting Bayham Street.
- 2.7 The western boundary to the current site comprised a two-storey, brick-built, pitched roof building. A car park lay beyond the western boundary with commercial units and Camden High Street further beyond.
- 2.8 Numerous drainage runs were noted across site as indicated by the presence of manhole and drainage covers.
- 2.9 Plates 1-3, appended, show general photographs of the site.

### 3.0 PHASE 1 ENVIRONMENTAL RISK ASSESSMENT

- 3.1 An EnviroCheck Report was commissioned for the current site covering an area of up to 1000m from the centre of the site.
- 3.2 Only criteria within 250m of the centre of the site are discussed in detail below but full results of all the search criteria up to 1000m from the centre of the site are summarised within the relevant pages of the appended EnviroCheck Report.

#### Geo-Environmental Hazards

- 3.3 The following table summarises the potential geo-environmental hazards and mitigation measures for this site.

Data Type	Hazard	Mitigation Measures for currently proposed development
Landfill & Waste Management Facilities	The Local Authority Landfill Coverage is designated as the London Borough of Camden. No Licensed Waste Management Facilities, Registered or Historic Landfills, Potentially Infilled Land or Registered Waste Transfer Treatment or Disposal Sites are noted within the 0-250m search band.	None required.
Local Authority Pollution Prevention and Controls	One Local Authority Pollution Prevention and Control is noted within the 0-250m search band. This relates to Dry Cleaning services located some 71m west of the current site and is permitted. A further fifteen Local Authority Pollution Prevention and Controls are noted within the 251-1000m search band.	Contamination testing will be undertaken as part of the current Phase II <i>intrusive</i> site investigation.
Hazardous Substances	No Hazardous Substances usages are noted within the 0-500m search band.	None required.
Coal Mining	The site lies within an area which would not normally be affected by coal mining activity.	None required.
Collapsible Ground Stability	"Very Low Hazard"	None required.
Compressible Ground Stability	"No Hazard"	None required.
Ground Dissolution	"No Hazard"	None required.
Landslide Stability	"Very Low Hazard"	None required.

Running Sand	"No Hazard"	None required.
Swelling/Shrinking	"Moderate Hazard"	Superseded by current work.
Radon	The site does not fall within shaded sections of Annex A of BRE Report 211 (2007) "Radon: guidance on protective measures for new dwellings". Therefore, <b>No Radon Protective Measures will be necessary in the construction of new buildings at this location</b>	None required.
Contemporary Trade Directory Entries	Of the forty Contemporary Trade Directory Entries noted within the 0-250m search band, only eight are listed as active. The active Contemporary Trade Directory Entries include; Commercial Cleaning Services, Quarries, Tyre Dealers, Printers, Cleaning Services -Domestic, Electrical Goods Sales, Manufacturers & Wholesalers, Printers and Electronic Component Manufacturers & Distributors.	None required.
Historic Contemporary Trade Directory Entries	The thirty-two Historic Contemporary Trade Directory Entries noted within the 0-250m search band include; Garage Services, Photographic Processors, Cleaning Services – Domestic, Carpet, Curtain & Upholstery Cleaners, Distribution Services, Clothing & Fabrics – Manufacturers, Shirt Makers, Antiques – Repairing & Restoring, Dry Cleaners, Cabinet Makers, Printers, Car Body Repairs, Engineers – General, Telecommunications Equipment & Systems, Food Products – Manufacturers, Laboratories, Computer manufacturers, Bags, Belts & Accessories – Manufacturers & Suppliers, Cosmetic Manufacturers.	Contamination testing will be undertaken as part of the current Phase II <i>intrusive</i> site investigation.
Fuel Station Entries	One Fuel Station is noted within the 0-250m search band. This relates to St Georges Service Station some 127m west of the current site, however, the status is now listed as obsolete.	None required.
Sensitive Land Use	No sensitive land uses are noted within the 0-500m search band.	None required.

### **Hydrology and Hydrogeology**

- 3.4 The following table summarises the potential **Hydrology and Hydrogeology** aspects for this site.

	<b>Hazard</b>	<b>Mitigation Measures for currently proposed development</b>
Discharge Consents	No Discharge Consents are noted within the 0-500m search band. Three Discharge Consents are noted within the 501m-1000m search band.	None required.
Nearest Surface Water Feature	The nearest significant surface water feature is noted to be some 403m south-west of the current site.	None required.
Water Abstractions	No Water Abstractions are noted within the 0-500m search band. Eight Water Abstractions are noted within the 501-1000m search band.	None required.
Pollution Incidents to Controlled Waters	No Pollution Incidents to Controlled Waters are noted within the 0-500m search band. Five Pollution Incidents to Controlled Waters are noted within the 501-1000m search band.	None required.
Groundwater Vulnerability	The appended Groundwater Vulnerability Map indicates that the site lies over a 'Non-Aquifer'.	Contamination testing will be undertaken as part of the current Phase II <i>intrusive</i> site investigation.
Bedrock Aquifer Designations	The Bedrock Aquifer Designation is given as: 'Unproductive Strata'.	
Superficial Aquifer Designations	The Superficial Aquifer Designation is given as: 'No Data Available'.	
Source Protection Zones	The appended Environment Agency Groundwater Map indicates that the site does not lie over an Environment Agency Source Protection Zone (SPZ).	
Flood Risk	The site does not lie within an Environment Agency Indicative Flood Plain and has no potential for groundwater flooding to occur at surface.	A full Flood Risk Assessment is outside the scope of the current Report.

## **4.0 HISTORICAL MAPS**

4.1 The following eleven historical plans covering the site are discussed below.

### *4.1.1 1875-1876 (1:2,500)*

The current site lies within the 1876 portion of this plan, which indicates that the site is mostly a wooded area or an orchard, possibly associated with the school to the west. A rectangular building is shown in the south-western portion of the site.

The surrounding area is shown to be built up with most of the available space developed. A school is shown to the immediate west of the current site with a monument further beyond. Mornington Crescent and associated open space is shown to the far south-west, with a Railway line shown further beyond. A public bath house is shown to the north-east of the current site with an associated pump house with mushroom grounds and the Royal Veterinary College further beyond. St Matthews Church is shown to the south-east of the current site.

### *4.1.2 1896 (1:2,500)*

Some twenty years later, and just before the turn of the century, and the current site is now shown to contain an additional two buildings, one along the southern boundary and one along the northern boundary. The previous building in the south-western portion of the site is now shown to have been extended northwards, now spanning the whole western boundary of the current site. A small square building is shown in the north-eastern portion of the site.

Elsewhere, little significant change is noted to the immediate surrounding area. The previous mushroom grounds have now been developed as a school.

#### 4.1.3 1916 (1:2,500)

Some twenty years later, and during the first world-war, and an additional square-shaped building is shown adjacent to the previous small square building in the north-eastern portion of the site.

Elsewhere, some residential buildings have been demolished to make way for a Picture Theatre, to the south of the current site, a Working Men's Club, to the east of the current site and a Carriage Shed, to the far south-west of the current site. A Methodist Chapel is shown to the north of the current site.

#### 4.1.4 1938 (1:10,560)

Some twenty-seven years later, and just before the start of the second world-war, and this plan, of a larger scale, shows no significant change to the current site.

The plan shows the surrounding areas of St Pancras to the north-east and Marylebone to the south-west.

#### 4.1.5 1953 (1:1,250)

Some fifteen years later and the building along the southern boundary is now denoted 7A and the building along the western boundary of the current site is now denoted 7B. The previous additional square building in the north-eastern portion of the site has now been removed leaving only a small square building in this portion of the current site.

Elsewhere, residential buildings have been demolished to make way for large residential blocks, namely Godwin Court to the east and Cobden House to the west of the current site. A tobacco works is shown to the south-west of the current site. The Picture Theatre to the south of the current site is now named the Camden Hippodrome.



#### 4.1.6 1962-1969 (1,1,250)

The current site lies within the 1964 portion of this plan which now shows three distinct rectangular buildings on the site, denoted 7A, 7B and 7C. 7A and 7B are as previously shown along the southern and western boundaries, respectively. 7C is now shown along the northern boundary, extended along to the east to the edge of the current site, fronting Bayham Street. A square wall is shown in the eastern portion of the site, adjacent to 7C.

Elsewhere, residential buildings to the east have been demolished to make way for a large residential block named Westerham. Further residential blocks are shown to the north, east and south of the current site.

#### 4.1.7 1971 (1:2,500)

Only seven years later and this plan shows no significant change to the current site. The site is now denoted as a 'Works'.

Elsewhere, again some residential buildings have been demolished to make way for residential blocks to the south-east and north of the current site.

#### 4.1.8 1991 (1:1,250)

Some twenty years later and no significant change is noted to the current site or the immediate surrounding area.

#### 4.1.9 1999 (1:10,000)

Only eight years later and this plan of a larger scale shows the surrounding areas of Camden Town, Somers Town, Regents Park and St Pancras.

*4.1.10 2006 (1:10,000)*

Only seven years later, this plan of a larger scale shows no significant change to the current site or immediate surrounding area.

*4.1.11 2018 (1:10,000)*

The plan of the current date now confirms the current site and immediate surrounding area as found during the current Walkover Survey.

## **5.0 FIELDWORK**

- 5.1 Fieldwork was generally executed in accordance with the recommendations given in British Standard BS 5930:2015, "Code of Practice for Ground Investigations". Contamination sampling was undertaken in accordance with BS 10175 : 2011, "Code of Practice for the Investigation of Potentially Contaminated Sites".
- 5.2 Borehole locations are shown on the appended Sketch Fieldwork Location Plan, Drawing No. RML 6698/1.
- 5.3 Fieldwork was undertaken over the weekend of 5<sup>th</sup> & 6<sup>th</sup> May 2018 and on Saturday 19<sup>th</sup> May 2018 and comprised the following:-

### Cable Percussion Boreholes

- 5.4 Two cable percussion boreholes (BH1 & BH2) were drilled at this site. Borehole BH1 was terminated at 25.50m below existing ground level and borehole BH2 was terminated at 4.00m below existing ground level.
- 5.5 Small disturbed samples and undisturbed U100 samples were taken from the boreholes at regular depth intervals within each stratum and when a change of strata was encountered.
- 5.6 In addition, Standard Penetration Tests (SPT's) were carried out within the boreholes in order to provide additional information on the consistency of the material encountered.
- 5.7 The appended Standard Penetration Test versus Depth Profile plots the SPT 'N' values against depth at this site for boreholes BH1 and BH2.
- 5.8 Upon completion of borehole BH1 a combined groundwater/gas monitoring standpipe was installed to a depth of 7.00m below existing ground level. The monitoring installation comprised a 1 metre length of plain 50mm diameter HDPE pipe followed by slotted geotextile wrapped HDPE pipe, capped at the base. A cement/bentonite seal was installed from 1.00m to ground level and each installation finished with a gas valve on top of the pipe and a lockable stopcock cover concreted in flush with ground level.
- 5.9 Full details of the cable percussion borehole findings are given on the appended borehole record sheets.

#### Drive-in-Sampler Boreholes

- 5.10 In addition to the above noted cable percussion boreholes, four drive-in-sampler boreholes (DIS1-DIS4) were drilled across the site. Boreholes DIS1 and DIS3 were terminated at a depth of 5.00m below existing ground level and boreholes DIS2 and DIS4 were terminated at a depth of 3.00m below existing ground level.
- 5.11 The drive-in-sampler comprises a series of 1 and 2 metre long metal tubes, varying in diameter from 80mm down to 35mm, driven into the ground using a mini-hydraulic breaker unit. The tubes are subsequently jacked out of the ground and side windows enable the tubes to be cleaned and small disturbed samples to be taken at regular intervals within each stratum.
- 5.12 Small disturbed samples were taken at regular depth intervals down the boreholes.
- 5.13 Upon completion of boreholes DIS1 and DIS3, combined groundwater/gas monitoring standpipes were installed to a depth of 5.00m below existing ground level. The monitoring installation comprised a 1 metre length of plain 19mm diameter HDPE pipe followed by slotted geotextile wrapped HDPE pipe, capped at the base. A cement/bentonite seal was installed from 1.00m to ground level and each installation finished with a gas valve on top of the pipe and a lockable stopcock cover concreted in flush with ground level.
- 5.14 Full details of the drive-in-sampler borehole findings are given on the appended borehole record sheets.

#### Falling Head Permeability Tests

- 5.15 Following the initial site work, three Falling Head Permeability Tests (SA1-SA3) were carried out at this site on the 9<sup>th</sup> June 2018. Falling Head Permeability Test SA1 was undertaken at 3.70m depth (the depth to groundwater) in the standpipe installed within borehole BH1, Falling Head Permeability Test SA2 was undertaken at 1.80m depth (the depth to groundwater) in the standpipe installed within borehole DIS1 and Falling Head Permeability Test SA3 was undertaken at 1.80m depth (the depth to groundwater) in the standpipe installed within borehole DIS3.
- 5.16 The permeability tests undertaken at this site were falling head tests undertaken in accordance with B.S. 5930:2015.

- 5.17 Full details are given on the attached summary sheet together with any assumptions made to obtain the permeability of the material tested and to help assess the drainage potential of the ground for proposed soakaways.

*Land-Borne Gas Monitoring*

- 5.18 Following the initial site work, six return gas/groundwater monitoring visits have been undertaken to the installations fitted within boreholes BH1, DIS1 and DIS3 on the 22<sup>nd</sup> and 29<sup>th</sup> May 2018 and the 1<sup>st</sup>, 9<sup>th</sup>, 20<sup>th</sup> and 27<sup>th</sup> June 2018.
- 5.19 On each visit the barometric pressure was recorded together with the level of Carbon Dioxide, Oxygen and Methane. In addition, gas flow measurements were taken and the depth to groundwater recorded.
- 5.20 Full details of the readings are included on the appended Gas/Groundwater Monitoring Record Sheet.

## **6.0 GROUND CONDITIONS**

- 6.1 According to information published by the British Geological Survey (Sheet 256, North London) the underlying geology at this site is shown as being London Clay of the Eocene Period.
- 6.2 It is thought that the London Clay formation was deposited during a period of sea inundation in the area up to 200m in depth. The London Clay can be up to 150m thick beneath south Essex thinning across London to about 90m near Reading. The formation consists of mainly dark blue to brown grey clay containing variable amounts of fine-grained sand and silt. London Clay generally weathers to an orange-brown colour with pockets of silty fine sand. The formation is particularly susceptible to swelling and shrinking when subjected to moisture content changes. In addition, gypsum (selenite) crystals and pyrite nodules are commonly found throughout the formation.
- 6.3 Full details of the ground conditions encountered are presented on the borehole records appended to this report and can be summarised as follows:-

Depth From (m)	Depth To (m)	Description
0.00	0.10/0.15	Concrete/Topsoil.
0.10/0.15	1.40/2.10	MADE GROUND.
1.40/2.10	7.20	Weathered London CLAY.
7.20	25.50 +	London CLAY (BH1 only).

- 6.4 Groundwater was not noted during boring, however groundwater was noted during all six return monitoring visits to the installations fitted within boreholes BH1, DIS1 and DIS3.
- 6.5 The depth to groundwater was found to range between 3.60m and 3.70m below existing ground level for borehole BH1, between 1.70m and 1.80m below existing ground level for borehole DIS1 and between 1.60m and 1.80m below existing ground level for borehole DIS3.

- 6.6 However, the water noted above is considered to represent “perched” water within the MADE GROUND lying above the relatively impermeable London Clay below.
- 6.7 Roots were not noted in any of the two cable percussion boreholes or within the four drive-in-sampler boreholes.

## **7.0    LABORATORY TESTING**

- 7.1    The following geotechnical and chemical laboratory tests have been carried out on samples recovered from the boreholes at this site.
- 7.2    Unless otherwise stated, the geotechnical tests have generally been carried out in accordance with the recommendations given in British Standard 1377:1990, "Methods of Test for Soils for Civil Engineering Purposes".
- 7.3    The chemical testing was carried out in accordance with standard industry methods in a UKAS approved laboratory which is also currently accredited in accordance with MCERTS for the majority of its testing. Further information regarding this accreditation is available on request together with a full list of test methods if required.

### **7.4    *Natural Moisture Content***

The natural moisture content has been determined for a total of twelve samples taken from boreholes BH1 and BH2.

The natural moisture content was found to range between 25% and 29%.

### **7.5    *Atterberg Limits***

The Atterberg Limits have been determined for one sample of the more cohesive element of MADE GROUND from 1.40m in borehole BH1 and three of the London clay from 2.00m and 3.00m depth in borehole BH1 and from 2.50m depth in borehole BH2.

The liquid limits (LL) were found to range between 62% and 68%, the plastic limits (PL) between 19% and 23%, and the plasticity index (PI) between 40 and 48.

These results indicate that all four of the samples tested can be classified as a clay of 'high' plasticity (CH) in accordance with the Casagrande Geotechnical classification system.

In addition, all the samples tested would all be classified as having a 'high' potential for swelling/shrinking in accordance with the National House Building Councils (NHBC) classification system given in Part 4 of their Standards.



#### 7.6 *Quick Undrained Triaxial Compression Tests.*

The undrained shear strength has been determined in single-stage triaxial compression for eight, nominally undisturbed, 104mm diameter samples.

The resulting mean shear stress (undrained cohesion)  $C_u$  values ranged between 72 kN/m<sup>2</sup> and 157 kN/m<sup>2</sup> indicating that the samples tested ranged from 'firm' to 'very stiff' in consistency.

Full results are plotted on the appended  $C_u$  versus Depth Profile.

#### 7.7 *pH and Sulphate Tests*

The pH has been determined for a total of eleven samples from across the site. The pH was found to range between 7.8 and 12.0.

The sulphate content has been determined for a total of three samples from across the site from 0.50m depth, 1.50m depth and 10.50m depth and was found to be, on a 2:1 water:soil extract, 0.08 g/l, 0.05 g/l and 0.72 g/l, respectively.

#### 7.8 *Chemical Analysis*

Eight shallow samples of MADE GROUND were selected and tested for a range of commonly occurring contaminants and indicators of contamination including those given by the Contaminated Land Exposure Assessment (CLEA).

The contamination suite undertaken at this site includes speciated **PolyAromatic Hydrocarbon (PAH)** and speciated **Total Petroleum Hydrocarbon (TPH)**, together with **BTEX**, **Benzene**, **Toluene**, **Ethylbenzene** and **Xylenes**.

#### 7.9 *Asbestos Identifications*

The same eight samples, as discussed above, were submitted to a UKAS accredited laboratory for asbestos identification and full details of the results are appended.

#### 7.10 *Waste Classification Test*

One shallow sample of MADE GROUND, from borehole DIS1 at a depth of 0.50m below existing ground level, was selected and tested for Waste Acceptance Criteria (WAC) testing in accordance with BS EN 12457 Part 3.

Full details of the results are given on the appended result sheets

## **8.0 DISCUSSION**

### **PROPOSED DEVELOPMENT & SCOPE OF WORKS**

- 8.1 As discussed in Section 1 above, it is understood that the existing buildings are to be demolished and a new six-storey (plus two-storey basement), Hotel is to be erected at the site. The currently proposed plan layout sequence of the development is indicated on the appended Messrs. TZG Partnership Limited Contract No. 6373 Drawing No. S800.
- 8.2 The current report comprises a Phase I, *Non-Intrusive*, Desk Study and a Phase II, *Intrusive*, Site Investigation.

### **DESK STUDY**

- 8.3 The site is shown as mostly a wooded area or orchard in the Plan from 1876, with a rectangular building located in the south-western portion of the current site. By 1896 an additional two rectangular buildings are shown along the southern and northern boundaries of the current site, with the previous rectangular building in the south-western portion is now shown to have been extended northwards, spanning the whole of the western boundary of the current site. A small square building is shown in the north-eastern portion of the site. The Plan of 1916 shows an additional, slightly larger, square building in the north-eastern portion of the site. No significant change is noted in the next Plan from 1938. The Plan from 1953 now shows the additional larger, square building has now been removed and the buildings along the southern and western boundaries denoted as 7A and 7B, respectively. The Plan from 1964 shows the northern building to have been extended westwards to the front of Bayham Street and is denoted as 7C. A square wall is shown to the immediate south of 7C in the north-eastern portion of the site. The Plan from 1971 shows the site is now denoted as 'works'. No significant change is noted on the next four plans.
- 8.4 The Plan from 1976 shows the surrounding area to be built up with most of the available space developed. A school is shown to the immediate west of the current site with a monument further beyond. Mornington Crescent and associated open space is shown to the far south-west, with a Railway line shown further beyond. A public bath house is shown to the north-east of the current site with an associated pump house with mushroom grounds and the Royal Veterinary College further beyond. St Matthews Church is shown to the south-east of the current site. The Plan from 1896 shows little significant change to the surrounding area. The previous mushroom grounds are now shown as a school. The Plan from 1916 shows some residential buildings have been

demolished to make way for; a Picture Theatre to the south of the current site, a Working Men's Club, to the east of the current site and a Carriage Shed, to the far south-west of the current site. A Methodist Chapel is shown to the north of the current site. The Plan from 1953 shows residential buildings have been demolished to make way for large residential blocks, namely Godwin Court to the east and Cobden House to the west of the current site. A tobacco works is shown to the south-west of the current site. The Picture Theatre to the south of the current site is now named the Camden Hippodrome. The Plan from 1964 shows the buildings to the east to have been demolished to make way for a large residential block named Westerham. Further residential blocks are shown to the north, east and south of the current site. The Plan from 1971 again shows residential buildings to have been demolished to make way for large residential blocks to the south-east and north of the current site. The remaining four plans show no significant change to the surrounding area.

- 8.5 No radon remedial measures would be required at this site. The site lies over a Non-Aquifer and an 'Unproductive' Bedrock Strata and the site does not lie over an Environment Agency Source Protection Zone (SPZ). The site does not lie within an Environment Agency indicative flood plain and has no potential for groundwater flooding to occur at the surface.
- 8.6 Provided the above noted points are taken into account, the environmental search has not therefore found any reason to preclude any proposed re-development of this site.

## **FOUNDATION DESIGN**

- 8.7 Based on borehole BH1 only, beneath Concrete, a band of MADE GROUND was noted to a depth of 2.00m below existing ground level. Beneath the MADE GROUND, Weathered London CLAY was encountered up to a depth of 7.20m below existing ground level where 'fresh', grey, fissured London CLAY was encountered and not penetrated at the borehole termination depth of 25.50m below existing ground level.
- 8.8 Based on the current boreholes, conventional strip or pad foundations would need to be set below any MADE GROUND within the underlying Weathered London Clay at a minimum depth of some 2.00m, where an allowable bearing pressure of 125 kN/m<sup>2</sup> could be adopted. This could be increased to 150 kN/m<sup>2</sup> at some 3.00 depth and to some 200 kN/m<sup>2</sup> below 4.00m depth. The currently proposed two-storey basement would be expected to found below the above noted 4.00m depth.
- 8.9 Settlement due to the above noted order of loading would not be expected to exceed 20-25mm, the majority of which would be 'long-term' occurring over a period of some 30-340 years after the construction period.

- 8.10 Groundwater was not encountered during boring, however groundwater was noted during all six of the return monitoring visits to the installations within boreholes BH1, DIS1 and DIS3. AS discussed in paragraph 6.6 above, this is considered to represent “perched” water within the MADE GROUND lying above the relatively impermeable London Clay below. Therefore, where seasonal groundwater or surface water accumulates at the base of service, basement or foundation excavations it is very important that these are kept dry by, for example, pumping from a sump, the foundation base is kept square and that any soft spots are replaced and compacted prior to pouring foundation concrete.
- 8.11 Further, we recommend that where groundwater or surface water flows into foundation excavations, ‘blinding’ concrete is used at the base of the foundation excavations and that foundation concrete is poured as soon as possible thereafter
- 8.12 In addition, from the evidence of the boreholes, basement or any shallow foundation or service excavations, deeper than 1 metre, will require support against collapse of sides in the MADE GROUND, and we recommend that a contingency is made for this at this stage.
- 8.13 Owing to the potentially high loads from the proposed six-storey Hotel building and two-storey basement, we would recommend consideration of piled foundations to support the proposed new building, as discussed below.
- 8.14 It should be noted that should ground conditions differing significantly from those described in our report be encountered during foundation excavation, then Risk Management Limited should be contacted immediately and that the above noted allowable bearing pressure or recommended foundation type may need to be altered accordingly.

## **BASEMENT**

- 8.15 It is understood that there is to be a two-storey basement at this site which will extend over the majority of the site footprint with the basement floor slab likely to be founded in the underlying London Clay.
- 8.16 The presence of ‘perched’ groundwater in the MADE GROUND should be noted with regards to basement wall design.
- 8.17 The allowable bearing pressures discussed above could be adopted for a basement slab of the size of the site footprint, however, settlements due to a uniformly distributed load of this order would be likely to exceed 75mm. Therefore, to keep settlements to within acceptable limits any uniformly distributed load on the basement slab itself should be kept to a maximum of 35-40 kN/m<sup>2</sup>.

- 8.18 Note that, even if groundwater is not encountered during basement construction, there is always a possibility that the basement excavation will act as a local “sump” for surface groundwater and run-off. Therefore, we would recommend that the basement construction is “tanked” to prevent any future problems with ingress of groundwater.
- 8.19 Design of the basement slab at this site should take into account the effects of ‘heave’ due to relief of overburden pressure caused by excavation. It is beyond the scope of the current report to provide a detailed basement slab design.

## PILED FOUNDATIONS

- 8.20 Piled foundations at this site could be bored or driven into the underlying London CLAY to support foundation loads to the new Hotel building mainly in adhesion within the London Clay. Given the nature of the ground conditions encountered, and the proximity to the adjacent structure, a bored pile solution would appear the most appropriate; particularly those formed by continuous flight auger.
- 8.21 It is beyond our brief to provide a full and detailed pile design and the advice of a specialist piling contractor should be sought in this respect. However, the following table gives typical working loads for isolated bored piles of varying diameter to 15m, 20m and 25m below existing ground level, and assumes that the London Clay continues to a greater depth below.

Pile Type	Depth below existing ground level (m)	Diameter (mm)	Working Load (tonnes)
Bored	15.00	0.30	20-25
Bored	15.00	0.45	35-40
Bored	15.00	0.60	45-50
Bored	20.00	0.30	30-35
Bored	20.00	0.45	50-55
Bored	20.00	0.60	70-75
Bored	25.00	0.30	45-50
Bored	25.00	0.45	70-75
Bored	25.00	0.60	95-105

- 8.22 In calculating the above working loads we have assumed an adhesion factor of 0.45 in the London Clay and a factor of safety of 2.5 on the sum of the skin friction and end bearing. In addition, we have ignored the upper 6 metres of each pile as this will be the approximate depth of the double basement.
- 8.23 Again, it is recommended that the advice of competent piling contractors is sought as to the most suitable pile type at this site and for confirmation of the order of working load achievable given the ground conditions encountered and the proprietary pile type selected.
- 8.24 Settlement of such piles can be expected to be small, typically less than 5 mm.

## RETAINING STRUCTURES

- 8.25 The full design of temporary and permanent retaining structures is beyond the scope of this report. However, the following values are given as a guide to assist in the design of these structures in the underlying Weathered London Clay encountered at this site.

Parameter	Value
Bulk Density ( $\gamma$ )	1.00 Mg/m <sup>3</sup>
Dry Density ( $\gamma_d$ )	1.60 Mg/m <sup>3</sup>
<b>TOTAL STRESS DESIGN (Temporary Works Only)</b>	
Undrained Cohesion ( $C_u$ )	75-200 kN/m <sup>2</sup> increasing with depth
Undrained Angle of Internal Friction ( $\phi_u$ )	0°
Wall Adhesion – Active ( $c_w$ )	= 0.5 * $C_u$ but max 50 kN/m <sup>2</sup>
Wall Adhesion – Passive ( $c_w$ )	= 0.5 * $C_u$ but max 25 kN/m <sup>2</sup>
<b>EFFECTIVE STRESS DESIGN (Permanent Works)</b>	
Effective Cohesion ( $c'$ )	1 kN/m <sup>2</sup>
Effective Angle of Internal Friction ( $\phi'$ )	20°
Wall Adhesion – Active ( $c_w$ )	0 kN/m <sup>2</sup>
Wall Adhesion – Passive ( $c_w$ )	0 kN/m <sup>2</sup>
Wall Friction – Active ( $\delta$ )	0.66 $\phi'$
Wall Friction – Passive ( $\delta$ )	0.50 $\phi'$

## **BURIED CONCRETE**

- 8.26 The results of the chemical analyses indicate that the shallow samples tested would fall into Class DS-1 of the Building Research Establishments (BRE) classification system Special Digest Part 1:2005 "Concrete in aggressive ground". The deeper sample tested from 10.50m depth would fall, as expected, into Class DS-3.
- 8.27 Therefore, and owing to the presence of selenite crystals found within the London Clay, we would recommend that Class DS-3 conditions are adopted for all concrete mix design in contact with the Weathered London Clay and London Clay at this site.
- 8.28 In addition, we would recommend that sulphate resisting cement is adopted for pile concrete mix design at this site.

## **LAND-BORNE GAS**

- 8.29 During the six return gas/groundwater monitoring visits to the installations fitted within boreholes BH1, DIS1 and DIS3, no methane was detected with a maximum carbon dioxide level of 0.2%.
- 8.30 CIRIA Publication C665 "*Assessing Risks Posed by Hazardous Ground Gases to Buildings (Revised 2007)*" includes a risk assessment for the current development type.
- 8.31 The gas flow was below the instrument detection limit and, therefore, the gas screening value (gsv) would be close to zero l/hr. Therefore, in accordance with the CIRIA risk assessment process, we would consider that the current site would be classified as being "Characteristic Situation 1" and no gas remedial measures would be required.

## **SOAKAWAYS**

- 8.32 Three Falling Head Permeability tests have been undertaken at this site and permeability was found to be 'poor' with only a little soakage in the upper 1 metre of MADE GROUND.
- 8.33 The underlying London Clay would be considered to be relatively impermeable.
- 8.34 Conventional shallow soakaways are therefore unlikely to be successful at this site.



## PRELIMINARY CONTAMINATION ASSESSMENT

- 8.35 Part IIA of the Environmental Protection Act 1990 contains the legislative framework for the regulation of contaminated land and this was implemented in the Contaminated Land (England) Regulations 2000. This legislation allows for the identification and remediation of land where contamination is causing unacceptable risks to human health or the wider environment. The approach adopted by the UK contaminated land policy is “suitable for use” which implies that the land should be suitable for its current use and made suitable for any known future use.
- 8.36 For this **Preliminary Contamination Assessment** the site has been modelled using the Source-Pathway-Receptor approach to produce a Conceptual Site Model.

Source (substances or potential contaminants which may cause harm)

Pathway (a linkage route between the source and receptor)

Receptor (something which may be harmed by the source e.g. humans, plant, groundwater)

### 8.37 Source

A total of eight shallow samples of MADE GROUND were selected from across site and tested for a range of commonly occurring contaminants and indicators of contamination including those given by the Contaminated Land Exposure Assessment (CLEA).

### 8.38 Pathways

The pathways needing to be considered, as discussed above, will depend on the land usage, and will include for, example; soil ingestion, inhalation of vapour and dust, and consumption of home-grown vegetables, where this is applicable.

### 8.39 Receptors

From the results of the Desk Study and the current possible development of part of the site as residential flats, the following potential receptors have been identified.

- Workers on the site likely to come into contact with the soils.
- Future Users of new hotel.
- Any proposed additional vegetation.
- Neighbours.

8.40 It should be noted that the CLEA software has limited functionality and contains algorithms, which the EA has publicly expressed its intention to update. As a consequence of this, some of the screening values generated by the CLEA software may not adequately reflect specific site conditions and, in some instances, are unduly conservative. In addition, it should also be noted that the figures given in the appended table are based on a 6% soil organic matter content.

8.41 The DEFRA/EA model has been developed on the basis of many critical assumptions about possible exposure to soil contamination and the development of conceptual exposure models to describe different land uses as follows:

- *Residential with consumption of home-grown fruit and vegetables*
- *Residential without consumption of home-grown fruit and vegetables*
- *Allotments*
- *Commercial*

8.42 The Contaminated Land Exposure Assessment (CLEA) model was originally published in March 2002 as joint DEFRA/EA publications; Contaminated Land Research (CLR) Report CLR 10, with Reports CLR7, 8 and 9 as supporting documents, providing toxicity data and human tolerable daily intake (TDI) data to be used with this model. This model enabled the derivation of more site-specific values for contaminants present on a site, rather than the use of 'generic' values, which were previously used.

8.43 DEFRA/EA previously published a number of Soil Guideline Values (SGVs) for certain determinands, (common toxic metals), which were generic guideline criteria for assessing the risks to human health from chronic exposure to soil contamination for standard land-use functions. However, these were withdrawn in late 2008 and DEFRA/EA have now issued a new set of guidance documents. With regard to the Risk Management Limited standard suite of tests, currently SGV figures have only been issued for Arsenic, Cadmium, Mercury, Nickel, Phenols and Selenium.

- 8.44 In the absence of currently published SGV values for the remaining contaminants, Messrs. W. S. Atkins have derived ATRISK<sup>soil</sup> Soil Screening Values (SSVs) which have been updated using CLEA v1.071 to incorporate changes to exposure assessment parameters, methodology, and land uses as set out in the Department for Environment, Food and Rural Affairs (Defra) Category 4 Screening Level (C4SL) Project Methodology Report.
- 8.45 Full details of how the SSVs have been derived and general notes as to their use are given on the ATRISK website and are available from Risk Management Limited upon request. A few of the PAH levels have not been updated and have been left as per the previous CLEA v1.04 derivation.
- 8.46 The SGV and SSV levels represent “intervention” levels above which the levels of contamination may pose an unacceptable risk to the health of site-users such that further investigation and/or remediation is required.
- 8.47 Total Petroleum Hydrocarbons are considered in accordance with the fractions proposed by The Environment Agency, drawing on the TPHCWG methodology. These are contained in Table 4.2 – Petroleum hydrocarbon fractions for use in UK human health risk assessment, based on Equivalent Carbon (EC) number, contained in Science Report P5-080/TR3, *The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soils*.
- 8.48 The contamination results have been compared with the **Commercial** criteria as shown on the table below.

Determinand (below)	Units	<b>ATRISK Contaminated Land Screening Values (SSV) derived using CLEA v1.071 as set out in DEFRA Category 4 Screening Levels (C4SL) Methodology. 6% SOM Sandy Loam.</b>			
		Residential with consumption of home-grown fruit and vegetables.	Residential without consumption of home-grown fruit and vegetables.	Allotments.	Commercial.
Aliphatic Hydrocarbons (mg/kg)	C5-C6	369	371	6110	29400
	C6-C8	1240	1240	18300	98200
	C8-C10	204	205	2390	14800
	C10-C12	1180	1190	8960	69500
	C12-C16	4130	2710	16300	139000
	C16-C35	210100	212000	477000	3620000
Aromatic Hydrocarbons (mg/kg)	C8-C10	232	332	73.9	20800
	C10-C12	468	1550	95.9	53800
	C12-C16	830	2710	176	65400
	C16-C21	1040	1930	321	28400
	C21-C35	1710	1930	1570	28400
<b>TOTAL TPH</b>					
Naphthalene	mg/kg	12.2	13.1	27.4	1050
Acenaphthylene	mg/kg	-	-	-	-
Acenaphthene	mg/kg	2760	6730	680	106000
Fluorene	mg/kg	2610	4860	796	72000
Phenanthrene	mg/kg	-	-	-	-
Anthracene	mg/kg	26200	37700	11300	544000
Fluoranthene	mg/kg	2980	5050	1010	72600
Pyrene	mg/kg	2120	3780	679	54400
Benz(a)anthracene	mg/kg	8.54	9.04	10.3	10.3
Chrysene	mg/kg	2.64	2.64	2.64	2.64
Benzo(b)fluoranthene	mg/kg	7.29	7.29	7.29	7.29
Benzo(k)fluoranthene	mg/kg	4.12	4.12	4.12	4.12
Benzo(a)pyrene	mg/kg	4.95	5.34	5.72	76.3
Indeno(123-cd)pyrene	mg/kg	9.75	10.3	16.6	144
Dibenz(ah)anthracene	mg/kg	1	1.03	2.57	14.4
Benzo(ghi)perylene	mg/kg	103	104	342	1450
<b>TOTAL PAH</b>					
Cyanide (Free)	mg/kg	34	34	34	373
pH	unit	-	-	-	-
Copper (Total)	mg/kg	4790	9060	1450	106000
Lead (Total)	mg/kg	200	313	79.1	2310
Zinc (Total)	mg/kg	20300	47000	5230	1100000
Chromium III	mg/kg	14300	16700	12600	208000
Chromium (Hexavalent)	mg/kg	20.5	20.5	171	49.1
<b>CLEA Soil Guideline Values (SGV)</b>					
Benzene	mg/kg	0.33	0.998	0.07	95
Toluene	mg/kg	610	2710	120	4400
Ethylbenzene	mg/kg	350	843	90	2800
Xylenes	mg/kg	230	321	160	2600
Arsenic (Total)	mg/kg	32	35	43	640
Cadmium (Total)	mg/kg	10	83.6	1.8	230
Mercury (Total)	mg/kg	170	238	80	3600
Nickel (Total)	mg/kg	130	130	230	1800
Phenols (Total)	mg/kg	420	519	280	3200
Selenium (Total)	mg/kg	350	595	120	13000

## ASSESSMENT OF RESULTS

- 8.49 Of the eight samples tested, three samples were found to contain determinands exceeding the CLEA Soil Guideline Values (SGV) or the ATRISK Contaminated Land Screening Values (SSV) for **Commercial** usage.
- 8.50 Samples from 0.15m depth in boreholes DIS1 and DIS3 and a sample from 0.50m depth in borehole DIS4 were found to contain PAH's (PolyAromatic Hydrocarbons) over the guideline values for Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene and Benzo(k)fluoranthene.
- 8.51 No Asbestos was identified in the eight samples tested.
- 8.52 **Discussion**

*The elevated levels of PAH's encountered within the MADE GROUND would only be relevant to proposed landscaped areas as the currently proposed new Hotel covers the whole of the site footprint.*

*However, for any new planting areas or shared access landscaped areas, at ground level, we would recommend removal of any MADE GROUND, to a minimum depth of 600mm, and replacement with some 300mm-400mm of "clean" imported material overlain by 200mm-300mm of "clean" Topsoil as necessary.*

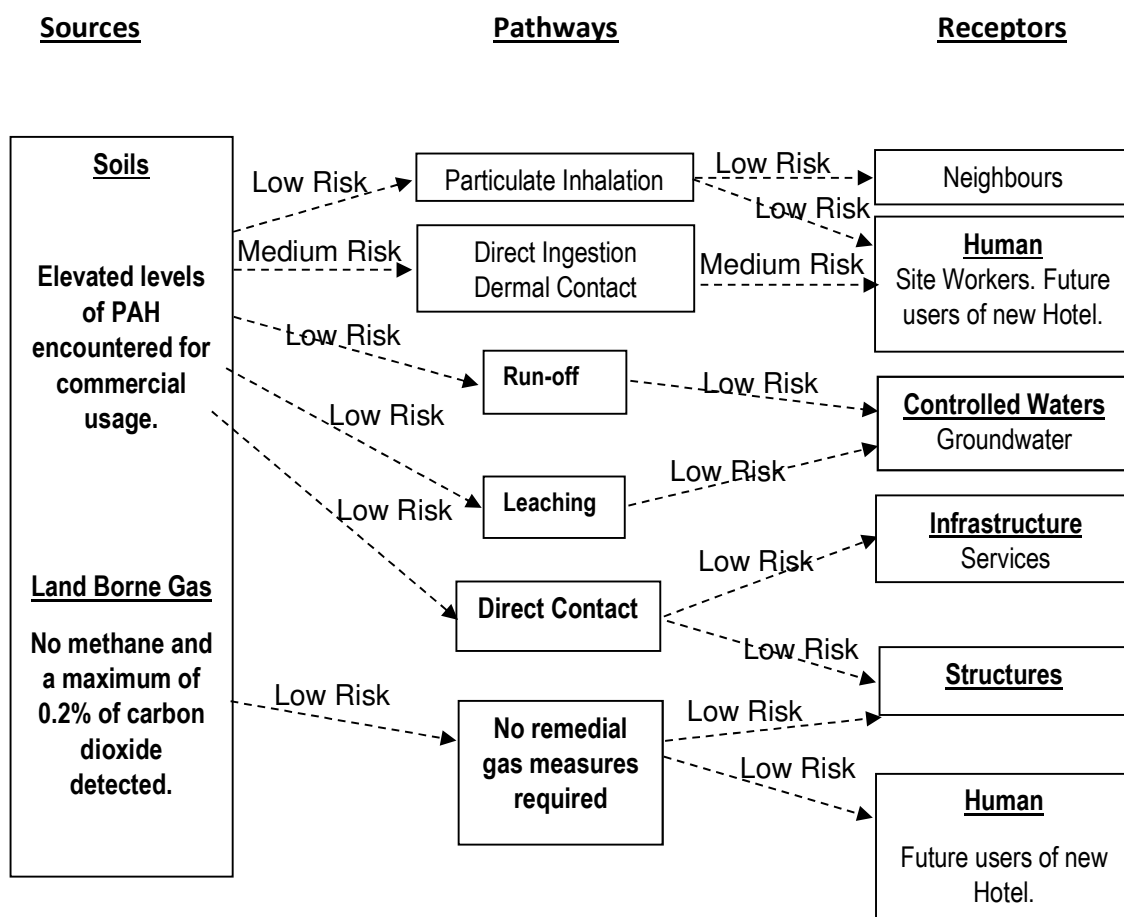
*The presence of a slightly elevated levels of PAH in the MADE GROUND should be noted by Groundworkers and included within the main contractors site method statements and risk assessments.*

*Any material removed from site should be sent to a suitably licensed landfill and waste tickets should be retained. In addition, any imported "clean" material and/or topsoil should be certified as 'clean' and suitable for use. The waste tickets and certification will need to form part of a final Verification Report for the site in due course.*

*In addition, to any precautions regarding the presence Lead as noted above, we would recommend that standard Health and Safety precautions be taken with regard to ground workers at this site and these should include PPE equipment such as gloves, overalls etc. and normal washing facilities available on-site.*

## CONCEPTUAL SITE MODEL

8.53 The following diagram summarises the potential pollution linkages identified for this site in the form of a diagrammatic Conceptual Site Model (CSM).



8.54 By employing the measures discussed in paragraph 8.52 above, the above noted 'medium' risks could be reduced to 'low' risk.

8.55 As always, the above recommendations are based on a selected number of representative samples and further testing may be required if any significant contamination is suspected or encountered during ground works.

## **WASTE ACCEPTANCE CRITERIA (WAC) TESTS**

- 8.56 One EN 14473/02 Waste Acceptance Criteria (WAC) test has been undertaken during the current work and the certificate pertaining to this is appended to this report.
- 8.57 The result tends to indicate that the material tested may be classified as 'Stable Non-reactive Hazardous waste' due to the levels of total TPH and Total PAH's.
- 8.58 However, it should be noted that Risk Management are not a licensed landfill operator and we therefore strongly recommend that the WAC data should be presented to potential Waste Management Companies in order for them to confirm the waste classification of surplus soils to be removed from this site and to determine its acceptability at appropriate landfill sites for disposal/treatment.

## **SOIL SAMPLES**

- 8.59 All soil samples will be kept for a period of 28 days after the date of the invoice for this project unless otherwise notified to Risk Management Limited in writing. Should samples be required to be stored for longer than 28 days then a storage charge may be levied.



**Prepared By :**

Richard Price B.Sc.  
Project Engineer



**Checked By :**

Malcolm S. Price B.Sc., M.Sc., M.I.C.E., C.Eng.  
Director

**Distribution :**

TZG Partnership Limited - 1 pdf copy

*The recommendations made and the opinions expressed in this report are based on the borehole records, examination of samples and the results of site and laboratory tests.*

*The report is issued on the condition that Risk Management Limited will under no circumstances be liable for any loss arising directly or indirectly from ground conditions between the boreholes or trial pits which have not been shown by the boreholes, trial pits or other tests carried out during the investigation.*

*In addition, Risk Management Limited will not be liable for any loss whatsoever arising directly or indirectly from any opinion given on the possible configuration of strata both between the borehole and/or trial pit positions and/or below the maximum depth of the investigation. Such opinions, where given, are for guidance only.*

*Groundwater levels may also vary with time from those reported during our site investigation due to factors such as tidal conditions, heavy pumping from nearby wells or seasonal changes.*

*No person other than the client to whom this report is addressed, shall rely on it in any respect and no duty of care shall be owed to any such third party.*

*Copyright of this Report remains with Risk Management Limited and in addition we will not accept any responsibility for the report and recommendations given until our invoice is settled in full.*