BASEMENT IMPACT ASSESSMENT

AT

1 & 2 FALKLAND MEWS,
FALKLAND ROAD, CAMDEN,
LONDON, NW5 2PP

FOR

A Patel & P Winford

REPORT REF: 3315

Engineering Geologists and Environmental Scientists

Ashton Bennett

North: Bridge Mills, Huddersfield Road,
West Yorkshire, Holmfirth HD9 3TW

South: 22c Lambourn Road,
Clapham, London SW4 0LY

Tel: 0845 8687488

email: geoenviro@ashton-bennett.co.uk
www.ashton-bennett.com

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MAY 2018

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QUALITY MANAGEMENT FOR REPORT

Project	1&2 Falkland Mews, Falkland Road, Camden, London, NW5 2PP		
Client	A Patel & P Winford		
Date	October 2017, May 2018		
Version	Issue 1, Issue 2		
Prepared by	Frances A Bennett	BSc (Hons), CGeol, FGS, FIMMM, C.WEM, MCIWEM, CEnv, AIEMA, MIEnvSci	Director Ashton Bennett Ltd
	Tristan T A Bennett	BSc	Ashton Bennett ltd
	Chris Tomlin	BEng, CEng MIStructE	Director Croft Structural Engineers
	Concetta Cosenza	BEng, MSc	Croft Structural Engineers
	Phil Hendry	BEng, CEng, MICE, CEng	Croft Structural Engineers
	Dan Lemon		Haigh Construction Management Ltd

EXECUTIVE SUMMARY

Site Location	1&2 Falkland Mews, Falkland Road, Camden, London, NW5 2PP
Site Description	Two semi detached 2 storey brick houses
Historical Land Use	Occupied by Cantelow Manor House until circa 1915 when demolished and new building constructed. Throughout the following years the building was modified and potentially extended to the east and used as a works before renovation post 1991.
Current Land Use	Residential houses with hard cover yards.
Potential Contamination	Low Risk. Elevated cadmium, but no harm to humans as site will be hard covered.
Archaeological Potential	Medium Risk. The site lies within the Kentish Town Archaeological Priority Area.
Geology	London Clay with no overlying superficial deposits.
Hydrogeology	Non productive strata of the London Clay.
Hydrology and Flooding	Very low risk of flooding from seas and rivers.
Underground rivers	None that could affect the basement or be affected by the basement
Critical Drainage Areas	Within a CDA, not within Local Flood Risk Zone. Site Area never Flooded. Kentish Town Road and Highgate Road to the west were flooded in 2002 as was Leighton Road to the south. Site specific FRA compiled by UK Flood Risk of London.
Flooding from Surface Water	Low Risk
Flooding Incidents	None recorded in the vicinity of the site.
Flooding from	Low Risk

Sewers	
Flooding from Reservoirs	Very Low Risk
Flooding from Groundwater	Low Risk
SUDS	Ground not suitable for soakaways
Landfill gas potential	No landfill within 250m, infilled ground within 250m and methane protection recommended. Radon gas protection is not required.
Geotechnical Properties	London Clay has good bearing strength where unweathered for housing and has high to very high plasticity.
Extra hard cover	None. No gardens, all outside areas are hard covered and will remain hard covered.
Groundwater	Local historic borehole indicates varied groundwater conditions, although monitoring after heavy rain indicated levels of around 1.00m bgl.
Concrete	Underground concrete to be designed to DS-2 due to selenite content of London Clay.
Ground Movement	Calculations to CIRIA 580 indicate a very slight Damage Category to neighbouring properties.
Monitoring Strategy	Party Wall Surveyor will undertake structural survey of adjacent properties and monitoring. Monitoring strategy is given in the SMS in Appendix E.
Waste Disposal	Waste disposal is responsibility of owner to ensure it is disposed appropriately to landfill. WACS tests indicate soil will be inert waste.
Tunnels	None recorded within 20m of the site boundary.
Structural design	The basement will be underpinned in sequence as per drawings in SMS in Appendix E.
Bearing Capacity	The London Clay has an allowable bearing capacity of 120kN/m2. Vertical dead load exceeds the uplift force therefore the building will be stable.
Retaining walls	Calculations for bearing capacity, heave and retaining walls are presented in the SMS in Appendix E.
Programme	A Construction Programme is presented in the SMS in Appendix E.
Conceptual Model	A Conceptual Model is presented in Appendix F.

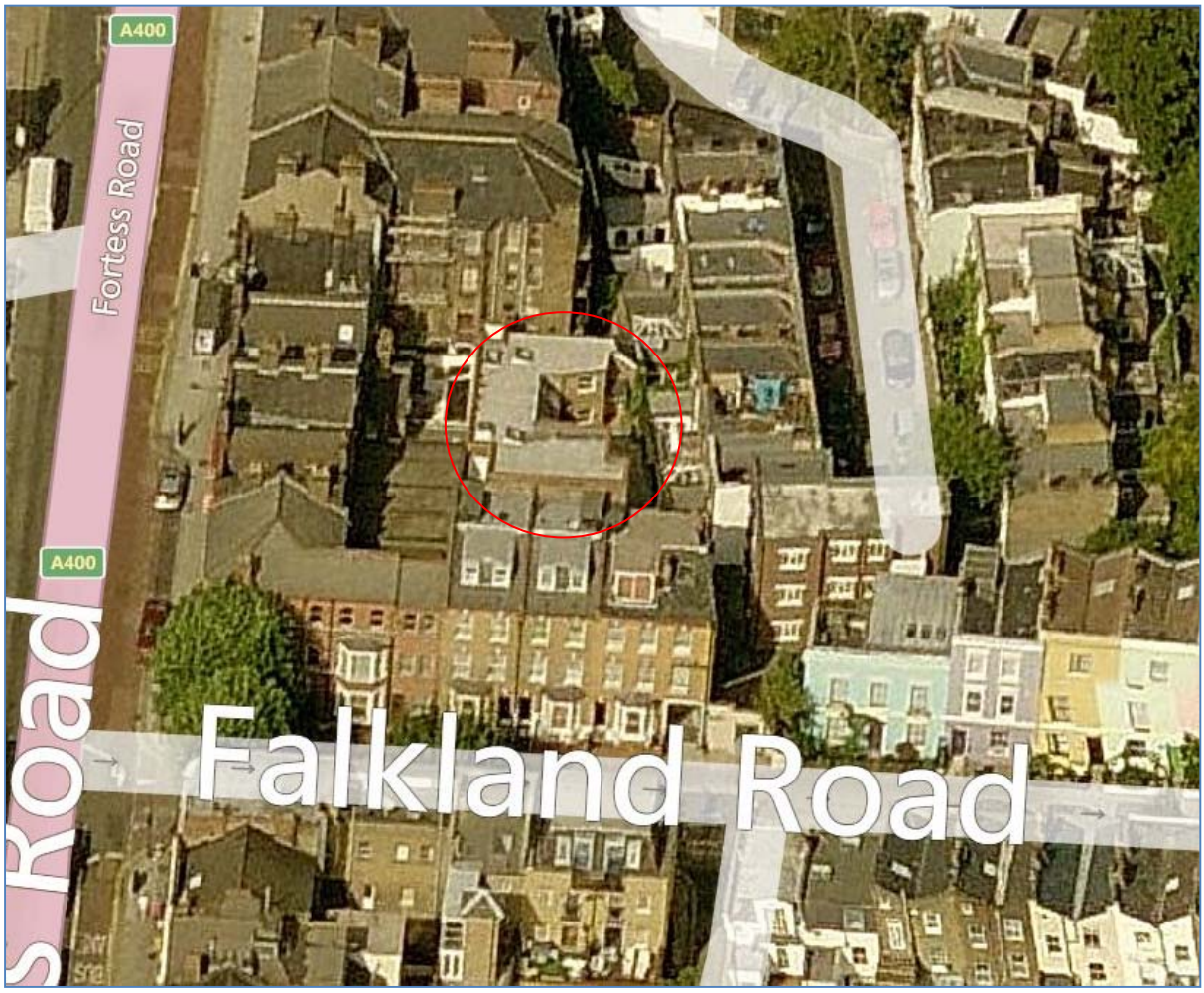
The development of the basements, provided they are constructed competently, will not harm neighbouring properties or have any significant effects on the stability or bearing capacity of adjacent land generally.

The development of the basements will not harm the water environment or ground permeability, will not have a cumulative impact on the water environment or flooding.

The development, provided it is constructed competently, will not impact on the structural stability of the property. The development will not detrimentally affect biodiversity.

The damage category for the neighbouring building is negligible to very slight.

Risks include an elevated groundwater in the London Clay and monitoring should be undertaken before construction.



1. INTRODUCTION

This report describes the results of the screening and scoping for a Basement Impact Assessment (Geology, Hydrogeology and Hydrology) a Ground Investigation and Structural Method Statement and Construction Management Plan undertaken for the development of a residential basement with lightwells at 1 and 2 Falkland Mews, Falkland Road, Camden, London, NW5 3NE. The work was commissioned by Bashkal Associates Architects and undertaken on behalf of their clients Mr A Patel and Mr P Winford. Plans of the proposed development are provided in Appendix A.

The purpose of this Report is to ascertain the potential impacts that the proposed basement and lightwells may have on the ground stability, the hydrogeology and the hydrology in the vicinity of the site and to undertake a ground investigation in order to design any necessary mitigating measures and to design foundations and assess any potential ground movement that could detrimentally affect neighbouring properties. In addition, the report comprises a Structural Method Statement and Construction Methodology and Programme, Ground Movement Calculations and Monitoring Schedule, and a Construction Management Plan.

The site lies within the London Borough of Camden. The assessments were carried out in general accordance with the London Borough of Camden Development Policy 27 "Basements and Lightwells" and Camden Planning Guidance 1 "Design Note prepared by London Borough of Camden for New Basement Development and Extensions to Existing Basement Accommodation" (LBC, 2010), and Camden's Planning Guidance Basements of March 2018.

As stated in Camden Development Policy DP27 paragraph 27.1, LB Camden "will only permit (basement and other underground development) that does not cause harm to the built and natural environment and local amenity and does not result in flooding or ground instability".

The approach followed in this report was initially to undertake screening of the site and provide a full site characterisation by a desk study of available geological, hydrological, hydrogeological, environmental and historical and topographic information together with a site visit. The results of the screening enabled scoping of the further reporting and intrusive investigations required to complete the Basement Impact Assessment. The screening and scoping has been undertaken in general accordance with the recommended methodologies highlighted in Arup document "Guidance for Subterranean Development", prepared for the London Borough of Camden and the URS Report 'Strategic Flood Risk Assessment', (2014) for LBC.

The project brief comprises of:

- Screening – Identification of matters of concern using checklists.
- Scoping – Definition of the matters of concern identified and design of BIA.
- Ground Investigation – Establishment of baseline ground and groundwater conditions
- Review of the ground/groundwater conditions.
- Review of the local hydrology/hydrogeology conditions.
- Structural Design and calculations for underpinning and retaining walls.
- Construction Methodology, Programme and Monitoring Strategy.
- Construction Management Plan.
- Impact Assessment – Determination of the potential impact of the proposed basement and lightwells on the baseline conditions.
- Recommendations and mitigating measures
- Review – by London Borough of Camden

This report comprises a full Basement Impact Assessment. The screening and scoping and ground investigation were prepared by Frances A Bennett an engineering geologist who is a Chartered Geologist CGeol, Chartered Environmentalist CEnv and Chartered Water and Environmental Manager C.WEM.

The Structural Method Statement and Construction Methodology and Programme and Monitoring Schedule was prepared by structural engineers Concetta Cosenza and Phil Henry and by Chris Tomlin Chartered Engineers and directors of Croft Structural Engineers and are presented in Appendix E. The Construction Management Plan was undertaken by Dan Lemon of Haigh Construction Management Ltd.

2. THE SITE
2.1 Site Description

The site is located at numbers 1 and 2 Falkland Mews on Falkland Road which lies north of Camden Town and east of Hampstead in the London Borough of Camden. A site walkover was undertaken on Monday October 9nd 2017 in order assess the property.

The site area comprises the attached houses of 1 and 2 Falkland Mews with tarmacadamed and patioed access road in the east of site running south to Falkland Road. The building, currently two private semi-detached residential houses, and the encompassing land total 0.02 hectares.

It is proposed to construct a basement with lightwells beneath the existing building.

Figure 1 Site Location Plan

The site is bounded to the north, south, east and west by the rear of the existing building with residential garden and properties beyond. To the west beyond the residential houses, commercial properties front onto Fortress Road, to the east the residential houses front onto Fortress Grove.

All land on the site was relatively flat and is very unlikely to cause any landslip, as described in Section 8.3. Land stability has been assessed by a chartered engineer Mr C Tomlin

BEng, CEng, MIStructE, MICE and Phil Hendry BEng, CEng, MICE in the Structural Method Statement (SMS). This confirms there is a very low risk of a landslip.

Roof drainage from the existing property is taken via down pipes into a drainage system in the front of the property which is understood to run north to south leading to Falkland Road. The drainage layout may be altered slightly to accommodate the gulley in the lightwell, SUDS will be considered, and outflow will be restricted to existing levels. The existing and proposed hard cover indicates that there will be no extra surface water run off created.

The site does not lie within a Conservation Area and is not a listed building. The site inspection indicated no trees that could be detrimentally affected by the basement construction, and no trees that could adversely affect the soils beneath the proposed basement.

Figure 2 Site Plan

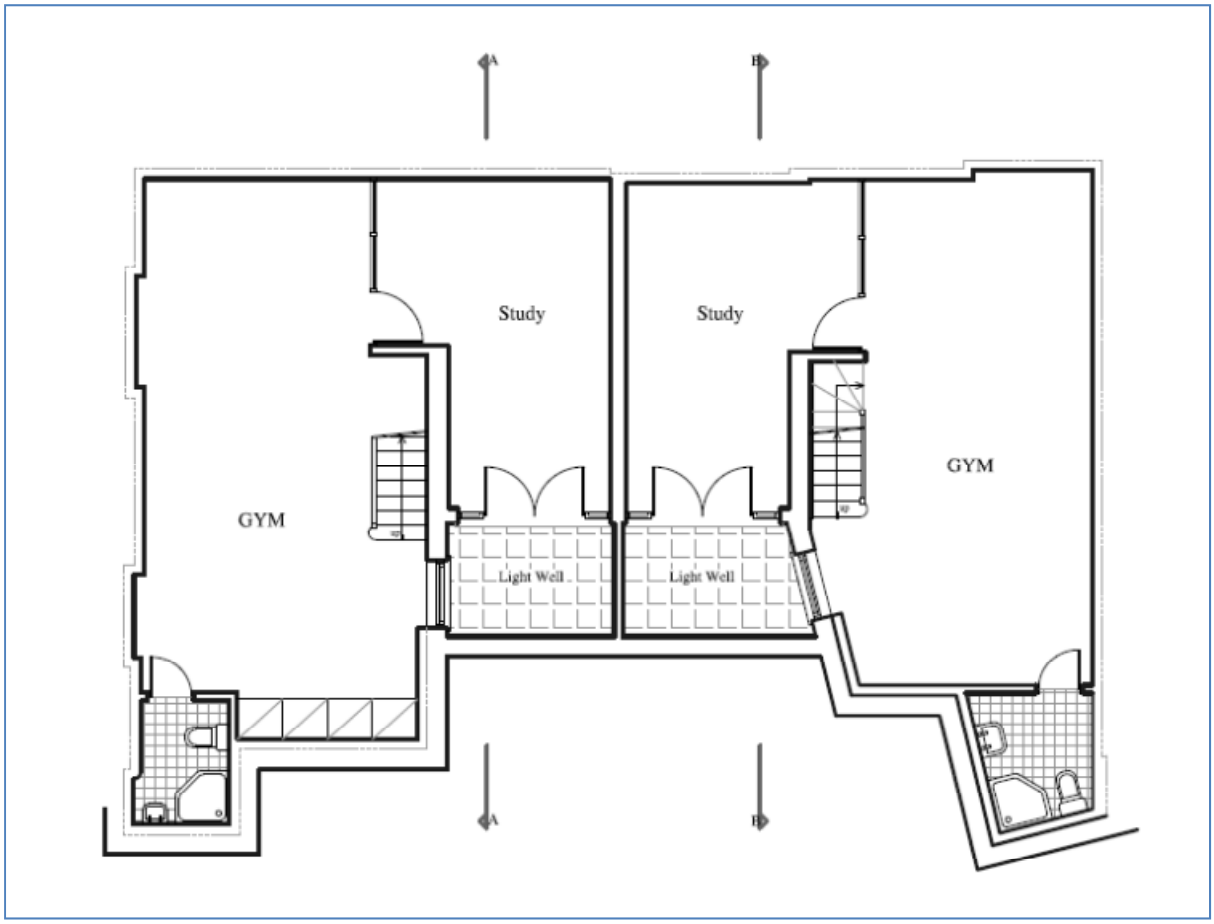


Figure 3 Proposed Lower Ground Floor

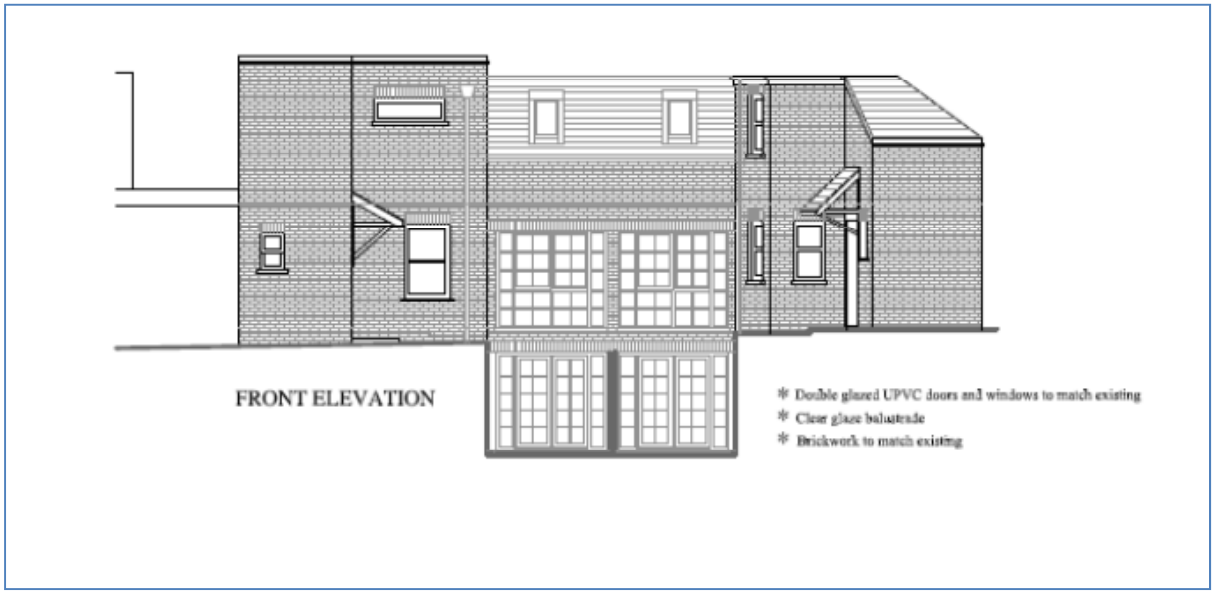


Figure 4 Proposed Front Elevation

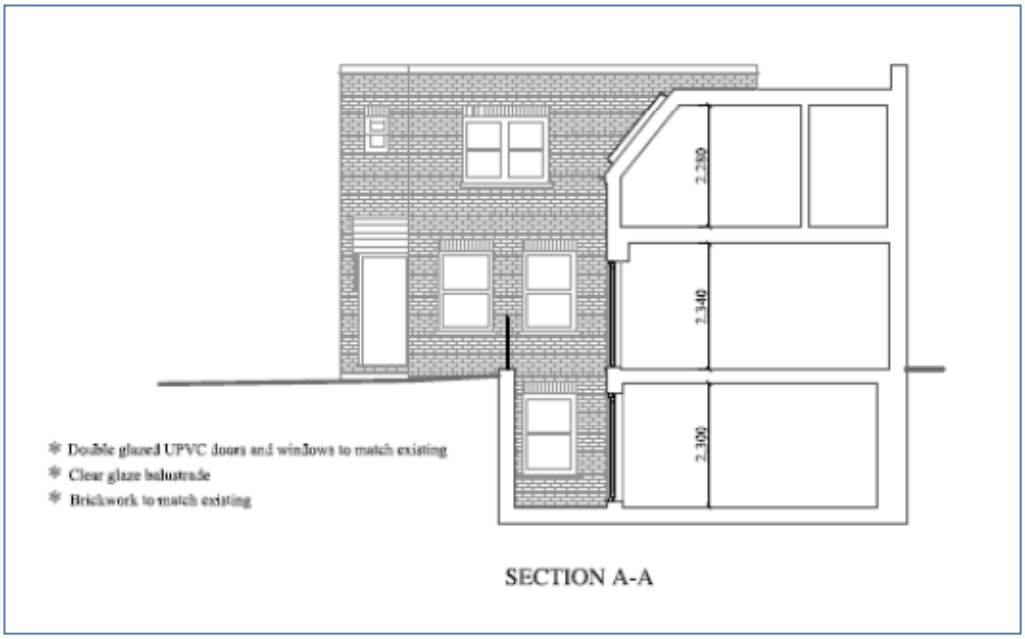


Figure 5 Proposed Section A-A

The site lies around National Grid Reference 529009^{E} 185360^{N} at a height of around 41m above Ordnance Datum. A Site Location Plan is presented as Figure 1 and a Site Plan is presented as Figure 2. The Proposed Lower Ground Floor is presented as Figure 3 and Proposed Front Elevation as Figure 4. The Proposed Section A-A is presented as Figure 5.

Historic Industrial Land Use is presented as Figure 6. Current Industrial Land Use is presented as Figure 7. A Landfill plan is presented as Figure 8. A Superficial Deposits Geological Plan as Figure 9. A Bedrock Geological Plan is presented as Figure 10. A BGS Landslip Plan is presented as Figure 11. A Local Borehole Plan is presented as Figure 12. Hydrogeology Plan of Bedrock is presented as Figure 13. The Detailed River Network is presented as Figure 14 and Lost Rivers in Camden as Figure 15. The Critical Drainage Areas and Flood Risk Zones is presented as Figure 16. The Environment Agency Flood Risk form Surface Water presented as Figure 17. The Flooded Roads 1975 and 2002 is presented as Figure 18. Risk of Flooding from Rivers and Seas is presented as Figure 19. Flood Defences Plan is presented as Figure 20 and Flood Risk from Reservoirs is presented as Figure 21. Borehole and Trial Pit Location Plan is presented as Figure 22. A Trial Pit (TP1) Drawing is presented as Figure 23.

Drawings of site proposals are presented in Appendix A and archival maps are presented in Appendix B. Borehole Logs are presented in Appendix C and Geotechnical and Environmental Test Results are presented in Appendix D. The Structural Method Statement and Construction Programme, and Monitoring Strategy are presented by Croft Structural Engineers in Appendix E. The Ground Movement Methodology and Conceptual Model are presented in Appendix F. The Construction Management Plan is presented in Appendix G.

3 SITE HISTORY, HISTORIC and CURRENT INDUSTRIAL LAND USE

3.1 Historic Mapping

The following maps and plans were inspected to assess the history of the site and its past environments. The archival Ordnance Survey maps are presented in Appendix B.

TABLE 1
Historical Maps Inspected

DATE	SCALE	DESCRIPTION	
		SITE	SURROUNDING AREA
1871 & 1871-3 & 1873 & 1879-82	1:1,056 & 1:10,560	The site is partially occupied by Cantelow Manor House in the north and west of site. The centre of the site is occupied by the courtyard/garden while the southern corner is occupied by the north of a building fronting on to Falkland Road.	The surrounding area is residential. Residential properties sit along the east boundary of site. Bull and Gate Public House to the south west, Railway lines located within 250m to the south west of site including large railway sheds with surrounding made ground and 500m to the north of site. Reservoirs located to the far north of site. Largely residential to the SW, SE and south of site while open land is evident to the NW, NE and north of site.
1894 & 1896	1:10,560 & 1:1,056 & 1:2,500	Cantelow Manor House is no longer evident, and the site now sits as open land.	Fire Bridge Station annotated 37m to the west of site. Large residential development in the NW, NE and north of site over previous open land. Tram lines are annotated to the west of site running north to south.
1915-6 & 1920	1: 2,500 & 1:10,560	A large building occupies the part of the site, backed against the west boundary.	Immediate surrounding area is residential with expanding railway lines to the south west and nearby stations, coal sheds, tanks and bottling stores. (164m West)
1936 & 1938	1:2,500 & 1:10,560	Possible minor changes to the north east of the existing building on site.	No change to the surrounding area. Railway sidings 92m+ to the west
1948-52 & 1952 & 1953-4	1:10,560 & 1:1,250 & 1:2,500	Slight extension of existing building around and along the north east corner of site.	Tram lines are no longer evident. Bottling store to the west replaced by a chemical warehouse, garage, cabinet works, wallpaper factory and depository.
1957-62 & 1965-8 & 1967 & 1963-8	1:10,560 & 1:2,500 & 1:1,250	By 1963 the building occupying the site is annotated as a works.	No significant change to the surrounding area. A garage and factory are annotated to the north of site while Industrial areas evident to the far west and south east of site.
1971-5 & 1975-7 & 1979-81	1:10,000 & 1:1,250	No significant change.	The surrounding area remains largely unchanged during this time though garage to north of site now annotated as a depot.
1990-1 & 1991-5	1:1,250	During this period the building is shown to extend eastwards across the length of the site.	No significant change to the surrounding area.
2002	1:10,000	No significant change.	The surrounding area remains largely unchanged.
2012	1:10,000 & 1:1,250	No significant change.	No significant change to the surrounding area.

In summary, the site was occupied since at least 1871 by Cantelow Manor House until circa 1915 when todays existing building was constructed. Throughout the following years the building was modified and potentially extended to the east and used as a works until circa

1991. The surrounding area is mostly residential, however a garage existing briefly during the 1960s to the north of site, while the site building was annotated as a works throughout the 1960s until around 1980.

3.2 Historic Industrial Land Use

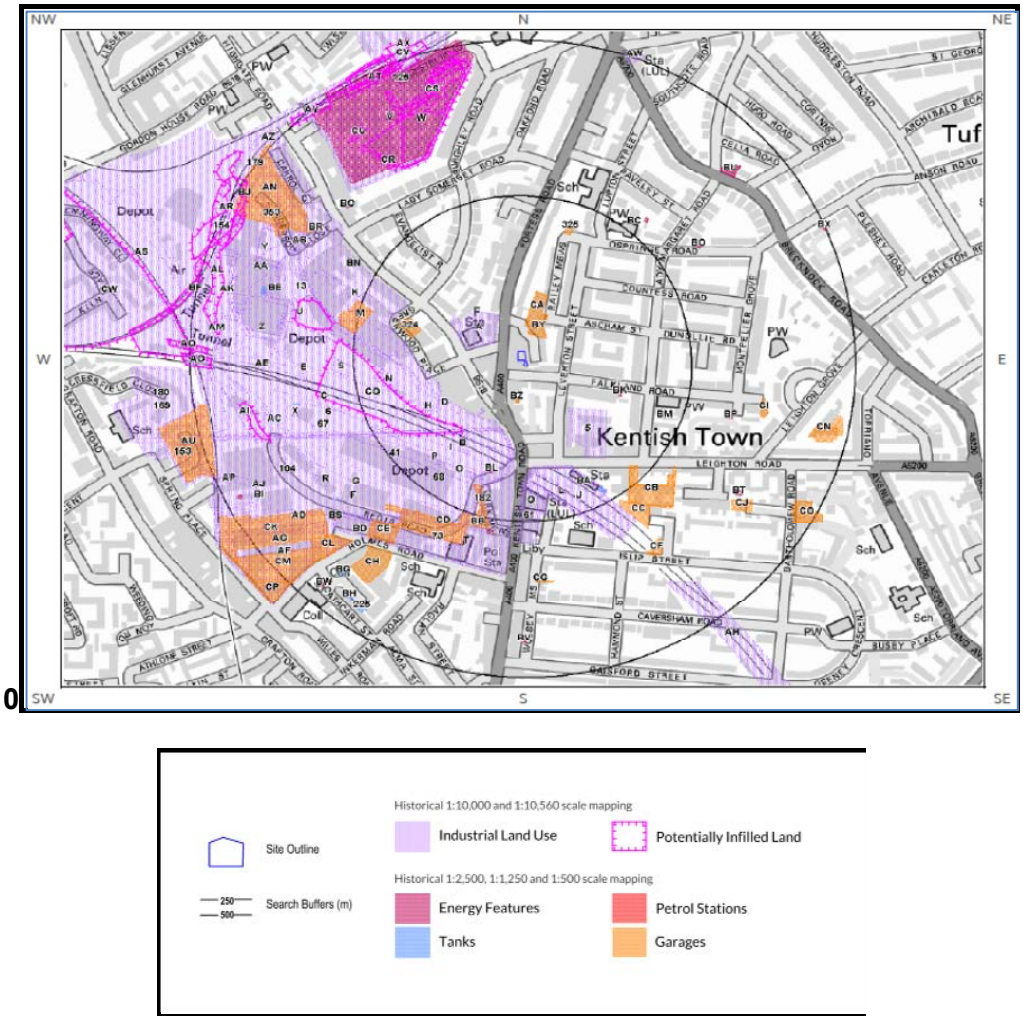


Figure 6 Historical Industrial Land Use

The historical land use indicates potentially infilled land to the south west, garages to the north and industrial land use to the west and south. Within 50m there was a fire station and within 90m to 100m there were railway sidings and a hospital. Within 100m to 250m the historic land use includes railway sidings, cuttings and buildings, electricity substation, bottling stores, London Transport Station and unspecified industrial and commercial uses and infilled land.

The industrial uses of land within 50m of the site are unlikely to have detrimentally affected the site as the existing properties were constructed by 1915, and the industries developed later. Due to the potentially infilled adjacent sites it would be prudent to incorporate a methane membrane in construction.

3.3 Current Industrial Land Use

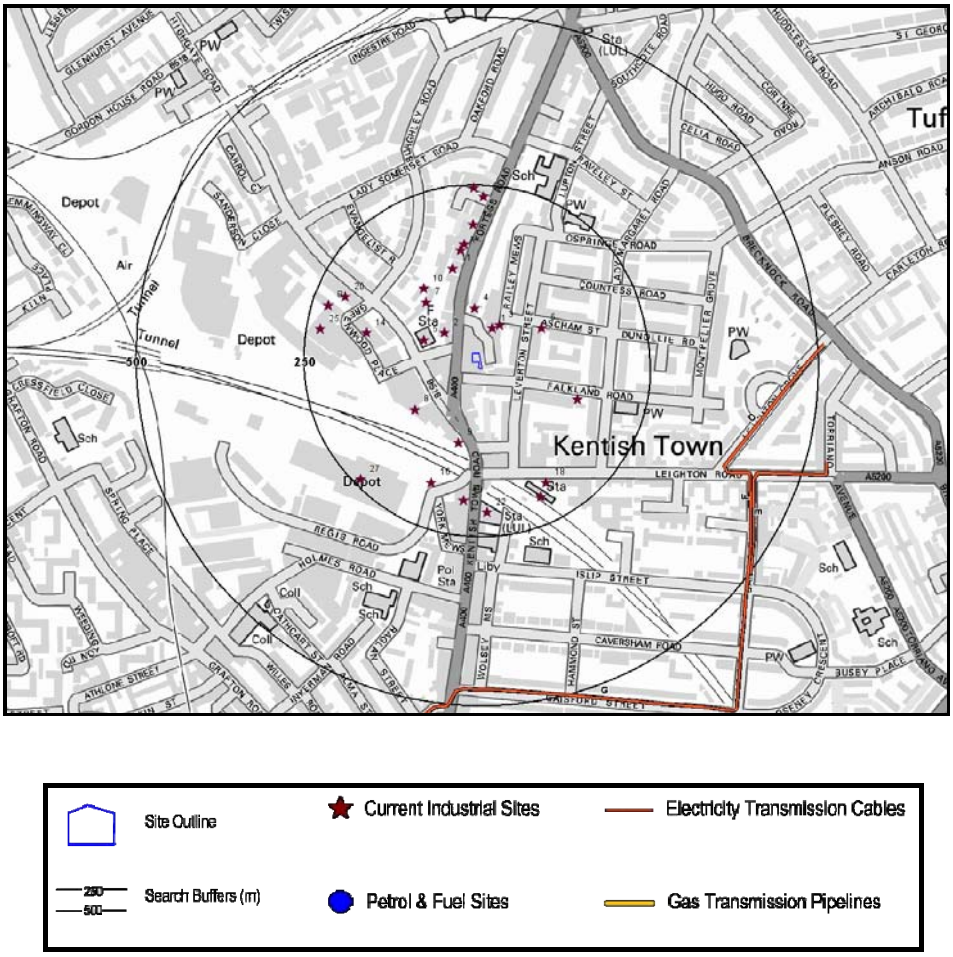


Figure 7 Current Industrial Land Use

Current land use in the vicinity of the site includes between 40m to 50m transport storage and delivery. Within 50m to 100m there is a construction tool hire company, vehicle repair, testing and servicing, factories and the fire brigade. Within 100m to 250m there are vehicle repair, testing and servicing, unspecified works, electricity substation, construction tool hire, electrical equipment repair, rag merchants, fish, meat and poultry suppliers, civil engineers, structural engineers, underground network stations, medical equipment supplies, clothing components and accessories, distribution and haulage.

As all current industrial activity is greater than 80m from the site it is considered highly unlikely that these industries have or will in the future detrimentally affect the site by contamination.

4. LANDFILL AND RADON

4.1 Landfill

According to the Environment Agency there are no landfill sites within 250m of the site and as gases emitting from landfill sites rarely travel more than 250m, the site does not require monitoring for landfill gas.

There is considered a low risk from landfill gases, however due to the presence of potentially infilled ground within 250m it is recommended that a methane membrane is incorporated in construction.

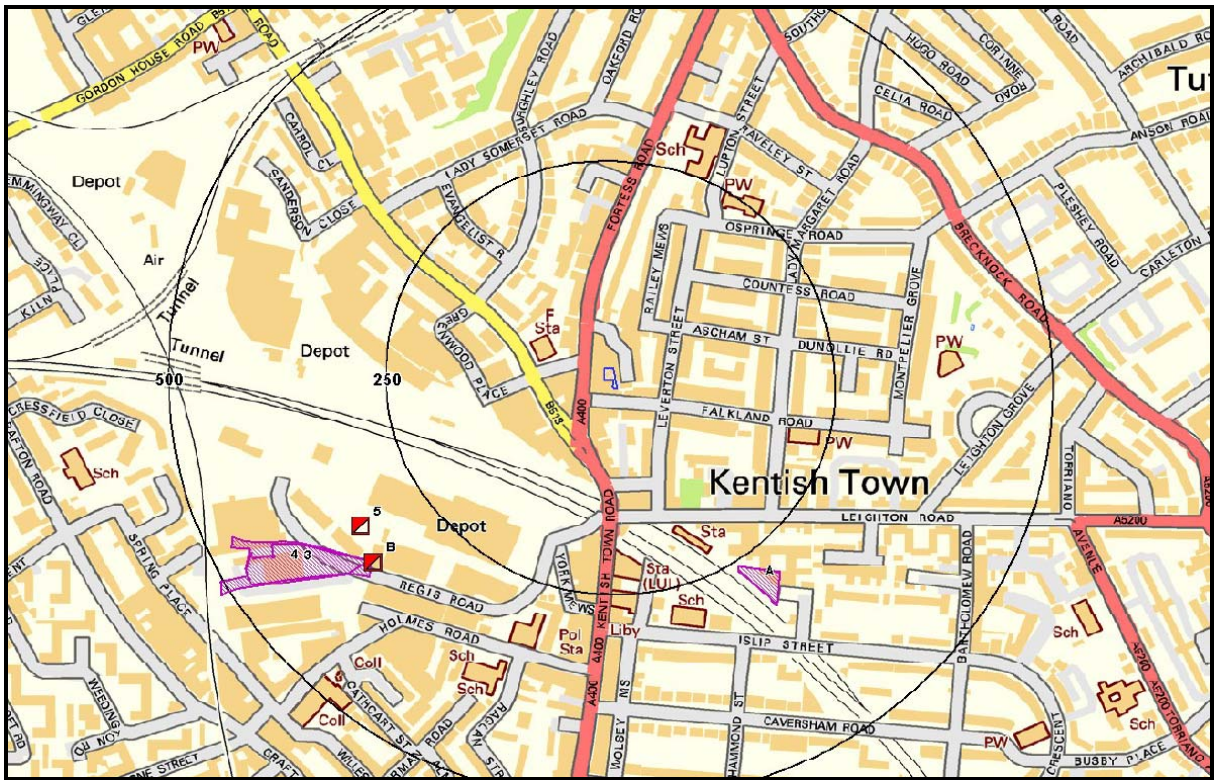


Figure 8 Landfill Plan

4.2 Radon Gas

There is a very low risk that the site is affected by radon gas and as such, radon protection measures will not be required in the basement as part of the proposed development.

5. REGULATED INDUSTRIES

5.1 Regulated Industries

Results of searches for regulated industries are presented in Table 2.

TABLE 2
Authorisations, Incidents and Registers

Regulated Industry	On SITE	Within 250m	DETAILS
Historic IPC Authorisations	None	None	-
Part A(1) and IPPC Authorised Activities	None	None	-
Water Industry Referrals	None	None	-
Records of Red List Discharge Consents	None	None	-
Records of List 1 Dangerous Substances Inventory Sites	None	None	-
Records of List 2 Dangerous Substances Inventory Sites	None	None	-
Records of Part A(2) and Part B activities and enforcements	None	7	10m west of site. Perk Clean, dry cleaning. Current & Historical Permit. Part B. No enforcement Notified. 43m south of site. Zappeo Dry cleaners. Current Permit Part B. No enforcement Notified. 57m north of site. M & A Coachworks. Respraying of vehicles. Current Permit, Part B. No enforcement Notified. 92m south of site. Zappeo Dry cleaners. Revoked Permit Part B. No enforcement Notified. 181m south of site. The Kleen Machine, dry cleaners-Historical Permit. No enforcement Notified. 222m south of site. The Kleen Machine, dry cleaners-Historical Permit. No enforcement Notified.
Records of Category 3 or 4 Radioactive Consents	None	None	-
Records of Licensed Discharge Consents	None	None	-
Records of Planning Hazardous Substance Consents and Enforcements	None	None	-
Records of COMAH and NIHHS sites	None	None	-
Records of National Incidents Recording System List 2	None	None	-
Records of National Incidents Recording System List 1	None	None	-
Records of sites determined as contaminated land under Section 78R of EPA 1990	None	1	62m east of site. Former metal plating works. Lead and cadmium potential contaminants. Remediated. Formerly contaminated land.
Records of Made Ground	None	None	-
Records from EA landfill Data	None	None	-
Records of Operational Landfill Sites	None	None	-
Records of EA historic landfill sites	None	None	-
Records of non operational landfill sites	None	None	-
Records of local authority landfill sites	None	None	-
Records of operational waste treatment, transfer or disposal sites	None	None	-

Records of non operational waste treatment, transfer or disposal sites	None	None	-
Records of EA licensed waste sites	None	None	-
Current Industrial Land Use	None	28	43m NE, 161m W & 240m SW of site. Container and Storage. 53m NE, 103m NW, 110m SW, 121m NW& 207m NW. Unspecific works or factories. 148m E & 183m SW of site. Electricity Sub Station 52m NW & 130m N of site. Construction tool hire. 67m N & 100m NE of site. Vehicle repair, testing and servicing 76m W of site. Fire Brigade 114m S of site. Vehicle cleaning 155m N of site. Electrical equipment repair and servicing 163m N of site. Rag merchants 192m N of site. Fish, meat and poultry products 193m SE & 247m N of site. Civil Engineers 196m S of site. Structural Engineers 208m SE of site. Railway stations, junctions and halts 213m S of site. Underground network stations 227m W of site. Medical Equipment, supplies etc 227m W & 229m W of site. Clothing, components and accessories 234m N of site. Distribution and haulage
Petrol and Fuel Sites	None	None	-
Underground High Pressure Oil and Gas Pipelines	None	None	-
NG High Voltage underground Electricity Transmission Cables	None	None	-
Residential Property (within 250m)	Yes	Yes	Residential to the west north and east
Radon Protection Required	No	-	The property is not in a Radon Affected Area, as <1% of properties lie above action level.

Results of searches for regulated industries, pollution incidents or registered authorisations are presented in Table 2 above and indicate that potentially contaminative land uses are not present on and within close vicinity to the site and there are no records of an environmentally sensitive nature which could be detrimentally affected by, or detrimentally affect, the construction of the basement and lightwells.

6. POTENTIAL CONTAMINATION

With the exception of made ground that may have been associated with the past residential development in the surrounding area and the brief period in which the site building was used as a works, the historical map search has not identified any potential sources of contamination that could be present on the site.

A search of environmental databases via an EnviroInsight report (provided by Centremaps) did not reveal any offsite sources of contamination that are considered likely to pose a risk to the site and the proposed development. It will be necessary to undertake screen tests for contamination for Health and Safety for workmen and due to the former presence of a garage <30m to the north of the site and the site being formerly occupied by a 'works'.

Soil tests should include a screen for asbestos, speciated polyaromatic hydrocarbons, speciated Total Petroleum hydrocarbons to CWG UK, 10 heavy metals, pH and sulphate, plus monitoring for toxic gases and VOCs. This schedule of tests is expected to highlight any adverse contamination in the ground.

7. ARCHAEOLOGY AND SENSITIVE SITES

7.1 Archaeology

The archival maps have identified potential for archaeological features that could be present on the site as the site lies within the Kentish Town Archaeological Priority Area.

7.2 Sensitive Sites

The site does not lie within 2000m of a Site of Special Scientific Interest, a National Nature Reserve, a Special Area of Conservation, a Special Protection Area, a Ramsar Site, Ancient Woodland or World Heritage Site. The site does not lie within 2000m of an Environmentally Sensitive Area, an Area of Outstanding Natural Beauty, a National Park, Nitrate Sensitive Area or Green Belt.

The site lies within 1475m of a Local Nature Reserve of Belsize Wood to the west of the site.

The site does not lie within a Nitrate Vulnerable Zone.

The development of the basement will not detrimentally affect any local sensitive sites.

8. SITE GEOLOGY

8.1 Geology

The published 1:50,000 scale British Geological Survey (BGS) geological map of the area (Sheet 270 “South London”) shows the site to be underlain by bedrock of the London Clay Formation (up to 55m thick in this area) of the Eocene geological epoch.

There are no superficial deposits underlying the site. An extract of the BGS Geological Map is provided in Figures 9 and 10 below.

The underlying London Clay is generally of medium strength silty often sandy with selenite crystals and very thin bands of siltstone.

Given the historical development of the site and surrounding areas, there may be made ground present on the site.

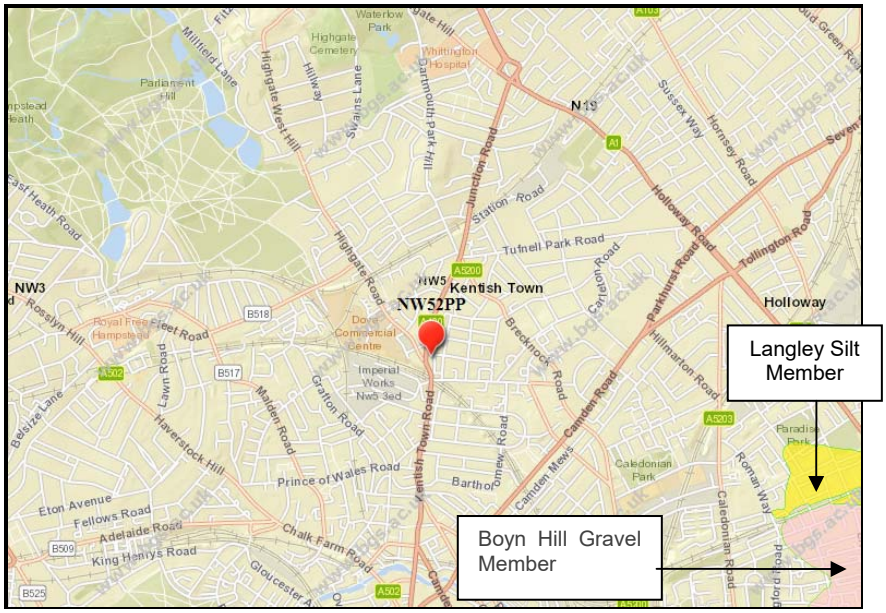


Figure 9 Superficial Deposits Geological Plan

It was recommended that boreholes should be sunk on the site to determine the sequence of strata and the thickness and strength of the strata in order to enable design of depth of foundations and floor slabs for the proposed development. The location of the boreholes should be as close as possible to the proposed basement taking into consideration the site constraints.

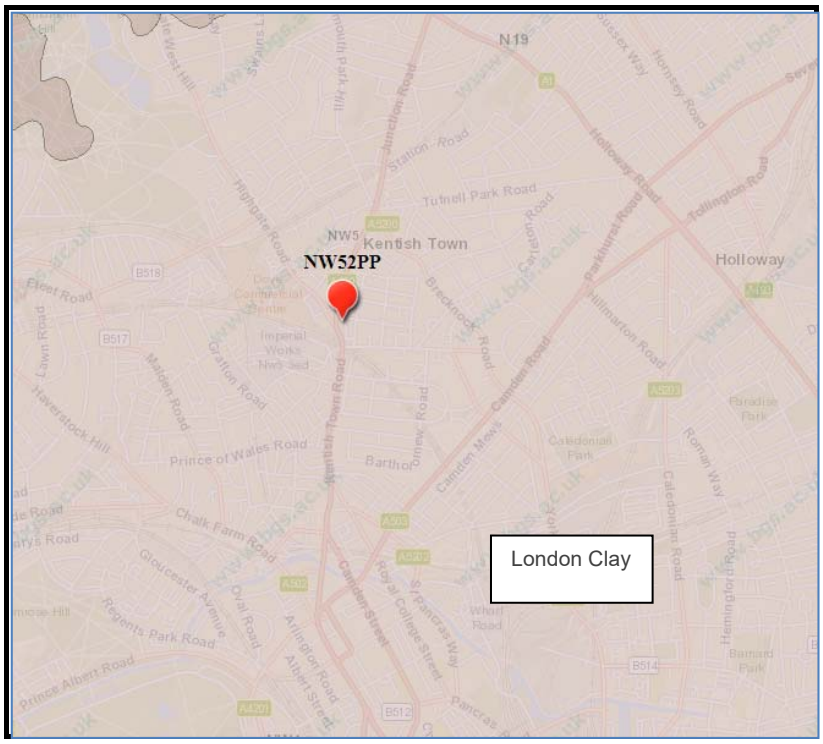


Figure 10 Bedrock Geological Plan

No geological faults are shown to be present within close proximity to the site.

8.2 Mining

There is no evidence of past or present mining or quarrying activity in the vicinity of the site. The site does not lie in a mining area for coal, tin, gypsum, stone or other recorded mineral works.

8.3 Landslips/Land Stability

The site is designated by the British Geological Survey as at very low risk of a landslide as shown on Figure 11. There are no railway embankments or cuttings nearby which could cause instability of the ground. The ground slopes at less than 7degrees to the horizontal.

The land stability has been further assessed by Mr C Tomlin of Croft Structural Engineers in the Structural Method Statement in Appendix E.

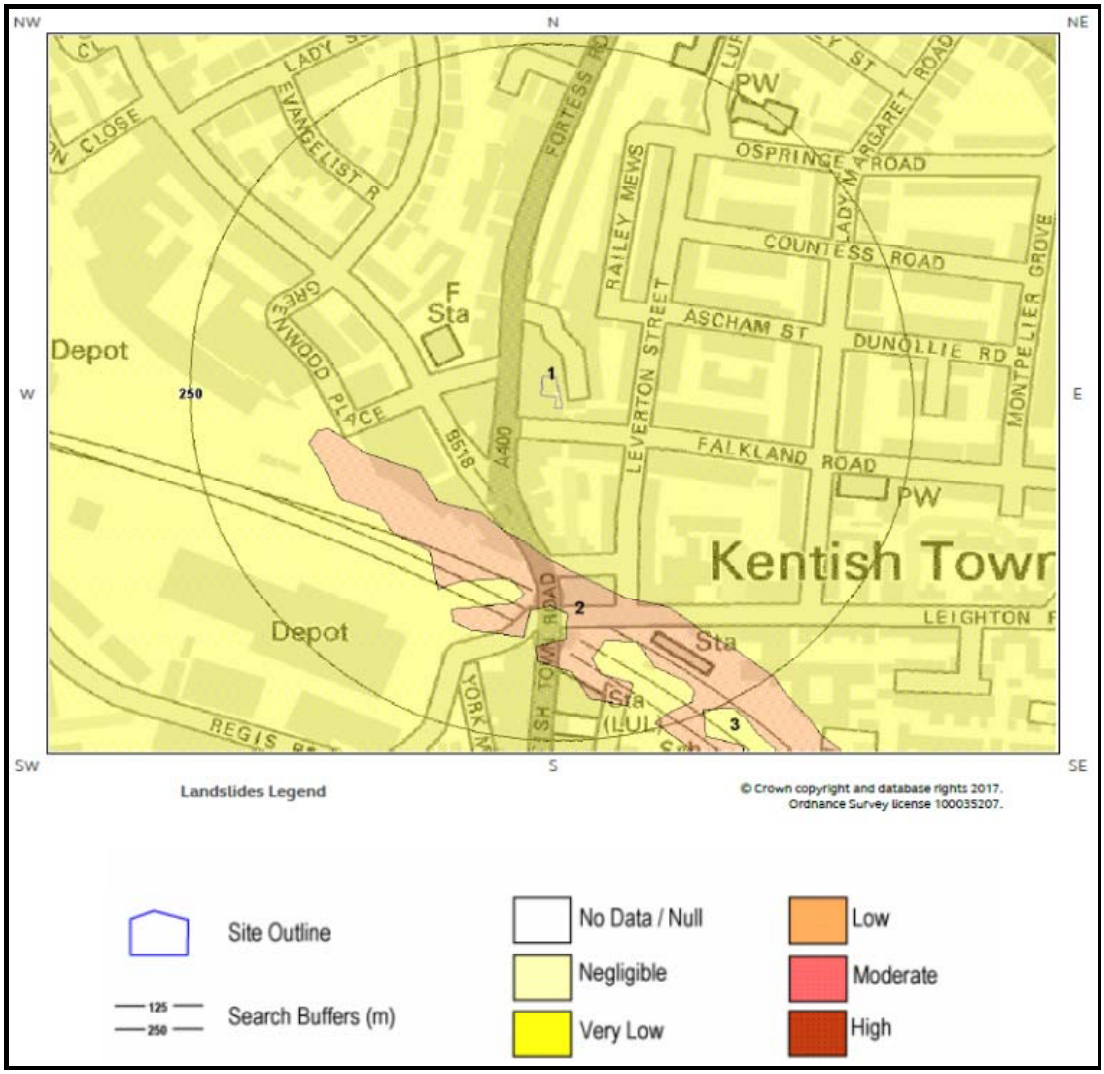


Figure 11 BGS Landslip Risk

8.4 Local Boreholes

A number of relevant available historic borehole logs have been obtained from the BGS website and are summarised in Table 3 below. A plan showing the available local borehole locations is presented in Figure 12.

TABLE 3
Summary of Historical Borehole Logs

BGS Reference	Depth bgl in m	Brief Summary of Ground Conditions	Water Level
TQ28NE49	56.38	GL-4.0m Made Ground 4.0-56.38 Firm to stiff clay.	Water strike at 47.1m bgl
TQ28NE413	9.14	GL – 1.65m Made ground 1.65 – 9.14m Firm to stiff clay	Water strike at 8.50m

These boreholes confirm the geology of the area surrounding the site to possibly comprise made ground overlying weathered London Clay overlying London Clay.

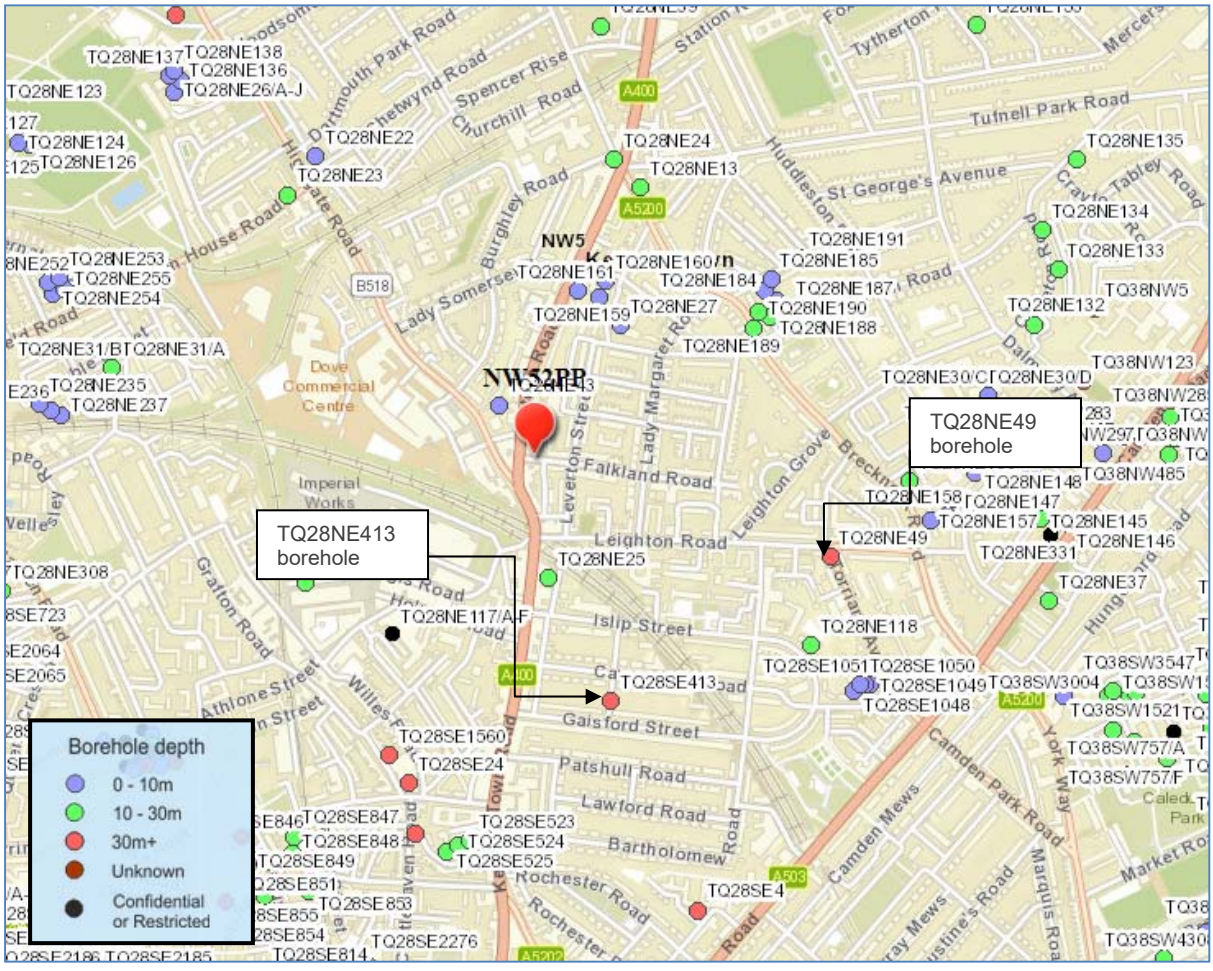


Figure 12 Local Boreholes Plan

9. HYDROGEOLOGY
9.1 Aquifers

The above referenced geological map indicates the site to be underlain by London Clay Formation, which is relatively impermeable and classified as unproductive. Superficial deposits do not underlie the site.

The Environment Agency have designated the London Clay Formation beneath the site as "Unproductive" which means the strata have a low permeability and negligible significance to water supply or base flow to rivers. Permeability of the London Clay varies from 5 $x10^{-6}$ to 1 $x10^{-10}$m/sec. (BS 8004, 1986). The site does not lie on a Groundwater Vulnerability Zone.

The natural soils underlying the site are likely to comprise a superficial covering of made ground (potentially absent) overlying the London Clay (clay soils). The London Clay has very low permeability and does not readily permit the downwards transfer of surface water or percolating groundwater.

It was recommended that standpipes should be installed in boreholes in order to determine the water levels beneath the site to determine any groundwater flows and the requirement for sump pumping or dewatering during construction. Results are discussed in Section 13.5.

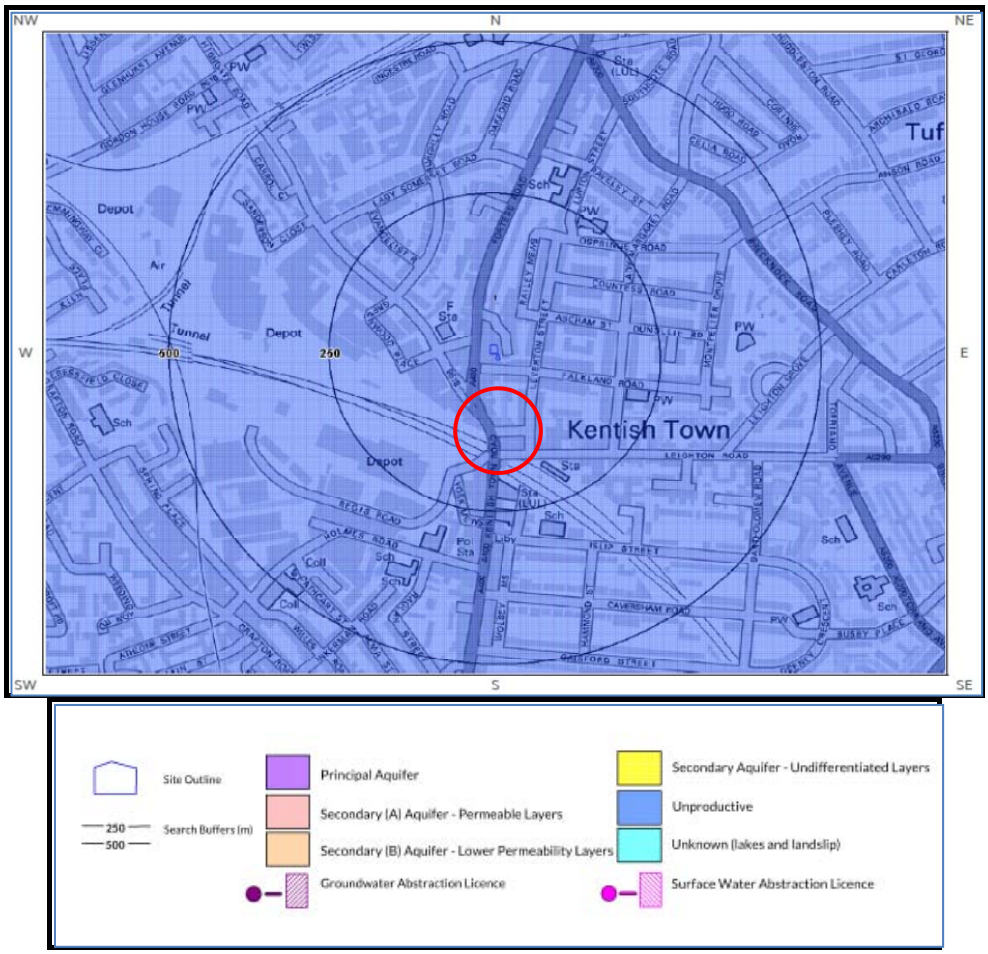


Figure 13 Hydrogeology Plan of Bedrock

9.2 Groundwater Depth and Flow

The development of a basement and lightwells are unlikely to detrimentally affect any groundwater in bedrock which lies > 50m bgl in the Thanet Sands and Woolwich and Reading Beds or underlying Chalk Aquifer.

Water levels encountered in local boreholes researched varied from dry to between 8.50m bgl and 47.1m bgl. The boreholes were sunk some years ago and water levels now may be different. Monitoring of groundwater levels was undertaken in 2no installed standpipes on to determine water levels and flow and results are presented in Section 13.5. Sump pumping or dewatering may be required for construction. Groundwater should be taken as ground level for structural design as recommended by Eurocode 7.

Groundwater within the London Clay is generally contained in isolated thin bands of silt or gravel of limited extent. It would be prudent to waterproof the basement and take into consideration the potential uplift pressures in structural design in case groundwater rises.

Due to the small footprint of the basement, and lack of adjacent basements (see SMS Report which has determined there are no adjacent basements), there is no risk of a cumulative effect on groundwater flow from the construction of the basement.

9.3 Groundwater Abstraction Wells, Wells and Springs

There are five groundwater water abstraction licences within 1000m of the site, all of which are located 684m to the south sourcing Thames groundwater via two bores at Kentish Sports centre on Prince of Wales Street. The groundwater is used for cooking, sanitary, washing, laundry use, process water etc. There are a further two groundwater abstraction licences between 1000m and 2000m from the site, both located 1588m to the south east. There are two potable water abstraction licences within 1000m of the site. The licences refer to Kentish Sports Centre 684m to the south of site with potable water for use with cooking, sanitary and washing. The boreholes extend through 62m of London Clay and 84m of Chalk, abstracting water from the chalk horizon. The site does not lie within or within 500m of a Source Protection Zone for a potable water supply.

Other unrecorded or unlicensed wells may be present close to the site. There are no springs recorded on the OS maps in the local vicinity. The development is unlikely to detrimentally affect groundwater abstraction wells, wells or springs.

9.4 Summary of Hydrogeology

Based on the potential for small lenses of water with the London Clay, groundwater monitoring was undertaken during the ground investigation.

The construction of the basement and lightwells are unlikely to detrimentally affect groundwater flow, and will not adversely affect any wells, springs or potable water supplies as the latter lies 684m distance and the site does not lie within a Source Protection Zone.

10. HYDROLOGY

10.1 Surface Water Drainage

Prior to the commencement of the redevelopment of the site, the rainfall over the area of the site drains in one of the following ways:

Surface water from the rear roof drains into the drainage system via underground pipes leading to the front of the site. Surface water from the front roof drains into the drainage system that runs under the front area and to the east of the site. Surface water on the rear hard covered yard drains under the house to the front and into town drains.

On completion of redevelopment the rainfall will drain in the same manner to public drains. There will be no change in the area of hard cover and no change in the existing drainage level to public drains.

10.2 Local Rivers

The Grand Union Canal is located at a distance 1255m to the south of the site. The Canal was graded as F for biological quality between 2005 and 2008 and grade E in 2009 by the Environment Agency in 2009. A culverted unnamed river is located 411m to the south west of site.

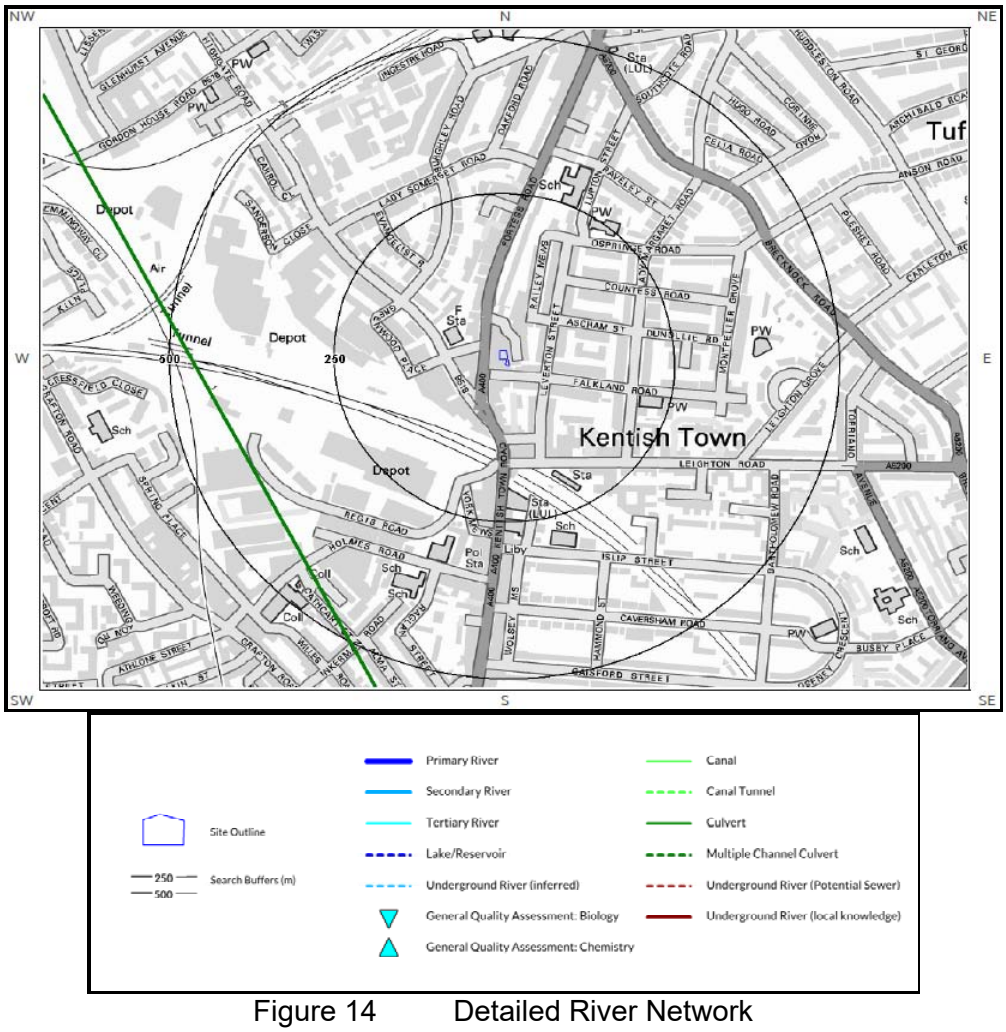


Figure 14 Detailed River Network

The site is unlikely to be affected by or to affect these rivers.

10.3 Lost Rivers

The River Fleet is recorded, by Nicholas Barton in Lost Rivers of London, as flowing to the west of the site in the past and crossing Highgate Road at a distance of circa 50m west of the site and is unlikely therefore to detrimentally affect the site.

Figure 15 Lost Rivers in Camden

10.4 Surface Water Abstractions

There are no surface water abstraction licences within 1000m of the site. Two surface water abstractions are located within 1500m of the site at 1425m and 1429m the south, surface water is sourced from the River Thames for non-evaporative cooling purposes.

10.5 Summary of Hydrology

There are no rivers, canals or lost rivers that are likely to cause concern to the development. There are no surface water abstractions that are likely to be detrimentally affected by the development.

11. FLOOD RISK
11.1 Flood Risk from Surface Water

Camden is at risk from surface water runoff (i.e. rainwater that is on the surface of the ground and has not entered a watercourse, drainage system or public sewer), because pipes have burst or gone beyond capacity due to heavy rainfall. These situations are only likely to occur in extreme rainfall events such as in 2002 when floods occurred in Camden.

The site does lie in a Critical Drainage Area, Group 3_003, but not in a Local Flood Risk Zone. It is considered that a site specific Flood Risk Assessment is required for construction of the basement and lightwells.

The Flood Risk Assessment is provided by UK Flood Risk of London in a separate report.

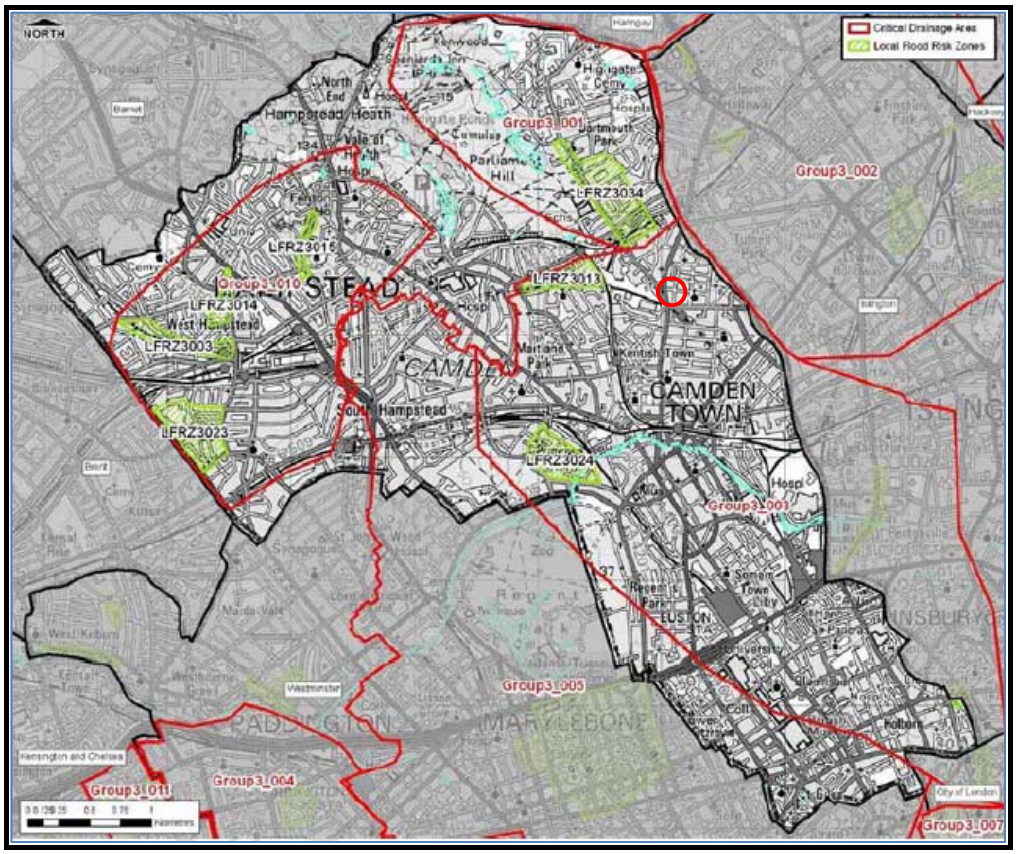


Figure 16 Critical Drainage Areas and Flood Risk Zones

Camden are, since publishing the Scrutiny Task Group Report on surface water flooding, aiming to increase clearage of gullies and drains to enable better discharge of water in times of heavy rain fall.

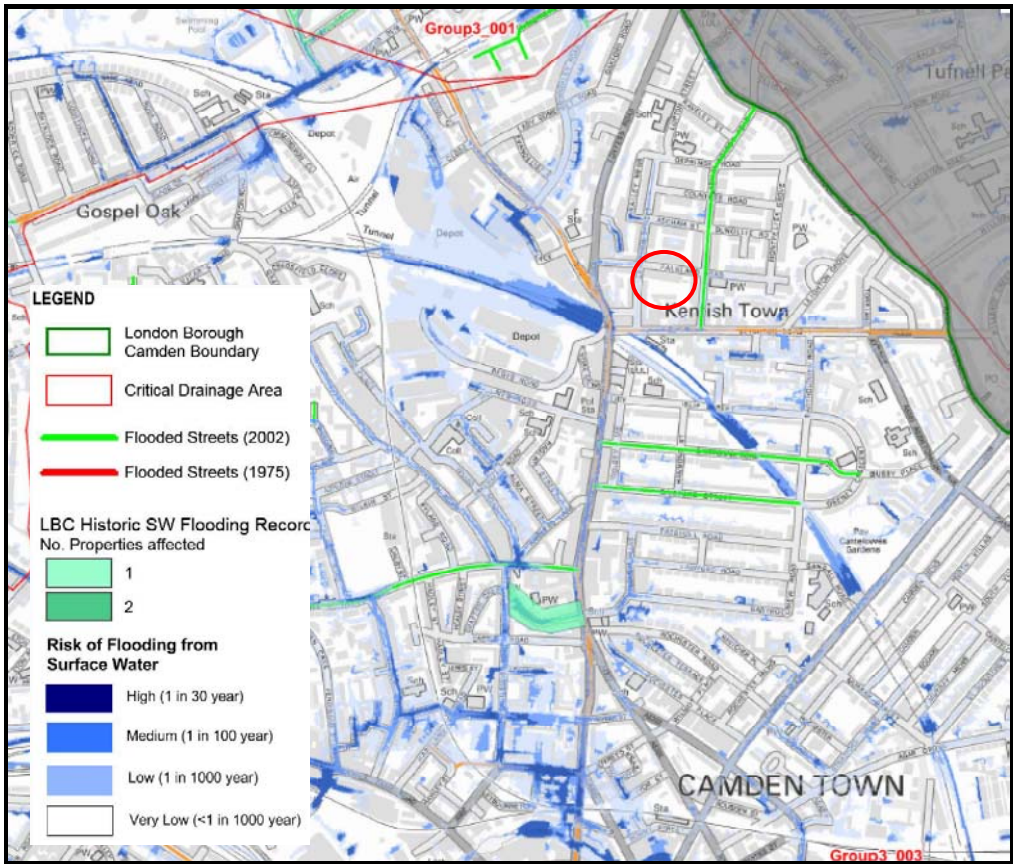


Figure 17 Environment Agency Flood Risk from Surface Water

The site is recorded as a low risk of flooding from surface water.

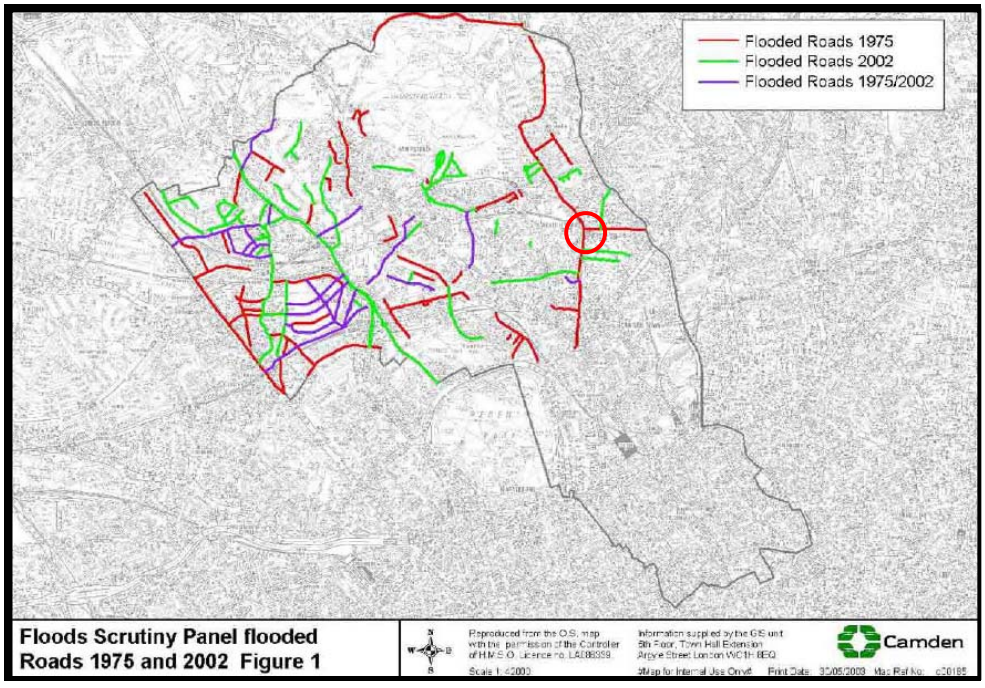


Figure 18 Flooded Roads 1975 and 2002

The Falkland Road was not flooded in 1975 nor 2002, however Kentish Town Road and Leighton Road to the west and south were flooded in 1975, and Lady Margaret Road to the east was flooded in 2002. The proposed basement and lightwells are unlikely to low likelihood to be affected by future flooding in the surrounding area.

There is a recorded potential for the railway cutting to the south west to be flooded but as this lies at a lower level this is unlikely to affect the site.

11.2 Flood Risk From Rivers and Seas

The site is shown by the Environment Agency (EA) to not lie within/on the boundary of an area at risk of flooding. The EA indicate a very low risk of flooding from rivers and the sea.

The Flood Zone maps produced by the Environment Agency provide an initial assessment of flood risk. The Flood Zones are divided into four categories of flood probability and do not take into account any flood defences. PPS25 defines the flood zones as:

Zone 1: Low Probability-This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).

Zone 2: Medium Probability-This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% to 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% to 0.1%) in any year.

Zone 3: High Probability- This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

Zone 3B 'The Functional Floodplain' – This zone comprises land where water has to flow or be stored in times of flood.

The site does not lie within a Flood Zone.

The site does not benefit from flood defences as detailed on Figure 20.

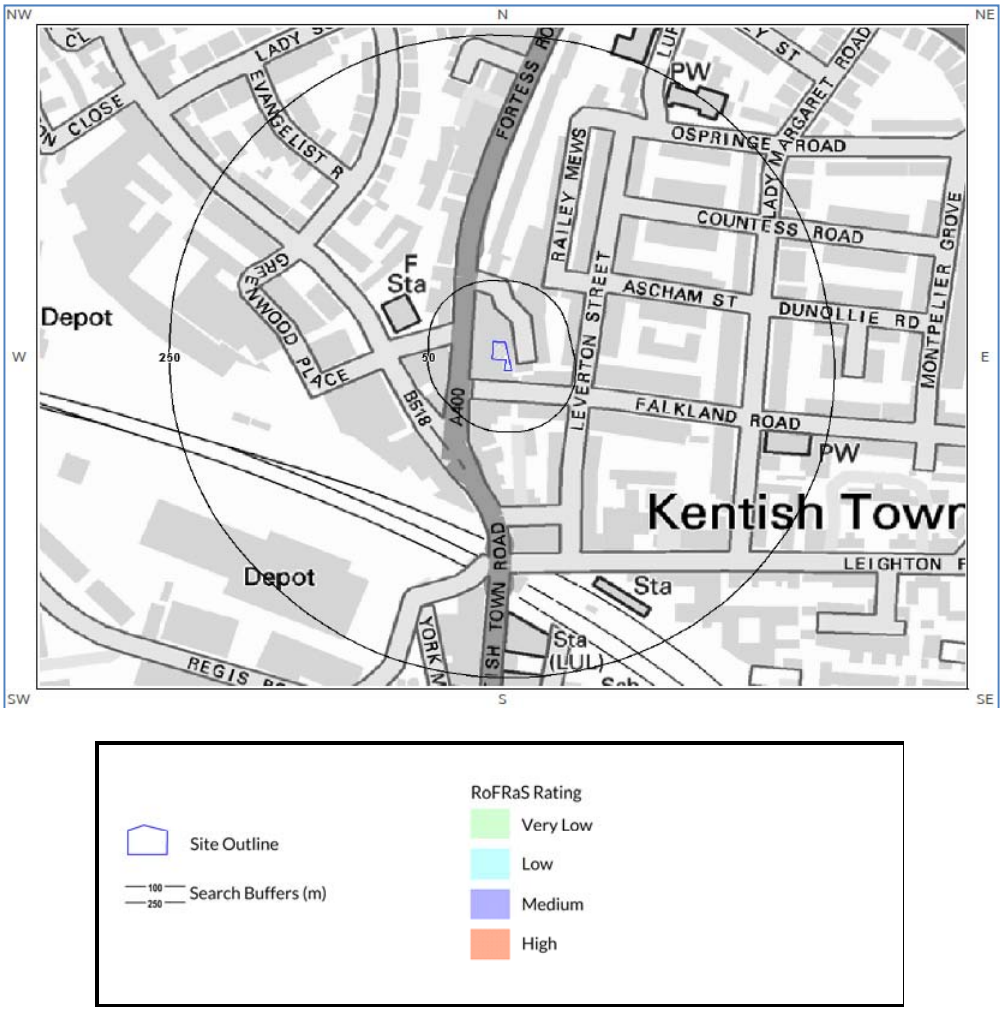


Figure 19 Risk of Flooding from Rivers and Seas

The risk of flooding from rivers and seas(RoFRaS) rating for the site is not a risk as detailed in Figure 19.

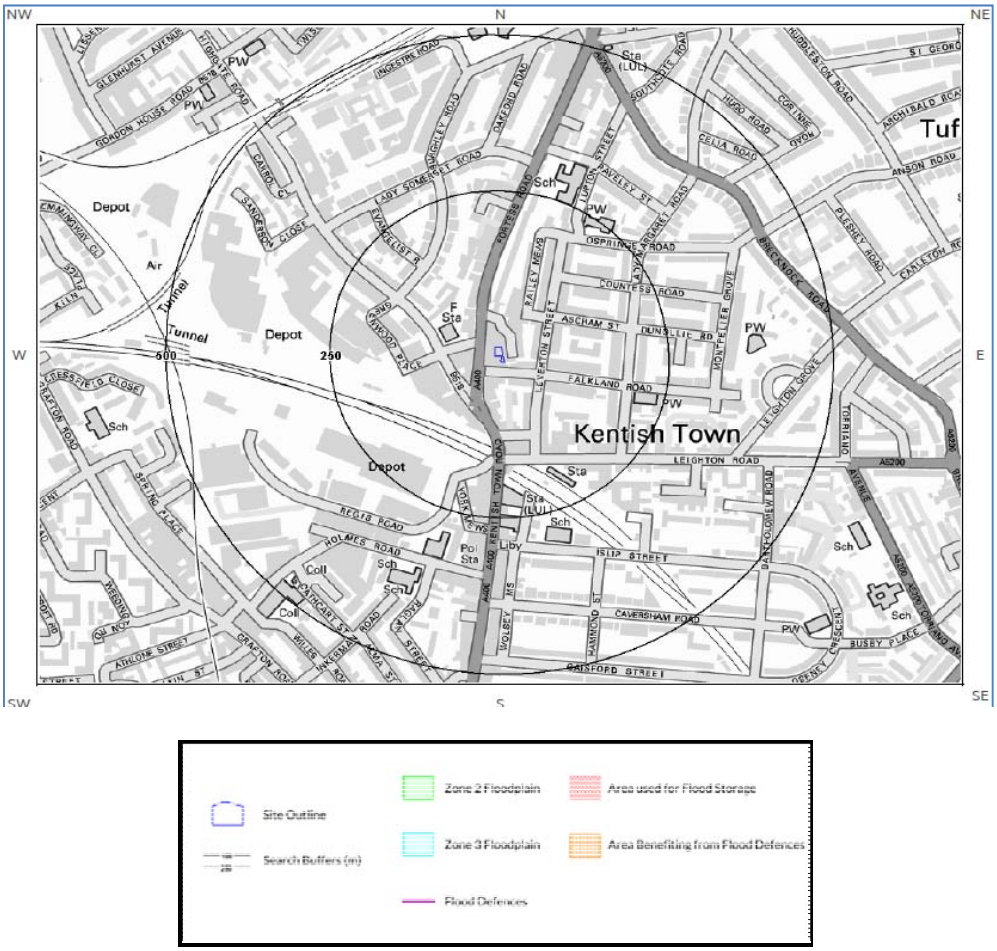


Figure 20 Flood Defences Plan

11.3 Flood Risk From Reservoirs

The Environment Agency are the enforcement authority for the Reservoirs Act (1975) and all large reservoirs are inspected and monitored by reservoir panel engineers. The risk of flooding from reservoirs is therefore very low. The Environment Agency Reservoir Flood Risk Maps for large reservoirs (>25,000m3) for this area indicate the site is at very low risk of flooding from reservoirs.

Reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, the Environment Agency ensure that reservoirs are inspected regularly, and essential safety work is carried out.

Figure 21 indicates the site is not at risk of flooding from reservoirs.

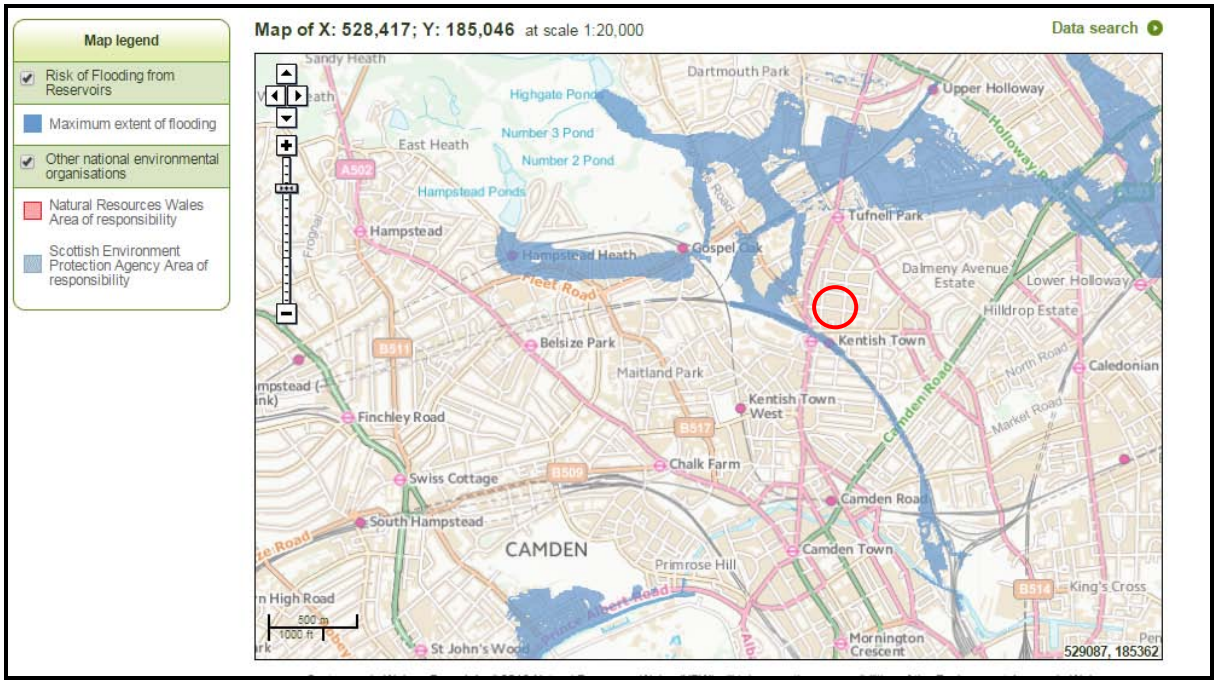


Figure 21 Flood Risk From Reservoirs

11.4 Flood Risk From Groundwater

According to the BGS there are no groundwater flood susceptibility areas within 50m of the site. There is according to the BGS a negligible risk of groundwater flooding based on the underlying geology. Groundwater flooding occurs as a result of water rising up from an underlying shallow aquifer or from water flowing from springs. It mostly occurs following heavy rainfall within aquifers and may detrimentally affect basements.

As the site is not underlain by a shallow aquifer there is a low risk of groundwater flooding.

There is a future susceptibility for increased groundwater flooding due to climate change bringing longer periods of rainfall and due to the use of SUDS increasing water held in the aquifer and reducing the unsaturated zone in the strata. However due to the impermeable nature of the London Clay there are unlikely to be soakaways that increase groundwater levels in this area.

The site lies in an area that is potentially unsuitable for soakaways due to the variable very low permeability of the London Clay.

11.5 Flood Risk From Sewers

Kentish town has not knowingly been subject to sewer flooding.

11.6 Summary of Flood Risk

The site is at low risk of flooding from rivers and seas, reservoirs, surface water, groundwater or sewers.

12. SCREENING AND SCOPING

12.1 Screening

Screening is the process of determining whether or not there are areas of concern which require further consideration and / or investigation for a particular project. In order to undertake screening a site characterisation was undertaken in the previous sections. Scoping is the process of producing a statement which defines further matters of concern identified in the screening stage. This defining is in terms of ground processes in order that a site specific BIA can be designed and executed by deciding what aspects identified in the screening stage require further investigation by desk research or intrusive drilling and monitoring or other work.

The scoping stage highlights areas of concern where further investigation, intrusive soil and water testing and groundwater or gas monitoring may be required.

A series of flowcharts have been used in the screening process to identify what issues are relevant to the site. Each question posed in the flowcharts is completed by answering “Yes”, “No” or “Unknown”. Any question answered with “Yes” or “Unknown” is then subsequently carried forward to the scoping phase of the assessment.

The results of the screening process for the site are provided in Table 4 below. Where further discussion is required the items have been carried forward to scoping.

Scoping often indicates that a ground investigation is required to establish more fully the base conditions. The Basement Impact Assessment determines the potential impacts of the proposed basement on the baseline conditions, taking into account any mitigating measures proposed.

Table 4
Screening For Basement Impact Assessment

Ref	Question	Response	Details
	Surface Flow and Flooding		
1	Is the site within the catchment of the pond chains of Hampstead Heath	No	Refer to Maps in Appendix B. Site lies outside the catchment area.
2	As part of the site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?	No	Drainage arrangements will be unchanged and volume of water to drains unchanged.
3	Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	No	Refer to Appendix A drawings, Section 2.1 drainage levels will not change. No increase in hard cover
4	Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses?	No	Surface water originating from the site is not received by adjacent properties or downstream watercourses (other than run-off to sewers).
5	Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No	Surface water originating from the site is not received by adjacent properties or downstream watercourses (other than run-off to sewers).

Table 4
Screening For Basement Impact Assessment

Ref	Question	Response	Details
6	Is the site in an area identified to have surface water flood risk according to either the Local Flood Risk Management Strategy or the Strategic Flood Risk Assessment* or is it at risk of flooding, for example because the proposed basement is below the static water level of a nearby surface water feature? '*South Hampstead, west Hampstead, Gospel Oak and Kings Cross	No	The site does not lie below the water level of any surface water feature. It is not at risk of being flooded by surface water, sewers, reservoirs or rivers and seas.
	Does site lie within Critical Drainage Area?	Yes	The site does lie within a CDA, 3-003. Carried forward to scoping
	Does the site lie within to a Local Flood Risk Zone	No	The site does not lie within a Local Flood Risk Zone
	Subterranean (groundwater) Flow		
1	Is the site located directly above an aquifer?	No	The site lies above the aquiclude of the London Clay
1b	Will the proposed basement extend beneath the water table surface?	No	The water table lies within permeable strata beneath the London Clay
2	Is the site within 100m of a watercourse, well (disused / used) or a potential spring line?	Yes	The site lies <100m from culverted River Fleet and the basement is unlikely to be affected by the river. The site lies >100m from existing watercourses/rivers/canals/springs Carried forward to scoping
3	Is the site within the catchment of the pond chains of on Hampstead Heath	No	Refer to Appendix A
4	Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	No	Refer to Appendix A drawings. All hard covered and will remain hard covered
5	As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)?	No	Refer to Appendix A. Soakaways unsuitable in London Clay discharge will be to public sewer. No increase in surface water runoff level.
6	Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond (not just the pond chains on Hampstead Heath) or spring line?	No	No surface water feature within 250m of the site.
	Ground Stability		
1	Does the existing site include slopes, natural or manmade, greater than 7°? (approx. 1 in 8)	No	Refer to site description and Section 8.3.
2	Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 7°? (approx. 1 in 8)	No	Refer to Appendix B and section 8.3.
3	Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°? (approx. 1 in 8)	No	Refer to site description.
4	Is the site within a wider hillside setting in	No	Refer to site description

Table 4
Screening For Basement Impact Assessment

Ref	Question	Response	Details
	which the general slope is >7° ?(approx. 1 in 8)		
5	Is the London Clay the shallowest strata at the site?	Yes	London Clay is shallowest strata Carried forward to scoping
6	Will any trees be felled as part of the proposed development and / or are any works proposed within any tree protection zones where trees are to be retained?	No	No trees to be felled as part of proposed development.
7	Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site?	No	No evidence of subsidence on property or adjacent properties, see SMS Section 3 Adjacent Properties, structural inspection.
8	Is the site within 100m of a watercourse or a potential spring line?	No	Refer maps in Appendix B
9	Is the site within an area of previously worked ground?	Possibly	Previously works/ buildings on site Carried forward to scoping
10	Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?	No	Site underlain by impermeable London Clay. Aquifer is >65m bgl.
11	Is the site within 50m of the Hampstead Heath ponds?	No	Refer to maps in Appendix B
12	Is the site within 5m of a pedestrian right of way?	No	Falkland Road lies >5m from the basement & lightwells which to the south of building.
13	Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Yes	Houses surrounding do not have basements. Carried forward to scoping
14	Is the site over (or within the exclusion of) any tunnels, e.g. railway lines?	No	Site is not located over any railway tunnels.

In summary the issues carried forward to scoping include those associated with the plasticity of the London Clay and the impact of the basement on the ground and on the ground supporting adjacent properties, the flood risk and local watercourse.

12.2 Scoping

Scoping is the activity of defining in further detail the matters to be investigated as part of the BIA process. Scoping comprises of the definition of the required investigation needed in order to determine in detail the nature and significance of the potential impacts identified during screening.

The potential impacts for each of the matters highlighted in Table 4 above are discussed in further detail below in Table 5 together with the requirements for further research and / or investigations. Detailed assessment of the potential impacts and recommendations are provided where possible.

Table 5
Scoping for Basement Impact Assessment

Reference	Issue	Potential Impact and Action
	Surface Flow and Flooding	
6	Site lies within a CDA	**Impact:** Possible flooding **Action:** Flood Risk Assessment**.** Mitigating measures to protect basement from flooding
	Ground Stability	
5	London Clay is shallowest strata	**Impact:** Shrinking and swelling under varying moisture conditions **Action:** Test clay for plasticity to determine level of potential shrink and swell
9	A former works site	**Impact**: Presence of made ground and/or contamination. **Action:** Determine made ground, test for contamination.
13	Adjacent properties do not have basements.	**Impact:** None provided foundations are similar or lower than neighbours foundations. **Action:** None
	Subterreanean Flow	
2	Is the site within 100m of a watercourse, well (disused / used) or a potential spring line? The site lies <100m from culverted River Fleet. The site lies >100m from existing watercourses/rivers/canals/springs	**Impact:** None the culverted River Fleet is >50m distance and unlikely to detrimentally affect the site. **Action:** None

The screening and scoping stage of the BIA indicated the requirement for a ground investigation. In addition a requirement for a Structural Method Statement and Construction Method Statement and Ground Movement Calculations and recommendations for mitigating measures in case of flooding in the road.

The ground investigation should comprise:

1. Two boreholes
2. In situ shear strength tests in strata
3. Collection of soil samples
4. Installation of standpipes
5. Monitoring of groundwater levels
6. Contamination testing on soil samples
7. Geotechnical testing of soil samples
8. Factual and Interpretative Report

13. GROUND INVESTIGATION

13.1 Fieldwork

In order to confirm ground conditions beneath the site and to collect soil samples for testing for contamination and engineering properties of the strata a ground investigation was undertaken. It was not possible to access the basement and therefore boreholes were sunk in the rear yard close to the building.

The ground investigation comprised the excavation of two trial pits (TP1) on 15th November 2017 and the drilling of two 80mm diameter window sampler boreholes (WS1 to WS2) which included insitu soil tests for strength and sampling of the soil for geotechnical and environmental testing. The site work was supervised by an Engineer following a walkover on October 9th 2017. The walkover did not encounter any obvious contamination or water problems or areas requiring specific investigation. There was no evidence of ground instability or subsidence to the building.

All soil samples were sent to a UKAS accredited laboratory, Structural Soils Ltd and three were selected for testing for heavy metals, redox value, sulphate and moisture content, the presence of hydrocarbons and Waste Acceptance Criteria Tests (WACS) to assess contamination and waste disposal. The window sampler boreholes (WS1 to WS2) were installed with standpipes to facilitate groundwater monitoring.

Borehole results are presented in Tables 6, 7, 8 and 9 and in Appendix C. Geotechnical and Environmental Test Results are presented in Tables 7 to 10 inclusive and full results are presented in Appendix D.

All exploratory points were marked out on site by reference to existing physical features on the site.

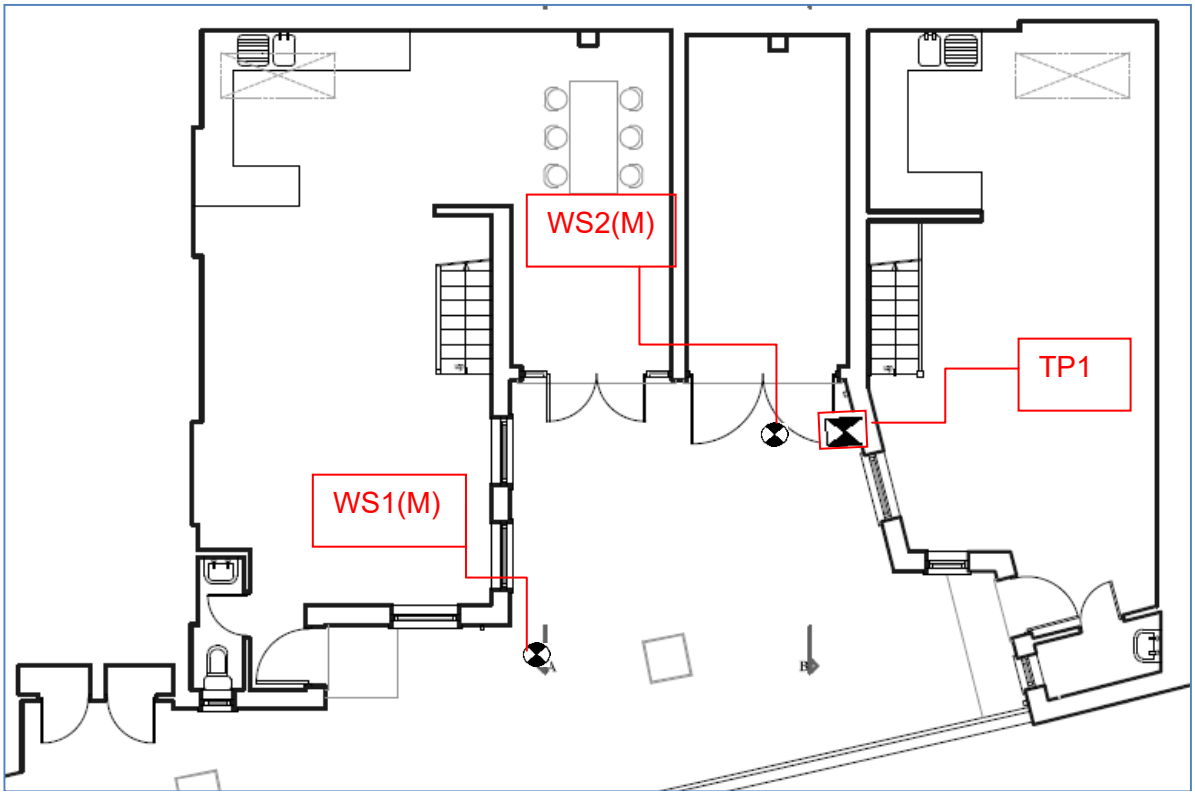


Figure 23 Borehole Location and Trial Pit Plan

13.2 Ground Conditions

The ground conditions encountered in the window sampler boreholes comprised of a layer of paving stones overlying fine grained orange sand overlying made ground down to 1.25m bgl in WS1 and 1.55m bgl in WS2. The made ground comprised brown grey damp silty clay with stones, red brick and occasional pebbles, coal specks and flint fragments. The made ground was underlain by low to medium strength very silty brown grey orange clay with occasional sub rounded to angular flint fragments and gravel. In WS1 and WS2 hole collapse was encountered from within the overlying made ground resulting in termination of WS1 at 4.95m bgl and WS2 at 5.15m bgl.

The ground conditions encountered are summarised in Table 6 below. WS1 was sunk within the floor of the proposed lightwell and WS2 was sunk on a level plane to the south east. The boreholes determined the ground conditions anticipated and are suitable to allow the design of the foundations for the proposed development.

TABLE 6
Ground Conditions Encountered in WS Boreholes and Trial Pits

Hole Ref.	MADE GROUND Depth in mbgl	CLAY (Low to Medium Strength) Depth in mbgl
WS1	GL – 1.25	1.25 – 4.95
WS2	GL – 1.55	1.55 – 5.15
TP1	GL- 0.60+	

The trial pit, TP1 encountered made ground underlying the paving stones and orange sand(circa 140mm thickness) to a depth of at least 600mm. The made ground comprises damp grey sand with pebbles, stones and gravel and red brick overlying brown grey damp clay with gravel of stones and sub rounded to angular pebbles first noted at circa 420mm bgl. During the excavation of TP1 a large concrete mass was discovered circa 150mm bgl and 170mm out from the property wall.

A suite of tests were undertaken for redox value and sulphate content in accordance with BS1377:1990. The results are presented in full in Appendix D.

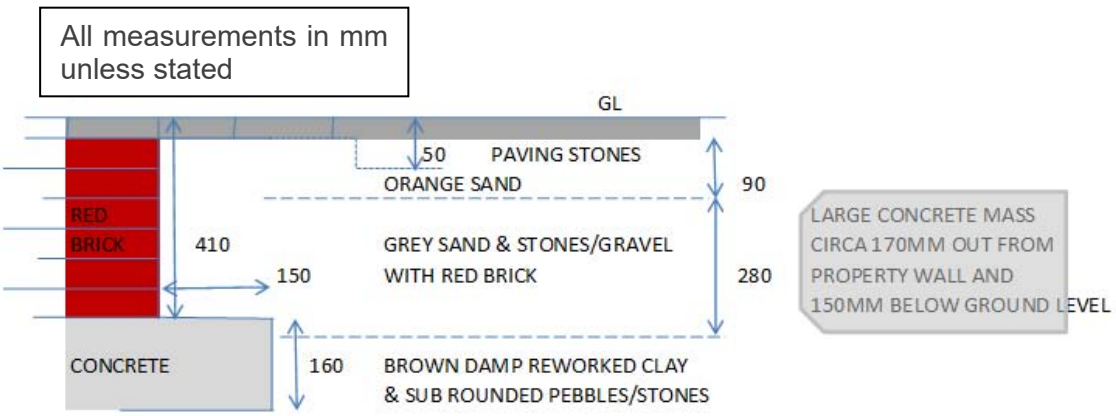


Figure 24 Trial Pit (TP1) Drawing

13.3 Geotechnical Test Results

13.3.1 Standard Penetration Test Results

The Standard Penetration Test (SPT) is undertaken in boreholes by means of a standard 50.80mm outside diameter split spoon sampler to determine the approximate in situ density of soils and when modified by a cone end (CPT) the relative strength or deformity of rock.

The results for the Standard Penetration Test are shown in Table 7 and on the borehole logs in Appendix C The Standard Penetration Test results indicate a low to high strength clay to 3.00m depth, a low to medium strength clay 3.00m to 5.20m bgl.

TABLE 7
Standard Penetration N Values Recorded

Depth	Made Ground/Topsoil	Silty Clay	Clay
0.00-1.00m	-	-	-
1.00-2.00m	48, 13		
2.00-3.00m		22, 9	
3.00-4.00m			15, 6
4.00-5.00m			15, 14
4.50-5.20m			16, 17
EC7	Assume low strength due to vertical and lateral variation	Low to High strength clay	Low to medium strength clay

13.3.2 pH and Sulphate Test Results

Two soil samples were tested for redox value and sulphate content to assess the design of underground concrete.

TABLE 8
pH and Sulphate Test Results

Sample	Depth in mbgl	pH	Sulphate mg/l
WS1	2.60	8.26	426
WS2	3.70	7.79	2800

The results indicate that considerations are required for design of underground concrete for foundations. According to BRE Special Digest 1 the ACEC Class for underground concrete is DS2-AC-2s.

13.3.3 Plasticity Test Results

TABLE 9
Plasticity Test Results

Sample	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Matrix
WS1 3.60m	29	72	26	46	Clay
WS2 2.50m	27	70	25	45	Clay

The results for plasticity tests indicate the soils at the depths tested have high to very high plasticity and are likely to shrink and swell under varying moisture conditions. This needs to be taken into account in design of construction.

13.4 Engineering Properties of Strata Tested

13.4.1 Topsoil and Made Ground

Topsoil and Made Ground are very variable both laterally and vertically and no test results should be assumed to represent the entire sequence. The made ground is likely to be in a loose state of compaction and highly compressible.

Topsoil and Made Ground are unsuitable material on which to place foundations without ground treatment.

13.4.2 Clay

Standard Penetration Test results in the clay indicate it to be generally low to high strength as described in Section 13.3.1. The clay was tested for plasticity. Tests in WS1 at 3.60m and WS2 at 2.50m bgl gave moisture contents of 29 and 27% respectively. Liquid Limits results were 72% and 70% with Plastic Limits of 26% and 25% and Plasticity Index of 46% and 45%. The results indicate the clays in WS1 circa 3.60m bgl to have very high plasticity and the clays in WS2 circa 2.50m bgl to have a borderline high to very high plasticity. It is likely that the clays therefore will shrink and swell under varying moisture conditions.

The London Clay where unweathered has a bulk density of 1900kg/m3, effective cohesion of zero and effective friction angle of 25degrees.

13.5 Groundwater Conditions and Flow

Groundwater was not encountered during drilling. Groundwater was encountered during monitoring at depths varying from 0.79m bgl to 1.78m bgl. Further readings are recommended before construction.

It is possible that sump pumping may be required for construction of the lightwell if undertaken during or after heavy rainfall.

13.6 Gas Conditions

As there are no recorded landfill sites within 250m of the site, monitoring for landfill gas was not required. However, due to the presence of potentially infilled ground within 250m it is recommended that a methane membrane is used in construction. There is a very low risk that the site is affected by radon gas and as such, radon protection measures will not be required in the basement as part of the proposed development. Monitoring undertaken for toxic gases gave results of nil methane, nil carbon dioxide and 20.4% oxygen with nil ppm of VOCs.

13.7 Environmental Conditions

13.7.1 Standards

There are no definitive legal standards for contaminated land in the United Kingdom. The UK Risk Assessment Framework is based on a tiered approach, Tier 1 being a risk screening or qualitative risk assessment, Tier 2 is a generic quantitative risk assessment and Tier 3 is a detailed quantitative risk assessment. Where the Tier 2 identifies a potentially unacceptable

risk to human health either a Tier 3 Detailed Quantitative Risk Assessment (DQRA) is undertaken or risk management action recommended to remove the pathway and the risk.

For this site both a Tier 1 and Tier 2 assessment have been undertaken using generic assessment criteria and site specific assessment criteria based on ATRISK soil SSVs 2016 which are based on the new CLEA Software version 1.071 (2016) incorporating 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. Where there are no figures for compounds in 2016 guidelines, then 2009 guidelines have been used for assessment.

With the exception to contaminants with published C4SLs (arsenic, benzene, benzo(a)pyrene, cadmium, chromium VI and lead), the toxicological assessment for contaminants Is based on minimal toxicological risk in accordance with the Environment Agency guidance (SR2). Toxicological data for some contaminants has been sourced from the CLAIRE-EIC Report.

The site will be used for the residential purposes. The risk assessment has used a scenario of residential use without plant uptake as the model for assessment. In deriving the SSVs a child has been chosen as the critical receptor with exposure over a lifetime being the most appropriate and conservative scenario.

The assessment of the risks to users on the site has been undertaken within the framework set out in guidance published by DEFRA and the Environment Agency for the assessment of risks to human health associated with chronic long term exposure to contaminated soils. The guidance set out in this documentation has been used to establish a conceptual model of the risks on the site following redevelopment.

The Contaminated Land Exposure Assessment (CLEA) model provides a means of establishing concentrations of contamination in soils at a site. If results exceed these concentrations then further assessment or intervention by mitigation or remediation may be required to reduce risks to human health.

13.7.2 Environmental Tests on Soils

Of the soil samples collected, 2 samples were selected from WS1 and WS2 and one from TP1for environmental testing. As the site was a works in the past and residential more recently, 2 soil samples were tested for a suite of potential contaminants. The samples were tested for total PAH, total TPH, BTEX, 10 metals, sulphate, pH, soil organic matter and fraction of organic matter and asbestos. One sample from WS2 at 0.80m bgl was tested for Waste Acceptance Criteria to enable disposal of excess soil during construction. Results are presented in full in Appendix D.

TABLE 10
Results of Environmental Tests on Soils

Compound	No of samples tested	WS1 1.65m mg/kg	WS1 0.45 mg/kg	WS2 0.80 mg/kg	TP1 mg/kg	SSV guideline Residential Use Without Plant Uptake 2016 mg/kg	Samples exceeding SSV 2016 guidelines
Phytotoxic							
Copper	1	13				4790	None
Nickel	1	114				136	None
Zinc	1	83				20,300	None
Selenium	1	<1				375	None

Compound	No of samples tested	WS1 1.65m mg/kg	WS1 0.45 mg/kg	WS2 0.80 mg/kg	TP1 mg/kg	SSV guideline Residential Use Without Plant Uptake 2016 mg/kg	Samples exceeding SSV 2016 guidelines
Metals							
Arsenic	1	2				37	None
Cadmium	1	64				22.1	one
Chromium	1	69				14,300	None
Chromium VI	1	<1				3.63	None
Lead	1	23				200	None
Mercury	1	<0.17				1.44	None
Organics							
TPH total	2		<10	<10		500	None
PAH total	1			<0.08		40	None
BTEX	1			<0.01			
PCB	1			<0.007			
Others							
Asbestos	1				NAD	NAD	None
Fraction of organic carbon %	1			2.54	-	-	-

*BRE Special Digest 2007
NAD=No Asbestos Detected
Red = above guideline

The area of the site was found where tested to be uncontaminated by heavy metals and hydrocarbons. Elevated cadmium levels of 64mg/kg above the SSV guideline of 22.1mg/kg were recorded in WS1 at 1.65mbgl. All other test results lay within guideline limitations. During drilling and sample collection none of the samples exhibited free product.

The soil samples tested gave a TPH result of <10mg/kg being within the 500mg/kg generally recognized figure for residential use. The PAH levels were within the generally accepted level of 40mg/kg. Redox values were near normal at 8.26 to 7.79 and sulphate levels were 426mg/l to 2800mg/l. Sulphate does not harm human health. Asbestos was not detected.

13.7.3 Environmental Risk

13.7.3.1 Sources of Contamination

Sources of contamination were investigated through archival maps and the Desk Study and the ground investigation. The site was found to be contaminated by cadmium.

A search of environmental databases via an EnviroInsight report (provided by Centremaps) did not reveal any offsite sources of contamination that are considered likely to pose a risk to the site and the proposed development.

13.7.3.2 Pathways for Migration

The potential pathways for carrying contamination present on the site to reach sensitive receptors may include:

a) *Ingestion of and/or skin contact with contamination in the soil*
Low Likelihood to Unlikely – Due to the hard cover on the site there is a restricted potential for ingestion/skin contact with contamination in soil. There may be a risk to workmen which may be mitigated by appropriate use of Personal Protective Equipment.

b) *Ingestion of contamination and uptake of contamination in plants/vegetables/animals/pets*
Low Likelihood to Unlikely – Vegetables and plants are unlikely to be grown on the site and ingestion of contamination through uptake in plants/vegetables is unlikely to occur. It is considered that animals in the food chain will not be present on site, although pets may be present. Hard cover will reduce risk.

c) *Ingestion of contaminated drinking water through leaching of contamination into groundwater flowing to underlying aquifers/water abstractions*
Unlikely – The contamination on the site is low and leaching will not occur due to hard cover, there are no potable boreholes within 2000m of the site. The site is not within a Source Protection Zone and there are no groundwater abstractions within 2000m.

d) *Inhalation of vapours produced by landfill/radon/hydrocarbons/old mines*
Low Likelihood to Unlikely – There are no historic or current recorded landfill sites within 250m of the site. There is a potential for infilled land on the site of the former railway. Hydrocarbons were not present in the ground from previous land use. The site does not lie within a radon protection area. There are no recorded old mines beneath the site. Although toxic gases were not detected it would be prudent to incorporate a methane membrane in construction.

e) *Inhalation of contaminated airborne dust*
Low Likelihood – The appropriate safety measures must be exercised to protect both the workers and the local residents from dust during any demolition and construction. Provided this work is carried out diligently, the ongoing risk is low.

f) *Contamination of controlled waters*
Unlikely – Leaching of contamination from the site into surface water is unlikely as the closest surface water is located >500m distance.

13.7.3.3 Sensitive Receptors

Sensitive receptors to the contamination on the site could include workmen and future occupants. However, based on the history of the site and its surrounds, sensitive receptors are unlikely to be detrimentally affected by the site.

13.7.3.4 Environmental Risk Assessment

The environmental liabilities of the site and risk assessments have been undertaken for the continued residential site use. If the site use changes then a further risk assessment may be required.

Environmental risk considerations on the site have been assessed by adopting a site specific qualitative approach to identify the risk, if any, of environmental harm. In accordance with the DETR Draft Statutory Guidance on Contaminated Land the approach is by identifying a hazardous source and establishing possible links between the source via exposure pathways to a potential receptor.

The hazard is a contaminant or potentially polluting substance that is in, on or under the land and which has the potential to cause harm or to cause pollution to controlled waters. The receptor is a living organism or organisms, an ecological system or piece of property, which is being harmed, interfered with or polluted by the contaminant. The pollutant linkage is by

means of the pathway which is one or more routes by or through which that receptor is being, or could be, exposed to, or affected by, that contaminant. Thus the presence of a hazard on a site does not necessarily mean that there are risks unless pathways and receptors are present and are receptive to being affected by that specific hazard or contaminant.

- SOURCE - release of pollutant - eg. oil spills
- PATHWAY - route to receptor - eg. permeable strata
- RECEPTOR eg. - river

The likelihood of contamination affecting the environment depends on the migration and persistence of contaminants which varies with the nature of the contaminant and the ground and groundwater conditions, and the presence of sensitive receptors.

The following tables (Tables 11, 12, 13 and 14) which are extracted from CIRIA C552 'Contaminated Land Risk Assessment – A Guide to Good Practice' have been used to assess the risk to sensitive receptors from site contamination.

Any category which shows as medium risk or above may require investigation and if high risk is proven, remediation may be required following investigation.

TABLE 11
Risk Matrix – Comparison of Consequence and Probability

Risk = Probability x Consequences		Consequence			
		Severe	Medium	Mild	Minor
Probability	High Likelihood	Very High Risk	High Risk	Moderate Risk	Moderate / Low Risk
	Likely	High Risk	Moderate Risk	Moderate / Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate / Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate / Low Risk	Low Risk	Very Low Risk	Very Low Risk

TABLE 12
Classification of Probability

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

TABLE 13
Classification of Consequence

Classification	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. Catastrophic damage to buildings/property. A short-term risk to a particular ecosystem or organisation forming part of such ecosystem (note: the definitions of ecological systems within the Draft Circular on Contaminated Land, DETR, 2000).	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. **Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied).**
Medium	Chronic damage to Human Health ("significant harm" as defined in DETR, 2000). Pollution of sensitive water resources (note: Water Resources Act contains no scope for considering significance of pollution). A significant change in a particular ecosystem or organism forming part of such ecosystem, (note: the definitions of ecological systems within Draft Circular on Contaminated Land, DETR, 2000).	Concentration of a contaminant from site exceeds the generic or site-specific assessment criteria. Leaching of contaminants from a site to a major or minor aquifer. Death of a species within a designated nature reserve. **Lesser toxic and asphyxiate effects of carbon dioxide**
Mild	P3ollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ("significant harm" as defined in the Draft Circular on Contaminated Land, DETR, 2000). Damage to sensitive buildings/structures/services or the environment.	Pollution of non-classified groundwater. Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing, etc). Easily repairable effects of damage to buildings, structures and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discoloration of concrete.

TABLE 14
Classification of Risks and Likely Action Required

Risk Classification	Definition
Very High Risk	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 Risk	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 longer term.
Moderate Risk	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. 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 Risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst be mild.
Very Low Risk	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.

Any category which shows as moderate risk or above may require investigation and possibly subsequent remediation.

13.7.3.5 Summary

The risk assessment has been based on the future use of the site for residential purposes. If the site is to be used for any other purpose a reassessment of the risk may be necessary.

The environmental test results have shown that soils are generally uncontaminated by the compounds tested for at the sampling locations. In line with CIRIA Risk Assessment recommendations, the levels of potential contamination detected are unlikely to cause harm to humans, animals, plants and controlled waters as the entire site will be hard covered. Workmen should take the usual precaution of wearing gloves when handling soil.

14. IMPACT ASSESSMENT AND CONCEPTUAL MODEL

14.1 Introduction

The BIA has been undertaken for the proposed construction of a new basement and lightwells. The anticipated bearing pressure of the new structure has not been provided.

The comprehensive desk based assessment together with the site inspection and walkover and ground and groundwater investigation have been sufficient to allow the potential impacts of the issues identified during the screening and scoping stage and ground investigation to be assessed and a Conceptual Model drawn.

This section of the report provides an interpretation of the findings of the Desk Study and Ground Investigation, in the form of a ground model, and provides advice and recommendations with respect to temporary and permanent works and foundation options. The detailed Structural Engineers Report is reported by Croft Structural Engineers in Appendix E. A Conceptual Model is presented in Appendix F.

14.2 Geological and Hydrogeological Setting

The ground conditions encountered in the window sampler boreholes comprised of a layer of paving stones overlying fine grained orange sand overlying made ground down to 1.25m bgl in WS1 and 1.55m bgl in WS2. The made ground comprised brown grey damp silty clay with stones, red brick and occasional pebbles, coal specks and flint fragments. The made ground was underlain by low to medium strength very silty brown grey orange clay with occasional sub rounded to angular flint fragments and gravel. In WS1 and WS2 hole collapse was encountered from within the overlying made ground resulting in termination of WS1 at 4.95m bgl and WS2 at 5.15m bgl.

Laboratory tests for plasticity on the clay indicated it to be the clay of high to very high plasticity and the clay is expected therefore to swell and shrink under varying moisture conditions.

There are no recorded abstraction licences which could be detrimentally affected by the basement development. The underlying London Clay is an aquiclude and protects the underlying major chalk aquifer.

Groundwater was monitored at levels of 0.79m to 1.78m bgl. The monitoring points should be reread again before construction commences.

The construction of the basement is unlikely to detrimentally affect groundwater flow, and will not adversely affect any wells, springs or potable water supplies.

14.3 Hydrology and Flood Risk

The screening indicated a Flood Risk Assessment may be required due to the site lying within a CDA and being flooded in 2002. A site specific flood risk assessment has been completed by others.

There are no rivers, canals or lost rivers that are likely to cause concern to the development.

14.4 Contamination

Ordnance Survey maps inspected indicated the site had the house constructed before 1915. As such there is a low risk of contamination being present on the site. The ground investigation did not reveal any soil that contained potentially contaminating or odorous material apart from one elevated level of cadmium. Results of soil tests undertaken for potentially contaminating compounds indicated the samples to be generally uncontaminated. As the garden will remain hard covered there is therefore no risk of the construction causing harm to humans, animals, controlled waters or the environment from the soils. As a precaution all builders should also use gloves when handling soil for Health and Safety and work in accordance with HSE and CIRIA guidelines.

14.5 Excavations

The excavation for the basement will be circa 2.50m below existing ground floor level. The floor formation level will be on the London Clay.

Excavation in the made ground and London Clay could be achieved by mechanical excavator. All excavations will require temporary support for construction.

Groundwater may be encountered especially during and after heavy rainfall. Temporary works may require sump pumping. If rainwater falls into the excavation it can easily be dealt with by sump pumping. If this occurs the softened surface of the clay strata should be removed prior to any pouring of concrete for the floor.

In accordance with Eurocode 7 (BSEN 1997-1) groundwater should be taken at ground level for short and long term design. Such design must resist the buoyant uplift pressures generated by groundwater at ground level. The design for the basement accounts for the weight of the building and the uplift forces due to the groundwater. The weight being greater than the uplift force, the building is stable.

Excavations for the proposed structure will require temporary support in all strata to maintain stability of the surrounding structures and to prevent any excessive horizontal ground movements. Refer to Structural Engineers Report and Construction Method Statement in Appendix E.

Construction of the proposed basement will need to be supported by new retaining walls. Formation level for the proposed development will be the clay beneath any topsoil or made ground, which are unsuitable bearing strata. The clay should provide a suitable bearing stratum for foundations, provided the bearing pressure is low, ie less than 120kN/m^2.

The support for the temporary and permanent conditions must take account of maintaining the stability of the excavation and the stability of the adjacent properties and surrounding structures. Design of the walls may be decided as to whether the temporary support is also incorporated into the permanent solution. The Structural Method Statement by Croft

Structural Engineers details the structural proposals and describes the proposed construction methodology.

Based on the plasticity tests of the clay it is possible that ground heave will occur on excavation. It is recommended that compressible material is laid beneath the floor slab or a void is created to accommodate any heave. Calculations undertaken by Croft Structural Engineers are presented in Appendix E.

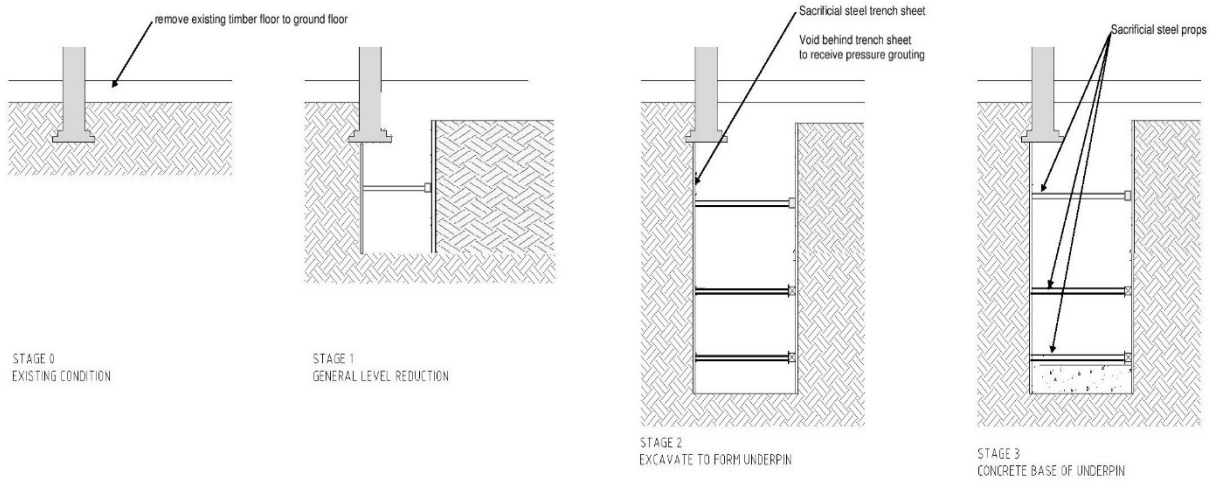
14.6 Foundation Design

The clay should provide a suitable bearing stratum for foundations, provided the allowable bearing pressure is low, ie less than 120kN/m^2. Bulk Density should be taken as 1900kg/m3, effective cohesion as 60kPa and effective friction angle as 0 degrees. Based on these figures the ultimate bearing capacity of the London Clay is 357kN/m2 and with a Factor of Safety of 3 is 120kN/m2.

Existing foundations should be underpinned to support the basement as designed by the structural engineers in the SMS in Appendix E.

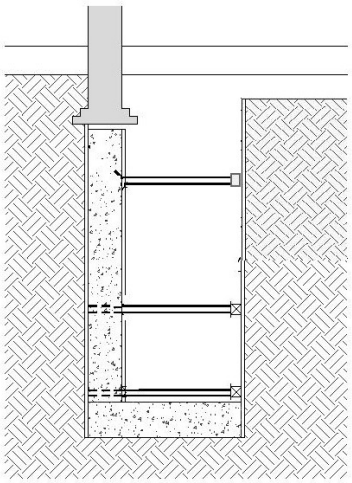
General underpinning temporary works:

1. Carry out soft strip and prop upper floor as required.
2. Install conveyor belt with appropriate boxing in to the front of the property to provide safe usage.
3. Follow proposed sequence of underpinning as per drawing by structural engineer - dig down to half depth while progressively installing temporary sacrificial propping, complete toe of underpin.

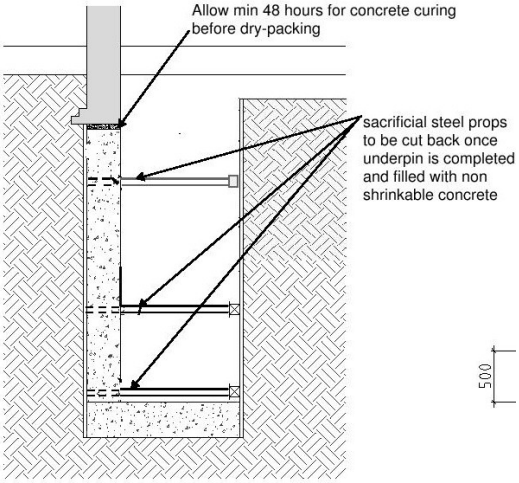


4. Install underpin –Allow a minimum curing duration of 24 hours between casting underpins and dry packing and a minimum of 48 hours curing period between dry packing and excavation of next underpin.
5. Waling beams may be used with individual underpins as well as retaining wall sections, as per the indicative drawing below.
6. On completion of each underpin sacrificial jacks/props can be cut back and the newly cast underpin propped against the middle earth with type 1 acrows or jacks at low, mid and high level until all RC walls are completed and excavation of middle earth is started.

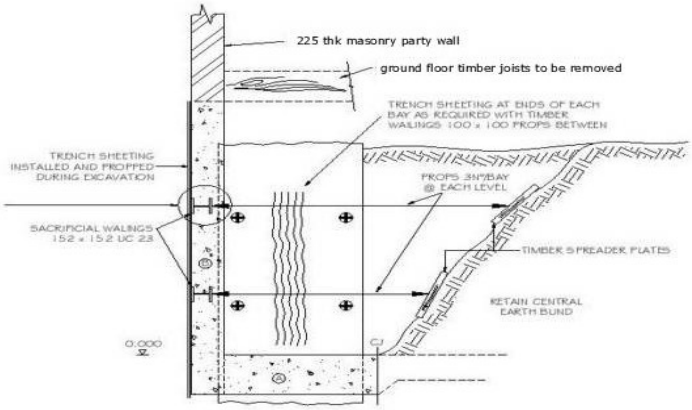
7. Once underpinning is completed including RC walls, dig out of middle earth is undertaken. After removing 1 meter of earth, super slim soldier props can be installed across the basement. Installation of soldier beams can be done progressively with the excavation.
8. Install reinforcement and cast basement slab.



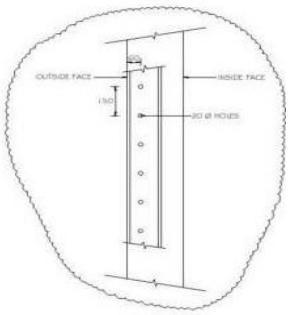
STAGE 4
ERECT SHUTTER
CONCRETE STEM OF UNDERPIN



STAGE 5
STRIKE SHUTTER WHEN CONCRETE HAS GAINED SUFFICIENT STRENGTH, DRYPACK, TRIM - OFF PROJECTING FOOTING, RE-PROP UNTIL BASEMENT SLAB IS CAST



SECTION A - A
INDICATIVE CONSTRUCTION FOR INDIVIDUAL BAYS
A - B SEQUENCE



DETAIL
TYPICAL PLAN OF WALING BEAM INCLUDING HOLES FOR VERTICAL REINFORCEMENT

14.7 Adjacent Structures

The development of the basement is unlikely to impact on adjacent properties provided mitigating measures and appropriate temporary and permanent design are undertaken.

The Party Wall Surveyor will undertake a structural condition survey of adjacent properties before work commenced on the main renovations.

The proposed basement will not lie within 5m of the pavement. Lateral movements associated with the excavations must be controlled by temporary and permanent works so as not to impact on the stability of any adjacent structures. It would be prudent to check all service locations before excavation.

Croft structural engineers have inspected the adjacent properties and confirm there is no evidence of subsidence and confirm that no adjacent structures have basements.

Ground movement calculations undertaken in accordance with CIRIA 580 indicate very slight Damage Category according to Burland and Boscardin Scale of Damage. Calculation Methodology is presented in Appendix F.

14.8 Underground Concrete

Results of testing for the levels of pH and sulphates in the clay indicate an elevated level of sulphate. The recommendation design of underground concrete is ACEC Class DS2-AC-2s from Table C2 of BRE Digest 1 Part C (2005). This assumes static or mobile water conditions on natural strata.

14.9 Service Excavations

Shallow excavations for services and the like are unlikely to be stable in the made or clay in the short or long term and will require substantial support. Some sump pumping may be required to keep the trenches dry.

14.10 Waste Disposal

Any spoil arising from excavations or landscaping works will need to be disposed of to a licensed tip in accordance with the EP (Duty of Care) Regs 1991 and Landfill (England and Wales) Regulations (2002) amended. Under the European Waste Directive landfills are classified as accepting inert non-hazardous or hazardous wastes in accordance with the EU Waste Directive. Based on the technical guidance provided by the Environment Agency it is considered likely that the soil from this site, would be classified as inert waste

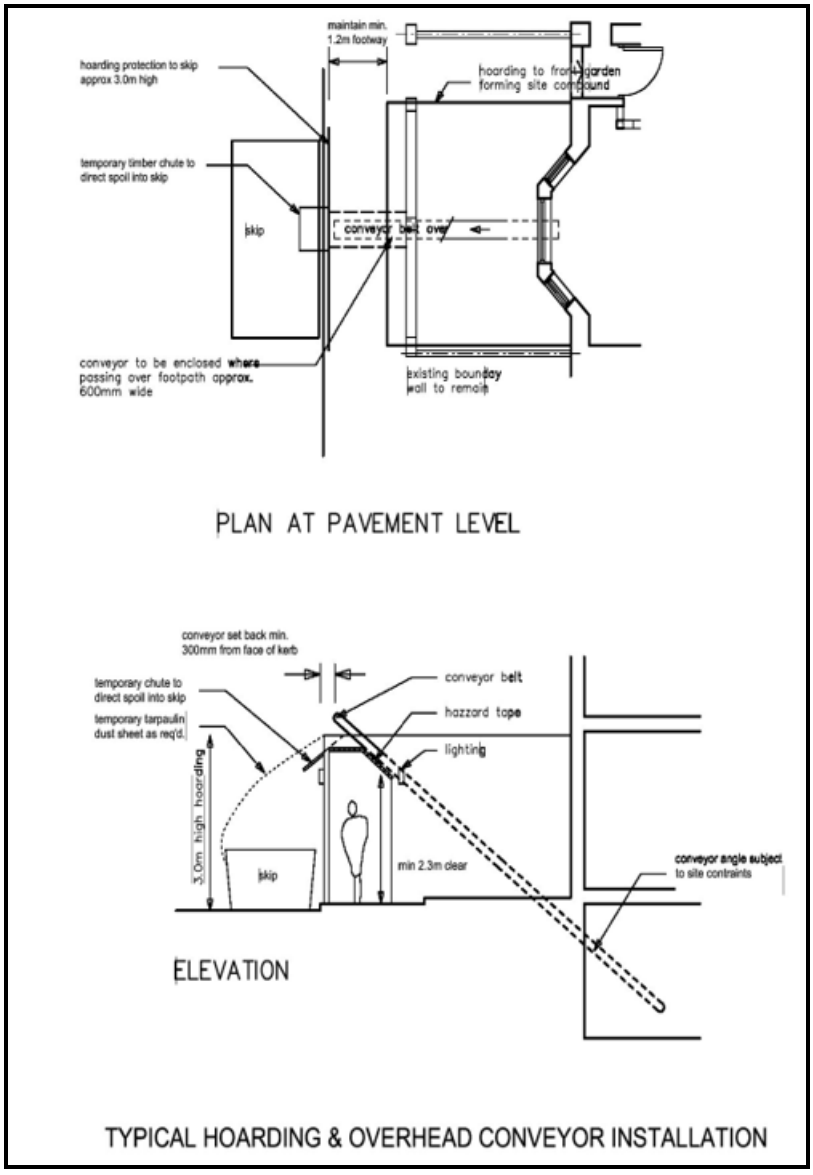
The local waste regulation department of the Environment Agency (EA) should be contacted to obtain details of tips that are licensed to accept the soil represented by the test results. The tips will be able to provide costs for disposing of this material if provided with the results of the environmental and Waste Acceptance Criteria Tests (WACS).

14.11 Hoarding and Conveyor System

The diagrams below illustrate a typical hoarding and conveyor system fr basement excavation**.**

14.12 Construction Management Plan

A Construction Management Plan is presented in Appendix G.



14.13 Recommendations

The development of the basement and lightwells is unlikely to impact on geology, groundwater, surface water or flooding, unlikely to impact on drainage or ground infiltration of rainwater.

It will be necessary to ensure that the basements are designed in accordance with the NHBC Standards and take due cognisance of the potential impacts highlighted above. This may be achieved by ensuring best practice engineering and design of the proposed scheme by competent persons and in full accordance with the Construction (Design and Management) Regulations.

Recommendations and mitigating measures are:

1. Make basement and lightwell watertight
2. Include compressible material or void beneath floor to accommodate heave.

3. Use non return valves in drains.
4. Underground Concrete design to DS-2.
5. Foundations to be on clay.
6. Emergency pump to be available.
7. Party Wall Surveyor to assess structural stability of adjacent properties.
8. Monitoring of adjacent properties to ensure movement predictions are of right order.

Full details of the suitable engineering design of the scheme in addition to an appropriate construction method statement and works programme and monitoring schedule are presented by Croft Structural Engineers in Appendix E.

Identified risks to the development include the possibility of shallow groundwater. Monitoring of groundwater levels should be undertaken for 3 months before construction starts. As the underlying geology is London Clay, it is probable that the water emanates from a thin siltstone band and will nor require dewatering. Sump pumping may be required especially during and after heavy rainfall.

The site was a works in the past and although contamination and toxic gases were not detected, and the site will be hard covered, reducing risk, it is recommended that a methane resistant membrane is used in construction.

There are no flood risks to the basement however, it is recommended that the water, electricity and gas services are located at ground level, non return valves are used in the drainage system, all service entries are sealed, wiring is protected and the basement walls are water resistant.

The main risks to development are to ensure that the work is carried out by a competent company.

15. GENERAL REMARKS

This report truly reflects the conditions found during the desk study and ground investigation. Whilst the desk study and ground investigation were undertaken in a professional manner taking due regard of additional information which became available as a result of ongoing research, the results portrayed only pertain to the information attained, and it is possible that other undetected information and undetected ground and gas conditions, undetected mining conditions and undetected contamination may exist. The desk study and ground investigation were only undertaken within the site boundaries and should not be used for interpretation purposes elsewhere. These conclusions are only a brief summary of the report, and it is recommended that the report is read in full to ensure that all recommendations have been understood.