BASEMENT IMPACT ASSESSMENT

AT

54 SHIRLOCK ROAD
LONDON, NW3 2HS

FOR

Mr & Mrs A. Kay

REPORT REF: AGK 3209

Engineering Geologists and Environmental Scientists

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June 2015

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Project	54 Shirlock Road, London NW6 1QJ		
Client	Mr and Mrs Kay		
Date	June 2015		
Version	Issue 2 Sept 2015		
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Information has been collated for the Report by:

- Ashton Bennett Ltd, Screening and Scoping for a Basement Impact Assessment, 54 Shirlock Road, London, NW3 2HS, Report No AGK 3206, April 2015.

EXECUTIVE SUMMARY

Site Location	54 Shirlock Road, London, NW3 2HS
Site Description	Residential House
Historical Land Use	Open Land and existing Residential House
Current Land Use	Residential House
Potential Contamination	Low Risk
Archaeological Potential	Low Risk
Hydrogeology	Non productive Aquifer
Hydrology and Flooding	No risk of flooding from seas and rivers Low risk from groundwater and surface water and reservoir water
Underground rivers	Culverted river 450m to the east
Critical Drainage Areas	Not within a CDA or Local Flood Risk Zone (LFRZ)
Flooding from Surface Water	Low Risk
Flooding Incidents	None recorded in Shirlock Road
Flooding from Sewers	Not within CDA or LFRZ
Flooding from Reservoirs	Low Risk
Flooding from Groundwater	Low Risk
SUDS	Ground not suitable for soakaways, therefore use of rainwater harvesting, and tanking to basement
Geology	London Clay, highly plastic and use of material to accommodate heave required.
Landfill gas potential	No landfill within 250m, no methane or radon gas protection required
Contamination	Soil tests indicate no contamination in soils tested. WACS Tests indicate Inert material for waste disposal
Geotechnical Properties	Highly plastic clay, low bearing capacity clay.
Extra hard cover	Garden to be reduced from 6m length to 4.5m length
Groundwater	Monitored as 2.80m bgl.
Concrete	Underground concrete to be designed to DS2-AC2
Ground Movement	To be assessed in accordance with Burland and Boscardin and Cording, See Structural Engineers Report
Waste Disposal	Waste disposal is responsibility of owner to ensure it is disposed appropriately to landfill. Likely to go as inert waste.
Tunnels and services	A search for underground services is presented separately.
Recommendations	Design of rainwater harvesting, waterproofing of basement, inclusion of compressible material/void beneath floor slab to accommodate heave.

1. INTRODUCTION

This report describes the results of a screening and scoping exercise, ground investigation and geology and hydrogeology Report for a Basement Impact Assessment for the development of a basement at 54 Shirlock Road, Gospel Hill, Camden, London, NW3 2HS. The work was undertaken for the client Mr and Mrs A and G Kay and was carried out by the Ashton Bennett Consultancy. 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 may have on the ground stability, the hydrogeology and the hydrology in the vicinity of the site. The site lies within the Administrative Boundary of Gospel Hill 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).

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 in the screening.
- Ground Investigation – Establishment of baseline ground and groundwater conditions
- Review of the ground/groundwater conditions
- Review of the local hydrology/hydrogeology conditions
- Impact Assessment – Determination of the potential impact of the proposed basement on the baseline conditions.
- Review – by London Borough of Camden

2. THE SITE

2.1 Site Description

The site is located at number 54 Shirlock Road a terraced property which lies between the A400 road to the east and the A41 Finchley Road to the west in the Gospel Hill District of Camden. The site lies on the east side of Shirlock Road and at the north end of the road. Shirlock Road lies between Roderick Road to the west and Courthope Road to the east.

A site walkover was undertaken on Thursday April 16th 2014 in order assess the property and assess the access for drilling rigs. The ground investigation was undertaken on May 14th 2015.

The site area comprises the premises of 54 Shirlock Road and is bounded to the north by No 56 Shirlock Road with All Hallow's Church beyond and Savernake Road with residential properties beyond. The site is bounded to the south by No 52 and further houses fronting onto Shirlock Road. The site is bounded to the west by Shirlock Road with houses beyond and to the east by Hampstead Hill pre-preparatory School and houses fronting onto Courthope Road.

The site is mostly hard covered with a small garden to the rear covered in timber decking.

It is proposed to extend the basement beneath the existing kitchen and part of the garden and to add a side extension to the existing kitchen.

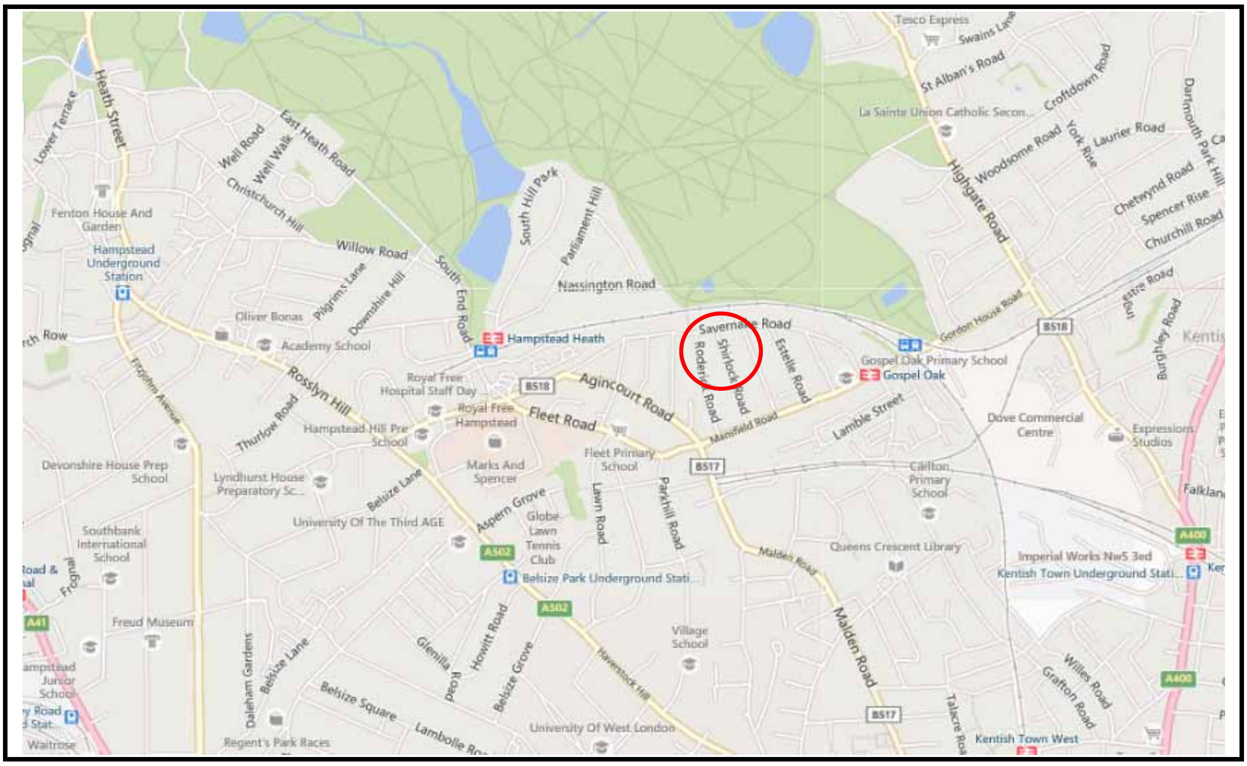

Figure 1 Site Location Plan

All land on the site was relatively flat at less than 7 degrees from the horizontal.

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 collecting drainage from the adjoining properties.

There is an existing garden area in the rear of the site which will be reduced in size following construction from 6.00m in length to 4.50m in length.

The proposed development is to construct a one storey basement to the property. There is an existing basement to the property beneath the front hall and the proposals are to extend the basement beneath the rear of the house and part of the garden and to increase the width of the ground floor kitchen. The basement will be founded 4.0m bgl at the front of the house and 3.0m at the rear.

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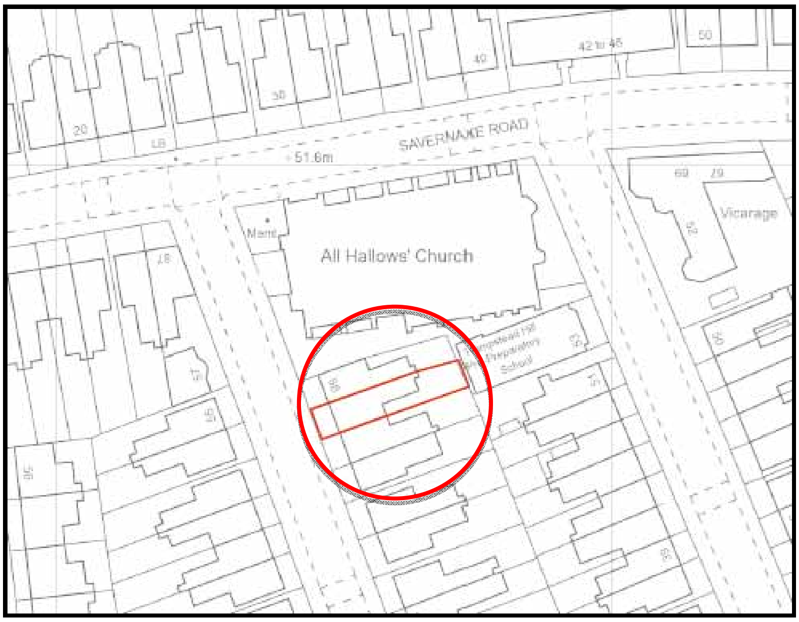

Figure 2 Site Plan and Site Frontage

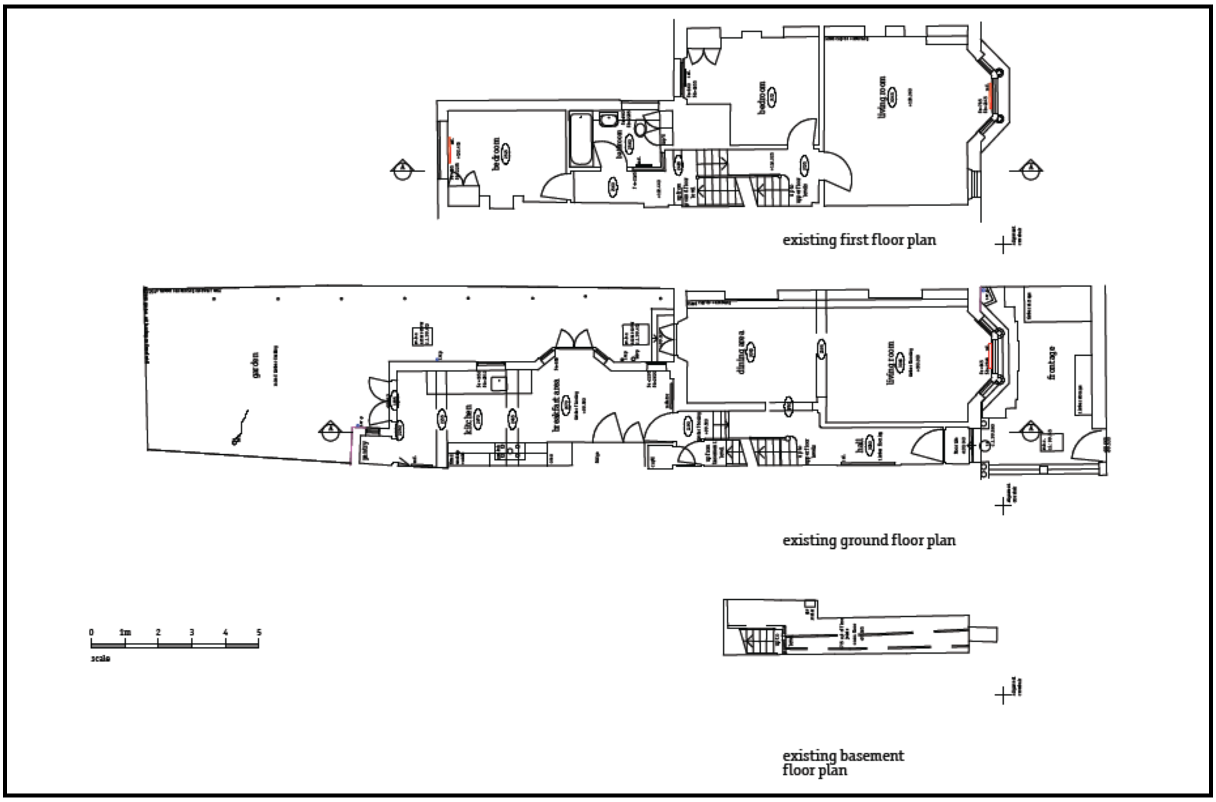

Figure 3A Existing Site Plan

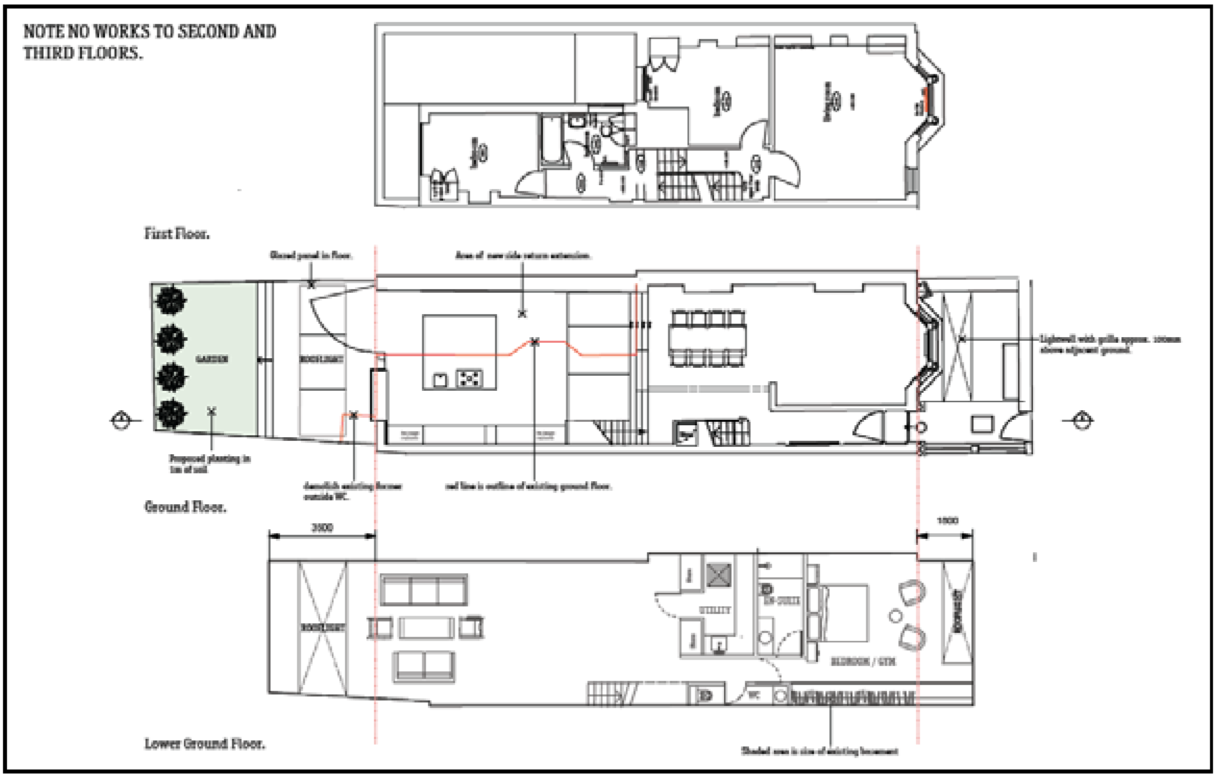

Figure 3B Site Proposals Plan

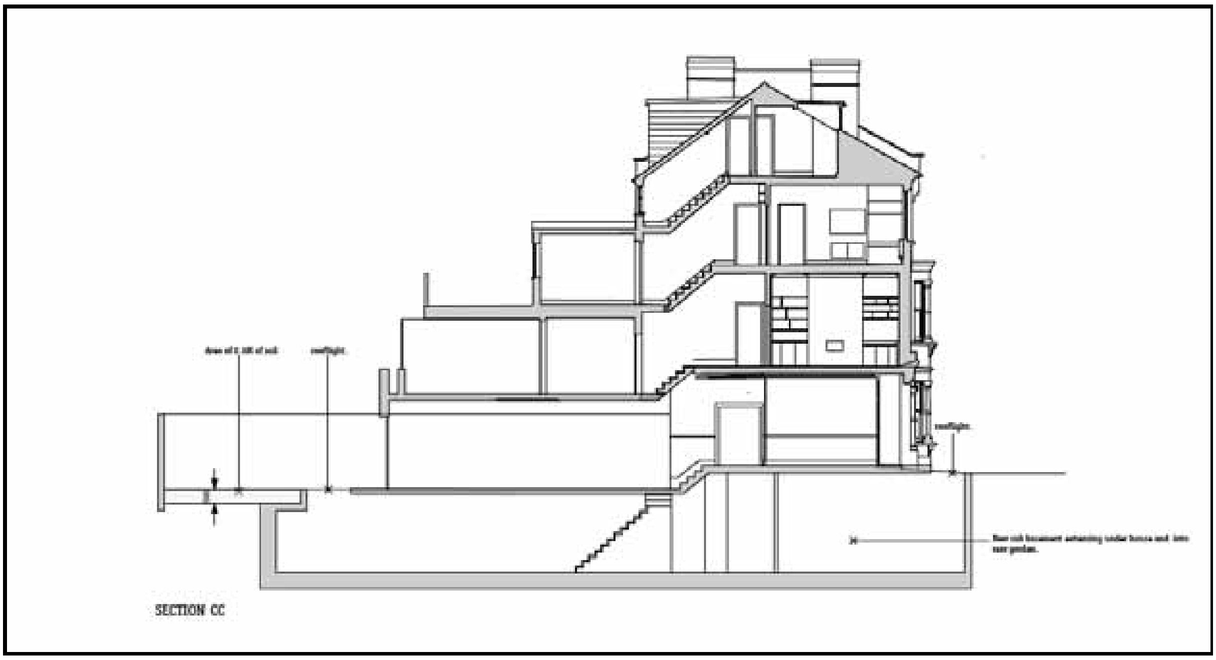

Figure 3C Site Section

The site lies around National Grid Reference 527860[E]185658[N] at a height of around 50m above Ordnance Datum. A Site Location Plan is presented as Figure 1 and a Site Plan and Site Frontage is presented as Figure 2. The Existing Site Plan, Site Proposals Plan and Site Section are presented as Figures 3A, 3B and 3C respectively and are also presented in Appendix A.

A Geological Plan is presented as Figure 4, and a Landslip Plan as Figure 5. A Local Borehole Plan is presented as Figure 6. A Hydrogeology Plan is presented as Figure 7. An EA Risk of Flooding from Groundwater Plan is presented as Figure 8. A Surface Water Features Plan is presented as Figure 9. Surface Water Flood Risk is presented as Figure 10 and Surface Water Flooding 1975 and 2002 is presented in Figure 11 and a 1 in 1000 Year Flood Event Plan in Figure 12, and Flooded Roads 1975 and 2002 as Figure 13. The NW Storm Relief Sewer Location is presented as Figure 14 and the EA Flood Risk from Reservoirs as Figure 15. External Sewer Flooding is presented as Figure 16. The Camden SWMP Critical Drainage Areas and Local Flood Risk Zones as Figure 17. The EA Recorded Landfill Sites within 500m is presented as Figure 18.

Transport Infrastructure is presented as Figure 19 and Railway Infrastructure as Figure 20. Tunnel Locations are presented as Figure 21. A Borehole Location Plan is presented as Figure 22 and a Trial Pit Drawing as Figure 23. Drawings of site proposals are presented in Appendix A and archival maps are presented in Appendix B. Borehole Logs and Laboratory Test Results are presented in Appendix C.

2.2 Site History

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
1872 & 1872-4	1:1,056 & 1:10,560	The site is shown occupied by open fields	The site is surrounded by open fields with large railway tracks and sidings to the north, east, south and west. Residential houses are annotated to the south.
1894 & 1896	1:1,056 & 1:10,560 & 1:2,500	The site is shown occupied by a terraced house occupying most of the centre and west of site. a garden area is shown in the east of site.	The site is surrounded residential terraced houses to the west, south and east with accompanying roads including Shirlock Road immediately west of site. Open land to the north of site including Highgate Ponds and Hampstead Ponds.
1915	1:2,500	The site is shown to be partly occupied by a building.	Further residential development to the north of the site and church annotated to the immediate north.
1920	1:10,560	The site is shown to be partly occupied by a building.	The surrounding area is by this date more developed with housing
1936 & 1938	1:2,500 & 1:10,560	The site is shown to be partly occupied by a building.	No change to the surrounding area.
1948-9	1:10,560	The site is shown to be partly occupied by a building.	The surrounding area is heavy developed with housing with the exception of Parliament Hill to the north of the site.
1952 & 1952-3	1:1:250 & 1:2,500	No change to the site area.	A running track is annotated to the north of site immediately north of the railway lines.
1957-8	1:10,560	No change to the site area.	No change to the surrounding area.
1965-67 & 1965-8	1: 2,500 & 10,560	No change to the site area.	No change to the surrounding area.
1973-4	1:1,250 & 1:10,000	No change to the site area.	No significant change to the surrounding area.
1991 & 1991-5	1:1,250	No significant change.	No significant change to the surrounding area.
2002	1:10,000	No significant change.	No significant change to the surrounding area.
2010	1:10,000	No significant change.	No significant change to the surrounding area.
2012	1:10,000 & 1:1,250	No significant change.	No significant change to the surrounding area.

In summary, the site was open fields until 1894, when Shirlock Road and the existing property was constructed. The site and surroundings have changed very little since 1893 apart from housing development to the west, south and east of site.

3. POTENTIAL CONTAMINATION

In addition to made ground that may have been associated with the nearby rail lines, the historical map search has identified the site as being open ground until circa 1894 when the house was constructed. There is therefore a very low potential for contamination on the site. Tests for contamination were undertaken for Health and Safety for workmen.

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.

4. ARCHAEOLOGY AND SENSITIVE SITES

4.1 Archaeology

The archival maps have not identified any potential for archaeological features that could be present on the site.

4.2 Sensitive Sites

The site does not lie within 1300m of a Site of Special Scientific Interest, within 200m of 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 Nitrate Vulnerable Zone or Green Belt.

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

5. SITE GEOLOGY

5.1 Geology

The published 1:50,000 scale British Geological Survey (BGS) geological map of the area (Sheet 256 “North London”) shows the site to be underlain by the London Clay Formation (up to 85m thick) of the Eocene geological epoch. The London Clay is underlain by further clays, sands and Chalk. An extract of the BGS Geological Map is provided in Figure 4 below.

The London Clay is shown not to be overlain by any superficial deposits. Given the historical development of the site and surrounding areas, there may be made ground present on the site. The London Clay may be susceptible to shrinkage and swelling under varying moisture conditions in the ground.

According to the BGS, the site is unlikely to be at risk from a landslide, compressible ground, collapsible rocks or soluble rocks or running sand based on the geology.

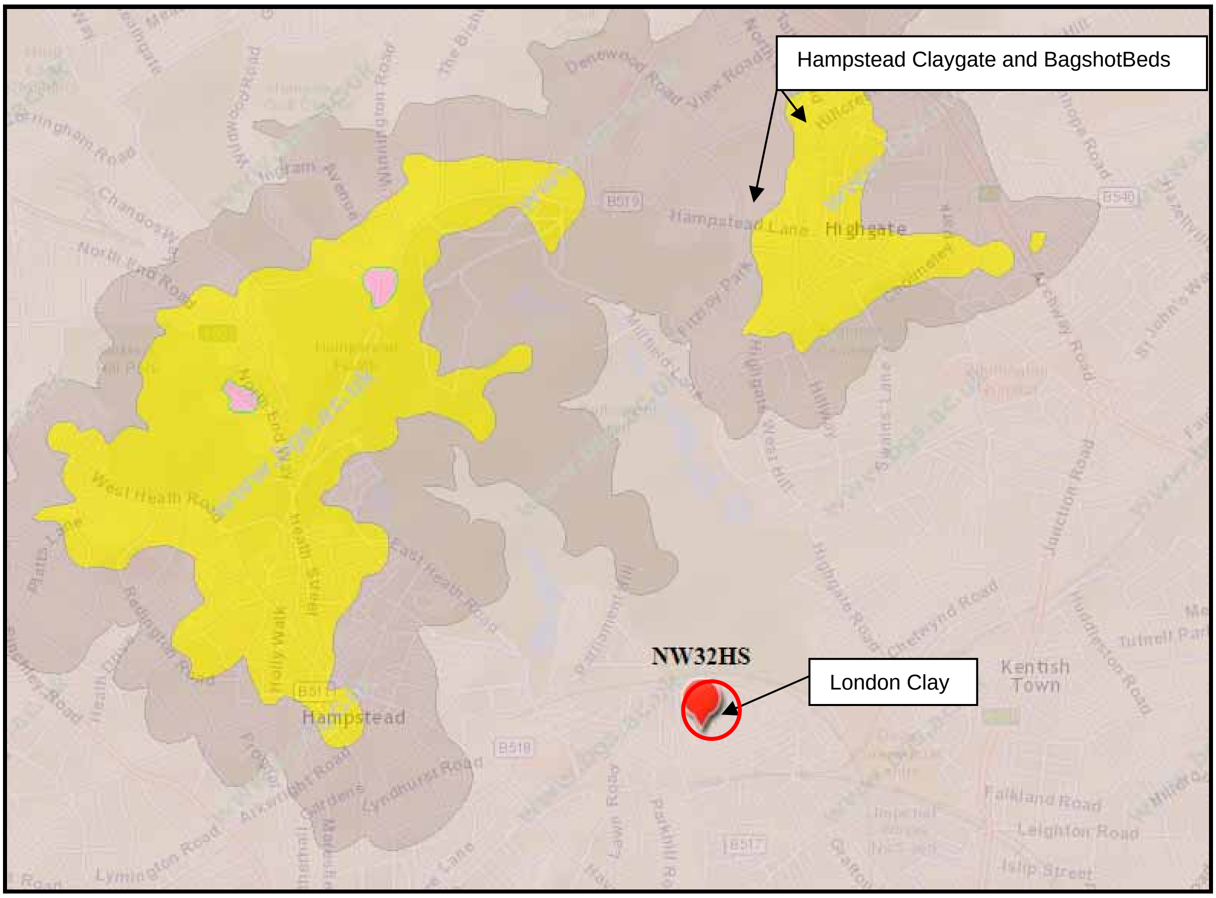

Figure 4 Geological Plan

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

5.2 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.

5.3 Landslips

The site is shown not to be within an area of significant landslide potential as shown in Figure 5 Landslip Plan. (reference Figure 16 of Arup Report for London Borough of Camden “Guidance for Subterranean Development”, 2010). This is reinforced by the very low slope angles recorded during the site walk over and the geology of the London Clay with no overlying deposits.

The railway cuttings to the north and south of the site are too distant to affect the site stability. The level of the ground in the area of the site is circa 1% angle slope to the horizontal. There are no plans to reprofile the site that could lead to ground instability.

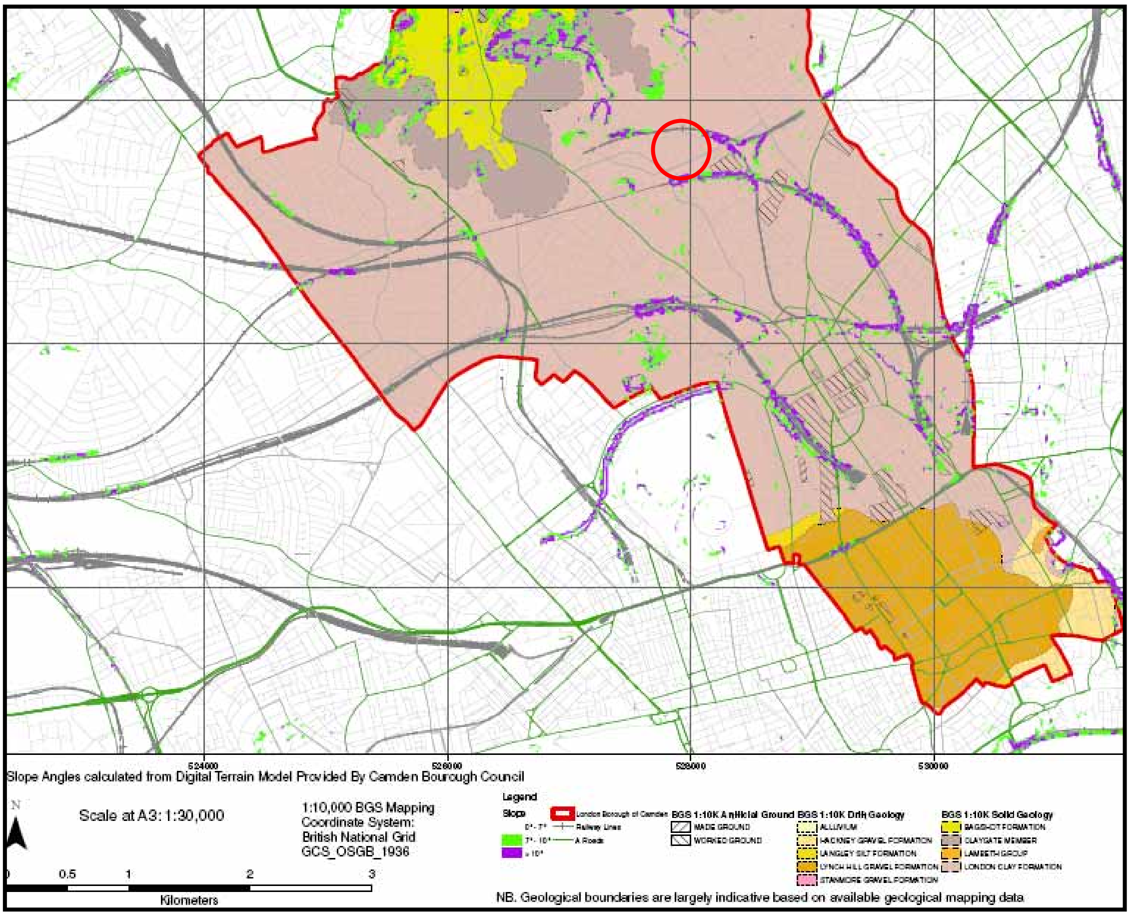

Figure 5 Landslip Plan

5.4 Local Boreholes

A number of relevant available historic borehole logs have been obtained from the BGS website and are summarised in Table 2 below. A plan showing the available local borehole locations is presented in Figure 6.

TABLE 2
Summary of Historical Borehole Logs

NGR	BGS Reference	Depth bgl in m	Brief Summary of Ground Conditions In m
527390E 185380N	TQ28NE27	177	London Clay 0-69m Woolwich & Reading Beds 69-90m Thanet Sand 90-101 Upper Chalk 101-177
528740E 186120N	TQ28NE14	396.84	London Clay 0-71 Woolwich and Reading Beds 71-90 Thanet Sand 90-98 Chalk 98-277 277+ older strata

These boreholes confirm the geology of the area surrounding the site and confirm that any local water abstraction wells are from generally >100m depth into the Chalk aquifer.

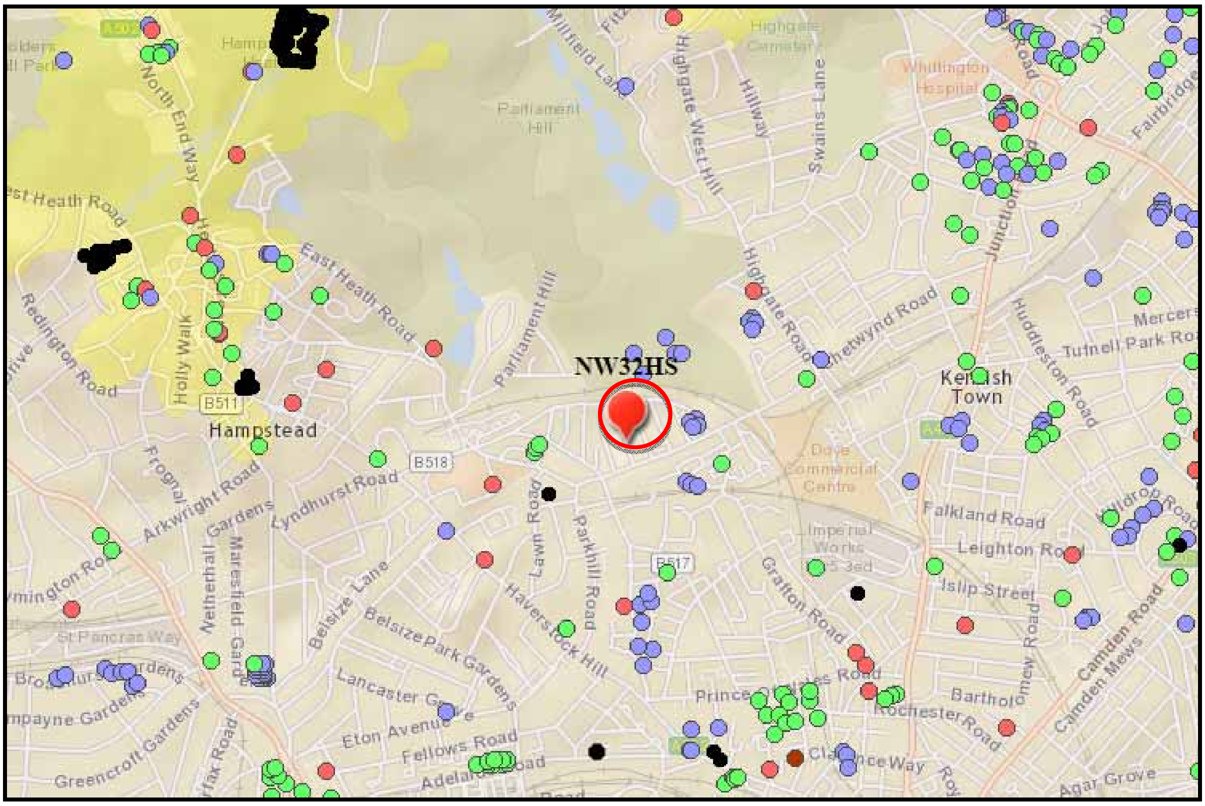

Figure 6 Local Borehole Plan

6. HYDROGEOLOGY
6.1 Aquifers

The above referenced geological map indicates the site to be underlain by the London Clay Formation, which is relatively impermeable. The Environment Agency have designated the London Clay Formation beneath the site as an “Unproductive Aquifer” which means the strata has a low permeability and negligible significance to water supply or base flow to rivers. Permeability of the London Clay varies from $5x10^{-6}$ to $1x10^{-10}$m/sec (BS 8004, 1986). The ground investigation confirmed the presence of London Clay.

The site does not lie on a Groundwater Vulnerability Zone.

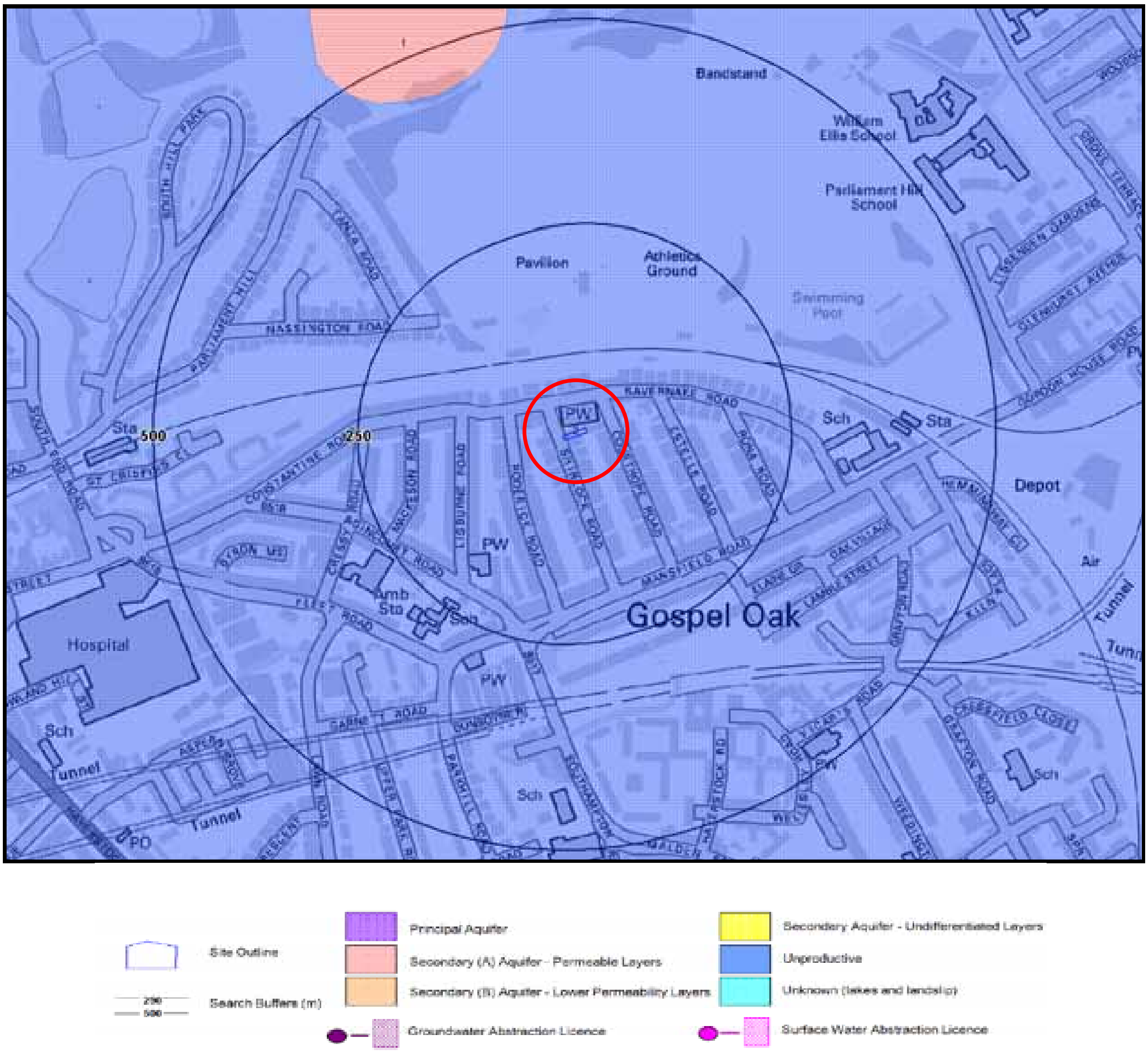

Figure 7 Hydrogeology Plan

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

6.2 Groundwater Depth and Flow

The development of a basement is unlikely to detrimentally affect any groundwater which lies circa >100m bgl in the Chalk Aquifer. There are no recorded Superficial Deposits overlying the London Clay which could hold perched water.

Monitoring of groundwater levels in an installed standpipe indicated a level of 2.80m bgl in the rear garden. This water is expected to issue very slowly from a silty or gravelly layer of restricted extent in the London Clay. The groundwater lies at formation level and therefore sump pumping may be required for construction. Dewatering is unlikely to be necessary.

Due to the impermeable nature of the strata it is unlikely that the basement will detrimentally affect any groundwater flow. Groundwater in the London Clay is generally contained in isolated thin bands of silt or gravel of limited extent. Nevertheless it would be prudent to waterproof the basement and take into consideration of potential uplift pressures in structural design if groundwater rises.

6.3 Wells and Springs

There are no groundwater or potable water abstraction licences within 1250m of the site. The site does not lie within a Source Protection Zone for a potable water supply.

Other unrecorded or unlicensed wells may be present close to the site, however abstractions are unlikely to be from the London Clay Formation and likely to be from the underlying Chalk Formation at circa >100m bgl. The development is unlikely to detrimentally affect any water abstractions.

There are no springs recorded on the OS maps in the local vicinity and springs are unlikely to occur in the London Clay.

6.4 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.

The Environment Agency Map reproduced in Figure 8 indicates there is no risk of flooding from groundwater on the site.

6.5 Summary

Based on the ground and groundwater conditions encountered it is considered that the development proposals are unlikely to pose a risk to groundwater levels or groundwater flow or to wells which lie >1250m from the site. It is unlikely that the basement will be detrimentally affected by the local hydrogeology provided sump pumping is available during construction, the basement is waterproofed (Grade 3 BS 8102) and uplift pressures from rising groundwater of at least 1m (BS 8102) are taken into consideration in design.

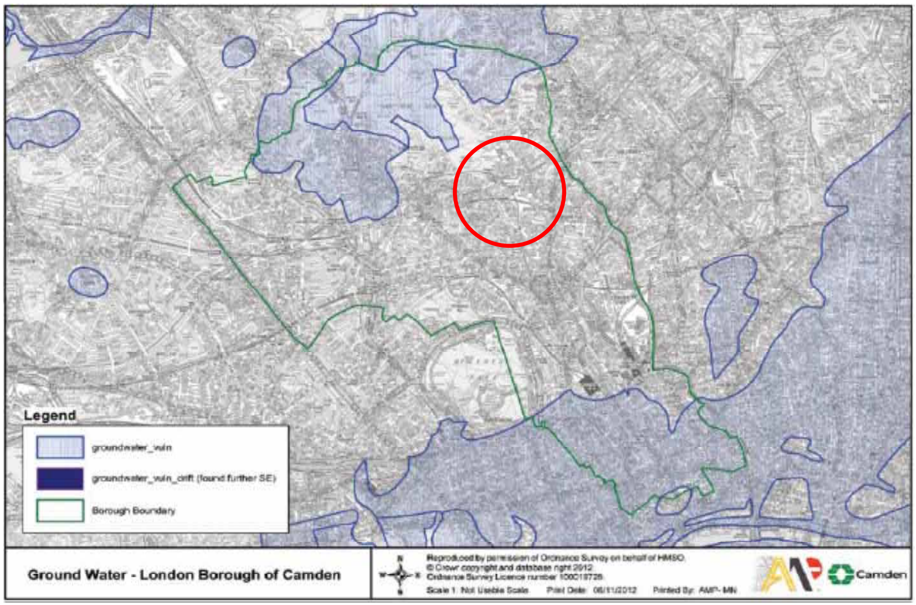

Figure 8 EA Risk of Flooding from Groundwater

7. HYDROLOGY AND FLOOD RISK

7.1 Hydrology

Prior to the commencement of the development on the site, the rainfall over the area of the site drains in the following ways:

- Surface water from the rear roof drains into the drainage system.
- Surface water from the front roof drains into the drainage system that runs under the front area and to the south east to Mansfield Road.
- Surface water falling on the rear garden drains into the ground.

On completion of development the rainfall will all drain into the town drains or rainwater harvesting. At the present time there is 6m of garden covered in timber decking to the rear of the house. Following construction the garden will be reduced to 4.50m, being 3.00m of original garden and 1.50m of 0.50m deep garden over the eastern extremity of the basement. Soakaways are highly unlikely to be successful in the London Clay and therefore surface water drainage should continue to be directed to the sewer system and rainwater harvesting could be considered.

It is unlikely that surface water flow from the site will increase significantly.

There are no ponds, ditches, streams or other surface water features within 250m of the site. There is one river which is culverted at 450m to the north east of the site as shown by a green line in Figure 9 Surface Water Features.

There are no biological or chemical river quality assessments within 1.5km of the site. There are no surface water abstraction licences within 1750m of the site.

The proposed basement development is considered to not present a risk to or likely to be harmed by surface water features.

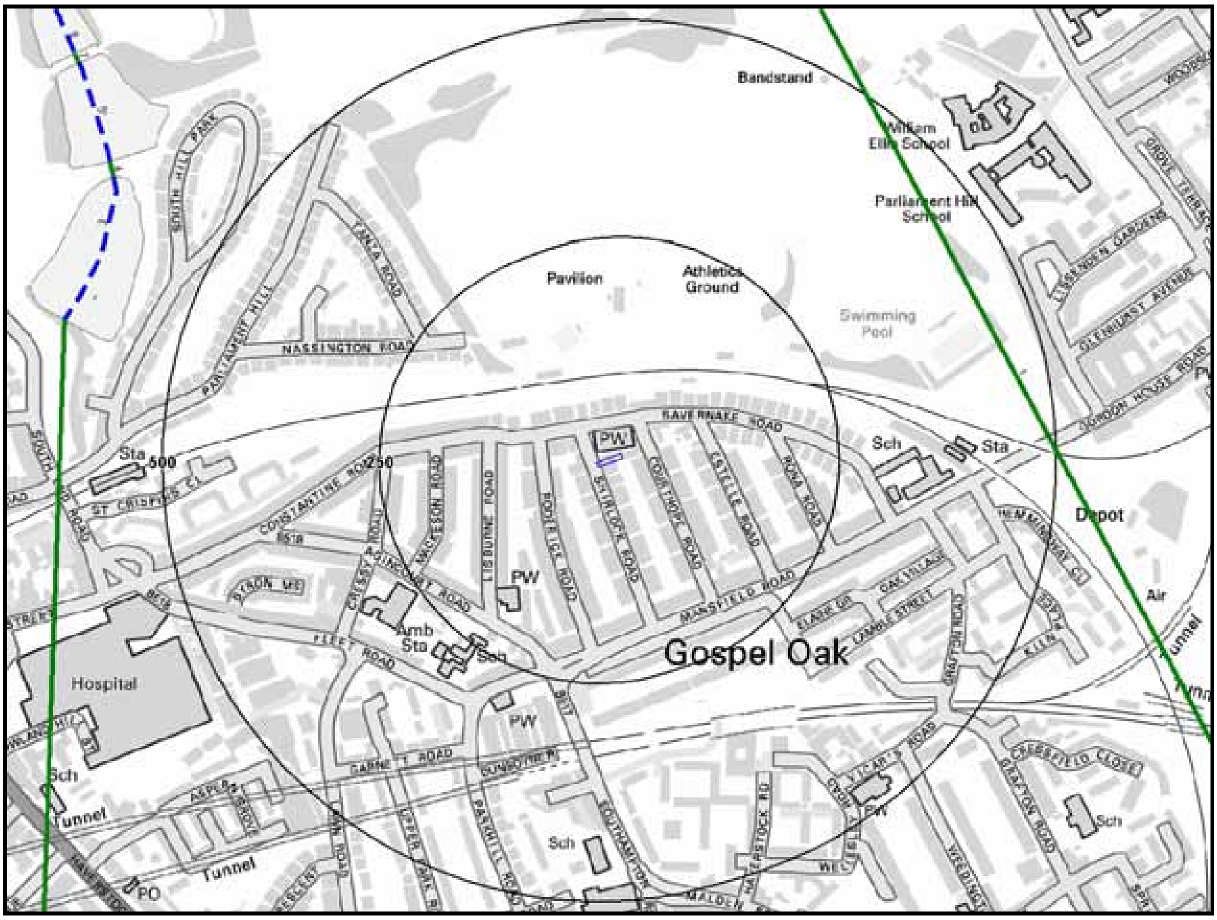

Figure 9 Surface Water Features

7.2. Flood Risk From Surface Water

The site is shown by the Environment Agency to lie within a low risk for flooding from rivers and very low from the sea.

Camden is primarily 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), flooding from sewers which have either burst or gone beyond capacity due to heavy rainfall. All of these situations are only likely to occur in extreme rainfall events such as in 1975 and 2002.

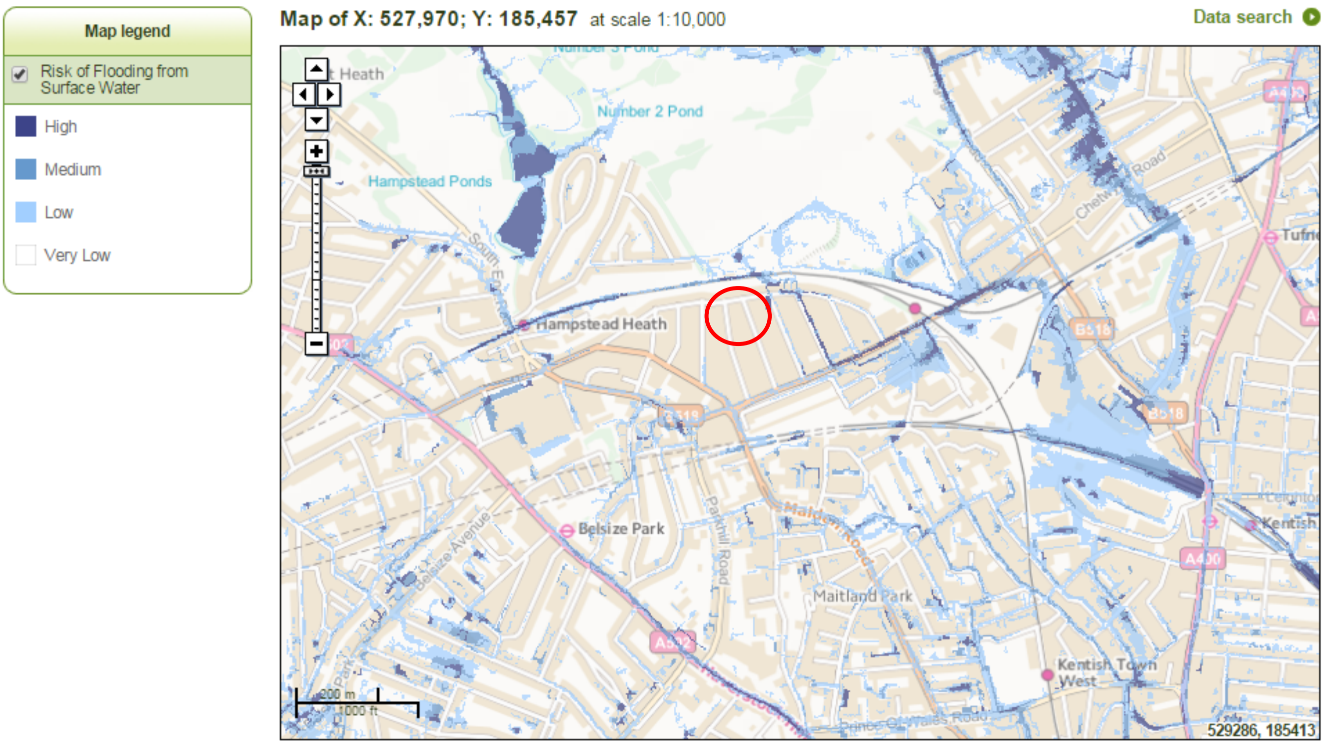

Figure 10 Surface Water Flood Risk

The history of flooding in this area is that Gospel Oak was subject to surface water flooding along Mansfield Road in 1975 but not in the flooding of 2002. Mansfield Road lies 250m to the south of Shirlock Road. Shirlock Road was not flooded in either event.

Thames Water invested in significant new flood risk infrastructure as part of the West Hampstead Flood Relief Scheme. The project involved larger diameter sewers and a holding tank both of which have substantially reduced flood risk in the area.

Shirlock Road was not flooded in 1975 or 2002 flood events as evidenced on Figures 10, 11 and 13, collected from several different sources including the EA website, Flood Scrutiny Panel 1975 and 2002 and the Surface Water Management Plan for London Borough of Camden 2011 and the URS SFRA Report (2014).

Shirlock Road is at low risk of being affected by a 1 in 1000 year flood event as detailed in Figure 12.

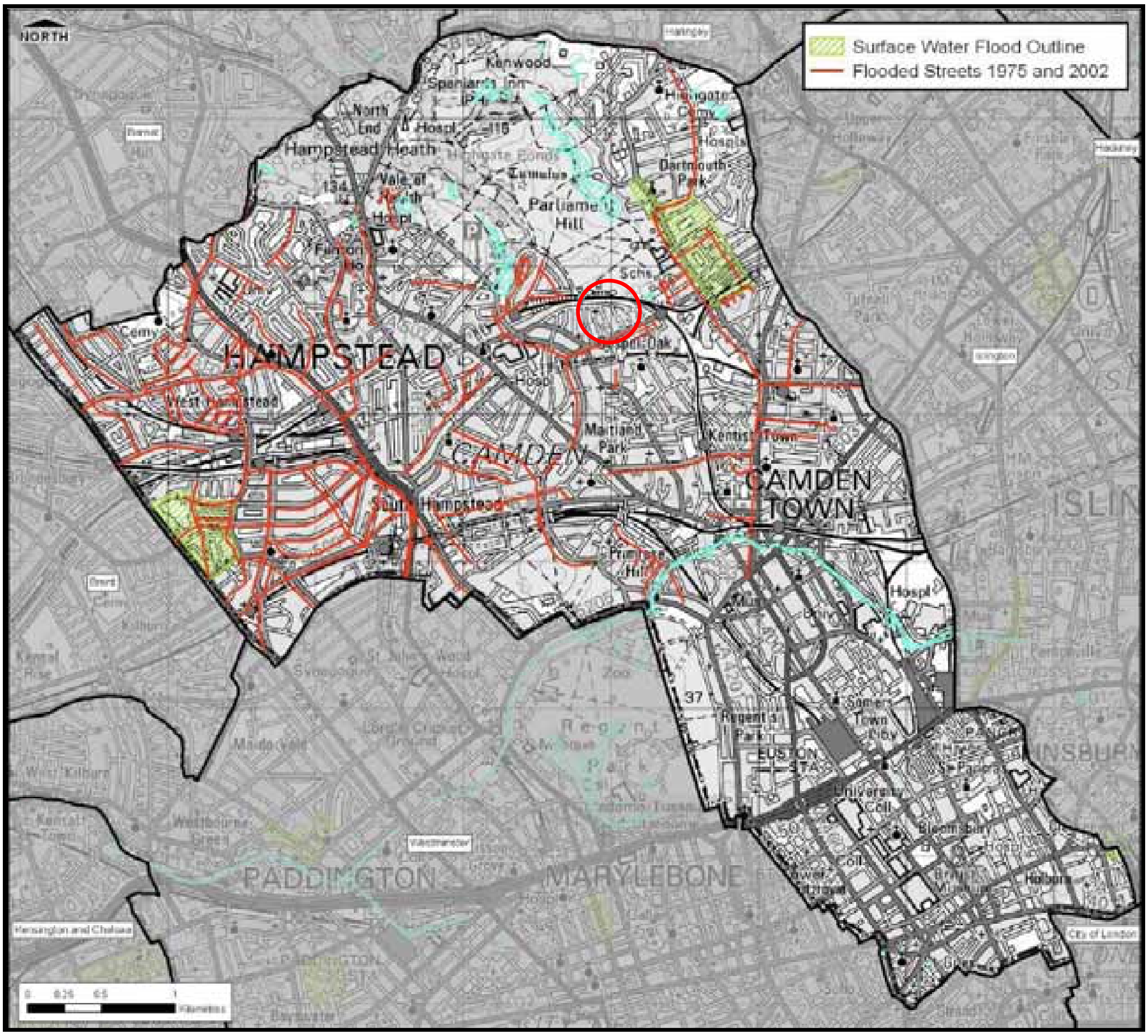

Figure 11 Surface Water Flooding 1975 and 2002

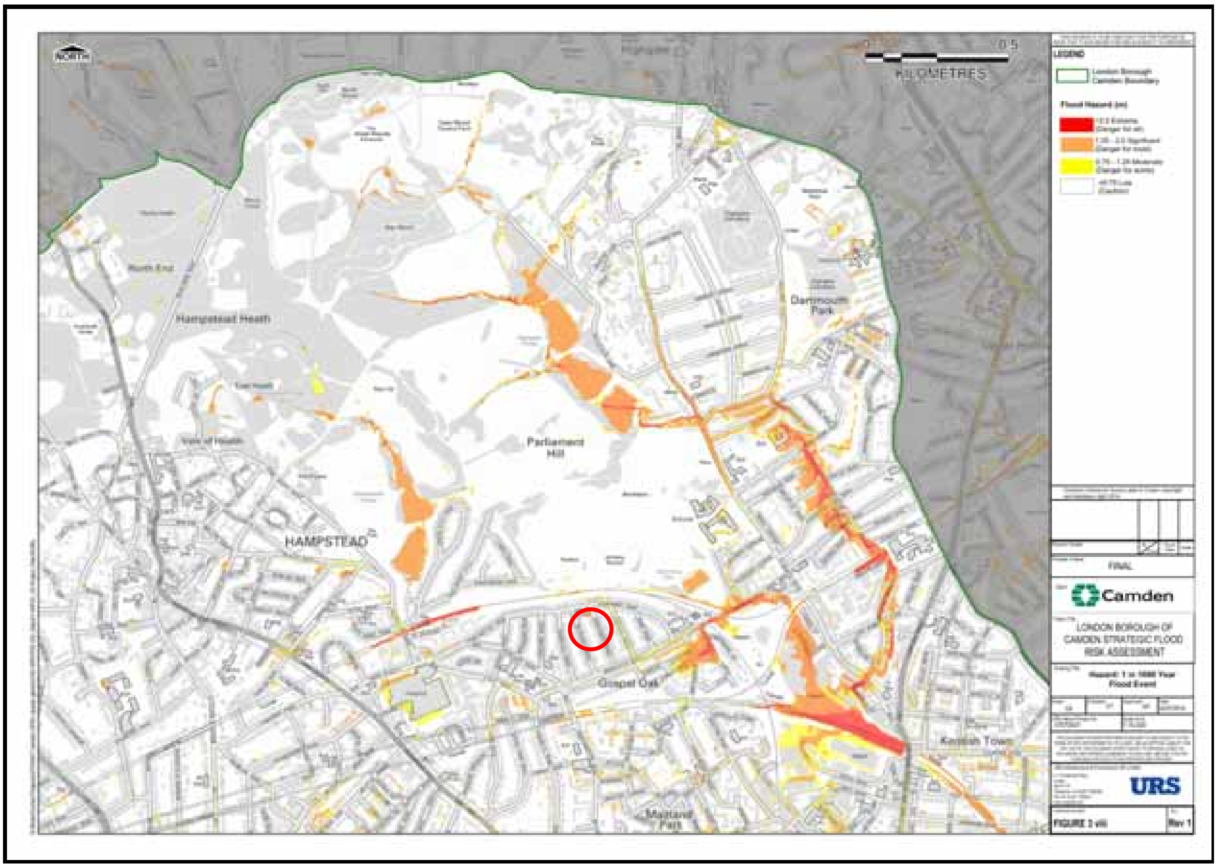

Figure 12 1 in 1000 year Flood Event

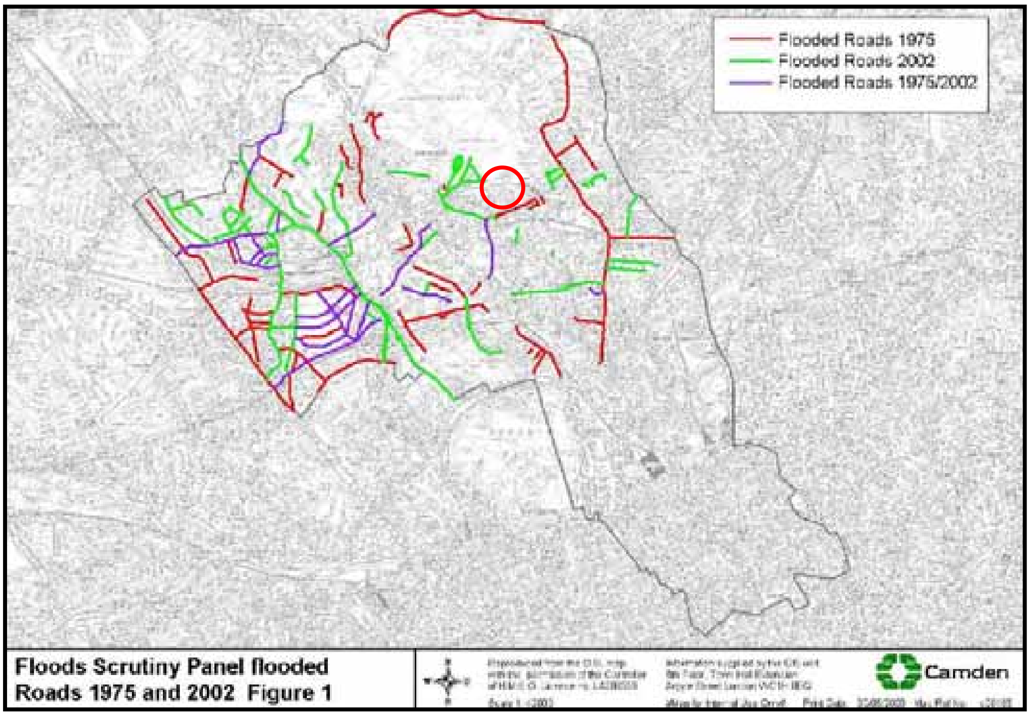

Figure 13 Flooded Roads 1975 and 2002

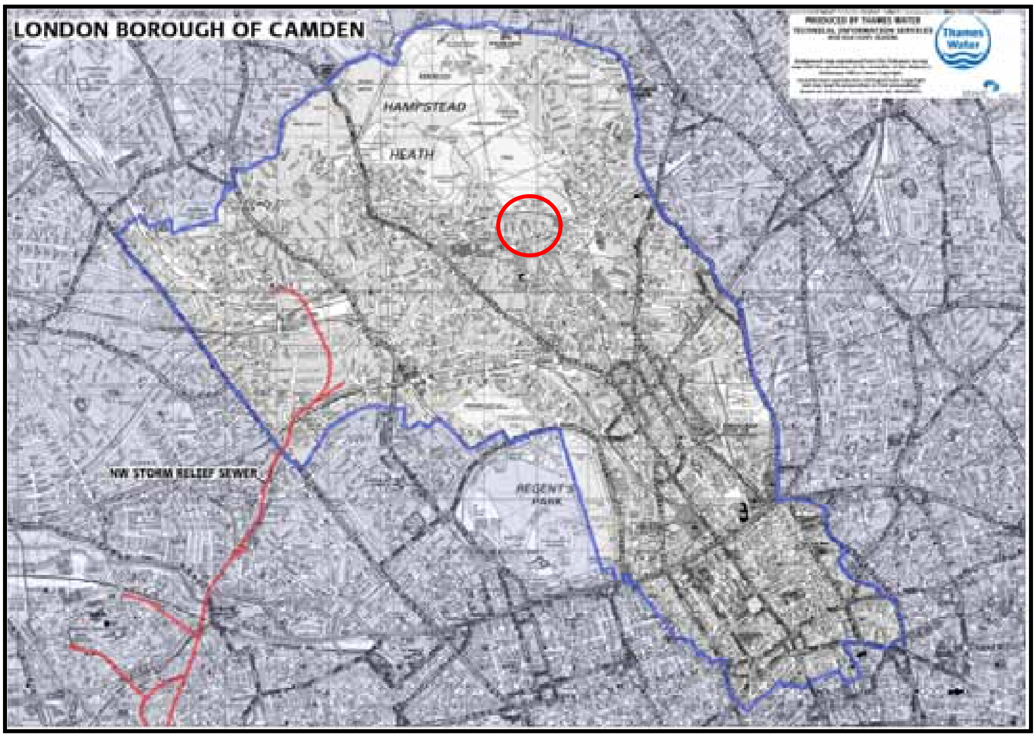

Figure 14 NW Storm Relief Sewer (shown in red)

7.3 Flood Risk From Rivers

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 is within a Flood Zone 1. The site does not lie within a Critical Drainage Area or in a Local Flood Risk Zone and a full Flood Risk Assessment is not required.

7.4 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 may be at risk of flooding from reservoirs. There is a risk from the Hampstead Heath Reservoir to the north east of the site as detailed in Figure 15.

Figure 15 EA Flood Risk From Reservoirs

Below are the reservoirs that could affect this area.

Hampstead Pond No.1		
Reservoir Owner: Corporation of London		
Reservoir location (grid reference): 527210, 185750	**Environment Agency Area:** North East Thames Area in South East Region	**Local Authority:** Camden

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.

7.5 Flooding from Sewers

Figures 5a and 5b within URS SFRA Report (2014) reproduced below in Figure 16, indicate the site has not been the subject of flooding internally or externally from sewers. The appropriate sewer design to Thames Water will be undertaken.

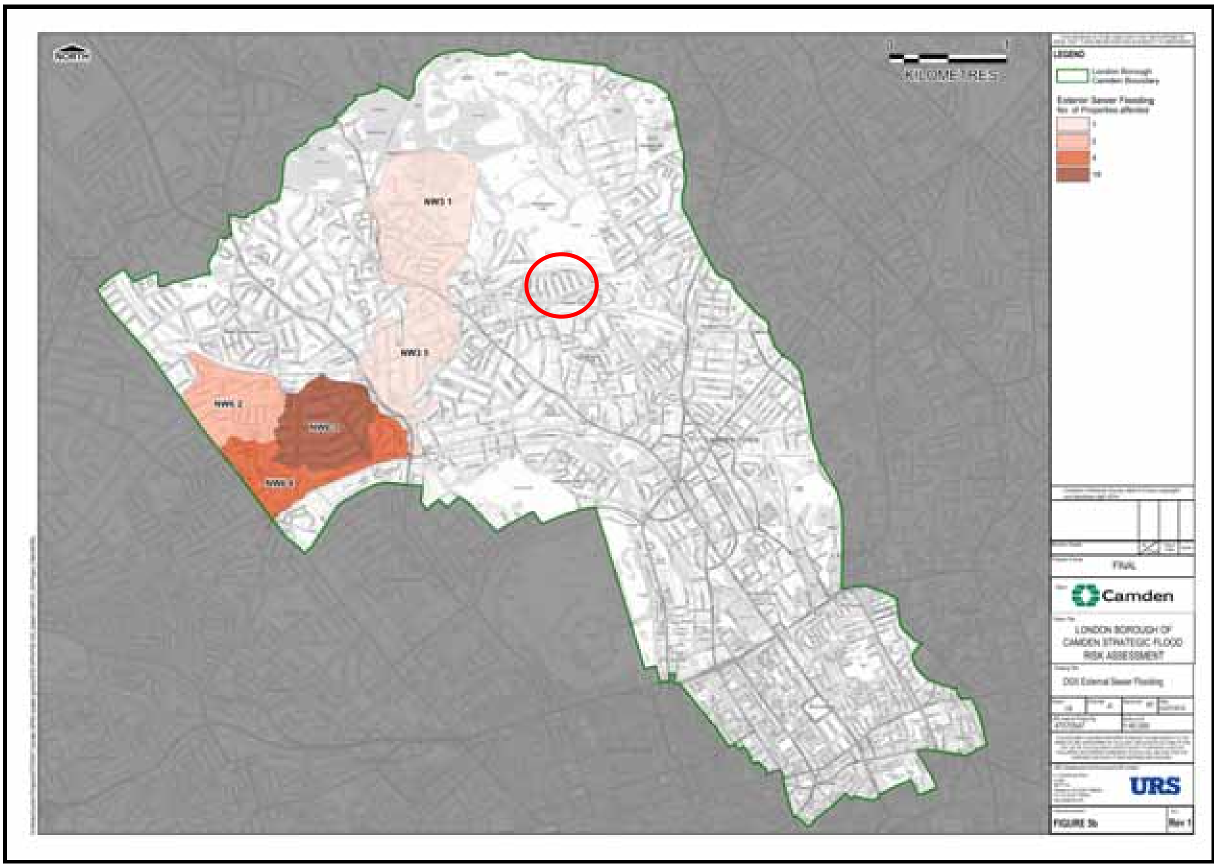

Figure 16 External Sewer Flooding

7.6 Critical Drainage Areas and Local Flood Risk Zones

The site does not lie within a Critical Drainage Area or Local Flood Risk Zone (LFRZ) as detailed below in Figure 17 and therefore a detailed Flood Risk Assessment is not required.

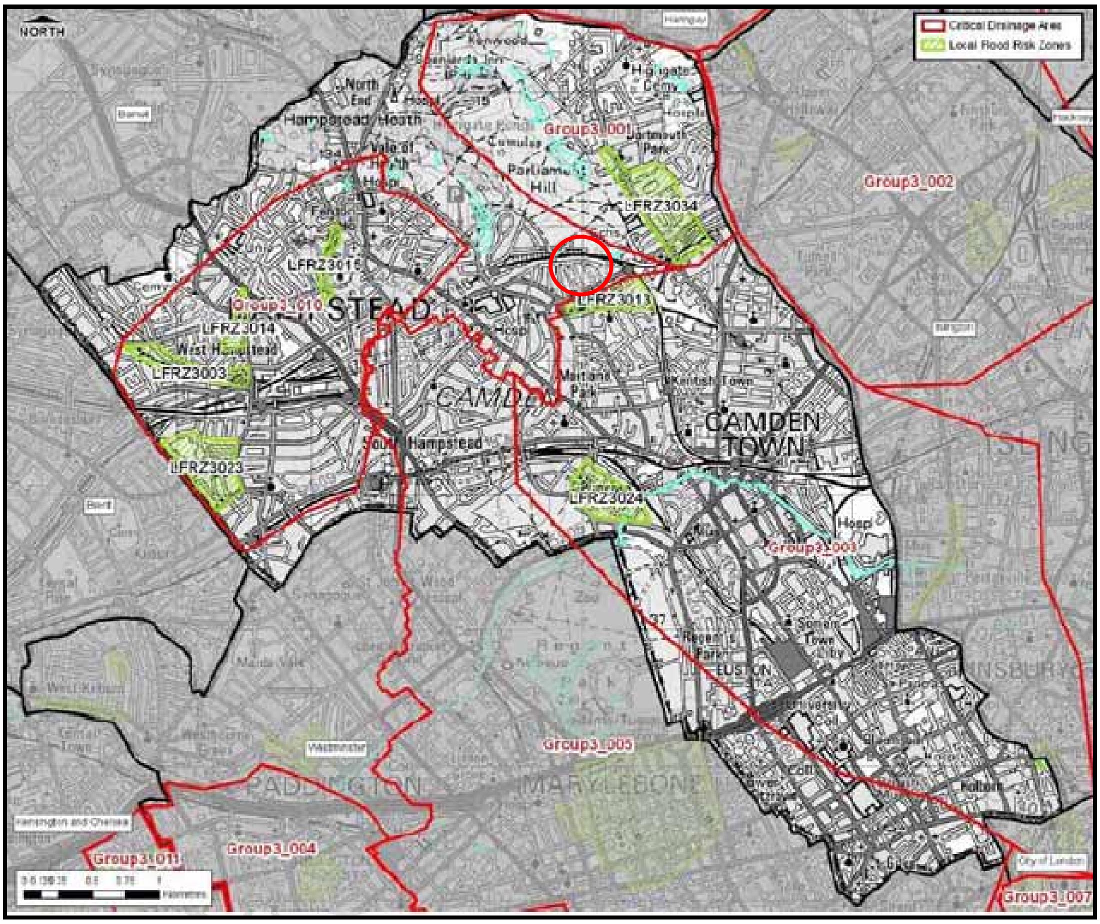

Figure 17 Camden SWMP Critical Drainage Areas and Local Flood Risk Zones

8. LANDFILL

According to the Environment Agency there are no operational landfill sites within 250m of the site as detailed in Figure 18. The site therefore does not require monitoring for landfill gas to determine the need for any gas protection 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.

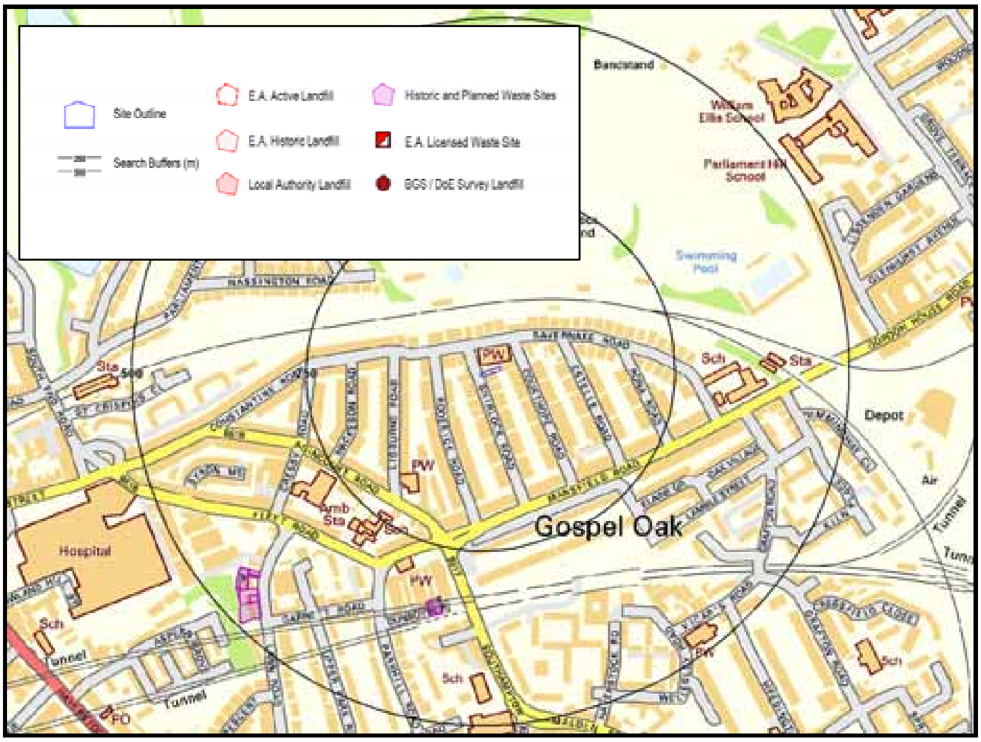

Figure 18 EA recorded Landfill Sites within 500m

9. REGULATED INDUSTRIES AND INFRASTRUCTURE

9.1 Regulated Industries

Results of searches for regulated industries are presented in Table 3 below.

TABLE 3
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	None	-
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	None	-
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 landfills	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	4	72m east and 160m south east of site. Electricity Sub station 136m north of site. Sand pit. Sand, gravel and clay extraction and merchants 203m south west of site. Cognetix, Electronic Equipment.
Petrol and Fuel Sites	None	None	-
Underground Oil and Gas Pipelines	None	None	-
Residential Property (within 250m)	Yes	Yes	Residential and commercial
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 3 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 the construction of a basement.

9.2 Infrastructure

The map in Figure 19 reproduced from the Camden Geological, Hydrogeological and Hydrological Study (Figure 18) indicates there is no transport infrastructure beneath the site.

Based on Open Street Map no underground railway lines or railway tunnels have been identified within the site or within 250m of the site boundary.

The site lies within 5km of the High Speed 2 rail project and is not within 500m of the route of Crossrail rail project.

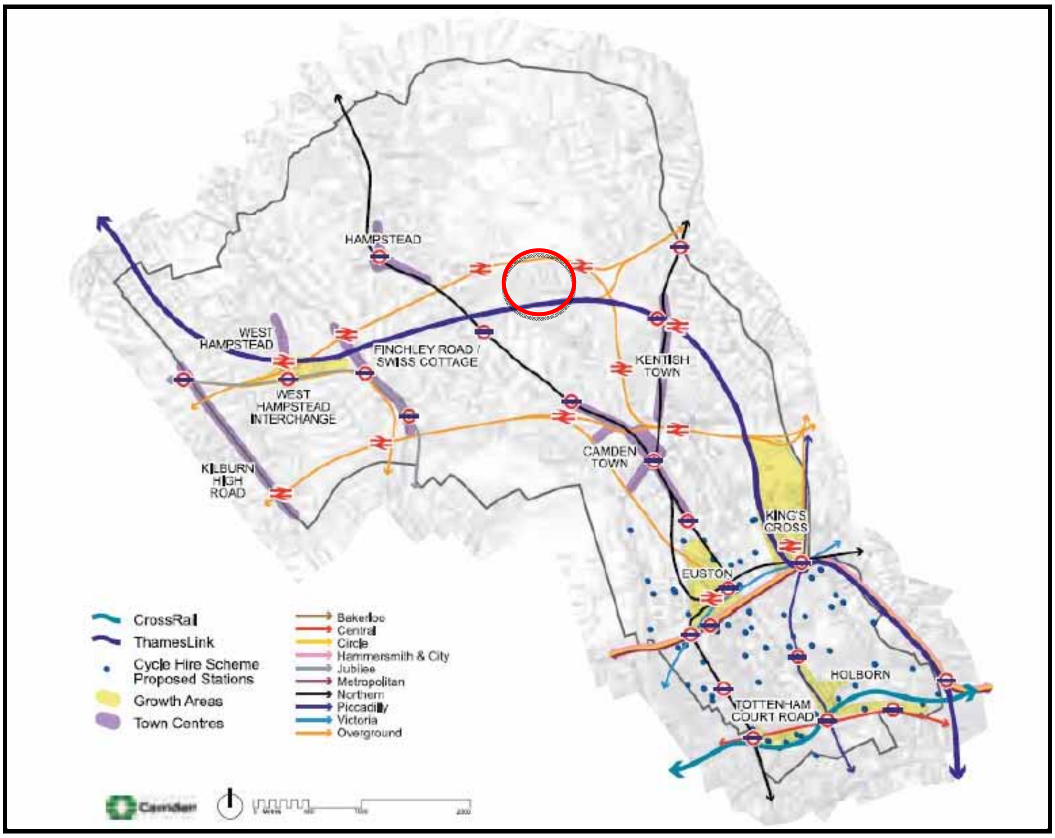

Figure 19 Transport Infrastructure

Overground railway lines to the north (100m) and south (300m) of the site are unlikely to be detrimentally by the basement construction or to detrimentally affect the construction. There are no slope stability issues with embankments or cuttings that could be affected by, or affect, the excavation for a basement.

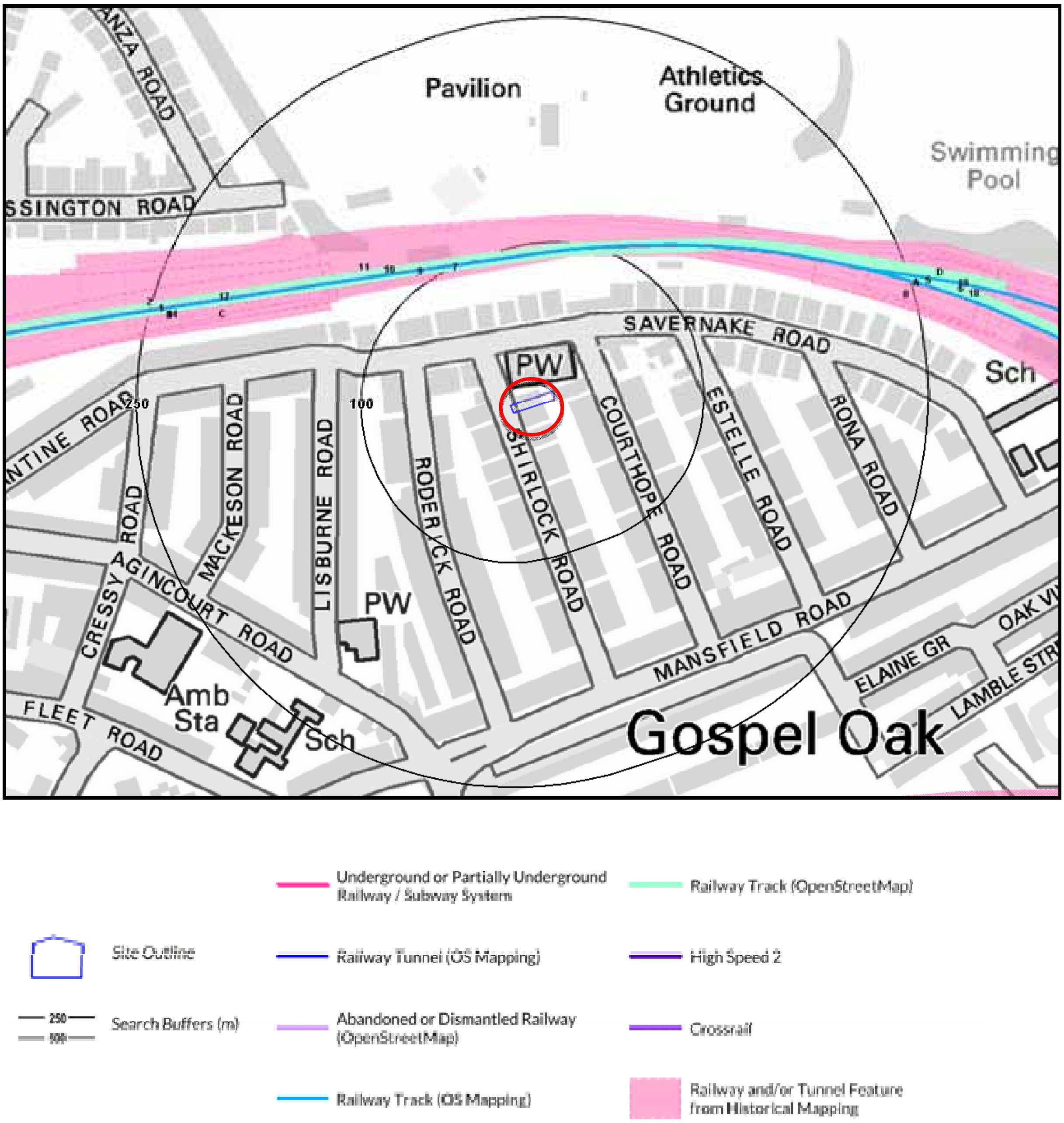

Figure 20 Railway Infrastructure

The following Historical Underground Working Features are provided by Groundsure:

ID	Distance (m)	Direction	NGR	Use	Date
Not shown	311.0	S	527029 185170	Tunnel	1974
Not shown	311.0	S	527029 185170	Tunnel	1995
Not shown	311.0	S	528025 185363	Tunnel	1965
Not shown	311.0	S	528025 185363	Tunnel	1995
Not shown	311.0	S	528025 185363	Tunnel	1974
Not shown	312.0	S	527029 185170	Tunnel	1965
Not shown	312.0	S	527029 185170	Tunnel	1958
Not shown	362.0	S	527203 185151	Tunnel	1974
Not shown	362.0	S	527203 185151	Tunnel	1995
Not shown	362.0	S	527203 185151	Tunnel	1965
Not shown	362.0	S	527203 185151	Tunnel	1958
Not shown	528.0	SW	527471 185273	Air Shaft	1920
Not shown	536.0	SW	527466 185268	Air Shaft	1912
Not shown	597.0	SE	528484 185446	Tunnel	1974
Not shown	597.0	SE	528484 185446	Tunnel	1965

Figure 21 Tunnel Locations

10. SCREENING AND SCOPING

10.1 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 monitoring and geotechnical design 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 ponds chain on Hampstead Heath?	No	Refer to Maps and Appendix B.
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	Developer to provide proposed drainage details
3	Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	Yes	Refer to Appendix A drawings and Section 7.1. Carried forward to scoping
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).
6	Is the site in an area known to be at risk from surface water flooding, such as South Hampstead, West Hampstead, Gospel Oak and King's Cross, or is it at risk from flooding, for example because the proposed basement is below the static water level of a nearby surface water feature? Does the site lie within a Critical Drainage Area (CDA)	Yes Within Gospel Oak Not in a CDA or LFRZ	The site was not affected by surface flooding in 1975 or in 2002. NW Relief Sewer constructed to alleviate surface water floods.There are no surface water features within 450m. Carried forward to scoping
	Subterranean (groundwater) Flow		
7	Is the site located directly above an aquifer?	No	Site underlain by London Clay with Chalk Aquifer >100m bgl.
8	Will the proposed basement extend below the surface of the water table?	No although perched water may be present	Site underlain by London Clay. Water table >100m bgl. Groundwater monitoring required in case of perched water. Carried forward to scoping
9	Is the site within 100m of a watercourse, well (disused / used) or a potential spring line?	No	No Historic water courses identified from "Lost Rivers of London". Tributary of R Fleet 250m south. Nearest culverted watercourse is 450m to the east. No wells or springs within 1000m.
10	Is the site within the catchment of the pond chains on Hampstead Heath?	No	Refer to Appendix B maps
11	Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	Yes	Refer to Appendix A drawings and Section 7.1. Carried forward to scoping.
12	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 or rainwater harvesting
13	Is the lowest point of the proposed excavation (allowing for	Yes	Site lies at 50m aOD, 25m

Table 4
Screening For Basement Impact Assessment

Ref	Question	Response	Details
	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?		lower than Hampstead Ponds which are 650m to NW. No other surface water feature local to site. Carried forward to scoping.
	Ground Stability		
14	Does the existing site include slopes, natural or manmade, greater than 7°?	No	Refer to site description. Section 2.1.
15	Will the proposed re-profiling of landscaping at site change slopes at the property to more than 7°?	No	Developer to provide details. Refer to Appendix A and Section 2.1.
16	Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	No	Refer to site description.
17	Is the London Clay the shallowest strata at the site?	Yes	London Clay has the potential to shrink and swell under varying moisture conditions Carried forward to Scoping
18	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.
19	Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site?	Yes	London Clay has potential to shrink and swell Carried forward to scoping.
20	Is the site within an area of previously worked ground?	No	No
21	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 a non productive aquifer, see Fig 7.
22	Is the site within 50m of the Hampstead Heath ponds?	No	No it is 650m distant from ponds
23	Is the site within 5m of a pedestrian right of way?	Yes	Shirlock road lies <5m from the basement. Carried forward to Scoping
24	Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Unknown	Adjacent properties may have basements. Depth of foundations to be confirmed. Carried forward to scoping
25	Is the site over (or within the exclusion of) any tunnels, e.g. railway lines?	Unknown	Site is not located over any railway tunnels. Services search presented separately. Carried forward to scoping.
26	Will the construction and excavation detrimentally affect adjacent properties. (reference Burland and Boscarding and Cording)	Unknown	Ground movement calculations required (Carried forward to scoping)

In summary the issues carried forward to scoping include those associated with change in hard surface (3 and 11), groundwater (8), flooding (6), lower than Hampstead Ponds (13), London Clay (17 and 19), distance to pedestrian right of way (23), differential foundation depths (24), tunnels (25) and ground movement (26).

10.2 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 actions required are provided where possible.

Table 5
Scoping for Basement Impact Assessment

Reference	Issue	Potential Impact and Action
	Surface Flow and Flooding	
6	The site lies within Gospel Oak. However the site was not affected by surface flooding in 1975 or in 2002 floods. NW Relief Sewer constructed to alleviate surface water floods. Site does not lie in a CDA or LFRZ	**Impact:** Low potential for future surface flooding. **Action:** Design basement as waterproof building. Flood Risk Assessment not required.
	Subterranean (groundwater) Flow	
8	Site underlain by London Clay, water table >100m, perched water may be present.	**Impact:** Flooding of basement **Action:** Monitor for perched water. Design basement as watertight if required. Install sump pump in basement patio if necessary.
	Change in proportion of hard surfacing	
3 and 11	The garden area will be reduced from 6m in length to 4.50m in length following construction.	**Impact:** Potential for higher water runoff **Action:** Use of rainwater harvesting. Soakaways not suitable in London Clay.
	Ground excavation level below Hampstead Ponds	
13	The ground level at the site lies 25m lower than the ponds at Hampstead Heath. The site does lie below the water level of Hampstead Ponds but they are 650m distance NW and unlikely to affect the site.	**Impact:** Ingress of water **No Action:** None as Hampstead Ponds are 650m distance NW.
	Ground Stability	
17	London Clay is the shallowest strata	**Impact:** Shrinkage and swelling **Action:** Soil Tests required for plasticity
19	London Clay has ability to shrink and swell under varying ground conditions. No evidence of damage to existing house.	**Impact:** Disturbance to foundations. Heave on excavation of basement. **Action:** Basement foundations will be below vulnerable zone. Suitable compressible material to be used in basement floor to accommodate heave.
23	Site lies within 5m of Shirlock Road pedestrian pavement	**Impact:** Damage existing services **Action:** Check services in the pavement
24	Adjacent properties may have basements.	**Impact:** Differential settlement to attached houses. **Action:** Check depth of foundations to Nos 52 and 56 Shirlock Road.
25	Site is not located over any railway tunnels.	**Impact:** Stress changes in ground, damage to tunnels **Action:** Services search check to be made on location of Royal Mail and other potential tunnels.

26	Likely damage to adjacent properties	**Impact:** Damage to adjacent houses **Action:** Undertake empirical calculations to assess damage category in line with Burland, Boscarding and Cording.

The scoping stage highlighted the need for:

- a ground investigation including soil testing
- groundwater monitoring
- SUDS consideration
- Geotechnical design
- Heave and damage assessment calculations
- Underground concrete design
- Search for underground tunnels
- Check of foundation depths of attached properties
- Empirical Damage Assessment to adjacent properties

It was recommended that an intrusive ground investigation should be undertaken to confirm ground and groundwater conditions, test the London Clay for strength, plasticity and sulphate content and monitor for groundwater levels and to undertake geotechnical calculations for heave and damage assessment and check adjacent foundations and services.

11 FLOOD RISK ASSESSMENT

11.1 Flooding by Surface Water, Groundwater and Reservoirs

Planning Policy Statement PPS25 "Development and Flood Risk" seeks to protect development from flooding as well as preventing flooding. PPS25 states that developers are responsible for providing a flood risk assessment:

- demonstrating whether any proposed development is likely to be affected by current or future flooding from any source;
- satisfying the local planning authority that the development is safe and where possible reduces flood risk overall;
- demonstrating whether the development will increase flood risk elsewhere;
- demonstrating measures proposed to deal with these effects and risks.

The site is within Gospel Oak which is an area known for surface water flooding, however the site does lie within a Critical Drainage Area or Local Flood Risk Zone. It is a low risk that the site will be affected by flooding of a 1 in 1000 year flood event. It is highly unlikely to be affected by rising groundwater from within an underlying relatively impermeable soil derived from London Clay. It is a low risk based on historical evidence and reservoir inspection regime that the site will be flooded from the Hampstead reservoirs.

It is considered that a detailed Flood Risk Assessment is not required for this property. The basement development is unlikely to be affected by flooding now or in the future, the development will reduce flood risk by rainwater harvesting and use of a garden above the basement outside the footprint of the ground floor level.

Recommendations are to incorporate rain water harvesting, for the basement to be tanked and for collection of rainwater and consideration of use of grey water and non return valves in drains.

12. GROUND INVESTIGATION

12.1 Fieldwork

In order to confirm ground conditions beneath the site and to collect soil samples for testing for engineering properties of the strata a ground investigation was undertaken.

The ground investigation comprised the drilling of two 80mm diameter window sampler boreholes (WS1 to WS2) on 14th May 2015 and the excavation of a trial pit in the cellar on 7th July 2015 and included insitu soil tests for strength and sampling of the soil for geotechnical and environmental testing. A trial pit was originally abandoned under the rear garden decking due to excessive concrete.

12 soil samples were sent to a UKAS accredited laboratory and three were selected for testing for redox value and sulphate content. One window sampler borehole (WS1) was allocated for testing for groundwater and installed with a standpipe to facilitate monitoring.

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

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

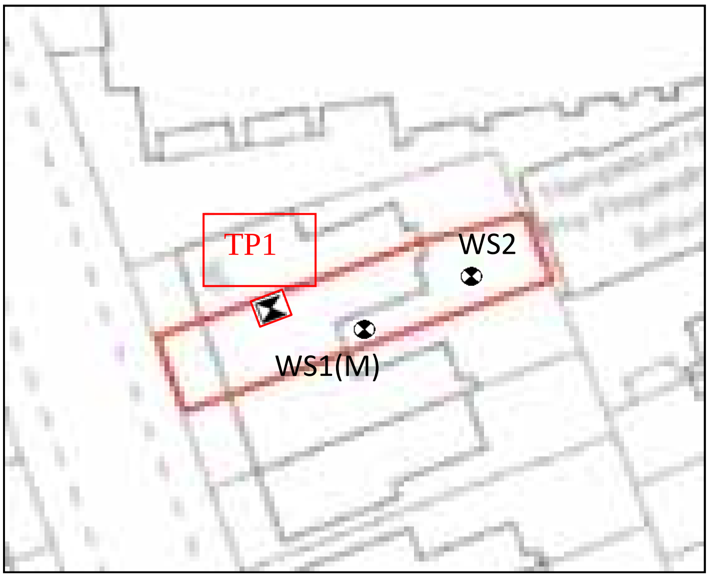

Figure 22 Borehole and Trial Pit Locations Plan

12.2 Ground Conditions

The ground conditions encountered in the window sampler boreholes comprised of a superficial covering of topsoil and concrete overlying made ground down to 0.45m to 1.00m bgl. The made ground was everywhere underlain by low strength orange brown grey silty clay becoming grey brown very silty clay with blue veins proven to a depth of 4.45m bgl. The ground conditions encountered during the trial pit excavation in the cellar of the property was red brown very wet silty sandy gravelly clay from 0.40m below the cellar floor. Made ground of weathered red brick with clay and stones were encountered just below the cellar floor slabs to 0.40m.

The ground conditions encountered are summarised in Table 6 below.

TABLE 6
Ground Conditions Encountered in WS Boreholes

Hole Ref.	TOPSOIL/CONCRETE/SLABS Depth in mbgl	MADE GROUND Depth in mbgl	CLAY (low strength) Depth in mbgl
WS1	GL to 0.08	0.08-0.45	0.45-4.45
WS2	GL-0.45	0.45-1.00	1.00-4.45
TP1	Cellar floor – 0.10	0.10-0.40	0.40 – 0.60+

All soil samples selected for geotechnical testing collected were sent to Structural Soils Limited (SSL) and Alcontrol Laboratories for geotechnical and environmental testing. Both laboratories hold UKAS accreditation for the testing undertaken as detailed on the testing certificates.

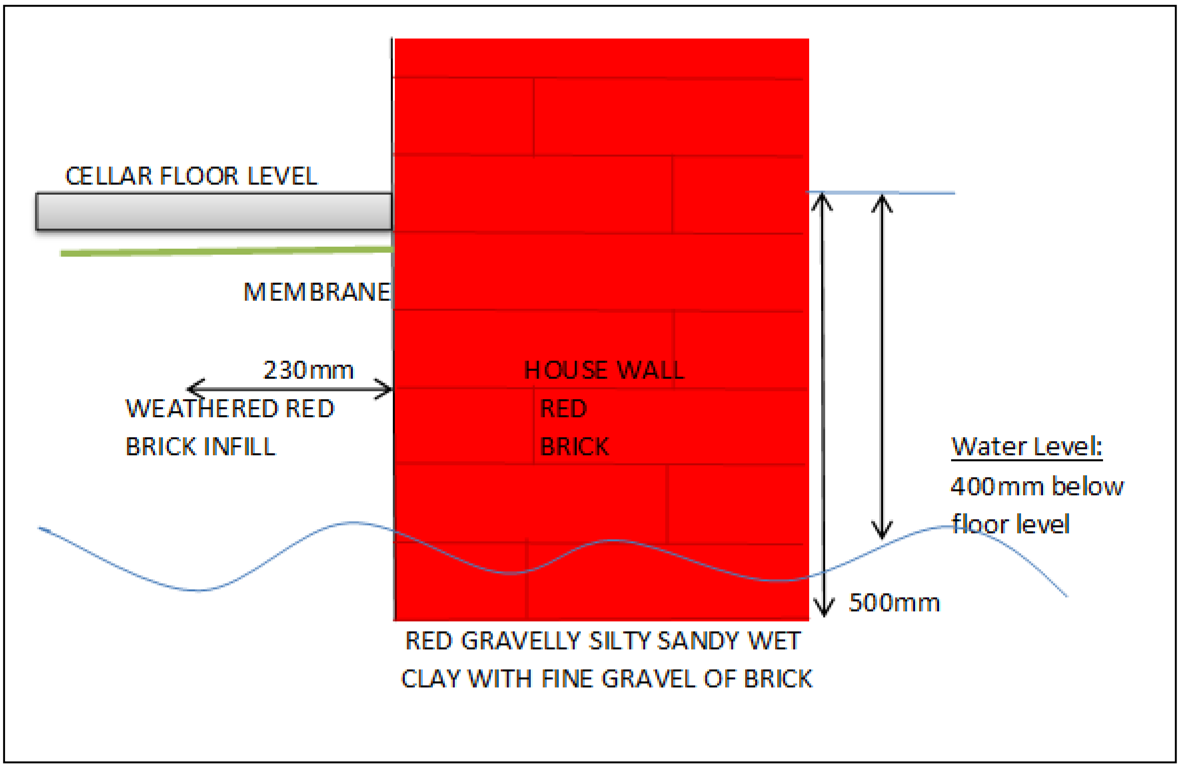

Figure 23 Trial Pit Drawing

A suite of geotechnical and environmental tests was scheduled by Ashton Bennett and the results are presented in full in Appendix C.

12.3 Geotechnical Test Results
12.3.1 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.

TABLE 7
Standard Penetration Test N Value Results (SPT)

Depth in m	Made Ground	Clay low strength
GL-1.00		
1.00-1.45		3, 4
2.00-2.45		3, 4
3.00-3.45		4, 4
4.00-4.45		4, 4

The SPT N values indicate the clay to be very low strength. Made ground should always be considered as in a loose state of compaction. In WS1 dynamic probe tests from 4.45m to 5.45m gave blows of 2,2,1,2,3,2,3,3,3,3 each for 100mm distance of the probe.

12.3.2 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 g/l
WS1	0.1	11	1.32
WS2	0.30	7.78	0.0375

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-2. The elevated sulphate encountered in WS1 is due to selenite, a calcium sulphate in the London Clay.

12.3.3 Atterberg Limit Test Results

Atterberg Limit Tests were undertaken on two samples from WS1 at 1.70m and WS2 at 2.50m bgl. The results indicate the clays are clays of high to very high plasticity and highly likely to shrink and swell under varying moisture conditions in the ground. This should be taken into account in design, by incorporating expanding material beneath the floor slab.

TABLE 9
Atterberg Limit Test Results

BH No	Depth in m bgl	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index %
WS1	1.7	28	70	23	47
WS2	2.5	32	74	26	48
TP1	(0.45m) 2.45	38	68	24	83
TP1	(0.55m) 2.55	34	69	25	95

12.4 Engineering Properties of Strata Tested

12.4.1 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.

12.4.2 Clay

SPT results in the clay indicate it to be generally very low strength with SPT N values of 3 to 4. The clay was tested for plasticity and found to have a very high to high plasticity and highly likely to shrink and swell under varying moisture conditions in the ground.

Based on the SPT results the clay has a low allowable bearing capacity. This is unusual for the London Clay and may be due to softening from leaking drains. When the trial pit was excavated in the cellar water ran into the trial pit from the ground.

12.5 Groundwater Conditions

Groundwater was not encountered during drilling. Groundwater was encountered during monitoring at depths of 2.80m bgl within the London Clay. It is considered that the elevated water level may be due to leaking drains based on the unexpected high level of groundwater, the alkaline pH value and the very soft nature of the clay. A CCTV Survey has confirmed leaking drains.

In summary it is expected that limited perched groundwater may be encountered within the made ground and London Clay during construction, however inflows into excavations are unlikely to be significant and are expected to be dealt with by sump pumping.

12.6 Gas Conditions

As there are no recorded landfill sites within 250m of the site and no significant made ground, monitoring for landfill gas was not required. 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.

12.7 Environmental Conditions
12.7.1 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 CLEA 2009 and ATRISK 2009 which are based on the new CLEA guidance 2008 and 2009 (SC050021/SR3 (the CLEA Report) and SC050021/SR2 (the TOX report), SC050021/SR4, CLEA Software version 1.06 (2009) and toxicological reports and SGV technical notes (2009)). The site will be used for residential purposes. The risk assessment has used a scenario of residential use with 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.

12.7.2 Environmental Tests on Soils

Of the soil samples collected, 2 samples were selected for testing. The samples were tested for total PAH, total TPH, 9 metals, sulphate, pH and asbestos. One sample was tested for Waste Acceptance Criteria to enable disposal of excess soil during construction. Results are presented in full in Appendix C.

TABLE 10
Results of Environmental Tests on Soils

Compound	No of samples tested	Min value mg/kg	Max value mg/kg	SSV guideline Residential Use mg/kg	Samples exceeding SSV guidelines
Phytotoxic					
Copper	2	23.2	44.5	402	None
Nickel	2	52.1	21.1	130	None
Zinc	2	84.1	82.6	17200	None
Metals					
Arsenic	2	14.7	17.5	32	None
Cadmium	2	1.62	1.33	10	None
Chromium	2	<0.60	<0.60	14.7	None

Compound	No of samples tested	Min value mg/kg	Max value mg/kg	SSV guideline Residential Use mg/kg	Samples exceeding SSV guidelines
Lead	2	23.3	136	168	None
Mercury	2	<0.14	0.315	1.0	None
Selenium	2	<1	<1	350	None
Organics					
TPH total	2	35.4	426	500	None
PAH total	2	<10	13.2	40	None
Others					
Sulphate g/l	2	0.0375	1.32	1.20	WS1 0.10m
pH	2	7.78	11	5-9	WS1 0.10m
Asbestos	2	NAD	NAD	NAD	None
WACS	1	See text	See text		See text

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

The area of the site was found where tested to be uncontaminated by phytotoxic compounds and heavy metals. Tests for total PAHs on two soil samples indicated total levels of <10mg/kg to 13.2mg/kg. It was noted that no free-product was observed in any of the samples during the investigation and therefore all the other results fall within the CLEA guidelines for CLEA combined assessment where no free product was encountered.

The two soil samples tested gave TPH results of 35.4mg/kg to 426mg/kg being within the 500mg/kg generally recognized figure for residential development. Asbestos was not detected in the soil samples. Redox values were near normal at 7.78 with an alkaline level of 11 detected in WS1 and sulphate levels were 0.0375g/l to 1.32g/l with one result falling above 1.20g/l where special consideration for design of underground concrete is required. Sulphate is not harmful to humans. Waste Acceptance Criteria Tests indicate the excess soil may be deposited at landfill as inert waste.

12.8 Summary

The risk assessment has been based on 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. The exceptions are elevated sulphate and alkaline pH value. The elevated level of sulphate can be mitigated by the use of hard cover and special consideration for underground concrete in the development.

13. ENVIRONMENTAL RISK ASSESSMENT

13.1 Introduction

It is proposed to develop the site for residential premises. The environmental liabilities of the site and risk assessments have been undertaken for this potential future use. If the proposed site use changes then a further risk assessment will 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 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 (Table 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.

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	Pollution 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.

13.2 Sources of Contamination, Pathways and Receptors
13.2.1 Sources of Contamination

Sources of contamination were determined through the ground investigation and found the site to be uncontaminated by the compounds tested with the exception of elevated sulphate and alkaline pH value. There is a low risk of undetected contamination existing on the site.

13.2.2 Potential Pathways for Migration

The potential pathways for carrying the detected contamination present on the site to reach sensitive receptors are water reacting with the sulphate to detrimentally affect underground concrete.

13.2.3 Potential Sensitive Receptors

Potential Sensitive receptors are expected to include workmen, occupants and visitors using the premises. Due to the general lack of contamination and hard cover over the majority of the site there is a low risk of sensitive receptors being detrimentally affected by contamination.

13.3 Risk

By considering where a viable pathway exists which connects a source to a receptor, this assessment will identify where pollutant linkages may exist. If there is no pollutant linkage, then theoretically there is no risk. Therefore only where a viable pollutant linkage is established does this assessment go on to consider the level of risk.

The risk is assessed by the combination of the probability of the risk and the severity of the risk in line with CIRIA recommendations.

TABLE 15

Risk Assessment for a Residential Land Use

Pathways	Receptors	Perceived Risk	Probability of Risk	Consequence of Risk	RISK
Humans					
Inhalation of vapours methane and hydrocarbons, mine gas	Occupants and visitors and workmen	Methane & Carbon Dioxide from infilled land,	Unlikely	Severe-Methane can be explosive in air	Low – no waste sites within 250m, no mining
Ingestion of and/or skin contact from contaminated soil	Occupants and visitors and workmen	Undetected contamination	Unlikely	Mild to Medium	Low as no contamination detected on site which is to be hard covered

Pathways	Receptors	Perceived Risk	Probability of Risk	Consequence of Risk	RISK
Humans					
Ingestion of contaminated drinking water	Local abstraction wells	Contamination of potable water.	Unlikely	Medium- prosecution can occur if site is affecting controlled waters	Low No local abstraction wells, clay presents protection to aquifer.
Transportation by surface and/or groundwater	Groundwater Surface Water	Contamination of groundwater Contamination of surface water	Unlikely Unlikely	Medium- prosecution can occur if site is affecting controlled waters.	Low risk to groundwater due to clay cover Low risk to surface water due to distance
Ingestion and uptake of contamination in plants/animals/ vegetables	Occupants and Visitors and workmen	Ingestion of contamination via homegrown produce	Unlikely	Low	Low – no contamination detected except sulphate which is not harmful to humans
Inhalation of airborne dust	Occupants, neighbours and children and workmen	Dust during construction.	Unlikely	Low	Low risk provided good construction practice to limit dust levels during construction

The potential sensitive receptors on the site which could be detrimentally affected by any contamination originating from the site are identified in Table 15. It is unlikely that the sensitive receptors identified will be detrimentally affected by contamination provided the mitigating measures recommended are carried out.

Due to the proposals for buildings and hard cover over the site the pathway for ingestion or skin contact of humans with contamination is eliminated.

14. IMPACT ASSESSMENT

14.1 Introduction

The BIA has been undertaken for the proposed construction of a new basement. The depth of the basement is anticipated to be 3.0m to 4.0m bgl. The anticipated bearing pressure of the new structure has not been provided.

The comprehensive desk based assessment together with the site inspection and ground investigation and flood risk assessment have been sufficient to allow the potential impacts of the issues identified during the screening and scoping stage of the project to be assessed.

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 Structural Engineers Report is presented separately by Croft Engineers Ltd.

14.2 Geological and Hydrogeological Setting

With regard to the geology and hydrogeology of the site, the report concludes that the site is immediately underlain by up to 0.80m of topsoil and loose made ground, underlain to 4.65m by very low strength silty clay representing the weathered surface of the London Clay. The London Clay is highly plastic in nature and has an elevated sulphate content due to the included selenite.

The London Clay is relatively impermeable and is classified by the Environment Agency as a non productive aquifer. There are no recorded abstraction licences which could be detrimentally affected by the basement development.

There was no recorded groundwater during the borehole ground investigation, groundwater was monitored at levels of 2.80m bgl in the standpipe following the borehole investigation. This is a high level considering the impermeable nature of the London Clay and may be due to leaking drains. Water entered the excavation for the trial pit in the base of the cellar and is considered to be leaking water rather than groundwater as no water bearing strata was encountered. A CCTV survey undertaken by others has confirmed leaking drains on the site. Drains should be replaced at the time of construction or earlier if construction does not go ahead. It is possible that sump pumping will be required for construction. It is unlikely that dewatering will be required. The basement floor depth is 3.0m bgl and is unlikely to cause disruption to any groundwater flow as groundwater in the London Clay is within silt/gravel of thin lenses and of restricted extent.

14.3 Hydrology and Flood Risk

There are no surface water features within 250m of the site which could affect the development. The River Fleet used to flow circa >300m to the west of the site and is now culverted and unlikely to detrimentally affect the site or be affected by the site.

There is a small proposed change of hard cover which could slightly increase run off. The site is not suitable for soakaways due to the underlying impermeable London Clay. Rainwater harvesting and use of grey water could reduce run off in the future.

Shirlock Road was not affected by the 1975 and 2002 floods, does not lie within a Critical Drainage Area or Local Flood Risk Zone and is at low risk of flooding in a 1 in 1000 year event and a Flood Risk Assessment was considered to be not required.

The basement is unlikely to impact on hydrology or flood risk.

14.4 Contamination

Ordnance Survey maps inspected indicated the site was an open field before construction of No 54 house around 1894. As such there is a low risk of contamination being present on the site. The ground investigation and testing for potential contaminants did not reveal any soil that contained potentially contaminating or odourous material. As a precaution all builders should use gloves when handling soil for Health and Safety and work in accordance with HSE and CIRIA guidelines.

14.5 Basement Excavations

The excavation for the basement will be 4.00m below existing ground floor level or 3.00m below existing ground level in the rear garden. The basement floor formation level will be on the London Clay. In order to form the floor beyond the influence of the zone of shrinking and swelling in the London Clay it is advisable to include the use of compressible material beneath the new floor to accommodate any heave in the future.

Excavation in the made ground and clay could be achieved by mechanical excavator.

Groundwater is unlikely to be encountered except during and after heavy rainfall when a sump pump is expected to deal with the water ingress. 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 basement floor.

Excavations for the proposed basement 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.

Construction of the proposed basement will need to be supported by new retaining walls. Formation level for the proposed development will be the London Clay beneath any topsoil or made ground which are unsuitable bearing strata. The London Clay should provide a suitable bearing stratum for underpinned foundations, a box construction or piles whichever is required based on the bearing pressure or ground loading of the structure. The clay encountered in the ground investigation gave an allowable bearing capacity of 30kN/m2 due to the softening of the strata by the water from the leaking drain. Further ground investigation will be required to determine the depth to suitable strata of higher bearing capacity to support the house and proposed basement.

The basement 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 potential for ground movement during the excavation and construction of the basement has to be considered. Any significant ground movements could cause structural damage to adjacent properties. Ground movement is discussed in the Structural Engineers Report.

Following the excavation of the basement, it is possible that the floor slab for the proposed basement will need to be suspended over a void to accommodate the anticipated heave, unless the slab can be suitably reinforced to cope with these movements or a layer of compressible material added to accommodate the heave. 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.

14.6 Basement Retaining Walls

The following parameters are recommended for design of retaining walls:

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Made Ground: 1600kN/m2 Bulk Density, Effective Cohesion of 0kN/m2, 20 degrees Effective Angle of Friction.
London Clay: 2000kN/m2 Bulk Density, Effective Cohesion of 0kN/m2, 26 degrees Effective Angle of Friction.

Groundwater should be taken as ground level for design purposes. The basement should be designed as water proofed and to accommodate groundwater pressures in line with BS 8102:2009.

14.7 Foundation Design

Foundations should be placed below the shrink and swell zone of the London Clay and in unweathered strata. Underpinned foundations may be placed on the London Clay, however it was encountered to 4.45m as of very low strength. Based on the SPT results of N = 4 and with an f value (Stroud) of 4.5, then a shear strength (Cu) of 18kPa can be assumed. A net allowable bearing pressure of 30kN/m^2 can be calculated from this shear strength.

Dynamic probe tests undertaken in WS1 from 4.45m to 5.45m did not record increased resistance results.

14.8 Adjacent Structures

The development of the basement may impact on adjacent properties if mitigating measures and appropriate temporary and permanent design are not undertaken.

Care should be taken to design a retention system that maintains stability to all adjacent structures at all times during the works. It would be prudent to investigate the depth of foundations of the adjacent property before construction. It is likely that foundations of the adjoining houses are similar to number 54. The new foundations for No 54 will therefore be deeper than adjacent properties and unlikely to load their foundations. This should be checked before construction.

It would be prudent to undertake a structural condition survey of adjacent properties on both sides of No 54 before work commences.

The proposed basement will lie within 5m of the pavement of Shirlock Road. Lateral movements associated with the basement excavations must be controlled during temporary and permanent works so as not to impact adversely on the stability of any footpath or services. A services search has been presented separately.

14.9 Underground Concrete

Results of testing for the presence of pH and sulphates in the clay indicate an elevated level of sulphates due to the presence of selenite. The recommendations for design of underground concrete is ACEC class DS2-AC-2 from Table C2 of BRE Special Digest 1 Part C (2005). This assumes a mobile water condition on natural strata with pH >5.5.

14.10 Service Excavations

Shallow excavations for services and the like are unlikely to be stable in the made ground in the short or long term and may require battering. Excavations within the clay may be stable in the short term but not the long term. Some sump pumping may be required to keep the excavations dry.

14.11 Waste Disposal

Any spoil arising from excavations or landscaping works will need to be disposed of to a licensed tip. 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 and WACS test results 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 and will require the Waste Acceptance Criteria Tests (WACS) test results to classify the waste.

14.12 Existing Tunnels

The proposed basement excavation will not be within the zone of influence of any of the London Underground (rail) tunnels shown on Figure 18 of Arup Report for London Borough of Camden “Guidance for Subterranean Development”, 2010).

Due to the possibility that other tunnels owned and maintained by other service providers may exist close to the site a full services search was undertaken and is presented separately.

On the assumption that it is confirmed that the site is not within the “zone of influence” of any underlying tunnels then no further activities in this regard will be required (the zone of influence is normally defined as the strip of land present above a tunnel with boundaries defined from a line drawn at 45° from the invert level of the tunnel to the ground surface). Service drawings have been provided separately and should be consulted by the Contractor before commencing work.

14.13 Recommendations

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

Recommendations include waterproofing the basement, allowing for groundwater at the surface for structural design, incorporating rainwater harvesting, use of grey water and use of non return valves on the drains. A CCTV survey of the existing drains has indicated leaking drains and these should be replaced during construction.

It is recommended that compressible material is used beneath the floor to accommodate potential heave and that sulphate resisting cement is used as detailed in this report. It is recommended that the depth of basements in adjacent properties is checked to ensure new foundations lie below adjacent foundations and will not impact by increasing load on existing adjacent foundations.

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. This will include:

- Establishment of the likely ground movements arising from the temporary and permanent works and the mitigation of excessive movements;
- Assessment of the impact on any adjacent structures
- Determination of the most appropriate methods of construction of the proposed basements;
- Undertake pre-condition surveys of adjacent structures;
- Monitor any movements and pre-existing cracks during construction;
- Establishment of contingencies to deal with adverse performance;
- Ensuring quality of workmanship by competent persons.

Full details of the suitable engineering design of the scheme in addition to an appropriate construction method statement and monitoring during construction are presented in the Structural Engineers report.

15. GENERAL REMARKS

This report truly reflects the conditions found during the desk study for the screening and scoping for a Basement Impact Assessment. Whilst the desk study was 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 investigation was 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.

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