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Your Ref:

Our Ref: **15/23973-2**
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9 HARLEY ROAD, ST JOHNS WOOD,

LONDON, NW3 3BX

BASEMENT IMPACT ASSESSMENT

Prepared for

engineersHRW

Acting on behalf of

Antigone & George Polychronopoulos

CONTENTS

1.0 NON-TECHNICAL SUMMARY

1.1 Project Objectives

At the request of engineersHRW, working on behalf of Antigone & George Polychronopoulos, a Basement Impact Assessment has been carried out at 9 Harley Road, London, NW3 3BX in support of a planning application for a proposed development which includes the construction of a single storey basement beneath the current property. It is understood that the proposed basement is at a level of approximately 45.7mOD (3.3m below ground level).

1.2 Desk Study Findings

From historical map evidence it would appear that the current property was built between 1896 and 1915 and has remained on-site and unchanged since its initial construction. The surrounding area has been predominantly residential throughout its history and was partly urbanised during the early 20th century.

1.3 Ground Conditions

The boreholes and trial pit revealed ground conditions that were consistent with the geological records and known history of the area and comprised Made Ground up to 1.00m in thickness resting on deposits of the London Clay Formation. The Made Ground extended down to depths of between 0.30m and 0.40m (48.86mOD to 48.24mOD) in the boreholes and to 1.00m below ground level in Trial Pit 1 (48.08mOD and the material generally comprised a surface layer of grass/brick paving overlying loose silty slightly sandy slightly gravelly clay with brick fragments and ashes. The London Clay Formation was encountered below the Made Ground and consisted of soft then firm followed by stiff becoming very stiff silty clay with occasional pockets and partings of silty fine sand and scattered gypsum crystals. These deposits extended down to the full depths of investigation of 15.00m below ground level in Boreholes 1 and 2 (34.16 to 33.64mOD). Following drilling operations groundwater monitoring piezometers were installed in Boreholes 1 and 2 to approximately 8.00m depth.

Groundwater was not subsequently encountered within these monitoring standpipes after a period of approximately four weeks.

1.4 Recommendations

A monitoring plan should be set out at design stage and should include a monitoring strategy, instrumentation and monitoring plans and action plans. Trigger levels on movements will need to be defined. Precise levelling or reflective survey targets should be installed at the garden walls and neighbouring buildings. It would be prudent to continue to monitor the standpipes for as long as possible in order to determine equilibrium level and the extent of any seasonal variations. The chosen contractor should also have a contingency plan in place to deal with any perched groundwater inflows as a precautionary measure.

2.0 INTRODUCTION

2.1 Project Objectives

At the request of engineersHRW, working on behalf of Antigone & George Polychronopoulos, a Basement Impact Assessment has been carried out at the above site in support of a planning application.

The purpose of this assessment is to consider the effects of a proposed basement construction on the local slope stability, surface water and groundwater regime at the existing residential property.

The recommendations and comments given in this report are based on the information contained from the sources cited and may include information provided by the Client and other parties, including anecdotal information. It must be noted that there may be special conditions prevailing at the site which have not been disclosed by the investigation and which have not been taken into account in the report. No liability can be accepted for any such conditions.

This report does not constitute a full environmental audit of either the site or its immediate environs.

2.2 Planning Policy Context

The information contained within this BIA has been produced to meet the requirements set out by Camden Planning Guidance – Basements and Lightwells (CPG4) including Camden Development Policies DP27 – Basements and Lightwells (Ref 1) in order to assist London Borough of Camden with their decision making process.

As recommended by the Guidance for Subterranean Development (Ref 1) the BIA comprises the following steps

1. **Initial screening** to identify where there are matters of concern

2. **Scoping** to further define the matters of concern

3. **Site Investigation and study** to establish baseline conditions

4. **Impact Assessment** to determine the impact of the basement on baseline conditions

5. **Review and Decision Making** (to be undertaken by LBC)

3.0 SITE DETAILS

(National Grid Reference: 527023, 184064)

3.1 Site Location

The site is located to the north-east of Harley Road in Hampstead, North London, NW3 3BX and comprises a two storey residential property, including rooms at roof level with front and rear garden areas. The site covers an area of approximately 0.1 hectares and the general area is under the authority of the London Borough of Camden.

The site is bound by Harley Road to the immediate south-west, with residential properties to the north-east, north-west and south-east.

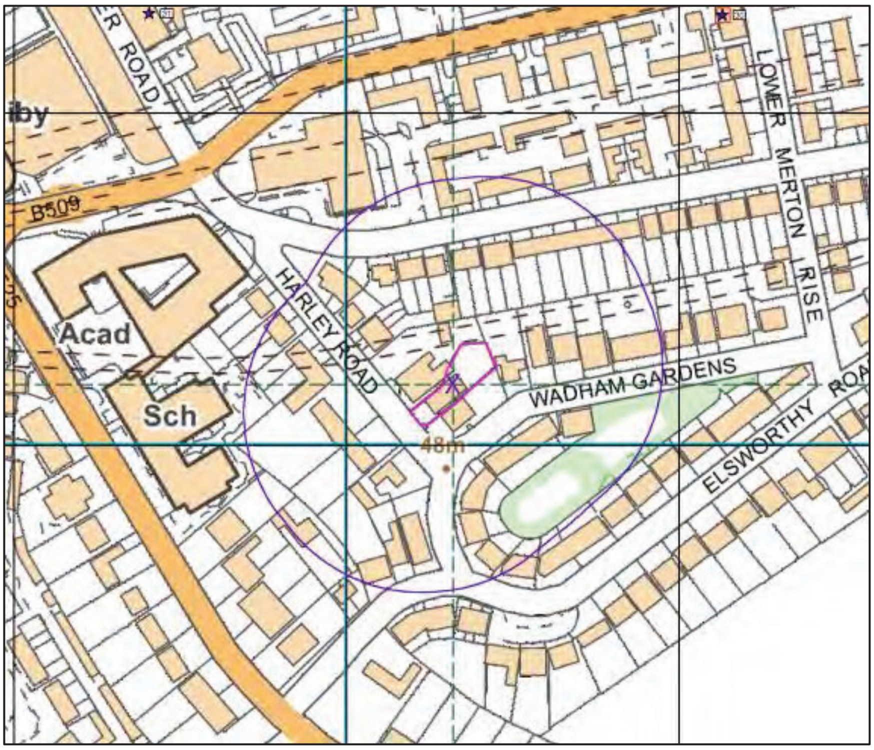


Figure 1. Site Location Plan

3.2 Site Layout and History

The site is accessed from Harley Road located to the south-east and comprises of a two storey residential property, including rooms at roof level with front and rear garden areas.

The property is bound by Harley Road to the south-east, with residential properties to the north-east, north-west and south-west.

The property contains a brick paved driveway in front of the main property, with a path along the southern boundary leading to the rear garden, which is predominantly covered by a grass lawn with flower beds running around the northern and eastern boundaries.

The site slopes very gently to the north-east with levels of 49.17mOD recorded at the front of the site and 48.54mOD recorded in the far rear garden area. The slope angle is less than 7 degrees. Also with reference to the Camden Geological, Hydrogeological and Hydrological Study, (Figure 2 below), the neighbouring properties also have slopes less than 7 degrees.

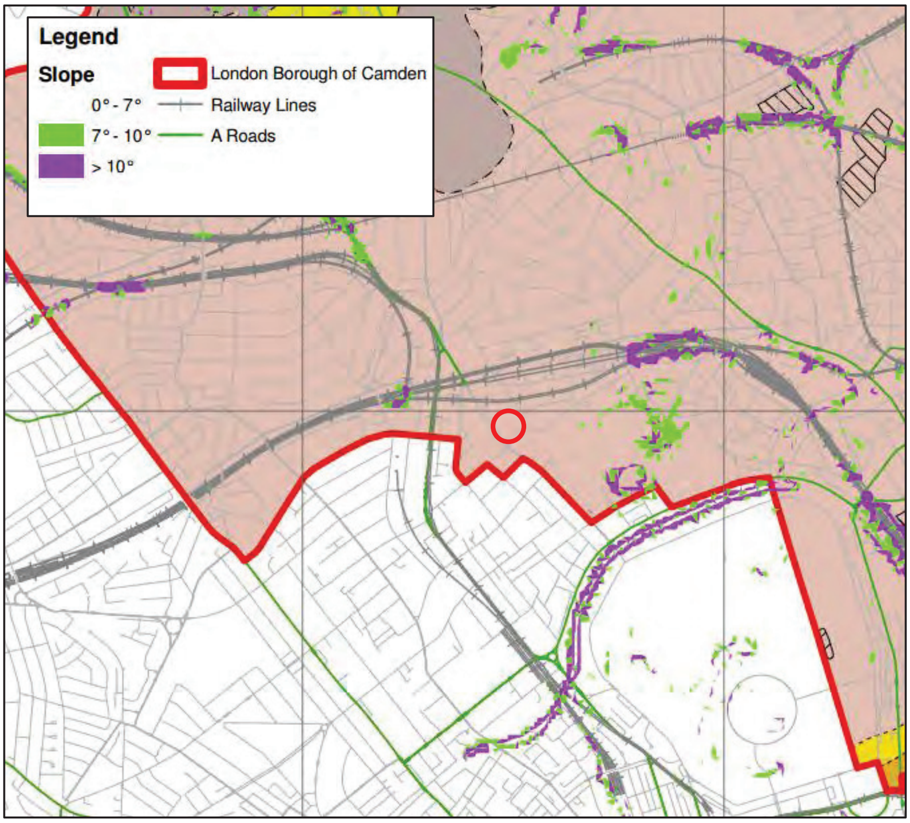


Figure 2. Exact from Figure 16 of the Camden CPG4 showing slope angles within the borough

The existing ground level in the area of the proposed basement is understood to be approximately 49.0mOD.

Network Rail, Transport for London and Cross Rail have all been contacted as part of this study. Whilst Transport for London and Cross Rail have confirmed that they do not have any assets within 50m of the site, the site is also located immediately to the south of the Network Rail tunnel.

It is understood that the tunnel is approximately 20m below pavement level and an exclusion zone of 10m from the tunnel edge should be maintained at all times.

The responses from Network Rail about the tunnel (including details of the tunnel depth and exclusion zone) are included in this report as Appendix A, whilst a plan of the site relative to the tunnel is detailed below as Figure 3.

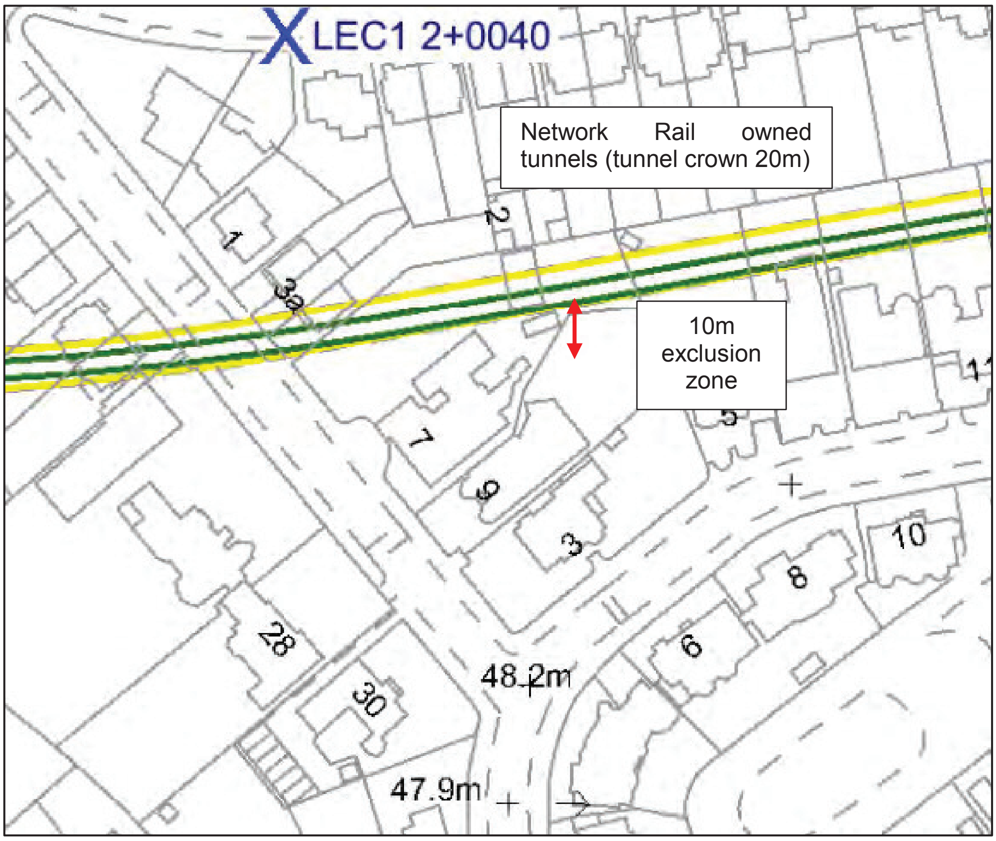


Figure 3. Detailing location of Network Rail owned tunnel immediately to the north of the site and mandatary 10m exclusion zone.

From historical map evidence it would appear that the current property was between 1896 and 1915 and has remained on-site and unchanged since its initial construction. The surrounding area has been predominantly residential throughout its history and was partly urbanised during the early 20th century.

3.3 Previous Reports

A Phase 1 Preliminary Risk Assessment (PRA) (SAS Report Ref: 15/23973-1) and Phase 2 Site Investigation (SAS Report Ref: 15/23973) was undertaken across the site by Site Analytical Services Limited in October 2015 and the results are discussed in this BIA.

3.4 Geology

The 1:50000 Geological Survey of Great Britain (England and Wales) covering the area is detailed in Figure 4 below and indicates the site to be underlain by the London Clay Formation. Deposits of the overlying Claygate Member are indicated to be over 1 kilometre to the north-west of the site.

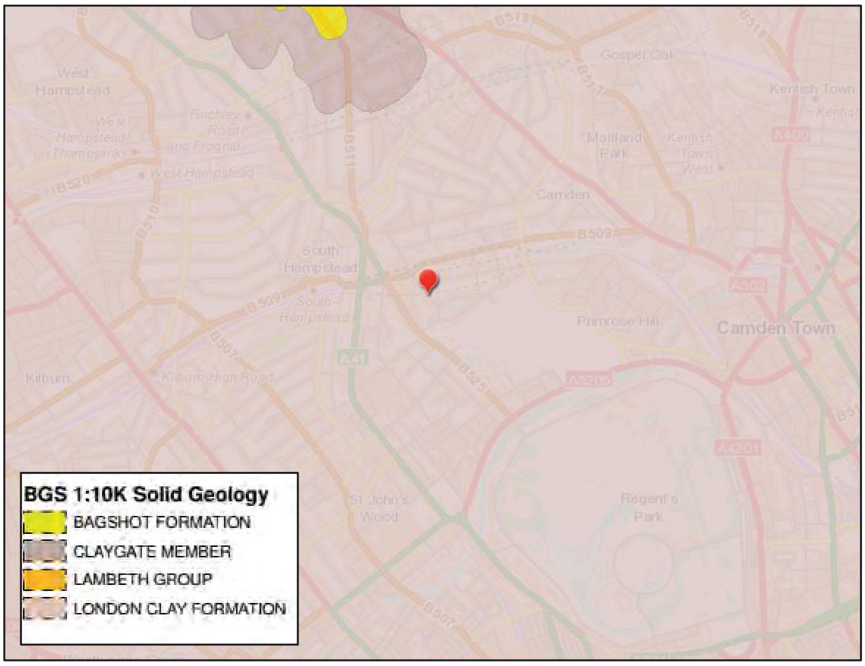


Figure 4. Geology of the Site (Ref. BGS Geoindex)

The British Geological Survey's online records indicate there are no boreholes located within 250m of the site.

3.5 Hydrology and drainage

3.5.1 Surface Water

According to Mayes (1997) rainfall in the local area averages around 610mm and significantly less than the national average of around 900mm.

Evapotranspiration is typically 450mm/year resulting in about 160mm/year as 'hydrologically effective' rainfall which is available to infiltrate into the ground or run-off as surface water flow.

With reference to Camden Geological, Hydrogeological and Hydrological Study (1999), Talling (2011) and Barton (1992) springs that sourced tributaries of the 'lost rivers' River Tyburn were located approximately 80m east and 180m west of the site respectively (Figure 5).

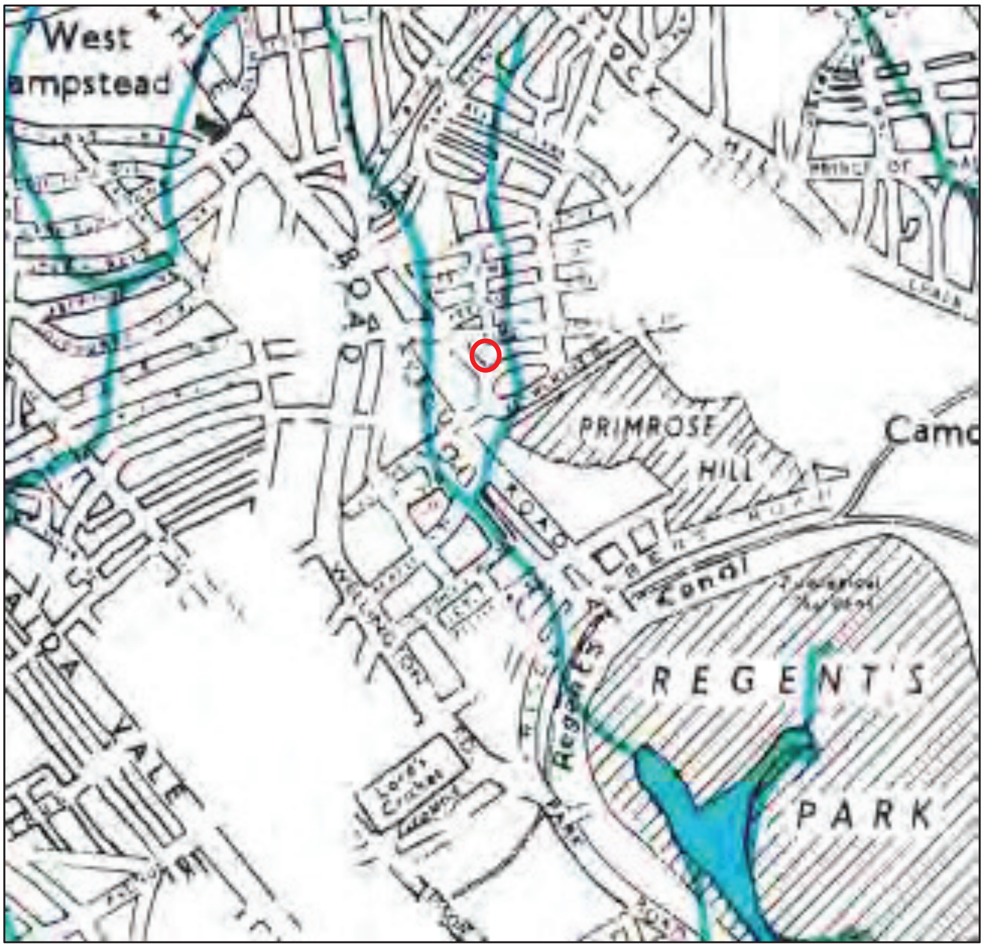


Figure 5. Location of site (circled) relative to the 'Lost Rivers' of London (Source: Barton, 1992)

The River Tyburn flowed in a southerly direction from Shepherds Well (or Conduit Well) located to the south of Spring Path. From the well it flowed southwards down Fitzjohn's Avenue, through Swiss Cottage and into Regent's Park, where it entered into a large lake. From the lake it flowed southwards through the West End and the City of Westminster, before issuing into the River Thames close to Vauxhall Bridge.

The watercourses have since been largely lost through a culverting system as the urban extent of the borough has grown over time.

Envirocheck indicates that the closest surface water feature is located 358m north-west of the site, but from mapping material, no feature can be found.

The area located immediately around the site is highly developed with more than 80% of the surface covered with hardstanding. Most of the rainfall in the area will run-off hard surface areas and be collected by the local sewer network.

Surface drainage from the site is assumed to be directed to drains flowing downhill to the south-east along Harley Road.

3.5.2 Flood Risk

3.5.2.1 River or Tidal flooding

According to Environment Agency Flood maps there are no flood risk zones within 1 kilometre of the site. The EA's website also shows that this area does not fall within an area at risk of flooding from reservoirs. Based on this information a flood risk assessment will not be required.

3.5.2.2 Surface water flooding

Figure 6 shows that Nutley Terrace flooded during the 1975 event, but not in the 2002 flood event.

Figure 6. Exact from Figure 15 of the Camden CPG4 showing roads which flooded in 1975 (light blue), in 2002 (dark blue) and 'areas with potential to be at risk from surface water flooding' (wide light blue bands)

Further modelling of surface water flooding has been undertaken by the Environment Agency and was published on its website in January 2014; an extract from their model is presented in Figure 7. Whilst this map identifies four levels of risk (high, medium, low and very low) it is understood that it is based at least in part on depths of flooding. This modelling shows a 'Very Low' risk of flooding (the lowest category for the national background level of risk) for No.9 and the surrounding area.

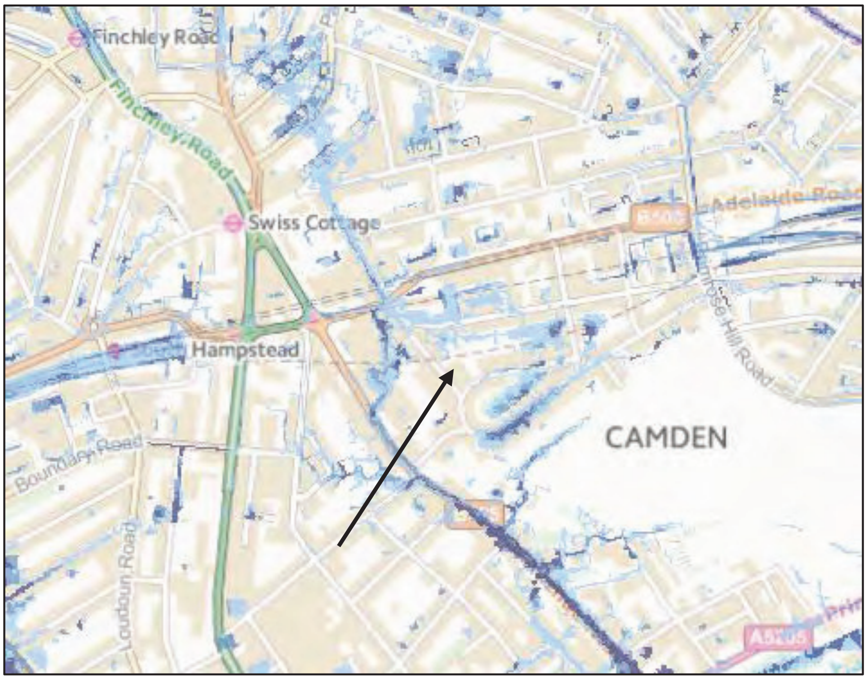


Figure 7. Extract from the Environment Agency's 'Risk of Flooding from Surface Water'. Ordnance Survey Crown copyright 2015. All rights reserved.

As detailed in Table 1 below, the scheme will result in a small decrease in impermeable areas by 7.0m^2.

Element	Existing (m^2)	Proposed (m^2)
Impermeable (hardstanding - building footprint, concrete areas)	355	348
Permeable (softscaping - grassed areas, (including green roof), permeable and porous paving)	624	631
Total (should be the site area and remain the same)	979	979

Table 1. Existing and Proposed Permeable Areas.

3.5.2.3 Sewer flooding

The London Regional Flood Risk Appraisal (2009) advises that foul sewer flooding is most likely to occur where properties are connected to the sewer system at a level below the hydraulic level of the sewage flow, which in general are often basement flats or premises in low lying areas. There is no record of sewer flooding having occurred at 9 Harley Road and therefore the risk of sewer flooding is considered low.

3.6 Hydrogeological setting

The Environment Agency Groundwater Protection Policy uses aquifer designations that are consistent with the Water Framework Directive. These designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) and also their role in supporting surface water flows and wetland ecosystems.

The Bedrock geology underlying the site (London Clay) has been classified as Unproductive Strata; rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Other hydrogeological data obtained from the Phase 1 Preliminary Risk Assessment (PRA) (SAS Report Ref: 15/23973-1) for the site include:

- The underlying soil classification of the site is of high leaching potential.
- The site is within a Zone II (Outer protection) source zone.
- There are 7 groundwater abstraction licences listed within one kilometre of the site. The closest is located 376m north-west of the site and relates to spray irrigation.
- There are no surface water abstraction licences within 1km of the site.
- There are no public potable water supply abstraction licences within 1km of the site.

3.7 Proposed Development

It is proposed to demolish part of the property and construct a new rear extension with a lower ground floor level. It is understood that the proposed lower ground floor is at a level of approximately 45.7mOD (3.3m below ground level).

Sections showing the proposed developments are detailed in Figure 8 below.

Figure 8. Sections of the proposed North and South Elevations of the property.

3.8 Results of Basement Impact Assessment Screening

A screening process has been undertaken for the site and the results are summarised in Table 2 below:

Table 2: Summary of screening results

Item	Description	Response	Comment
Sub-terranean (Ground water Flow)	1a. Is the site located directly above an aquifer.	No	The site has been classified as being situated above an unproductive (negligibly permeable) formation (London Clay) that is generally regarded as containing insignificant quantities of groundwater.
	1b. Will the proposed basement extend beneath the water table surface.	Unknown – to be confirmed by Ground Investigation	Given the presence of a non-aquifer below the site it is unlikely that groundwater will be encountered during any excavations for the proposed basement, however this will be confirmed by the ground investigation.
	2. Is the site within 100m of a watercourse, well (used / disused) or potential spring line.	Yes	Envirocheck indicates that the closest surface water feature is located 358m north-west of the site, but from mapping material, no feature can be found. According to publications regarding Lost Rivers of London (Barton, 1992) and (Talling, 2011) and Stanford (1868) the site is 80m west and 180m east of tributaries to the River Tyburn (Figure 5). From the British Geological Society 'Geoindex' the nearest water well is located approximately 320m north-west of the site.
	3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas.	Yes	The amount of hardstanding on-site is expected to decrease.
	4. As part of 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	Existing drainage paths are to be utilised where possible. Whether soakaways/SUDS are used on the proposed development is to be confirmed (beyond the scope of this report). An appropriately qualified engineer should be engaged to ensure mandatory requirements are met.
	5. 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 or spring line.	Yes	Envirocheck indicates that the closest surface water feature is located 358m north-west of the site, but from mapping material, no feature can be found. According to publications regarding Lost Rivers of London (Barton, 1992) and (Talling, 2011) and Stanford (1868) the site is 80m west and 180m east of tributaries to the River Tyburn (Figure 5). From the British Geological Society 'Geoindex' the nearest water well is located approximately 320m north-west of the site.

Slope Stability	1. Does the existing site include slopes, natural or man-made greater than 7 degrees (approximately 1 in 8).	No	There is a slight slope from north to south across the site, but is below 7 degrees.
	2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7 degrees (approximately 1 in 8).	No	Re-profiling of landscaping at the site is not proposed.
	3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 degrees (approximately 1 in 8).	No	The surrounding area drops to the south-east, but from survey information and with reference to Figure 16 from Camden CPG 4, this is at angles of less than 7 degrees.
	4. Is the site within a wider hillside setting in which the general slope is greater than 7 degrees (approximately 1 in 8).	No	There is a general slope in the area towards the south down to the south-east, but this is at an angle of less than 7 degrees.
	5. Is the London Clay the shallowest strata at the site.	Yes	With reference to available BGS records, the London Clay Formation is expected to be encountered from ground level.
	6. Will any trees be felled as part of the development and/or are any works proposed within any tree protection zones where trees are to be retained.	No	It is understood that no trees are to be felled as part of the development.
	7. Is there a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site.	Yes	The site lies above the London Clay Formation well known as having a high tendency to shrink and swell.
	8. Is the site within 100m of a watercourse or a potential spring line.	Yes	Envirocheck indicates that the closest surface water feature is located 358m north-west of the site, but from mapping material, no feature can be found. According to publications regarding Lost Rivers of London (Barton, 1992) and (Talling, 2011) and Stanford (1868) the site is 80m west and 180m east of tributaries to the River Tyburn (Figure 5).
	9. Is the site within an area of previously worked ground.	No	According to records from the BGS the site is not in the vicinity of any recorded areas of worked ground.

	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	The site has been classified as being situated above an unproductive (negligibly permeable) formation (London Clay) that is generally regarded as containing insignificant quantities of groundwater.
	11. Is the site within 50m of the Hampstead Heath Ponds	No	With reference to the Camden Geological, Hydrogeological and Hydrological Study, the site is not within the catchment of the pond chains on Hampstead, nor the Golder's Hill Chain.
	12. Is the site within 5m of a highway or pedestrian right of way.	Yes	The site lies within 5m of Harley Road.
	13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties.	Yes	The development will increase the depths of foundation at the site, although the foundation depths of adjacent properties are not known.
	14. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines.	Yes	The development is within 5m of Network Rail tunnels which are at a depth of 20m below ground level.
Surface Water and Flooding	1. Is the site within the catchment of the ponds chains on Hampstead Heath	No	With reference to the Camden Geological, Hydrogeological and Hydrological Study, the site is not within the catchment of the pond chains on Hampstead, nor the Golder's Hill Chain.
	2. As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route.	No	No – any additional surface water generated from an increased hardstanding area will be attenuated to ensure they are not increased or altered. The basement will be beneath the footprint of the new dwelling therefore the 1m distance between the roof of the basement and ground surface as recommended by Chapter 5 of the Arup report, does not apply across these areas.
	3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas.	Yes	Yes, there will be a small change in the area of hard surfacing. The surface permeability will be affected with a slight decrease in the footprint of the new building and a small increase in the amount of paved surface in relation to the total site.

	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	All surface water for the site will be contained within the site boundaries and collected as described above; hence there will be no change from the development on the quantity or quality of surface water being received by adjoining sites. The basement will be beneath the footprint of the dwelling therefore the 1m distance between the roof of the basement and ground surface as recommended by Chapter 5 of the Arup report does not apply across these areas.
	5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses.	No	The surface water quality will not be affected by the development, as in the permanent condition collected surface water will be generally be from roofs, domestic hard landscaping or collected from beneath the landscaping layer over the basement.
	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	Yes	Harley Road flooded during either the 1975 flood event. According to modelling by the Environment Agency, there is a 'Very Low' risk of surface water flooding (the lowest category for the national background level of risk) for No.9 and the surrounding area.

3.9 Non Technical Summary of Chapter 3.0

The site is located to the north-east of Harley Road in Hampstead, North London, NW3 3BX and comprises a two storey residential property, including rooms at roof level with front and rear garden areas.

The property is constructed on slightly sloping ground to the north-east.

The 1:50000 Geological Survey of Great Britain (England and Wales) covering the area indicates the site to be underlain by the London Clay Formation. The London Clay Formation is classed as unproductive strata or a non-aquifer.

According to publications regarding Lost Rivers of London (Barton, 1992) and (Talling, 2011) and Stanford (1868) the site is 80m west and 180m east of tributaries to the River Tyburn (Figure 5).

The nearest surface water feature from mapping evidence is located 358m north-west of the site.

According to Environment Agency Flood maps there are no flood risk zones within 1 kilometre of the site. The EA's website also shows that this area does not fall within an area at risk of flooding from reservoirs.

Based on this information a flood risk assessment will be required. Harley Road flooded during the 1975 flood event. Modelling of surface water flooding by the Environment Agency shows a 'Very Low' risk of flooding (the lowest category for the national background level of risk) for No.10 and the surrounding area.

The Screening Exercise has identified the following potential issues which will be carried forward to the Scoping Phase

Subterranean Groundwater Flow

- Will the proposed basement extend beneath the water table surface.
- Is the site within 100m of a watercourse, well (used / disused) or potential spring line.
- 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 or spring line.

Slope Stability

- Is the London Clay the shallowest strata at the site.
- Is there a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site.
- Is the site within 5m of a highway or pedestrian right of way.
- Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties.
- Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines.

Surface Water and Flooding

- Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas.

4.0 SCOPING PHASE

4.1 Introduction

This purpose of the scoping phase is to assess in more detail the factors to be investigated in the impact assessment. Potential impacts are assessed for each of the identified impact factors and recommendations are stated.

A conceptual ground model is usually complied at the scoping stage however, because the ground investigation has already been undertaken for this project, the conceptual ground model including the findings of the ground investigation is described under Chapter 4.

Subterranean (Groundwater Flow)

Potential Issue (Screening Question)		**Potential impacts and actions**
1b	Will the proposed basement extend beneath the water table surface?	**Potential impact:** Local restriction of groundwater flows (perched groundwater or below groundwater table). **Action:** Ground investigation required, the review.
2	Is the site within 100m of a watercourse, well (used / disused) or potential spring line	**Potential impact:** The flow from a spring, well or watercourse may increase or decrease if the groundwater flow regime is affected by the proposed basement **Action:** Review hydrogeology of the site and undertake a ground investigation.

Slope Stability

5	Is the London Clay the shallowest strata at the site?	**Potential impact:** The London Clay is prone to seasonal shrink-swell (subsidence and heave). **Action:** Ground investigation required, the review.
7	Is there a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site?	**Potential Impact:** Ground movements will occur during and after the basement construction. **Action:** Ground investigation required, then review.
11	Is the site within 5m of a highway or a pedestrian right of way?	**Potential impact:** Excavation of basement causes loss of support to footway/highway and damage to the services beneath them. **Action:** Ensure adequate temporary and permanent support by use of best practice working methods.
12	Will the proposed basement substantially increase the differential depth of foundations relative to neighbouring properties?	**Potential impact:** Loss of support to the ground beneath the new foundations to neighbouring properties if basement excavations are inadequately supported. **Action:** Ensure adequate temporary and permanent support by use of best practice methods.
14	Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines.	**Potential impact:** Excavation of basement damages the underlying tunnels **Action:** Ensure foundation solution is agreed with Network Rail prior to commencing on site.

Surface Water and Flooding

Potential Issue (Screening Question)		**Potential impacts and actions**
3	Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas.	**Potential impact:** May increase flow rates to sewer, and thus increase the risk of flooding **Action:** Assess net change in hard surfaced/paved areas and, if required, recommend appropriate types of SUDS for use as site-specific mitigation.
6	Is the site in an area known to be at risk from surface water flooding.	**Potential impact**: Flooding occurs during the excavation of the basement **Action**: A groundwater exception test should be carried out prior to any construction works.

These potential impacts have been further assessed through the ground investigation, as detailed in Section 4 below.

4.2 Non-Technical Summary of Chapter 4.0

The scoping exercise has reviewed the potential impacts for each of the items carried forward from Stage 1 screening, and has identified the following actions to be undertaken:

- A ground investigation is required (which has already been undertaken).
- Review of site's hydrogeology and groundwater control requirements.

All these actions are covered in Stage 4 or Stage 3 for the ground investigation.

5.0 SITE INVESTIGATION DATA

5.1 Records of site investigation

A site-specific ground investigation was undertaken by Site Analytical Services Limited (SAS) in October 2015 and included two rotary percussive boreholes (Boreholes 1 and 2) and one hand dug trial pit (Trial Pit 1) excavated to 1.5m depth.

The factual findings from the investigation are presented in Appendix B, including a site plan, exploratory hole logs, groundwater monitoring and laboratory test results.

5.2 Ground conditions

The boreholes and trial pit revealed ground conditions that were consistent with the geological records and known history of the area and comprised Made Ground up to 1.00m in thickness resting on deposits of the London Clay Formation.

5.2.1 Made Ground

The Made Ground extended down to depths of between 0.30m and 0.40m (48.86mOD to 48.24mOD) in the boreholes and to 1.00m below ground level in Trial Pit 1 (48.08mOD) and the material generally comprised a surface layer of grass/brick paving overlying loose silty sandy gravelly clay with brick fragments and ashes.

5.2.2 London Clay Formation

The London Clay Formation was encountered below the Made ground and consisted of soft to firm then stiff becoming very stiff silty clay with occasional pockets and partings of silty fine sand and scattered gypsum crystals. These deposits extended down to the full depths of investigation of 15.00m below ground level in Boreholes 1 and 2 (34.16 to 33.64mOD).

5.3 Groundwater

Groundwater was not encountered within the boreholes and the trial pit and the soils remained essentially dry throughout.

It must be noted that the speed of excavation is such that there may well be insufficient time for further light seepages of groundwater to enter the boreholes and trial pit and hence be detected, particularly within more cohesive soils.

Isolated pockets of groundwater may also be present perched within any less permeable material found at shallower depth on other parts of the site especially within any Made Ground.

Following drilling operations groundwater monitoring piezometers were installed in Boreholes 1 and 2 to approximately 8.00m depth.

Groundwater was not subsequently encountered within these monitoring standpipes after a period of approximately four weeks.

It should be noted that the comments on groundwater conditions are based on observations made at the time of the investigation (October and November 2015) and that changes in the groundwater level could occur due to seasonal effects and also changes in drainage conditions.

5.4 Foundations

Trial Pit 1 was excavated adjacent to the wall of the existing property on the site in order to expose the foundations and founding soils. Trial Pits 1 and 2 showed the walls are supported on outstepped brick foundations resting on the London Clay Formation at a depth of approximately 1.20m below ground level (47.88 mOD).

5.5 In-Situ and Laboratory Testing

The results of the laboratory and in-situ tests are presented in the factual report contained in Appendix A.

5.5.1 Standard Penetration Tests

The results of the Standard Penetration Tests carried out in the natural soils are shown on the exploratory hole records in Appendix A. SPT ‘N’ values range between 7 and 58.

5.5.3 Undrained Triaxial Compression Test Results

Quick Undrained Triaxial Compression tests were carried out on ten selected undisturbed 100mm diameter samples taken from Boreholes 1 and 2 at varying depths. The results show the samples to be of medium then high becoming very high strength in accordance with BS 5930 2015.

5.5.4 Classification Tests

Atterberg Limit tests have been conducted on four selected samples taken from Boreholes 1 and 2, and showed the samples tested to fall into Class CH according to the British Soil Classification System.

These are fine grained silty clay soils of high plasticity and as such generally have a low permeability and a medium susceptibility to shrinkage and swelling movements with changes in moisture content, as defined by the NHBC Standards, Chapter 4.2. The results indicated Plasticity Index values of between 35% and 38%, with all of the samples being below the higher 40% boundary between soils assessed as being of medium swelling and shrinkage potential and those assessed as being of high swelling and shrinkage potential.

5.5.5 Sulphate and pH Analyses

The results of the sulphate and pH analyses show the natural soil samples to have water soluble sulphate contents of up to 2.57g/litre associated with near neutral to slightly acidic pH values.

5.6 Non-Technical Summary of Chapter 5.0

A site-specific ground investigation was undertaken by Site Analytical Services Limited (SAS) in October 2015 and included two rotary percussive boreholes (Boreholes 1 and 2) drilled to 15m below ground level and one hand dug trial pit (Trial Pit 1) excavated to 1.5m depth.

The boreholes and trial pit revealed ground conditions that were consistent with the geological records and known history of the area and comprised Made Ground up to 1.00m in thickness resting on deposits of the London Clay Formation.

Following drilling operations groundwater monitoring piezometers were installed in Boreholes 1 and 2 to approximately 8.00m depth.

Groundwater was not subsequently encountered within these monitoring standpipes after a period of approximately four weeks.

6.0 FOUNDATION DESIGN

6.1 Introduction

It is proposed to demolish part of the property and construct a new rear extension with a lower ground floor level.

It is understood that the proposed lower ground floor is at a level of approximately 45.7mOD (3.3m below ground level).

6.2 Site Preparation Works

The main contractor should be informed of the site conditions and risk assessments should be undertaken to comply with the Construction Design Management (CDM) regulations. Site personnel are to be made aware of the site conditions. It is recommended that extensive searches of existing man-made services are undertaken over the site prior to final design works.

6.3 Ground Model

On the basis of the fieldwork, the ground conditions at the site can be characterised as follows:

- Made Ground extends to depths of between 0.30m to 1.00m depth below ground level (48.86 to 48.08mOD).
- The London Clay Formation comprising soft then firm becoming stiff silty sandy clay with gypsum crystals to the full depths of investigation of 15.00m below ground level (34.16 to 33.64mOD).
- Groundwater was not encountered in the monitoring standpipes installed above 8.0m depth in Boreholes 1 and 2. This suggests that the water table is deeper than 8.0m below ground level (i.e. below the base of the standpipe) across the site.

6.4 Basement Excavation

Groundwater is not expected to be encountered in the basement excavation, but it would be prudent for the chosen contractor to have a contingency plan in place to deal with any perched groundwater inflows as a precautionary measure. Trial excavations to the proposed basement depth could be carried by the main contractor to confirm the stability of the soil and to further investigate the presence of any groundwater inflows.

6.5 Conventional Spread Foundations

A result of the inherent variability of uncontrolled fill, (Made Ground) is that it is usually unpredictable in terms of bearing capacity and settlement characteristics. Foundations should therefore, be taken through any Made Ground and either into, or onto a suitable underlying natural stratum of adequate bearing characteristics.

Based on the ground and groundwater conditions encountered in the boreholes and trial pit, it should be possible to support the proposed new development on conventional strip or basement raft foundations taken down below the Made Ground and any weak superficial soils and placed in the natural firm sandy silty clay deposits which occur at depths of between approximately 0.30m and 1.00m below ground level over the site. Foundations should be placed in the natural deposits at a minimum depth of 1.00m below final ground level in order to avoid the zone affected by seasonal moisture content changes.

Using theory from Terzaghi (1943), strip foundations placed within natural soils may be designed to allowable net bearing pressures of approximately 125kN/m^2 at 3.00m depth increasing to 185kN/m^2 at 5.00m depth in order to allow for a factor of safety of 2.5 against general shear failure. The actual allowable bearing pressure applicable will depend on the form of foundation, its geometry and depth in accordance with classical analytical methods, details of which can be obtained from “Foundation Design and Construction”, Seventh Edition, 2001 by M J Tomlinson (see references) or similar texts.

Any soft or loose pockets encountered within otherwise competent formations should be removed and replaced with well compacted granular fill.

In addition, foundations may need to be taken deeper should they be within the zones of influence of both existing or recently felled trees and any proposed tree planting. The depth of foundation required to avoid the zone likely to be affected by the root systems of trees is shown in the recommendations given in NHBC Standards, Chapter 4.2, April 2010, “Building near Trees" and it is considered that this document is relevant in this situation.

6.6 Piled Foundations

In the event that the use of conventional spread foundations proves either impracticable or uneconomical due to the size and depth of foundation required, then a piled foundation will be required. In these ground conditions, it is considered that some form of bored and in-situ cast concrete piled foundation with reinforced concrete ground beams should prove satisfactory.

The construction of a piled foundation is a specialist activity and the advice of a reputable contractor, familiar with the type of soil and groundwater conditions encountered at this site should be sought prior to finalising the foundation design. The actual pile working load will depend on the particular type of pile chosen and method of installation adopted.

To achieve the full bearing value a pile should penetrate the bearing stratum by at least five times the pile diameter.

Where piles are to be constructed in groups the bearing value of each individual pile should be reduced by a factor of about 0.8 and a calculation made to check the factor of safety against block failure.

Driven piles could also be used and would develop much higher working loads approximately 2.5 to 3 times higher than bored piles of a similar diameter at the same depth. However, the close proximity of adjacent buildings will in all probability preclude their use due to noise and vibration.

6.7 Retaining Walls

Several methods of retaining wall construction could be considered. These may include retaining structures cast in an underpinning sequence, or the use of temporary or sacrificial works to facilitate the retaining structure's construction. The excavation of the basement must not compromise the integrity of adjacent structures.

The full design of temporary and permanent retaining structures is beyond the scope of this report. However, the following design parameters for each element of soil recorded in the relevant exploratory holes are provided in Table 3 below to assist the design of these structures.

Stratum	**Depth to top (mOD)**	**Bulk Density (Mg/m3) (γ)**	**Effective Angle of Internal Friction (Φ)**
Made Ground	49.16 to 48.64	2.00	28
London Clay Formation	48.86 to 48.08	2.00	23

Table 3. Retaining Wall Design Parameters

The designer should use these parameters to derive the active and passive earth pressure coefficients ka and kp. The determination of appropriate earth pressure coefficients, together with factors such as the pattern of the earth pressure distribution, will depend upon the type/geometry of the wall and overall design factors.

6.8 Chemical Attack on Buried Concrete

The results of the chemical analyses show the natural soil samples tested to have water soluble sulphate contents of up to 2.57g/litre associated with near neutral to slightly acidic pH values.

In these conditions, it is considered that deterioration of buried concrete due to sulphate or acid attack is likely to occur. The final design of buried concrete according to Tables C1 and C2 of BRE Special Digest 1:2005 should be in accordance with Class DS-3 conditions.

In addition, segregations of gypsum were noted within the London Clay and also are well known to occur within London Clay deposits. Consequently, it is considered that any buried concrete at depth may be attacked by such sulphates in solution and that it would be prudent to design any such concrete in accordance with full Class DS-3 conditions.

6.9 Non-Technical Summary of Chapter 6.0

On the basis of the fieldwork, the ground conditions at the site can be characterised as follows: Made Ground extends to depths of between 0.30m to 1.00m depth below ground level (48.86 to 48.08mOD), The London Clay Formation extends to the full depth of investigation of 15.00m below ground level (34.16 to 33.64mOD). Groundwater was not encountered in the monitoring standpipes installed above 6.0m depth. This suggests that the water table is deeper than 6m below ground level (i.e. below the base of the standpipe) across the site.

Groundwater is not expected to be encountered in the basement excavation, but it would be prudent for the chosen contractor to have a contingency plan in place to deal with any perched groundwater inflows as a precautionary measure.

Several methods of retaining wall construction could be considered. These may include retaining structures cast in an underpinning sequence, or the use of temporary or sacrificial works to facilitate the retaining structure’s construction. The excavation of the basement must not compromise the integrity of adjacent structures.

Based on the water soluble sulphate tests carried out as part of these works, it is considered that deterioration of buried concrete due to sulphate or acid attack is likely to occur. The final design of buried concrete according to Tables C1 and C2 of BRE Special Digest 1:2005 should be in accordance with Class DS-3 conditions.

In addition, segregations of gypsum were noted within the London Clay and also are well known to occur within London Clay deposits. Consequently, it is considered that any buried concrete at depth may be attacked by such sulphates in solution and that it would be prudent to design any such concrete in accordance with full Class DS-3 conditions.

7.0 BASEMENT IMPACT ASSESSMENT

7.1 Summary

The screening identified a number of potential impacts. The table below summarises the previously identified potential impacts and the additional information that is now available from the site investigation in consideration of each impact.

Potential Impact	Site Investigation conclusions	Impact sufficiently addressed without further justification?
The proposed basement extends beneath the water table surface.	Groundwater was not encountered in the monitoring standpipes installed above 8.0m depth. This suggests that the water table is deeper than 8.0m below ground level (i.e. below the base of the standpipe) across the site. This is below the depth of the proposed basement at 45.70mOD and therefore the influence of the development on groundwater is expected to be minimal.	Yes
The site is within 100m of a watercourse, well (used / disused) or potential spring line	The site lies within 80m of the one of the tributaries of the former River Tyburn.	No – see below for further details.
The lowest point of the proposed excavation is close to, or lower than, the mean water level in any local pond or spring line		
There a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site.	The London Clay was proven below the site and was recorded as having a high susceptibility to shrinkage and shrinkage. However, the base of proposed basement will extend well below the potential depth of root action.	Yes
The site is within 5m of a highway or pedestrian right of way.	The proposed basement is not to be extended below Harley Road and therefore it is suggested that the impact on these access roads is likely to be minimal. There is nothing unusual in the proposed development that would give rise to any concerns with regard to the stability of public highways.	Yes.
The proposed basement will significantly increase the differential depth of foundations relative to neighbouring properties.	The development will result in the extension of the foundation depth of the basement relative to neighbouring properties.	No – see below for further details.

The site is within 5m of a Network Rail tunnel	The retention system will ensure the stability of the nearby tunnels at all times. Correspondence with Network Rail must be undertaken prior to and during the final design of the basement to insure the safety of the underlying tunnel.	Yes
Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas.	There is a small decrease in impermeable area on-site following development, which equates to a decrease in the rate of runoff from the site.	Yes
The site is in an area known to be at risk from surface water flooding.	There is a potential risk of surface water following the construction.	No – see below for further details.

7.2 Outstanding risks and issues

The site is within 100m of a watercourse, well (used / disused) or potential spring line & the lowest point of the proposed excavation is close to, or lower than, the mean water level in any local pond or spring line

As noted, there are no watercourses in the vicinity of the site.

The site is within a densely developed urban area, with a number of barriers to overland flow created by the existing residential development (i.e. the building footprint and the walls around the perimeter of the site).

Current information suggests that Fitzjohns Avenue marks the route of the River Tyburn, a former watercourse that has become lost through culverting and urban development of the catchment.

Assuming the watercourse exists in the area within a culverted section, this would flow southwards following the slope along Fitzjohns Avenue towards the River Thames. In an extreme flood event, the highway provides an open - and largely unobstructed - flow route.

The proposed basement development is located to the rear (west) side of the existing property and would be outside the extent of any such flow route. As such, no overland pathways to or from this feature exist across the site.

The proposed basement will significantly increase the differential depth of foundations relative to neighbouring properties.

The excavation and construction of the basement at the site has the potential to cause some movements in the surrounding ground if not properly managed. However, it is understood that ground movements and/or instability will be managed through the proper design and construction of mitigation measures during the works. This will require close collaboration with the appointed contractor’s temporary works coordinator.

The Party Wall Act (1996) will apply to this development because neighbouring houses lie within a defined space around the proposed building works. The party wall process should be followed and adhered to during this development.

A ground movement assessment was carried out at the site by Geo-Environmental Services Limited under the instruction of Site Analytical Services Limited (Report Reference GE1 5167). The report is provided as Appendix C to this report and concludes that the predicted level of damage to No. 7 Harley Road and No. 3 Wadham Gardens, due to the excavation of a lower ground floor at No. 9 Harley Road, is predicted to be negligible. This conclusion assumes a high standard of workmanship and adequate propping of the basement excavation.

A monitoring plan should be set out at design stage and should include a monitoring strategy, instrumentation and monitoring plans and action plans. Trigger levels on movements will need to be defined. Precise levelling or reflective survey targets should be installed at the garden walls and neighbouring buildings. Monitoring should take place in advance of the proposed works as a base-line survey, during the works and for a period following the completion of the works, to understand the long term effects.

Change in paved surfacing and surface water runoff.

As identified in the initial screening and scoping stages there will be a small change in the amount of hard surfacing at the site where the property will be constructed and as a result total surface water flows may decrease.

Overall it is concluded that the surface water flows will not materially change in response to the small decrease in hardstanding. On completion of the development the surface water flows will be routed in a similar way to the existing condition, with rainwater run-off collected in a surface water drainage system and discharged to a combined sewer. It will not be necessary to consider additional mitigation measures such as SUDS or soft landscaping over to reduce the rate of any surface water run-off.

The site is in an area known to be at risk from surface water flooding.

Harley Road flooded during either the 1975 flood event. According to modelling by the Environment Agency, there is a ‘Very Low’ risk of surface water flooding (the lowest category for the national background level of risk) for No.9 and the surrounding area.

In applying the Exception Test and assessing the risk associated with surface water and sewer flooding the following is considered:

- The proposed basement construction does not change the impermeable proportion at the site (this remains essentially the same). As such, the basement will not have an adverse impact on the site's surface water run-off.

- Intrusive investigation indicated that the groundwater table is below the proposed basement level. Groundwater is therefore unlikely to adversely impact the site as a result of the development.

- At the time of writing this report, the drainage details had not been finalised; however it is our understanding that the drainage details will incorporate a pumping device to protect the property from sewer flooding.

The proposed development will not increase flood risk at the site or the surrounding area. Also since the development is on already developed land, it will not adversely impact the Council's sustainability objectives.

7.3 Advice on Further Work and Monitoring

A monitoring plan should be set out at design stage and should include a monitoring strategy, instrumentation and monitoring plans and action plans. Trigger levels on movements will need to be defined. Precise levelling or reflective survey targets should be installed at the garden walls and neighbouring buildings. Monitoring should take place in advance of the proposed works as a base-line survey, during the works and for a period following the completion of the works, to understand the long term effects.

It would be prudent to continue to monitor the standpipes for as long as possible in order to determine equilibrium level and the extent of any seasonal variations. The chosen contractor should also have a contingency plan in place to deal with any perched groundwater inflows as a precautionary measure.

7.4 Non-Technical Summary of Chapter 7.0

The excavation and construction of the basement at the site has the potential to cause some movements in the surrounding ground if not properly managed. However, it is understood that ground movements and/or instability will be managed through the proper design and construction of mitigation measures during the works. It is not considered that the proposed basement would result in a significant change to the groundwater flow regime in the vicinity of the proposal. Also, given limited scope of the scheme and limited increase in impermeable areas, the scheme is also considered compliant with the surface water management and flood risk elements of NPPF and Camden policy.

Given good workmanship, the basement to No. 9 Harley Road can be constructed without imposing more than negligible damage on the adjoining properties. The development is not likely to significantly affect the existing local groundwater regime.

It would be prudent to continue to monitor the standpipes for as long as possible in order to determine equilibrium level and the extent of any seasonal variations.

8.0 REFERENCES

1. CIRIA Special Publication 69, 1989. The engineering implications of rising groundwater levels in the deep aquifer beneath London

2. Environment Agency, 2006. Groundwater levels in the Chalk-Basal Sands Aquifer in the London Basin

3. Tomlinson, M J, 2001. “Foundation Design and Construction”, Seventh Edition, Prentice Hall (ISBN 0-13-031180-4).

4. British Standards Institution, 2015. Code of Practice for Site Investigations, BS5930, BSI, London

5. British Standards Institution, 1986. Code of practice for foundations, BS 8004, BSI, London.

6. British Standards Institution, 2009. Code of Practice for Protection of Below Ground Structures Against Water from the Ground. BS 8102, BSI, London

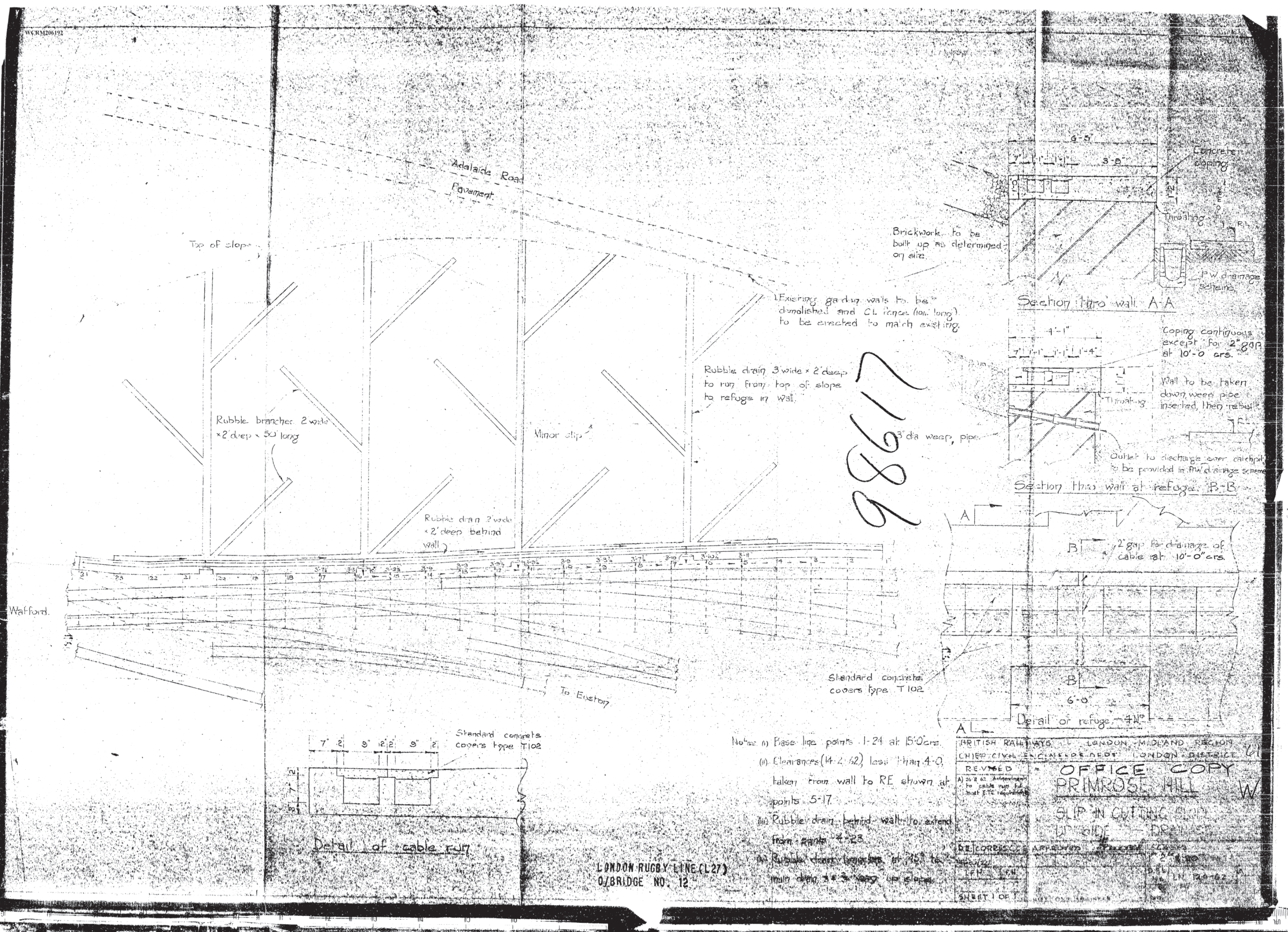
7. CIRIA, 2000. Sustainable Urban Drainage Systems: Design Manual for England and Wales. CIRIA C522, Construction Industry Research and Information Association, London

8. Environment Agency Status Report 2010. Management of the London Basin Chalk Aquifer. Environment Agency

9. NHBC Standards, Chapter 4.1, "Land Quality - managing ground conditions", September 1999.

10. NHBC Standards, Chapter 4.2, "Building near Trees", April 2010.

Appendix A. Responses from Network Rail, TFL and Crossrail


WCRM206192
Adelaide Road
Pavement
Top of slope
Existing garden walls to be demolished and CL fence (100' long) to be erected to match existing
Rubble drain 3' wide × 2' deep to run from top of slope to refuge in wall
Rubble branches 2' wide × 2' deep × 50' long
Minor slip
3" dia weep pipe
Rubble drain 2' wide × 2' deep behind wall
To Watford
To Euston
98617
Brickwork to be built up as determined on site
Concrete coping
Section thro' wall A-A
Coping contiguous except for 2" gap at 10'-0 crs.
Wall to be taken down, weep pipe inserted, then rebuilt
Section thro' wall at refuge B-B
2" gap for drainage of cable at 10'-0" crs.
Standard concrete covers type T102
Detail of refuge - 4 No
Standard concrete covers type T102
Detail of cable run
LONDON RUGBY LINE (L27)
O/BRIDGE NO. 12
Notes (i) Base line points 1-24 at 15'0 crs.
(ii) Clearances (14-2-62) less than 4-0 taken from wall to RE shown at points 5-17
(iii) Rubble drain behind wall to extend from points 4-23
(iv) Rubble drain branches at 45° to main drain
BRITISH RAILWAYS LONDON MIDLAND REGION
CHIEF CIVIL ENGINEER'S DEPT LONDON DISTRICT
REVISED
A) 26-2-62 Amendment to cable run to meet E.T.C. requirements
OFFICE COPY
PRIMROSE HILL
SLIP IN CUTTING
UP SIDE
SHEET 1 OF 1
MICRO FILM UNI
EUSTON HOUSE