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Basement Impact Assessment
Stage 1 & 2 (Screening and Scoping Study)

Desk Studies | Risk Assessments | Site Investigations | Geotechnical | Contamination Investigations | Remediation Design and Validation

Site: 465-467 Finchley Road, NW3 6HS

Client: Mr A Govani

Report Date: March 2015

Project Reference: J12147

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A INTRODUCTION

1 Introduction

The object of this study was to produce an impact assessment for the proposed basement construction on this site in accordance with the requirements of the London Borough of Camden. Their requirements are set out within their Development Policy DP27 – Basements and Lightwells the LB Camden guidance document entitled "Camden geological, hydrogeological and hydrological study – Guidance for subterranean development" and Camden Planning Guidance document CPG4 – Basements and Lightwells.

This report covers the initial desk study, screening and scoping processes, referred to as Stages 1 and 2 in CPG4.

2 Scope

This report presents our desk study findings and our interpretation of this data.

The findings and opinions conveyed via this report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Limited believes are reliable. Nevertheless, Southern Testing Laboratories Limited cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

This report was conducted and prepared for the sole internal use and reliance of Mr A Govani and the appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorization of Southern Testing Laboratories Limited. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

The recommendations contained in this report may not be appropriate to alternative development schemes.

B THE SITE

3 Site Location

The subject site comprises an existing end of terraced property, No 465-467 Finchley Road, NW3 6HS which is located on the north west corner of the junction of Finchley Road (A41) and West End Lane. The site is located approximately 0.5km north west of Finchley and Frognal Railway Station. The approximate National Grid Reference of the site is TQ 256 853.

The property comprises an existing four storey building of masonry construction with a cellar area beneath its rear section and a triangular open section on its southern frontage with West End Lane.

The regional topography of the area comprises general falls at approximately 4-5° from the northeast towards the site/junction of Finchley Road and West End Lane. From the site location

ground levels then tend to comprise more southerly falls at about 2-3°.

At the time of the investigation no significant vegetation was present on the site itself. A Conifer is located to the front of the Church (St. Andrew's United Reformed Church) on the opposite side of Finchley Road to the site and approximately 22m from the front of the property. In addition a Plane tree is located in the front pavement area to the north on Finchley Road approximately 20m from the property.

The majority of the neighbouring properties comprise a mixture of retail shops/restaurants at ground floor level with residential above. The surrounding areas to Finchley Road comprise mainly residential houses and mansion flats.

A site location plan is presented as Figure 1.

4 Proposed Development

The proposed works includes the construction of a basement beneath the front ground floor area of the property. Figure 2 illustrates the proposed basement area. The basement formation level will be in the region of 3.7mBGL and will be constructed using underpinning methods.

C GROUND CONDITIONS

5 Published Geological Data

The British Geological Survey Map No 256 indicates that the site geology consists of a solid geology London Clay with a propensity to be overlain by a Head Deposit.

The study site is marked on appended Figure 3 based upon the North Camden Geological Map taken from "Camden geological, hydrogeological and hydrological study – Guidance for subterranean development", which indicates the same mapped solid geology of London Clay.

6 Previous Ground Investigation data

Very few publicly available records of ground investigation or historical boreholes are shown on the BGS website. The borehole information that is available does not disagree with the published information.

D HYDROLOGY & HYDROGEOLOGY

Data from the Environment Agency and other information relating to controlled waters is summarised below. The groundwater vulnerability assessment is based on the current data on the EA website.

Data		Remarks
Aquifer Designation	Superficial Deposits	No superficial Deposits present.
	Bedrock	The bedrock (London Clay) is mapped as an unproductive strata

Data	Remarks
Groundwater Vulnerability	Non Aquifer
Abstractions	On the basis of the information given on the EA website (February 2015) there are no water abstraction licenses in the area.
Source Protection Zones	The site is not located within a Source Protection Zone.
Surface Water Features	The nearest surface water features are the Hampstead Heath Pond Chain some 1.0km to the north east. The site lies outside of the catchment area to the ponds.
Marine/Fluvial Flood Risk	On the basis of the information given on the EA website (February 2015) the site is not located within an area at risk of flooding from fluvial sources.
Surface Water Flood Risk	The "Risk of Flooding from Surface Water" mapping on the Environment Agency website (February 2015) shows that the site is located within an area of very low risk. Very low means that each year, this area has a chance of flooding of less than 1 in 1000 (0.1%). Cannon Hill to the north west of the site is situated within an area of Medium Risk. Medium Risk means that each year, this area has a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%).
Reservoir Flood Risk	On the basis of the information given on the EA website (February 2015) the site is not located within an area of potential risk of flooding from reservoirs.

7 Shallow Groundwater

As the site is directly underlain by London Clay which is an unproductive strata, there are no shallow groundwater aquifers present. (see figure 8)

8 Surface Water Features

No culvert, rivers and or other water bodies are known within the immediate vicinity of the site. (see figure 5). The nearest water courses shown on the Camden Plan of Watercourses-Figure 6 (Source:" Lost Rivers of London"), shows two tributaries to the River Westbourne which follow a southwesterly route and at their nearest points are approximately 170m to the north and 280m to the south east of the site.

E UNDERGROUND STRUCTURES

9 Basements

Given that the adjacent properties fronting onto Finchley Road are of similar age and construction to that of the subject property, and given that the subject property has a rear

cellar area, we would anticipate that the neighbouring properties could also have cellar areas. The presence of a basement area beneath the adjacent property should be confirmed at some stage by the Engineer with an internal inspection of the property.

From a further brief inspection of planning applications for basements within the immediate adjacent properties, no applications for basements were noted.

10 Transport & Other Infrastructure

No tunnels are known to be present within the immediate vicinity of the site. The nearest railway line (which runs overground) is approximately 0.5km to the south of the site.

F BASEMENT IMPACT ON STRUCTURAL STABILITY

11 Structural Stability

DP27 "Maintain the structural stability of the building and neighbouring properties".

The proposed works include the construction of a basement beneath the front section to the building. The works will entail the excavation of a basement with a founding level of approximately 3.7m below existing ground levels.

All works will be carried out in accordance with the Structural Engineers design. In terms of the method of basement construction it is envisaged that conventional underpinning methods will be adopted. Appropriate propping methods and working practices will be carried out to ensure that movements associated with the works are kept within acceptable limits.

The extent and nature of the propping/works will be evaluated during the detailed design phase of the works in order to allow discussions (should they be required) with the party wall surveyor to occur.

Throughout the construction phase the party walls on both sides of the building would be monitored for both movement and vibration to make sure these are within acceptable limits.

G STAGE 1-SCREENING EXERCISE

Guidance from Camden Borough Council through its Development and Planning documents requires that any development proposal which includes a subterranean basement should be screened in order to determine whether there is a requirement for a full BIA to be carried out.

The proposed works include the construction of a basement beneath the front section to the building. The works will entail the excavation of a basement with a founding level of approximately 3.7m below existing ground levels. **Therefore screening is required.**

In this section, the screening flowchart questions contained within CPG4 are addressed in turn.

12 Surface Flow and Flooding

Question 1	**Is the site within the catchment of the pond chains on Hampstead Heath?**	**Action Required**
	No. The site is outside the catchment of the pond chains on Hampstead Heath (see Figure 4).	None
Question 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.	None
Question 3	**Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?**	
	No.	None
Question 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.	None
Question 5	**Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?**	
	No.	None
Question 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. (See Figure 7). This figure indicates that the majority of Finchley Road, Cannon Hill and West End Lane suffered from surface water flooding in 2002.The table contained within CPG4 also indicates Cannon Hill was also subject to flooding in 1975.	Take to Stage 2 Scoping

13 Groundwater Flow

Question 1a	**Is the site located directly above an aquifer?**	**Action Required**
	No. The site is not located within an area designated as an aquifer. The site is underlain by London Clay designated as unproductive strata, (see Figure 8).	None
Question 1b	**Will the proposed basement extend beneath the water table surface?**	
	Unknown. The presence of a perched groundwater table within more permeable made ground overlying the London Clay is considered possible at this stage. Subject to an intrusive investigation, allowances in construction and design could be required.	Take to Stage 2 Scoping
Question 2	**Is the site within 100m of a watercourse, well (used/disused) or potential spring line?**	
	No. (see Figure 6). The nearest water courses shown on the Camden Plan of Watercourses (Source:" Lost Rivers of London") shows two tributaries to the River Westbourne which follow a southwesterly route and at their nearest points are approximately 170m to the north and 280m to the south east of the site. According to the EA website there are no abstraction licenses within the locality of the site. Given the geology of the area (London Clay) the potential presence of spring lines is negligible.	None
Question 3	**Is the site within the catchment of the pond chains on Hampstead Heath?**	
	No. (See Figure 4). The Golders HillChain Catchment is some 1.0km to the north east to the site.	None
Question 4	**Will the proposed basement development result in a change in the proportion of hard surfaced /paved areas?**	
	No.	None

Question 5	**As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)?**	
	No.	None
Question 6	**Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond (not just the pond chains on Hampstead Heath) or spring line?**	
	No. There are no known local water features or spring lines in the immediate vicinity of this site.	None

14 Slope Stability

Question 1	**Does the existing site include slopes, natural or manmade, greater than 7 degrees? (approximately 1 in 8)**	**Action Required**
	No. (see Figure 9)	None
Question 2	**Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 7 degs? (approximately 1 in 8)**	
	No. There is no re-profiling proposed.	None
Question 3	**Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 degs? (approximately 1 in 8)**	
	No. (see Figure 9)	None
Question 4	**Is the site within a wider hillside setting in which the general slope is greater than 7 degrees? (approximately 1 in 8)**	
	No. (see Figure 9)	None
Question 5	**Is the London Clay the shallowest strata at the site?**	
	Yes. (see Figure 3).	None
Question 6	**Will any tree/s 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? (Note that consent is required from LB Camden to undertake work to any tree/s protected by a Tree Protection Order or to tree/s in a Conservation Area if the tree is over certain dimensions).**	
	No.	None

Question 7	**Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site?**	
	No. We have no evidence indicating any possible shrink-swell subsidence in the local area.	None
Question 8	**Is the site within 100m of a watercourse or a potential spring line?**	
	No. (see Figure 6). The nearest water course shown on the Camden Plan of Watercourses (Source:"Lost Rivers of London") shows two tributaries to the River Westbourne which follow a southwesterly route and at the nearest points are approximately 170m to the north/north west and 280m to the south east of the site. Furthermore, given the geology of the area (London Clay) the potential presence of spring lines is negligible.	None
Question 9	**Is the site within an area of previously worked ground?**	
	No. The nearest area of worked ground shown is just to the north and on the opposite side of Finchley Road. (see Figure 3).	None
Question 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 is not underlain by an aquifer. However it is common for perched groundwater to be present if made ground or more permeable Head Deposits overlies the London Clay in which case some dewatering of the perched groundwater could be required. Minor seepage into the working area would be dealt with using sumps or other localised measures.	Take to Stage 2 Scoping
Question 11	**Is the site within 50m of the Hampstead Heath ponds?**	
	No. (see Figure 5). The site is located approximately 1.0km south west of the Hampstead Heath Ponds.	None
Question 12	**Is the site within 5m of a highway or pedestrian right of way?**	
	Yes.	Take to Stage 2 Scoping

Question 13	**Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?**	
	Yes. The proposed finished floor levels of the basement structure will be approximately 3.2m below the ground level/foundations of the adjacent neighbouring property.	Take to Stage 2 Scoping
Question 14	**Is the site over (or within the exclusion zone of) any tunnels, e.g. Railway lines?**	
	No tunnels are known to be present within the immediate vicinity of the site. The nearest railway line (which runs overground) is approximately 0.5m to the south of the site.	None

STAGE 2 - SCOPING EXERCISE

On the basis of the above screening exercise, it is concluded that there are a number of items that will need to be investigated further to assess their potential impacts.

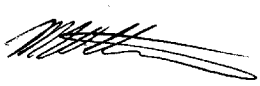
These are as follows:

- *A geotechnical investigation to confirm the ground conditions underlying the site.*
- *Groundwater monitoring.*
- *A series of trial pits to establish party wall foundations.*
- *An assessment of the potential impact of the new basement on groundwater levels and also the potential cumulative effects on the groundwater environment in the area.*
- *An assessment of potential surface water flooding at the site, from the neighbouring highway.*
- *An assessment of any ground movements in relation to the nearby Highway and adjacent property.*

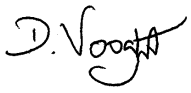
The reader is referred to the attached Stage 3 Ground Investigation Report which considers some of the above issues.

The reader is also referred to other reports prepared by the Structural Engineer and others on construction methodology, monitoring of movements, damage category classification of proposed works, surface water flooding, etc.

J N Race MSc CGeol
(Countersigned)



M W Stevenson MICE
(Countersigned)



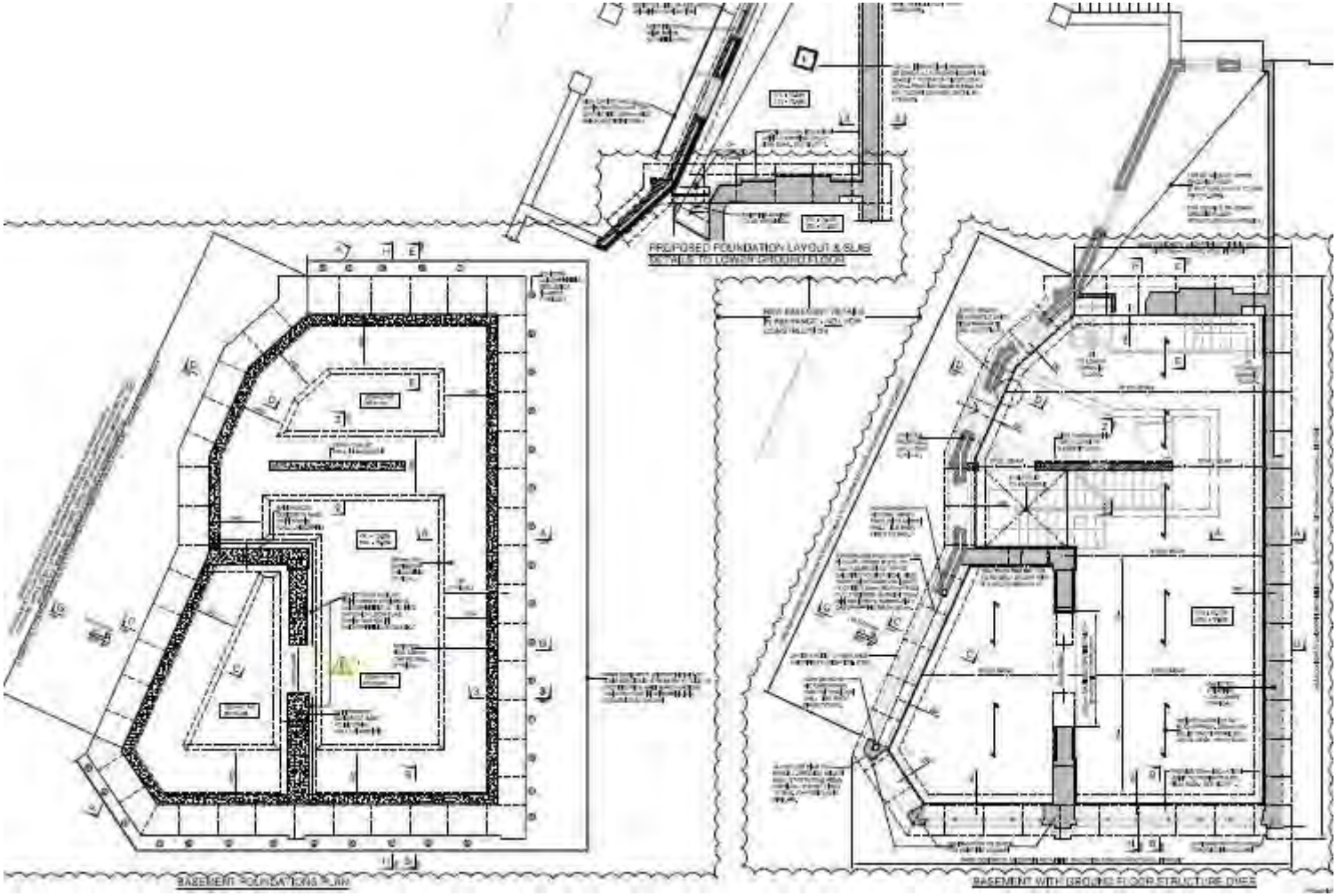
D Vooght MSc
(Signed)

For and on behalf of Southern Testing Laboratories Limited

STL: J12147
25 March 2015

FIGURES

Site:	465-467 Finchley Road, NW3 6HS	STL:J12147	Fig No: 1
Date:	16 February 2015	Site Location	



Site: 465-467 Finchley Road, NW3 6HS	STL: J12147	Fig No: 2
Date: 20 March 2015	Plan showing proposals	

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ST Consult

524000 526000 528000

186000

THE SITE

Data Source: BGS Mapping - Scale 1:10,000

N

Scale at A3: 1:15,000

Coordinate System:
British National Grid
GCS_OSGB_1936

0 0.25 0.5 1 1.5
Kilometers

Legend

- London Borough of Camden
- Railway Lines
- A Roads

BGS 1:10K Artificial Ground

- MADE GROUND
- WORKED GROUND

BGS 1:10K Drift Geology

- ALLUVIUM
- HACKNEY GRAVEL FORMATION
- LANGLEY SILT FORMATION
- LYNCH HILL GRAVEL FORMATION
- STANMORE GRAVEL FORMATION

BGS 1:10K Solid Geology

- BAGSHOT FORMATION
- CLAYGATE MEMBER
- LAMBETH GROUP
- LONDON CLAY FORMATION

NB. Geological boundaries are largely indicative based on available geological mapping data

Camden Geological, Hydrogeological and Hydrological Study

North Camden Geological Map

Report: J12147 Site: 465-467 Finchley Road, NW3 Figure: 3

526000

528000

188000

186000

THE SITE

Catchments and Drainage after Haycock, 2010

N

Scale at A3: 1:10,000

Coordinate System:
British National Grid
GCS_OSGB_1936

0 0.125 0.25 0.5 0.75 1

Kilometers

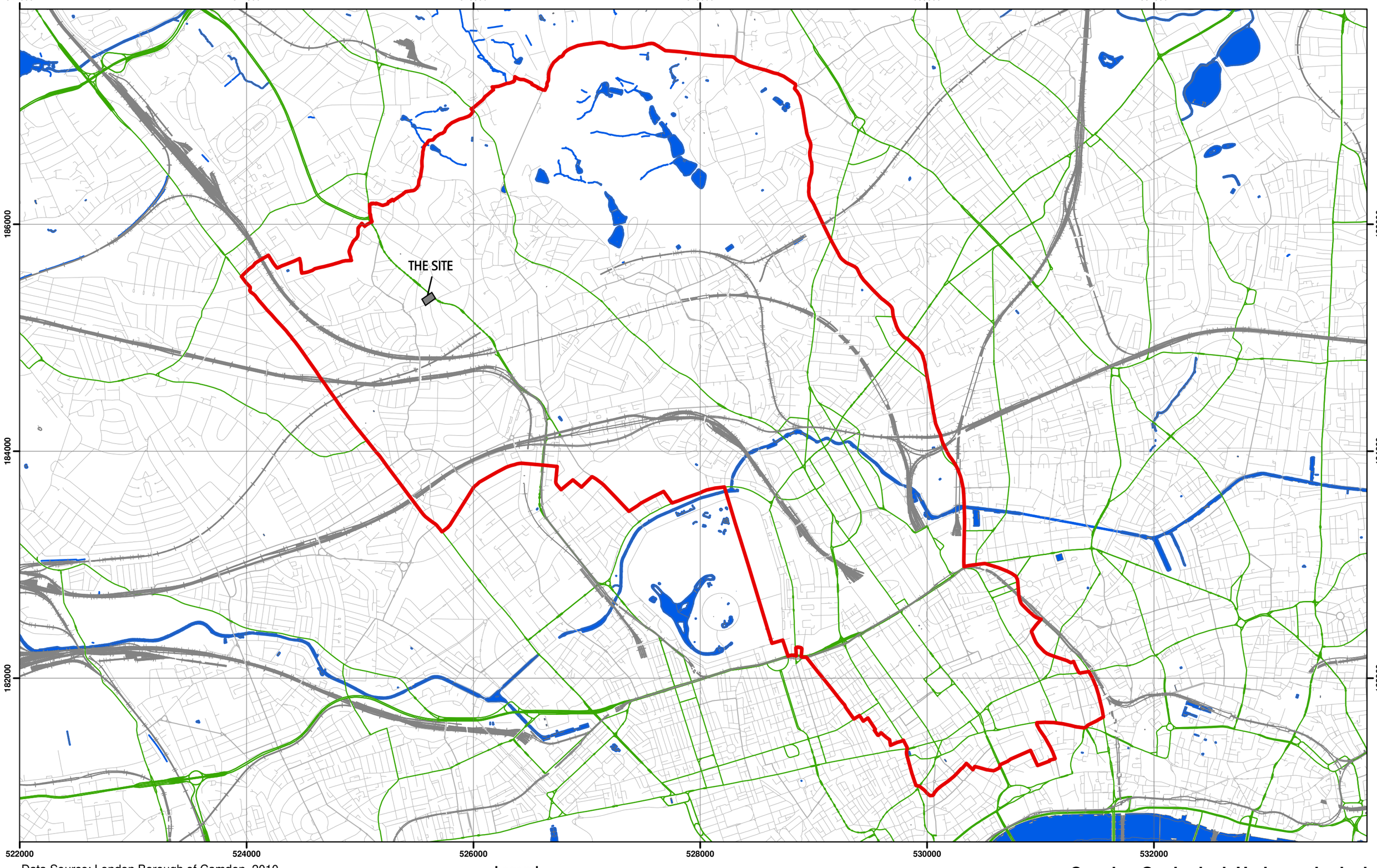
Legend

- London Borough of Camden
- Railway Lines
- A Roads
- Surface Water
- Highgate Chain Catchment
- Golders Hill Chain Catchment
- Hampstead Chain Catchment
- Hampstead Heath Extension Chain Catchment

Camden Geological, Hydrogeological and Hydrological Study

Hampstead Heath Surface Water Catchments and Drainage

Report: J12147 Site: 465-467 Finchley Road, NW3 Figure: 4



Data Source: London Borough of Camden, 2010

N

Scale at A3: 1:30,000

Coordinate System:
British National Grid
GCS_OSGB_1936

0 0.5 1 2 3
Kilometers

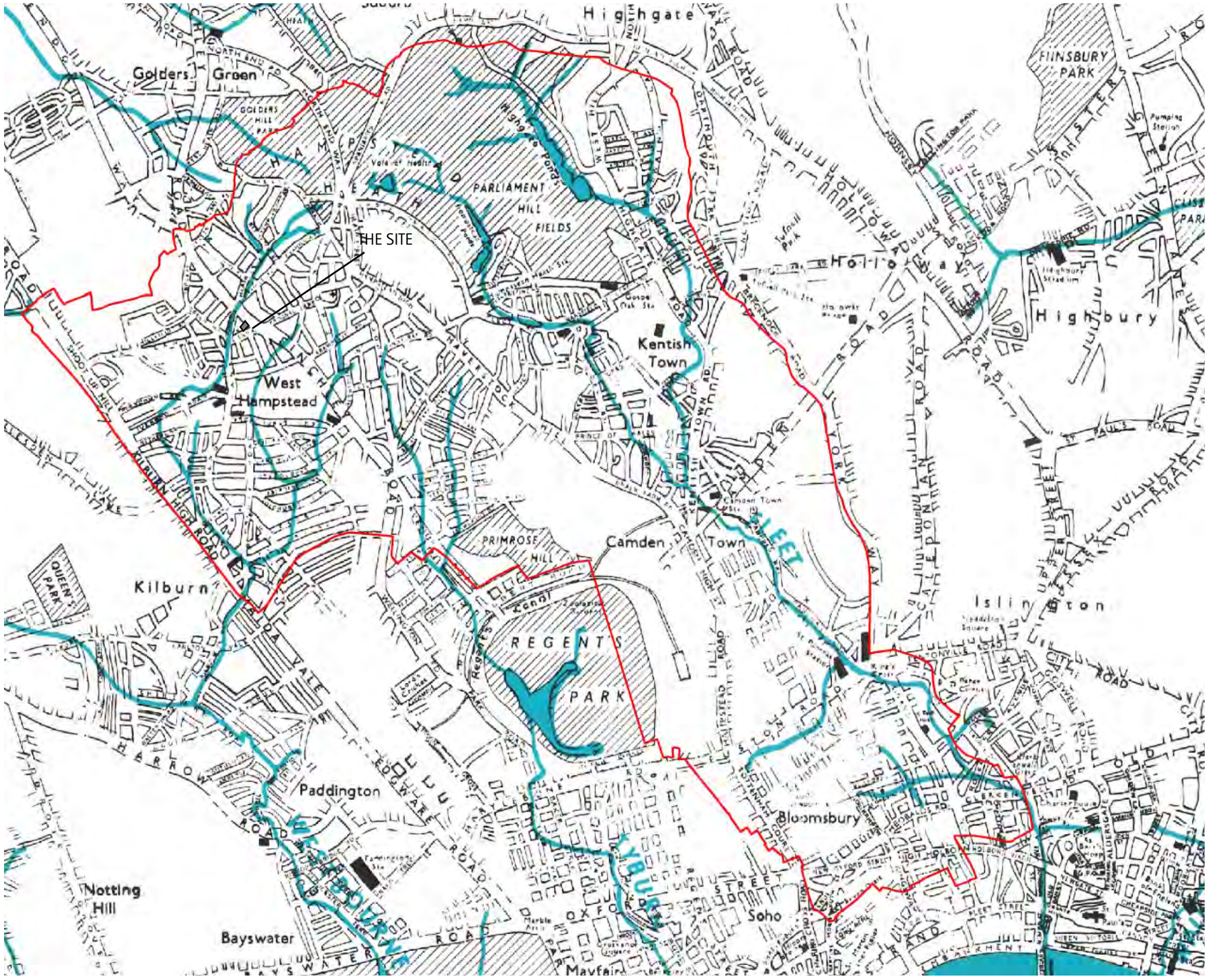
Legend

- London Borough of Camden
- Surface water
- Railway Lines
- A Roads

Camden Geological, Hydrogeological and Hydrological Study

Camden Surface Water Features

Report: J12147 Site: 465-467 Finchley Road, NW3 Figure: 5



Source – Barton, Lost Rivers of London

Camden Geological, Hydrogeological and Hydrological Study
Watercourses

Report: J12147 Site: 465-467 Finchley Road, NW3 Figure: 6

Figure 5 from Core Strategy, London Borough of Camden

Camden Geological, Hydrogeological and Hydrological Study
Flood Map

J12147 Site: 465-467 Finchley Road, NW3 Figure 7

524000 526000 528000 530000 532000 534000

188000 186000 184000 182000

THE SITE

Environment Agency Aquifer Designation based on BGS Mapping

N

Scale at A3: 1:30,000

Coordinate System:
British National Grid
GCS_OSGB_1936

0 0.5 1 2 3
Kilometers

Legend

Borough of Camden
Railway Lines
A Roads

Aquifer Designation

Secondary A Aquifer
Unproductive Strata

Source Protection Zone

Outer Source Protection Zone
Inner Source Protection Zone

NB. Aquifer boundaries are indicative based on available geological mapping data

Camden Geological, Hydrogeological and Hydrological Study

Camden Aquifer Designation Map

Report: J12147 Site: 465-467 Finchley Road, NW3 Figure: 8

524000 526000 528000 530000 532000 534000

186000

184000

182000

THE SITE

Slope Angles calculated from Digital Terrain Model Provided By Camden Bourough Council

N

Scale at A3: 1:30,000

1:10,000 BGS Mapping
Coordinate System:
British National Grid
GCS_OSGB_1936

0 0.5 1 2 3
Kilometers

Legend

Slope
- 0° - 7°
- 7° - 10°
- > 10°

London Borough of Camden
Railway Lines
A Roads

BGS 1:10K Artificial Ground
- MADE GROUND
- WORKED GROUND

BGS 1:10K Drift Geology
- ALLUVIUM
- HACKNEY GRAVEL FORMATION
- LANGLEY SILT FORMATION
- LYNCH HILL GRAVEL FORMATION
- STANMORE GRAVEL FORMATION

BGS 1:10K Solid Geology
- BAGSHOT FORMATION
- CLAYGATE MEMBER
- LAMBETH GROUP
- LONDON CLAY FORMATION

NB. Geological boundaries are largely indicative based on available geological mapping

Camden Geological, Hydrogeological and Hydrological Study

Slope Angle Map

Report: J12147 Site: 465-467 Finchley Road, NW3 Figure: 9

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Stage 3-Site Investigation Report

Desk Studies | Risk Assessments | Site Investigations | Geotechnical | Contamination Investigations | Remediation Design and Validation

Site: 465-467 Finchley Road, NW3 6HS

Client: Mr A Govani

Report Date: March 2015

Project Reference: J12147

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SUMMARY

The site, currently comprises the existing end of terrace property (No 465-467 Finchley Road, London, NW3 6HS) which is located on the north west corner of the junction of Finchley Road and West End Lane.

The property comprises a four storey building with a cellar area beneath its rear section. The building was unoccupied at the time of our works, and the internal fabric to the building had been stripped out due to significant refurbishment works that were being carried out. However, in keeping with the rest of the properties on the terrace, the ground floor level to the building appeared to comprise a former retail shop/outlet with the upper floors having residential usage.

As part of the refurbishment works to the building the proposal is to construct a basement beneath the existing ground floor area to the front section of the building.

Geological records indicate the site to be underlain by London Clay with a propensity for being overlain by Head Deposits.

A single phase of intrusive investigation was carried out.

The soils encountered comprised Made Ground over London Clay. The London Clay was proved to a depth of 6.0m below the existing ground floor level.

During the course of the siteworks groundwater was not in the exploratory trial pits and borehole. In the subsequent groundwater monitoring visits of the standpipe installed in WS1 groundwater levels of between 3.6m and 3.8m from existing ground floor level were measured.

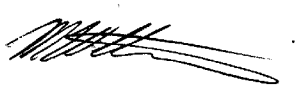
The soluble sulphate content of the natural clays soils was found to fall within Class DS-4. The ACEC classification for the site is AC-3s.

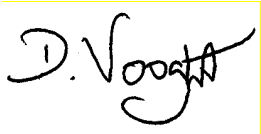
The proposed development includes a basement structure which is to be constructed using conventional underpinning methods and parameters for retaining wall design are given.

The design of the new basement foundation system should take into account the nature of the existing/adjacent foundations and their condition.

The site investigation was conducted and this report has been prepared for the sole internal use and reliance of Mr A Govani and the appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorization of Southern Testing Laboratories Ltd. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

The findings and opinions conveyed via this Site Investigation Report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Ltd believes are reliable. Nevertheless, Southern Testing Laboratories Ltd cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.





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M.W. Stevenson MICE (Countersigned)

D. Vooght MSc (Signed)

For and on behalf of Southern Testing Laboratories Limited

STL: J12147
25 March 2015

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A INTRODUCTION

1 Authority

Our authority for carrying out this work is contained in a completed Southern Testing Project Order form received 29/01/2015 from Mr. A. Govani.

2 Location

The subject site comprises an existing end of terrace property, No 465-467 Finchley Road, NW3 6HS located on the north west corner of the junction of Finchley Road (A41) and West End Lane. The site is located approximately 0.5km north west of Finchley and Frognal Railway Station. The approximate National Grid Reference of the site is TQ 256 853.

3 Proposed Construction

As part of the refurbishment works to the building the proposal is to construct a basement beneath the ground floor area of the front section to the building.

4 Object

The object of the investigation was to assess foundation bearing conditions and other soil parameters relevant to the proposed development.

5 Scope

This report presents our desk study findings, exploratory hole logs and test results and our interpretation of these data. This forms Stage 3 of the Basement Impact Assessment as outlined in Camden Council planning guidance document CPG4.

As with any site there may be differences in soil conditions between exploratory hole positions.

This report is not an engineering design and the figures and calculations contained in the report should be used by the Engineer, taking note that variations will apply, according to variations in design loading, in techniques used, and in site conditions. Our figures therefore should not supersede the Engineer's design.

Contamination issues are not considered in this report.

The findings and opinions conveyed via this Site Investigation Report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Ltd believes are reliable. Nevertheless, Southern Testing Laboratories Ltd cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

The site investigation was conducted and this report has been prepared for the sole internal use and reliance of Mr A Govani and the appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorization of Southern Testing Laboratories Ltd. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

The recommendations contained in this report may not be appropriate to alternative development schemes.

B THE SITE

5.1 Geology

The British Geological Survey Map of the area (No. 256-North London) indicates that the site geology consists of London Clay with a propensity for being overlain by Head Deposits.

Head Deposits

Head is a superficial deposit predominantly formed by solifluction processes during cold, periglacial periods in the Ice Ages. Shallow soils were frequently waterlogged during these periods and together with freeze/thaw cycles caused a gradual downward migration of shallow soils. Although the climate has since changed, poorly designed engineering works, or periods of adversely high rainfall may still reactivate the relic slip surfaces.

Head soils characteristically comprise sandy silty clay containing randomly oriented fragments of angular materials of local derivation. Stratification, if present, is generally poor and the upper and lower surfaces of the deposits are rarely horizontal.

London Clay

London Clay is a well-known stiff (high strength) blue-grey, fissured clay, which weathers to a brown colour near the surface. It contains thin layers of nodular calcareous mudstone - "claystone" - from place to place, and crystals of water clear calcium sulphate (selenite) are common.

5.2 Hydrology and Hydrogeology

Data from the Environment Agency and other information relating to controlled waters is summarised below. The groundwater vulnerability assessment is based on the current data on the EA website.

Data		Remarks
Aquifer Designation	Superficial Deposits	No superficial Deposits present.
	Bedrock	The bedrock (London Clay) is mapped as an unproductive strata
Groundwater Vulnerability		Non Aquifer
Abstractions		On the basis of the information given on the EA website (February 2015) there are no water abstraction licenses in the area.
Source Protection Zones		The site is not located within a Source Protection Zone.
Surface Water Features		The nearest surface water features are the Hampstead Heath Pond Chain some 1.0km to the north east. The site lies outside of the catchment area to the ponds.
Marine/Fluvial Flood Risk		On the basis of the information given on the EA website (February 2015) the site is not located within an area at

Data	Remarks
	risk of flooding from fluvial sources.
Surface Water Flood Risk	The "Risk of Flooding from Surface Water" mapping on the Environment Agency website (February 2015) shows that the site is located within an area of very low risk. Very low means that each year, this area has a chance of flooding of less than 1 in 1000 (0.1%). Cannon Hill to the north west of the site is situated within an area of Medium Risk. Medium Risk means that each year, this area has a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%).
Reservoir Flood Risk	On the basis of the information given on the EA website (February 2015) the site is not located within an area of potential risk of flooding from reservoirs.

5.3 Bomb Map

The published bomb map for the area, taken from the London County Council Bomb Damage Maps (1939-1945), shows that the site did not suffer bomb damage (Refer Figure A: Appendix D).

5.4 Historical Maps

An inspection of historical maps freely available on the internet was carried out. The earlier maps available, between 1850 and 1896, shows the site and surrounding area as undeveloped, but do show the basic road lines including Finchley Road and West End Lane. By 1915 the site is developed along with the surrounding area with what appears to be the subject property and current adjacent buildings. The later maps do not show any significant changes to the site or surrounding area.

5.5 Radon Risk

With reference to BRE guidance: no radon protection is required on this site.

6 Walkover Survey

A walkover survey was carried out on 18th February 2015.

6.1 General Description and Boundaries

The subject property comprises a four storey building of masonry construction with a cellar area beneath its rear section and a triangular open section on the site frontage with West End Lane. To the rear of the property a flight of steps lead up from West End Lane to an alleyway that passes along the rear boundary of the properties fronting onto Finchley Road.

At the time of our site visit the building was unoccupied with the windows and entrances to former ground floor retail area boarded over. The ground floor and residential floors above were undergoing refurbishment works at the time of our visit and the majority of the windows to the former residential areas on the upper floors had been sealed up with blockwork. The property represents an end of terrace building with the adjacent properties being of similar age and construction.

The regional topography of the area comprises general falls from the northeast towards the site/junction of Finchley Road and West End Lane at approximately 4-5°. From the site ground levels then tend to comprise more southerly falls at about 2-3°.

At the time of the investigation no significant vegetation was present on the site itself. A Conifer is located to the front of the Church (St. Andrew's United Reformed Church) on the opposite side of Finchley Road to the site, approximately 22m from the front of the property. In addition a Plane tree is located in the front pavement area to the north on Finchley Road approximately 20m from the property.

The majority of the neighbouring properties comprise a mixture of retail shops/restaurants at ground floor level with residential above. The surrounding areas to Finchley Road comprise mainly residential houses and mansion flats.

C SITE INVESTIGATION

11 Method

The strategy adopted for the intrusive investigation comprised the following:

- 1 No. 6.0m deep borehole was drilled from ground level using hand held window sampler equipment (WS1).
- A groundwater monitoring well was installed within WS1 for groundwater monitoring purposes.
- A series of 7 foundation inspection pits (TP1 – 7) were excavated by hand to establish existing foundation conditions.

Exploratory hole locations are shown in Figure 1 in Appendix A.

12 Weather Conditions

The fieldwork was carried out on 18th February 2015 at which time the weather was dry. The rainfall of the preceding month of January 2014 was approximately 99% of the average rainfall in the southeast of England.

13 Soils as Found

The soils encountered are described in detail in the attached exploratory hole logs (Appendix A), but in general within the window sample hole carried out (WS1) the soils comprised a Made Ground, over London Clay. A summary is given below.

Depth to Base (m)*	Soil Type	Description
GL-0.04	Floor tiles over concrete	
0.26	Made Ground	Firm dark grey brown sandy CLAY, with

Depth to Base (m)*	Soil Type	Description
		occasional to frequent fragments of brick, and concrete fragments
6.0+	London Clay	Firm to stiff turning stiff high to very high strength, pale/grey brown mottled CLAY, with occasional selenite crystals and silty lenses.

*It should be noted that WS1 was drilled from ground level.

14 Groundwater Strikes

At the time of our field works on the 18th February 2015, no groundwater entries were encountered within the hand excavated trial pits and window sample borehole.

The site was revisited on two separate occasions to carry out measurements of the standing water levels within the standpipe installed in the window sample borehole. The reader is referred to Section 17 for the results of these measurements.

D FIELD TESTING AND SAMPLING

The following in-situ test and sampling methods were employed. Descriptions are given in Appendix B together with the test results.

- Disturbed Samples
- Hand Penetrometer Tests

E GEOTECHNICAL LABORATORY TESTS

The following tests were carried out on selected samples. Test method references and results are given in Appendix C.

- Atterberg Limit Tests
- Moisture Content
- Soluble Sulphate and pH

F DISCUSSION OF GEOTECHNICAL TEST RESULTS AND RECOMMENDATIONS

15 Soil Classification and Properties

Soil Type	Compressibility	VCP	Permeability	Frost Susceptible	CBR	Remarks
Made Ground	N/A	N/A	Low but seepages from more permeable horizons are anticipated	Yes	N/A	Not suitable for foundations
London Clay	Medium	High	Very low/impermeable, but seepages from fissures can occur	No	Poor	

16 Swelling and Shrinkage

Atterberg Limit tests classified the natural London Clay soils as being NHBC HIGH Volume Change Potential (VCP). Therefore we would recommend that NHBC High Volume Change Potential (VCP) should be adopted for a general site classification with regards to the London Clay Soils on site.

However, given the depth of the proposed foundations to the proposed basement, which is expected to be in the region of 3.7m BGL, and the distances of the nearest trees, no specific precautions are considered necessary with respect to further foundation deepening of the basement foundations. Where shallower or existing foundations are required/present, then NHBC High Volume Change precautions would be applicable.

17 Groundwater Levels and Hydrogeology

Groundwater levels vary considerably from season to season and year to year, often rising close to the ground surface in wet or winter weather, and falling in periods of drought. Long-term monitoring from boreholes or standpipes is required to assess the ground water regime and this was not possible during the course of this site investigation.

While siteworks were in progress no groundwater entries were noted in the trial pits and window sample hole carried out.

Following the siteworks, the site was revisited on two separate occasions to monitoring well installed in boreholes WS1. The results of the monitoring visits are shown in the table below.

Hole ID	Date	Standing water level (m bgl)*
WS1	18/02/2015 (during site work)	Dry
	4/03/2015	3.68
	13/03/2015	3.60

*It should be noted that WS1 was drilled from existing ground level.

On the basis of the measurements to date, groundwater ingress is not expected to be a significant problem in terms of dewatering issues etc during construction. However, allowances for some dewatering, should be made from perched sources e.g. within the made ground/base of existing foundations, in the form of intermittent pumping from strategically placed collector sumps.

For the longer term condition, seepage entries from fissure flow within the clays and any perched water from within the overlying made ground should be allowed for in the design of the basement area e.g. provision of waterproofing measures, and also for hydrostatic uplift of the basement floor slab.

Published data for the permeability of the London Clay indicates the horizontal permeability to generally range between 1 x 10^{-9} m/s and 1x 10^{-14} m/s, with an even lower vertical permeability. Accordingly, the groundwater flow rate is anticipated to be extremely low to negligible.

Any groundwater flows that take place will likely follow the local/regional topography which in this instance comprises general falls to the south west. Given the gentle falls in the local/regional topography, hence negligible hydraulic gradient, and the very low/impermeable nature of the underlying clay materials, there is negligible risk of the proposed basement walls causing a "damming effect" or mounding of water on the upstream faces.

Given the above observations/comments, it is concluded that the proposed development will not result in any specific issues relating to the hydrogeology and hydrology of the site.

In terms of the potential cumulative effects on the groundwater environment in the local area, i.e. the effects of the proposed basement construction, and should other future basements be granted beneath adjacent properties, the combination of the overall regional and local topographic falls of the area (hence negligible to low hydraulic gradients), and the very low/impermeable nature of the underlying London Clay, any resulting increases in groundwater levels within the area (locally or regionally) will be negligible.

18 Sulphates and Acidity

The measured pH of the made ground and natural clay soils tested ranged between 7.6 and 7.9.

The soluble sulphate levels recorded within the made ground ranged between 440mg/l & 690mg/l and within the underlying natural clay soils soluble sulphate concentrations ranged between 400mg/l & 3300mg/l.

On the basis of the above measurements, we would recommend that BRE Class DS-4 precautions should be adopted for subsurface concrete together with an ACEC class of AC-3s.

19 Bearing Capacity

We understand that it is proposed to construct the basement, possibly using conventional underpinning methods.

Where it is necessary to construct spread foundations or bases to retaining walls/underpinned sections as part of the proposed works, all foundations should clearly penetrate any made ground and be formed on the underlying natural High Strength Clay materials. For foundations formed on these materials, an allowable bearing capacity of 125kPa may be adopted.

20 Heave

Due to stress relief following the removal of the existing soils to form the basement structure, both immediate (undrained) and long term (drained) heave displacements can be expected to occur in the underlying London Clay.

The immediate (undrained) heave displacements will essentially occur as excavation of the basement takes place and before the construction of basement elements e.g. slabs etc. Accordingly, only the long term (drained) heave displacements will need to be catered for in design, to overcome the problem of uplift pressures forming. This is normally overcome by installing appropriate void forming materials beneath the basement elements.

For the analysis of heave movements, the following stiffness parameters after Burland and Kalra (1986)[1] are suggested for the London Clay:

$$\text{Undrained Young's Modulus } (E_u) = (10+5.2z)\ (MN/m^2)$$

$$\text{Undrained Poisson Ratio } (\nu_u) = 0.5$$

$$\text{Drained Young's Modulus } (E_d) = (7.5+3.9z)\ (MN/m^2)$$

$$\text{Drained Poisson Ratio } (\nu_d) = 0.2$$

Where z (m) is taken from the surface of the London Clay

An estimate of the likely magnitude of heave displacements associated with the excavation of the basement has been carried out using PDisp and the above parameters. For the purpose of the estimate an unload pressure of 70kPa across the full footprint of the basement area has been adopted.

The results of the analysis are given in Appendix E. Figure U1 relates to the immediate (undrained) heave displacements and Figure V1 to the total long term (drained) heave displacements (which includes the immediate undrained heave displacements).

The maximum predicted undrained heave displacement (10mm) occurs beneath the central point of the proposed basement floor area. The total long term drained heave movement (which includes the initial undrained heave movement) occurs at the same point and is 16mm.

21 Basement Construction

Based on the findings of the boreholes (WS1) and the soil types encountered, the following soil parameters are suggested for design of retaining walls:

[1] Burland J.B. and Kalra J.C. (1986) Queen Elizabeth Conference Centre: geotechnical aspects, Proc. Inst. Civ. Engnrs, Part 1,80,1479-1503

Soil Type	Bulk density γ_b (kN/m^3)	Undrained Shear Strength (Temporary Condition)	Long Term Drained Condition	
			c' (kN/m^2)	φ^o
Made Ground	19	n/a	0	25
London Clay	19	Cu=85kPa	0	25

22 Excavations and Trenching

Statutory lateral earth support will be required in all excavations where men must work. Instability of the sides of any excavations carried out must be expected. Accordingly, measures should be taken at all times to ensure that excavations undertaken during underpinning operations are adequately supported.

Given the presence of the existing/adjacent foundations, close attention in design of temporary and permanent propping is required of the underpinning works at all times to prevent settlement or excessive lateral yielding of the excavation/foundations.

Providing good levels of construction are employed and close attention is taken to temporary/permanent propping measures as noted above, it is unlikely that the proposed construction will result in any specific issues relating to land stability issues, however monitoring of the adjacent properties are likely to be required while the works are in progress.

Allowances should be made for breaking out subsurface obstructions, e.g. old footings, drain runs etc. associated with the existing development on the site.