LMB GEOSOLUTIONS LTD

GROUND INVESTIGATION & BASEMENT IMPACT ASSESSMENT

LAND TO REAR OF 75-76 OAKLEY SQUARE, LIDLINGTON PLACE, LONDON, NW1

January 2020

DOCUMENT RECORD

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	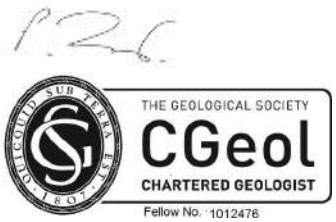

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Executive Summary

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Proposed Development	It is understood that the client wishes to construct a new two storey residential building with single storey basement.
Ground & Groundwater Conditions	Made Ground overlying London Clay Formation. No groundwater was recorded during the borehole drilling. During return monitoring standing water was recorded in the monitoring well at a depth of 2.89m. Groundwater is commonly recorded within the London Clay Formation, particularly around foundations. However, rather than being representative of a permanent and laterally continuous aquifer unit, the groundwater is present as discrete units within (for example) micro fissures and local mudstone horizons and the recorded groundwater level will most likely be reflective of the pore water pressures within these discrete features.
Desk Study	Low to moderate/low environmental sensitivity.
Geotechnical Advice	For traditional spread foundations (placed on the competent firm to stiff London Clay) at the assumed formation level of c.3.50m a net safe bearing pressure of 115kN/m2 should be available. Given the size of the excavation and the adjacent and nearby structures, it is considered likely that temporary or permanent support/strutting will be needed for construction. All temporary and permanent propping should provide high stiffness. Coefficient of active earth pressure: Made Ground: 0.35. London Clay Formation: 0.40. Coefficient of passive earth resistance: Made Ground: 3.5. London Clay Formation: 2.7. Buried Concrete: Made Ground: DS-1, AC-1. London Clay Formation: DS-1, AC-1s.
Assessment of Soil Analytical Results	The analytical results suggest that the majority of the Made Ground will be listed as non-hazardous wastes and that they meet stable non-reactive hazardous waste in non-hazardous landfill waste acceptance criteria. This should be confirmed by the receiving facility.
Basement Impact Assessment	The assessment completed indicates that potential impacts resulting from the basement development are likely to be negligible.
Recommendations	The full set of recommendations should be reviewed, but in summary the following are provided: • It is recommended that maintenance and construction workers involved in below ground works adopt appropriate management procedures to mitigate potential risks. • It is recommended that movement monitoring is undertaken as part of basement construction.
This executive summary is not a stand alone document and should be read in conjunction with the full report text, including conclusions and recommendations.	

INTRODUCTION

Introduction

AUTHORISATION

LMB Geosolutions Ltd (LMB) was instructed by Minh Quach (the Client) in December 2019 to undertake ground investigation and assessment works (including a Basement Impact Assessment) in relation to the proposed development at Land to Rear of 75-76 Oakley Square, Lidlington Place, London NW1 1NH (the Site).

PROJECT AND SITE DETAILS

Site Address	Land to Rear of 75-76 Oakley Square, Lidlington Place, London NW1 1NH (the Site). A site Location Plan is provided as **Figure 1**.
Proposed Development	The site currently comprises an area of vacant land. It is understood that the client wishes to construct a new two storey residential building with single storey basement. A development schematic is included in **Appendix A**.
Background	The scope of works and requirements of this report were based on the information provided by the Client and the project Architect (Davide di Martino).

AIMS & OBJECTIVES

This report aims to provide details of the local ground and groundwater conditions beneath the site to aid in basement design and to enable completion of a Basement Impact Assessment in accordance with Camden Planning Guidance for Basements and Lightwells (ref. CPG 2015 & 2018).

SCOPE OF WORKS

The following scope of works has been completed:

Desk Study

- Completion of a site reconnaissance survey to make a preliminary assessment of the site and immediately surrounding area;
- Review of information on the planning portal for records pertaining to development on the site and in the neighbouring area;
- Review of plans for the area to assess historical land development on and immediately surrounding the site;

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- Assessment of the 'sensitivity' of the site location as determined by factors such as hydrogeology, proximity of watercourses, neighbouring land use, ecologically sensitive uses and geology detailed on British Geological Survey (BGS) maps;
- Completion of an interpretive report that includes details of current site conditions based on the reconnaissance survey.

Ground Investigation & Assessment

- Site set up including liaison with Consultant Engineers, Client and appointment of sub-contractors;
- Mobilisation to site and transport of the rig to the proposed location;
- Completion of 3No. heavy duty dynamic (windowless) boreholes to depths of between 0.80m and of 10.0m below ground level (bgl) with insitu testing and collection of samples for laboratory testing;
- Supervision and geological logging of the soil arisings in accordance with BS5930 by an appropriately experienced geo-environmental engineer;
- Installation of a monitoring well to depth of 5.0m below ground level and return monitoring of groundwater levels on 1no. occasion;
- Completion of a factual and interpretive report section (within BIA report) that includes;
  - Details of the ground and groundwater conditions encountered;
  - Presentation of borehole log in AGS format;
  - Assessment of foundation options based on ground conditions encountered;

Basement Impact Assessment (BIA)

Completion of BIA that follows the guidance and the framework prescribed by London Borough of Camden in the relevant guidance documents, comprising the following elements:

- Screening;
- Scoping;
- Site Investigation and study (divided into desk study, field investigation, monitoring, reporting & interpretation); and
- Impact Assessment.

CONTRIBUTORS

This report has been compiled by Philip Lewis, a hydrogeologist and chartered Geologist with over twenty years experience as a geoscience professional, including over eighteen years experience as a professional adviser (consultant) in hydrogeology, engineering geology and contaminated land.

The Ground Movement Assessment has been completed by Corrado Candian a geotechnical engineer and chartered engineer (CEng, MICE) with over ten years experience.

INTRODUCTION

LIMITATIONS

LMB has prepared this report solely for the use of the named Client and those parties with whom a warranty agreement and/or assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from LMB and the Client.

LMB accepts no responsibility or liability for:

a) the consequences of this document being used for any purpose or project other than for which it was commissioned, and

b) issue of this document to any third party with whom an agreement has not been executed.

The risk assessment and opinions provided, among other things, take in to consideration currently available guidance and best available techniques relating to acceptable contamination concentrations and interpretation of these values. No liability can be accepted for the retrospective effects of any future changes or amendments to these value.

Baseline Data & Criteria

INTRODUCTION

This section provides the baseline (desk study) data used to complete the Basement Impact Assessment (BIA) in relation to the proposed development. Reference information used for this purpose is outlined below:

- British Geological Survey – 1:50,000 Geological Sheet 256, North London (Solid & Drift);
- British Geological Survey borehole archive records;
- Environment Agency Groundwater Vulnerability Mapping (1:100,000 series) Sheet 40, Thames;
- Information contained on the gov.uk website (https://flood-warning-information.service.gov.uk/long-term-flood-risk/map);
- URS (2014). London Borough of Camden Strategic Flood Risk Assessment.
- Halcrow (2011). London Borough of Camden Surface Water Management Plan.
- NERC (2008). UK Hydrometric Register;
- River Basin Management Plan (RBMP). Thames River Basin District (2009);
- Barton, N.J. (1982). Lost Rivers of London; and
- LBC: Camden geological, hydrogeological and hydrological study Guidance for subterranean development (Issue 01, November 2010).

Guidance and Frameworks

The following documents are considered to be relevant for this BIA:

- Camden Planning Guidance: Basements and Lightwells (CPG 4, 2015);
- LBC: Camden geological, hydrogeological and hydrological study Guidance for subterranean development (Issue 01, November 2010); and,
- Camden Planning Guidance: Basements (March 2018).

The above documents provide information and a framework for undertaking a BIA within LBC. In summary, the key aim of the documents is to ensure that basement and underground development is only permitted where it does not:

- Cause harm to the built and natural environment and local amenity;
- Result in flooding; or
- Lead to ground instability.

LBC require that a submission for a proposed basement development should include information relating to the above within a BIA which is site and development specific.

BASELINE DATA & CRITERIA

About this Assessment

In the context of this assessment greatest emphasis has been placed on the requirements highlighted above relating to potential impacts on drainage, flooding from all sources, groundwater conditions and ground stability.

In accordance with the referenced guidance this report includes the following elements:

- Desk Study;
- Screening & Scoping;
- Site Investigation, monitoring, interpretation and ground movement assessment;
- Impact Assessment.

Consultation

The Client undertook enquires with LBC appointed auditors (Campbell Reith) for Basement Impact Assessments. From these enquiries the Client was provided with links to and copies of guidance relating to the requirements for undertaken BIA in LBC.

The guidance provided is consistent with that previously referenced within this report.

SIGNIFICANCE CRITERIA

The assessment of potential effects from the proposed development has taken into account both the construction and operational phases. The significance level attributed to each effect has been assessed based on the magnitude of change due to the development proposals and the sensitivity of the effected receptor/receiving environment to change, as well as a number of other factors.

Assessment criteria developed from the guidance and frameworks referenced have been used to determine the significance of the potential effects as a result of construction and operation of the proposed development.

The significance of potential effects has been determined by considering the magnitude of the effect, in terms of a change in existing baseline conditions.

Significance Measures

The following terms have been used to define the significance of the effects identified:

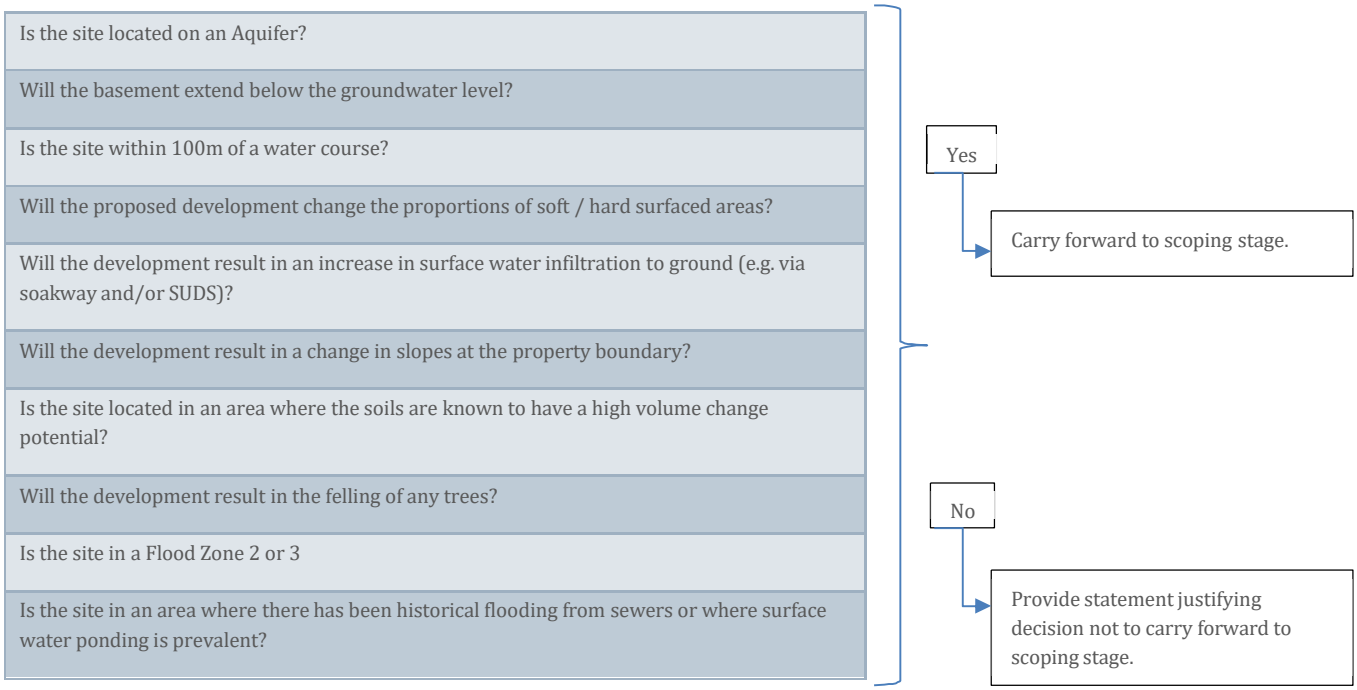
- **Major effect**: where the proposed development could be expected to have a very significant effect (either positive or negative) e.g. significant risk of flooding effect, an improvement in water quality class, allowing new uses to be made of the water resource (e.g. potable water supply) or impacts from contamination issued e.g. risk to groundwater or future site users;
- **Moderate effect**: where the proposed development could be expected to have a noticeable effect (either positive or negative) e.g. moderate flooding effect;

- **Minor effect**: where the proposed development could be expected to result in a small, barely noticeable effect (either positive or negative), but where current uses could still be maintained; and
- **Negligible**: where no discernible effect is expected as a result of the proposed development.

Screening Assessment

The information presented within the LBC guidance provides decision-making matrices to enable an initial screening assessment to be made in relation to potential impacts and issues related to proposed basement development.

The matrices specifically focus on Land Stability, Groundwater Movement and Surface flow and Flooding. An example of the type of matrix is presented below:



Desk Study

A desk study has been undertaken and is presented in this section in order to provide further background and context for the ground investigation and assessment (including BIA) presented in the later sections of this report.

SITE RECONNAISANNCE

A representative of LMB completed a site walkover survey on Friday 6th December 2019.

The site currently comprises an area of vacant land accessed via a double gate from Lidlington Place and enclosed within brick boundary walls to the north and west and a wooden fence to the east (see Photo 1).

The site is bounded to the north and east by rear gardens associated with residential properties on Oakley Square and to the west by a small car park with rear gardens of Harrington Square beyond (see Photos 2). To the south is a road (Lidlington Place) with a residential tower block and bar located on the opposite side of the road from the site (see Photo 3).

The site is located in a generally flat lying area that slopes gently to the south (see Photo 4). The properties on Oakley Square and Harrignton Square were observed to include lower ground floors (see Photos 5 & 6).

A photographic record is provided as **Appendix B**.

ENVIRONMENTAL SETTING

Published Geology & Aquifer Designations	Reference to British Geological Survey (BGS) Digital Map (1:50,000) indicates that the site is directly underlain by the London Clay Formation. No superficial deposits are anticipated at the site based on available sources of information. The London Clay Formation is designated as Unproductive Strata.
Local Hydrology	Reference to information on local mapping indicates that there are no surface water features within 250m of the site. The nearest surface water feature is Regents Canal located approximately 700m to the east-north-east of the site. Reference to the *Lost Rivers of London* (Barton, N.J, 1982) suggests that the site is located approximately 1200m east-north-east of the former course of a tributary of the River Tyburn. Information relating to the Thames region within the UK Hydrometric Register indicates that the average annual rainfall in the region is 710mm. Information on the gov.uk website indicates that the site is located in an area at very low risk of flooding from rivers and sea and from surface water flooding. The site is not considered to be located in an area prone to groundwater flooding.

	Reference to the LBC SWMP and FRMS indicates that the site is not located on the streets listed as having been subject to historical surface water flooding (1975 & 2002). In addition, the documents indicate that the site is located within a Critical Drainage Area (CDA, group3_0030) but is not located within a Local Flood Risk Zone.
Resource Potential & Ecological Quality	**Surface Water**: Based on available information there are no identified surface water features within 250m of the site.
	Groundwater: The groundwater in the London Clay Formation is designated Unproductive Strata and as such is not characterised as a groundwater body within the relevant River Basins Management Plan. In addition, the site is not located within an EA designated Source Protection Zone (SPZ).
Surrounding Land Use	Surrounding land uses are primarily residential with associated nearby amenities.
Local Designations	Reference to information contained on the Defra Magic website indicates that the site is located approximately 720m west-south-west of a local nature reserve (Camley Street Nature Park). There are no other known designations (e.g. Sites of Special Scientific Interest) within 500m of the site.

BELOW GROUND ASSETS

As part of the assessment the following organisations were contacted to ascertain if they held any below ground assets below or in close proximity to the site:

- Network Rail;
- Crossrail;
- London Underground Ltd (LUL) / Transport for London (TfL).

Responses have been received from Network Rail, Crossrail and London Underground (including HV power assets) confirming they do not hold any below ground assets beneath the site.

The response from LUL/TfL confirmed that a branch of the Northern Line runs beneath Eversholt Street to the east and that the Zone of Interest (ZoI) extends into the rear garden of 76 Oakley Square but that the site itself is outside the ZoI.

Copies of correspondence are included in **Appendix C**.

DESK STUDY

Drainage Search

The Client has provided a drainage and water search for the site which has identified mains sewer and water utilities running approximately parallel to the property within the highway of Lidlington Place with the closest to the site estimated to be the mains water approximately 7.5m from the site boundary. The property search detailing the location of the utilities is provided in **Appendix D**. Liaison has also been undertaken with Thames Water to confirm the proposed works and their requirements. A copy of this email is provided in **Appendix C**.

SITE HISTORY

A review of historical map data indicates that from c. 1851 the site comprised open land adjacent to Lidlington Place. Historical mapping indicates that by c. 1873 the site was part of the rear garden area of a property on Oakley Square and that there had been mass residential development of the surrounding area. Historical mapping from c. 1972 indicates that the rear garden of the property on 76 Oakley Square has been divided to include the current site layout.

SUMMARY OF LIKELY GROUND & GROUNDWATER CONDITIONS

The information presented in the following sections is based on review of available BGS borehole logs for the local area and interpretation of BGS mapping.

The interpretation of this information should be considered preliminary pending completion of site specific ground investigation works.

Review of BGS Borehole Logs

The two neared BGS borehole records have been reviewed, which are located approximately 100m east (ref. TQ28SE1024) and 120m south east (ref. TQ28SE1025) of the site respectively.

Borehole log TQ28SE1024 records approximately 1.20m of Made Ground (described as brick rubble, topsoil gravel and clay) overlying firm to stiff fissured brown occasionally mottled brown and orange silty clay with occasional claystone, pockets and partings of fine sand and gypsum crystals (interpreted to represent the London Clay Formation). A groundwater seepage was recorded in the claystone bands, but no depth is provided. Standing groundwater was recorded at a depth of approximately 11.5m.

Borehole log TQ38NW378 records approximately 0.90m of Made Ground (described as concrete over brick rubble and topsoil) overlying firm to stiff fissured brown occasionally mottled brown and orange silty clay with occasional claystone, pockets and partings of fine sand and gypsum crystals (interpreted to represent the London Clay Formation). Groundwater was recorded at a depth of approximately 3.50m bgl.

DESK STUDY

REVIEW OF LOCAL PLANNING

A search of planning applications on the London Borough of Camden website has been completed to review any existing and proposed development in the vicinity of the site. The majority of planning applications relate to building alterations and other minor works. The nearest planning decision notices to the site are as follows:

- 67 Oakley Square London NW1 1NJ (ref. 2016/3189/NEW). Internal and external alterations in association with conversion of existing dwelling house into 2 flats; (1x2beds) at basement and ground floor levels and 1x3bed) flat at 1st, 2nd and 3rd floor levels. This application has been withdrawn and relates to a property on the opposite side of Oakley Square to the site.
- Footway adjacent to 2 Lidlington Place London NW1 2JU (ref. 2017/5256/P). Installation of a electric vehicle rapid charging point and a feeder pillar to create parking bay for electric vehicles within existing parking bay.
- 21 Harrington Square London NW1 2JJ (ref. 2019/5264/L). Alterations for refurbishment of Listed Building including; repair/replacement of roof tiles, replacement of window casements, re-ordering of internal layout, reinstatement of front railings at first floor, enlargement of rear lightwell, works to basement and creation of bridge to the rear of the property.

No planning applications and/or decision notices related to new basement development were viewed.

ENVIRONMENTAL SENSITIVITY

Overall, the site setting is considered to be of **low** to **moderate/low** environmental sensitivity, for the following reasons:

- The Site is located in a predominantly residential land use area;
- The published geological data suggests that the Site is underlain by the London Clay Formation, which is designated as Unproductive Strata;
- The Site is not located within an SPZ;
- The site is located within an area with very low risk of flooding from rivers and sea and from surface water flooding;
- The are no known surface water features within 250m of the site; and
- There are no sensitive land use designations within 500m of the site.

Ground Investigation & Findings

INTRODUCTION

The ground investigation works were undertaken on 15th December 2019 and comprised the progression of 3no. dynamic (windowless) sampler boreholes to depths of between 0.80m and 10.00m bgl, with insitu testing and sampling of soil for laboratory testing (see **Figure 2**).

Groundwater monitoring was undertaken following completion of the fieldworks on 8th January 2020.

Details of the ground investigation completed, along with the findings of the investigation, are provided in the following sections. The exploratory hole logs are presented in **Appendix E**.

Guidance Documents

Details of the best practice guidance documents and reference information used in undertaking the ground investigation and assessment are provided at the end of this report (see REFERENCES & GUIDANCE).

INVESTIGATION STRATEGY

The ground investigation was designed based on the requirements of the Client and Architect to help aid in basement design and assist in gaining planning permission for the proposed basement development.

Soil Chemical Analysis & Laboratory Testing

Soil samples were submitted to the UKAS and MCERTS accredited laboratories of i2 Analytical for chemical analysis and geotechnical testing.

The results of the geotechnical and chemical analysis (including waste acceptance criteria testing) are presented in **Appendix F** and **G** respectively.

GROUND & GROUNDWATER CONDITIONS

Ground Conditions

The table below provides a summary of ground conditions encountered with full descriptions provided in the associated exploratory hole logs provided in **Appendix E**:

GROUND INVESTIGATION & FINDINGS

Strata	Depth Range to Top (m bgl)	Depth Range to (Base (m bgl)	Summary Description
Made Ground (1)	Ground Level	0.80 – 0.85	The ground surface was found to comprise concrete. The Made Ground soils were found to comprise gravelly slightly sandy clay with varying proportions of brick and occasional flint overlying clay with occasional brick grave and carbonaceous material. In addition, locations BH02 and BH02a both refused at c. 0.80m bgl on concrete which may be indicative of a relict structure.
London Clay Formation (2)	0.80 – 0.85	10.00	Found to comprise an upper horizon (1.25m) of firm clay overlying a firm becoming stiff closely to very closely fissured clay which in turn overlies a very stiff extremely closely fissured clay.

(1) Base not determined in all locations

(2) Base not determined.

Visual and Olfactory Observations

No visual or olfactory evidence of contamination was observed during the ground investigation works. However, Made Ground soils were encountered in the exploratory hole location and can be indicative of the presence of contaminants.

Groundwater Conditions

No groundwater was recorded during the borehole drilling. During return monitoring standing water was recorded in the monitoring well at a depth of 2.89m bgl.

Groundwater is commonly recorded within the London Clay Formation, particularly around foundations. However, rather than being representative of a permanent and laterally continuous aquifer unit, the groundwater is present as discrete units within (for example) micro fissures and local mudstone horizons and the recorded groundwater level will most likely be reflective of the pore water pressures within these discrete features.

Characteristic Values of Soil Parameters

A summary of the geotechnical properties of the strata based on the field and laboratory testing is provided in the table below.

GROUND INVESTIGATION & FINDINGS

Soil Property		**Stratum**	
		Made Ground	London Clay Formation
SPT 'N' Value		-	9 – 45
Undrained shear strength (kN/m^2)	Hand shear vane	-	65 – 127
	Triaxial testing (3.60m)	-	58
Bulk Density (kg/m^3)		1.70(1)	1.96
Plasticity Index (%)		-	36
Moisture Content (%)		9.4 – 14	29
pH		7.6 – 7.7	8.0
Sulphate (g/l)		0.026 – 0.10	0.29

(1) Assumed value based on literature information.

Geotechnical Advice

INTRODUCTION

As outlined, the site currently comprises an area of vacant land. It is understood that the client wishes to construct a new two storey residential building with single storey basement.

On this basis, it the following assumptions have been made:

- The formation level of the basement will be approximately 3.50m bgl.
- The load from the proposed new structure will be in the region of 25-30KN/m^2.
- There will be no significant changes in elevation over the proposed basement development.
- Foundations will not be eccentrically loaded.

GROUND CONDITIONS SUMMARY

The ground conditions encountered in the exploratory holes comprise Made Ground overlying the London Clay Formation, which comprises a sequence of firm becoming very stiff brown to dark grey clay.

No groundwater was recorded during the borehole drilling. During return monitoring standing water was recorded in the monitoring well at a depth of 2.89m bgl.

Groundwater is commonly recorded within the London Clay Formation, particularly around foundations. However, rather than being representative of a permanent and laterally continuous aquifer unit, the groundwater is present as discrete units within (for example) micro fissures and local mudstone horizons and the recorded groundwater level will most likely be reflective of the pore water pressures within these discrete features.

FOUNDATION OPTIONS

Potential Influence of Trees

Structures constructed within influencing distance of trees (whether on or off site and whether to remain or be removed), should be in accordance with NHBC and BRE guidance.

Foundations that are carried deep to minimise lateral stresses on existing adjacent foundations/due to tree influence may be stepped up, in accordance with a suitable specification, such as BS8004:1986, as long as a suitable founding stratum is present at shallower depth.

The Client has provided an Arboricultural Impact Assessment report (ref. 02992R, October 2019) completed at the site by Tamla Trees.

GEOTECHNICAL ADVICE

A full review of the survey information is not within the remit of this report. However, the survey does identify a number of low and moderate water demand tress (e.g. Sycamore, Tree of Heaven, Elder and Fig) within potential influencing distance of existing and proposed building foundations.

In the context of this report and the proposed development the salient information relates to the location of moderate-water demand trees (Sycamore & Tree of Heaven) within influencing distance of proposed structures.

NHBC guidance suggests that the following foundation depths and options would apply:

Water demand	Distance to structure (m)	Min Foundation Depth (m)	Foundation Options
Moderate (i.e. Sycamore & Tree of Heaven)	<2.00	2.15 – 2.20	Traditional Spread

It is recommended that any tree and/or root removal should be undertaken in accordance with the advice of aboricultural consultants and that foundation options be appraised according to relevant NHBC/BRE guidance.

Spread Foundations

Based on the findings of the ground investigation it has been concluded that for traditional spread foundations (placed on the competent firm to stiff London Clay) at the assumed formation level of c.3.50m bgl a net safe bearing pressure of 115kN/m^2 should be available.

The net safe bearing pressure is based on a factor of safety of 3 to ensure that settlement remains within normally acceptable limits.

The above advice assumes that the proposed basement development and in particular foundations are below the influencing depth of any trees or tree routes.

Piled Foundations

Based on the proposed development it is unlikely that a piled foundation would be the preferred solution.

GROUND STABILITY & RETAINING STRUCTURES

Retaining walls constructed in open cut would be the preferred solution but given the size of the excavation, and the adjacent and nearby residential structures it is considered likely that temporary support/strutting will be needed for construction.

GEOTECHNICAL ADVICE

Groundwater was recorded above formation level and as such the stability of unsupported excavations at the site should not be relied upon. Zones loosened by the removal of existing and relict construction may be particularly unpredictable and liable to collapse.

It may be beneficial to install the retaining wall and floor slab sequentially to provide propping and lateral restraint, which could help to minimise deflections. It is likely that this will need to be given particular consideration beneath the party wall of the adjoining properties.

Safe working conditions should be ensured where persons are required to work in excavations. It is recommended that reference be made to CIRIA Report No. 97,"Trenching Practice" 1992.

The parameters presented in the table below may be considered within the design of retaining walls.

Strata	Depth Range (m bgl)		Effective Angle of Shear Resistance (2)	Coefficient of Active Earth Pressure (Ka) (2)	Coefficient of Passive Earth Resistance (Kp) (2)	Bulk Density
	Top	Base				
Made Ground	Ground Level	0.80 – 0.85	27	0.35	3.5	1.70(1)
London Clay	0.80 – 0.85	10.00	22	0.40	2.7	1.96

(1) Assumed value based on literature information.
(2) Based on soil properties and reference to BS8002 & Tomlinson, M.J. (1986) for a free standing wall.

BURIED CONCRETE

In accordance with BRE Special Digest 1 (2005), the results indicate that the following design sulphate classes and Aggressive Chemical Environment for Concrete (ACEC) classes would apply:

- Made Ground: DS1 & AC-1.
- London Clay Formation: DS1 & AC-1s.

ADDITIONAL CONSIDERATIONS

Existing Structures

It is recommended that any existing buried construction that will underlie the new development is broken out and removed. However, if buried construction (such as existing foundations) are to remain close to the new structure then care should be taken to avoid interaction i.e. to prevent the slab 'breaking its back' over the existing construction. This is particularly relevant in the vicinity of locations BH02/BH02a where concrete was encountered at a depth of c.0.80m bgl.

GEOTECHNICAL ADVICE

Potential for Heave, Settlement & Inward Yielding

Based on the ground investigation data the basement excavation is anticipated to be entirely within the Made Ground and London Clay Formation. The laboratory testing on the London Clay Formation confirms that it is typically a high plasticity clay.

The removal of the overburden during the excavation of the basement is likely to result in some heave and inward yielding of the soils at formation level and possibly a subsequent settlement of the soils outside the excavation. Based on the ground investigation data, the London Clay at formation level is anticipated to comprise firm to stiff clay and so the potential effects may be limited by their relatively low compressibility (as compared to soft clay soils). Inward yielding in firm to stiff clays is typically in the range of 5-40mm (Tomlinson, M.J. (1986).

The total uplift will be a function of the soil heave pressure and water pressure, assuming an unsaturated unit weight of 20kN/m^3 the estimated unload due to the excavation (c.3.50m) would be in the order of 70kN/m^2.

It is anticipated that following excavation and construction of the basement, the load imposed by the new sub-structure will be less than the overburden pressure at formation prior to excavation.

Based on the information presented above it is recommended that the potential for short term and long term heave and inward yielding during construction and following construction.

A discussion of potential heave is provided in the Ground Movement Assessment section.

Management of Formation Level

Should pockets of inferior material be present during the inspection of the foundation excavation, they should be removed and replaced with well graded, well compacted hardcore or lean mix concrete. The excavated surface should be protected from deterioration and a blinding layer of concrete used where foundations are not completed without delay. Any surface or perched water should not be allowed to collect in the base of excavations since the clay is prone to rapid deterioration in the presence of water, with loss of their favourable bearing properties.

Groundwater & Groundwater Management

As outlined, groundwater was not encountered during the borehole drilling but during return monitoring it was recorded at 2.89m bgl i.e. just above assumed formation level.

Significant dewatering is not anticipated during the construction of foundations but given the observations in the trial pits, some groundwater seepages and/or surface water infiltration into the excavation should be anticipated. It is anticipated that any seepages or rates of inflow of groundwater would be slow and it is recommended that seepages be dealt with by pumping from sumps.

GEOTECHNICAL ADVICE

Potential Project Risk

It should be noted that the excavation of the basement may undermine the adjacent property and could lead to settlement in gardens and damage to buildings and below ground services. This potential is discussed in more detail within the Ground Movement Assessment section.

Assessment of Soil Analytical Results

INTRODUCTION

As outlined, the basement will extend beneath the footprint of the proposed new development. As such, the majority of the Made Ground soils at the site will be removed to facilitate development and the soil sampling and analysis has primarily been undertaken to aid in waste soil disposal.

Notwithstanding this a conservative approach has been adopted and a Generic Quantitative Risk Assessment (GQRA) has been completed along with a preliminary waste characterisation. No statistical analysis has been completed and recorded concentrations have been compared directly to Generic Assessment Criteria (GAC) considering a residential (without plant uptake) end use.

In addition to the GAC, the provisional Category 4 Screening Levels (pC4SL) developed by CL:AIRE for DEFRA in response to the new definitions within the Contaminated Land Statutory Guidance (ref. DEFRA, April 2012) have also been considered within the assessment.

RISK ASSESSMENT

Assessment of Potential Risks to Future Site Users (Soil Contamination)

Two samples of the Made Ground soils were collected during the ground investigation (BH01 at 0.40 & BH02 at 0.50m) and analysed for a range of determinands including, heavy metals, Polycyclic Aromatic Hydrocarbons (PAH), asbestos screening and Waste Acceptance Criteria Testing.

The majority of the recorded concentrations of determinands were found to either be below the limit of detection for the laboratory method applied or below relevant GAC considering a residential (without plant uptake) end use.

The exception is the recorded concentration of Lead in BH01 (680mg/kg) which is elevated compared to the applied assessment criteria (pC4SL, 330mg/kg). However, as discussed Made ground soils will be removed to facilitate development and thus residual risks to future site users are considered to be minimal.

Asbestos in Soils

The sample of the Made Ground soil from BH01 was screened for the presence of Asbestos Containing Materials (ACM). No ACM were detected.

WASTE CHARACTERISATION

The Landfill (England and Wales) Regulations (2002, as amended), the Hazardous Waste (England and Wales) Regulations (2005, as amended) and the Waste (England and Wales) Regulations (2011) have changed the way in which waste materials have traditionally been managed (i.e. landfill disposal). If materials are to be

discarded from site, appropriate characterisation and classification are required prior to disposal, to determine whether a waste should be described as either non-hazardous or hazardous. The process of classification is based around the List of Wastes (England) Regulations in conjunction with the Environment Agency Guidance Document WM3 (edition 1, 2015). Waste Acceptance Criteria (WAC) are often confused as a means of classification when, in actuality, they represent criteria that wastes must satisfy for disposal in target landfill types (i.e. non-hazardous waste may be described as inert if it satisfies the appropriate WAC; however, hazardous waste can never be classified as inert even if it satisfies the WAC for an inert landfill).

Certain categories of waste material are termed 'absolute entries' within the List of Wastes Regulations (2005) and are automatically classified as inert or hazardous e.g. glass packaging and acid tars respectively.

Source of Potential Wastes

The waste materials on site are considered to comprise the Made Ground soils that occupy (typically) the upper 0.50-1.0m below ground level.

The source of the Made Ground materials is not known but based on the ground conditions encountered it appears to primarily comprise reworked and possible demolition material that is considered to have been derived from historical, local demolition and construction and possibly reworking of the natural soils in the area of the existing property.

PRELIMINARY WASTE CHARACTERISATION

Made Ground

On a purely visual basis, the majority of the Made Ground would appear to conform with 'soils and stones' excluding topsoil, peat and excluding soil and stones from contaminated sites (European Waste Catalogue Code 17 05 04). However, where soil and stones are not automatically classified as inert they will always be treated as so called 'mirror entries' of the List of Waste Regulations (European Waste Catalogue Code 17 05 03 mirror hazardous or 17 05 03 mirror non-hazardous). An assessment of the composition of the soil is required to determine the concentrations of potentially dangerous substances that maybe present in the soils to allow the waste to be classified accordingly.

As such, chemical analysis has been completed on a sample of Made Ground (BH01) in general accordance with the Environment Agency document Waste Sampling and Testing for Disposal to Landfill (ref. EBPRI 11507B, March 2013). The results have been used to aid in basic waste characterisation utilising the information presented within the WM3 document for Hazardous wastes.

In addition, a sample of Made Ground was tested for the presence of Asbestos Containing Materials with none detected.

ASSESSMENT OF SOIL ANALYTICAL RESULTS

Reference to the WM3 document suggests that the majority of the Made Ground materials will be listed as non-hazardous wastes. Any basic waste characterisation will need to be confirmed by the receiving facility.

Natural Ground Deposits

The natural soils (London Clay Formation) are likely to be listed as inert (soils and stones, European Waste Catalogue Code 17 05 04), again this will need to be confirmed by the receiving landfill facility.

In addition, given the scarcity of inert landfill cells it may be more appropriate (depending on timescales and feasibility etc) to source an alternative use for the soils (such as fill materials or daily cover) or to dispose to non-hazardous landfill.

Waste Acceptance Criteria (WAC) Testing

WAC testing has been undertaken on the sample of Made Ground collected from BH02 (0.50m), with the results presented in **Appendix G**.

The results indicate that Made Ground soils would meet non-hazardous waste (stable non-reactive hazardous waste in non-hazardous landfill) landfill waste acceptance criteria.

Screening & Scoping Assessment

SCREENING ASSESSMENT

The decision-making matrices presented in the Screening Assessment below have been completed based on the information presented in the previous sections.

Groundwater Flow

Is the site located on an Aquifer?	No The site is underlain by the London Clay Formation which is designated as an Unproductive Strata.
Will the basement extend below the groundwater level?	No Groundwater was not encountered during borehole drilling. During return monitoring standing water was recorded in the monitoring well at a depth of 2.89m bgl. However, rather than being representative of a permanent and laterally continuous aquifer unit, the groundwater is present as discrete units within (for example) micro fissures and local mudstone horizons and the recorded groundwater level will most likely be reflective of the pore water pressures within these discrete features.
Is the site within 100m of a water course, well or potential springline?	No Based on the desk study information, no known surface water courses are located within 250m of the site.
Is the site within the catchment of local surface water courses?	No Based on the desk study information, no known surface water courses are located within 250m of the site and the site lies outside the catchment.
Will the proposed development change the proportions of soft / hard surfaced areas?	No The ground surface currently comprise concrete and based on the information reviewed areas of hard surfacing are predicted to remain the same.
Will the development result in an increase in surface water infiltration to ground (e.g. via soakaway and/or SUDS)?	No There is predicted to be no change as there are no plans to introduce infiltration drainage.
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 surface water feature or spring line.	No There are no known surface water courses within 250m of the site.

Land Stability

Does the existing site include slopes, natural or manmade, greater than 7°?	No Observations during a site visit, reference to proposed development schematics and local mapping suggests that there are no slopes > 7°.
Will the proposed re-profiling or landscaping at the site change slopes at the property boundary to more than 7°?	No Information presented on the proposed development schematics confirms that there will be no slopes > 7° following development.
Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	No Observations during a site visit and reference to proposed development schematics indicates that there are no slopes > 7°.
Is the site within a wider hillside setting in which the general slope is greater than 7°?	No The site is not located on a wider hillside setting and is in a relatively flat lying area.
Is the London Clay the shallowest strata at the site?	No Made Ground deposits have been recorded to 0.85m bgl and overlie the London Clay Formation.
Will any trees be felled as part of the proposed development and/or are any works proposed within any tree protection zones where trees are to be retained?	No There are no known plans to feel trees to enable the development.
Is there a history of seasonal shrink swell subsidence in the local area and/or evidence of such effects at the site?	**Unknown** The London Clay has a high plasticity with a high volume change potential. However generally movement that causes subsidence is due to trees and/or drains or poor subsoil and there is no visible evidence of such movement at the site.
Is the site within 100m of a water course or potential springline?	No Based on the desk study information, no known surface water courses are located within 250m of the site.
Is the site in an area of previously worked ground?	No Ground investigation identified up to 0.85m of Made Ground and review of historical plans indicate no previous site uses indicative of worked ground have been identified.
Is the site within an aquifer?	No

	The site is underlain by the London Clay Formation which is designated as an Unproductive Strata.
Is the site within 5m of a highway or pedestrian right of way?	**Yes** The development is within 5m the pavement of a public highway.
Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	No The site is surrounded by gardens and car parking and neighbouring properties include lower ground floors.
Is the site over any tunnels e.g. railway lines?	No Enquiries with assets holders have also been undertaken and confirm that the site is not located over any known tunnels.

Surface Flow and Flooding

Is the site within the catchment of local surface water courses?	No Based on the desk study information, no known surface water courses are located within 250m of the site and the site lies outside the catchment.
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 The development will not alter the proportion of hard surfaced areas and drainage and surface water flow should not alter significantly.
Is the site within 100m of a water course, well or potential springline?	No Based on the desk study information, no known surface water courses are located within 250m of the site.
Will the proposed development change the proportions of soft / hard surfaced areas?	No The ground surface currently comprise concrete and based on the information reviewed areas of hard surfacing are predicted to remain the same.
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 There are no proposals to alter the site drainage and surface water flows following development and there is not anticipated to be any significant alteration to the profile of inflows being received downstream of the site (if applicable).
Is the site in an area known to be at risk from surface water flooding?	No The desk study information indicates that the site is not at risk of flooding from surface water.

SCREENING & SCOPING ASSESSMENT

Summary

Based on the Screening Assessment presented above, the following potential issues have been carried forward to the scoping stage of the assessment:

- Parts of the site and proposed development are within 5.0m of a pavement with a public highway beyond.
- There is no known history of seasonal shrink swell subsidence in the local area and/or evidence of such effects at the site, but it does lie on the London Clay Formation which is a high plasticity clay with high volume change potential.

SCOPING ASSESSMENT

The potential issues identified within the screening assessment are considered within the following scoping sub-sections:

Land Stability

The site and proposed basement development are within 5.0m of a pavement in a relatively flat lying area and the site lies on the London Clay Formation which is which is a high plasticity clay with high volume change potential.

As such a Ground Movement Assessment (GMA) has been undertaken to appraise the potential impacts on neighbouring properties.

The GMA is provided in the following sections, with the tabular and graphical results provided in **Appendix H.**

Ground Movement Assessment

INTRODUCTION

There is the potential for ground movements due to the proposed development from the wall installation and from the excavation process. The structural engineer for the project has indicated that construction will utilise a pinning sequence where the perimeter retaining walls and toes are emplaced prior to further excavation to enable casting of the basement slab (i.e. bottom-up construction), with a maximum excavation depth of c. 3.50m bgl. It has been assumed that the wall will be propped during construction and as such, the retaining walls are considered to be 'high stiffness' for the purpose of assessment.

To provide some basis of estimating likely movements and damage resulting from excavating the basement in front of the underpinning, and in the absence of underpinning specific guidance, the underpinned sections of the new basement have been treated as piles.

The magnitude and extent of ground movements resulting from installation of a piled wall and excavation in front of such a wall are typically estimated based on the guidance given in the CIRIA publication C760 'Guidance on embedded retaining wall design'. The guidance in the CIRIA publication is based on the behaviour of embedded walls at numerous sites in London, which are predominantly walls embedded in London Clay, though typically with some near surface deposits consisting of River Terrace Deposits and Made Ground.

BUILDING DAMAGE ASSESSMENT

CIRIA C760 provides curves estimating horizontal and vertical ground surface movements due to piled wall installation and to excavation in front of wall. Total ground movements resulting from the excavation will be the combination of the installation movements and the excavation movements.

Oasys XDisp software has been used to inform the assessment. Oasys XDisp considers curves shown in CIRIA C760 (Fig. 6.9a, 6.9b, 6.15a, 6.15b) to make a prediction of ground movement assuming a high support stiffness wall. Potential corner stiffening effects have not been applied.

Ground Movements – Wall Installation

The movements resulting from excavation in front of the underpins incorporate the movements resulting from the construction (i.e. installation) of the underpins, since, unlike for the piles, the construction process requires an excavation prior to the pins being formed. However, the analysis has conservatively adopted the values for 'installation of a planar diaphragm wall' to represent the installation of the underpins (Fig. 6.9a and Fig. 6.9b in CIRIA C760).

For movement due to retaining wall installation, the magnitudes of the movements are dependent on the total wall depth. Maximum vertical movements occur at the wall itself. C760 indicates movements will be 0.05% of the wall depth, with negligible vertical movement at one and a half times the wall depth from the wall. On this

basis, maximum vertical movements due to stem installation of approx. 2mm are predicted with vertical movements extending to a maximum of 4.5m from the wall. Anticipated maximum horizontal movements due to wall installation are 0.05% of the wall depth, with negligible horizontal movement one and a half times the wall depth from the wall. Maximum horizontal movements are therefore predicted to be approx. 2mm with horizontal movements extending to a maximum of 4.5m from the wall.

Ground Movements – Excavation in Front of Wall

Consideration has been given to account for the nature of the soil to be excavated which primarily comprise the London Clay formation. Fig. 6.15a and Fig. 6.16b from CIRIA C760 have been used to reflect the nature of the soil excavated.

For movements due to excavation in front of the retaining wall, the magnitudes of the movements are dependent on the excavation depth. Based on the Contractor adopting a stiffly propped method of excavation, C760 indicates maximum vertical movements of 0.10% of excavation depth, with negligible movement three and a half times excavation depth from the wall. Maximum vertical movements due to excavation of approx. 3mm are predicted, extending 10.5m from the wall.

Anticipated maximum horizontal movement due to excavation are 0.15% of the excavation depth, with negligible horizontal movements four times the excavation depth from the wall. Maximum horizontal movements are predicted to be approx. 5mm, extending 12m from the wall.

Sensitivity Analysis

To provide a sensitivity check of the methodology adopted, the movement values predicted have been compared with:

- the typical range of movements reported by underpinning contractors, which is between 5mm and 10mm vertical / horizontal movement for a single lift;
- consideration of a 'low stiffness' construction methodology (i.e. without the use of temporary propping to restrain movements), which indicates up to 12/14mm vertical /horizontal movements.

The methodology adopted predicts results within the range of values provided by underpinning contractors and is therefore considered a reasonably conservative and robust approach. The conservative 'low stiffness' range of movements could be considered a worst case scenario, if propping was omitted for instance.

Damage category

Using these predicted movements, estimates of possible damage have been made for the surrounding structures, based on the Damage Classification Scheme proposed by Burland and Wroth (1974), and later supplemented by the work of Boscardin and Cording. This methodology is described within Box 6.3 in CIRIA C760 (and preceding CIRIA publications).

The 'Burland Scale' damage categories are presented in the table below:

Category of damage	Description of typical damage (ease of repair is underlined)	Approximate crack width (mm)	Limiting tensile strain, ε_{lim} (%)
0 Negligible	Hairline cracks of less than about 0.1 mm are classed as negligible	<0.1	0.0 to 0.05
1 Very slight	**Fine cracks that can easily be treated during normal decoration.** Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection	<1	0.05 to 0.075
2 Slight	**Cracks easily filled. Redecoration probably required.** Several slight fractures showing inside of building. Cracks are visible externally and **some repointing may be required externally** to ensure weathertightness. Doors and windows may stick slightly.	<5	0.075 to 0.15
3 Moderate	**The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable lining. Repointing of external brickwork and possibly a small amount of brickwork to be replaced.** Doors and windows sticking. Service pipes may fracture. Weathertightness often impaired.	5 to 15 or a number of cracks >3	0.15 to 0.3
4 Severe	**Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows.** Windows and frames distorted, floor sloping noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Services pipes disrupted.	15 to 25, but also depends on number of cracks	>0.3
5 Very severe	**This requires a major repair, involving partial or complete rebuilding.** Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion. Danger of instability.	Usually >25, but depends on numbers of cracks	

Damage categories 1 and 2 are generally considered to represent aesthetic damage only.

Summary of Results

Copies of tabular and graphical results are presented in **Appendix H** and are summarised in the table below:

Nearby Building / Structure	Estimated Damage Category No.	Category of Damage
15 Harrington Square	0	Negligible
76 Oakley Square		

The ground movement assessment undertaken indicates that damage to surrounding properties will be Burland Category 0 (Negligible).

The results achieved in the GMA, adopting the C760 empirical assessment approach, are considered to represent an upper bound of theoretical movements, based on historical data. These movements should be reduced by adopting modern techniques, a suitable sequence of works, and a high stiffness propping system. In addition, it should be noted that the presence of existing lower ground floors in the neighbouring properties

has not be considered in the analyses. The presence of such lower ground floors would typically reduce the effects of ground movements. In addition, potential corner stiffening effects have not been applied.

In general, ground movements can be minimised by careful design, sequencing and supervision of the works, ensuring that a high quality of workmanship is maintained.

ADDITIONAL CONSIDERATIONS

Slope Stability

A slope stability analysis has been undertaken to assess the global stability of the open cut excavation considering the presence of the building at 76 Oakley Square (as a surcharge). Analysis was undertaken in accordance with Eurocode 7. A batter angle of 45° (i.e. 1H:1V) was considered. Results of analyses indicate that an utilisation factor of 42% can be obtained (i.e. FoS of 2.3). This confirms that the slope is stable for an excavation of 3.5m. However, it should be noted that this analysis refers to a short term condition (i.e. the excavation will be done in sections and each section of the wall will be built relatively quickly). As such this condition will be applicable for a normal construction programme.

The results of the analysis are presented in **Appendix H**.

Thames Water Assets

Based on the Thames Water asset search the nearest assets are a water main and a combined sewer running beneath Lidlington Place at a distance of approximately 7.5m from the excavation (a distance of 5.0m has been considered). The maximum vertical movement on the assets is approx. 2mm and the maximum horizontal movement is approx. 3mm.

The magnitude of the predicted movements suggests that there would be no impact/damage to the Thames Water assets.

The results of the analysis are presented in **Appendix H**.

Car Park

An assessment of potential impacts on the car park adjacent to the site (between the site and the building at 15 Harrington Square) has been completed. According to XDisp the maximum horizontal and vertical movements expected adjacent to the western side of the excavation are approximately 4mm and 7mm respectively. These movements are relatively small and are not anticipated to result in any damage to the car park.

The results of the analysis are presented in **Appendix H**.

GROUND MOVEMENT ASSESSMENT

Heave

As outlined in earlier sections, the excavation of about 3.50m thickness of soil will generate a maximum unloading of c. 70kN/m^2.

This will result in a measure of short term heave and long term swelling of the underlying London Clay, which theoretically takes a number of years to complete. The new basement slab will be designed to withstand the potential heave forces and movements. About 30 to 50% of soil heave pressure would normally be expected to occur prior to construction of the slab (for a normal construction programme). As such 50% to 70% of potential heave will occur following excavation.

The excavation depth and modest dimensions of the site are such that heave movement associated with unloading of the clay is unlikely to exceed a few millimetres or to have any significant impact on the surrounding structures. Any movement that does occur will be further mitigated by the necessarily slow rate of the excavation and construction.

Ground Movement & Construction

The predicted building damage during construction is based on a conservative approach and it is recommended that the contractor gives consideration to the Association of Specialist Underpinning Contractors (ASUC) guidelines which should provide some mitigation and reduce the potential movements.

Ground Movements Monitoring

It is recommended that movement monitoring should be undertaken with surveying points set up prior to commencement of the works and it is recommended that monitoring be undertaken at weekly intervals. It is recommended that trigger values for monitoring are based on the predicted ground movements to ensure conservatism and that they are agreed under the Party Wall Act (if appropriate).

Impact Assessment & Mitigation Measures

SUMMARY OF POTENTIAL IMPACTS & MITIGATION MEASURES

The table below provides a summary of the potential impacts and mitigation measures adopted to ensure that residual risks are minimised:

Description of Potential Impact		**Significance of Impact**	**Summary of Mitigation Measures**	**Residual & Cumulative Effects following Mitigation**
Land Stability	Impact on local properties/structures	Minor negative	• The GMA completed suggests that potential damage associated with the excavation would be negligible. • Adoption of appropriate management procedures for basement excavation/ construction. • Surveying and monitoring of surrounding buildings / structures will be undertaken. • Repair and maintenance in accordance with C760.	Negligible

Conclusions and Recommendations

CONCLUSIONS

Ground & Groundwater Conditions

The ground conditions encountered in the exploratory holes comprise Made Ground overlying the London Clay Formation, which comprises firm becoming very stiff brown to dark grey brown clay.

No groundwater was recorded during the borehole drilling. During return monitoring standing water was recorded in the monitoring well at a depth of 2.89m bgl. Groundwater is commonly recorded within the London Clay Formation, particularly around foundations. However, rather than being representative of a permanent and laterally continuous aquifer unit, the groundwater is present as discrete units within (for example) micro fissures and local mudstone horizons and the recorded groundwater level will most likely be reflective of the pore water pressures within these discrete features.

Geotechnical Advice

The structural engineer for the project has indicated that construction will utilise a pinning sequence where the perimeter retaining walls and toes are emplaced prior to further excavation to enable casting of the basement slab.

Spread Foundations

Based on the findings of the ground investigation it has been concluded that for traditional spread foundations (placed on the competent firm to stiff London Clay) at the assumed formation level of c.3.50m bgl a net safe bearing pressure of 115kN/m^2 should be available.

The net safe bearing pressure is based on a factor of safety of 3 to ensure that settlement remains within normally acceptable limits.

The above advice assumes that the proposed basement development and in particular foundations are below the influencing depth of any trees or tree routes.

Piled Foundations

Based on the proposed development it is understood that a piled foundation would not be a feasible solution.

Ground Stability & Retaining Structures

Parameters that may be considered within the design of the basement retaining walls are provided in the Geotechnical Advice section of the report.

CONCLUSIONS AND RECOMMENDATIONS

Assessment of Soil Analytical Results

Potential sources of on site contamination are limited to elevated concentrations of Lead in the Made Ground soils. However, the majority of the Made Ground will be removed as part of basement development and following development the ground surface will comprise hard surfacing. As such potential residual risks to future site users are considered to remain low.

The analytical results suggest that the majority of the Made Ground will be listed as non-hazardous wastes and that they meet stable non-reactive hazardous waste in non-hazardous landfill waste acceptance criteria. This should be confirmed by the receiving facility.

Basement Impact Assessment

Assuming the correct mitigation measures are adopted, the assessment completed indicates that potential impacts on groundwater flow, land stability and local surface water resulting from the basement development are likely to be negligible.

RECOMMENDATIONS

It is recommended that movement monitoring be undertaken with surveying points set up prior to commencement of the works and it is recommended that monitoring be undertaken at weekly intervals. It is recommended that trigger values for monitoring are based on the predicted ground movements to ensure conservatism.

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[1] This document has been withdrawn but is considered to remain useful in proving technical background for designing ground investigation works.

[2] This document has been withdrawn but is considered to remain useful in proving technical background for designing ground investigation works.

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FIGURES

Key:

Approximate site location

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Ground Investigation
Land Contamination
Hydrogeology
Engineering Geology

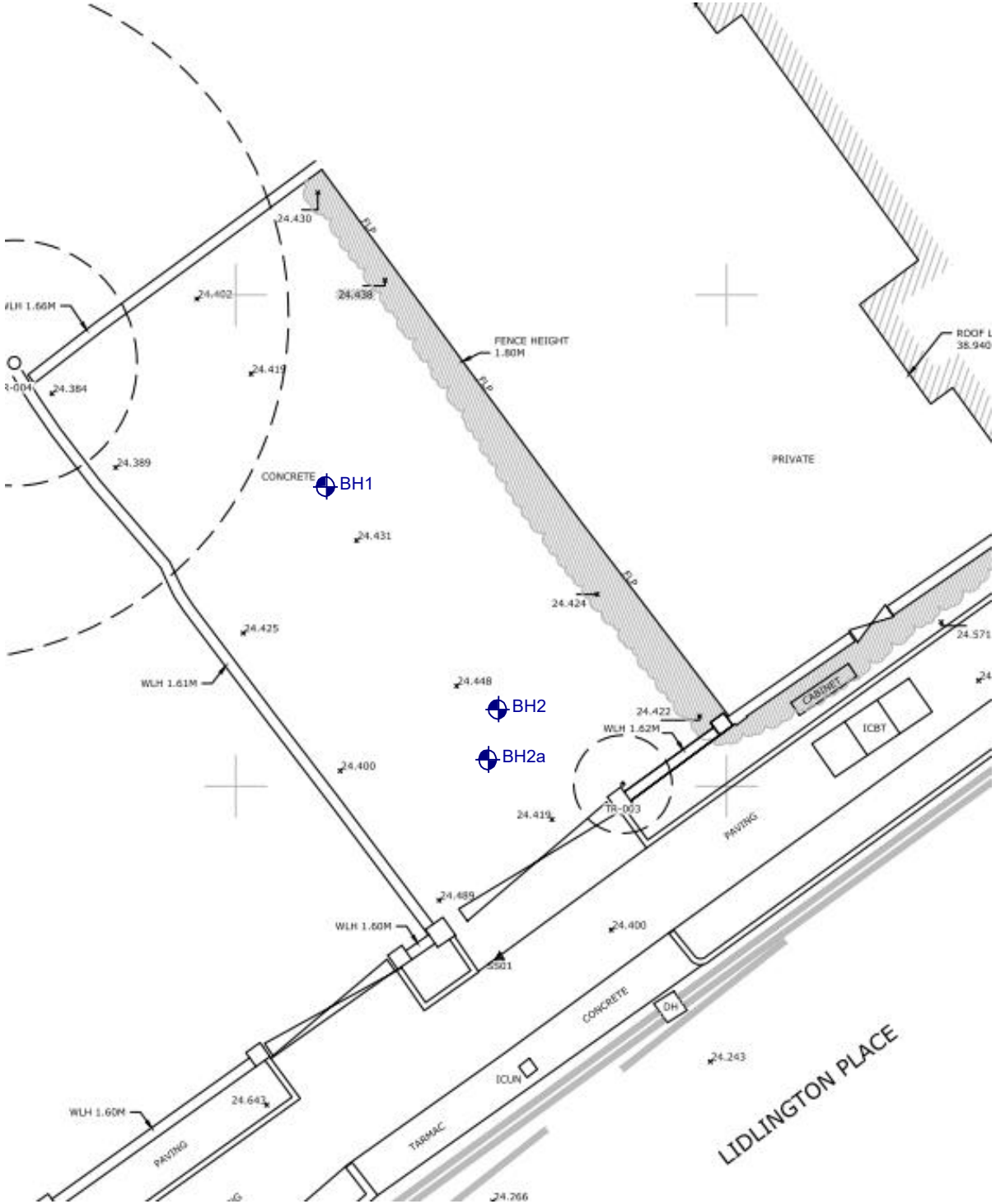
Site: Lidlington Place, London NW1

Figure Number: Figure 1

Title: Site Location Plan

Project No:	Created By:	Date:
	PIL	Dec 2019

Client: Minh Quach



Key:

BH Approximate Borehole location

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Hydrogeology
Engineering Geology

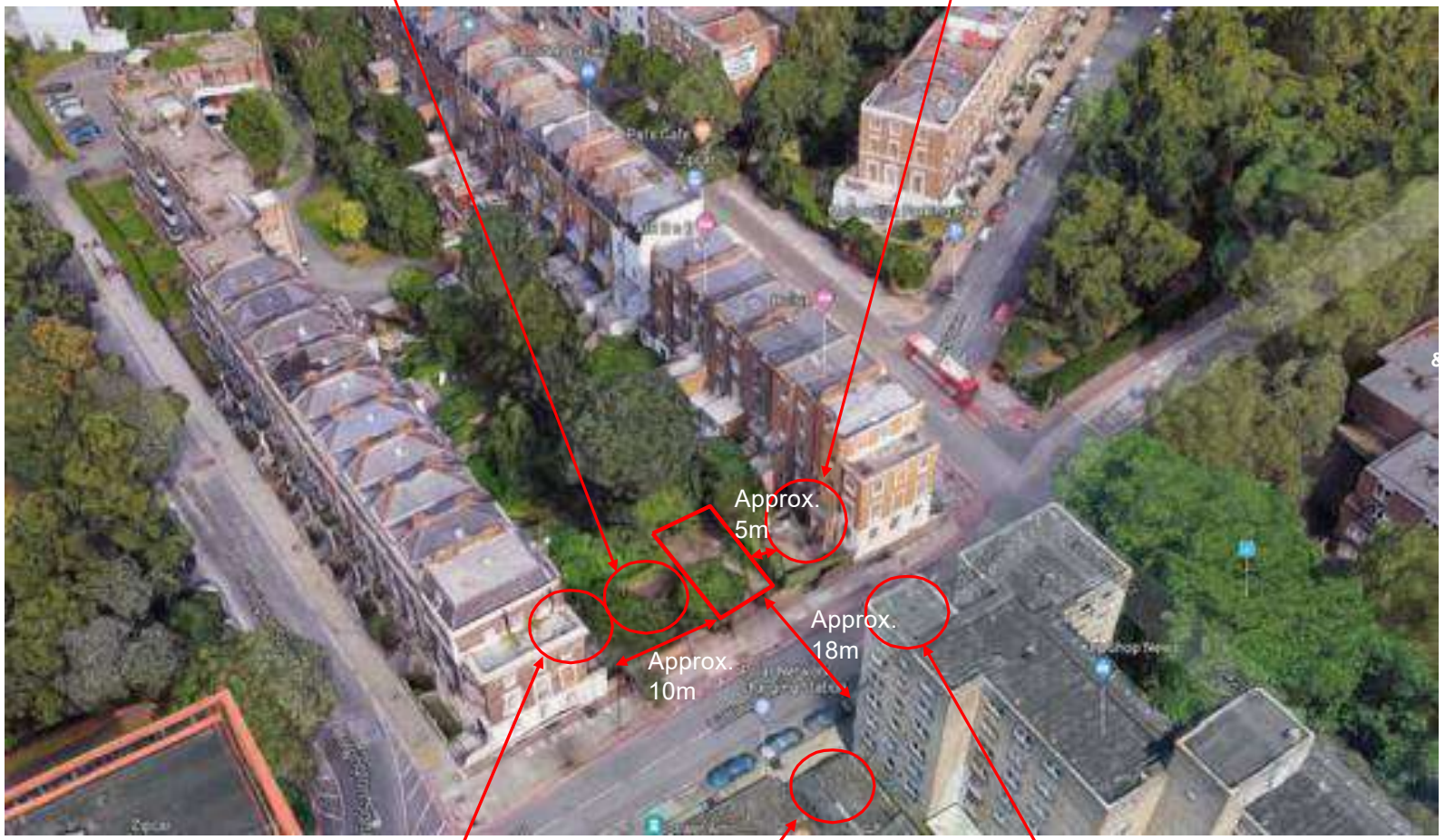
Site: Lidlington Place, London NW1

Figure Number: Figure 2

Title: Exploratory Hole Location Plan

Project No:	Created By:	Date:
	PIL	Dec 2019

Client: Minh Quach



Key:

Approximate site location

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Ground Investigation
Land Contamination
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Engineering Geology

Site: Lidlington Place, London NW1

Figure Number: Figure 3

Title: Neighbouring Properties

Project No:	Created By:	Date:
	PIL	Dec 2019

Client: Minh Quach