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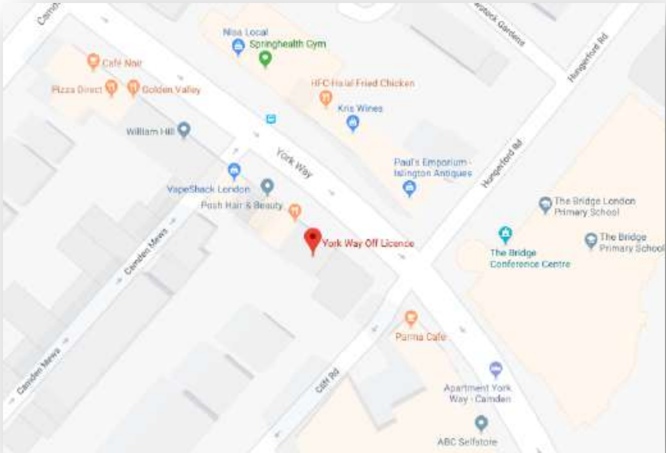
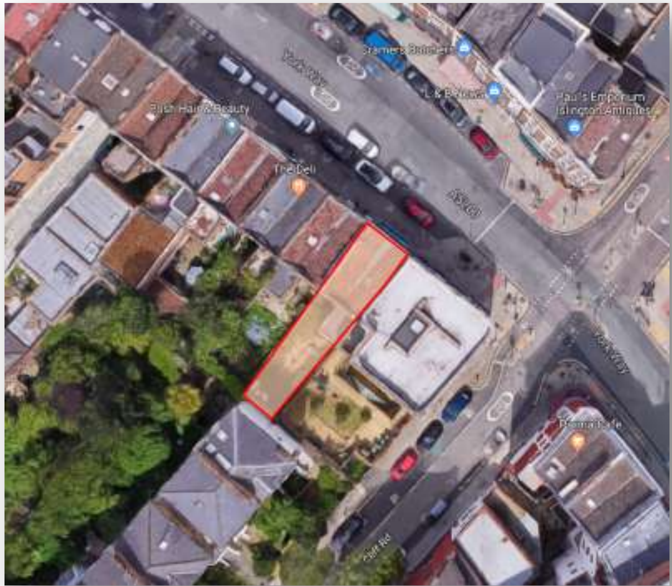


157 YORK WAY LONDON N7 9LN

Impact Assessment of Below-Ground Development

MBP-7441 Issue P1.1

June 2018



PREMISE

As part of the proposed renovation, improvement and development of 157 York Way, new residential accommodation will be formed at ground and lower ground levels while retaining the commercial area of the property with residential accommodation over. This report assesses the impact of the construction and development of this on the property, its immediate surroundings and the local geology in accordance with the Camden SPD / guidance document CPG4 and concludes that the proposed development and works required to achieve them will not present an adverse impact during the works or thereafter as a consequence of them.

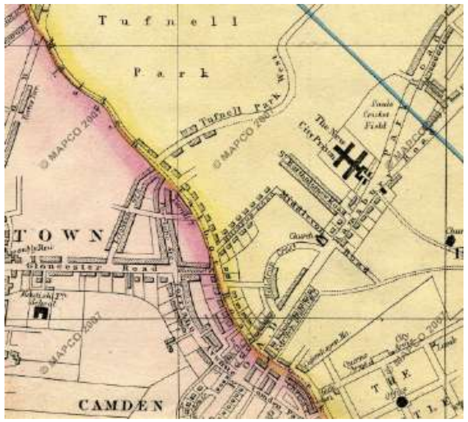
THE PROPERTY & SITE

157 York Way is a terraced townhouse dating from the late 19th Century located in Camden, north of King's Cross Station. York Way is shown as York Road on Cross's Map of London 1861 and an extract from a Map of 1820, which reflects the development of this area of London with the emergence and establishment of the railway lines and stations.

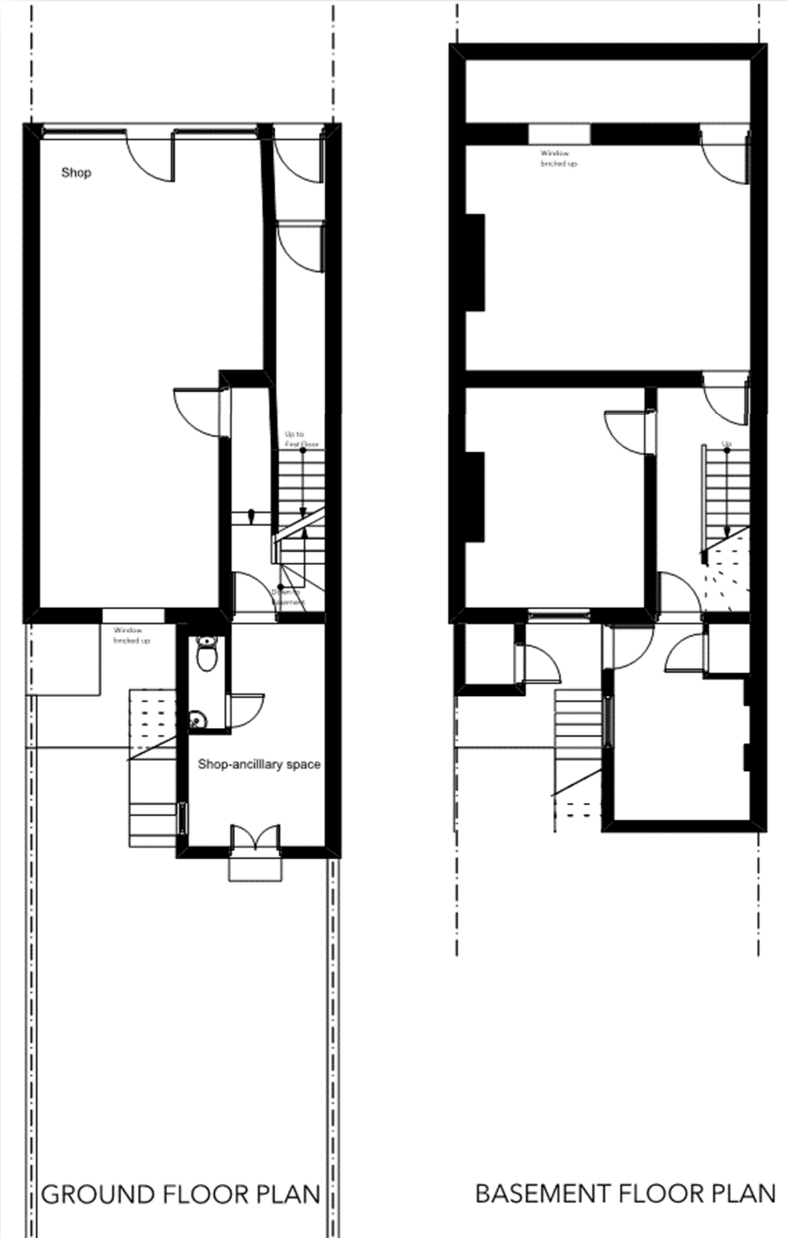
The building has a traditional style typical of its period and a construction similarly typical of that period, i.e. loadbearing masonry walls supporting timber floors and rafters. The house is arranged over four levels, from lower ground through ground, first, second, a part third and has a central valley roof.

157 York Way is a four-storey mixed-used development with an original basement. Commercial units are provided at ground and basement levels with residential accommodation over in an arrangement typical of the period the area was developed. Traditional in construction the buildings, along with the road, has masonry walls supporting timber floors and a cut-timber valley roof; the front elevation will be supported on a bressumer beam, more than likely to be timber if original, or steel if the shopfront has been renovated more recently. The property does not appear to be in a poor condition not exhibit any indications of distress, disturbance or disruption but, as with many building of this age, has indications of age and weathering.

Extract from 1820 Map



Extract from Cross's New Plan 1861



The area is generally flat, and the properties have even levels across their section, front to rear. A small number of trees are established in the rear gardens to the houses on the side streets to the back of the rear garden, which is mostly landscaped hard.
The existing basements are sufficient for headroom and of suitably robust construction though are not currently waterproofed to Category 3, as defined by BS8102: 2009.

Neither the building, nor the road that it sits on in general, suggest by construction or condition that they cannot support the proposed development.

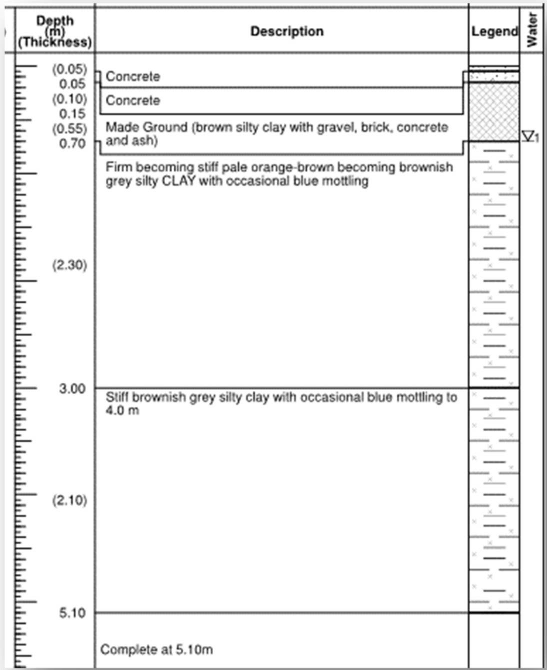
The site is underlain by the London Clay Formation, containing sand and silts, to a high level with no overlying superficial deposits but as with most developed areas in London a band of made ground can be expected. A site soil investigation by **GEA LTD** in April 2018 confirmed this profile along with the depth & profile of existing foundations: laboratory tests established that the clay is shrinkable and has a 'HIGH' plasticity index, which impacts on depth of foundations.

Given the absence of plantation there are unlikely to be many roots but the water demand of any trees or bushes will lead to seasonal swelling & shrinkage of the London Clay and any new foundations will be required to accommodate the high potential for volume change of that sub-soil.

York Way is comfortably north of the Thames Flood Zones. The Environment Agency has identified the risk of flooding from rivers to be very low (1/1000) and from surface water it is low (< 1/100); the anticipated depth of the latter is less than 300mm so with careful and considered detailing there is no obstacle to having residential accommodation in these buildings.

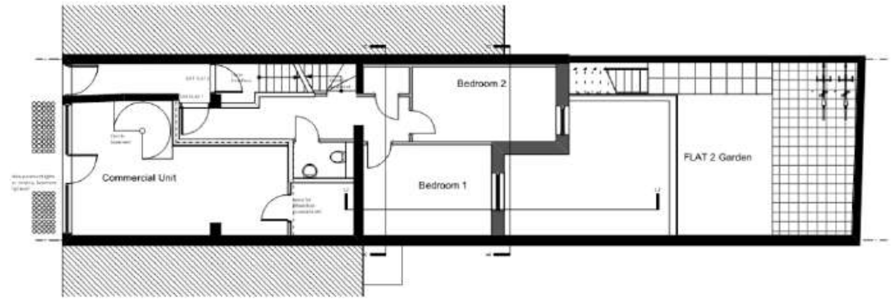
The area around N^{os}. 157 York Way generally has hard surfacing with little or no planting except for a couple of trees in the grounds to the rear of the garden.

The WWII Bomb Map records hits to buildings on York Way but not to No. 157; it is likely though, that No. 157 would have suffered secondary damage form the vibrations generated by nearby damage: the adjacent buildings were damaged beyond repair and the plots were subsequently cleared to accommodate the block of flats on the adjacent corner with Hungerford Road.



Depth (m) (Thickness)	Description	Legend	Water
(0.05) 0.05	Concrete		
(0.10) 0.15	Concrete		
(0.55) 0.70	Made Ground (brown silty clay with gravel, brick, concrete and ash)		∇1
(2.30) 3.00	Firm becoming stiff pale orange-brown becoming brownish grey silty CLAY with occasional blue mottling		
(2.10) 5.10	Stiff brownish grey silty clay with occasional blue mottling to 4.0 m		
	Complete at 5.10m		

Records suggest then that the development of this area was within the last 150-200 years and, generally, was undertaken with some consideration and deliberation, using good practices and competent materials. The area was light agricultural, grazing or perhaps hunting land before it was developed and has not been used in the past for industrial purposes, nor has it been repeatedly developed so the ground is likely to be relatively free from contamination and obstruction such as old foundations and cellars.



GROUND FLOOR PLAN

BASEMENT FLOOR PLAN

THE PROPOSED DEVELOPMENT

The development will extend the existing lower ground floor to the rear and introduce separation between the retained commercial space at the front and the new accommodation space at the rear. The entire space will, nevertheless, have the same floor level. Existing walls to the rear of the current basement will be taken down and the lines of the party walls extended to a new rear wall, which will be a retaining structure: the new walls on the party lines will underpin the retained walls over.

The new construction to the new rear party walls will be in reinforced concrete cast in a hit-&-miss sequence commonly used for underpinning operations, which, although a lengthy process, is a low-impact technique that permits the maximum space to be achieved and has the least impact on existing constructions, boundaries and the like. Casting the wall in pins controls the extent of soil exposed, avoids extensive temporary works and they can be varied in size and sequence to reflect and accommodate the condition and capability of the walls they will be built beneath.

A drained cavity system will be installed inside the new construction to capture, manage and remove any water penetrating the underpins and retaining walls so ensuring the residential areas meet **Category 3 of BS 8102**; given the absence of groundwater any ingress will be from surface water percolating down the interface between the concrete and retained clay, which is very-low risk occurrence.

Table 2 **Grades of waterproofing protection**

Grade	Example of use of structure [A)]	Performance level
1	Car parking; plant rooms (excluding electrical equipment); workshops	Some seepage and damp areas tolerable, dependent on the intended use [B)] Local drainage might be necessary to deal with seepage
2	Plant rooms and workshops requiring a drier environment (than Grade 1); storage areas	No water penetration acceptable Damp areas tolerable; ventilation might be required
3	Ventilated residential and commercial areas, including offices, restaurants etc.; leisure centres	No water penetration acceptable Ventilation, dehumidification or air conditioning necessary, appropriate to the intended use

A) The previous edition of this standard referred to Grade 4 environments. However, this grade has not been retained as its only difference from Grade 3 is the performance level related to ventilation, dehumidification or air conditioning (see BS 5454 for recommendations for the storage and exhibition of archival documents). The structural form for Grade 4 could be the same or similar to Grade 3.

B) Seepage and damp areas for some forms of construction can be quantified by reference to industry standards, such as the ICE's *Specification for piling and embedded retaining walls* [1].

The new construction above ground level will use traditional construction materials, i.e. masonry and timber, to form the new walls, floors and roof.

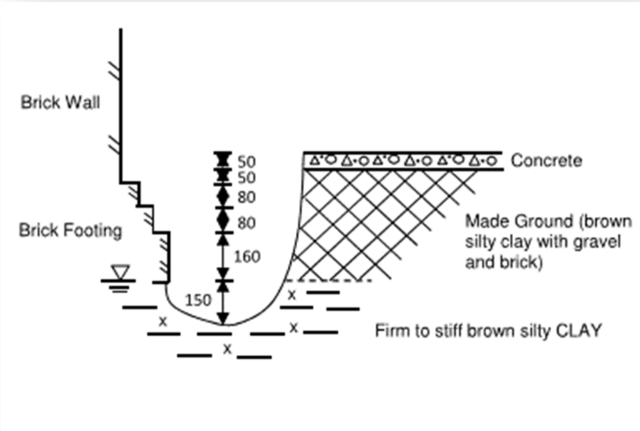
Nearby trees are not close to the works area and not be an issue in this case. The depth of foundation required to support the new underpins and retaining wall should be sufficient to meet NHBC requirements for building near trees.

There is no active groundwater within the depth or perimeter of the development although perched water was identified from the made ground. The inflow will be relatively minor and can be dealt with through pumping and no drains (land, storm or foul) passing through to be affected by the works or construction.

The proposed development is a relatively low-level, low-density construction and will be entirely within the existing boundaries.

Damage Category	Description of Typical Damage	Approximate Individual Crack Width
Negligible (0)	Hairline cracks	< 0.1 mm
Very Slight (1)	Very slight damage includes fine cracks which can be easily treated during normal decoration, perhaps an isolated slight fracture in building, and cracks in external brickwork visible on close inspection.	1 mm
Slight (2)	Slight damage includes cracks which can be easily filled and redecoration would probably be required, several slight fractures may appear showing the inside of the building, cracks which are visible externally and some repointing may be required, and doors and windows may stick.	< 5 mm
Moderate (3)	Moderate damage includes cracks that require some opening up and can be patched by a mason, recurrent cracks that can be masked by suitable linings, repointing of external brickwork and possibly a small amount of brickwork replacement may be required, doors and windows stick, service pipes may fracture, and weather-tightness is often impaired.	5 mm to 15 mm or a number of cracks > 3 mm
Severe (4)	Severe damage includes large cracks requiring extensive repair work involving breaking-out and replacing sections of walls (especially over doors and windows), distorted windows and door frames, noticeably sloping floors, leaning or bulging walls, some loss of bearing in beams, and disrupted service pipes.	15 mm to 25 mm but also depends on the number of cracks
Very Severe (5)	Very severe damage often requires a major repair job involving partial or complete rebuilding, beams lose bearing, walls lean and require shoring, windows are broken with distortion, and there is danger of structural instability.	> 25 mm

Table 1: Severity of Cracking Damage[4, 5]



RISKS TO & IMPACT ON SURROUNDING BUILDINGS

The surrounding buildings fall in to Group 1a defined by BS ISO 4866:2010, i.e. **Ancient, Historical** or **Old**; the foundations to the new building fall in to Classes B & C and the soil as Type e: from Table B1 of BS ISO 4866 the surrounding buildings fall within Category 6 and can be considered to have a medium resistance to vibration. From Table B.2 of BS ISO 4866 the surrounding buildings fall in to Class 8, which are deemed to have a medium level of resistance to vibration and, conversely, to require no or little protection against vibration for the types of works intended.

- Although the construction will be further below ground level than the existing building it will not be significantly deeper than the lowest level of the surrounding buildings.
- The lower ground floor construction will not be lower than the prevailing groundwater level in this area so will not interfere with the natural flow of the groundwater.
- The building will be formed off of the claygate members, which have a significant bearing capacity, and the foundations will be designed to reflect the recommended permissible pressures and ensure they will not be compressed by more than 10mm
- Removal of the existing construction will generate little relief and consequent heave in the London Clay that underlies which will in part be counteracted by the proposed structure.
- The boundary walls on four sides can be retained safely and easily following industry-standard practices and, by following a pre-determined sequence will allow the lower ground floor walls to be constructed without detriment to the existing, surrounding construction.
- Excavations for the pins that will form the new lower ground floor walls can be undertaken using small excavators, which will be low-impact technique and known not to generate excessive vibration.

Adopting a controlled and sequenced work process will limit any damage to surrounding buildings to Category 0 or 1 or 2 the Burland Scale, i.e. *Hairline Or Very Slight Cracks, Easily Repaired With Filling & Decoration*.

Temporary Cover to Works Area

Small Excavator

NOISE & NUISANCE

Construction works generally are a source of noise and nuisance which can affect both operatives with the work site as well as neighbours and passing members of the public. Demolition and excavation works are particular sources of this potential harm, so it will be necessary during these works for the contractor to mitigate the extent and impact of noise, dust, traffic and vibration.

Noise: Generated by the mechanical equipment used to demolish existing construction and excavate for the new lower ground floor;
Mitigated by using electrical equipment where possible and mufflers or attenuators on diesel engines or generators, by working only within agreed and designated hours;

Dust: Generated by excavation works and the transfer of arisings from the works area to the disposal skip or wagon;
Mitigated by damping conveyors when in operation, by installing a weatherproof cover over the site, by washing-down vehicle wheels before leaving site;

Traffic: Generated by delivery and removal vehicles travelling to and from site;
Mitigated by establishing a traffic management plan, by identifying and using routes appropriate to the vehicles, by scheduling vehicle movements to avoid peak traffic periods, by ensuring vehicles are low-emission standard

Vibration: Generated by use of heavy breakers for sustained periods and by heavy vehicles;
Mitigated by using light, hand-held and electrical breakers, by avoiding excessively heavy vehicles.

Protection: Robust hoarding will be erected around the site, front rear and sides, to secure the site from intrusion as well as provide protection to neighbours and passing public from noise, dust and material arisings

CONCLUSION

The development is within firm, stiff London Clay of substantial bearing capacity and will not lead to or generate movement beneath or around the plot; heave potential following excavation will develop but more than 50% of this will be relieved by excavation, a further 50% of the residual will be relieved during the works period; the remainder will be managed by the weight of the existing and added construction. Furthermore:

- The area is not within a flood risk zone identified by EA.
- There is no ground water to affect or be affected by the development.
- The new development will not influence or divert surface water drainage which will still be managed by the existing system.
- The works or completed development will be executed in manner that will preserve and protect neighbouring structures, which are close enough to be impacted.
- The construction sequence and strategy will ensure that surrounding foundations and buildings will not be affected by the new construction, which will be formed off firmer & stiffer formation and so will not consolidate when complete and loaded.
- The site is on level ground in any case but, notwithstanding this, the construction techniques and sequences proposed minimises the risk of instability, ground slip and movement.
- There are no critical utilities or infrastructure beneath the site that cannot be relocated easily to accommodate the construction and, as there is no change in use or level of occupancy proposed there will be no significant increase in foul discharge to the public sewer.
- The proposed construction will not be beneath the prevailing groundwater level. The lower ground floor can be constructed using relatively light techniques, in controlled and pre-determined sequences and without the need for a large open excavation before construction can start and consequent extensive temporary works. Where mechanical means are necessary to construct permanent works, these can be of a type that generates low vibrations to which the surrounding buildings have a form and construction that is robust and resistant to.
- The excavation for, and construction of the lower ground floor will need to be completed without involving or disturbing the existing ground and upper floors and finishes throughout the building. Underpinning will be carried out in 1m-sections of mass concrete.

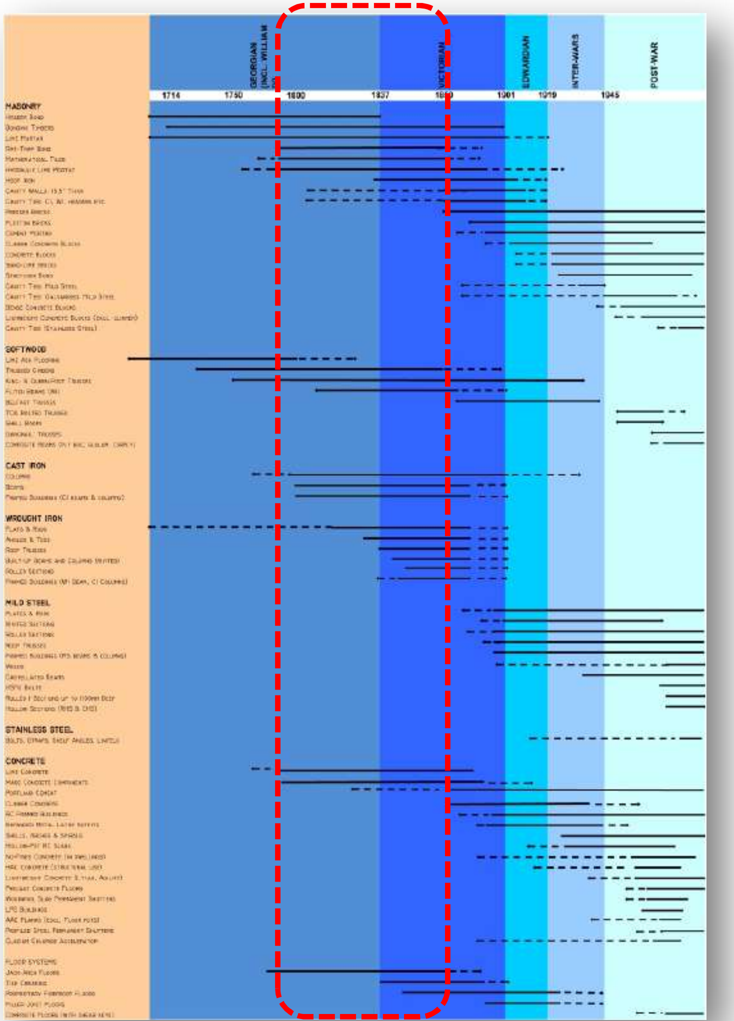
- By adopting an underpinning technique and following a hit-&-miss sequence it will be possible to construct the lower ground floor without extensive temporary works.
- Any temporary works will be designed by the Contractor to current British Standards.
- The main surrounding roads are wide enough and without tight bends or corners that will hinder or prevent site traffic and will not cause site traffic to hinder or delay local and residential traffic

We therefore believe that the site is suitable for a partially subterranean development and have not identified any constraints or conditions, topographical or environmental, that would prevent the build or be affected by it.

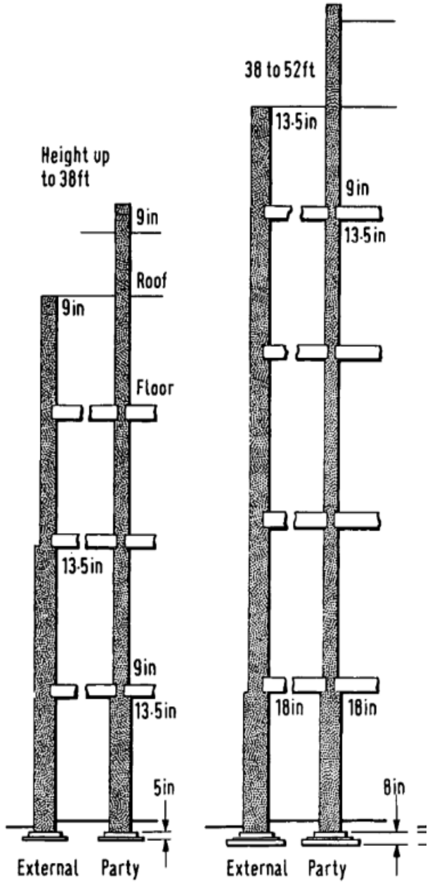
Report Version	Revision	Issue Date	Prepared By	Checked By
1.0		01/06/2018	Sina Heidarzadeh MEng CEng MICE	Malcolm Brady BEng CEng MIStructE

APPENDIX A EXISTING CONSTRUCTION

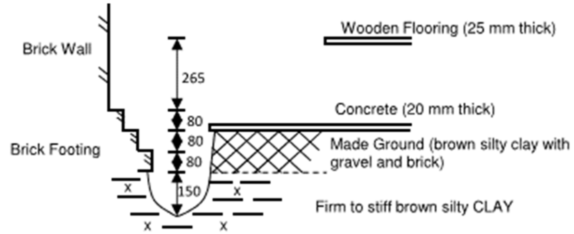
The construction of Georgian and Victorian buildings are well-known from records, studies and experience and York Way conforms to the following.



Construction Timeline



Common Wall Constructions of 19th-20th Century London Housing



APPENDIX B PROCEDURE FOR MONITORING ADJACENT BUILDINGS

The contractor will monitor the adjacent structures and party walls for movements throughout the principal demonstration & construction works and, in the event of any movements exceeding the agreed target levels the method of works will be reviewed and altered as necessary.

- The proposed monitoring points will be agreed with the contractor
- The Green/Amber trigger level will be 3mm
- The Amber/Red trigger level will be 5mm

The monitoring regime and frequency proposed is:

Activity	Frequency of monitoring
Site set up	Bi-Weekly
Demolition & Excavation	Weekly
Underpinning & Ground Works	Weekly
Principal Construction Works	Weekly

Target monitoring will monitor the party walls and rear elevation with an accuracy of +/- 2mm. The results of the monitoring are to be recorded and issued by email to the project engineer, CA and engineers for the adjoining properties, on the day that the results are taken. The results are to be presented both in table and graphical form with the graphs for each point plotting the readings taken against time. The following actions will be taken if the trigger levels are exceeded:

Trigger Level	Action
Green/Amber	Immediately notify the engineers. Increase frequency of monitoring to a daily basis.
Amber/Red	Contractor to stop all works and immediately notify the engineers. Contractor and project engineer to put forward proposals, such as additional propping, to limit further movement to an acceptable level.

APPENDIX C PROCEDURES FOR CONTROL OF NOISE, DUST & NUISANCE

To control the disturbance due to noise and vibrations, all works on site will be restricted to the hours of Monday to Friday 8 am to 6 pm, Saturdays 8 am to 1 pm. Works that create excessive noise and/or vibration are prohibited, as are any works on Sundays and the bank holidays. The contractor employed to undertake the work will be a member of the considerate constructor scheme.

Appropriate measures will be taken to keep dust pollution to a minimum, which are compliant with the RBKC, Westminster & Camden SPDs. Such measures will include the use of water to suppress dust and soil being excavated from reduced level, covers for conveyors and skips, and barriers installed around dusty activities that are undertaken externally.

All work will be carried out in accordance with BS 5228-1:2009 and BS 5228-2:2009. All works will employ Best Practicable Means as defined by section 72 of the Control of Pollution Act 1972 to minimise the effects of noise and vibration. All means of managing and reducing noise and vibration which can be practically applied at reasonable cost will be implemented.

The following measures will be taken:

- Consultation/ communication with neighbours/affected others prior to the start of the works.
- Use only of modern, quiet and well-maintained equipment, all of which will comply with the EC Directives and UK regulations set out in BS 5228-1:2009
- Use of electrically powered hand tools rather than air powered tools and a compressor will be used for to the minimum extent practicable
- Avoidance of unnecessary noise (such as engines idling between operations or excessive engine revving, no radios, no shouting)
- Use of screws and drills rather than nails for fixing hoarding.
- Careful handling of materials, so no dropping off materials from an excessive height (no more than 2m) into skip etc.

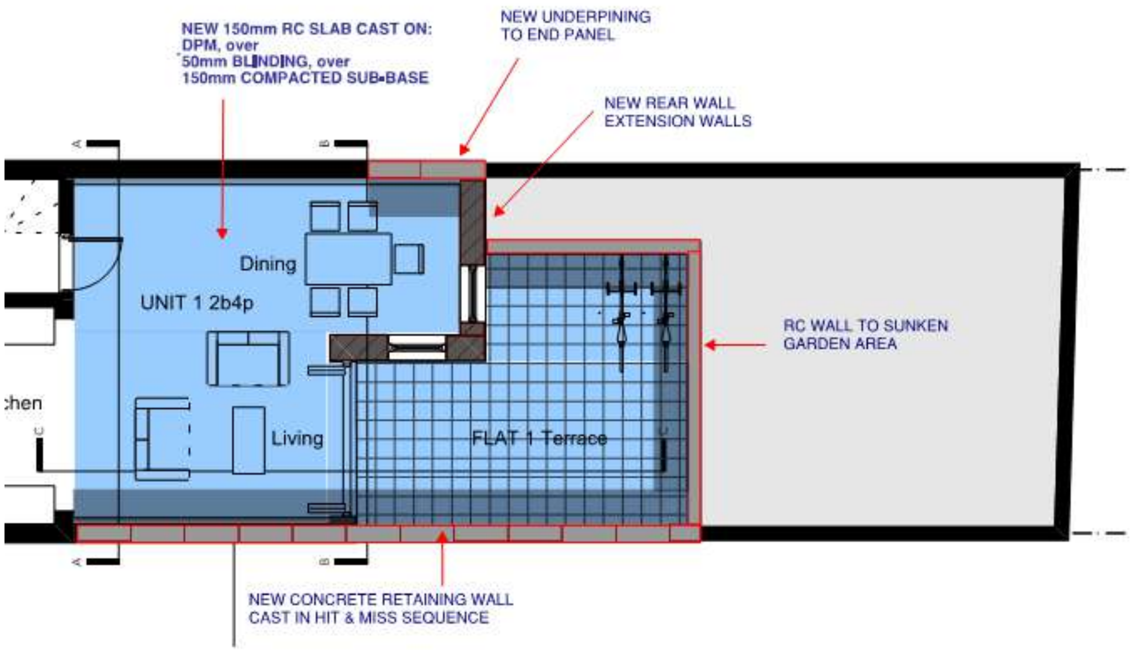
- Ensuring that the conveyor is well maintained with rollers in good working order and well oiled.

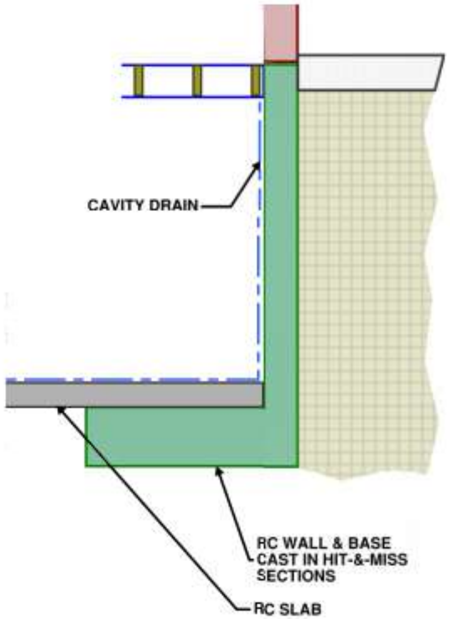
- Isolating the neighbouring properties from vibration /breaking out work where practicable.
- Collection /delivery times will be as given in the CTMP
- Collection/delivery vehicles will not loiter/wait in the area before the allowed times
- No site run-off of water or mud until the water has been left to settle and is free from particles
- During Demolition:
  - Special Care to ensure the site is closed-over
  - Dust suppression with water if necessary if needed (recommended)
  - Cutting equipment to use water suppressant or local extraction & ventilation

If measures to control dust are unsuccessful works will be stopped and alternative methods proposed and implemented.

A detailed CTMP will be required for the execution of these works

APPENDIX D MBP-7441-BASEMENT SCHEME





APPENDIX E GEA REPORT J18052

SITE INVESTIGATION & BASEMENT IMPACT ASSESSMENT REPORT

157 York Way
London
N7

Client: Kapilaben Patel

Engineer: Michael Barclay Partnership LLP

J18052

May 2018




GEA

Document Control

Project title	157 York Way, London, N7 9LN	**Project ref**	J18052
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Issue No	Status	Amendment Details	Date	Approved for Issue
1	Final		21 May 2018	

This report has been issued by the GEA office indicated below. Any enquiries regarding the report should be directed to the office indicated or to Steve Branch in our Herts office.

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Geotechnical & Environmental Associates Limited (GEA) disclaims any responsibility to the Client and others in respect of any matters outside the scope of this work. This report has been prepared with reasonable skill, care and diligence within the terms of the contract with the Client and taking account of the manpower, resources, investigation and testing devoted to it in agreement with the Client. This report is confidential to the Client and GEA accepts no responsibility of whatsoever nature to third parties to whom this report or any part thereof is made known, unless formally agreed beforehand. Any such party relies upon the report at their own risk. This report may provide advice based on an interpretation of legislation, guidance notes and codes of practice. GEA does not however provide legal advice and if specific legal advice is required a lawyer should be consulted.

This report is intended as a Ground Investigation Report (GIR) as defined in BS EN1997-2, unless specifically noted otherwise. The report is not a Geotechnical Design Report (GDR) as defined in EN1997-2 and recommendations made within this report are for guidance only.

CONTENTS

Part 3: GROUND MOVEMENT ASSESSMENT

Part 4: BASEMENT IMPACT ASSESSMENT

EXECUTIVE SUMMARY

This executive summary contains an overview of the key findings and conclusions. No reliance should be placed on any part of the executive summary until the whole of the report has been read. Other sections of the report may contain information that puts into context the findings that are summarised in the executive summary.

BRIEF

This report describes the findings of a site investigation carried out by Geotechnical and Environmental Associates Limited (GEA) on the instructions of Michael Barclay Partnership LLP, on behalf of Kapilaben Patel, with respect to the extension of the single-storey basement to the rear of the existing property, as well as reconstruction of the rear extension to include an additional bedroom for an above ground level apartment. The purpose of the investigation has been to determine the ground conditions and hydrogeology, to carry out an assessment of ground movements resulting from excavation of the proposed basements, to assess the extent of any contamination and to provide information to assist with the design of the basement structure and suitable foundations. The report also includes information required to comply with London Borough of Camden (LBC) Draft Planning Guidance CPG4, relating to the requirement for a Basement Impact Assessment (BIA).

DESK STUDY FINDINGS

The desk study findings indicate that the site does not have a potentially contaminative history as it has apparently been developed with the existing building, which has a mixed commercial and residential end use, since prior to 1873.

There is, therefore, assessed to be a VERY LOW RISK of contamination at this site.

GROUND CONDITIONS

The investigation has confirmed the expected ground conditions in that, below a variable, but generally moderate thickness of made ground, London Clay was encountered and proved to the full depth of the investigation.

At the rear of the property, made ground, comprising dark brown silty clay with gravel, brick, rootlets, rare ash and occasional concrete fragments, was found to extend to depths of between 0.55 and 1.05 m below existing garden level, whilst in the trial pits excavated within the existing basement brown silty clay with brick was encountered to depths of 0.39 m to 0.51 m below existing basement level. The London Clay comprises an initial weathered horizon of firm becoming stiff orange-brown becoming brownish grey silty clay with occasional blue mottling, below which stiff brownish grey silty clay with occasional blue mottling was proved to the full depth of the investigation of 5.10 m below garden level.

Groundwater seepages were encountered within the made ground, indicating the presence of perched water above the London Clay, and subsequent monitoring of the three standpipes installed in the rear garden has recorded water at depths of 0.68 m to 1.16 m.

Contamination testing has revealed elevated concentrations of lead within made ground recovered from the existing rear garden.

RECOMMENDATIONS

Formation level for the proposed basement is likely to be within the firm to stiff clay of the London Clay, which should provide an eminently suitable bearing stratum for spread foundations. Excavations for the proposed basement structure will require temporary support to maintain stability and to prevent any excessive ground movements. Perched water is likely to be encountered within the garden area, towards the base of the made ground. However, significant groundwater inflows are not anticipated.

Site workers should adopt suitable precautions with regard to the lead contamination within the existing garden area and areas of proposed soft landscaping / planting should be formed with a cover thickness of imported soils.

BASEMENT IMPACT ASSESSMENT

The BIA has not indicated any concerns with regard to the effects of the proposed basement on the site and surrounding area. It has been concluded that the impacts identified can be mitigated by appropriate design and standard construction practice.

Part 1: INVESTIGATION REPORT

This section of the report details the objectives of the investigation, the work that has been carried out to meet these objectives and the results of the investigation. Interpretation of the findings is presented in Part 2 and an assessment of the ground movements associated with the basement excavation are included in Part 3.

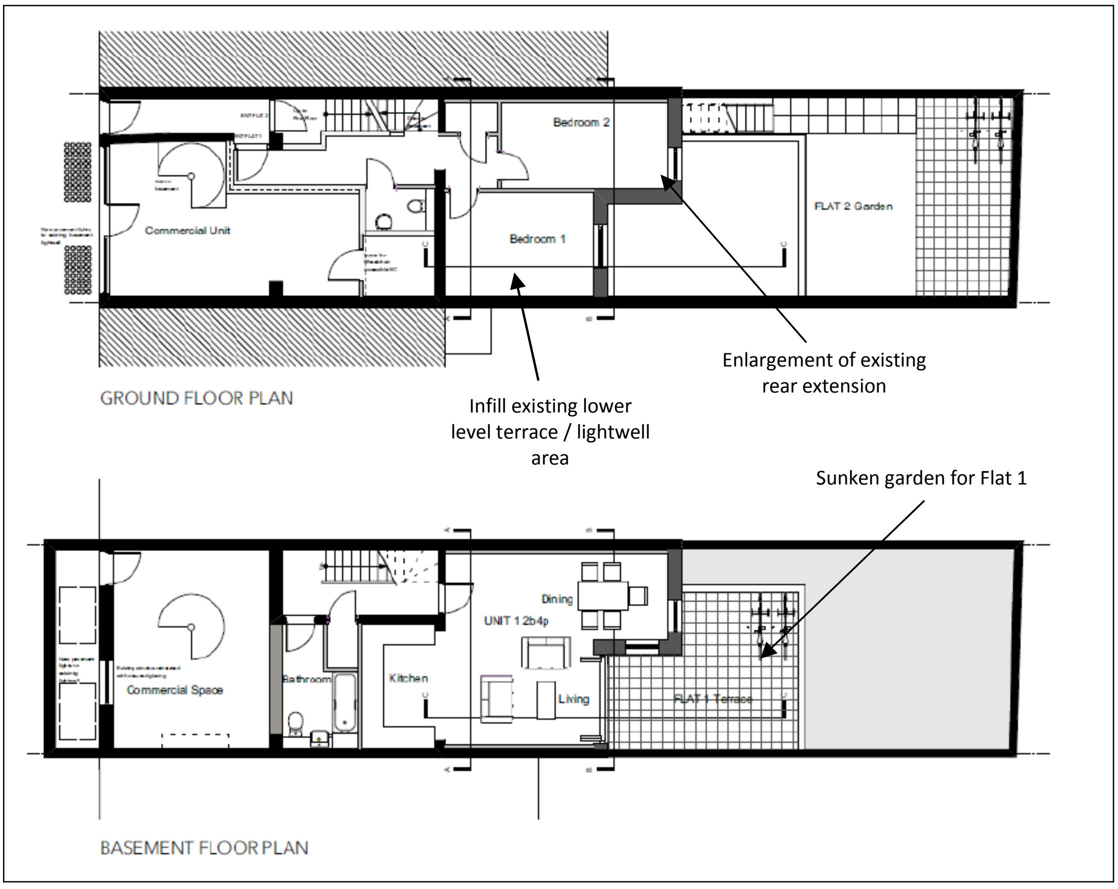
1.0 INTRODUCTION

Geotechnical and Environmental Associates Limited (GEA) has been commissioned by Michael Barclay Partnership LLP, on behalf of Kapilaben Patel, to carry out a desk study, ground investigation and ground movement assessment at 157 York Way, London N7 9LN.

This report also forms part of a Basement Impact Assessment (BIA), which has been carried out in accordance with guidelines from the London Borough of Camden (LBC) in support of a planning application.

1.1 Proposed Development

It is understood that it is proposed to extend the existing single storey basement beneath the rear part of the site and to reconstruct the rear extension to create space for a new self - contained flat at basement and ground level, as shown on the drawing extracts included below



The proposals also include an additional bedroom at first floor level for the existing above ground flat, along with the refurbishment of the existing commercial space.

This report is specific to the proposed development and the advice herein should be reviewed if the proposals are amended.

1.2 Purpose of Work

The principal technical objectives of the work carried out were as follows:

- to check the history of the site with respect to previous contaminative uses;
- to provide information on the level of Unexploded Ordnance (UXO) risk;
- to determine the ground conditions and their engineering properties;
- to provide advice and information with respect to the design of suitable foundations and retaining walls;
- to assess the impact of the proposed basement on the local hydrogeology, hydrology and stability of the surrounding natural and build environment;
- to provide an indication of the degree of soil contamination present; and
- to assess the risk that any such contamination may pose to the proposed development, its users or the wider environment.

1.3 Scope of Work

In order to meet the above objectives, a desk study was carried out, followed by a ground investigation. The desk study comprised:

- a review of historical Ordnance Survey (OS) maps and environmental searches sourced from the Envirocheck database;
- a review of readily available geology maps;
- a walkover survey of the site carried out in conjunction with the fieldwork;
- commissioning of 1st Line Defence to undertake a preliminary UXO risk assessment;

In light of this desk study an intrusive ground investigation was carried out which comprised, in summary, the following activities:

- three drive-in window sampler boreholes advanced to a depth of up to 5.1 m;
- installation of three groundwater monitoring standpipes, to a maximum depth of 5.0 m;
- seven hand excavated trial pits to a maximum depth of approximately 1.2 m;
- testing of selected soil samples for contamination and geotechnical purposes;
- provision of a report presenting and interpreting the above data, together with our advice and recommendations with respect to the proposed development.

The report includes a contaminated land assessment which has been undertaken in accordance with the methodology presented in Contaminated Land Report (CLR) 11[1] and involves identifying, making decisions on, and taking appropriate action to deal with, land contamination in a way that is consistent with government policies and legislation within the United Kingdom. The risk assessment is thus divided into three stages comprising Preliminary Risk Assessment, Generic Quantitative Risk Assessment, and Site-Specific Risk Assessment.

The exploratory methods adopted in this investigation have been selected on the basis of the constraints of the site including but not limited to access and space limitations, together with any budgetary or timing constraints. Where it has not been possible to reasonably use an EC7 compliant investigation technique a practical alternative has been adopted to obtain indicative soil parameters and any interpretation is based upon engineering experience, local precedent where applicable and relevant published information.

1.3.1 Basement Impact Assessment

The work carried out includes a Hydrological and Hydrogeological Assessment and Land Stability Assessment (also referred to as Slope Stability Assessment), all of which form part of the BIA procedure specified in the London Borough of Camden (LBC) Draft Planning Guidance CPG4[2] and their Guidance for Subterranean Development[3] prepared by Arup ('the Arup Report') in accordance with Policy A5 of the Camden Local Plan 2017. The aim of the work is to provide information on surface water, groundwater and land stability and, in particular, to assess whether the development will affect neighbouring properties or groundwater movements and whether any identified impacts can be appropriately mitigated by the design of the development.

1.3.2 Qualifications

The land stability element of the Basement Impact Assessment (BIA) has been carried out by Martin Cooper, a BEng in Civil Engineering, a chartered engineer (CEng), member of the Institution of Civil Engineers (MICE), and Fellow of the Geological Society (FGS) who has over 20 years' specialist experience in ground engineering. The subterranean (groundwater) flow assessment has been carried out by John Evans, MSc in Hydrogeology, Chartered Geologist (CGeol) and Fellow of the Geological Society of London (FGS). The surface water and flooding assessment has been carried out by Rupert Evans, a hydrologist with more than ten years consultancy experience in flood risk assessment, surface water drainage schemes and hydrology / hydraulic modelling. Rupert Evans is a Chartered Environmentalist, Chartered Water and Environmental Manager and a Member of CIWEM.

The assessments have been made in conjunction with Steve Branch, a BSc in Engineering Geology and Geotechnics, MSc in Geotechnical Engineering, a Chartered Geologist (CGeol) and Fellow of the Geological Society (FGS) with some 30 years' experience in geotechnical engineering and engineering geology.

All assessors meet the qualification requirements of the Council guidance.

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1 *Model Procedures for the Management of Land Contamination* issued jointly by the Environment Agency and the Department for Environment, Food and Rural Affairs (DEFRA) Sept 2004

2 London Borough of Camden Draft Planning Guidance CPG4 (November 2017) *Basements and lightwells*

3 Ove Arup & Partners (2010) *Camden geological, hydrogeological and hydrological study. Guidance for Subterranean Development.* For London Borough of Camden November 2010

1.4 Limitations

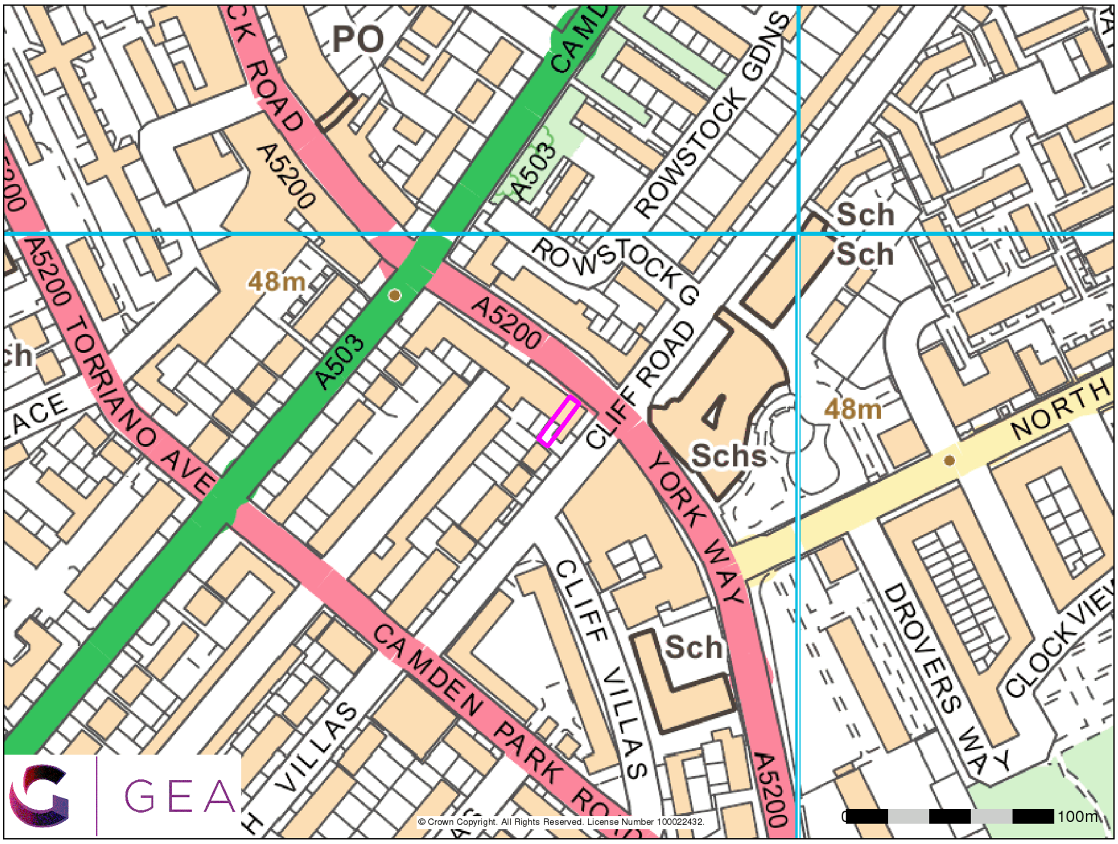
The conclusions and recommendations made in this report are limited to those that can be made on the basis of the investigation. The results of the work should be viewed in the context of the range of data sources consulted, the number of locations where the ground was sampled and the number of soil, gas or groundwater samples tested; no liability can be accepted for information in other data sources or conditions not revealed by the sampling or testing. Any comments made on the basis of information obtained from the client or other third parties are given in good faith on the assumption that the information is accurate; no independent validation of such information has been made by GEA.

2.0 THE SITE

2.1 Site Description

The site is located in the London Borough of Camden, roughly 800 m west of Caledonian Road Underground Station and 950 m to the east-southeast of Kentish Town. It is rectangular in shape, measuring approximately 6 m by 25 m in maximum extent. The site fronts onto York Way to the northeast and is bounded by similar three-storey terraced properties to the northwest and southeast and the side elevation of a three-storey end of terrace property fronting onto Cliff Road to the southwest.

The site may additionally be located by National Grid Reference 529880, 184910 and is shown on the map extract below.



The northern half of the site is entirely occupied by the existing three-storey mid-terrace property, with an existing single storey basement, extending to a depth of between 2.5 m and 3.0 m below ground level, and two-storey rear extension, whilst the southern part of the site comprises an existing garden. The ground and basement levels were previously used for retail space, with a private flat above.

The existing rear garden is predominantly covered with concrete hardstanding, with raised borders of limited width running along the sides and across the rear part of the garden. The boundary with No 159 York Way is formed by a 1.0 m high brick wall, which is in poor condition and is proposed to be repaired / replaced as part of the proposed development. A 2.6 m high brick wall forms the boundary with No 155 York Way, the rear section of which shows signs of damage, due to downward movement at the base of the wall, close to the boundary with No 1 Cliff Road, where the adjoining boundary wall has been underpinned to create a reduced level garden.

The site is essentially level and devoid of any significant vegetation, although the rear garden is presently overgrown with weeds. A number of mature deciduous trees are present within rear gardens of properties to the west and within the front garden of the adjoining property to the south.

2.1.1 Adjoining Structures

The adjoining properties along York Way, to the northwest and southeast of the site, along with No 1 Cliff Road to the southwest are all known to have basements, the details of which are summarised on the plan below.

2.2 Site History

The history of the site and surrounding area has been researched by reference to archive historical maps and Ordnance Survey (OS) maps sourced from the Envirocheck database.

The earliest map studied, dated 1851, shows that the existing road network around the site had been established, although York Way and Cliff Road were then known as Brecknock Road and Clifton Road respectively. The Metropolitan Cattle Market was present approximately 125 m to the southeast of the site.

The next map, dated 1873, shows that the existing row of terraced properties, including the existing building on the site, had been established prior to this time, as had the existing semi-detached property that bounds the site to the southwest. The majority of the surrounding area was predominantly residential, much as it is today, with the cattle market to the southeast and a small reservoir approximately 60 m to the south.

At some time between 1882 and 1895, a small Organ Works was constructed approximately 100 m to the southeast, which was seriously damaged by bombing and subsequently demolished during the 1940s.

The small reservoir to the south of the site was removed and redeveloped with an existing residential development, comprising Camelot House, at some time between 1920 and 1938, whilst the former cattle market was closed and subsequently redeveloped with a mixture of housing and the existing Caledonian Park between 1966 and 1972.

The site and surrounding area have since remained essentially unchanged.

2.3 Other Information

A search of public registers and databases has been made via the Envirocheck database and relevant extracts from the search are appended. Full results of the search can be provided if required.

The search has revealed that there are no landfills, waste management, transfer, treatment or disposal sites within 500 m of the site. There have been no pollution incidents to controlled waters within 250 m of the site.

The search has indicated that the site is located in an area where less than 1% of homes are affected by radon emissions; which is the lowest classification given by the Health Protection Agency (HPA) and therefore no radon protective measures will be necessary.

The site is not located within a nitrate vulnerable zone or any other sensitive land use.

Information obtained on buried services has not identified any potentially sensitive infrastructure, beneath York Way or the adjoining sites that could be adversely affected by the proposed development. There are also no London Underground or Network Rail Tunnels within close proximity of the site. Copies of the service search information are included within the appendix.

2.4 Geology

The British Geological Survey (BGS) map of the area (Sheet 256) indicates the site is directly underlain by the London Clay.

According to the BGS memoir, the London Clay is homogenous, slightly calcareous silty clay to very silty clay, with some beds of clayey silt grading to silty fine-grained sand.

GEA has previously carried out a ground investigation at No 139-143 York Way, located roughly 75 m to the southeast of the site. The investigation encountered a significant thickness of made ground, predominantly comprising demolition rubble, to a depth of 4.2 m, below which stiff brown becoming very stiff grey fissured occasionally silty clay was proved to the full depth of the investigation of 25.0 m.

A search of the BGS records has identified records of a deep borehole that was drilled roughly 350 m to the northwest of the site, which confirms that the London Clay is likely to extend to a depth of at least 50 m, below which mottled clay of the Lambeth Group is likely to be present.

2.5 Hydrology and Hydrogeology

The London Clay is classified by the Environment Agency (EA) as Unproductive Stratum, referring to rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

The London Clay is not capable of supporting a groundwater table, although isolated pockets of perched groundwater do occur within fissures and silt and sand partings. Published data for the permeability of the London Clay indicates the horizontal permeability to generally range between 1×10^{-11} m/s and 1×10^{-9} m/s, with an even lower vertical permeability.

Groundwater was not encountered during the previous GEA investigation at No 139-143 York Way, nor were any shallow water strikes recorded within the aforementioned BGS borehole.

The site is not indicated as being at risk from flooding, nor is it located within a Groundwater Source Protection Zone as defined by the Environment Agency. It is not listed within the London Borough of Camden report[4] as having suffered from surface water flooding in the 1975 or 2002 flooding events and is not shown on Figure 15 of the Arup report[5], or the EA surface water flood maps, as being in an area with a potential risk from surface water flooding.

Figure 11 of the Arup report and reference to the Lost Rivers of London[6] indicates that the site is not located in the vicinity of any of London's lost rivers. The search indicates there are no surface water features within 500 m of the site.

The existing garden is almost entirely covered by concrete hardstanding, with borders of limited width along the sides and rear part of the garden. Infiltration of rain water is therefore generally restricted to surface water drains, such that the majority of surface runoff currently drains into combined sewers in the road.

As the development does not result in a change to the present conditions, for example through the loss of any permeable areas, there will not be an increase in runoff rate or volume into the existing sewer system, or that could have a potentially adverse impact on the surrounding area. There should not, therefore, be any requirement for any mitigation measures.

4 London Borough of Camden (2003) *Floods in Camden, Report of the Floods Scrutiny Panel*
5 Ove Arup & Partners (2010) *Camden geological, hydrogeological and hydrological study. Guidance for Subterranean Development.* For London Borough of Camden November 2010
6 Nicholas Barton and Stephen Myers (2016) *London's Lost Rivers. Revised Edition.* Historical Publications Ltd

Mitigation measures are unlikely to be feasible in any case, due to a lack of available space and little opportunity to reduce runoff rates from the site via attenuation or rainwater harvesting. However, alternative SUDS measures could be considered, such as rain gardens or permeable paving which could temporarily retain surface water flows, if a requirement to reduce the rate and amount of flow into the existing sewer system from present levels is identified.

2.6 Preliminary Risk Assessment

Part IIA of the Environmental Protection Act 1990, which was inserted into that Act by Section 57 of the Environment Act 1995, provides the main regulatory regime for the identification and remediation of contaminated land. The determination of contaminated sites is based on a "suitable for use" approach which involves managing the risks posed by contaminated land by making risk-based decisions. This risk assessment is carried out on the basis of a source-pathway-receptor approach.

2.6.1 Source

The desk study research has indicated that the site has only had a mixed commercial and residential end use for its entire developed history and is therefore not considered to have had a contaminative history. No sources of soil gas have been identified on site or in the surrounding area.

2.6.2 Receptor

The future occupants of the house will represent relatively high sensitivity receptors. Buried services are likely to come into contact with any contaminants present within the soils through which they pass, and site workers are likely to come into contact with any contaminants present during construction works.

Perched water may be present in the made ground or in the vicinity of existing foundations, although such pockets of water are likely to be localised and unlikely to form part of a wider aquifer.

2.6.3 Pathway

Within the site, end users will be isolated from direct contact with any contaminants present within the made ground by the proposed house and surrounding hard surfacing, thus no potential contaminant exposure pathways will exist with respect to end users. Only in areas of proposed soft landscaping will end users potentially come into contact with contaminants.

There will be a potential for contaminants to move onto or off the site horizontally within the made ground, although these pathways are already in existence. A pathway for ground workers to come into contact with any contamination will exist during construction work and services will come into contact with any contamination within the soils in which they are laid.

There is thus considered to be a low potential for a contaminant pathway to be present between any potential contaminant source and a target for the particular contaminant.

2.6.4 Preliminary Risk Appraisal

On the basis of the above it is considered that there is a VERY LOW risk of there being a significant contaminant linkage at this site, which would result in a requirement for major remediation work. Furthermore, as there is no evidence of filled ground within the vicinity of the site and no landfill sites, there is not considered to be a significant potential for hazardous soil gas to be present on or migrating towards the site.

2.7 UXO Risk Assessment

A Preliminary UXO Risk Assessment has been completed by 1st Line Defence (report ref EP6235-00, dated March 2018), and a copy of the report is included in the appendix.

The risk assessment has been carried out in accordance with the guidelines provided by CIRIA, which state that the likelihood of encountering and detonating UXO below a site should be assessed along with establishing the consequences that may arise. The first phase comprises a preliminary risk assessment, which should be undertaken at an early stage of the development planning. If such an assessment identifies a high level of risk then a detailed risk assessment should be carried out by a UXO specialist, which will identify an appropriate course of action with regard to risk mitigation.

During World War II (WWII) the site was located within the Metropolitan Borough of St Pancras which sustained a very high bombing density according to official statistics. Despite this, no bomb strikes are recorded within the site area, with the closest recorded strike located approximately 50 m from the site. The site was initially recorded on the London County Council bomb damage maps as having sustained damage from this event. However, this was later rectified to show no damage, or only minor damage. This is supported by other evidence, such as historical mapping and aerial photography, and it is considered unlikely that an item of UXO could have remained unnoticed or unrecorded at this site.

Following the findings of this preliminary report, the site has been classified as having a minimal to low risk, such that no further action is required.

3.0 SCREENING

The LBC guidance suggests that any development proposal that includes a basement should be screened to determine whether or not a full BIA is required.

3.1 Screening Assessment

A number of screening tools are included in the Arup document and for the purposes of this report reference has been made to Appendices E1, E2 and E3 which include a series of questions within screening flowcharts for surface flow and flooding, subterranean (groundwater) flow and land stability. The flowchart questions and responses to these questions are tabulated below.

3.1.1 Subterranean (groundwater) Screening Assessment

Question	Response for 157 York Way
1a. Is the site located directly above an aquifer?	No. The site is directly underlain by the London Clay, which is classified as an Unproductive stratum.
1b. Will the proposed basement extend beneath the water table surface?	No. The London Clay cannot support a water table and is classified as an unproductive stratum. However, if an upper weathered layer is present, this may have a higher permeability and could have the potential to collect groundwater if the stratum has a predominantly granular matrix, which is unlikely in this setting.
2. Is the site within 100 m of a watercourse, well (used/ disused) or potential spring line?	No. Topographical maps acquired as part of the desk study and Figures 11 and 12 of the Arup report confirm this.
3. Is the site within the catchment of the pond chains on Hampstead Heath?	No. Figure 14 of the Arup report confirms that the site is not located within this catchment area.

Question	Response for 157 York Way
4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	No. The basement extension will extend beneath an existing area of external hardstanding and will not therefore result in a significant change in the proportion of hard surfaced / paved areas.
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. It is not considered feasible that the ground would be sufficiently permeable to allow for a soakaway discharge design, nor do the details of the proposed development indicate the use of soakaway drainage.
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 or spring line?	No. Topographical maps acquired as part of the desk study and Figures 11 and 12 of the Arup report confirm this.

The above assessment has not identified any potential issues that need to be further assessed:

3.1.2 Stability Screening Assessment

Question	Response for 157 York Way
1. Does the existing site include slopes, natural or manmade, greater than 7°?	No, as indicated on the Slope Angle Map Fig 16 of the Arup report.
2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7°?	No. The site is not to be significantly re-profiled as part of the development.
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	No. As indicated on the Slope Angle Map Fig 16 of the Arup report.
4. Is the site within a wider hillside setting in which the general slope is greater than 7°?	No. As indicated on the Slope Angle Map Fig 16 of the Arup report.
5. Is the London Clay the shallowest strata at the site?	*Yes. As indicated on the geological map and Figures 3, 5 and 8 of the Arup report*
6. Will any trees be felled as part of the proposed development and / or are any works proposed within any tree protection zones where trees are to be retained?	No. There are no trees on the site.
7. Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site?	*Yes. The area is prone to these effects as a result of the presence of shrinkable London Clay.*
8. Is the site within 100 m of a watercourse or potential spring line?	No. Not according to Figure 12 of the Arup report, extracts from the Envirocheck report and Ordnance Survey maps.
9. Is the site within an area of previously worked ground?	No. Not according to Figure 3 of the Arup report.
10a. Is the site within an aquifer?	No. The site is located above an unproductive stratum.
10b. Will the proposed basement extend beneath the water table such that dewatering may be required during construction?	No. The London Clay cannot support a water table and is classified as an unproductive stratum.
11. Is the site within 50 m of Hampstead Heath ponds?	No. Figure 14 of the Arup report confirms that the site is not located within this catchment area.
12. Is the site within 5 m of a highway or pedestrian right of way?	Yes, the site fronts onto York Way. However, the proposed basement extension is set back on the rear part of the site at a distance more than 10 m from the front of the site.
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	No. The neighbouring properties include existing basement or lower ground floor levels, such that the development is unlikely to increase the foundation depths relative to the neighbouring properties.
14. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	No. Not according to Figure 18 of the Arup report and information provided by London Underground.

The above assessment has identified the following potential issues that need to be assessed:

Q5 The London Clay is the shallow stratum on the site.
Q7 The site is in an area likely to be affected by seasonal shrink-swell.
Q12 The site is within 5 m of York Way.

3.1.3 Surface Flow and Flooding Screening Assessment

Question	Response for 157 York Way
1. Is the site within the catchment of the pond chains on Hampstead Heath?	No. Figure 14 of Arup report confirms that the site is not located within this catchment area.
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. There will not be an increase in impermeable area across the ground surface above the basement, so the surface water flow regime will be unchanged. The basement will be beneath the footprint of the existing building and areas of hardstanding, therefore the 1m distance between the roof of the basement and ground surface as recommended by the Arup report and para 2.16 of the CPG4 does not apply across these areas.
3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	No. There will not be an increase in impermeable area across the ground surface above the basement.
4. Will the proposed basement development 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 will not be an increase in impermeable area across the ground surface above the basement, so the surface water flow regime will be unchanged. The basement will be beneath the footprint of the existing building and hardstanding, therefore the 1m distance between the roof of the basement and ground surface as recommended by the Arup report and para 2.16 of the CPG4 does not apply across these areas.
5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No. The proposed basement is very unlikely to result in any changes to the quality of surface water being received by adjacent properties or downstream watercourses as the surface water drainage regime will be unchanged and the land uses will remain the same.
6. Is the site in an area identified to have surface water flood risk according to either the Local Flood Risk Management Strategy or the Strategic Flood Risk Assessment or is it at risk of flooding, for example because the proposed basement is below the static water level of nearby surface water feature?	No. The findings of this BIA together with the Camden Flood Risk Management Strategy dated 2013 and Figures 3iv, 4e, 5a and 5b of the SFRA dated 2014, in addition to the Environment Agency online flood maps show that the site has a low flooding risk from surface water, sewers, reservoirs (and other artificial sources), groundwater and fluvial/tidal watercourses. In accordance with paragraph 5.11 of the CPG a positive pumped device will be installed in the basement in order to further protect the site from sewer flooding. *The site is located within the Critical Drainage Area number GROUP3-003, but is not in a Local Flood Risk Zone as identified in the Camden SWMP and Updated SFRA Figure 6/Rev 2.*

The above assessment has identified no potential issues that need to be assessed.

4.0 SCOPING AND SITE INVESTIGATION

The purpose of scoping is to assess in more detail the factors to be investigated in the impact assessment. Potential impacts are assessed for each of the identified potential impact factors.

4.1 Potential Impacts

The following potential impacts have been identified by the screening process

Potential Impact	Consequence
London Clay is the shallowest stratum at the site.	The London Clay is prone to seasonal shrink-swell (subsidence and heave).
Seasonal shrink-swell can result in foundation movements.	Multiple potential impacts depending on the specific setting of the basement development. For example, in terraced properties, the implications of a deepened basement/foundation system on neighbouring properties should be considered.
The site is located within 5 m of a highway or pedestrian right of way	Excavation of a basement may result in structural damage to the road or footway.

These potential impacts have been investigated through the site investigation, as detailed in Section 13.0.

5.0 EXPLORATORY WORK

In order to meet the objectives described in Section 1.2, as far as possible within the access limitations presented by the presence of the existing building, three drive-in window sampler boreholes were drilled within the rear garden, to depths of 5.0 m to 5.1 m.

Groundwater monitoring standpipes were installed into all of the boreholes to a depth of 5.0 m and have been subsequently monitored on single occasion to date.

Seven trial pits were hand excavated to a maximum depth of approximately 1.2 m in order to determine the configuration of the existing foundations and boundary wall conditions.

A selection of the disturbed samples recovered from the boreholes was submitted to a soil mechanics laboratory for a programme of geotechnical testing and an analytical laboratory for a programme of contamination testing.

All of the work was carried out under the supervision of a geotechnical engineer from GEA.

The borehole and trial pit records are appended, together with the results of the laboratory testing and a site plan indicating the borehole locations.

5.1 Sampling Strategy

The boreholes and trial pits were positioned on site by an engineer from GEA in accessible areas, with due regard to the proposed development and the locations of known buried services.

Three samples of the shallow soil and were subjected to analysis for a range of common industrial contaminants and contamination indicative parameters. For this investigation the analytical suite for the soil and water included a range of metals, total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), total cyanide and monohydric phenols.

The soil samples were selected to provide a general view of the chemical conditions of the soils that are likely to be involved in a human exposure or groundwater pathway and to provide advice in respect of re-use or for waste disposal classification. The contamination analyses were carried out at a MCERTs accredited laboratory with the majority of the testing suite accredited to MCERTS standards.

A number of the disturbed samples of natural soil were submitted to a geotechnical testing laboratory and were subject to a number of material property tests, including four-point Atterberg Limit, moisture content tests and particle size distribution tests (PSD).

6.0 GROUND CONDITIONS

The investigation has confirmed the expected ground conditions in that, below a variable but generally moderate thickness of made ground, London Clay was encountered and proved to the full depth of the investigation.

6.1 Made Ground

The made ground in the rear garden was found to extend to depths of between 0.55 m and 1.05 m, where it generally comprised dark brown silty clay with gravel, brick, rootlets, rare ash and occasional concrete fragments.

At a lower level, within the internal trial pits excavated from the existing basement, the made ground was generally found to extend to depths of between 0.39 m and 0.51 m and comprised brown silty clay with gravel and brick. Made ground was absent in Trial Pit No 6.

No evidence of significant contamination was identified during the fieldwork. As a precaution, three samples of the made ground were tested for the presence of contamination and the results are presented in Section 6.4.

6.2 London Clay

The London Clay initially comprised a weathered horizon of firm becoming stiff orange-brown becoming brownish grey silty clay with occasional blue mottling which was proved in Borehole Nos 1, 2 and 3 to a depth of 3.0 m below existing garden level and to the base of Trial Pit Nos 4 to 7 to depths of between 0.54 and 0.66 m below existing basement level.

Beneath this initial layer, the three window sample boreholes encountered stiff brownish grey silty clay with occasional blue mottling, which was proved to the full depth of the investigation of 5.10 m below existing garden level.

Laboratory plasticity index tests indicate the initial clay layer to be of high volume change potential.

This stratum was observed to be free of evidence of contamination.

6.3 Groundwater

Groundwater seepages were encountered from the base of the made ground in Borehole Nos 1 and 2, at depths of 0.7 m and 0.6 m below existing garden level respectively, and from the base of the foundations in Trial Pit No 1 at a depth of 0.7 m below existing garden level.

Groundwater seepages were also observed from the base of the foundations in Trial Pit Nos 4 and 5 at depths of 0.42 m and 0.39 m below existing basement level respectively.

The standpipes installed in Borehole Nos 1, 2 and 3 have been monitored on a single occasion since installation, the results of which are shown in the table below.

Date	Borehole No	Depth to water (m) below existing garden level
25/04/2018	1	0.80
	2	0.68
	3	1.16

6.4 Soil Contamination

The table below sets out the values measured within three samples of made ground; all concentrations are in mg/kg unless otherwise stated.

Determinant	BH1 – 0.5 m	BH2 – 0.5 m	BH3 – 0.3 m
Asbestos	Not detected	Not detected	Not detected
pH	8.6	8.8	8.0
Arsenic	33	23	38
Cadmium	<0.2	<0.2	2.0
Chromium	28	31	53
Copper	140	69	190
Mercury	3.1	2.0	2.7
Nickel	24	21	35
Lead	**540**	**500**	**1900**
Selenium	<1.0	<1.0	1.2
Zinc	130	180	1100
Total Cyanide	<1.0	<1.0	2.0
Total Phenols	<1.0	<1.0	<1.0
Sulphide	1.0	<1.0	<1.0
Total TPH	<10	<10	280
Naphthalene	<0.05	<0.05	<0.05
Benzo(a)pyrene	<0.05	<0.05	1.5
Total PAH	<0.05	<0.05	17.6

Determinant	BH1 – 0.5 m	BH2 – 0.5 m	BH3 – 0.3 m
Total organic carbon %	2.3	1.7	3.6

6.4.1 Generic Quantitative Risk Assessment

The use of a risk-based approach has been adopted to provide an initial screening of the test results to assess the need for subsequent site-specific risk assessments. Contaminants of concern are those that have a value in excess of a generic human health risk-based guideline values, which is either the CLEA Soil Guideline Value where available, a Generic Screening Value calculated using the CLEA UK Version 1.06 software assuming a residential end use or is based on the DEFRA Category 4 Screening values. The key generic assumptions for this end use are as follows:

- that groundwater will not be a critical risk receptor;
- that the critical receptor for human health will be a young female child aged 0 to 6 years old;
- that young children will not have prolonged exposure to the site;
- that the exposure duration will be six years;
- that the critical exposure pathways will be direct soil and indoor dust ingestion, skin contact with soils and dust, and inhalation of dust and vapours; and
- that the building type equates to a two-storey small terraced house.

It is considered that these assumptions are suitable for this generic first assessment of this site. The tables of generic screening values derived by GEA and an explanation of how each value has been derived are included in the Appendix.

Where contaminant concentrations are measured below the generic screening value it is considered that they pose an acceptable level of risk and thus further consideration of these contaminant concentrations is not required. However, where concentrations are measured in excess of these generic screening values there is considered to be a potential that they could pose an unacceptable risk and thus further action will be required which could include;

- additional testing to zone the extent of the contaminated material and thus reduce the uncertainty with regard to its potential risk;
- site specific risk assessment to refine the assessment criteria and allow an assessment to be made as to whether the concentration present would pose an unacceptable risk at this site; or
- soil remediation or risk management to mitigate the risk posed by the contaminant to a degree that it poses an acceptable risk.

The results of the contamination testing have revealed elevated concentrations of lead within the samples of made ground tested from Borehole Nos 1, 2 and 3. All other contaminants were found to be below their respective generic guideline value and of generally low concentrations.

This assessment is based upon the potential for risk to human health, which at this site is considered to be the critical risk receptor.

The results are discussed in detail in Section 2 of this report.

6.5 Existing Foundations

Seven trial pits were excavated to investigate the existing foundations and boundary wall conditions.

The trial pit findings are summarised in the table below and the trial pit records and associated site plan can be found in the appendix.

Trial Pit No	Structure	Foundation detail	Bearing Stratum
1 - AA	Garden wall with No 159 York Way	Brick footing Top 0.41 m bgl Base 0.70 m bgl Lateral projection 100 mm	Made Ground
2 - AA	Garden wall with No 155 York Way	Brick footing Top N/A Base 0.15 m bgl Lateral projection N/A	Made ground
2 - BB	Boundary Wall with No 1 Cliff Road	Foundation detail not proved – Garden wall underpinned to facilitate lowering of adjoining garden	Not proved
3 - AA	Garden wall with No 155 York Way	Mass concrete strip Top 0.61 m bgl Base 1.01 m bgl Lateral projection 200 mm	Firm pale orange-brown silty CLAY
4 – AA	Party wall with No 155 York Way / rear elevation	Brick footing Top 0.10 m bgl Base 0.42 m bgl Lateral projection 150 mm	Firm to stiff brownish grey silty CLAY
5 -AA	Party wall with No 155 York Way	Brick footing Top 0.15 m bgl Base 0.39 m bgl Lateral projection 150 mm	Firm to stiff brownish grey silty CLAY
6 -AA	Rear elevation	Brick footing Top 0.21 m bgl Base 0.39 m bgl Lateral projection 150 mm	Firm to stiff brownish grey silty CLAY
6 -BB	Party wall with No 159 York Way	Brick footing Top 0.25 m bgl Base 0.41 m bgl Lateral projection 100 mm	Firm to stiff brownish grey silty CLAY
7 -AA	Internal wall	Brick footing Top 0.21 m bgl Base 0.35 m bgl Lateral projection 220 mm	Firm to stiff brownish grey silty CLAY
7 -BB	Party wall with No 159 York Way	Brick footing Top 0.27 m bgl Base 0.51 m bgl Lateral projection 150 mm	Firm to stiff brownish grey silty CLAY

Part 2: DESIGN BASIS REPORT

This section of the report provides an interpretation of the findings detailed in Part 1, in the form of a ground model, and then provides advice and recommendations with respect to foundation options and contamination issues.

7.0 INTRODUCTION

It is understood that it is proposed to extend the existing 2.5 m to 3.0 m deep basement beneath part of the rear garden as part of the reconstruction of the existing rear extension and to form a separate sunken garden area for the lower level flat.

The proposals also include reconstruction of the existing rear extension to create additional space for the proposed flat at basement and ground level, as well as forming an additional bedroom at first floor level for the existing above ground flat. The works will also include refurbishment of the existing retail unit at the front of the site.

Anticipated loads are not known at this stage. However, given the nature of the proposals and the fact that the majority of the excavations are to form the proposed sunken garden area, they are expected to be light.

8.0 GROUND MODEL

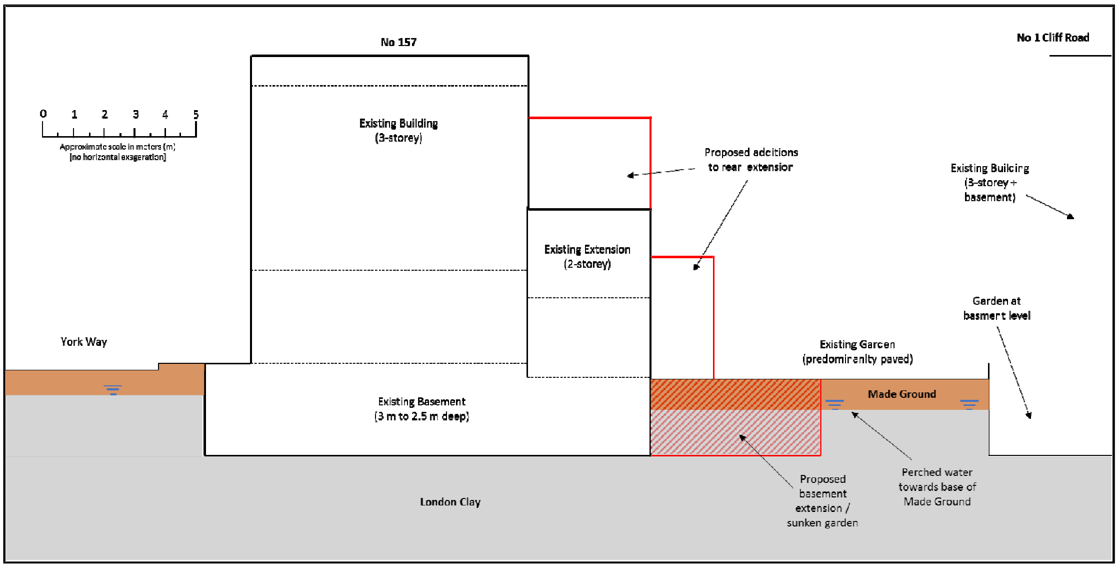
The desk study research indicates that the site has not had a potentially contaminative history, having had a mixed residential and retail use for its entire developed history. On the basis of the fieldwork, the ground conditions at this site can be characterised as follows:

- below a generally moderate thickness of made ground, the London Clay is present and was proved to the maximum depth investigated of 5.1 m below existing garden level;
- made ground, comprising dark brown silty clay with gravel, brick, rootlets, rare ash and occasional concrete fragments, was found to extend to depths of between 0.55 and 1.05 m below existing garden level and 0.39 m to 0.51 m below existing basement level, where it comprised brown silty clay with brick;
- the underlying London Clay comprises an initial weathered horizon of firm becoming stiff orange-brown becoming brownish grey silty clay with occasional blue mottling which was proved to a depth of 3.0 m below existing garden level and to depths of between 0.54 and 0.66 m below existing basement level;
- beneath the upper layer, the London Clay comprised stiff brownish grey silty clay with occasional blue mottling, which was proved to the full depth of the investigation of 5.10 m below existing garden level;
- groundwater seepages were encountered at the interface between the made ground and underlying low permeability soils of the London Clay and subsequent monitoring after a period of approximately two weeks has recorded perched water at depths of between 0.68 m and 1.16 m within the three standpipes installed in the rear garden; and

- the contamination testing has measured elevated concentrations of lead within the samples of the made ground tested from the existing rear garden; and

8.1 Conceptual Site Model

A section through the proposed scheme with the above ground model is shown below.



8.2 Recommended Parameters

The table below summarises the vertical soil parameters to be used in any subsequent analysis and is based on the findings of the investigation. Values of stiffness for the soils at this site are readily available from published data[7, 8, 9 & 10] and a well-established method has been used to provide the estimated values. All depths are given relative to existing garden level.

Stratum	Base of Stratum (m bg.l)	Bulk Unit Weight (kN/m³)	Effective Friction Angle (φ' °)	Undrained Cohesion (C_u - kN/m²)	Drained Young's Modulus* (E' - kN/m²)	UndrainedYoung's Modulus* (E_u - kN/m²)
Made Ground	1.0 (varies)	17	27	25	7500	12500
London Clay	5.0⁺	19.5	23	50 to 80	15000 to 24000	25000 to 40000
London Clay	>5.0	19.5	23	80 + 7.5	24000 + 2250	40000 + 3750

⁺Maximum depth of investigation. *Values based on the conservative relationship of E_u = 500 C_u and E' = 300 C_u from Padfield and Sharrock [8]. **An increase in cohesion of 7.5 kN/m² per metre increase in depth has been adopted to provide a conservative estimate of the likely strength profile below the depth of the investigation.

7 Padfield CJ and Sharrock MJ (1983) *Settlement of structures on clay soils*. CIRIA Special Publication 27
8 Butler FG (1974) *Heavily overconsolidated clays: a state of the art review*. Proc Conf Settlement of Structures, Cambridge, 531-578, Pentech Press, Lond
9 O'Brien AS and Sharp P (2001) *Settlement and heave of overconsolidated clays - a simplified non-linear method*. Part Two, Ground Engineering, Nov 2001, 48-53
10 Burland JB, Standing, JR, and Jardine, FM (2001) *Building response to tunnelling, case studies from construction of the Jubilee Line Extension*. CIRIA Special Publication 200

9.0 ADVICE AND RECOMMENDATIONS

Excavations for the proposed basement structure will require temporary support to maintain stability and to prevent any excessive ground movements. It should be feasible to construct the basement without the requirement for groundwater protection measures, although provision will need to be made to control perched water inflows from the base of the made ground.

Formation level for the proposed development is likely to be within the London Clay, which should provide an eminently suitable bearing stratum for spread foundations excavated from basement level.

9.1 Basement Excavation

9.1.1 Basement Construction

It is understood that the proposed basement will extend to a depth of approximately 2.5 m below existing garden level, such that formation level is likely to be within the firm to stiff London Clay, encountered at, or immediately below existing basement level.

The investigation has indicated that groundwater is unlikely to be encountered within the London Clay. Shallow inflows of perched water should be anticipated from within the made ground, particularly in the vicinity of existing structures. However, any such inflows are likely to be relatively minor in nature and should be adequately dealt with through sump pumping, although it would be prudent for the chosen contractor to have a contingency plan in place to deal with more significant or prolonged inflows as a precautionary measure.

There are a number of methods by which the sides of the basement excavation could be supported in the temporary and permanent conditions. The choice of wall will be governed, to a large extent, by whether it is to be incorporated into the permanent works and have a load bearing function and also by the limited available access. The final choice will depend on a number of factors, including the need to protect nearby structures from movements, the required overall stiffness of the support system and the potential need to control groundwater movement through the wall in the temporary condition. In this respect the stability of the adjacent buildings will be paramount.

It is understood that the preferred method of retaining wall construction is through a mixture of open cut excavations, which will take advantage of the presences of adjoining basement structures, and / or by casting reinforced concrete retaining walls in the same sequence as underpinned walls, which will have the benefit of minimising the plant required and maximising usable space in the new basement construction.

Whilst the proposed construction will not result in foundation depths being increased relative to the neighbouring properties, careful workmanship will still be required to ensure that movement of the surrounding structures does not arise. The contractor should also be required to provide details of how they intend to control groundwater and instability of excavations, should it arise.

The ground movements associated with the basement excavation will depend on the method of excavation and support and the overall stiffness of the basement structure in the temporary condition. Thus, a suitable amount of propping will be required to provide the necessary rigidity. In this respect the timing of the provision of support to the wall will have an important effect on movements. The stability of the adjacent foundations will need to be ensured at all times and the existing foundations will need to be underpinned prior to construction of the proposed new basements or will need to be supported by new retaining walls. A Ground Movement Analysis has been carried out in accordance with the requirements of CPG4 and is presented in Part 3 below.

9.1.2 Retaining Walls

The following parameters are suggested for the design of the permanent basement retaining walls.

Stratum	Bulk Density (kg/m³)	Effective Cohesion (c' – kN/m²)	Effective Friction Angle (Φ' – degrees)
Made Ground	1700	Zero	27
London Clay	1950	Zero	23

Significant inflows of groundwater are unlikely to be encountered within the basement excavation, although monitoring of the standpipes should be continued to confirm this.

Consideration should, however, be given to the risk of surface water building up behind the retaining walls and unless adequate drainage can be incorporated to prevent such build-up, it is recommended that the basement is designed with a water level assumed to be 1.0 m below ground level.

Reference should be made to BS8102:2009[11] regarding requirements for waterproofing.

9.1.3 Basement Heave

The 2.5 m to 3.0 m deep excavations to form the proposed basement extension and sunken garden to the rear of the property will result in a net unloading of up to approximately 55 kN/m².

This unloading will result in elastic heave and long term swelling of the underlying clay soils, although these movements will to a certain extent be counteracted by the applied loads from the proposed development.

Further consideration is given to heave movements in Part 3.0 of this report.

9.2 Spread Foundations

Spread foundations, including underpinned foundations, bearing beneath basement formation level in the firm to stiff silty clay of the London Clay may be designed to apply a net allowable bearing pressure of 125 kN/m². This value incorporates an adequate factor of safety against bearing capacity failure and should ensure that settlement remains within normal tolerable limits.

The depth of the basement excavation is expected to be such that foundations will be placed below the depth of actual or potential desiccation, but this should be checked once the proposals have been finalised, with the survey drawing showing former and existing trees. Notwithstanding NHBC guidelines, all foundations should extend beyond the zone of desiccation. In this respect, it would be prudent to have all foundation excavations inspected by a suitably experienced engineer. Due allowance should be made for future growth of existing / proposed trees. The requirement for compressible material alongside foundations should be determined by reference to the NHBC guidelines.

11 BS8102 (2009) *Code of practice for protection of below ground structures against water from the ground*

9.3 Basement Floor Slabs

Following the excavation of the single level basements, it is likely that the floor slab for the proposed basement will need to be suspended over a void or layer of compressible material to accommodate the anticipated heave unless the slab can be suitably reinforced to cope with these movements. This should be reviewed once the levels and loads are known.

9.4 Shallow Excavations

On the basis of the borehole findings it is considered that shallow excavations for foundations and services that extend through the made ground should remain generally stable in the short term, although some instability may occur. Where personnel are required to enter excavations, a risk assessment should be carried out and temporary lateral support or battering of the excavation sides considered in order to comply with normal safety requirements.

Significant inflows of groundwater into shallow excavations are not generally anticipated, although seepages may be encountered from localised perched water tables within the made ground or underlying London Clay, particularly in the vicinity of existing foundations, although such inflows should be suitably controlled by sump pumping.

9.5 Effect of Sulphates

Chemical analyses carried out on selected samples for water soluble sulphate have been compared with of Table C2 of BRE Special Digest 1: SD1 Third Edition (2005) in order to determine the sulphate class and are summarised in the table below. The assessment has been based on static groundwater conditions and the guidelines contained in the above digest should be followed in the design of foundation concrete.

Stratum	No of samples	pH	SO_4 (mg/l)	Design Sulphate Class	ACEC Class
Made Ground	3	8.8 to 8.8	45 to 80	DS-1	AC-1s
London Clay	2	7.6 to 7.8	130 to 340	DS-1	AC-1s

9.6 Site Specific Risk Assessment

The desk study has indicated that the site has not had a contaminative history, having had a mixed residential and commercial use throughout its developed history, in an area dominated by residential streets. However, the results of the contamination testing have identified elevated concentrations of lead within the three samples of the made ground tested from the existing rear garden.

The exact source of the contamination is unknown. However, the made ground was noted as containing variable amounts of extraneous material, including ash, and it is therefore likely that a fragment of such material was present within the samples tested, accounting for the elevated concentration. Information on Urban Soil Chemistry provided by the BGS also indicates that background concentrations for lead in the vicinity of the site are between 600 g/kg and 900 mg/kg, such that a significant proportion of the measured concentrations could be the result of residual airborne sources.

Lead compounds are relatively immobile and unlikely to be in a soluble form and are considered to be non-volatile or of a low volatility. The contamination does not therefore present a significant vapour risk or a significant risk of leaching and migration within any perched groundwater within the made ground. As the site is underlain by the London Clay, classified as Unproductive Strata, a risk to groundwater has not been identified.

9.6.1 End Users

End users will be effectively isolated from any potential contamination within the extent of the existing and proposed structures, such that, only in proposed garden areas could end users conceivably come into direct contact with the contaminated soils, although this pathway is already in existence.

At this stage it is recommended that a cover thickness of imported subsoil and topsoil of 600 mm in thickness should be specified for any areas of new landscaping in accordance with recommendations from BRE[12]. It is likely to be possible to reduce the final thickness of cover required, but this will need to be determined once final levels have been established and the concentrations of potential contaminants within the imported material and in the soils at formation level are known.

9.6.2 Protection of Site Workers

Site workers should be made aware of the potential contamination and a programme of working should be identified to protect workers handling any soil. The method of site working should be in accordance with guidelines set out by HSE[13] and CIRIA[14] and the requirements of the Local Authority Environmental Health Officer.

A watching brief should be maintained during the site works and if any suspicious soil is encountered, it should be inspected by a suitably qualified engineer and further testing carried out if required.

9.6.3 Protection of Buried Services

It is unlikely that services are at risk from the contamination noted in the made ground. However, details of any proposed protection measures for buried plastic services will in any case need to be approved by the EHO and the relevant service authority prior to the adoption of any scheme.

9.7 Waste Disposal

Under the European Waste Directive, waste is classified as being either Hazardous or Non-Hazardous and landfills receiving waste are classified as accepting hazardous or non-hazardous wastes or the non-hazardous sub-category of inert waste in accordance with the Waste Directive. Waste classification is a staged process and this investigation represents the preliminary sampling exercise of that process. Once the extent and location of the waste that is to be removed has been defined, further sampling and testing may be necessary. The results from this ground investigation should be used to help define the sampling plan for such further testing, which could include WAC leaching tests where the totals analysis indicates the soil to be a hazardous waste or inert waste from a contaminated site. It should however be noted that the Environment Agency guidance WM3[15] states that landfill WAC analysis, specifically leaching test results, must not be used for waste classification purposes.

12 BRE (2004) *Cover systems for land regeneration. Thickness of cover systems for contaminated land.* BRE pub 465
13 HSE (1992) HS(G)66 *Protection of workers and the general public during the development of contaminated land* HMSO
14 CIRIA (1996) *A guide for safe working on contaminated sites* Report 132, Construction Industry Research and Information Association
15 Environment Agency 2015. *Guidance on the classification and assessment of waste.* Technical Guidance WM3 First Edition

Any spoil arising from excavations or landscaping works, which is not to be re-used in accordance with the CL:AIRE[16] guidance, will need to be disposed of to a licensed tip. Waste going to landfill is subject to landfill tax at either the standard rate of £88.95 per tonne (about £160 per m^3) or at the lower rate of £2.80 per tonne (roughly £5 per m^3). However, the classifications for tax purposes and disposal purposes differ and currently all made ground and topsoil is taxable at the 'standard' rate and only naturally occurring soil and stones, which are accurately described as such in terms of the 2011 Order, would qualify for the 'lower rate' of landfill tax.

Based upon on the technical guidance provided by the Environment Agency it is considered likely that the soils encountered during this ground investigation, as represented by the three chemical analyses carried out, would be generally classified as follows;

Soil Type	Waste Classification (Waste Code)	WAC Testing Required Prior to Landfill Disposal?	Comments
Made Ground	Non - hazardous (17 05 04)	No	-
Natural Soils	Inert (17 05 04)	Possibly	Requires confirmation from receiving landfill

Under the requirements of the European Waste Directive all waste needs to be pre-treated prior to disposal. The pre-treatment process must be physical, thermal, chemical or biological, including sorting. It must change the characteristics of the waste in order to reduce its volume, hazardous nature, facilitate handling or enhance recovery. The waste producer can carry out the treatment but they will need to provide documentation to prove that this has been carried out. Alternatively, the treatment can be carried out by an approved contractor. The Environment Agency has issued a position paper[17] which states that in certain circumstances, segregation at source may be considered as pre-treatment and thus excavated material may not have to be treated prior to landfilling if the soils can be segregated onsite prior to excavation by sufficiently characterising the soils insitu prior to excavation.

The above opinion with regard to the classification of the excavated soils is provided for guidance only and should be confirmed by the receiving landfill once the soils to be discarded have been identified.

The local waste regulation department of the Environment Agency (EA) should be contacted to obtain details of tips that are licensed to accept the soil represented by the test results. The tips will be able to provide costs for disposing of this material but may require further testing.

16 CL:AIRE March 2011. *The Definition of Waste: Development Industry Code of Practice* Version 2

17 Environment Agency 23 Oct 2007 *Regulatory Position Statement Treating non-hazardous waste for landfill - Enforcing the new requirement*