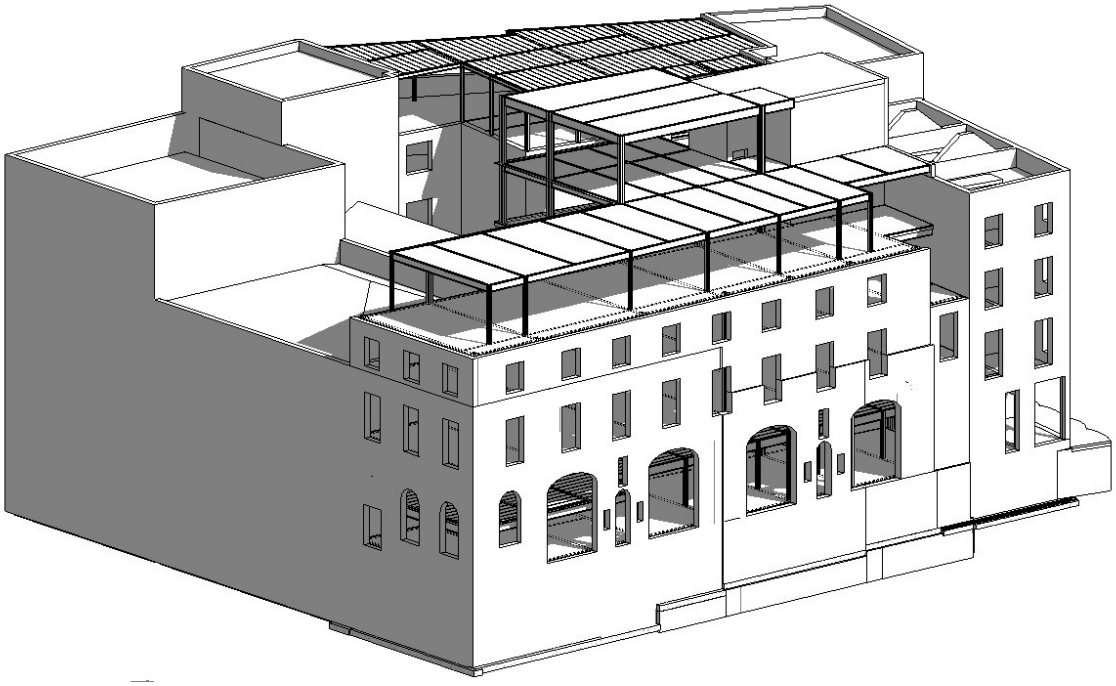
GROUND INVESTIGATION AND BASEMENT IMPACT ASSESSMENT REPORT

New Oxford Street Site
London
WC1A 1JJ



Client: Sollidon Limited

Engineer: Mason Navarro Pledge

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	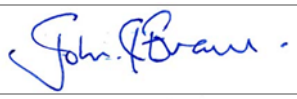		
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Part 3: GROUND MOVEMENT ANALYSIS

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 Sollidon Limited with respect to the refurbishment and redevelopment of the existing buildings to provide a new mixed use office / retail and residential development. The purpose of the investigation has been to research the history of the site with respect to previous contaminative uses, to determine the ground conditions, to provide a preliminary assessment of the extent of any contamination and to provide information to assist with the design of new foundations. This report has been revised to include a Basement Impact Assessment in order to comply with London Borough of Camden (LBC) Planning Guidance CPG4.

DESK STUDY FINDINGS

At the time of John Roque's 1746 map of London, the site and the majority of the immediate surrounding area was developed with well-established streets, albeit in a different configuration to the present day. At that time, Museum Street was known as Peters Street, whilst West Central Street formed part of both Brewer Street and Duke Street. Some time between Greenwood's 1827 map and John Snow's 1859 map, the majority of the road network had been reconfigured to form essentially the existing layout. Peters Street had also been renamed Museum Street during that period. The earliest Ordnance Survey (OS) map studied, dated 1878, shows the site to be developed with a number of terraced buildings fronting onto New Oxford Street to the north, Museum Street to the east and Brewer Street to the south and all positioned around a central courtyard. The surrounding area was extensively developed with mainly terraced buildings, although the Horseshoe Brewery was present approximately 200 m to the west of the site and a foundry approximately 180 m to the east. With the exception of minor layout changes the site remained essentially unchanged throughout the 20th Century, with the buildings being occupied by a variety of shops, a small garage, a plumber, offices and residential dwellings amongst others. The existing nightclub infill building appears to have been constructed some time after 2006.

GROUND CONDITIONS

The investigation has encountered a generally significant thickness of made ground over Lynch Hill Gravel, which is underlain by the London Clay Formation. Made ground was encountered below all of the buildings with the exception of Nos 16 and 18 West Central Street and extended to depths of between 0.35 m (22.39 m OD) and 1.45 m (21.29 m OD). Below the made ground, or directly below the basement floor slab, the Lynch Hill Gravel was found to generally comprise dense brown, yellowish brown and dark orange-brown locally silty, medium to coarse sand and fine to coarse angular to subrounded gravel and extended to the maximum depths investigated in the window sampler boreholes of between 1.80 m (19.42 m OD) and 2.10 m (19.12 m OD) and to a depth 3.50 m (18.75 m OD) in Borehole No 1, 6.50 m below ground level. The London Clay initially comprised stiff fissured brown silty clay to a depth of 6.75 m below ground level (18.50 m OD), whereupon stiff becoming very stiff fissured high strength becoming very high strength dark grey silty clay with partings of pale grey silt and fine sand, fine selenite crystals, occasional fine white shells and pyrite nodules was proved to the maximum depth investigated of 25.00 m below ground level (0.25 m OD). Groundwater has been measured at depths of between 2.89 m (19.36 m OD) and 2.87 m (19.37 m OD) below basement level and the contamination testing has not indicated any elevated concentrations of the contaminants tested.

RECOMMENDATIONS

New spread foundations excavated from basement level and bearing in the Lynch Hill Gravel may be designed to apply a net allowable bearing pressure of 250 kN/m^2. If the initial sandy gravelly clay of the Lynch Hill Gravel is exposed at formation level it is recommended that the bearing pressure is limited to 120 kN/m^2. Alternatively consideration could be given to the use of a raft foundation, although further analysis should be carried out into likely settlement movements once proposed loads have been finalised. Consideration should also be given to the suitability of the existing basement retaining walls for re-use as part of the proposed structure. As the basement structure will not intercept the groundwater table, it is unlikely to have an effect on the local hydrogeology. There is considered to be a low risk to end users from contamination and therefore a requirement for remedial measures is not envisaged.

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.

1.0 INTRODUCTION

Geotechnical and Environmental Associates (GEA) has been commissioned by Sollidon Limited, to carry out a desk study and ground investigation at the New Oxford Street Site, London WC1A 1JJ. Mason Navarro Pledge are the structural engineers.

This report has been revised to form part of a Basement Impact Assessment (BIA), including a ground movement analysis and damage assessment, which has been carried out in accordance with guidelines from the London Borough of Camden in support of a planning application.

1.1 Proposed Development

It is proposed to retain Nos 35 to 41 New Oxford Street and construct a new single storey light-weight steel framed roof extension across all of the properties. Some internal layout changes will also be made with the existing basement floor slab lowered slightly. Nos 10–12 Museum Street will also be retained but with internal layout changes and the basement floor slab lowered slightly.

The existing properties along West Central Street will be demolished down to basement level and a new four-storey building constructed. The current basement will be lowered by 1.00 m and the new buildings founded on a 600 mm thick raft foundation. Once completed, the buildings will form a mixed-use commercial and residential development.

This report is specific to the proposed development and the advice herein should be reviewed if the development 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 determine the ground conditions and their engineering properties;
- to investigate the configuration of existing foundations;
- to assess the possible impact of the proposed development on the local hydrogeology and hydrology and on surrounding structures;
- to provide advice with respect to the design of suitable foundations;
- 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 readily available geological maps;
- a review of historical Ordnance Survey (OS) maps and environmental searches sourced from the Envirocheck database;
- a review of Post Office directories and online planning records; and
- a walkover survey of the site carried out in conjunction with the fieldwork.

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

- a single borehole advanced to a depth of 25.00 m below ground level using a dismantlable cable percussion rig;
- standard penetration tests (SPTs), carried out at regular intervals in the borehole, to provide additional quantitative data on the strength of the soils;
- the installation of a groundwater monitoring standpipe to a depth of 7.00 m and two subsequent monitoring visits;
- an additional three boreholes advanced to depths of between 1.80 m and 2.10 m using window sampling equipment;
- a single dynamic probe advanced to a depth of 6.00 m to provide additional quantitative data on the density of the granular deposits and to confirm the depth to the London Clay;
- a series of 25 manually excavated trial pits to determine the configuration and bearing stratum of existing foundations;
- laboratory testing of selected soil samples for geotechnical purposes and the for presence of contamination; and
- 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.

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

1.3.1 Basement Impact Assessment

The work carried out also 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) Planning Guidance CPG4[2] and their Guidance for Subterranean Development[3] prepared by Arup ('the Arup Report'). 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 over 25 years' experience in geotechnical engineering and engineering geology.

All assessors meet the qualification requirements of the Council guidance.

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.

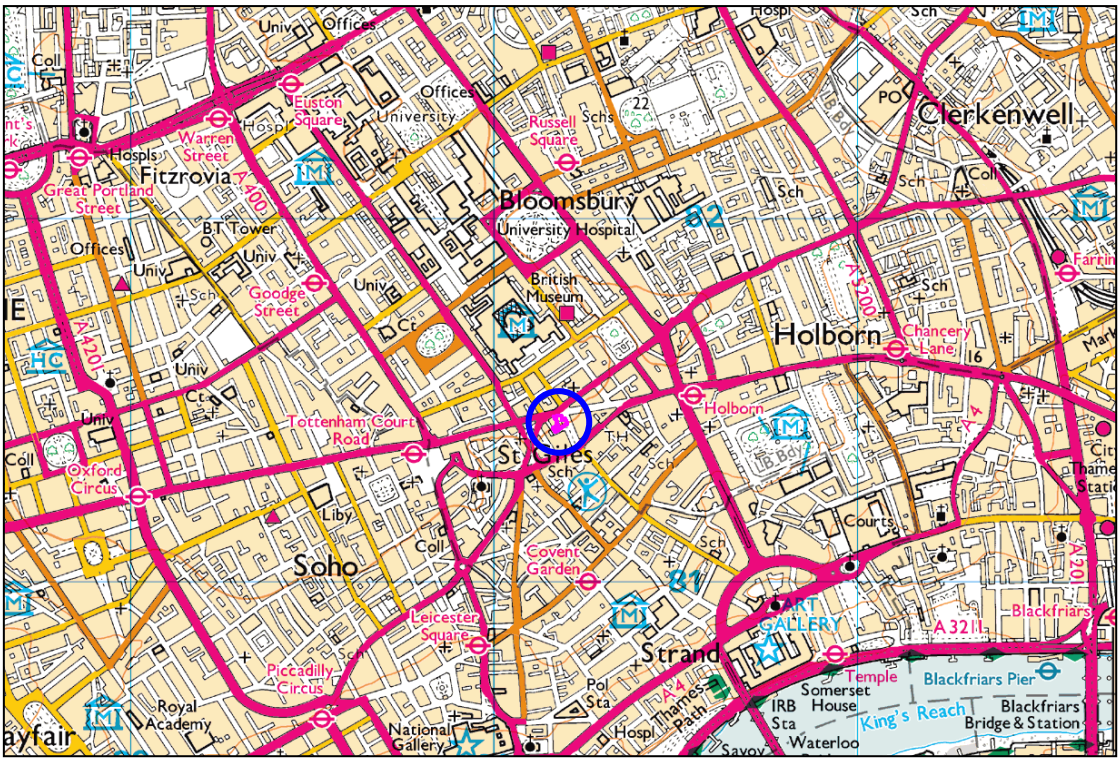
2.0 THE SITE

2.1 Site Description

The site is located in the City of Westminster, approximately 320 m east / northeast of Holborn London Underground Station and approximately 385 m west / southwest of Tottenham Court Road London Underground Station. The site forms part of a square of adjoining properties that are bordered to the north by New Oxford Street, to the south and west by West Central Street and to the east by Museum Street. The northern and northwestern

2 London Borough of Camden Planning Guidance CPG4 *Basements and lightwells* July 2015
3 Ove Arup & Partners (2010) *Camden geological, hydrogeological and hydrological study. Guidance for Subterranean Development.* For London Borough of Camden November 2010

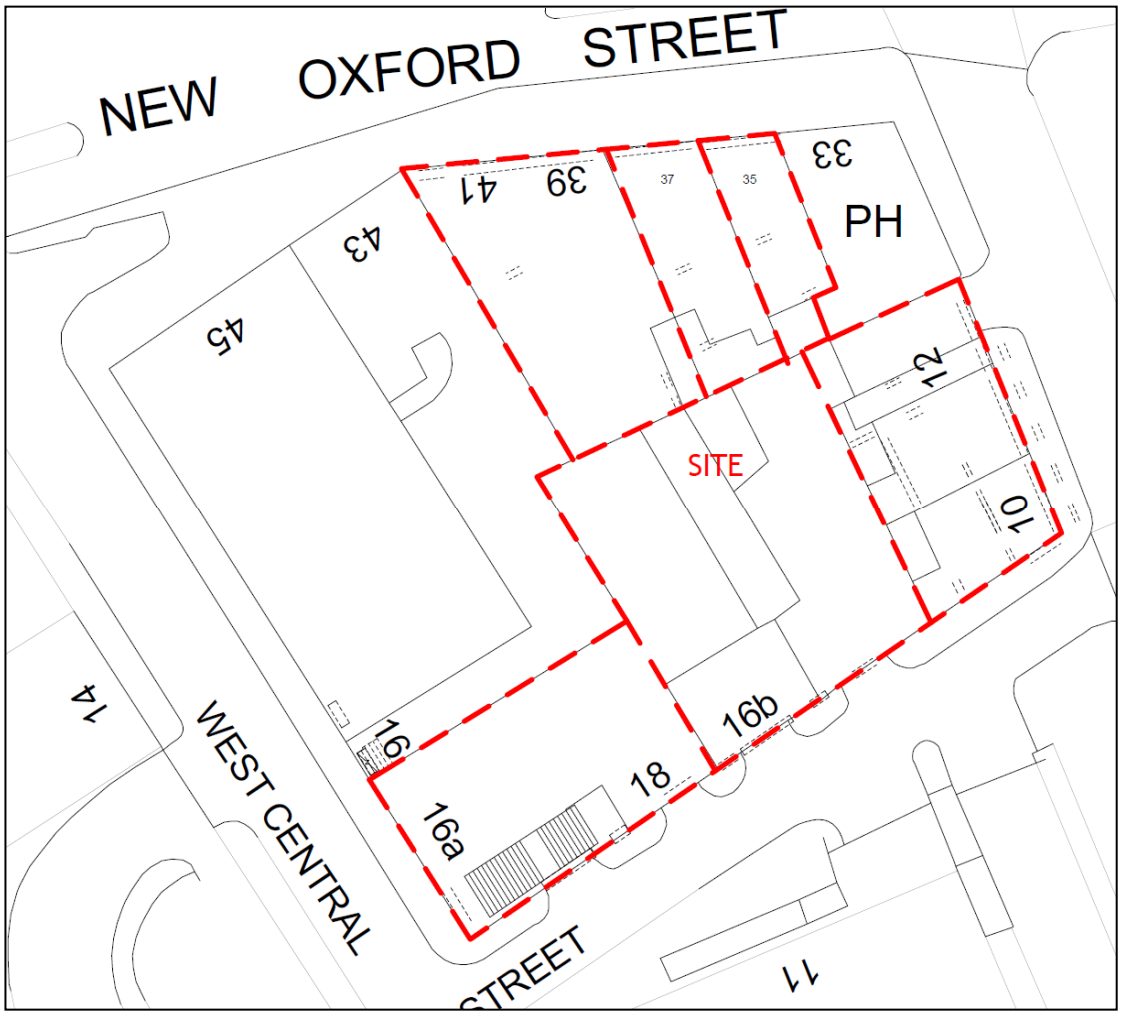
corners of the group of properties do not form part of the site and are occupied by a public house and a similar four-storey and three-storey mixed residential and commercial properties respectively. It may additionally be located by National Grid Reference (NGR) 530180,181440 and is shown on the location map below.



The site covers a roughly L-shaped area with maximum dimensions of approximately 34 m northwest-southeast by 36 m northeast-southwest and is currently occupied by a number of adjoining vacant and occupied properties that range from single storey to four-storeys in height and all include a single level basement, which is at a depth of approximately 3.00 m below ground level. The layout of the site can be seen from the plan overleaf, while a further description of the existing buildings occupying the site is given in the table below.

Property	No of Storeys	Previous / Existing Use
16a, 16b and 18 West Central Street	Single / two and three	Ground floor and basement levels currently vacant, although formerly a nightclub. Upper Storeys residential
10-12 Museum Street	Four	Currently vacant and divided into a number of self-contained flats on all floors
35 New Oxford Street	Four	Ground floor and basement currently in use as a temporary site office for building contractors, previously used as sandwich shop. Upper floors residential
37 New Oxford Street	Four	Ground floor and basement currently used as an acupuncture and massage shop, upper floors residential
39-41 New Oxford Street	Four	Basement used as offices, ground floor in use a gift shop and upper floors offices and residential

The plan below indicates the existing site layout.

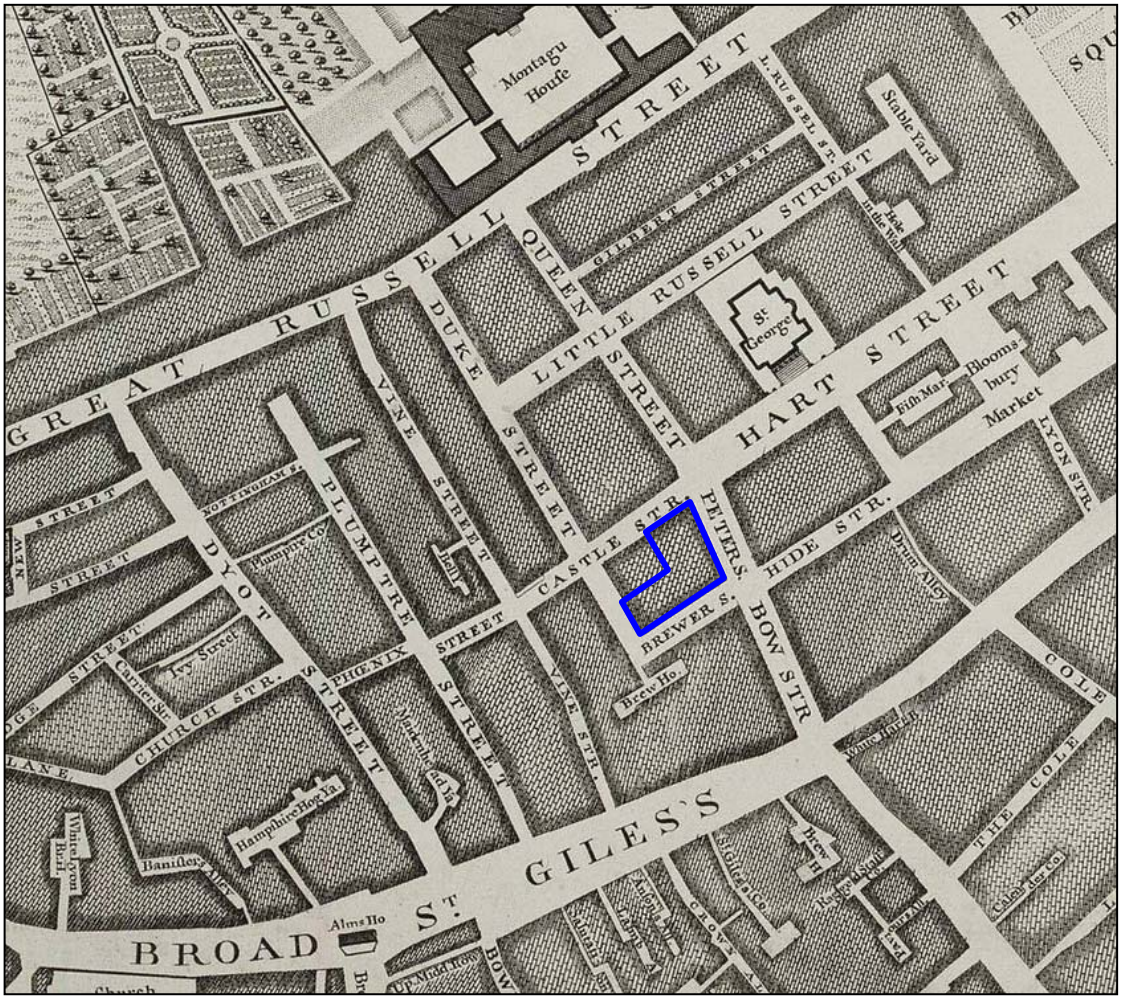


The site and surrounding area are topographically essentially level, at a level of approximately 25 m OD, and as the existing buildings occupy the whole site, it is completely devoid of vegetation. No potential sources of contamination were identified during the site walkover.

2.2 Site History

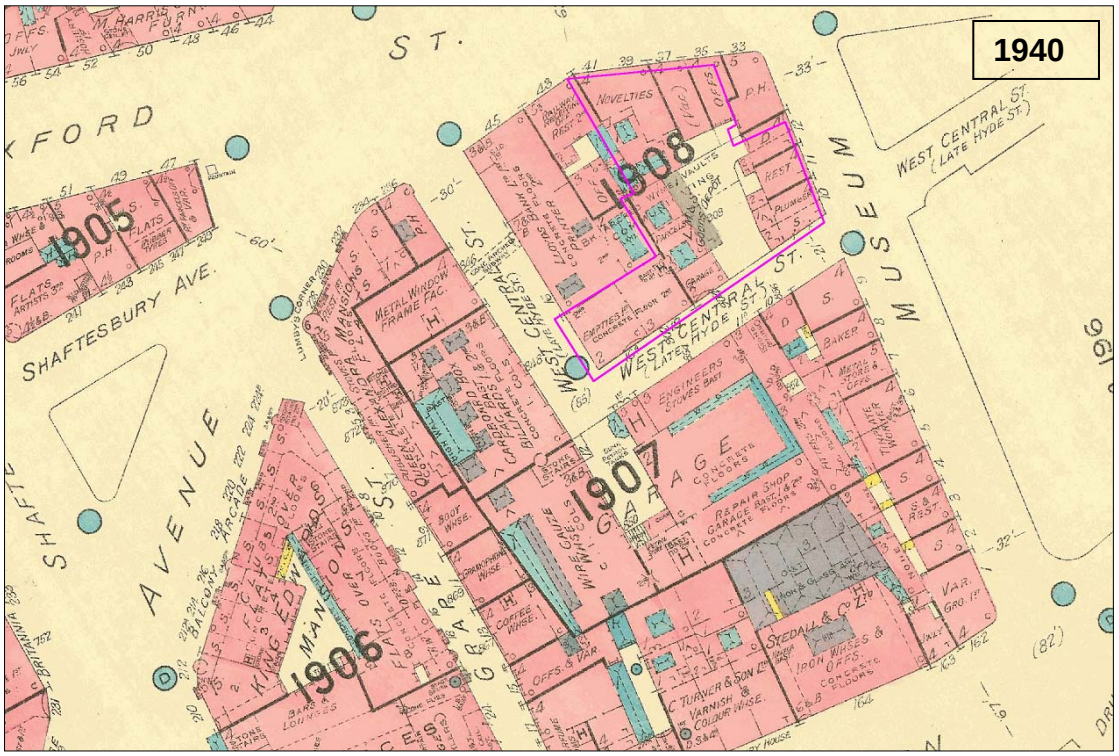
The site history has been researched with reference to historical Ordnance Survey (OS) maps and publicly available data provided by the Envirocheck Database.

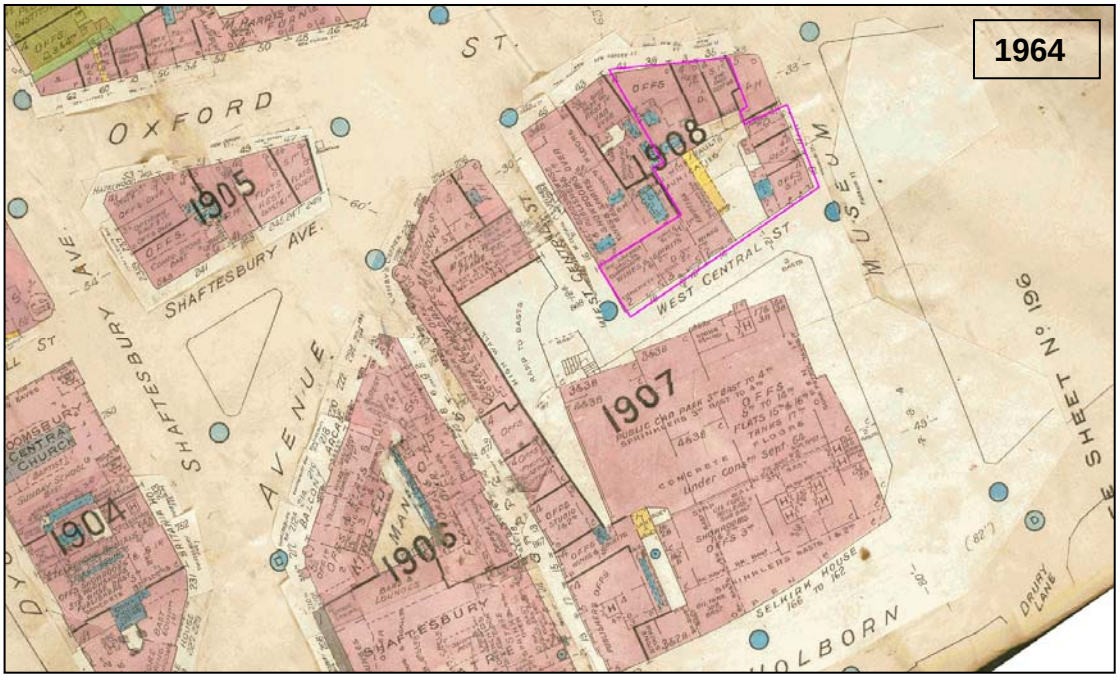
At the time of John Roque's 1746 map of London, the site and the majority of the immediate surrounding area was developed with well-established streets, albeit in a different configuration to the present day. At that time, Museum Street was known as Peters Street, whilst West Central Street formed part of both Brewer Street and Duke Street. It is however unclear whether the site itself was developed at that time, as shown by an extract of the map overleaf.



Some time between Greenwood's 1827 map and John Snow's 1859 map, the majority of the road network had been reconfigured to form essentially the existing day layout. Peters Street had also been renamed Museum Street during that period. The earliest Ordnance Survey (OS) map studied, dated 1878, shows the site to be developed with a number of terraced buildings fronting onto New Oxford Street to the north, Museum Street to the east and Brewer Street to the south and all positioned around a central courtyard. The surrounding area was extensively developed with mainly terraced buildings, although the Horseshoe Brewery was present approximately 200 m to the west of the site and a foundry approximately 180 m to the east. With the exception of, what appear to be, minor layout changes between 1875 and 1895, the historical maps throughout the 20th Century show the site to remain essentially unchanged.

A series of Goad's Insurance plans, dated from 1940 to 1970 indicate the buildings on the site to have been occupied by a variety of shops, a small garage, a plumber, offices, residential dwellings, a radio showroom, various stores and a wine and spirits stores, as shown by the insurance plan extracts overleaf. The existing nightclub infill building, No 18 West Central Street, appears to have been constructed some time after 2006.





The aforementioned foundry is no longer shown on maps dated after 1896 and the brewery was demolished and replaced with a theatre and a number of buildings between 1938 and 1947. The existing post office and sorting office, directly to the east of the site, was constructed some time between 1896 and 1916, although it had been modified by the 1940s. The Goad Insurance Plans indicate the buildings surrounding the site from 1940 until the 1970s were occupied a mixture of residential dwellings, offices, warehouses and small-scale manufactories such as a metal window frame manufactory, a cardboard box factory and a printers.

The site directly on the opposite side of West Central Street to the south, was occupied by a garage and repair shop, which annotation on the insurance plans indicates included below ground petrol tanks. The garage and a large number of the majority of the surrounding buildings were however demolished between 1960 and 1964 and replaced with what is essentially the existing building on the site known as Selkirk House, which includes three levels of basement, used as basement car parks, as shown on the previous insurance plan.

The bomb damage map of the area indicates that none of the buildings were damaged as a result of aerial delivered UXO during World War II.

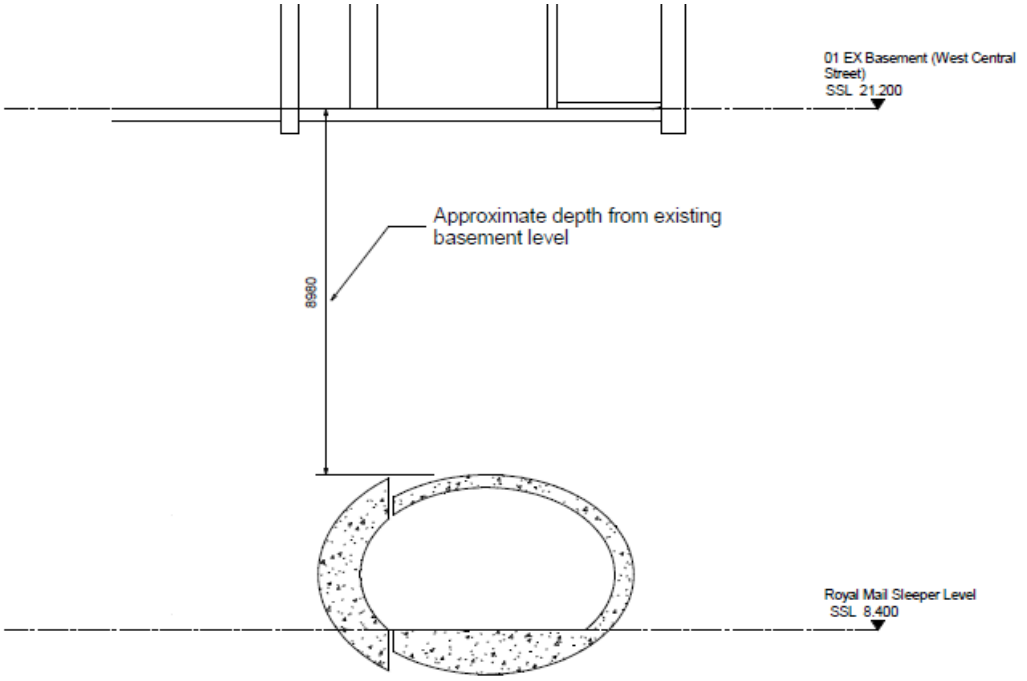
2.3 Other Information

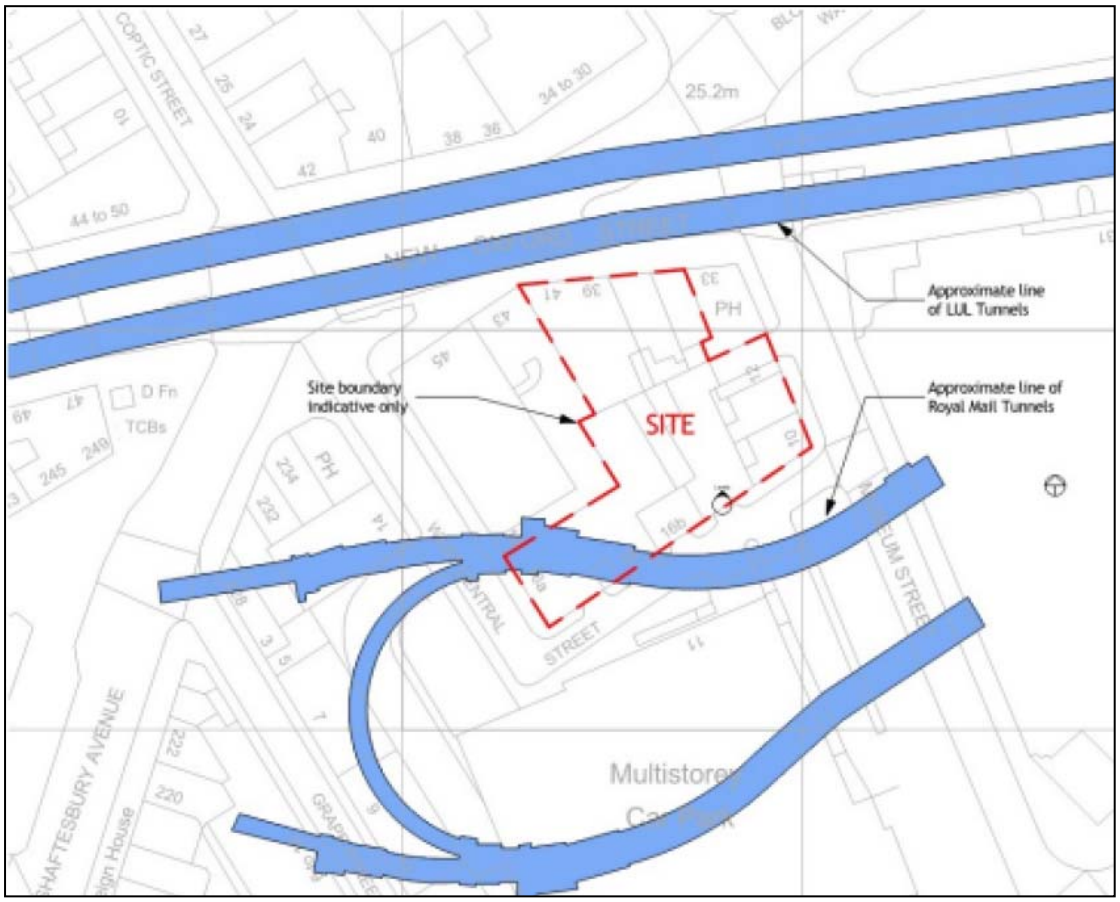
A search of public registers and databases has been made via the Envirocheck database and relevant extracts from the search are appended. Full results of the search can be provided if required.

The search has revealed that there are no existing or historical landfill sites, waste management, transfer or disposal sites within 500 m of the site. There have also not been any recorded pollution incidents to controlled waters within 500 m of the site and there are no recorded contaminated land registered sites within 500 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; as classified by the Health Protection Agency (HPA) and therefore no radon protective measures will be necessary.

Information provided by Mason Navarro Pledge indicates that a former Post Office mail rail tunnel passes below the southwestern corner of the site. The information indicates that the tunnel has an external diameter of approximately 3 m with the tunnel crown approximately 8.98 m below existing basement level, as shown by the cross-section and map extract below.





In addition to the Post Office Tunnels, the Central Line London Underground tunnels run below New Oxford Street to the north of the site. Information provided by Transport for London (TfL) indicates that the tunnel crowns are at a level of 0.6 m OD and 1.4 m OD, approximately 24.0 m below ground level.

2.4 Geology

The Geological Survey map of the area (sheet 256) indicates that the site is underlain by Lynch Hill Gravel, which is in turn underlain by the London Clay Formation.

Online borehole records held at the British Geological Survey (BGS), of a number of boreholes advanced directly to the south and east of the site on the sites of Selkirk House and the Sorting Office respectively, indicate that the Lynch Hill Gravel is likely to extend to depths of between 5 m and 6 m below ground level, whilst the underlying London Clay extends to a depth of between approximately 28.0 m to 30.0 m, whereupon the Lambeth Group is present.

2.5 Hydrology and Hydrogeology

The Lynch Hill Gravel is classified as a Secondary 'A' Aquifer, as defined by the Environment Agency (EA). This stratum is likely to comprise permeable horizons that are cable of supporting local water supplies and may form an important source of base flow for local rivers. There are no Environment Agency designated Source Protection Zones (SPZs) within 500 m of the site. There are no natural surface water features within 500 m of the site and the River Thames is located approximately 900 m to the southeast of the site. Groundwater is expected to flow in a

generally southerly direction towards the Thames and generally in keeping with the local topography. The site is not shown to be in an area at risk of flooding from rivers or sea without defence, as defined by the EA.

Groundwater was encountered close to the base of the gravel in the aforementioned BGS boreholes, at a depth of approximately 5.0 m.

2.6 Preliminary Contamination 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 been occupied by mainly commercial buildings throughout its developed history. The buildings have been used as shops, offices and small-scale commercial uses such as a small garage, a radio showroom and various stores for wine and spirit merchants among others. It is not however possible to determine from the insurance plans or historical maps whether or not the buildings were used as offices for these various trades or if the various process were actually carried out on site. Whilst these processes may have led to the contamination of the underlying soil, given the size of the individual small units, the industries would have only carried out work on a very small scale and are therefore not considered to have presented significant sources of contamination, although hotspots of contamination may conceivably be present. The last uses of the site as offices, a nightclub, various shops and residential flats are not considered to be a contaminative use.

The desk study has also indicated that a number of the buildings close to the site were used for light industrial purposes throughout the 20th Century. As most of these were all of a relatively small scale, they are not considered to pose a significant risk to the site. The site on the opposite side of West Central Street to the south however was used as a garage, which is indicated on historical insurance plans to have included below ground tanks, which are conceivably a source of hydrocarbon contamination. The garage was demolished and replaced with the existing building, which contains three levels of basement, in the 1960s and therefore the tanks and associated surrounding contamination is likely to have been removed during the basement excavation. Mobile contamination from the historical tanks would also be expected to migrate southwards in the direction of groundwater flow and thus away from the site. Any made ground below the site would be considered to be a potential source of contamination. The desk study has not indicated a source of landfill gas, with no historical or existing landfill sites within 500 m of the site.

2.6.2 Receptor

As commercial units will occupy the lower levels of the proposed building, with residential apartments above, future end users will represent relatively low sensitivity receptors. The site is underlain by a Secondary 'A' Aquifer and therefore groundwater is considered to be a relatively sensitive receptor, as are neighbouring sites. 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 demolition and construction works.

2.6.3 Pathway

The proposed buildings will occupy the entire site and also include the existing single level basements, which will act as a permanent barrier between end users and the underlying soil. There is thus not considered to be a potential pathway by which end users could come into contact with any contamination. Buried services may be exposed to any contaminants present within the soil through direct contact. Site workers will come into contact with the soils during demolition and construction works.

The site is underlain by a Secondary 'A' Aquifer, underlain by relatively impermeable London Clay and there is a low potential for contamination to reach groundwater in the chalk aquifer. There is a conceivable pathway for soluble contamination to migrate to and from adjacent sites via the Secondary Aquifer, although this is already in existence. Groundwater is likely to be flowing in a generally southerly direction and therefore it is considered unlikely that any contamination associated with former below ground tanks to the south would have reached the subject site. These tanks were however removed and therefore there is considered to be a low potential for a significant 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 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.

3.0 SCREENING

The LBC guidance suggests that any development proposal that includes a subterranean 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 New Oxford Streets Site
1a. Is the site located directly above an aquifer?	*Yes. The Lynch Hill Gravel is a designated Secondary 'A' Aquifer.*
1b. Will the proposed basement extend beneath the water table surface?	*Unknown. Groundwater is expected tom be encountered in the Lynch Hill Gravel and therefore the lowering of the existing basement will possibly intercept the groundwater table.*
2. Is the site within 100 m of a watercourse, well (used/ disused) or potential spring line?	No.
3. Is the site within the catchment of the pond chains on Hampstead Heath?	No.

4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	No. The proposed building footprint will occupy the same area as the existing building and therefore will occupy the site in its entirety.
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. Run-off from hardstanding will remain the same.
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.

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

Q1a The site is located directly above a Secondary 'A' Aquifer.
Q1b The proposed basement extension may extend below the water table

3.1.2 Stability Screening Assessment

Question	Response for New Oxford Street Site
1. Does the existing site include slopes, natural or manmade, greater than 7°?	No.
2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7°?	No.
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	No.
4. Is the site within a wider hillside setting in which the general slope is greater than 7°?	No.
5. Is the London Clay the shallowest strata at the site?	No.
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.
7. Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site?	No.
8. Is the site within 100 m of a watercourse or potential spring line?	No.
9. Is the site within an area of previously worked ground?	No.
10. Is the site within an aquifer?	*Yes. The Lynch Hill Gravel is a designated Secondary 'A' Aquifer.*
11. Is the site within 50 m of Hampstead Heath ponds?	No.
12. Is the site within 5 m of a highway or pedestrian right of way?	*Yes. Museum Street, West Central Street and New Oxford Street all border the site.*
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	*Yes. The lowering of the basement is likely to result in differential founding depths.*
14. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	*Yes. The site is over Post Office Tunnels and with the exclusion zone to the Central Line London Underground tunnels.*

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

Q10 The site is located directly above a Secondary 'A' Aquifer.
Q12 The site is located within 5 m of serval highway structures.

Q13 The basement extension is likely to result in differential founding depths.
Q14 The site is located above Post Office Tunnels and within the exclusion zone of London Underground Tunnels.

3.1.3 Surface Flow and Flooding Screening Assessment

Question	Response for New Oxford Street Site
1. Is the site within the catchment of the pond chains on Hampstead Heath?	No.
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. There will be no surface expression of the basement development, so the surface water flow regime will be unchanged. The basement will be located under the proposed building and therefore the ground surface above the basement will not change and will remain as hardstanding. This will ensure no increase in runoff rate or volume as a result of the proposed basement construction.
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. The basement will be entirely beneath the footprint of the proposed building and therefore the 1m distance between the roof of the basement and ground surface as recommended by the Arup report does not generally apply.
5. Will the proposed basement result in changes to the quantity of surface water being received by adjacent properties or downstream watercourses?	
6. Is the site in an area known to be at risk from surface water flooding such as South Hampstead, West Hampstead, Gospel Oak and Kings Cross, or is it at risk of flooding because the proposed basement is below the static water level of a nearby surface water feature?	No. The Camden Flood Risk Management Strategy dated 2013, North London Strategic Flood Risk Assessment dated 2008, and 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.

The above assessment has not identified any potential issues that need further assessment, although the hydrological setting is discussed further within this report.

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
Is the site located directly above an aquifer?	The site is underlain by Lynch Hill Gravel, which is classified as a Secondary 'A' Aquifer. This has the potential of being able to support local water supplies as well as forming an important source of base flow for local rivers. There is the potential for the hydrogeological setting to be affected by a basement development.

Will the proposed basement extend beneath the water table surface?	It is possible that the basement excavation will extend below the water table. Should this happen, the basement structure is capable of diverting groundwater flow such that groundwater level is affected on both the up slope and down slope side of the basement structure. This in turn has the potential to affect the local hydrogeology and any adjacent structures.
Is the site located within 5 m of a public highway or pedestrian right of way?	The public walkways and highways of New Oxford Street, Museum Street and West Central Street border the site on all sides. The excavation of new basement or the lowering of an existing basement can cause instability of such structures.
Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Where differential founding depths between adjacent foundations occur, it may result in structural damage to both the neighbouring structures and the proposed development if foundations are not designed to support additional loading or where neighbouring foundations are not underpinned.
Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	The disused Post Office Tunnels run below the southwestern corner of the site, whilst the Central Line London Underground tunnels run below New Oxford Street directly to the north of the site. The excavation of a new basement or the lowering of an existing basement, in addition to changes in loads of the associated superstructures or the way in which those loads are transmitted to ground, will change vertical and horizontal stresses below the site. Such change in stress can result in an increase in strain at the depth of tunnels, which may lead to movements above that which can be tolerated by the tunnel structure.

Whilst the ground investigation was carried out prior to the completion of the screening and scoping sections, the scope of the previous investigation, as detailed below, is considered to have been sufficient in order to investigate the above potential impacts.

4.2 Exploratory Work

Access to the site was limited by the presence of the existing buildings, with Nos 35 and 3941 occupied at the time of the investigation, such that access to these buildings was not possible. Therefore in order to meet the objectives described in Section 1.2 as far as possible within these restrictions, a single borehole was advanced to 25.00 m below ground level using a dismantlable cable percussion drilling rig. The rig was positioned within No 18 West Central Street at ground floor level. The ground floor and basement slabs were both cored and the basement void cased in order to allow the borehole to be advanced below basement level. SPTs were carried out at regular intervals within the borehole in order to provide quantitative data on the strength of the underlying soils and disturbed and undisturbed samples were recovered for subsequent laboratory testing and examination.

The deep borehole was supplemented with a series of three window sampler boreholes advanced to depths of between 1.80 m and 2.10 m from basement level, in addition to a single dynamic probe advanced from the basement of No 16 West Central Street to a depth of 6.00 m in order to provide further quantitative data on the density of the granular soils and to confirm the depth to the London Clay.

A groundwater monitoring standpipe was installed in the cable percussion borehole to a depth of 4.00 m below basement level and has been monitored on two occasions over a one month period.

In order to identify the configuration of existing foundations a series of 25 trial pits was manually excavated from basement level within the various buildings. All of the fieldwork was carried out under the supervision of a geotechnical engineer from GEA and a selection of the samples recovered from the boreholes and trial pits were submitted to a soil mechanics laboratory for a programme of geotechnical testing and analytical laboratory for a suite of contamination testing.

The borehole, trial pit and dynamic probe records, in addition to the results of the laboratory analyses, are appended together with a site plan indicating the exploratory positions. The ordnance datum (OD) levels shown on the exploratory records have been interpolated from spot heights shown on a proposed site plan provided by Mason Navarro Pledge (drawing ref: SK08 rev P3, dated June 2015).

4.3 Sampling Strategy

The trial pit locations were specified by Mason Navarro Pledge, and positioned on site by GEA, along with the boreholes and dynamic probe in order to provide suitable coverage of the site, whilst avoiding known buried services.

Three samples of made ground were subjected to analysis for a range of common industrial contaminants and contamination indicative parameters. For this investigation the analytical suite for the soil included a range of metals, speciation of total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), total cyanide and monohydric phenols. In addition, the samples were also screened for the presence of asbestos. The soil sample was 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 an MCERTs accredited laboratory with the majority of the testing suite accredited to MCERTS standards. Details of the MCERTs accreditation and test methods are included in the Appendix together with the analytical results.

5.0 GROUND CONDITIONS

The investigation has encountered a generally nominal to moderate thickness of made ground over Lynch Hill Gravel, which is underlain by the London Clay Formation. All depths quoted are relative to basement level, unless stated otherwise.

5.1 Made Ground

The basement floor build-up within Nos 16 and 18 West Central Street was found to comprise a suspended timber floor over a waterproofing membrane, underlain by between 100 mm and 370 mm thick concrete slab that was locally reinforced with 6 mm reinforcement and was cast over a damp proof membrane (DPM). In the other buildings, the basement slab was between 60 mm and 200 mm in thickness and was not reinforced, but was locally cast over a DPM.

Made ground was encountered below all of the buildings with the exception of Nos 16 and 18 West Central Street. It generally comprised a matrix of dark brown and brown locally clayey, sandy silt with various inclusions of gravel, brick, concrete, coal, slate, china and timber fragments and extended to depths of between 0.35 m (22.39 m OD) and 1.45 m (21.29 m OD), although the base was not proved in a number of the trial pits, particularly those excavated within No 35 New Oxford Street.

With the exception of notable fragments of coal and other extraneous material, no visual or olfactory evidence of significant contamination was noted during the investigation. Three samples of the made ground have been subject to a suite of contamination testing and the results are discussed below in Section 5.5.

5.2 Lynch Hill Gravel

Below the made ground, or directly below the basement floor slab, the Lynch Hill Gravel was found to generally comprise brown, yellowish brown and dark orange-brown locally silty, medium to coarse sand and fine to coarse angular to subrounded gravel and extended to the maximum depths investigated in the window sampler boreholes of between 1.80 m (19.42 m OD) and 2.10 m (19.12 m OD) and to a depth 3.50 m (18.75 m OD) in Borehole No 1, a depth of 6.50 m below ground level. This depth was also confirmed by the results of Dynamic Probe No 1. In Borehole No 4 however, this stratum was found to initially comprise a horizon of firm brown silty sandy clay with fine to medium subrounded gravel, which extended to a depth of 1.80 m (20.94 m OD).

Dynamic probing and the results of the SPTs have indicated these soils to be in a generally dense condition, which restricted the depth that the window sampler boreholes were able to penetrate. These soils were observed to be free of any evidence of soil contamination and the results of particle size distribution tests, when analysed using Hazen's formula, indicate these soils to have permeability of between approximately 1.6×10^{-3} m/s and 9×10^{-4} m/s. The permeability would however need to be confirmed through insitu testing.

5.3 London Clay Formation

This stratum was encountered in Borehole No 1 only and initially comprised stiff fissured brown silty clay to a depth of 6.75 m below ground level (18.50 m OD), whereupon stiff becoming very stiff fissured high strength becoming very high strength dark grey silty clay with partings of pale grey silt and fine sand, fine selenite crystals, occasional fine white shells and pyrite nodules was proved to the maximum depth investigated of 25.00 m below ground level (0.25 m OD). A claystone was present at a depth of 17.50 m below ground level (7.75 m OD).

These soils were observed to be free of any evidence of soil contamination. The results of laboratory Atterberg limit tests have indicated the clay to be of high shrinkability whilst undrained triaxial tests have indicated the clay to increase in strength with depth from high strength to very high strength and undrained shear strength from 96 kN/m^2 to 191 kN/m^2.

5.4 Groundwater

During the drilling of the boreholes, groundwater was encountered at depths of 1.45 m (21.29 m OD) and 3.00 m (19.25 m OD) below basement level within the Lynch Hill Gravel. The results of the subsequent groundwater monitoring of the standpipe installed in Borehole No 1 is shown below.

Monitoring Date	Depth to groundwater below basement level (m) [Level)m OD)]
During Drilling	3.00 [19.25]
20/07/15	2.89 [19.36]
07/08/15	2.87 [19.38]

5.5 Soil Contamination

The table below sets out the values measured within the three samples analysed; all concentrations are in mg/kg unless otherwise stated and the depths of the samples are relative to basement level.

Determinant	TP3 – 0.50 m	TP4 – 0.40 m	TP28 – 0.30 m
pH	9.1	11.1	9.3
Arsenic	26	22	41
Cadmium	0.77	0.64	0.65
Chromium	31	29	42
Lead	14	14	1900
Mercury	<0.1	<0.1	17
Selenium	<0.20	<0.20	<0.20
Copper	29	19	240
Nickel	63	27	49
Zinc	57	37	1200
Total Cyanide	<0.50	<0.50	<0.50
Total Phenols	<0.30	<0.30	<0.30
Total PAH	<2.0	<2.0	<2.0
Sulphide	1.3	3.6	1.4
Benzo(a)pyrene	<0.10	<0.10	<0.10
Naphthalene	<0.10	<0.10	<0.10
TPH	<10	<10	49
Total Organic Carbon %	<0.20	<0.20	0.63

Note: Figure in bold indicates concentration in excess of risk-based soil guideline values, as discussed in Part 2 of this report

5.5.1 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. To this end the table below indicates those contaminants of concern that have values in excess of a generic human

health risk based guideline values which are either that of the CLEA[4] Soil Guideline Value where available, or is a Generic Screening Value calculated using the CLEA UK Version 1.06[5] software assuming a commercial end use, or is based on the DEFRA Category 4 Screening values[6]. The key generic assumptions for this end use are as follows:

- that groundwater is not a critical risk receptor;
- that the critical receptor for human health will be working female adults aged 16 to 65 years old;
- that young children will not have prolonged exposure to the site;
- that the exposure duration will be a working lifetime of 49 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 commercial building.

It is considered that these assumptions are considered acceptable for this generic 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 at concentrations 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 do not indicate any elevated concentrations of the contaminants tested. The significance of the contamination results is considered further in Part 2 of the report.

4 *Updated Technical Background to the CLEA Model (Science Report SC050021/SR3) Jan 2009* and Soil Guideline Value reports for specific contaminants; all DEFRA and Environment Agency.
5 Contaminated Land Exposure Assessment (CL|EA) Software Version 1.06 Environment Agency 2009
6 CL:AIRE (2013) *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination* Final Project Report SP1010 and DEFRA (2014) *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination* Policy Companion Document SP1010

5.6 Existing Foundations

The findings of the trial pits are summarised in the table below. Sketches and photographs of each pit are included in the Appendix. All depths quoted are relative to basement level.

Trial Pit No	Structure	Foundation detail	Bearing Stratum
1	Western boundary wall of No 16a	Mass concrete strip / trench fill Top 0.24 m Base 0.49 m Lateral projection 150 mm	Orange-brown sandy GRAVEL
2	Western boundary wall of No 16a and party wall with No 16	**Boundary Wall** Concrete strip Top 0.20 m Base 0.50 m Projection 170 mm **Party Wall** Concrete strip Top 0.09 m Base 0.47 m Flush	Brown sandy GRAVEL
3	Party wall between No 16a and No 16	Concrete strip Top 0.09 m Base 0.25 m Flush	Brown sandy GRAVEL
4	Party wall between No 16a and 16b	Mass concrete strip / trenchfill Top 0.19 m Base 0.37 m Lateral projection 230 mm	Dark orange-brown sandy GRAVEL
5	Party wall between No 16a and No 16b and southern boundary wall	**Boundary Wall** Mass concrete strip Top 0.17 m Base 0.47 m Projection 250 mm **Party Wall** Concrete strip Top 0.17 m Base 0.47 m Flush	Dark orange-brown sandy GRAVEL
6	Party Wall between No 18 and No 16b	Mass concrete strip / trenchfill Top 0.43 m Base 0.58 m Lateral projection 100 mm	Dark reddish brown sandy GRAVEL
7	Party Wall between No 18 and No 16b	Mass concrete strip / trenchfill Top 0.08 m Base 0.98 m Lateral projection 390 mm	Orange-brown sandy GRAVEL
8	Party Wall between No 18 and No 16b	Mass concrete strip / trenchfill Top 0.55 m Base 0.95 m Lateral projection 100 mm	Orange-brown sandy GRAVEL
9	Internal column of No 18	Unable to penetrate through concrete	Not Proved.
10	Southern boundary wall of No 18	Concrete strip Top flush with basement slab Base 0.28 m Flush	Dark orange-brown silty gravelly SAND
11	Internal wall of No 18	Brick strip Base 0.50 m Flush	Orange-brown sandy GRAVEL
12	Internal wall of No 18	Mass concrete strip Top 0.18 m Base 0.58 m Lateral projection 350 mm	Orange-brown sandy GRAVEL
13	Internal wall within toilets of No 18	Unable to penetrate through concrete	Not Proved.

Trial Pit No	Structure	Foundation detail		Bearing Stratum
14	Boundary wall of No 18	Unable to penetrate through concrete		Not Proved.
15	Southern boundary wall of 10 Museum Street	Brick corbel and concrete trenchfill Top 0.30 m Base 0.70 m Lateral projection 180 mm		Brown sandy GRAVEL
16	Southern and eastern boundary walls of 10 Museum Street	Brick corbel and concrete trenchfill Top 0.30 m Base 0.75 m Lateral projection 350 mm and 200 mm		Made Ground
17	Internal wall within 10 Museum Street and party wall with No 11	**Internal Wall** Brick Corbel Top 0.19 m Base 0.45 m Projection 260 mm	**Party Wall** Brick corbel and concrete trenchfill Top 0.27 m Base 0.56 m Projection 480 mm	Brown sandy GRAVEL
18	Eastern boundary wall of 11 Museum Street and party wall with No 10	**Boundary Wall** Concrete trenchfill Top 0.35 m Base 0.75 m Projection 370 mm	**Party Wall** Concrete trenchfill Top 0.42 m Base 0.75 m Projection 300 mm	Brown clayey silty sandy GRAVEL
19	Internal Wall of No 12 Museum Street	Unable to excavate due to the position of services		Not Proved.
20	Northern and eastern boundary walls of No 12 Museum Street	Concrete trenchfill Top 0.13 m Base 0.60 m Lateral projection 450 mm and 150 mm		Brown clayey silty sandy GRAVEL
21	Eastern boundary wall of emergency exit to No 18	Concrete strip Top 0.15 m Base 0.55 m Lateral projection 250 mm		Orange-brown slightly silty sandy GRAVEL
22	Northern party wall of emergency exit to No 18	Concrete strip Top 0.15 m Base 0.55 m Lateral projection 250 mm		Orange-brown slightly silty sandy GRAVEL
23	Southern boundary wall of No 35 New Oxford Street (NOS)	Access to position not possible		Not Proved.
24	Party Wall between No 37 NOS and No 39	Access to No 37 not possible as the premises is still occupied		Not Proved.
25	Eastern party wall of No 35 NOS	Single brick corbel Top 0.08 m Base 0.16 m Lateral projection 90 mm		Made Ground
26	Party wall between No 35 NOS and No 37	Access to No 37 not possible as the premises is still occupied		Not Proved.

Trial Pit No	Structure	Foundation detail	Bearing Stratum
27	Eastern party wall and northern boundary wall of No 35 NOS	Two brick corbels Top 0.35 m Base 0.55 m Lateral projection 140 mm	Made Ground
28	Northern boundary wall of No 35 NOS	Single brick corbel Top 0.20 m Base 0.26 m Lateral projection 100 mm	Made Ground
29	Northern boundary wall of No 37 NOS	Access to No 37 not possible as the premises is still occupied	Not Proved.

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 other aspects of the development.

6.0 INTRODUCTION

Consideration is being given to the partial demolition, refurbishment and conversion of the existing properties to form a new mixed-use residential and commercial development. This will include the construction of a new light-weight steel framed roof extension to a number of the properties and the lowering of a number of the existing basement levels, followed by the construction of new four-storey building to be supported on a raft foundation.

7.0 GROUND MODEL

The desk study has indicated that the site has not had a particularly contaminative history, being occupied by various shops and small-scale commercial uses throughout the 19th and 20th Centuries, with it most recently being occupied by a mixture of offices, shops, residential apartments and a nightclub. 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, Lynch Hill Gravel overlies the London Clay Formation;
- made ground is present across the eastern half of the site and extends to depths of between 0.35 m (22.39 m OD) and 1.45 m (21.29 m OD) below basement level;
- below the made ground and directly below the basement slabs across the western half of the site, the Lynch Hill Gravel extends to a depth of 3.50 m (18.75 m OD) below basement level, 6.50 m below ground level;
- groundwater is present in the Lynch Hill Gravel at depths of between 2.89 m (19.36 m OD) and 2.87 m (19.37 m OD);
- the London Clay extends to the maximum depth investigated of 25.00 m (0.25 m OD), 22.00 m below basement level and increases in strength with depth from stiff and high strength to very stiff and very high strength; and
- the made ground, where tested, has been found to be free from contamination.

8.0 ADVICE AND RECOMMENDATIONS

For Nos 35 to 41 New Oxford Street and Nos 10 to 12 Museum Street, the properties will be retained but will undergo a number of internal layout changes, with a new roof extension constructed above the New Oxford Street Properties. The ground floor slabs will be lowered by less than 1.00 m and therefore localised underpinning of existing foundations is proposed. The loads provided by Mason Navarro Pledge however indicate very little change from the existing loads for these properties.

The existing properties along West Central Street will be demolished down to basement level and a new four-storey building constructed. The current basement will be lowered by 1.00 m and the new buildings founded on a 600 mm thick raft foundation. Formation level for this section of the development will be 20.60 m OD. On this basis the lowering of the existing basement will not encounter groundwater.

8.1 Spread Foundations

Moderate width pad or strip foundations bearing in the sand and gravel of the Lynch Hill Gravel below basement level, may be designed to apply a net allowable bearing pressure of 250 kN/m^2. If the initial sandy gravelly clay of the Lynch Hill Gravel is exposed at formation level it is recommended that the bearing pressure is limited to 120 kN/m^2. These values incorporate an adequate factor of safety against bearing capacity failure and should ensure that settlement remains within normal tolerable limits. Foundations that span both cohesive and granular soils should be nominally reinforced to protect against differential settlement.

It is proposed to underpin a number of the foundations to allow for the lowering of the existing basement below the West Central Street properties, in addition to existing foundations to the remaining other properties as part of lowering of the existing ground floor slabs. Conventional concrete underpinning should be possible, particularly as on the basis of the groundwater monitoring results, groundwater is expected to be encountered at a level of approximately 19.30 m OD, approximately 1.00 m below proposed formation level, although perched groundwater inflows may be encountered in close proximity of existing foundations. On the basis of the trial pitting observations, conventional underpinning is considered to be feasible, as no major instability of the soils was noted. Careful workmanship will in any case be required to ensure that movement of the surrounding structures does not arise, but this method will have the benefit of minimising the plant required. The contractor should however be required to provide details of how they intend to control any groundwater inflows and instability of excavations, should they arise.

8.2 Raft Foundation

The suitability of a basement raft foundation will depend on the resultant net loading intensity of the new structure, which is likely to be relatively high, given the proposed seven-storey structure. The raft would need to be designed to be rigid to resist the variation in upwards and downwards forces. As the site has been developed for over 100 years, ground movements associated with construction of the existing buildings would now be expected to be complete. However, it is understood that No 18 West Central Street, the nightclub infill building at the centre of the site, was only constructed after 2006 and therefore it is possible that where new foundations where installed, settlements may still be ongoing.

As the current proposed founding level will require minimal excavation below existing basement level, the amount of settlement and / or heave will be governed by the load applied by the new structures compared to the existing buildings. However, although the overall

weights of the existing and proposed buildings may be similar, the way in which the structural loads are applied to the ground may differ. For example if the existing building is supported on relatively heavily loaded pad foundations there will be concentrations of stresses below these foundations, which would not be replicated by a raft foundation that would apply a more uniform loading to the ground. In such a scenario there is a potential for heave to occur below the areas of former foundations, whilst settlement may occur where a raft applies loading to areas that have not been loaded previously.

The use of a raft foundation has been considered further within the Ground Movement Analysis in Part 3 of this report.

8.3 Piled Foundations

For the ground conditions at this site some form of bored pile is likely to be the most appropriate type. A conventional rotary augered pile may be appropriate, with temporary casing installed to maintain stability and prevent groundwater inflows, or alternatively the use of bored piles installed using continuous flight auger (cfa) techniques, which would not require the provision of casing, would also be an appropriate choice of pile.

The following table of ultimate coefficients may be used for the preliminary design of bored piles, based on the SPT & Cohesion / level graph in the appendix.

Stratum	Level (m OD)	kN / m²
Ultimate Skin Friction		
Made Ground	All soil above 21.29	Ignore (existing basement and made ground)
Lynch Hill Gravel (Φ = 40°)	21.29 to 18.75	15
London Clay (α = 0.5)	18.75 to 0.25	Increasing linearly from 37 to 102
Ultimate End Bearing		
London Clay	10.25 to 0.25	Increasing linearly from 1215 to 1845

In the absence of pile tests, guidance from the London District Surveyors Association[7] (LDSA) suggests that a factor of safety of 2.6 should be applied to the above coefficients in the computation of safe theoretical working loads. On the basis of the above coefficients and a factor of safety of 2.6, the following safe working loads have been estimated for 300 mm and 450 mm diameter CFA piles.

7 LDSA (2009) *Foundations No 1 – Guidance notes for the design of straight shafted bored piles in London Clay*. LDSA Publication

Level (m OD) [depth below basement m]	Safe Working Load (kN)	
	300 mm Ø	450 mm Ø
10.25 [12.00]	210	340
12.25 [15.00]	295	465
0.25 [22.00]	535	835

The above examples are not intended to constitute any form of recommendation with regard to pile size or type, but merely serve to illustrate the use of the above coefficients. Specialist piling contractors should be consulted with regard to the design of a suitable piling scheme for this site and their attention should be drawn to the presence of claystones and the possibility of associated groundwater inflows from within the London Clay.

In addition to the above, any piling scheme at this site will need to take into account the presence of the Post Office tunnels below the site. C2M Hill, who manage the asset, are likely to have certain restrictions in place in order to maintain the structural integrity of the tunnel. Should a piled foundation solution be adopted, consideration will need to be given to further analysis once the proposed pile layout has been finalised.

8.4 Existing Retaining Structures

If it is proposed to re-use the retaining walls of the existing basement during the redevelopment of the site, the suitability of these walls will need to be assessed on the basis of the effect of any additional loads that may be imposed during the redevelopment and whether any part will be damaged and / or significantly weakened by the demolition of the existing buildings. It would be prudent to carry out material testing on the existing retaining walls and it is likely that a certain amount of propping or additional reinforcement may be required to ensure that the existing walls meet current safety and design requirements.

8.5 Basement Floor Slab

On the basis that the existing basement floor slab has performed adequately, in the absence of the use of a raft foundation solution, it should be possible to adopt a ground bearing floor slab directly on the Lynch Hill Gravel, following a proof rolling exercise and the infilling of any soft spots with suitably compacted granular material.

8.6 Effect of Sulphates

Generally low concentrations of total sulphate have been measured in selected soil samples and on this basis buried concrete could be designed in accordance with Class DS-2 conditions of Table C2 of BRE Special Digest 1: SD1 Third Edition (2005). The measured pH conditions are near neutral to alkaline and on the basis of mobile groundwater conditions being assumed for buried concrete an ACEC classification of AC-2s may be adopted.

The guidelines contained in the above digest should be followed in the design of foundation concrete.

8.7 Site Specific Risk Assessment

The desk study has indicated that the site has not had a particularly contaminated history, although it has been occupied by a number of small scale light industries. The contamination testing has in any case not indicated any elevated concentrations of the contaminants. Furthermore the building will continue to occupy the whole site and therefore end users will remain effectively isolated from the underlying soil. On this basis, remediation should not be required, although it would be prudent to carry out testing on addition samples of any made ground from below the existing buildings where investigation has yet to be carried out.

As with any site, it is good practice to maintain a watching brief during the ground work and if any suspicious soil is encountered then an inspection should be made by a suitably qualified engineer and additional testing carried out if required.

8.9 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[8] states that landfill WAC analysis, specifically leaching test results, must not be used for waste classification purposes.

Any spoil arising from excavations or landscaping works, which is not to be re-used in accordance with the CL:AIRE[9] 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 £82.60 per tonne (about £150 per m^3) or at the lower rate of £2.60 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 (East of site)	Non-hazardous (17 05 04)	No	
London Clay	Inert (17 05 04)	Should not be required but confirm with 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

8 Environment Agency 2015. *Guidance on the classification and assessment of waste.* Technical Guidance WM3 First Edition
9 CL:AIRE March 2011. *The Definition of Waste: Development Industry Code of Practice* Version 2

out. Alternatively, the treatment can be carried out by an approved contractor. The Environment Agency has issued a position paper[10] 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.

9.0 BASEMENT IMPACT ASSESSMENT

The screening identified a number of potential impacts. The desk study and ground investigation information has been used below to review the potential impacts, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

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

Potential Impact	Site Investigation Conclusions
The site is located directly above an aquifer	The investigation has indicated a groundwater level of 19.30 m OD. Any proposed lowering of the existing basements will be founded at a maximum level of 20.60 m OD. The basements will therefore remain above the groundwater table and will therefore not have an impact on the local hydrogeological setting.
The proposed basement may extend beneath the water table surface?	As above, the investigation has indicated that the proposed lowering of the basements will not extend below the water table.
The site is located within 5 m of a public highway and pedestrian right of way?	Very little excavation will take place below the site, with the foundations to the existing facades to be underpinned. The limited scale of the proposed works is not considered to pose a risk to the stability of the footway and highway structures. This is confirmed by the GMA in Part 3 of the report.
The proposed basement may significantly increase the differential depth of foundations relative to neighbouring properties?	The configuration of the existing foundations has been established by the investigation. It is proposed to underpin the party walls where the lowering of existing basement slabs and levels are proposed. The underpinning of the foundations will prevent deferential founding depths. In any case, the GMA in Part 3 of this report has indicated negligible movement associated with any excavation work and negligible building damage to surrounding properties.
The site is located over (or within the exclusion zone of) underground tunnels	The disused Post Office Tunnels run below the southwestern corner of the site, while the Central Line London Underground tunnels run below New Oxford Street to the north of the site. Using the information supplied by C2M Hill and TfL, via Mason Navarro Pledge, the potential movements at the respective tunnel depths have been analysed as part of the GMA in Part 3 of this report. The analysis has indicated that movements induced into the tunnels will be negligible and probably below detectable limits.

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

The results of the site investigation have therefore been used below to review the remaining potential impacts, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

The site is located above a Secondary 'A' Aquifer but will not extend below water table.

The investigation has confirmed that the site is underlain by the Lynch Hill Gravel, which is designated as a Secondary 'A' Aquifer. Groundwater monitoring has however indicated that the groundwater table is at a level of 19.30 m OD, 1.30 m below the depth of the proposed formation level for the lowered basement. Therefore as the basement structure will not extend below the groundwater table, it will not have an impact on the local hydrogeological setting.

Despite basements being present below the properties surrounding the site, again, as the basement levels will not extend below the groundwater table, they will not have a cumulative impact on the groundwater flow and the local hydrogeological setting.

Location of public highway

The proposed basement excavation will take place in close proximity of the footways to Museum Street, West Central Street and New Oxford Street. Very little excavation will take place below the site, with the foundations to the existing facades to be underpinned. The limited scale of the proposed works is not considered to pose a risk to the stability of the footway and highway structures. This is confirmed by the GMA in Part 3 of this report.

Differential founding depths

The party walls are currently founded on strip foundations bearing on the Lynch Hill Gravel. As indicated in the information provided by Mason Navarro Pledge, these foundations will be underpinned as part of the lowering of the basement structure and basement floor slabs, which will prevent differential founding depths and maintain structural stability. This has been confirmed by the results of the ground movement analysis which has indicated that any building damage is likely to be Category 0 'negligible'.

The Site is located above railway tunnels

The disused Post Office Tunnels run below the southwestern corner of the site, while the Central Line London Underground tunnels run below New Oxford Street to the north of the site. Information supplied by C2M Hill indicates that the crown of the postal tunnels is at a depth of approximately 9.00 m below existing basement level, while information supplied by TfL indicates that the underground tunnels are at a depth of 24.00 m below ground level. The potential movements at the respective tunnel depths have been analysed as part of the GMA in Part 3 of this report, which has indicated that differential movements of 2 mm of heave are expected over the 50 m of tunnel analysed whilst those predicted for the LUL tunnels are less than 0.1 mm.

9.1 Non-Technical Summary of Evidence

This section provides a short summary of the evidence acquired and used to form the conclusions made within the BIA.

9.1.1 Screening

The following table provides the evidence used to answer the surface water flow and flooding screening questions.

Question	Evidence
1. Is the site within the catchment of the pond chains on Hampstead Heath?	Topographical maps acquired as part of the desk study and Figures 12 and 14 of the Arup report
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?	A site walkover confirmed that the site is currently entirely covered in hardstanding and the details provided on the proposed development indicate that this situation will remain once the development is complete.
3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	
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?	As above. As the site is currently covered in hardstanding, surface water does not discharge to the ground but discharges to the existing sewer system. This will remain and therefore there will also not be any changes in the quantity of surface water received by adjacent properties or watercourses.
5. Will the proposed basement result in changes to the quantity of surface water being received by adjacent properties or downstream watercourses?	
6. Is the site in an area known to be at risk from surface water flooding such as South Hampstead, West Hampstead, Gospel Oak and Kings Cross, or is it at risk of flooding because the proposed basement is below the static water level of a nearby surface water feature?	Flood risk maps acquired from the Environment Agency as part of the desk study, Figure 15 of the Arup report, the Camden Flood Risk Management Strategy dated 2013 and the North London Strategic Flood Risk Assessment dated 2008.

The following table provides the evidence used to answer the subterranean (groundwater flow) screening questions.

Question	Evidence
1a. Is the site located directly above an aquifer?	Aquifer designation maps acquired from the Environment Agency as part of the desk study and Figures 3, 5 and 8 of the Arup report.
1b. Will the proposed basement extend beneath the water table surface?	Previous nearby GEA investigations and BGS archive borehole records.
2. Is the site within 100 m of a watercourse, well (used/ disused) or potential spring line?	Topographical maps acquired as part of the desk study and Figures 11 and 12 of the Arup report.
3. Is the site within the catchment of the pond chains on Hampstead Heath?	Topographical maps acquired as part of the desk study and Figures 12 and 14 of the Arup report
4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	A site walkover confirmed that the site is currently entirely covered in hardstanding and the details provided on the proposed development indicate that this situation will remain once the development is complete.
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)?	The details of the proposed development do not indicate the use 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?	Topographical maps acquired as part of the desk study and Figures 11 and 12 of the Arup report.

The following table provides the evidence used to answer the subterranean (groundwater flow) screening questions.

Question	Evidence
1. Does the existing site include slopes, natural or manmade, greater than 7°?	Topographical maps and Figures 16 and 17 of the Arup report and confirmed during a site walkover
2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7°?	The details of the proposed development provided do not include the re-profiling of the site to create new slopes
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	Topographical maps and Figures 16 and 17 of the Arup report and confirmed during a site walkover
4. Is the site within a wider hillside setting in which the general slope is greater than 7°?	
5. Is the London Clay the shallowest strata at the site?	Geological maps 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?	A site walkover confirmed that there are no trees on site.
7. Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site?	Knowledge on the ground conditions of the area were used to make an assessment of this, in addition to a visual inspection of the buildings carried out during the site walkover
8. Is the site within 100 m of a watercourse or potential spring line?	Topographical maps acquired as part of the desk study and Figures 11 and 12 of the Arup report
9. Is the site within an area of previously worked ground?	Geological maps and Figures 3, 5 and 8 of the Arup report
10. Is the site within an aquifer?	Aquifer designation maps acquired from the Environment Agency as part of the desk study and Figures 3, 5 and 8 of the Arup report.
11. Is the site within 50 m of Hampstead Heath ponds?	Topographical maps acquired as part of the desk study and Figures 12 and 14 of the Arup report.
12. Is the site within 5 m of a highway or pedestrian right of way?	Aerial photography, site plans and the site walkover confirmed that the site is within 5 m of the footways and highways of Museum Street, West Central Street and New Oxford Street.
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	The site walkover has indicated the position of the proposed development in relation to neighbouring properties. A review of the proposed development has been used to provide an initial assessment of whether the basement extension will alter differential founding depths.
14. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	Maps and plans of infrastructure tunnels suuplied by C2M Hiill and Tfl were reviewed, in addition to online infrastructure maps, showing exclusions zones, made available by TfL, as shown in Section 2.3 of this report.

9.1.2 Scoping and Site Investigation

The questions in the screening stage that there were answered ‘yes’, were taken forward to a scoping stage and the potential impacts discussed in Section 4.0 of this report, with reference to the possible impacts outlined in the Arup report.

A ground investigation was carried out, which has allowed an assessment of the potential impacts of the basement development on the various receptors identified from the screening and scoping stages. Principally the investigation aimed to establish the ground conditions, including the groundwater level, the engineering properties of the underlying soils to enable suitable design of the basement development and the configuration of existing party wall foundations. The findings of the investigation are discussed in Section 5.0 of this report and summarized in both Section 7.0 and the Executive Summary.

9.1.3 Impact Assessment

Section 9.0 of this report summarises whether or not, on the basis of the findings of the investigation, the potential impacts still need to be given consideration and identifies ongoing risks that will require suitable engineering mitigation. Section 8.0 of this report also provides recommendations for the design of the proposed development, whilst Part 3 provides the outcomes of a ground movement analysis and building damage assessment, which has also been used to provide a conclusion on any potential impacts from the proposed basement development.

Part 3: GROUND MOVEMENT ANALYSIS

This section of the report comprises an analysis of the ground movements arising from the proposed basement and foundation scheme discussed in Part 2 and the information obtained from the investigation, presented in Part 1 of the report.

10.0 INTRODUCTION

The sides of a basement excavation will move to some extent regardless of how they are supported. The movement will typically be both horizontal and vertical and will be influenced by the engineering properties of the ground, groundwater level and flow together with the efficiency of the various support systems employed during construction.

An analysis has been carried out of the likely movements arising from the proposed underpinning and localised deepening of the existing basement and the results of this analysis have been used to predict the effect of these movements on surrounding structures.

10.1 Construction Methodology

The façades of the existing buildings are to be largely retained and supported by a temporary steel frame prior to incorporation into the permanent works. It is proposed that mass concrete underpins will be used to provide temporary and permanent support where the basement will be deepened.

Following completion of the underpinning, new ground bearing raft slabs will be formed to support the new structure.

11.0 BASIS OF ANALYSIS

An assessment of ground movements arising from the basement deepening and loading from the new structure has been undertaken using the The analysis of potential ground movements within the excavation, as a result of unloading and reloading the underlying soils, has been carried out using the Oasys P-Disp (Version 19.3) software package and is based on the assumption that the soils behave elastically, which provides a reasonable approximation to soil behaviour at small strains.

For the purpose of these analyses, the corners have been defined by x and y coordinates, with the x-direction parallel with West Central Street towards Museum Street, whilst the y-direction is parallel with West Central Street towards New Oxford Street. Vertical movement is in the z-direction.

The full outputs of all the analyses are provided for the two worst cases; further data can be provided on request but samples of the output movement contour plots are included within the appendix along with a damage assessment.

The outline demolition and construction sequence along with details of the proposed foundations have been provided by Mason Navarro Pledge in their structural calculations and drawings.

11.1 Underpinning Related Movements

The drawings provided by Mason Navarro Pledge (MNP) indicate that the underpinning will generally extend to between 1.0 m and 1.2 m below the existing structure. Since an underpinning lift of 2.5 m or so will typically induce a vertical movement in the order of 2 mm to 5 mm it is anticipated that the much shallower underpinning will induce movements of 1 mm to 2 mm. These are considered negligible for the purposes of this assessment.

11.2 Basement Heave Related Movements

At this site the loads imposed by the existing building are supported by spread foundations bearing in the Lynch Hill Gravel and are assumed to be in equilibrium since the buildings that occupy the site are over 50 years old. Certain of the loads will remain essentially unchanged whilst new raft slabs will transfer some loadings to a lower level. The existing and new loads have been provided by MNP.

For the analysis the ground movements have been estimated at an initial stage where the demolition has taken place, and a second stage following excavation of the site to the formation level of the new raft slab which is generally at 20.6 m OD. The unloading of the London Clay that lies beneath the Lynch Hill Gravel will take place as a result of the basement deepening and the reduction in vertical stress will cause heave to take place in the short term although the proposed reloading will enable recovery of some of that heave.

The loading conditions at the various stages of work are shown in the table below; the loading intensities are the differences from the existing situation and therefore reflect the net loading at each point in time.

Site Area	Existing Loading pre-demolition (kN/m^2)	Loading following Demolition (load change) (kN/m^2)	Loading following Excavation (load change) (kN/m^2)	Loading following Construction (load change) (kN/m^2)
A	47.7	47.7 (0)	47.7 (0)	48 (+0.3)
B	72.9	51.5 (-21.4)	51.5 (-21.4)	57 (-15.9)
C	72.9	51.5 (-21.4)	51.5 (-21.4)	57 (-15.9)
D	80.1	58.5 (-21.6)	58.5 (-21.6)	70.8 (-9.3)
E	42.9	0 (-42.9)	-23.4 (-66.3)	71 (+28.1)
F	53.7	0 (-42.9)	0 (-53.7)	20 (-33.7)

Undrained soil parameters have been used to estimate the potential short term movements, which include the "immediate" elastic movements due to the load changes in the short term. These include the unloading due to demolition and the deepening of the basement as well as the introduction of the new loads. The final loadings have then been checked for long term movements using drained soil parameters.

The elastic analysis requires values of soil stiffness at various levels to calculate displacements. Values of stiffness for the soils at this site are readily available from published data and we have used a well-established method to provide our estimates. This relates values of E_u and E', the drained and undrained stiffness respectively, to values of undrained cohesion, as described by Padfield and Sharrock[11] and Butler[12] and more recently by O'Brien and

[11] Padfield CJ and Sharrock MJ (1983) *Settlement of structures on clay soils*. CIRIA Special Publication 27

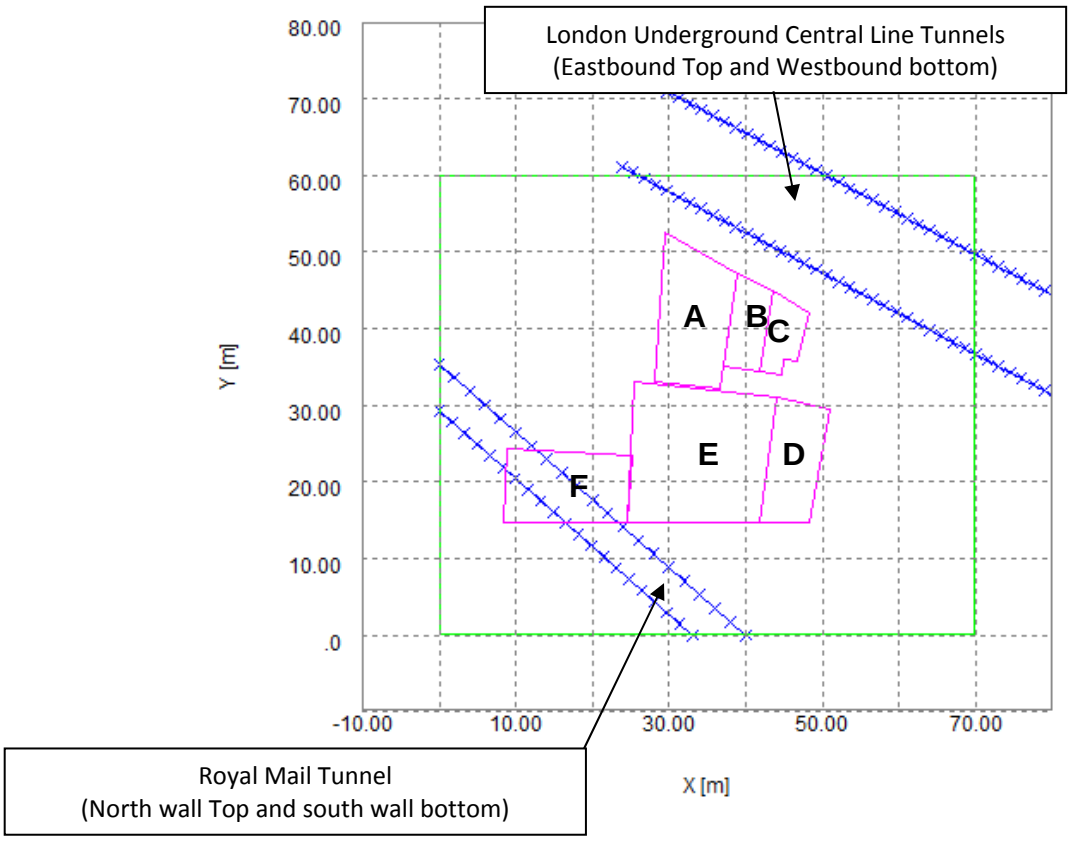
Sharp[13]. Relationships of E_u = 500 C_u and E' = 300 C_u for the cohesive soils and 2000 x SPT 'N' for granular soils have been commonly used to obtain values of Young's modulus. More recent published data[14] indicates stiffness values of 750 x Cu for the London Clay and a ratio of E' to Cu of 0.75. It is considered that the quality of the more recent research and the central London location of its study sites justify the use of the values from Burland, Standing and Jardine for this site and therefore provide a sensible approach for this stage in the design.

The soil parameters used in this assessment are tabulated below.

Stratum	Depth range (m) [Level range mOD]	Eu (MPa)	E' (MPa)
Lynch Hill Gravel	Basement Level to 3.5 [21.95 to 18.75]	90	90
London Clay	From 3.5 [18.75]	53 - 124	39 - 93

A rigid boundary for the analysis has been set at a depth of roughly 30 m (-5.0 m OD) in the London Clay. Below this depth the soils of the Lambeth Group are anticipated to be present and are considered to be essentially incompressible for the purpose of this analysis.

The loading zones and tunnel locations are shown on the plan below.



[12] Butler FG (1974) *Heavily overconsolidated clays: a state of the art review.* Proc Conf Settlement of Structures, Cambridge, 531-578, Pentech Press, Lond

[13] 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

[14] 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

12.0 RESULTS

12.1 Heave and Settlement Movements

The P-Disp analysis indicates that, by the time the demolition and unloading are complete up to around 5 mm of heave is likely to have taken place at the centre of the proposed excavation, increasing to around 8 mm following the deepening of the basement. The heave movements reduce to typically less than 3 mm of movement at the edges. Following completion the total ground movements vary between a maximum heave of 5 mm in Zone F and a maximum settlement of less than 5 mm in the centre of Zone E.

The effect on the LUL tunnels is movement of much less than 0.1 mm at any stage of the construction. These movements are therefore deemed to be of no consequence to the structure of the tunnel.

The effect on the Royal Mail Tunnel is a maximum movement of between zero and 2.0mm over the 50 m of tunnel analysed.

The predicted movements are summarised in the table below; the results are presented to the degree of accuracy required to allow predicted variations in ground movements around the structure to be illustrated, but may not reflect the anticipated accuracy of the predictions.

Location	Maximum Unloading Movements relative to the original level (mm)	Long Term Total Movements relative to the original level (mm)
Centre of the basement Zone E	-5	5
LUL Tunnel Westbound (0.6 m OD)	zero to - 0.08	zero to 0.02
LUL Tunnel Eastbound (1.4 m OD)	zero to – 0.016	zero to 0.01
Royal mail Tunnel (10.0 m OD)	zero to – 2.0	zero to 1.0
Note: Positive movements are settlements and negative movements are heave		

The analysis has concluded that the ground movements at the crown of the Central Line Tunnel will be less than 0.1 mm of heave in the short term followed by recovery of that heave and further settlement of less than 0.1 mm; these movements are considered to be negligible.

The movements along the length of the Royal Mail Tunnel, whilst greater than those of the LUL tunnels are less than 2.0 mm over the 50 m length studied. This represents a strain of less than 0.004 % and may again be considered negligible.

13.0 DAMAGE ASSESSMENT

In addition to the above assessment of the likely movements that will result from the proposed development on key sensitive third party structures, the surrounding structures that form this ‘block’ of buildings have been considered. There has been a focus on balancing the loading of the new structure with that of the existing structure. Inspection of the contour plots for each stage of the demolition and construction does not indicate differential movements of more than about 3 mm over a 10 m length of wall. This represents a strain of less than 0.03 % which is well within the 0.05 % that is within Burland Category 0 – negligible.

13.1 Monitoring of Ground Movements

The predictions of ground movement based on the ground movement analysis will be checked by monitoring of adjacent buildings. Condition surveys of the above existing structures will be carried out before and after the proposed works.

The precise monitoring strategy will be developed at a later stage and it will be subject to discussions and agreements with the owners of the adjacent properties and structures. Contingency measures will be implemented if movements of the adjacent structures exceed predefined trigger levels. Both contingency measures and trigger levels will need to be developed within a future monitoring specification for the works.

14.0 CONCLUSIONS

The analysis has concluded that the predicted damage to the neighbouring properties would, at worst be 'negligible'. On this basis, the damage that would inevitably occur as a result of such an excavation would fall well within acceptable limits.

The demolition and subsequent excavation and construction will in practice be separated by a number of weeks. This will provide an opportunity for the ground movements to be measured and the data acquired can be fed back into the design and compared with the predicted values. Such a comparison will allow the ground model to be reviewed and the predicted long term movement predictions reassessed.

15.0 OUTSTANDING RISKS AND ISSUES

This section of the report aims to highlight areas where further work is required as a result of limitations on the scope of this investigation, or where issues have been identified by this investigation that warrant further consideration. The scope of risks and issues discussed in this section is by no means exhaustive, but covers the main areas where additional work may be required.

The ground is a heterogeneous natural material and variations will inevitably arise between the locations at which it is investigated. This report provides an assessment of the ground conditions based on the discrete points at which the ground was sampled, but the ground conditions should be subject to review as the work proceeds to ensure that any variations from the Ground Model are properly assessed by a suitably qualified person.

The ground movement analysis has concluded that the predicted damage to the neighbouring structures would be 'Negligible',On this basis, the damage that would inevitably occur as a result of such an excavation would fall within the acceptable limits.

It is recommended that movement monitoring is carried out on all structures prior to and during the proposed basement construction.

These limited areas of risk should be drawn to the attention of prospective contractors and sufficient contingency should be provided to cover the outstanding risk.

APPENDIX

Borehole Records

SPT Summary Sheet

Trial Pit Records

Geotechnical Test Results

SPT & Cohesion/ Level Graph

Chemical Analyses (Soil)

Generic Risk Based Screening Values

Envirocheck Extracts

Historical Maps

Site Plan

P-DISP ANALYSIS
Short Term Movement
Total Movement