WEBB YATES ENGINEERS

Geotechnical Desk Study

15 Great James Street

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1. INTRODUCTION

Webb Yates Engineers Ltd (Webb Yates) were engaged by Marrick Consult to prepare a geotechnical desk study on behalf of 15 Great James Street Ltd for the proposed redevelopment of 15 Great James Street, located in central London.

The desk study provides a preliminary assessment of the proposed development with regards to ground engineering considerations.

Based on information available in the public domain, the desk study makes preliminary recommendations regarding:

- Potential foundation design options.
- Basement retention considerations.
- The identification geo-hazards that may affect design and construction.
- Identification of hazards and associated risk of ground contamination.
- Recommendations for future ground investigation.

The outcomes of this desk study are preliminary and have been developed based on limited information regarding the proposed development and environs of the site. The information provided within is not suitable for detailed design or costing purposes.

2. DEVELOPMENT SITE

2.1. Development location

The proposed development is located at 15 Great James Street, London WC1N 3DP and it is shown in Figure 1. The site is located approximately 1.0 km southeast of London Kings Cross station at approximate grid reference TQ 30742 81987, within the administrative boundaries of the Borough of Camden and it is neighbouring with residential buildings (14 & 16 Great James Street), as depicted in Figure 2.

Figure 1: Location of proposed development.

2.2. Site history

Detailed maps and aerial photographs of the site and surrounding area dated 1877 to 2019 (at scales of 1:2,500 and 1:10,000), provided as part of the Envirocheck Report for the site, have been reviewed. This process has been undertaken to identify any former land uses at the site and within the surrounding area that may have geotechnical or geo-environmental implications for the proposed redevelopment. The findings are summarised in Table 1. Only features considered to have a potential contaminative impact on the site and usually within a notional 250m radius of the site boundaries are discussed. Google Earth and other publicly available sources of information have also been reviewed to support this assessment.

Table 1: Former land use history.

Date range	Key on-site features	Key off-site features
1877 – 1878	The present day building does not appear to have been constructed at this time and the frontage of the site to Great James Street is unoccupied.	Surrounding area predominantly comprising residential properties.
1896	Present day building appears to be present at this time, with a property now occupying the previously unoccupied frontage to Great James Street.	No significant off-site changes noted.
1916	No changes noted.	No significant off-site changes noted.
1952 – 1953	The plan layout of the building appears to have changed, perhaps due to the merging of properties off Great James Street and Cockpit Yard, respectively.	Large council depot shown to the immediate south-east of the site on Cockpit Yard. Properties on the junction of Theobald's Road and John Street noted as 'Ruins' – presumably due to bomb damage.
1953 – 1954	No changes noted.	No significant off-site changes noted.
1958 – 1966	No changes noted.	No significant off-site changes noted.
1962 – 1990	No changes noted.	No significant off-site changes noted.
1963 – 1974	No changes noted.	'St George the Martyr C of E Primary School' now shown circa 45m north of the site.
1965 – 1968	No changes noted.	'St George the Martyr C of E Primary School' no longer shown and a series of residential properties are present.
1975 – 1983	No changes noted.	No significant off-site changes noted.
1991 – 2019	No changes noted.	No significant off-site changes noted.

2.3. Current site use

The site is currently occupied by a four-storey residential property (which may at present be unoccupied) with a single storey basement level / lower ground floor. See Figure 2.

Figure 2: 15 Great James Street – view from street (16, left, and 14, right, Great James Street either side).

3. ENVIRONMENTAL SETTING

3.1. Mining and mineral extraction

There are no BGS Mineral Sites, man-made mining cavities or natural cavities listed within 1km of the site boundary.

The site is not listed within the Envirocheck Report as within an area affected by coal mining.

3.2. Soil chemistry

A review of the BGS soil chemistry data for the average concentrations in the area of the site, included within the Envirocheck Report, has been undertaken and is summarised below / overleaf. These concentrations are considered to be background levels for heavy metals at the site and should be considered in any future contaminated land assessment undertaken.

Arsenic: 15 to 25 mg/kg

Cadmium: < 1.8 mg/kg

Chromium: 60 to 90 mg/kg

Lead: 300 to 600 mg/kg

Nickel: 30 to 45 mg/kg

It should be noted that the concentrations indicated above do not exceed the relevant residential without plant uptake Generic Assessment Criteria (GAC), which include Soil Guidance Values (SGVs) (CL:aire), Category 4 Screening Levels (C4SLs) (DEFRA) and the 2014 Land Quality Management (LQM) / Chartered Institute of Environmental Health (CIEH) Suitable for Use Levels for Human Health Risk Assessment (S4ULs).

3.3. Radon

The Indicative Atlas of Radon for England and Wales and the Envirocheck Report indicate that the site is within a Lower Probability Radon Area (less than 1% of homes are estimated to be at or above the Action Level). The BGS and the Building Research Establishment Radon Guidance Document indicates that no radon protection measures are required in the construction of new dwelling or extensions required in this area.

3.4. Hydrogeology

The bedrock at the site, the London Clay Formation (Clay, Silt and Sand) is classified as Unproductive Strata and comprises rock layers with low permeability, that have negligible significance for water supply or river base flow. Unproductive Strata were formerly classified as Non-Aquifers by the Environment Agency.

The site is not located within a Groundwater Source Protection Zone. There are 2 no. Groundwater Source Protection Zones within 1km of the site.

There are no surface or groundwater abstractions on site. There are 5 no. groundwater abstractions within 1km of the site.

3.5. Hydrology

There is one discharge consent listed 904m to the west of the site within the Envirocheck Report. The consent is listed as operated by The London School of Hygiene and Tropical Medicine. The consent has been active since the 12th January 2011 and remains active. The discharge type is classified as trade discharge – cooling water.

The nearest surface water feature to the site is listed 877m south-east of the site.

There are 3 no. pollution incidents to controlled waters listed to have taken place within 1km of the site. These incidents are listed in the Envirocheck report with an Incident Severity of Category 3 – Minor Incident.

3.6. Flood risk

The Envirocheck report states that the site is located within an area with potential for groundwater flooding of property situated below ground level.

The site is not situated in an area that is at risk of extreme flooding from rivers or seas without defences and does not benefit from flood defences.

No further consideration of flood risk is given in this report. Specialist flood risk advice should be sought with regards to drainage and flooding.

3.7. Ecology

No ecological receptors have been identified on site. No invasive weeds were noted to be present within the front and rear gardens of the existing residential property on site during the site walkover.

There are no sensitive land uses identified within 1km of the site including nature reserves, Ramsar sites or ancient woodland. No areas of adopted greenbelt, areas of scientific interest, protected areas or national parks are present within 1km of the site.

3.8. Archaeology

No archaeological features have been identified on site or in the immediate vicinity.

3.9. Waste management and hazardous materials

There are no historical landfill sites within 700m of the site and no current landfill or waste transfer sites located within 2km sites within 2km of the site boundary.

There are no areas of infilled land (non-water) or areas of infilled land (water) listed within 2km of the site.

There is 1 no. registered radioactive substance site listed within 250m of the site in the Envirocheck report associated with the Great Ormond Street Hospital For Children.

3.10. Contemporary trade directories

There are no contemporary trade directory entries listed on site. The closest entry to the site relates to a ceramic manufacturing and supply business at Studio 2e Cockpit Yard, which is listed as inactive. A number of additional entries are listed adjacent to the site on Cockpit Yard, including cabinet makers, milling manufacturers, stained glass designers and picture / picture frame restorers – all of which are listed as inactive.

1 no. active contemporary trade directory entry is present adjacent to the site, associated with a jewellery manufacture and repair business.

A further 7 no. entries are listed within 50m of the site, 13 no. between 50 – 100m. The majority of these entries are inactive. Active entries between 100 – 200m from the site include a garage, a perfume supplier, a clothing and fabric manufacturer, and a dry cleaners.

3.11. Unexploded ordnance

The web-based mapping service www.bombsight.org provides an interactive map showing the recorded locations of bomb strikes in London during WWII. The maps are based on bomb census data collected during the war, which is held by the National Archives. Figure 3 shows a screen capture, which identifies that a High Explosive bomb strike was recorded close to Cockpit Yard, immediately adjacent to the proposed development.

In addition, a preliminary UXO threat assessment undertaken by 6 Alpha highlights that this area has undergone a high level of bombing with respect to the rest of London with an approximate bombing density of over 46 bombs per 100 hectares.

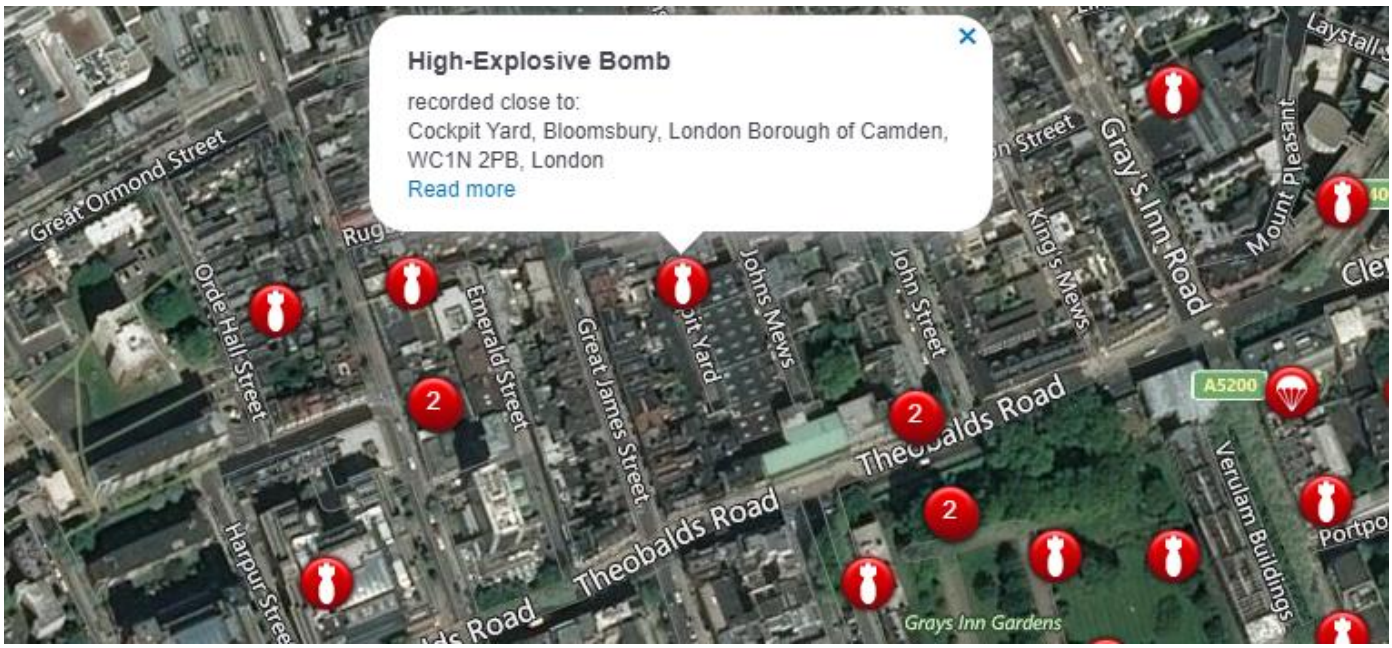

Figure 3: High-explosive bomb recorded close to Cockpit Yard.

Details of risk management strategies are outlined in CIRIA C681.

Due to the proximity of recorded bomb strikes, it is recommended that a UXO specialist is engaged to assess the site and provide recommendations on appropriate mitigation measures and strategies. The 6 Alpha preliminary threat assessment recommends that a detailed UXO threat and risk assessment is undertaken.

As a minimum, it is strongly recommended that all contractors and specialist subcontractors undertaking intrusive works adopt appropriate procedures to mitigate against risks associated with encountering UXOs on site. In this particular instance, this may include briefing all site staff and operators with regards to the inherent risks, establishing simple, robust and safe procedures in the event where UXOs are encountered. This aspect should be confirmed and detailed in all relevant contractor/works method statements in order to ensure appropriate protocols are adopted.

3.12. Geotechnical hazards

The British Geological Survey and Environment Agency hazard mapping have identified the following potential geotechnical hazards at the proposed development site:

- Very Low potential for collapsible ground stability hazards.
- Very Low Potential for landslide ground stability hazards.
- Very Low potential for running sand ground stability hazards.
- No Hazard potential for ground dissolution stability hazards.
- No Hazard potential for compressible ground stability hazards.
- No Hazard for shrinking or swelling clay ground stability hazards.

4. GEOLOGICAL SETTING

4.1. Information sources

The following sources were consulted to obtain information regarding the regional and local geological conditions at the proposed development site.

- British Geological Survey, 1:50,000 scale, England and Wales, Sheet 256 – North London.
- British Geological Survey, GeoIndex Onshore GIS database,
- British Geological Survey.

4.2. Regional geological history

The development site is located within the London Basin, which refers to an approximately triangular synclinal structure in which the sedimentary units underlying London and much of south-east England were deposited.

The basement formation of the London Basin is a deep (~200m thick) layer of chalk, which was deposited throughout the Upper Cretaceous period during a period of high sea levels and warm oceans.

Following global cooling and retreat of inland seas, the next major event to affect the basin's formation was the Alpine-Himalayan orogeny. Collision of the southern hemisphere African and Indian plates with the northern hemisphere Eurasian plate compressed the chalk formation across south-east England. The effect was the creation of a sinusoidal compression wave in the upper crust, which is apparent today in the synclinal structure that is the London Basin and the remnants of the anticlinal structure that was, visible in the adjacent Wealden Dome to the south (Figure 4).

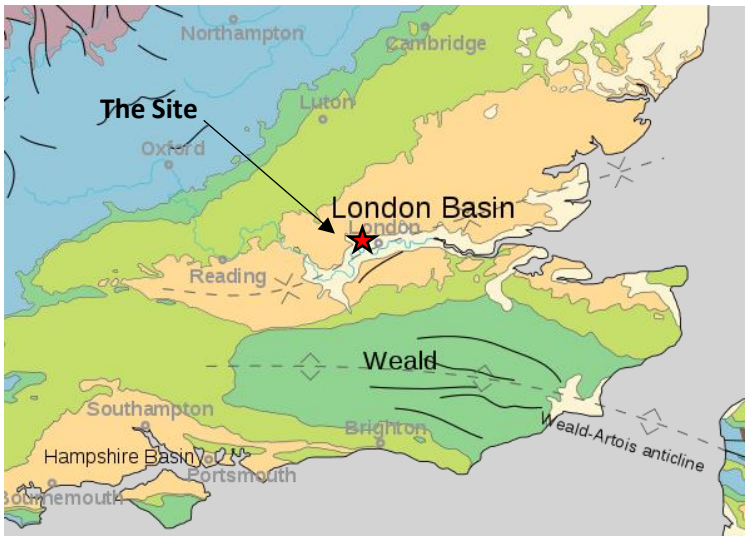

Figure 4: Relationship between the synclinal London Basin and Wealden anticline (based on the Geologic map of SE England and the English Channel, Wouldloper, distributed under a CC-By-3.0 licence).

Subsequent sea level rise and fall led to deposition of sediments within the London Basin. The oldest (and deepest) sediments in the basin are the Thanet Beds, which comprise fine, silty glauconitic sands originating in shallow seas.

Overlying the Thanet Beds is the Lambeth Group, a depositionally and geographically complex unit which comprises layers of sands and gravels, shelly and mottled clays and minor limestones and lignites and occasional sandstone and conglomerate.

The Lambeth Group was deposited during successions of relatively minor, but important sea level fluctuations. The sub-units encountered at any particular geographical location within the London Basin today reflect that location's relative proximity to a prehistoric coastline and whether deposition was dominated by marine, estuarine, lagoonal, fluvial or terrestrial processes.

Overlying the Lambeth Group are the deposits of the Thames Group, that were laid down throughout the Eocene. Following a brief period of uplift and erosion that deposited the basal Harwich Formation, the London Basin was subject to a significant marine transgression, which shifted the coastline far to the west of its present limits.

As the marine transgression progressed and the shallow seas within the basin became ever deeper, the characteristics of deposition changed to fine grained silty clay, which is today identified as the London Clay Formation.

In the Quaternary period, the London Basin was affected by the Anglian glaciation, where ice sheets extended over the British Isles and terminated north of the Basin. A significant geomorphological consequence of this glacial period was the diversion of the proto-Thames to the south and into the London Basin.

The diversion of the river was followed by erosion of the London Clay and aggradation of extensive sand and gravel river deposits. As the relative sea level reduced, the Thames and its tributaries incised deeper into the underlying London Clay, leaving a series of river terraces (Figure 5), which are encountered throughout and near to the surface of the basin today.

Most recently, deposition may take the form of alluvium, comprising sand, silt and clay occurring within the depositional fields of existing tributaries. Additionally, the presence of anthropogenic deposits, such as deep fills associated with historic industry, or site levelling activities are typically encountered within London.

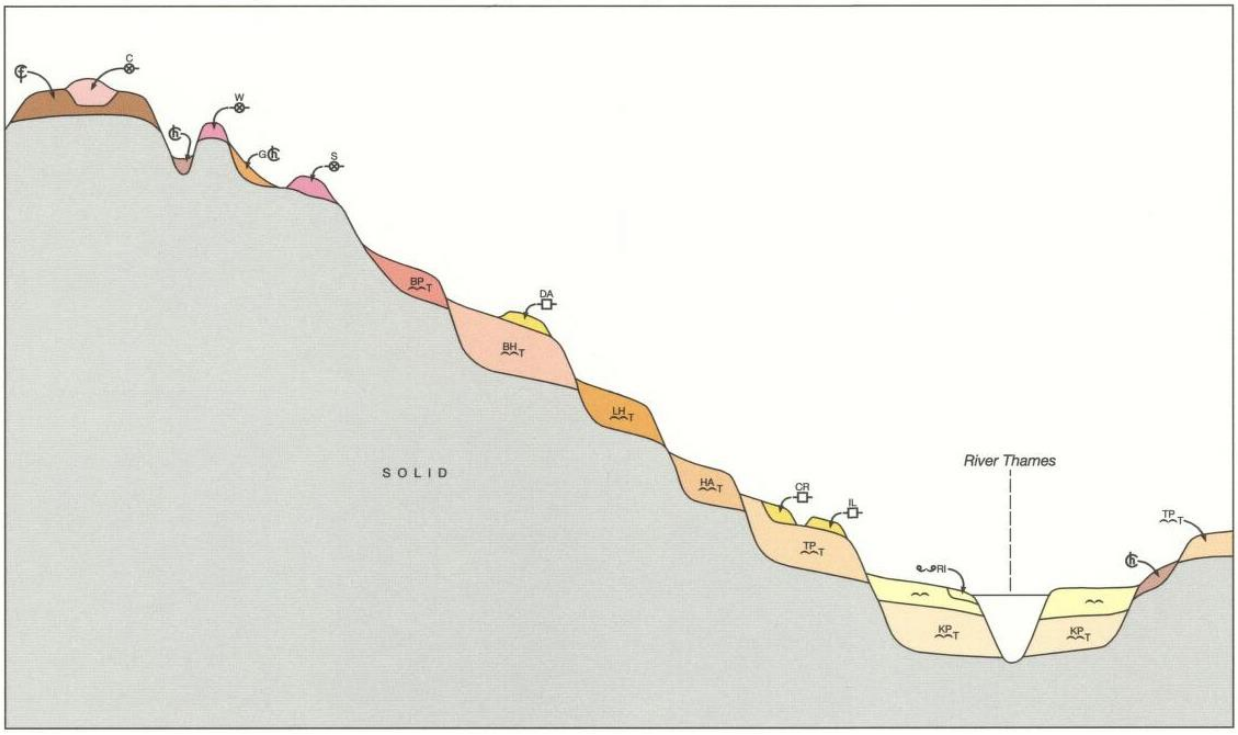

Figure 5: Schematic representation of the distribution of river terrace deposits within the London Basin.

4.3. Local geology and topography

The site is located approximately at the British National Grid coordinates of 570747E, 181988N.

Figure 6 illustrates the location of the development within the context of a regional geological map. The map illustrates the spatial distribution of superficial (drift) and bedrock units that outcrop at the ground surface (n.b. made ground is generally not shown but can be assumed to exist in most developed areas).

The site is located in an area comprising superficial deposits of the Lynch Hill Gravel Member (river terrace deposits) overlying the London Clay Formation.

Historical boreholes TQ38SW124, TQ38SW266, TQ38SW143 and TQ38SW157 are positioned circa 100m from the site to the west, north, east and south of the site, respectively. There are currently no historical records available in the public domain at the proposed development site, or at immediately neighbouring properties.

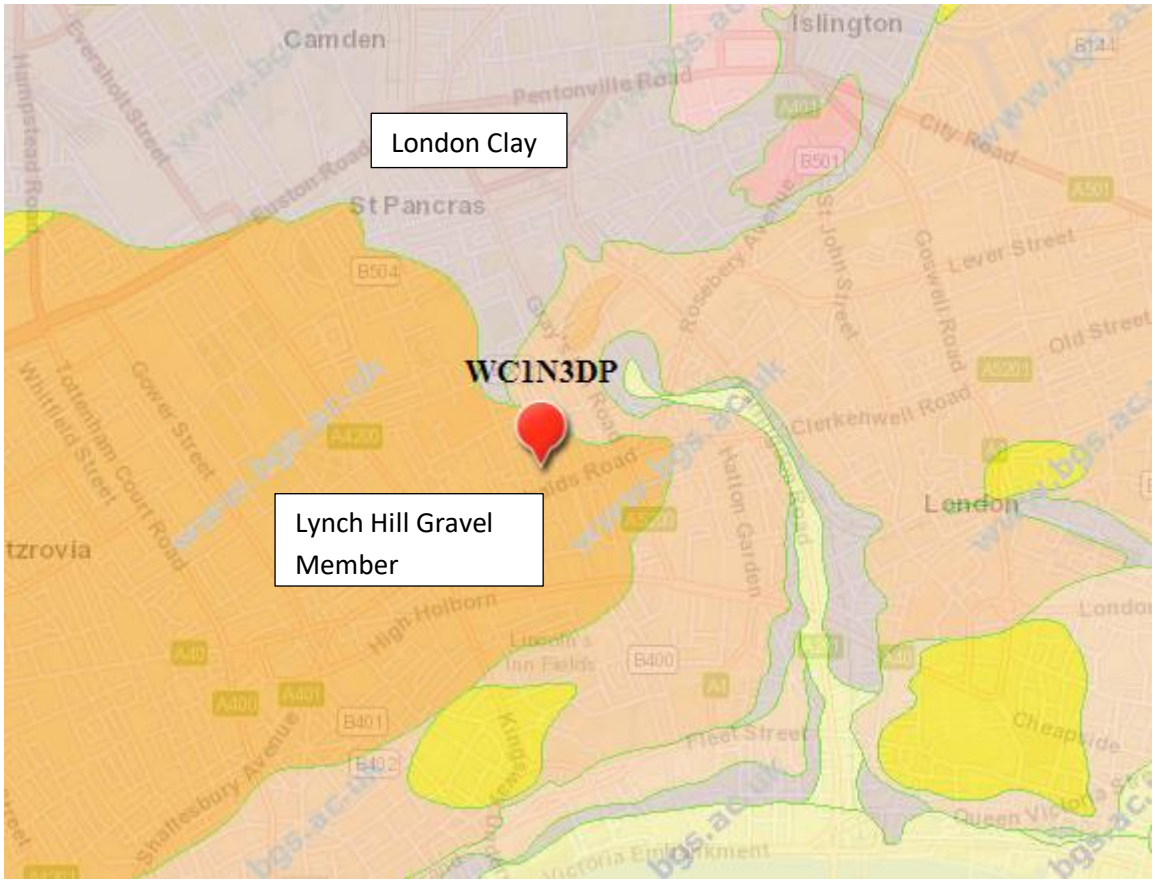

Figure 6: Regional geology.

4.4. Preliminary ground model

The general conclusion that can be drawn by inspecting the boreholes outlined in Section 4.3 is that the ground model is expected to consist of a variable thickness of Made Ground, of the order of 0.5 to 1.5 m thick, underlain by Alluvium & River Terrace Deposits and finally the London Clay Formation to a considerable depth.

Given the extent of the scheme proposals at the time of writing (extension of the existing basement / lower ground floor level to the rear of the property) it is not considered that the thickness of the London Clay or its boundary with underlying deposits require determination.

4.5. Groundwater model

Perched ground is expected to be present within the Made Ground and River Terrace Deposits, atop the London Clay aquiclude. Such bodies of water are expected to fluctuate in level seasonally, or due to anthropogenic influences such as burst water mains etc.

Groundwater monitoring will be required during the ground investigation phase to confirm the hydrogeology of the development site.

5. PROPOSED DEVELOPMENT

5.1. Overview

The proposed works will comprise the redevelopment of the existing 15 Great James Street property and the extension of the existing basement / lower ground floor level to the rear of the property. The proposed basement excavation works will extend from the existing lower ground floor level to the east toward Cockpit Yard.

Figure 7 and Figure 8 display existing and proposed sections through the development, respectively.

Figure 7: Section through existing property with excavation area in red hatching.

Figure 8: Section through final proposed arrangement with basement extension.

5.2. Substructure proposals

The substructure proposals, current at the time of writing, for the extension works to the rear of the property include a combination of underpins on party wall boundaries and L-shaped retaining wall sections as the primary means of earth retention and load bearing support.

The new basement floor will comprise a ground bearing slab tied into underpin / retaining wall sections.

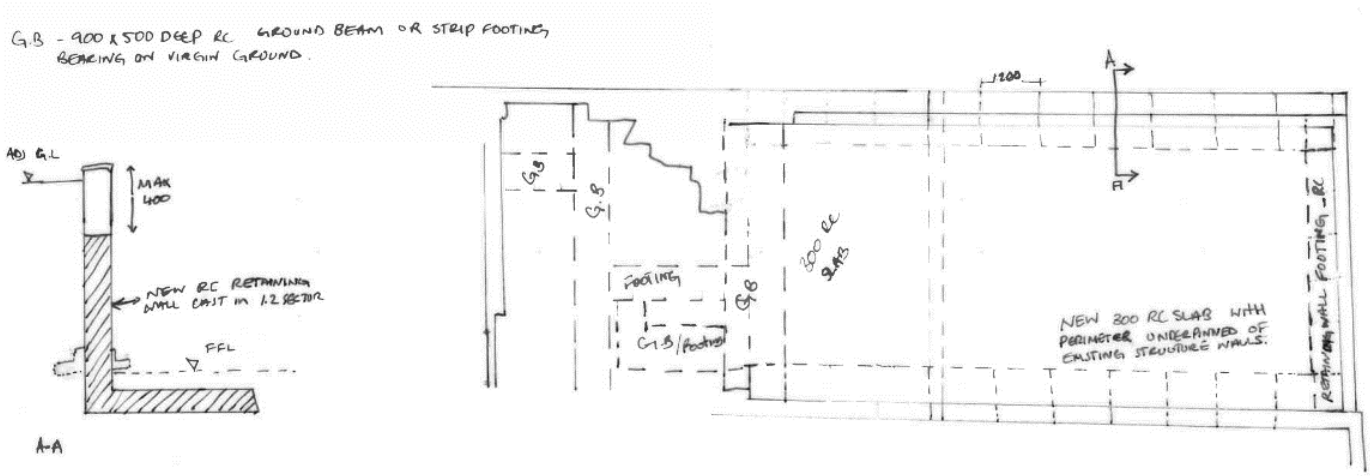

Figure 9: Indicative basement extension foundation layout.

6. GEOTECHNICAL DESIGN AND CONSTRUCTION

6.1. Standards and codes of practice

The design of ground works should be carried out in accordance with (but not limited to) the following standards and codes of practice:

Permanent works:

- BS EN 1991 (all parts) – Eurocode 1: Actions on structures.
- BS EN 1997-1:2004+A1:2013 – Eurocode 7: Geotechnical design – Part 1: General rules.
- BS 8004:2015 – Code of practice for foundations.
- BS 8002:2015 – Code of practice for earth retaining structures.
- LDSA:2017 – Guidance notes for the design of straight shafted bored piles in London Clay.

Temporary works:

- PAS 8811:2017 – Code of practice for temporary works.
- PAS 8812:2016 - Guide to the application of European Standards in temporary works design.
- BS5975: Code of practice for temporary works procedures and the permissible stress design of falsework.

Ground investigation:

- BS EN 1997-2:2007 – Eurocode 7: Geotechnical design – Part 2: Ground investigation and testing (incorporating corrigendum 2010).
- BS 59300:2015 - Code of practice for site investigation.
- Other references that may be of use:
- CIRIA C760 – Guidance on embedded retaining wall design.

6.2. Ground engineering considerations

6.2.1. Groundwater

Nearby historic boreholes indicate that the ground water table may be present within the River Terrace Deposits overlying the London Clay Formation.

Standpipe piezometers should be installed within the River Terrace Deposits as part of the ground investigation phase, to record possible groundwater level variation with time and the prevailing direction of groundwater flow.

This information will be required to facilitate the design of retaining systems, foundations and basement waterproofing requirements – should the water table be found to be present above the formation level of the proposed basement.

6.2.2. Uplift conditions

Unless underdrainage measures are included beneath the basement slab, the substructure design will need to consider the effect of any possible groundwater uplift condition.

This facet should be reviewed in detail upon receipt of site specific ground investigation data, in order to inform the ongoing design development of the foundations and earth retention system.

6.2.3. Basal heave

The demolition and excavation works are expected to cause heave pressures to develop beneath the proposed basement slabs due to the long term dissipation of suctions generated in the London Clay Formation as a result of overburden removal.

Following receipt of the site specific ground investigation data, the requirement (if any) for heave mitigation measures should be reviewed.

6.2.4. Basement earth retention system

Excavation depths of approximately 3.0 to 4.0m are currently proposed to form the basement extension.

In order to enable these bulk excavation works, the current scheme proposals adopt earth retention solutions in the form of underpinning and RC L-sections around the basement perimeter, installed in bays.

Temporary propping may be required to limit the ground movements around the proposed construction site during excavation works and prior to installation of permanent works elements. Localised pumping of groundwater inflow arising from finite bodies of perched water within the Made Ground / River Terrace Deposits may be required to keep the basement dry as the works progress. This is subject to confirmation of the groundwater table elevation following site specific ground investigation works.

A ground movement assessment should be carried out to confirm that installing a soil retention system and conducting the required excavation will not produce excessive ground movements that may result in damage to existing buildings or third-party infrastructure. This is discussed in greater detail in Section 6.3. If ground movements pose an unacceptable risk to existing property or assets, the retaining wall may need to be propped until the basement and ground floors are substantially complete.

6.3. Third party interfaces

Ground movements resulting from the proposed sequence of works may pose a risk of damage to adjacent properties and/or third party assets such as utilities. A ground movement assessment may be required to assist with planning approvals and to facilitate detailed design. It is anticipated that this would be form part of a Basement Impact Assessment, which would be developed to support the planning process.

The ground movement assessment would assess the displacement of the soil surrounding the proposed development site and the associated impact of that movement on existing structures and infrastructure.

Based on previous experience, the following items are generally required to be assessed:

- Risk of damage to existing buildings due to ground movements associated with basement construction and operation of the proposed building. Generally submitted to the Local Authority for review of planning consent. The assessment of risk to buildings is usually based on Burland's Damage Scale. Historically in central London, approval for the would require that the risk of damage to existing buildings does not exceed *Category 2 – Slight*. In the Borough of Camden, this requirement has now been restricted with planning approval only discharged if it can be demonstrated that the risk of damage does not exceed *Category 1 – Very Slight*.
- Ground movements may also impact buried services. The presence of any buried services should be investigated further as the scheme progresses.

It is recommended that asset protection teams for the various utility owners are engaged early in the project design life. In our experience, asset owners such as Thames Water will require a relatively detailed assessment of the impact of ground movement on their services, in particular if there are Victorian-era brick masonry sewers or cast-iron trunk mains. The utility providers will generally define the performance limits that must not be exceeded for their assets.

7. OUTLINE GROUND INVESTIGATION SCOPING

7.1. Investigation context

The ground investigation will form an integral part of the planning and design process moving forward.

The ground investigation will be required to inform (among other things):

- Selection of geotechnical parameters for the founding soil.
- Groundwater regime to inform foundation design, construction methodology, basement design and waterproofing requirements, etc.
- Geotechnical parameters for numerical modelling of soil-structure interactions and preparation of ground movement and building damage assessments.
- The presence of contaminated made ground and disposal requirements.
- Groundwater quality and gas.

7.2. Preliminary investigation scope

It is recommended that site specific ground investigation to be undertaken, in order to inform design development. It is suggested that the geotechnical scope includes the following:

- One window sample in general compliance with BSEN1997.
- One cable percussion borehole in general compliance with BSEN1997.
- In-situ testing in the form of Standard Penetration Testing including in-situ strength testing for characterisation purposes.
- Trial pitting around the perimeter of the existing property, as required.
- Classification and index property laboratory testing.
- Chemical testing (full conditional suite to BRE SD1).
- In-situ groundwater monitoring.

The ground investigation works should also include full Phase I & II geo-environmental risk assessments with regards to contamination and any required remediation measures.

8. CLOSING REMARKS

Webb Yates Engineers Ltd (Webb Yates) were engaged by Marrick Consult to prepare a geotechnical desk study on behalf of 15 Great James Street Ltd for the proposed redevelopment of 15 Great James Street, located in central London.

The anticipated ground conditions at the site comprise a thin layer of Made Ground overlying Alluvium and River Terrace Deposits and finally the London Clay Formation to depth.

Mapping of bomb strikes in London during WWII shows that a high explosive bomb strike was recorded in close proximity of the site (recorded as close to Cockpit Yard). It is recommended that a UXO specialist is engaged to review the proposed development site as part of a detailed UXO threat and risk assessment and advise on risk mitigation measures.

It is understood that the basement extension works will be enabled by the construction of a combination of underpins to party walls and RC L-section retaining walls cast in bays. A detailed ground movement assessment should be undertaken in order to ascertain the likely impact of the works on adjacent properties and/or third-party assets such as buried services.

An outline ground investigation scope has been produced, in order to facilitate costing during the ongoing scheme development. It is considered that this scope would be sufficient to satisfy all design element and planning condition requirements, as the scheme progresses. The detailed scope of the ground investigation works will be captured in a scheme ground investigation performance specification document.