Engineering Design
and Construction Method Statement

PRE-PLANNING STAGE

PROJECT:

33 Cadogan Lane, London, SW1X 9DR

CLIENT:

Cavendish Corporate Investments PCC Ltd

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EXECUTIVE SUMMARY

This report has been prepared to address the engineering issues associated with the proposed alterations including the vertical basement extension at the property known as 33 Cadogan Lane, London, SW1X 9DR. The report follows the format recommended within the “Royal Borough of Kensington and Chelsea Basement Study Report”– March 2013 by Alan Baxter Associates.

This proposed basement is located beneath the footprint of the property at 33 Cadogan Lane and extends partially into the rear garden to the property. The construction of this basement presents logistical and engineering challenges which are covered by this report.

The basement extension below the existing ground floor level of the property is intended to be constructed using well proven traditional techniques comprising segmental reinforced concrete cantilever underpins beneath the existing foundations to the front and party walls in order to achieve the required reduced level. A full width opening is proposed at both ground and basement levels to the main rear wall of the property and a double height steel ‘box’ frame structure is to be provided to support the existing rear wall above first floor level. The proposed basement is to extend into the rear garden below a single storey extension above ground level and beyond to achieve a part covered sunken area with steps up to the rear garden level.

The design of the proposed basement is covered in the report and a sequence of work showing how the basement can be safely constructed is also presented.

A geotechnical basement impact assessment has been carried out by a qualified geotechnical engineering firm, GEA Associates Ltd and is appended to this document.

During the construction of the proposed basement a comprehensive monitoring scheme is to be implemented, this is to ensure that any settlement or deflections are identified at an early stage and adequate measures can be undertaken to limit further movement.

Excavation of the basement footprint will require that temporary propping be installed to the concrete cantilever underpinning. These temporary props will be carefully designed by a specialist temporary works engineer acting on behalf of the main contractor to ensure that ground movements are minimised and outline temporary works scheme is presented within this report.

The combination of these recommendations represents a full suite of measures designed to ensure the proposed basement can be constructed safely avoiding any significant damage to the existing building, adjoining properties or adjoining roads.
SECTION 1 | INTRODUCTION

Ward Cole Consulting Engineers Ltd have been appointed by Cavendish Corporate Investments PCC Ltd – Cell 344 to assess the civil and structural impact of the proposed basement extension to 33 Cadogan Lane, London, SW1X 9DR.

The proposed alterations to the subject property are to include the construction of a new basement underneath the existing building footprint, extending back into part of the rear garden.

The following issues relating to the site have enabled Ward Cole to undertake the feasibility study and prepare this Construction Method Statement:

- Existing and proposed layouts of the property provided by the Architect for the project, Red Button Developments Ltd.
- A geotechnical and contamination assessment has been undertaken based on the findings of a site investigation undertaken by GEA Associates Ltd in November 2016 and borehole logs are included in the Appendix to this report.
- The site is in flood risk zone 1: designated as very low risk and therefore a flood risk assessment will not be required.
- The site investigation report and boreholes records from GEA Associates Ltd indicate made ground to a depth down to 3.00 m, whereupon the Kempton Park Gravel extended to 8.80 m is underlain by the London Clay Formation.
- The site investigation measured groundwater at 6.00 m below ground level. It is therefore unlikely that groundwater will be encountered during the proposed excavations for the single level basement formation.
- The site is considered sufficiently far away from the underground lines for these not to affect the site.

1.1 DESCRIPTION OF PROPERTY AND WORKS

1.1.1 Description of the Property

The property under consideration is currently a three storey mid-terraced building constructed, it is estimated, during the 1960’s or the 1970’s using traditional loadbearing masonry walls and timber upper floors with a conventional timber framed pitched roof. The front and rear elevations appear to be cavity wall construction and it is considered likely that the party walls have been built in solid brickwork. The first and second floor timber joists span front to back with intermediate steel beams within the floor construction spanning between the party walls. The ground floor is solid concrete and incorporates a garage to the left hand side. To the rear a single storey glazed conservatory is present leading to the rear garden. The site is relatively true and level with no obvious significant retaining conditions present.

1.1.2 Description of the Proposed Works

It is proposed to construct a new basement beneath the footprint of the existing building extending at the rear into the back garden below a single storey rear extension and beyond into the rear garden to facilitate a part open courtyard area with stepped access up to the rear garden at ground floor level.

The proposed alterations to the building also include an architectural reconfiguration of the existing floor layouts and the formation of a near full width opening at ground and basement levels below the main rear wall to the property using a double height steel ‘box’ frame installation.
The primary structural works will comprise the following:

~ Underpinning to existing perimeter walls to the building including party wall foundations in order to achieve reduced level to allow construction of the proposed basement. Construction of a reinforced concrete basement slab structurally tied into the base of the underpinning and the formation of a new ground floor slab using steel beams and proprietary metal decking.

~ Extension of the basement level construction into the rear garden using underpinning techniques similar to that used to construct the extension under the footprint of the building.

~ Construction of a new ground floor slab in reinforced concrete using proprietary metal decking as permanent shuttering supported on steel beams integral with the floor construction spanning between the party walls.

~ Formation of near full width openings below the main rear wall of the property at ground and proposed basement levels using a double height steel ‘box’ frame installation.

~ Formation of a new single storey rear extension to the property with external terracing.

~ Reconfiguration of the internal architectural layouts at the existing first and second floor levels including the replacement of the existing timber staircase.

~ The above ground drainage will, subject to invert levels, be drained by gravity to the existing combined sewer system, replicating the existing drainage strategy.

~ The basement level foul water will be drained by gravity to a proprietary specialist design and supply pump chamber and pumped via a rising drain to the existing combined manhole located to the front of the property. This combined manhole discharges into the existing combined sewer in Cadogan Lane.

~ The basement level cavity drainage system and storm water are to be collected by gravity to separate proprietary pump chambers designed and supplied by a specialist which are to be pumped via a rising drain to the existing combined manhole located to the front of the property.

~ The proposed development falls within the scope of the Party Wall Act 1996 and procedures under the act will be dealt with in full by a qualified professional Party Wall Surveyor appointed on behalf of the client. The designs for the new basement structure will be developed so as not to preclude or inhibit similar works on the adjoining properties. This will be verified by Surveyors as part of the process under the Act.
1.1.3 Diagrammatic Existing and Proposed Building Sections
2.1 THE SITE AND EXISTING USE

The site is located on Cadogan Lane bounded by Cadogan Place to the west and by Chesham street to the east.

The subject property is incorporated within a substantial three storey terrace block consisting of similar properties in terms of scale and construction situated on either side of the site and share party walls. The other properties on Cadogan Lane vary in form with historic two storey mews type properties present on the opposite side of the Lane and a relatively more recent multiple occupancy residential mansion block located adjacent to the terrace block incorporating the subject property.

The site occupies a plot of approximately 9m x 9m plan dimensions.

2.2 SITE TOPOGRAPHY

The site is relatively level with no significant retaining conditions present. Generally the ground levels appear to be approximately similar for all surrounding and adjacent properties with no significant variation in ground level.

2.3 GEOTECHNICAL SITE INVESTIGATION

The following information is based on intrusive site investigation works undertaken at the subject property on the 21st November 2016 comprising a single borehole [BH1] taken down to 15 metres in depth by Geotechnical & Environmental Associates and their factual and interpretative report dated January 2016 outlining the findings. This report is appended to this document.

The structural design of the proposed basement works has been informed by the findings of the site investigation including parameters established therein for the design of foundations and retaining wall conditions. Additional site investigations have been undertaken consisting of shallow trial pitting and excavation in order to establish the nature and extent of the existing building foundations and the ground conditions likely to be encountered during the proposed excavation for the basement including any water seepage issues that may arise.

The soils encountered within BH1 below an existing 200 mm thick concrete ground bearing slab are described below:

<table>
<thead>
<tr>
<th>Top [AD]</th>
<th>Base [AD]</th>
<th>Depth [m]</th>
<th>Description</th>
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<tr>
<td>15.15</td>
<td>12.15</td>
<td>3.00</td>
<td>Made Ground: brick rubble, earth and gravel fill.</td>
</tr>
<tr>
<td>12.15</td>
<td>6.35</td>
<td>5.80</td>
<td>River Terrace Deposits: Medium dense to dense and very dense orange brown sandy fine to coarse gravel.</td>
</tr>
<tr>
<td>6.35</td>
<td>0.15</td>
<td>6.20</td>
<td>London Clay: Stiff to very stiff grey silty clay.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>~ Borehole complete at 15.00 m</td>
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2.3.1 Allowable Ground Bearing Pressure

A net allowable bearing pressure of 350 kN/m² is stated in the Site Investigation report as acceptable for spread foundations bearing in the gravel at 3.0m below existing ground level. This assumes a safety factor of 3.

2.3.2 Heave

There is no requirement for the provision of heave protection measures to the basement slab in the form of heave protection board as likely heave movements are not considered to be significant by the geotechnical investigation.

2.3.3 Contamination

A sample of made ground recovered from Borehole No 1 was analysed as part of the geotechnical investigations for a range of contaminants and the results have not revealed any elevated concentrations of the contaminants tested.

2.4 DRAINAGE

The existing foul and surface drainage serving the property discharge to a manhole in front of the entrance to the property and then to the combined sewer extending down Cadogan Lane. A combined sewer is routed down the centre of Cadogan Lane running southern direction down towards West Eaton Place. Details of the sewer and water main retrieved from Thames Water are included in the Appendix.

As the basement is being constructed beneath the footprint of the building the existing below ground drainage will become redundant and a new storm and foul drainage system constructed below basement floor level. This will require the installation of proprietary storm and foul dual pump packages and chambers to pump the storm and foul water via rising mains into the existing combined manhole at the front of the property which then discharges by gravity into the public sewer, as currently is the case. The proposed basement scheme will not increase existing surface storm water runoff areas from the site.

A geotechnical borehole investigation within the plan area of the proposed basement confirmed ground water level to be at 6m below existing ground level ie some 3m below the proposed basement floor level. Ground water levels are being monitored at the site but it is likely that the level of ground water will be several metres below the depth of the proposed basement. Waterproofing strategy for the proposed basement based upon the borehole site investigation undertaken will comprise a Delta Membrane cavity drain water management system. The primary barrier to water penetration will be the reinforced concrete underpinning and basement floor with the cavity drain system collecting any “perched water” that penetrates the primary underpinning construction. Any Delta Membrane cavity drain water will be collected by a perimeter channel drain discharging into a separate proprietary dual pump chamber and then pumped via a rising main to the combined manhole at the front of the property. The Delta Membrane cavity drain system will be to specialist design.
SECTION 3 | GEOTECHNICAL, HYDROGEOLOGICAL AND HYDROLOGICAL ASSESSMENT

3.1 GEOLOGY

The British Geological Survey Map No270 shows the site to be underlain by the Kempton Park Terrace Gravels over London Clay. The 6th geological map of the area shows the site to be underlain by Alluvium over First Terrace Sands and Gravels over London Clay.

The borehole [BH1] investigation undertaken by Geotechnical & Environmental Associates Ltd in November 2016 has confirmed this information.

Alluvium

Alluvium is, geologically speaking, a recent deposit found in association with streams, rivers and other watercourses. It usually consists of soft clays and silts and often has a high organic content. Lenses and bands of peat are commonly found.

It is inherently variable and rapid lateral transitions in soil type should be anticipated, even though borehole sampling may indicate fairly consistent conditions.

The soft and variable nature of the soil gives rise to many construction problems. Running sand or silt is often encountered when least expected. Excavations deeper than 1.5 to 2m are often unstable and close sheeting and strutting is usually required. Bottom heave may be encountered in clayey soils below 3m.

Kempton Park Gravels

Kempton Park Gravels are part of the former Flood Plain gravel, which is the youngest of the three river Terrace Gravels that were laid down by the Thames when the climate was much wetter and cooler than at present. The terrace consists of a sheet of gravel and sand with an overlying deposit of Brickearth (really an ancient alluvium). Some variability in soils is to be expected at junctions with the other terraces, as the remains of the old riverbanks can be soft and silty or contain clay.

In common with other gravels in the area, it has often been worked in the past, on a piecemeal basis. The old pits were usually infilled with rubbish and are very difficult to detect by random excavations. Intensive geophysical testing will find most of the old pits, but it should be noted that deeper foundations may be required in some areas and that some noxious fill may also be found.

London Clay

London Clay is a well-known stiff (high strength) blue-grey, fissured clay, which weathers to a brown colour near the surface. It contains thin layers of nodular calcareous mudstone – “claystone” – from place to place, and crystals of water clear calcium sulphate (selenite) are common. Although slopes will stand in the clay at steep angles in the short term, the long-term stable slope angle is about 7 degrees for grassed, or cleared slopes, and a few degrees more for wooded slopes.

3.1.1 Slope Stability

The site is on generally level ground and not cut into the side of hills or valleys and therefore slope instability is not considered to be an issue associated with the proposed basement development.
3.1.2 Existing foundations

The existing foundations appear to consist of traditional mass concrete strip footings to the front, rear and party walls extending to approximately 0.6m below existing concrete ground floor slab level. Findings of the exploratory investigation carried out in order to establish the existing wall foundation profiles and formation levels are presented within the Appendix to this report.

In so far as it has been possible to establish, the site is not located above any historic tunnels, LUL assets, infrastructure, sewers or utilities.

3.2 HYDROGEOLOGY

3.2.1 Existing Water Table

Groundwater was encountered during the intrusive investigation measured at 6.00 m below ground level within the Kempton Park Gravels.

It is therefore unlikely that groundwater will be encountered during the 3.00 - 3.50 m deep basement excavation.

A groundwater monitoring standpipe was installed within BH1 to allow future periodic measurements to establish seasonal variations in the water level. A trial pit excavation is recommended prior to commencement of construction of the basement.

It should be noted that changes in groundwater levels do occur for a number of reasons including effects and variations in drainage. Such fluctuations may only be recorded by the measurement of the groundwater level within a standpipe or piezometer installed within appropriate response zones.

3.2.2 Ground Water Flow

It is our considered assessment that the flow of ground water around the basement will not be affected by the new basement construction. The relatively small size of the basement's footprint combined with the limited depth of excavation primarily within the made ground above the zone of gravels indicates that the existing flow of ground water will not be adversely affected or impeded.

In general the “natural” trend in groundwater flow directions within the Upper Aquifer would originally have tended to be towards the old river courses incised in the River Terrace Deposits which have largely been culverted. This is believed to be the case of the old Westbourne River and surrounding ground water.

The old Westbourne River was diverted into an egg brick culvert that runs to the north of the site down Chesham Street. The old route of the river is evident in the old boundaries between Cadogan Lane and Chesham Street and would indicate that the flow of the ground water is in a northerly direction through the site.

Arup’s Subterranean Development Scoping Study (para 5.1) June 2008, states that the impact of subterranean development on groundwater flows is negligible as groundwater flows will find an alternative route if blocked by a subterranean structure.

RBKC Supplementary Planning Document. Adopted May 2009, (para 4.5.1) states with regard to the impact of subterranean development on ground water flows and levels, groundwater flows will find an alternative route if blocked by a subterranean structure, although there may be very small rises in level these changes in level are likely to be significantly less than the natural variations in the water table associated with seasonal variations.
In the unlikely event that ground water is encountered during the course of excavation a localised excavated sump of size 1m x 1m x 1m is to be formed at a level lower than the progressive base of excavation being carried out.

A timber perforated plywood shell is to be constructed to support the perimeter of the temporary working sump and placed within the excavated zone. Any ground water which is present will naturally flow to the sump area and at this point a 50mm diameter semi trash water pump unit is to be introduced with a 50mm diameter discharge hose. Once located adjacent to the excavation level sump the solids pump hose is to be routed to the nearest adjacent manhole for discharge.

3.3 FLOOD RISK ASSESSMENT

The site is in Flood Risk zone 1 according to Environmental Agency mapping and although a flood risk assessment is not required, a flood risk assessment has nonetheless been undertaken and is appended to this report for information.

~ The proposed development area falls within Flood Zone 1 i.e. an area having low probability of flooding.

~ The development proposal is classified as ‘more vulnerable’ according to Planning Policy Statement 25 (PPS25) Development and Flood Risk (Communities and Local Government 2006) as a residential home and considered to be ‘Appropriate’.

~ There will be no change to the surface runoff from the proposed development.

~ The basement will only be accessible from within the property, thus there is no increase in flood risk to the basement.

~ There is no increased risk to flooding.

Surface water has been managed to prevent any increase in adverse impacts on neighbouring land and infrastructure. The development does not increase flood risk elsewhere in the neighbourhood.
SECTION 4 | PROPOSED STRUCTURAL WORKS

4.1 BASEMENT DESIGN

The following sections should be read with reference to the drawings contained within Appendix to this report.

The proposed vertical basement extension to 33 Cadogan Lane sits under the footprint of the existing building and is extended beneath the rear garden area of the subject property.

The proposed basement walls are to be extended below the existing ground floor level to form the proposed basement level using traditional steel reinforced concrete underpinning techniques.

Underpinning of the party walls with adjoining properties to either side and front wall to 33 Cadogan Lane will be undertaken to ensure that the walls are not undermined during the excavation works and to ensure that continuous support is provided. The underpins will be constructed in short (approximately 1.0m) sections in a ‘hit and miss’ pattern typical of this type of construction.

The foundations for the party walls will be extended down below the proposed basement level in order to prevent excessive settlement with the underpinning acting to transfer the vertical load from the party wall foundations down to the new lower level and, with the aid of temporary propping, act as temporary support against the lateral pressures from the sides of the excavations during construction.

Underpinning is the primary component of the works and the safe and proper execution of the construction will require the works to be undertaken by a contractor with considerable experience of this type of construction technique ensuring high quality workmanship together with a well-defined sequence of construction and with appropriate levels of attention to the temporary works design including the provision of an adequate level of lateral propping.

The temporary propping system will be designed by a specialist chartered temporary works design engineer acting on behalf of the contractor undertaking the works and installed in sufficient quantities so as to minimise any settlement of adjacent ground. A suggested sequence for the underpinning works is included on Ward Cole drawings appended to this report.

Following the completion of the underpinning and the installation of the temporary works, excavation can proceed ensuring provision of additional temporary propping across the width of the building between completed sections of the underpinning to the front and party walls at the top, intermediate and base levels as the excavation is taken down to basement slab level. Construction of the reinforced concrete basement and ground floor slabs can then be completed.

4.1.1 Hydrostatic Pressure

The basement has been designed for the equivalent hydrostatic force of a head of water located 1m below ground level. This pressure is counteracted by the dead load of the proposed structure in the completed permanent condition.
4.1.2 Clay Heave

The excavation of the basement will result in an unburdening of the stiff London clay formation, potentially resulting heave. This is a long term effect that occurs due to unloading of the shrinkable soils. This effect will start during excavation and will continue over a number of years. This effect results in a force being exerted on the underside of the new basement over time.

The 3.00 m deep excavation will result in a net unloading of 55 kN/m². Given the generally minimal excavation, the remaining thickness of the gravel below the proposed basement and the continued loads applied by the retained house, heave movements are not considered likely to be significant.

4.1.3 Waterproofing Systems

The basement waterproofing will be provided with a type ‘C’, grade 3 level of protection in accordance with the architects specification and as defined by BS 8102:2009.

Water and moisture will be excluded from the finished basement by the installation of a proprietary specialist designed cavity drained system with an inner liner wall. The cavity drained waterproofing system will discharge to a sump chamber and pump system into the public sewer.

The waterproofing system will be installed in accordance with the specialist contractors details and manufacturers technical specification

4.2 TEMPORARY WORKS

An outline sequence of construction for the proposed basement is detailed within the drawings prepared by Ward Cole and appended to this report. The final detailed temporary works design will be carried out by an appropriately qualified professional temporary works engineer acting on behalf of the main contractor and will be checked on behalf of the client by the consulting structural engineer.

Prior to commencement of any works the full detailed design, drawings, method statements and calculations shall be submitted to the consulting structural engineer for comment and approval purposes.

4.2.1 Outline Sequence of Works and Method of Construction

The following is a suggested proposed sequence of works, which should be read in conjunction with all relevant Ward Cole drawings and specification, and as previously stated the final detailed temporary works design will be carried out by an appropriately qualified professional temporary works engineer acting on behalf of the main contractor.

1. Set up monitoring points on front and back of the existing buildings and start taking weekly readings for a period of two months prior to start of work to establish naturally occurring background movements. Prior to start of construction instigate the monitoring regime noted in this report.

2. Install standpipes and monitor existing ground water levels.

3. During this period the contractor is to appoint a specialist temporary works engineer to carry out a full and detailed design of the temporary works needed to construct the basement. This temporary works design will be sent to the consulting structural engineer for comment and approval.

4. Brace all existing window and door openings to the front and rear elevations using timber framing and cross bracing.

5. Insert temporary ‘waler’ and cross brace propping across building at base of existing perimeter walls above ground floor slab level.
6. Commence underpinning to form the perimeter walls to the proposed basement in accordance with an agreed sequence of construction. Underpinning will be executed in a series of gradual steps. It relies on the integrity of the surface wall to share load whilst small sections are progressively undermined. A suggested sequence is indicatively shown on Ward Cole drawings.

   o The first step is the exposure of the top of the existing foundation, by breaking out the existing lower ground/ground floor construction along the edge of the foundation to the wall that is to be underpinned.

   o The next step is to excavate along the existing wall foundations in a series of small sections [each typically of length 1m to 1.5m], in a “hit and miss” pattern that alternates an excavated section with one where the soil under the foundation is left in place. Each pit would be approximately 3.0 - 3.5 m in depth to achieve the required formation level. Given the presence of a significant thickness of made ground over granular soils, some instability may occur, in which case, limiting panel widths and extending the underpin legs in two stages may be necessary in order to help limit the amount of instability.

   o The excavation is anticipated to be undertaken by hand. All excavations for individual underpinning pits must be considered at risk and suitably designed appropriate levels of propping and shoring of the excavation is to be provided at all times. In the unlikely event that groundwater encountered, this will be locally pumped to enable the works to progress.

   o When a series of spaced gaps under a particular run of wall have been excavated and installation of reinforcement has been completed concrete will be cast under the existing foundation using suitable plywood shuttering, thus filling the excavated holes to form underpins.

   o The cast concrete will be stopped approximately 75 mm short of the soffit to the existing foundation to the wall being underpinned and this space will be packed with dry pack rammed into place to ensure full load transfer from the wall to the underpinning.

   o After the concrete in the first set of underpins has cured, the remaining intermediate sections of soil (which have been left in place between the first underpins) will be gradually excavated piecemeal. Concrete underpins will then be cast into these holes. Together, the series of underpins form a continuous concrete strip footing.

   o When the full perimeter of the basement area has been underpinned in this manner, extending down to the necessary depth, the full excavation of the basement space will proceed, followed by casting the basement floor slab and fitting out of the basement.

7. When commencing the main excavation it should be noted that the walls of the basement will not be stable in the temporary condition once the main bulk is removed. Horizontal forces will act to cause the basement walls to overturn or collapse and the bottom of the walls to slide inwards. A horizontal propping scheme must be designed and installed in line with the construction sequence in order to prevent structural failure. This horizontal propping usually consists of horizontal ‘waler’ and cross propping across the width of the building at the top intermediate and base height levels to facilitate the main excavation.

8. Construct the basement floor slab. After all concrete is fully cured remove temporary propping as necessary and construct new ground floor steelwork and composite deck floor slab.

9. Complete basement works including installation of proprietary cavity drained system and lining wall.
Following the completion of the proposed works associated with the basement under the foot print of the building it is anticipated that excavation to allow the extension of the basement into the rear at this level will be undertaken using a “bottom-up” construction technique where the basement extends beyond the adjoining single storey extensions to the neighboring properties.

It is anticipated that the perimeter retaining walls and associated foundations to the rear and sides of the basement extension into the rear garden will be formed using reinforced concrete construction designed in accordance with the recommendations of BS 8110. The method of construction envisaged for the formation of this area of basement to the rear garden is a “bottom-up” type of construction approach; as follows:

- Excavate top down installing trench sheeting extended as the depth of the excavation is increased. Retention of the soil behind the required excavation is to be provided by a suitably designed temporary support system comprising trench sheeting with horizontal ‘wales’ at the top, bottom and intermediate vertical intervals together with corresponding horizontal strutting across the full width of the excavation.

- Temporary works to be extended down vertically as excavation proceeds to final formation level.

- Once temporary works system to support the excavation is complete, the permanent reinforced concrete retaining walls, base foundations and slab will be constructed. The temporary works are to be maintained intact and in place until the permanent works are complete to ensure the stability of the excavation and surrounding and adjacent building structures.
SECTION 5 | POTENTIAL IMPACT OF PROPOSED DEVELOPMENT

5.1 STRUCTURAL SETTLEMENT OR DAMAGE

The underpinning process involves transferring the foundation loads to a lower level and inevitably this can lead to settlement. Some movement will be caused by the sequential transfer of load between different parts of the structure but the careful control of the underpinning process and sequence will keep such movements to a practicable minimum. Particular care will be taken in the vicinity of the more vulnerable parts of the existing building fabric.

The depth to the London Clay and modest dimensions of the site are such that the heave of the Clay is unlikely to exceed a few millimetres or to have any discernible effect outside the site boundaries. Any movement that does occur will be further mitigated by the slow rate of the excavation and construction.

By installing adequate temporary propping and new permanent works the anticipated movements caused by the development are to be limited to not exceed 5mm at any location within the host or adjacent properties. It is anticipated that the crack widths will not exceed 5mm within the slight category as described by BRE Digest 251, Category 2. The definition of these classifications is given in “Building Response to the Excavation-Induced Settlement” M.D. Boscardin and E.J. Cording, ASCE 1989 and summarised below:

<table>
<thead>
<tr>
<th>Class of Damage</th>
<th>Description of Damage</th>
<th>Approximate Crack Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negligible (Cat 0)</td>
<td>Hairline Cracks</td>
<td>&lt; 0.1mm</td>
</tr>
<tr>
<td>Very Slight (Cat 1)</td>
<td>Fine Cracks easily treated during normal Redecoration. Perhaps isolated fracture in building. Cracks in exterior brickwork visible upon close inspection.</td>
<td>&lt; 1mm</td>
</tr>
<tr>
<td>Slight (Cat 2)</td>
<td>Cracks easily filled. Re-decoration probably Required. Several slight fractures inside building. Exterior cracks visible, some re-pointing may be required for weather tightness. Doors and windows may stick slightly.</td>
<td>&lt; 5mm</td>
</tr>
<tr>
<td>Moderate (Cat 3)</td>
<td>Cracks may require cutting out and patching. Recurrent cracks can be masked by suitable Linings. Tuck-pointing and possibly replacement of a small amount of exterior brickwork may be Required. Doors and windows sticking. Utility Services may be interrupted. Weather tightness often impaired</td>
<td>5 to 15mm or several cracks &gt;3mm.</td>
</tr>
<tr>
<td>Severe (Cat 4)</td>
<td>Extensive repair involving removal and replacement of sections of walls, especially over doors and windows required. Windows and door frames distorted, floor slopes noticeably, some loss of bearing in beams. Utility service disrupted.</td>
<td>15 to 20mm depends on number of cracks</td>
</tr>
<tr>
<td>Very Severe (Cat 5)</td>
<td>Major repair required involving partial or complete re-construction. Beams lose bearing. Wells lean badly and require shoring. Windows lean badly and require shoring. Windows broken by distortion. Danger of instability.</td>
<td>usually &gt; 25mm depends on number of cracks</td>
</tr>
</tbody>
</table>

It is anticipated that no more than ‘very slight’ to ‘slight’ damage will be inflicted on the adjoining buildings as a result of the proposed basement construction at 33 Cadogan Lane.
5.2 MOVEMENT MONITORING OF ADJACENT PROPERTIES

Throughout the construction process including underpinning, basement excavations, basement and ground floor slabs and construction of the superstructure structural works an independent specialist surveying company is to be appointed by the main contractor to monitor movement of the adjacent properties.

The methodology for the monitoring to be as follows:

~ Set up monitoring points on front and back of the existing buildings and start taking weekly readings for a period of two months prior to start of work to establish naturally occurring background movements. 3D reflective targets to be established on the front and rear of 33 Cadogan Lane as well as on the adjacent properties to each side of the subject property.

~ Establish a suitable monitoring control station(s) at the perimeter of the site from which the monitoring targets will be surveyed. The coordinate system for the monitoring to be specific to the monitoring of properties adjacent to 33 Cadogan Lane.

~ Fix additional targets for control on surrounding structures outside the zone of influence of the site works. The location of these targets to be determined during establishment of the primary control targets and will be used to establish station coordinates prior to commencement of each set of survey readings. This method of control establishment will allow for accurate control to be determined without having to rely on a fixed position in close proximity of the site works.

~ Minimum two rounds of readings to be taken to establish baseline readings before commencement of any basement works.

~ The instrument readings of the targets fixed to the adjacent building will provide both level and eastings and northing movement data. The 3D target monitoring will provide a plus or minus 2mm accuracy.

The following items will be monitored to ensure precise information is available the engineer and the team carrying out the works:

**Ground conditions:**

Observe soil and groundwater levels. Conditions that are not in accordance with design data, including unforeseen obstructions will be reported to the engineer.

**Ground Movements:**

Measuring points will be set up outside the front and the rear of 33 Cadogan Lane adjacent to the wall installation/excavation. These points will be monitored for the duration of the structural works.

**Frequency of monitoring:**

At least twice a week during the construction of the basement, during excavation and construction of permanent supports.

Thereafter: once a week until a reading of less than 3mm is reached Then once a month until the completion of the structural works.
Wall Movements:

A minimum of 6 No. spot targets will be located on the front and rear elevation of 33 Cadogan Lane & a minimum of 6 No. spot targets will be located on the front and rear of 31 and 35 Cadogan Lane.

These points will be monitored for the duration of the structural works.

Frequency of monitoring:

At least twice a week during the construction of the basement, during excavation and construction of permanent supports

Thereafter: once a week until a reading of less than 3mm is reached
Then once a month until the completion of the structural works.

It is required that monitoring points are set up well in advance of any works commencing to obtain readings for background movement.

Trigger Levels:

Limits on ground movement during wall installation movement of survey points must not exceed:

<table>
<thead>
<tr>
<th></th>
<th>Amber trigger level</th>
<th>Red trigger level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settlement</td>
<td>6mm</td>
<td>10mm</td>
</tr>
<tr>
<td>Lateral displacement</td>
<td>6mm</td>
<td>10mm</td>
</tr>
<tr>
<td>Lateral wall movement</td>
<td>6mm</td>
<td>10mm</td>
</tr>
</tbody>
</table>

Movement approaching critical values:

**Amber:** Notify engineer immediately and await response. Install additional propping as instructed. The consulting engineer is to attend site to inspect the area locally for signs of new defects such as hairline cracking. If new defects are visible then the contractor is to stop work in the affected area. The defects are to be recorded with photographs and distributed to the consulting engineer. The contractor is to await instructions from the engineer prior to proceeding with works in the affected area. If the amber level is reached a decision is to be made by the engineer if the frequency of monitoring to be increased.

**Red:** Stop work. The contractor is to stop work and put in place any temporary works measures necessary to prevent further movement. The project and temporary works engineers are to be informed and proposals agreed to limit further movement. The monitoring frequency to be increased to daily until movement is deemed to have stopped.

A monthly report will be provided to the consulting structural engineer showing the movements recorded on all survey points in the form of a graph of displacement versus time with clear lines indicating the amber and red trigger levels.
5.3 OTHER CONSIDERATIONS

5.3.1 Trees

A single tree and shrub vegetation is present within the rear garden of the subject property and it is assumed similar shrub vegetation is present within the gardens of the neighboring properties. The tree does not appear to be of significant structural significance with respect to the proposed construction proposals and any effect on the tree or its roots will need to be established following an arboricultural assessment.

5.3.2 Excavation and removal of soil

It is anticipated that hand-dug and excavated spoil is to be removed using small excavators in conjunction with conveyor belts up to ground level. Lorries will then take the spoil off-site.

A detailed construction traffic management plan has been produced by Traffic Management London Ltd. and is appended to this report.

Public rights of way will be maintained. Footpaths and roads adjacent to the site will be maintained in a clean state.

5.3.3 Demolition, Dust & Noise Control

Demolition work is to take place within the hoarded confines of the site. Materials such as stock bricks, re-usable timbers; steel beams etc. are to be recycled where possible. To minimise dust and dirt from demolition netting is to be installed where possible, fine mist water dust suppression spray to be used and roads and pavements adjacent to the site to be cleaned regularly.

5.3.4 Pre-Contract Procedures

It is anticipated that the following procedures will be undertaken at Pre-Contract stage prior to works commencing on site:

- Undertake a detailed site investigation to determine all design parameters sufficient to allow the final structural design.

- Undertake pre-condition surveys of adjacent and neighboring properties. It is expected that these surveys will be undertaken by suitably qualified party wall surveyors as part of the party wall award agreements with the neighbouring property owners/occupiers.

- To undertake a detailed structural design relating to the proposals together with the preparation of detail design structural drawings sufficient in detail for building regulation approval and construction purposes.
SECTION 6 | SUMMARY AND CONCLUSIONS

The design and construction methods to be used to achieve the proposed alterations which include a vertical single storey basement extension are conventional well tried and tested methods.

The detailed structural assessment of the proposals has demonstrated, in our view, that the design and construction methods to be used are such as to ensure that the construction, either during the course of works or upon the completion of works, will not cause harm to the built environment and will at all times maintain the structural integrity of the subject property as well as neighboring properties.

Khalid M Choudhary - BEng [Hons] CEng MIStructE FConsE

DIRECTOR - WARD COLE LTD
DATED - 20th December 2016
APPENDIX - 1

GEOTECHNICAL SITE INVESTIGATION REPORT

Geotechnical Environmental Associates
DESK STUDY & GROUND INVESTIGATION REPORT

33 Cadogan Lane
London
SW1X 9DR

Client: Cavendish Corporate Investments PCC Ltd

Engineer: Ward Cole

J16262

January 2017
Document Control

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<th>Project ref</th>
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<td></td>
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<tr>
<td>Matthew Legg BEng FGS</td>
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<td>Checked and approved for issue by</td>
<td>[Signature]</td>
<td>Steve Branch BSc MSc CGeol FGS FRGS MiEnvSc</td>
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This report has been issued by the GEA office indicated below. Any enquiries regarding the report should be directed to the office indicated or to Steve Branch in our Herts office.

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

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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 Cavendish Corporate Investments PCC Ltd-Cell 344 with respect to the refurbishment of the existing property, to include the excavation and construction of a single level basement below the footprint of the building and partially out below the rear garden. 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 assess the extent of any contamination and to provide information to assist with the design of the basement structure and suitable foundations.

DESK STUDY FINDINGS

At the time of the earliest map studied, John Roque’s 1746 map of London, the site was undeveloped within open fields with the River Westbourne, one of London’s ‘Lost Rivers’, shown flowing in a southerly direction, directly to the east of the site. By the time of Greenwood’s 1827 map of London, the surrounding area had begun to be developed with essentially the existing road network, including Cadogan Lane, although it was known as Little Cadogan Place at that time. The River Westbourne is still shown flowing to the east of the site, although it is understood that it was culverted within the Ranelagh Sewer between 1856 and 1857. The earliest Ordnance Survey (OS) map studied, dated 1878, shows the site in greater detail and to be occupied by two terraced properties fronting Little Cadogan Place and a row of five terraced properties behind, which were accessed via an undercroft from Little Cadogan Place. Some time between 1896 and 1916, all of the buildings occupying the site were demolished and the site redeveloped with a single terraced building that occupied the majority of the site over a much larger footprint than the existing property. Several other neighbouring buildings were also redeveloped at that time. Little Cadogan Place was renamed Cadogan Lane between 1938 and 1951 and by 1968 the terraced property occupying the site was demolished and the existing property constructed.

GROUND CONDITIONS

The investigation has generally confirmed the expected ground conditions in that, below a significant thickness of made ground, Kempton Park Gravel was encountered over the London Clay Formation, which was proved to the maximum depth investigated. Made ground extended to a depth of 3.00 m and generally initially comprised dark grey clayey silt with gravel and brick rubble below which, between 2.00 m and 2.40 m, a layer of loosely cemented brick was encountered over dark greyish brown silty clay with gravel and brick fragments. The underlying Kempton Park Gravel comprised dense becoming medium dense brown, yellowish brown and orange-brown locally clayey, fine to coarse sand with fine to coarse angular to rounded gravel, which extended to a depth of 8.80 m. Below the superficial soils, the London Clay comprised stiff becoming very stiff fissured high strength to very high strength dark grey silty clay with fine mica, occasional selenite crystals and partings of pale grey silt, which was proved to the maximum depth investigated, of 15.00 m. Groundwater has been measured at depths of 5.63 m and 5.76 m and the contamination testing did not reveal any elevated concentrations of the contaminants tested.

RECOMMENDATIONS

Formation level for the proposed basement should be in the Kempton Park Gravel. On the basis of the groundwater observations to date, groundwater will not be encountered in the excavation and therefore the use of conventional underpinning is considered to be an appropriate option for constructing the new retaining walls. Consideration will however need to be given to the stability of the granular soils. New spread foundations bearing below the new lower ground floor level may be designed to apply a net allowable bearing pressure of 350 kN/m². On the basis of the proposed development, remedial measures with respect to soil contamination are not generally considered to be required, although should any modification of the existing soft landscaping be proposed, this should be reviewed and additional testing carried out if deemed to be required. With the groundwater table remaining below the proposed basement, it is not considered that the proposed development will have an impact on the local hydrogeological setting.
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 Cavendish Corporate Investments PCC Ltd-cell 344 to carry out a desk study and ground investigation at 33 Cadogan Lane, London SW1X 9DR. Ward Cole are the structural engineers.

1.1 Proposed Development

It is understood that it is proposed to refurbish and extend the existing property, which will include the excavation and construction of a single level basement beneath the entire footprint of the building and extend out into the rear garden in the form of an enhanced lightwell. The lightwell will form a rear patio area at basement level with steps leading up into the garden, as shown on the proposed cross-section below. The excavation will extend to approximately 3.00 m with finish floor level at approximately 2.80 m below the ground floor.

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 research the history of the site with respect to past contaminative uses;
- to determine the ground conditions and their engineering properties;
- to provide advice with respect to the design of the new retaining walls;
- 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; 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 15.00 m using a cable percussion drilling rig;
- Standard Penetration Tests (SPTs) carried out at regular intervals within the borehole in order to provide additional quantitative data on the strength of the soils;
- the installation of a groundwater monitoring standpipe to a depth of 9.00 m and a two groundwater monitoring visits over a one-month period;
- laboratory testing of selected soil samples for geotechnical purposes and 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 and involves identifying, making decisions on, and taking appropriate action to deal with, land contamination in a way that is consistent with government policies and legislation within the United Kingdom. The risk assessment is thus divided into three stages comprising Preliminary Risk Assessment, Generic Quantitative Risk Assessment, and Site-Specific Risk Assessment.

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

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

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1 Model Procedures for the Management of Land Contamination issued jointly by the Environment Agency and the Department for Environment, Food and Rural Affairs (DEFRA) Sept 2004
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 within a residential area in the Royal Borough of Kensington and Chelsea, approximately 465 m to the north of Sloane Square London Underground station and approximately 800 north / northwest of Victoria railway and London Underground station. It may additionally be located by National Grid Reference (NGR) 528070, 179120 and is shown on the location map below.

The site forms a roughly rectangular-shaped area with maximum dimensions of approximately 30 m east-west and 5 m north-south and fronts onto Cadogan Lane to the west. It is occupied by a three-storey brick-built townhouse, with a small driveway along the site frontage with Cadogan Lane, which leads to a single garage that is incorporated within the ground floor. The house was vacant at the time of the investigation, and the eastern half of the site forms the rear private garden which was covered in a combination of block paving, artificial grass and rough lawn, with planted borders. Vegetation within the garden mainly comprises shrubs and bushes, whilst a number of the neighbouring gardens to the north also include deciduous trees of up to 12 m in height.

The site is bordered to the north and south by adjoining three-storey terraced townhouses, whilst to the east it is bordered by four-storey properties fronting Chesham Place that include
lower ground levels and mansard roof accommodation. The topography of the site and surrounding area is essentially flat and the area mostly occupied by residential properties. No potential sources of contamination were identified on the site or within the immediate surrounding area during the site walkover.

2.2 Site History

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

At the time of the earliest map studied, John Roque’s 1746 map of London, the site was undeveloped within open fields. The River Westbourne, one of London’s ‘Lost Rivers’ is shown flowing in a southerly direction, directly to the east of the site, as highlighted on the map extract below.

By the time of Greenwood’s 1827 map of London, the surrounding area had begun to be developed with essentially the existing road network, including Cadogan Lane, although it was known as Little Cadogan Place at that time and it is unclear if the site was developed at that time. The River Westbourne is still shown as an open water course just to the east of the site.
The earliest Ordnance Survey (OS) map studied, dated 1878, shows the site in greater detail and to be occupied by two terraced properties fronting Little Cadogan Place and a row of five terraced properties behind, which were accessed via an undercroft from Little Cadogan Place. The line of the Westbourne River is still shown and marks the boundary between the site and neighbouring properties fronting Chesham, Street to the east, as shown by the 1869 map extract below. However, information contained within available literature on the Lost Rivers of London\(^2\) indicates that the river had been culverted between 1856 and 1857 to form the Ranelagh Sewer and therefore the line on the historical map below is likely to mark the line of the sewer rather than an open watercourse.

Some time between 1896 and 1916, all of the buildings occupying the site were demolished and the site redeveloped with a single terraced building that occupied the majority of the site over a much larger footprint than the existing property. Several other neighbouring buildings were also redeveloped at that time.

Little Cadogan Place was renamed Cadogan Lane between 1938 and 1951 and by 1968 the terraced property that formerly occupied the site had been demolished and the existing property constructed. It was during the same period that a number of other surrounding buildings were demolished and new properties constructed, mostly presumably due to bomb damage sustained during the Second World War. This is confirmed by bomb damage maps of the area, which also confirm that the building occupying the site did not suffer bomb damage.

### 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 within 1 km of the site and that there are no waste management, transfer or disposal sites within 250 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 entries for sites within 1 km 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.

2.4 Geology

The Geological Survey map of the area (sheet 270) indicates that the site is underlain by Alluvium, associated with the former river channel of the Westbourne, over Kempton Park Gravel, which is in turn underlain by the London Clay Formation.

![Geological Map Diagram]

GEA has carried out a number of investigations in the surrounding area, including a number along Cadogan Lane. An investigation carried out at No 19 Cadogan Lane, approximately 35 m to the north, encountered a moderate thickness of made ground to a depth of 1.40 m, whereupon the Kempton Park Gravel was encountered and underlain by London Clay. The Kempton Park Gravel comprised medium dense brown sand and gravel which extended to a depth of 7.60 m, whilst the underlying London Clay comprised firm becoming stiff grey fissured clay, which was proved to the maximum depth investigated, of 15.00 m.

Additionally, an investigation carried out at Nos 51 & 53 Cadogan Lane, 70 m to the south, encountered made ground to 1.25 m, whereupon the Kempton Park Gravel extended to a depth of 6.00 m. It generally comprised an upper layer of firm becoming stiff brown to orange-brown silty sandy gravelly clay over dense orange-brown sandy gravel with occasional cobbles. Below 6.00 m the London Clay was proved to the full depth of the investigation, of 10.00 m.

Alluvium was noted to be absent at both of these sites and is likely to have been replaced by the made ground present over the Kempton Park Gravel.
2.5 Hydrology and Hydrogeology

The Kempton Park 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 capable of supporting local water supplies and may form an important source of base flow for local rivers. The underlying London Clay is classified as a Non-Aquifer and Unproductive Stratum, which refers to a soil or rock with low permeability that has a negligible effect on local water supply or river base flow as defined by the EA.

The nearest natural surface water feature is a lake within the grounds of Buckingham Palace, which is located approximately 760 m to the northeast of the site. The Serpentine within Hyde Park is located approximately 950 m to the north, whilst the River Thames is approximately 1.3 km to the south. As indicated in the site history, the River Westbourne\(^3\), which rises on Hampstead Heath, flowed southwards from Hyde Park and the Serpentine towards the River Thames. The records indicate that on leaving Hyde Park, the river flowed south along the line of what is now Lowndes Street, and continued south along the eastern boundary of the site between Cadogan Lane and Chesham Street, before meeting Sloane Street close to Sloane Square, as shown on the map below. The lower part of the Westbourne River remained open until 1856 to 1857, when its lower sections through central London were covered to become part of the Ranelagh Sewer.

![Map of the area showing the location of the site and nearby water features.](image)

In the aforementioned GEA investigations, groundwater was measured at depths of 5.00 m and 5.90 m within the Kempton Park Gravel.

The site is not located within an area at risk of flooding from rivers of sea and is not indicated on flood maps to be in an arear at risk of surface water flooding, as defined by the EA. There are no discharge consents or groundwater abstraction licences within 1 km of the site, which is also not located within a Source Protection Zone, as defined by the EA.

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\(^3\) Nicholas Barton (2000) *London’s Lost Rivers*. Historical Publications Ltd
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 only been occupied by residential properties and is therefore not considered to have had a contaminative history and no potential sources of contamination were noted during the site walkover. No off-site sources of contamination have been identified in the immediate surrounding area, including existing or historical landfill sites.

2.6.2 **Receptor**
The future users of the residential property will represent relatively high sensitivity receptors. Groundwater within the Secondary ‘A’ Aquifer of the Kempton Park Gravel is considered to be a sensitive receptor, as are neighbouring sites. New 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 the construction works.

2.6.3 **Pathway**
Across the western half of the site, the house including the single level basement and surrounding areas of hardstanding will essentially act as a barrier between end users and the underlying soils. Areas of soft landscaping are however likely to remain in the eastern half of the site, which will form a possible pathway by which end users will come into direct contact with the underlying soils; this pathway is however already in existence. The groundwater is considered to be a pathway by which soluble contaminants may migrate off and on to site via groundwater flow and the groundworks and construction period is considered to provide a pathway by which site workers and new buried services may come into contact with the shallow soils.

The London Clay below the Kempton Park Gravel is a non-aquifer and therefore forms an aquiclude and a barrier to contaminants migrating vertically down towards the Chalk Principal Aquifer. Overall 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 VERY LOW risk of there being a significant contaminant linkage at this site, which would result in a requirement for major remediation work. Furthermore, as there is no evidence of filled ground within the vicinity of the site and no landfill sites, there is not considered to be a significant potential for hazardous soil gas to be present on or migrating towards the site.

3.0 **EXPLORATORY WORK**

Access to the site was limited by the presence of the existing property. Therefore, in order to meet the objectives described in Section 1.2 as far as possible within the access restrictions, a
A single borehole was advanced to 15.00 m using a dismantlable cable percussion rig positioned in the rear garden. Standard Penetration Tests (SPTs) were carried out at regular intervals in 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.

A groundwater monitoring standpipe was installed to a depth of 9.00 m and has been monitored on two occasions over a one-month period.

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

The borehole record and the results of the laboratory analyses are included in the appendix, together with a site plan indicating the borehole position.

3.1 Sampling Strategy

The scope of the work was specified by Ward Cole. The borehole was positioned in the rear garden by an engineer from GEA in an accessible location, whilst avoiding known buried services.

A single sample of made ground was 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. The soil samples were selected to provide a general view of the chemical conditions of the soils that are likely to be involved in a human exposure or groundwater pathway and to provide advice in respect of re-use or for waste disposal classification.

The contamination analyses were carried out at 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.

4.0 GROUND CONDITIONS

The investigation has generally confirmed the expected ground conditions in that, below a significant thickness of made ground, Kempton Park Gravel was encountered over the London Clay Formation, which was proved to the maximum depth investigated.

4.1 Made Ground

Made ground extended to a depth of 3.00 m and generally initially comprised dark grey clayey silt with gravel and brick rubble below which, between 2.00 m and 2.40 m, a layer of loosely cemented brick was encountered over dark greyish brown silty clay with gravel and brick fragments. The significant thickness of made ground may be relic from previous structures, potentially including basement levels that occupied the site prior to the existing property.

With the exception of fragments of extraneous material, no visual or olfactory evidence of significant contamination was noted during the investigation. A single sample of the made
ground was sent to analytical laboratory for a suite of contamination testing and the results are discussed in Section 4.5.

4.2 **Kempton Park Gravel**

This stratum generally comprised brown, yellowish brown and orange-brown locally clayey, fine to coarse sand with fine to coarse angular to rounded gravel, which extended to a depth of 8.80 m. The results of SPTs indicate the granular soils to be in an initially dense becoming medium dense from 6.50 m. These soils were observed to be free from any evidence of contamination.

4.3 **London Clay Formation**

The London Clay comprised stiff becoming very stiff fissured high strength to very high strength dark grey silty clay with fine mica, occasional selenite crystals and partings of pale grey silt, which was proved to the maximum depth investigated, of 15.00 m.

Geotechnical laboratory testing has indicated the clay to increase in strength with depth from high strength and an undrained shear strength of 99 kN/m² to very high strength and an undrained shear strength of 153kN/m². In addition, Atterberg Limit Tests have indicated the clay to be of high shrinkability, with a plasticity index of 51 %.

4.4 **Groundwater**

During drilling, groundwater was encountered in Borehole No 1 at a depth of 6.00 m in the Kempton Park Gravel. Two groundwater monitoring visits have been carried out over a one-month period and groundwater measured at depths of 5.63 m and 5.76 m.

4.5 **Soil Contamination**

A single sample of made ground recovered from Borehole No 1 was analysed for a range of contaminants and the results have not revealed any elevated concentrations of the contaminants tested. The results are included within the appendix.
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 methods of constructing the proposed basement. This report does not comprise a design document and the advice should be reviewed as the scheme progresses through the design process.

5.0 INTRODUCTION

Consideration is being given to refurbishment and extension of the existing property through the excavation and construction of a single level basement beneath the entire footprint of the building and out into the rear garden in the form of an enhanced lightwell. The excavation will extend to approximately 3.00 m with finish floor level at approximately 2.80 m below the ground floor.

6.0 GROUND MODEL

The desk study has indicated that the site has not had a contaminative history, having been occupied by residential properties since the mid-19th Century. On the basis of the fieldwork, the ground conditions at this site can be characterised as follows:

- the site is underlain by a significant thickness of made ground over the Kempton Park Gravel, which is in turn underlain by the London Clay Formation;
- made ground is present to a depth of 3.00 m;
- the Kempton Park Gravel is in a dense to medium dense condition and extends to a depth of 8.80 m;
- groundwater is present within the Kempton Park Gravel at a depth of 5.50 m;
- the London Clay increases in strength with depth from stiff and very stiff and high strength to very high strength;
- the made ground where tested has not been found to include elevated concentrations of common contaminants above a residential end use.

7.0 ADVICE AND RECOMMENDATIONS

Formation level for the proposed basement will be within the Kempton Park Gravel at a depth of approximately 3.00 m. Groundwater is not expected to be encountered within the basement excavation and therefore the use of conventional concrete underpinning of the existing foundations is likely to be the most suitable form of construction of the basement retaining walls.

7.1 Basement Construction

7.1.1 Excavation
The proposed formation level will be at a depth of approximately 3.00 m. Groundwater has
been recorded at depths of 5.63 m and 5.76 m, approximately 2.50 m below the proposed excavation. It is therefore apparent that groundwater will not be encountered within the excavation, although it is recommended that the monitoring of the standpipe is continued over a longer period of time in order to determine the extent of any seasonal variations. It is possible that minor seepages may be encountered within the made ground, particularly around existing foundations; however such inflows are unlikely to be prolonged and should be adequately controlled using conventional methods, such as sump pumping.

On the basis of the above, the proposed use of traditional concrete underpinning using a “hit and miss” approach to extend the existing foundations is considered to be a suitable option. This will however require the soils being underpinned to stand unsupported, and in the granular soils of the made ground and Kempton Park Gravel, difficulties may be encountered with unsupported excavations, particularly where inflows of groundwater are encountered. Ideally trial excavations to as close to the proposed basement depth as possible would be carried out in order to assess the stability of these soils and to confirm the absence of significant groundwater inflows.

Careful workmanship will 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 and maximising usable space in the new basement. The contractor should however be required to provide details of how they intend to control groundwater inflows and instability of excavations, should they arise.

The ground movements associated with the basement excavation will depend on the method of excavation and support and the overall stiffness of the basement structure in the temporary condition. Thus, a suitable amount of propping will be required to provide the necessary rigidity. In this respect the timing of the provision of support to the wall will have an important effect on movements. The stability of the adjacent foundations will need to be ensured at all times and the retaining walls will need to be designed to support the loads from these foundations unless they are underpinned.

As part of the planning application, it is likely that the Royal Borough of Kensington and Chelsea (RBKC) will require a ground movement analysis and building damage assessment to be carried out.

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

<table>
<thead>
<tr>
<th>Stratum</th>
<th>Bulk Density ($kg/m^3$)</th>
<th>Effective Cohesion ($c’ – kN/m^2$)</th>
<th>Effective Friction Angle ($\phi’ – \text{degrees}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Made ground</td>
<td>1800</td>
<td>Zero</td>
<td>27</td>
</tr>
<tr>
<td>Kempton Park Gravel</td>
<td>1850</td>
<td>Zero</td>
<td>38</td>
</tr>
<tr>
<td>London Clay</td>
<td>2000</td>
<td>Zero</td>
<td>24</td>
</tr>
</tbody>
</table>

On the basis of the groundwater observations made to date, groundwater is not thought likely to be encountered within the excavation. At this stage, it is considered that for the design of new retaining walls, groundwater can be assumed to be below the depth of the excavation. However, consideration will need to be given to the risk of groundwater and surface water collecting behind the retaining walls and unless this can be adequately negated, possibly with the use of a suitable drainage system behind the walls, then it may be necessary to adopt an assumed groundwater level of two-thirds of the retained height for the design of new retaining
walls. The advice in BS8102:2009\(^4\) should be followed in the design of the retaining walls and with regard to waterproofing requirements.

7.1.3 **Basement Heave**

The 3.00 m deep excavation will result in a net unloading of 55 kN/m\(^2\). Given the generally minimal excavation, the remaining thickness of the gravel below the proposed basement and the continued loads applied by the retained house, heave movements are not considered likely to be significant.

7.2 **Spread Foundations**

It should be possible to adopt spread foundations excavated from basement level. Moderate width spread foundations bearing at a depth of approximately 3.00 m below ground level, within the dense Kempton Park Gravel, may be designed to apply a net allowable bearing pressure of approximately about 350 kN/m\(^2\). This bearing pressure incorporates an adequate factor of safety to ensure that settlement remains within normal tolerable limits.

7.3 **Basement Floor Slab**

Following the excavation of the basement, with a formation level in the Kempton Park Gravel, it should be possible to adopt a ground bearing slab, subject to a proof rolling exercise and the infilling of any soft spots with suitably compacted granular fill.

7.4 **Effect of Sulphates**

Chemical analyses have revealed generally low concentrations of soluble sulphate in the shallow soils in accordance with Class DS1 conditions of Table C2 of BRE Special Digest 1 Part C (2005). The measured pH values of the samples show that an ACES class of AC-1s would be appropriate for the site, assuming a static water condition at the site.

7.5 **Site Specific Risk Assessment**

The desk study research has indicated that the site has not had a contaminative history in that it has only been occupied by residential properties throughout its developed history. On the basis of the contamination results and the proposed development, there is considered to be a low risk to future end users and therefore remedial measures are not considered to be required.

As with any development site, a watching brief should be maintained during the ground work and if any suspicious soil is identified then an inspection should be made by a suitably qualified engineer and further testing carried out if required.

7.6 **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

---

\(^4\) BS8102 (2009) *Code of practice for protection of below ground structures against water from the ground*
noted that the Environment Agency guidance WM3\(^5\) 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\(^6\) 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 ££84.40 per tonne (about £150 per m\(^3\)) or at the lower rate of £2.65 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 chemical analyses carried out, would be generally classified as follows;

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Waste Classification (Waste Code)</th>
<th>WAC Testing Required Prior to Landfill Disposal?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Made ground</td>
<td>Non-hazardous (17 05 04)</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>London Clay</td>
<td>Inert (17 05 04)</td>
<td>Should not be required but confirm with receiving landfill</td>
<td></td>
</tr>
</tbody>
</table>

Under the requirements of the European Waste Directive all waste needs to be pre-treated prior to disposal. The pre-treatment process must be physical, thermal, chemical or biological, including sorting. It must change the characteristics of the waste in order to reduce its volume, hazardous nature, facilitate handling or enhance recovery. The waste producer can carry out the treatment but they will need to provide documentation to prove that this has been carried out. Alternatively, the treatment can be carried out by an approved contractor. The Environment Agency has issued a position paper\(^7\) 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.

7.7 Hydrogeological Assessment

The desk study and ground investigation have confirmed that the site is underlain by the Secondary ‘A’ Aquifer of the Kempton Park Gravel. However, groundwater has been measured at a depth of 5.50 m, which is approximately 2.50 m below the proposed excavation and as such the proposed development will not have an effect on groundwater flow.
8.0 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 is considered to 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. 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.

This report provides recommendations with regard to further monitoring of the standpipes to determine the extent of any seasonal variations in groundwater level and for trial excavations to be undertaken to fully assess the stability of the granular soils, in order to confirm the suitability of traditional underpinning methods.

As part of the planning application, it is likely that the Royal Borough of Kensington and Chelsea (RBKC) will require a ground movement analysis and building damage assessment carried out.

These areas of doubt should be drawn to the attention of prospective contractors and further investigation will be required or sufficient contingency should be provided to cover the outstanding risk.
APPENDIX

Borehole Record
Geotechnical Test Results
SPT & Cohesion / Depth Graph
Contamination Test Results
Risk-Based Generic Guideline Values
Envirocheck Summary
Historical Maps
Site Plan
**Location**

Widbury Barn
Widbury Hill
Ware, Herts
SG12 7QE

**Site**
33 Cadogan Lane, London SW1X 9DR

**Ground Level (mAD)**
15.15

**Client**
Cavendish Corporate Investments PCC Ltd - Cell 344

**Engineer**
Ward Cole

**Borehole Number**
BH1

**Dates**
16/11/2016-
18/11/2016

**Job Number**
J16262

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Sample / Tests</th>
<th>Casing Depth (m)</th>
<th>Water Depth (m)</th>
<th>Field Records</th>
<th>Level (mAD)</th>
<th>Depth (m)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.20</td>
<td>D1</td>
<td></td>
<td></td>
<td></td>
<td>14.50</td>
<td>0.20</td>
<td>Made Ground (artificial grass surface over dark brownish grey clayey silt with rootlets, gravel and brick fragments)</td>
</tr>
<tr>
<td>0.50</td>
<td>B1</td>
<td></td>
<td></td>
<td></td>
<td>14.50</td>
<td>0.65</td>
<td>Made Ground (dark grey clayey silt with gravel and brick rubble)</td>
</tr>
<tr>
<td>1.20-1.65</td>
<td>SPT(C) N=8</td>
<td>1.20-1.65</td>
<td>1.20-1.65</td>
<td></td>
<td>3.1/3,1,2,2</td>
<td>(1.35)</td>
<td>Layer of brick</td>
</tr>
<tr>
<td>1.75</td>
<td>D2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.00</td>
<td>Made Ground (dark greyish brown silty clay with gravel and brick fragments)</td>
</tr>
<tr>
<td>2.00-2.45</td>
<td>SPT(C) N=17</td>
<td>2.00-2.45</td>
<td>2.00-2.45</td>
<td></td>
<td>8,12/5,5,3,4</td>
<td>(0.40)</td>
<td>Dense brown, orange-brown initially clayey fine to coarse SAND and fine to coarse angular to rounded GRAVEL</td>
</tr>
<tr>
<td>2.75</td>
<td>D3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12.75</td>
<td>2.40</td>
</tr>
<tr>
<td>3.00-3.45</td>
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<td>3.00-3.45</td>
<td>3.00-3.45</td>
<td></td>
<td>8,9/10,10,11,14</td>
<td>(0.60)</td>
<td>Dense brown, orange-brown initially clayey fine to coarse SAND and fine to coarse angular to rounded GRAVEL</td>
</tr>
<tr>
<td>3.75</td>
<td>D4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12.15</td>
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<td>4.00-4.45</td>
<td>SPT(C) N=45</td>
<td>4.00-4.45</td>
<td>4.00-4.45</td>
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<td>7.9/9,12,12,12</td>
<td></td>
<td>Medium dense from 6.50 m</td>
</tr>
<tr>
<td>4.75</td>
<td>D5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7.50</td>
<td>8.80</td>
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<td>5.00-5.45</td>
<td></td>
<td>7.8/9,9,9,14</td>
<td></td>
<td>Brown and not clayey from 5.00 m</td>
</tr>
<tr>
<td>6.00</td>
<td>D6</td>
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<td></td>
<td></td>
<td></td>
<td>Slow(1) at 6.00m.</td>
<td></td>
</tr>
<tr>
<td>6.50-6.95</td>
<td>SPT(C) N=32</td>
<td>6.50-6.95</td>
<td>6.50-6.95</td>
<td></td>
<td>6,7/8,8,7,9</td>
<td></td>
<td>Medium dense from 6.50 m</td>
</tr>
<tr>
<td>7.50</td>
<td>D7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.00-8.45</td>
<td>SPT(C) N=28</td>
<td>8.00-8.45</td>
<td>8.00-8.45</td>
<td></td>
<td>5,5/7,6,7,8</td>
<td></td>
<td>Slightly clayey from 8.00 m</td>
</tr>
<tr>
<td>9.00</td>
<td>D8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>9.50-9.95</td>
<td>U1</td>
<td></td>
<td></td>
<td></td>
<td>6.35</td>
<td>8.80</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks**
- Manhandling rig and equipment through house and setup for 8hrs.
- Services inspection pit excavated to 1.20 m for 1 hr.
- Groundwater monitoring standpipe installed to 9.00 m.
- Dismantling rig and manhandling equipment back through house for 8hrs.
- Groundwater monitoring on 25/11/16 recorded groundwater at 5.63 m.
- Groundwater monitoring on 6/01/17 recorded groundwater at 5.76 m.

**Scale (approx)**
1:50
**Logged By**
ML
**Figure No.**
J16262.BH1

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# Geotechnical Report

**Location:** Widbury Barn, Widbury Hill, Ware, Herts SG12 7QE

**Ground Level (mAD):** 15.15

**Dates:** 16/11/2016 - 18/11/2016

**Engineer:** Ward Cole

**Job Number:** J16262

## Boring Method
- **Cable Percussion**

## Casing Diameter
- 150mm cased to 9.00m

## Client
- Cavendish Corporate Investments PCC Ltd-Cell 344

## Site
- 33 Cadogan Lane, London SW1X 9DR

## Groundwater Depth

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Sample / Tests</th>
<th>Casing Depth (m)</th>
<th>Water Depth (m)</th>
<th>Field Records</th>
<th>Level (mAD)</th>
<th>Depth (m) (Thickness)</th>
<th>Description</th>
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</tr>
<tr>
<td>11.00-11.45</td>
<td>SPT N=23</td>
<td>9.00</td>
<td>DRY</td>
<td>1,2/5,5,6,7</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>11.00-11.45</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.50-12.95</td>
<td>U2</td>
<td></td>
<td>45 blows</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>14.55-15.00</td>
<td>SPT N=27</td>
<td>9.00</td>
<td>DRY</td>
<td>2,3/5,6,7,9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.55-15.00</td>
<td>D13</td>
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<td></td>
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</table>

**Remarks:**
- Complete at 15.00m

**Scale (approx):**
- 1:50 ML

**Logged By:**
- ML

**Figure No.:** J16262.BH1
### Summary of Natural Moisture Content, Liquid Limit and Plastic Limit Results

<table>
<thead>
<tr>
<th>Hole No.</th>
<th>Sample</th>
<th>Soil Description</th>
<th>NMC Ref</th>
<th>Passing</th>
<th>LL</th>
<th>PL</th>
<th>PI</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH1</td>
<td>8</td>
<td>9.00 D</td>
<td>31</td>
<td>99</td>
<td>75</td>
<td>24</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dark grey silty CLAY with rare fine gravel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BH1</td>
<td>11</td>
<td>12.00 D</td>
<td>28</td>
<td>100</td>
<td>75</td>
<td>24</td>
<td>51</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Dark grey CLAY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Test Methods:**
- BS1377: Part 2: 1990:
  - Natural Moisture Content: clause 3.2
  - Atterberg Limits: clause 4.3 and 5.0

**Test Report by:**
- K4 SOILS LABORATORY
  - Unit 8 Olds Close Olds Approach
  - Watford Herts WD18 9RU

**Checked and Approved**
- Initials: J.P
- Date: 12/12/2016

---

**NMC Passing LL PL PI**

<table>
<thead>
<tr>
<th>425μm</th>
</tr>
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<tbody>
<tr>
<td>%</td>
</tr>
</tbody>
</table>

---

**Approved Signatories:**
- K.Phaure (Tech.Mgr)
- J.Phaure (Lab.Mgr)
LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Site Name</td>
<td>33 CADOGAN LANE</td>
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<tr>
<td>Borehole/Pit No.</td>
<td>BH1</td>
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<tr>
<td>Sample No.</td>
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<td>Project No.</td>
<td>J16262</td>
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<tr>
<td>Client</td>
<td>GEA</td>
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<tr>
<td>Soil Description</td>
<td>Dark grey silty CLAY with rare fine gravel</td>
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NATURAL MOISTURE CONTENT | 31 |
% PASSING 425μm SIEVE | 99 |
LIQUID LIMIT | 75 |
PLASTIC LIMIT | 24 |
PLASTICITY INDEX | 51 |

Remarks

PLASTICITY INDEX

TEST METHOD
BS1377: Part 2: Clause 4.4: 1990 Determination of the liquid limit by the cone penetrometer method
BS1377: Part 2: Clause 5.0: 1990: Determination of the plastic limit and plasticity index
BS1377: Part 2: Clause 3.2: 1990: Determination of the moisture content by the oven drying
Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU
Tel: 01923 711 288  Email: James@k4soils.com
LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

Job No. 22008

Site Name 33 CADOGAN LANE

Project No. J16262  Client GEA

Sample No. 11

Depth Top 12.00 m

Depth Base - m

Sample Type D

Samples received 23/11/2016

Schedules received 29/11/2016

Project Started 29/11/2016

Date Tested 10/12/2016

Plasticity Index 51 %

NATURAL MOISTURE CONTENT 28 %

% PASSING 425μm SIEVE 100 %

LIQUID LIMIT 75 %

PLASTIC LIMIT 24 %

PLASTICITY INDEX 51 %

Remarks

Soil Description Dark grey silty CLAY

NATURAL MOISTURE CONTENT

% PASSING 425μm SIEVE

LIQUID LIMIT

PLASTIC LIMIT

PLASTICITY INDEX

PLASTICITY INDEX

TEST METHOD
BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method
BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index
BS1377: Part 2 :Clause 3.2 : 1990: Determination of the moisture content by the oven drying

Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU
Tel: 01923 711 288  Email: James@k4soils.com

### Particulate Size Distribution

**Site Name:** 33 CADOGAN LANE  
**Borehole/Pit No.:** BH1  
**Sample No.:** 4  
**Client:** GEA  
**Depth:** 3.00 m

**Soil Description:** Brown and orangish brown very clayey very gravelly SAND (gravel is fmc and angular to rounded)

**Test Method:** BS1377:Part 2: 1990, clause 9.0

**Test Method:**

- **Date tested:** 09/12/2016  
- **Samples received:** 23/11/2016  
- **Schedules received:** 28/11/2016  
- **Project started:** 29/11/2016  
- **Date tested:** 09/12/2016

**Sample Proportions**

- Very coarse: 0.0
- Gravel: 35.7
- Sand: 37.3
- Fines <0.063mm: 26.9

**Grading Analysis**

- **D100:** 1.17 mm  
- **D60:** 0.128 mm  
- **D30:** 0.63 mm  
- **D10:** 0.05 mm

**Uniformity Coefficient:**

**Curvature Coefficient:**

**Remarks:** Preparation and testing in accordance with BS1377 unless noted below.
### PARTICLE SIZE DISTRIBUTION

**Site Name:** 33 CADOGAN LANE  
**Borehole/Pit No.:** BH1  
**Sample No.:** 6  
**Project No.:** J16262  
**Client:** GEA  
**Sample Type:** B  
**Soil Description:** Brown very gravelly SAND (gravel is fmc and sub-angular to rounded)  
**Test Method:** BS1377:Part 2: 1990, clause 9.0  
**Date tested:** 09/12/2016  
**Date started:** 29/11/2016

#### Grading Analysis

- **D10**:
  - mm: 0.063  
  - % Passing: 3
- **D30**:
  - mm: 0.212  
  - % Passing: 19
- **D60**:
  - mm: 0.425  
  - % Passing: 62
- **D100**:
  - mm: 3.35  
  - % Passing: 77
- **D150**:
  - mm: 2.00  
  - % Passing: 76
- **D300**:
  - mm: 1.18  
  - % Passing: 74
- **D600**:
  - mm: 0.6  
  - % Passing: 70
- **D1200**:
  - mm: 0.425  
  - % Passing: 62
- **D2400**:
  - mm: 0.212  
  - % Passing: 19
- **D4800**:
  - mm: 0.15  
  - % Passing: 6
- **D9600**:
  - mm: 0.063  
  - % Passing: 3

#### Sample Proportions

- **Very coarse**: 0.0%  
- **Gravel**: 24.3%  
- **Sand**: 73.2%  
- **Fines <0.063mm**: 2.5%

#### Dry Mass of sample, g

- 4311

#### Remarks

Preparation and testing in accordance with BS1377 unless noted below.
### Particle Size Distribution

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<td>Client</td>
<td>GEA</td>
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<tr>
<td>Depth</td>
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<td>Brown slightly clayey very gravelly SAND (gravel is fmc and sub-angular to rounded)</td>
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<td>Schedules received</td>
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#### Grading Analysis

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<th>Particle Size (mm)</th>
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<tr>
<td>0.15</td>
<td>4</td>
<td>0.063</td>
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#### Uniformity Coefficient

8.6

#### Curvature Coefficient

0.42

#### Sample Proportions

- Very coarse: 0.0%
- Gravel: 41.0%
- Sand: 55.2%
- Fines <0.063mm: 3.8%

#### Dry Mass of Sample

4045 g

#### Remarks

Preparation and testing in accordance with BS1377 unless noted below.
**Sulphate Content (Gravimetric Method) for 2:1 Soil: Water Extract and pH Value - Summary of Results**

Tested in accordance with BS1377 : Part 3 : 1990, clause 5.3 and clause 9

<table>
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<th>Sample</th>
<th>Soil description</th>
<th>Dry Mass passing 2mm %</th>
<th>SO3 Content g/l</th>
<th>SO4 Content g/l</th>
<th>pH</th>
<th>Remarks</th>
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<td>BH1</td>
<td>2</td>
<td>1.75</td>
<td>Brown silty CLAY with large dark carbonaceous pockets and fm brick fragments</td>
<td>96</td>
<td>0.19</td>
<td>0.23</td>
<td>7.46</td>
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<tr>
<td>BH1</td>
<td>9</td>
<td>10.50</td>
<td>Dark grey silty CLAY</td>
<td>100</td>
<td>0.44</td>
<td>0.52</td>
<td>7.46</td>
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---

**Job No.** 22008  
**Project Name** 33 CADOGAN LANE  
**Project No.** J16262  
**Client** GEA

---

**Testing Started** 08/12/2016  
**Samples received** 23/11/2016  
**Schedule received** 28/11/2016  
**Project started** 29/11/2016

---

Test Report by K4 SOILS LABORATORY  
Unit 8 Olds Close Olds Approach  
Watford Herts WD18 9RU  
Tel: 01923 711 288  
Email: James@k4soils.com  

2519  
Checked and Approved  
Initials: J.P  
Date: 12/12/2016  
Checked: MSF-5-R29
<table>
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<th>Test Type</th>
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<th>ø3</th>
<th>Cell pressure</th>
<th>Mode of failure</th>
<th>Remarks</th>
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<td>BH1</td>
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<td>High strength dark grey silty CLAY</td>
<td>UU</td>
<td>2.03</td>
<td>1.58</td>
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<td>198</td>
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<td>BH1</td>
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<td>Very high strength dark grey silty CLAY</td>
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<td>1.58</td>
<td>26</td>
<td>198</td>
<td>102</td>
<td>11</td>
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</tbody>
</table>

**Legend**
- UU - single stage test (single and multiple specimens)
- σ3 - Cell pressure
- UUM - Multistage test on a single specimen
- σ1 - σ3 - Maximum corrected deviator stress
- cu - Undrained shear strength, ½ (σ1 - σ3)
- B - Brittle
- P - Plastic
- C - Compound
Test Report by K4 SOILS LABORATORY
Unit 8 Olds Close Olds Approach
Watford Herts WD18 9RU
Tel: 01923 711 288
Email: James@k4soils.com


---

**Test Method**
BS1377 : Part 7 : 1990, clause 8, single specimen

**Date of test**
09/12/2016

**Soil Description**
High strength dark grey silty CLAY

---

**Deviator Stress v Axial Strain**

---

**Mohr Circles**

---

**Deviator Stress corrected for area change and membrane effects**

**Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.**
Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Test Method: BS1377 : Part 7 : 1990, clause 8, single specimen

Date of test: 09/12/2016

Soil Description: Very high strength dark grey silty CLAY

Position within sample: Compound

Remarks:

Test Number | Length (mm) | Diameter (mm) | Bulk Density (Mg/m³) | Moisture Content (%) | Dry Density (Mg/m³) | Rate of Strain (‰/min) | Cell Pressure (kPa) | Axial Strain (%) | Deviator Stress, \((\sigma_1 - \sigma_3)\) (kPa) | Undrained Shear Strength, \(c_u\) (kPa) | Mode of Failure
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
1 | 198.0 | 102.0 | 2.00 | 26 | 1.58 | 2.0 | 250 | 11.1 | 305 | 153 | \(\frac{1}{2}(\sigma_1 - \sigma_3)\) | Compound

Deviator Stress v Axial Strain

Mohr Circles

Test Report by K4 SOILS LABORATORY
Unit 8 Olds Close Olds Approach
Watford Herts WD18 9RU
Tel: 01923 711 288
Email: James@k4soils.com

Envirocheck® Report:

Datasheet

Order Details:

Order Number:
106726237_1_1

Customer Reference:
J16262

National Grid Reference:
528070, 179120

Slice:
A

Site Area (Ha):
0.02

Search Buffer (m):
1000

Site Details:
33 Cadogan Lane
LONDON
SW1X 9DR

Client Details:
Mr S Branch
GEA Ltd
Widbury Barn
Widbury Hill
Ware
Herts
SG12 7QE
The Environment Act 1995 has made site sensitivity a key issue, as the legislation pays as much attention to the pathways by which contamination could spread, and to the vulnerable targets of contamination, as it does the potential sources of contamination. For this reason, Landmark’s Site Sensitivity maps and Datasheet(s) place great emphasis on statutory data provided by the Environment Agency/Natural Resources Wales and the Scottish Environment Protection Agency; it also incorporates data from Natural England (and the Scottish and Welsh equivalents) and Local Authorities; and highlights hydrogeological features required by environmental and geotechnical consultants. It does not include any information concerning past uses of land. The datasheet is produced by querying the Landmark database to a distance defined by the client from a site boundary provided by the client.

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**Introduction**

The Environment Act 1995 has made site sensitivity a key issue, as the legislation pays as much attention to the pathways by which contamination could spread, and to the vulnerable targets of contamination, as it does the potential sources of contamination. For this reason, Landmark’s Site Sensitivity maps and Datasheet(s) place great emphasis on statutory data provided by the Environment Agency/Natural Resources Wales and the Scottish Environment Protection Agency; it also incorporates data from Natural England (and the Scottish and Welsh equivalents) and Local Authorities; and highlights hydrogeological features required by environmental and geotechnical consultants. It does not include any information concerning past uses of land. The datasheet is produced by querying the Landmark database to a distance defined by the client from a site boundary provided by the client.

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**Report Version v50.0**
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## Summary

### Data Type Page Number On Site 0 to 250m 251 to 500m 501 to 1000m (*up to 2000m*)

#### Geological
- **BGS 1:625,000 Solid Geology**
  - Page 42
  - Yes
  - n/a
  - n/a
  - n/a
- **BGS Estimated Soil Chemistry**
- **BGS Recorded Mineral Sites**
- **BGS Urban Soil Chemistry**
  - Page 42
  - Yes
  - Yes
  - Yes
- **BGS Urban Soil Chemistry Averages**
- **Brine Compensation Area**
  - n/a
  - n/a
  - n/a
- **Coal Mining Affected Areas**
  - n/a
  - n/a
  - n/a
- **Mining Instability**
  - n/a
  - n/a
  - n/a
- **Man-Made Mining Cavities**
- **Natural Cavities**
- **Non Coal Mining Areas of Great Britain**
  - n/a
  - n/a
  - n/a
- **Potential for Collapsible Ground Stability Hazards**
  - Page 45
  - Yes
  - Yes
  - n/a
  - n/a
- **Potential for Compressible Ground Stability Hazards**
  - Page 45
  - Yes
  - n/a
  - n/a
- **Potential for Ground Dissolution Stability Hazards**
  - n/a
  - n/a
  - n/a
- **Potential for Landslide Ground Stability Hazards**
  - Page 45
  - Yes
  - n/a
  - n/a
- **Potential for Running Sand Ground Stability Hazards**
  - Page 45
  - Yes
  - n/a
  - n/a
- **Potential for Shrinking or Swelling Clay Ground Stability Hazards**
  - Page 46
  - Yes
  - n/a
  - n/a
- **Radon Potential - Radon Affected Areas**
  - n/a
  - n/a
  - n/a
- **Radon Potential - Radon Protection Measures**
  - n/a
  - n/a
  - n/a

#### Industrial Land Use
- **Contemporary Trade Directory Entries**
  - Page 47
  - 13
  - 44
  - 332
- **Fuel Station Entries**
  - Page 79
  - 4
- **Points of Interest - Commercial Services**
  - Page 80
  - 2
  - 37
- **Points of Interest - Education and Health**
  - Page 83
  - 1
- **Points of Interest - Manufacturing and Production**
  - Page 83
  - 7
  - 32
- **Points of Interest - Public Infrastructure**
  - Page 86
  - 32
- **Points of Interest - Recreational and Environmental**
  - Page 89
  - 12
- **Gas Pipelines**
- **Underground Electrical Cables**
## Summary

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### Local Authority Pollution Prevention and Controls

**Name:** Victoria Dry Cleaners  
**Location:** 5a Allington Street, London, SW1E 5EB  
**Authority:** Westminster City Council, Environmental Health Department  
**Permit Reference:** 06/48944/EE1EP  
**Dated:** 2nd August 2007  
**Process Type:** Local Authority Pollution Prevention and Control  
**Description:** PG6/46 Dry cleaning  
**Status:** Permitted  
**Positional Accuracy:** Manually positioned to the address or location

### Local Authority Pollution Prevention and Controls

**Name:** Lewis And Wayne  
**Location:** 13-15 Elystan Street, London, SW3 3NU  
**Authority:** Royal Borough of Kensington And Chelsea, Environmental Health Department  
**Permit Reference:** 06/008703  
**Dated:** 31st March 2008  
**Process Type:** Local Authority Air Pollution Control  
**Description:** PG6/46 Dry cleaning  
**Status:** Permitted  
**Positional Accuracy:** Manually positioned to the address or location

### Local Authority Pollution Prevention and Controls

**Name:** Four Seasons Hotel  
**Location:** Hamilton Place, London  
**Authority:** Westminster City Council, Environmental Health Department  
**Permit Reference:** DC72/11/00226/EE1EP  
**Dated:** 18th March 2011  
**Process Type:** Local Authority Pollution Prevention and Control  
**Description:** PG6/46 Dry cleaning  
**Status:** Permitted  
**Positional Accuracy:** Manually positioned to the address or location

### Nearest Surface Water Feature

**Name:** A17SE (NW)  
**Location:** 179706  
**Authority:** Environment Agency, Thames Region  
**Pollutant:** Oils - Unknown  
**Note:** Confirmed As A Pollution Incident  
**Incident Date:** 20th September 1995  
**Incident Reference:** SE950451  
**Catchment Area:** Not Given  
**Receiving Water:** Not Given  
**Cause of Incident:** Not Given  
**Incident Severity:** Category 3 - Minor Incident  
**Positional Accuracy:** Located by supplier to within 100m

---

**Order Number:** 106726237_1_1  
**Date:** 30-Nov-2016  
**rpr_ec_datasheet v50.0**  
**A Landmark Information Group Service**  
**Page 6 of 100**
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| 25    | Water Abstractions | Operator: Mr R Goldstein  
Licence Number: 28/39/39/0228  
Permit Version: 1  
Location: Eaton Place, London- Borehole  
Authority: Environment Agency, Thames Region  
Abstraction: Private Water Supply: General Use (Medium Loss)  
Abstraction Type: Water may be abstracted from a single point  
Source: Groundwater  
Daily Rate (m3): Not Supplied  
Yearly Rate (m3): Not Supplied  
Details: 65 Eaton Place & 65 Lyall Mews, London Sw1x | A13SE (E) | 105 | 3 | 528190
179120 |
| 25    | Water Abstractions | Operator: Mr R Goldstein  
Licence Number: 28/39/39/0228  
Permit Version: 1  
Location: Eaton Place, London- Borehole  
Authority: Environment Agency, Thames Region  
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Permit Version: 1  
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179120 |
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179120 |
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179120 |
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### Coal Mining Affected Areas
- In an area that might not be affected by coal mining

### Non Coal Mining Areas of Great Britain
- No Hazard

### Potential for Collapsible Ground Stability Hazards
- Source: British Geological Survey, National Geoscience Information Service
- Hazard Potential: Very Low
- Estimated Distance From Site: 0
- Contact: 2
- NGR: 528069 179122

### Potential for Collapsible Ground Stability Hazards
- Source: British Geological Survey, National Geoscience Information Service
- Hazard Potential: No Hazard
- Estimated Distance From Site: 0
- Contact: 2
- NGR: 528069 179122

### Potential for Collapsible Ground Stability Hazards
- Source: British Geological Survey, National Geoscience Information Service
- Hazard Potential: Very Low
- Estimated Distance From Site: 0
- Contact: 2
- NGR: 527963 179090

### Potential for Compressible Ground Stability Hazards
- Source: British Geological Survey, National Geoscience Information Service
- Hazard Potential: No Hazard
- Estimated Distance From Site: 0
- Contact: 2
- NGR: 528069 179122

### Potential for Compressible Ground Stability Hazards
- Source: British Geological Survey, National Geoscience Information Service
- Hazard Potential: Very Low
- Estimated Distance From Site: 0
- Contact: 2
- NGR: 527963 179090

### Potential for Compressible Ground Stability Hazards
- Source: British Geological Survey, National Geoscience Information Service
- Hazard Potential: Moderate
- Estimated Distance From Site: 0
- Contact: 2
- NGR: 528069 179122

### Potential for Compressible Ground Stability Hazards
- Source: British Geological Survey, National Geoscience Information Service
- Hazard Potential: No Hazard
- Estimated Distance From Site: 0
- Contact: 2
- NGR: 527963 179090

### Potential for Ground Dissolution Stability Hazards
- Source: British Geological Survey, National Geoscience Information Service
- Hazard Potential: No Hazard
- Estimated Distance From Site: 0
- Contact: 2
- NGR: 528069 179122

### Potential for Landslide Ground Stability Hazards
- Source: British Geological Survey, National Geoscience Information Service
- Hazard Potential: Very Low
- Estimated Distance From Site: 0
- Contact: 2
- NGR: 528069 179122

### Potential for Running Sand Ground Stability Hazards
- Source: British Geological Survey, National Geoscience Information Service
- Hazard Potential: Very Low
- Estimated Distance From Site: 0
- Contact: 2
- NGR: 528069 179122

### Potential for Running Sand Ground Stability Hazards
- Source: British Geological Survey, National Geoscience Information Service
- Hazard Potential: Low
- Estimated Distance From Site: 0
- Contact: 2
- NGR: 528069 179122
## Geological

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A selection of organisations who provide data within this report

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## Useful Contacts

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<thead>
<tr>
<th>Contact</th>
<th>Name and Address</th>
<th>Contact Details</th>
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</table>
| 2 | British Geological Survey - Enquiry Service | Telephone: 0115 936 3143  
Fax: 0115 936 3276  
Email: enquiries@bgs.ac.uk  
Website: www.bgs.ac.uk |
| 3 | Environment Agency - National Customer Contact Centre (NCCC) | Telephone: 03708 506 506  
Email: enquiries@environment-agency.gov.uk |
| 4 | Royal Borough of Kensington And Chelsea - Environmental Health Department | Telephone: 020 7937 5464  
Fax: 020 7938 1445 |
| 5 | Westminster City Council - Environmental Health Department | Telephone: 020 7641 1317  
Fax: 020 7641 1142  
Website: www.westminster.gov.uk |
| 6 | Royal Borough of Kensington And Chelsea | Telephone: 020 7341 5284 |
| 7 | PointX | Website: www.pointx.co.uk |
| 8 | Natural England | Telephone: 0300 060 3900  
Email: enquiries@naturalengland.org.uk  
Website: www.naturalengland.org.uk |
| 9 | English Heritage - National Monument Record Centre | Telephone: 01793 414600  
Fax: 01793 414606  
Email: nmrinfo@english-heritage.org.uk  
Website: www.english-heritage.org.uk |
| 10 | Environment Agency - Head Office | Telephone: 01454 624400  
Fax: 01454 624409 |
| - | Public Health England - Radon Survey, Centre for Radiation, Chemical and Environmental Hazards | Telephone: 01235 822622  
Fax: 01235 833891  
Email: radon@phe.gov.uk  
Website: www.ukradon.org |
| - | Landmark Information Group Limited | Telephone: 0844 844 9952  
Fax: 0844 844 9951  
Email: customerservices@landmarkinfo.co.uk  
Website: www.landmarkinfo.co.uk |

Please note that the Environment Agency / Natural Resources Wales / SEPA have a charging policy in place for enquiries.
Order Details
Order Number: 106726237_1_1
Customer Ref: J1262
National Grid Reference: 528070, 179120
Slice: A
Site Area (Ha): 0.02
Plot Buffer (m): 100

Site Details
33 Cadogan Lane, LONDON, SW1X 9DR
Order Details
Order Number: 106726237_1_1
National Grid Reference: Slice: J16262
Site Area (Ha): 0.02
Search Buffer (m): 1000

Site Details
33 Cadogan Lane, LONDON, SW1X 9DR
For Borehole information please refer to the Borehole .csv file which accompanied this slice.

A copy of the BGS Borehole Ordering Form is available to download from the Support section of www.envirocheck.co.uk.
Geology 1:50,000 Maps

This report contains geological map extracts taken from the BGS Digital Geological map of Great Britain at 1:50,000 scale and is designed for users carrying out preliminary site assessments who require geological maps for the area around the site. This mapping may be more up to date than previously published paper maps.

The various geological layers - artificial and landslip deposits, superficial geology and solid (bedrock) geology are displayed in separate maps, but superimposed on the final "Combined Surface Geology" map. All map legends feature on this page. Not all layers have complete nationwide coverage, so availability of data for relevant map sheets is indicated below.

Geology 1:50,000 Maps Coverage

Order Details:
Order Number: 10G2623F_1_1
Customer Reference: J16262
National Grid Reference: 528807, 179120
Slice: A
Site Area (Ha): 0.02
Search Buffer (m): 1000

Site Details:
33 Cadogan Lane, LONDON, SW1X 9DR

Geology 1:50,000 Maps - Slice A