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Basement Impact Assessment

Client:	London Basement
Site:	69 Redington Road London NW3 7RP
CCS Ref:	BIA/3230
Dated:	March 2013

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FOREWARD

This report has been prepared in accordance with the scope and terms agreed with the Client, and the resources available, using all reasonable professional skill and care. The report is for the exclusive use of London Basement and shall not be relied upon by any third party without explicit written agreement from Chelmer Site Investigation Laboratories Ltd.

This report is specific to the proposed site use or development, as appropriate, and as described in the report; Chelmer Site Investigation Laboratories Ltd accept no liability for any use of the report or its contents for any purpose other than the development or proposed site use described herein.

This assessment has involved consideration, using normal professional skill and care, of the findings of ground investigation data obtained and other sources. Ground investigations involve sampling a very small proportion of the ground of interest as a result of which it is inevitable that variations in ground conditions, including groundwater, will remain unrecorded around and between the exploratory hole locations; groundwater levels/pressures will also vary seasonally and with other man-induced influences; no liability can be accepted for any adverse consequences of such variations.

This report must be read in its entirety in order to obtain a full understanding of our recommendations and conclusions.

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1.0 INTRODUCTION

1.1 This Basement Impact Assessment has been prepared in support of planning application 2012/2548/P submitted to the London Borough of Camden (LBC) by London Basement and Kyson Design Ltd for construction of a single storey basement at two different levels beneath No.69 Redington Road, NW3 7RP. The assessment is in accordance with the requirements of the London Borough of Camden (LBC) Development Policy DP27 in relation to basement construction, and follows the requirements set out in LBC's guidance document CPG4 'Basements and Lightwells'.

1.2 This assessment has been prepared by Keith Gabriel, a Chartered Geologist with a MSc degree in Engineering Geology and Mike Summersgill, a Chartered Civil Engineer and Chartered Water and Environmental Manager with MSc degree in Soil Mechanics. Both authors have previously undertaken assessments of basements in several London Boroughs including Barnet, Camden, Kingston and Kensington & Chelsea.

1.3 A preliminary site inspection (walk-over survey) of the vicinity of the house was undertaken by both authors on Monday 18th February 2013, and an inspection of the lower ground floor of the house and the rear garden was undertaken by Keith Gabriel on Tuesday 26th February 2013. Photos from both visits are presented in Appendix A. Desk study data have been collected from various sources including geological data, environmental data and historic maps from GroundSure which are presented in Appendices C, D and E. Relevant information from the desk study and site inspections is presented in Sections 2–6, followed by the basement impact assessment in accordance with CPG4 Stages 1–4 in Sections 7–10 respectively.

1.4 The following site-specific documents in relation to the proposed new basement and planning application have been considered:

Kyson: Integrated Planning Statement (May 2012). Includes drawings:

- E/1000 to E/1003 Existing Floor Plans
- E/1100 to E/1103 Existing Elevations
- E/1200 Existing Section A
- P/1999 to P/2003 Proposed Floor Plans
- P/2100 to P/2004 Proposed Elevations
- P/2200 Proposed Section A

Hockley & Dawson drawings:

- Drg No.16279.2/101 Lwr Gr Fl & Basement Sections with adjacent Properties
- Drg No.16279.1/102 Elevations showing Existing & Proposed Ground Profiles
- Drg No.16279.1/103 Lwr Gr Fl & Basement Plans, Steelwork Details
- Drg No.16279.1/104 Lwr Gr Fl & Basement Plans, U'pinning & Found'n Details
- Drg No.16279.1/105 Lwr Gr Fl & Basement Sections & Details

Chelmer Site Investigations:
Factual Report on Site Investigation, Ref: 3230 (June 2012). See Appendix B.

This report should be read in conjunction with all the documents and drawings listed above.

1.5 Instructions to prepare this Basement Impact Assessment (BIA) were received by email from London Basement on 13th February 2013 (confirmed by purchase order No. 001704).

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2.0 THE PROPERTY AND TOPOGRAPHIC SETTING

2.1 No.69 Redington Road is within the Redington & Frognal Conservation Area at the location shown in Figure 1. It was built in the early 20th Century, sometime before 1915 when it and the houses around it first appeared on the Ordnance Survey maps in Appendix E. Further details of the development history of the area is provided in Kyson's Integrated Planning Statement.

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Figure 1: Extract from 1:1,250 OS map (at reduced scale) with the site outlined in red.

2.2 The existing property is a substantial 4 storey, 9 bedroom detached house with white painted pebble-dashed finish to the external walls (see cover photo). Its current layout includes a lower ground floor, ground floor and two upper floors. The extent of the lower ground floor is restricted to approximately the rear half of the house. A garage with a flat roof is attached to the south flank wall at lower ground floor level. Further photos of the property and its garden are presented in Appendix A.

2.3 No.69 is located on a southwest-facing slope on the east side of a narrow valley aligned broadly north-south between the houses on Redington Road and the houses on Hollycroft Avenue (see Figure 1). This valley is associated with a former tributary of the Westbourne, one of the 'lost' rivers of London, which reputedly now runs in culvert somewhere close to No.69's rear boundary. The alignment of the valley is illustrated by kinks in the 90m, 95m and 100m contours in Figure 2. The valley drains southwards at overall slope angles of 5.0-6.5° upslope of No.69 reducing to approximately 5° downslope of No.69 (calculated from the contour spacing), although many of the rear gardens within the valley have been levelled by cutting into the slope on the up-hill side and filling on the downslope side.

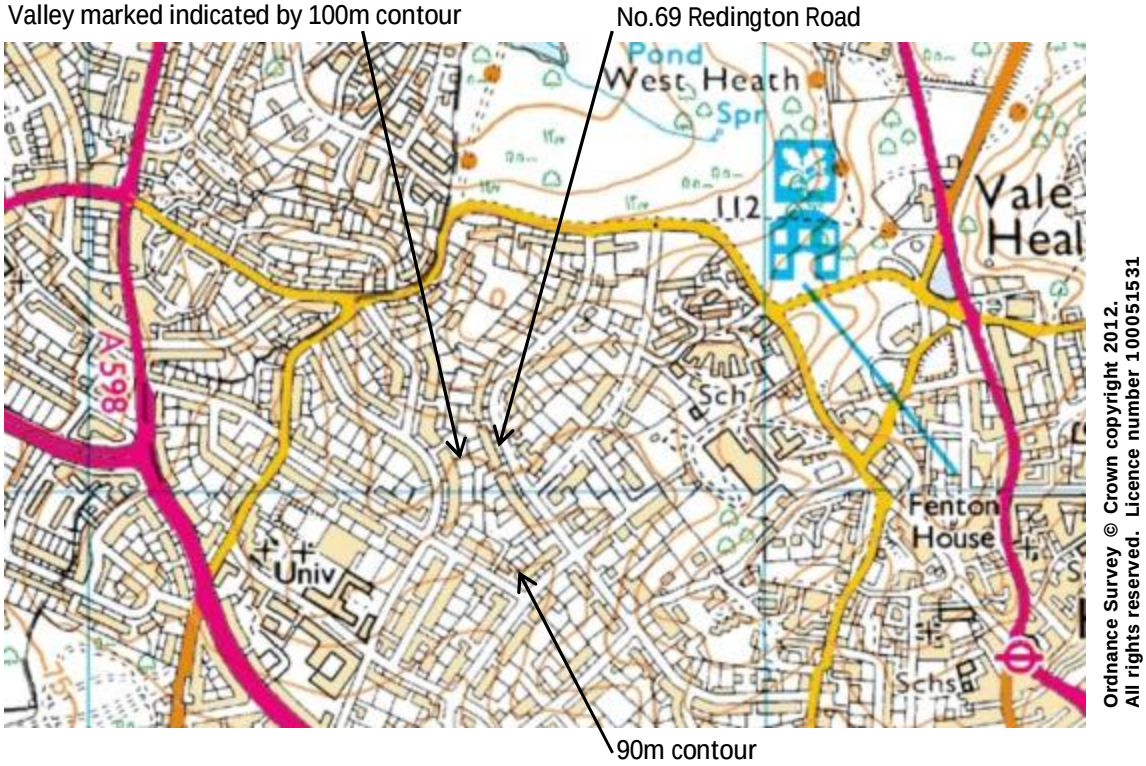

Figure 2: Enlarged extract from 1:25,000 Ordnance Survey map showing site location.

2.4 To the front of the house there is a small broadly level lawn on the north side of the plot, a path leading to the front door which rises slightly from the Redington Road's footway (against the general fall of the valley side) and, on the south side of the plot, a paved driveway which slopes down to the garage but also widens out in front of the house to provide additional parking space which inclines up to a curved retaining wall along the path to the front door (see Photo 1 and cover photo).

2.5 The rear garden is mainly laid to lawn and backs onto the gardens of houses on Hollycroft Avenue (Photos 3/4 and 5/6/7). Several large trees were present including an 18m Oak at the south end of the terrace (Photo 8), holly, various conifers and an 18m Silver Birch. Further trees were present in the gardens to the north including a large Oak.

2.6 Along the north boundary of the rear garden there was a stonework retaining wall which supports No.71's garden, a flower bed and then a low dry stone wall bordering the lawn. The maximum retained height of the two retaining walls combined was approximately 1.5m, and this height gradually reduced westwards. The terrace at the rear of the house was separated from the lawn by flower beds and a brickwork retaining wall of approximately 1m in height. This wall showed some outward movement near its southern end (Photo 9) and is to be replaced as part of the proposed scheme. The southern boundary is marked by another retaining wall supporting No.69's garden where the ground steps down in No.67's garden.

2.7 A further retaining wall of at least 1m in height was present approximately 1m beyond the rear (west) boundary of No.69 in the garden to No.39 Hollycroft Avenue (one of the two properties which No.69 backs onto), where the neighbour had excavated into the slope to create a level decked area (Photo 10).

2.8 A small, partially subterranean building which is understood to be a former air raid shelter is present near the northwest corner of the garden.

2.9 The side access path along the north flank wall appeared to have settled relative to the smooth rendered detail at the base of the wall, with greater settlement at the upslope end (Photo 11). This path appeared to at or just below the level of a damp proof course (see 2.11 below) so is higher than current good practice would require. A new Aco-type slot drain had been installed alongside this wall.

2.10 The crawl space beneath the front part of the house was inspected from a hatch in the store room near the northeast corner of the Lower Ground Floor. The ground rose gradually towards the front wall and appeared to have been covered with an oversite screed, although this had been removed close to the hatch. The ground was 'dry' and very dusty. Another store cupboard was inspected near the southeast corner of the Lower Ground Floor; no evidence of any damp penetration was seen, although none of the stored items were moved to enable a full inspection.

2.11 Most, but not all of the smooth rendered detail at the base of the external walls included a pronounced groove which was probably installed at the level of a damp proof course (dpc, possibly slate), in order to avoid the render enabling moisture to bridge the dpc. At the east end of the south flank wall this groove rises in a series of steps which appears to represent the level below which the wall acts as a retaining structure (Photo 12).

2.12 To either side of No.69 are large detached houses which stand within 1.5m of the common boundaries.

3.0 PROPOSED BASEMENT

3.1 The proposed new basement areas for which planning permission is sought comprise:

- Single storey beneath the front of the house, so as to extend the Lower Ground Floor beneath the full footprint of the house, with a lightwell at the left hand (south) end of the front wall.
- Single storey basement plus swimming pool beneath the rear right section of the Lower Ground Floor and extending out beneath the garden.

Other associated works will include an enlarged garage and reconstruction of the retaining walls supporting the rear terrace. These are not considered further in this assessment.

3.2 The property is a family dwelling and internal access is to be maintained for occupants to reach a higher floor within the building in the event of a flood.

3.3 London Basement's design is understood to include a pumped cavity drainage system with 'dual' pumps as standard and fitted with a high level alarm with battery backup to warn in the event of pump failure.

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4.0 GEOLOGICAL SETTING

4.1 Mapping by the British Geological Survey (BGS) indicates that the site is underlain by the Claygate Member, with the overlying Bagshot Formation outcropping 32m to the north of the site (see Appendix C, Section 1.3.1). Figure 3 shows an extract from Figure 4 of the Camden GHHS (Camden Geological, Hydrogeological and Hydrological Study by Arup, November 2010) which illustrates the site geology of the West Hampstead area.

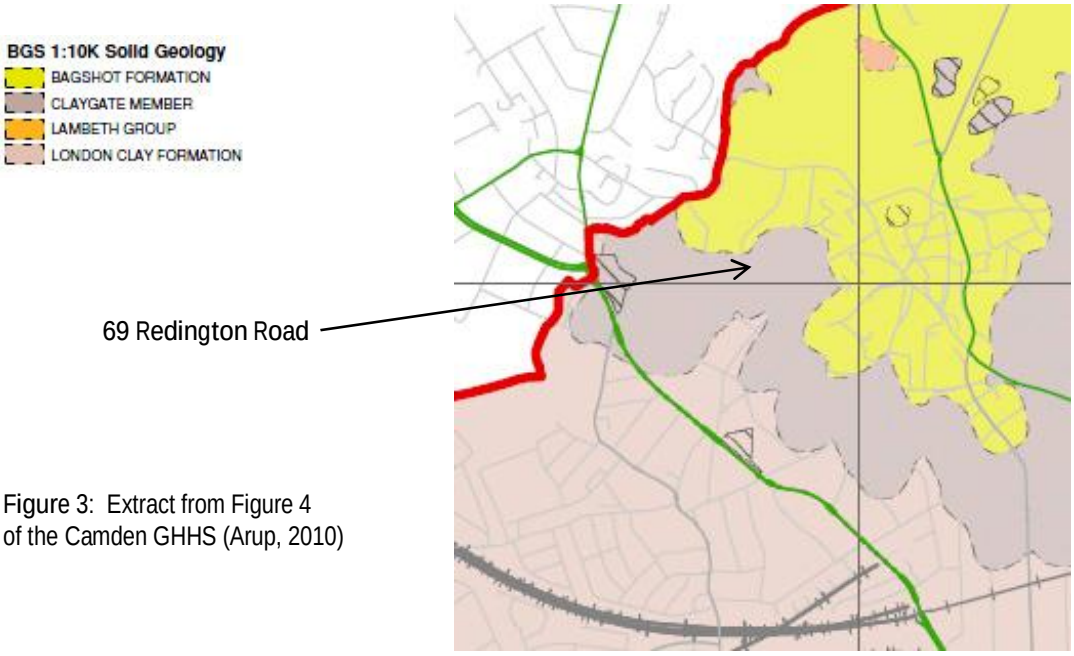

Figure 3: Extract from Figure 4 of the Camden GHHS (Arup, 2010)

4.2 The Claygate Member forms the uppermost unit of the London Clay Formation and is described in the relevant BGS memoir (Ellison et al, 2004) as "alternating beds of clayey silt, very silty clay, sandy silt and glauconitic silty fine sand. Beds are generally 1 to 5m thick, although the boundaries are generally diffuse as a result of bioturbation". The Claygate Member was 16.0m thick in the Hampstead Heath borehole (located to the northeast of Redington Road, near the top of the Heath) where it occurred between the levels of 93.71m and 109.71m AOD). No.69's plot straddles the 100m contour.

4.3 A thin superficial layer of natural, locally-derived re-worked soils called Head deposits may also be present (because these are not mapped by the British Geological Survey where they are expected to be less than 1.0m thick). In the areas which have been excavated some or all of these deposits will have been removed. Made Ground will be present in areas where ground levels have been raised.

4.4 The London Clay beneath the Claygate Member is well documented as being a stiff over-consolidated clay which is typically of high or very high plasticity and high shrinkage potential. As a result it undergoes considerable volume changes in response to variations in its natural moisture content (the clay shrinks on drying and swells on subsequent rehydration). These changes can occur seasonally, in response to normal climatic variations, to depths of up to 1.50m and to much greater depths in the presence of the trees whose roots abstract moisture from the clay. The clay will also swell when unloaded by excavations such as those required for the construction of basements. The more silty and sandy clays of the Claygate Member generally have somewhat lower plasticities.

4.5 There are no BGS boreholes within 250m of the property, the nearest being approximately 400m to the east near Spedan Close. This location is underlain by the Bagshot Formation, so those boreholes are not comparable with the site of current interest.

5.0 HYDROLOGICAL SETTING

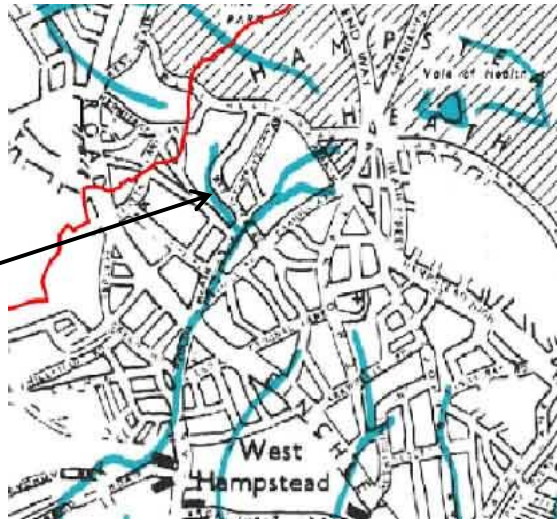

Figure 4: Extract from Figure 11 of the Camden GHHS (Arup, 2010) showing former watercourses, based on Barton (1992).

5.1 As already noted, one of the former northern tributaries to the Westbourne is understood to run in a culvert somewhere close to the rear boundary of No.69, as indicated on Figure 4. The 1870 Ordnance Survey map (1:2,500 scale, Appendix E) shows a stream a short distance to the west of (beyond) No.69's rear boundary; the course of that steam and other tributaries in the vicinity match closely with the positions shown in Figure 4.

5.2 By 1893 the 1:1,056 OS Town Plan shows that the stream had disappeared, having presumably been culverted in preparation for development of the houses which had already started on the lower sections of Redington Road.

5.3 The ground surface, currently as well as pre-development, continues falling to the west beyond the rear boundary of No.69, following the defined contoured 'valley' feature, and so the surface water catchment area of No.69's plot would never have included the main/upper part of the historical valley. As a result, the surface water catchment for No.69 is restricted to only surplus overland water seeping from a few of the gardens immediately upslope of No.69 on the west side of Redington Road. All other surface water run-off upslope of No.69 should be intercepted by the established highway/road gullies system and thus be discharged into the mains sewers.

5.4 Figure 5 shows that Redington Road did not suffer surface water flooding in either the 1975 or the 2002 floods.

Figure 5: Extract from Figure 15 of the Camden GHHS (Arup, 2010) showing roads which flooded in 1975 (light blue), in 2002 (dark blue), and 'Areas with potential to be at risk of surface water flooding' (wide light blue bands).

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6.0 HYDROGEOLOGICAL SETTING

6.1 The Claygate Member together with the Bagshot Formation is classified by the Environment Agency as a 'Secondary A aquifer', whereas the underlying London Clay is an 'Unproductive Stratum' as indicated by Figure 6.

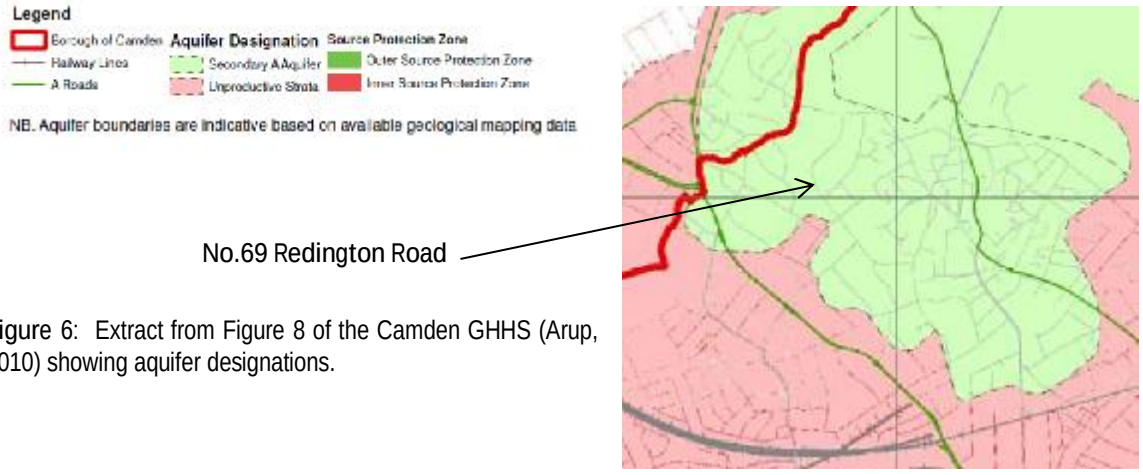

Figure 6: Extract from Figure 8 of the Camden GHHS (Arup, 2010) showing aquifer designations.

6.2 Under the old groundwater vulnerability classification scheme, which now applies only to superficial soils, the area is classed as 'Minor Aquifer High' groundwater vulnerability.

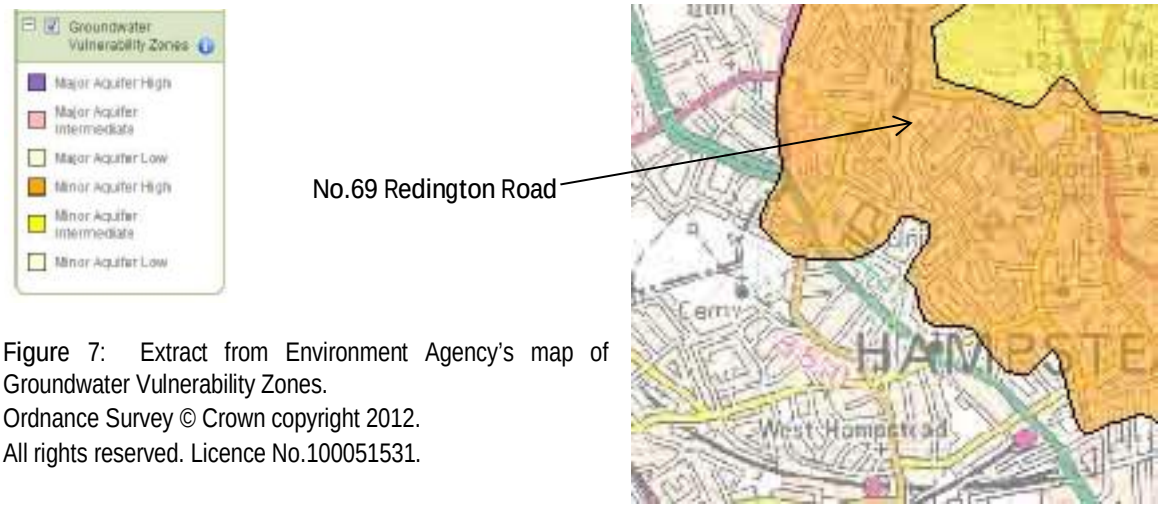

Figure 7: Extract from Environment Agency's map of Groundwater Vulnerability Zones.
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6.3 A spring line would be expected if the interface between the Bagshot Formation, which is predominantly composed of sands, and the Claygate Member cropped out at the surface. The pre-development Ordnance Survey maps in Appendix E show no evidence of any springs so either the interface sub-crops beneath Head deposits (which provide a pathway for water to seep/flow downhill) or the Bagshot Formation sands are less extensive than is shown on the BGS maps (as we have found to be the case previously, elsewhere on the west side of Hampstead Heath).

6.4 The degree to which the culverted Westbourne tributary is still capable of receiving baseflow and hence providing drainage to this part of the valley is not known.

6.5 The beds of silty sand and sandy silt within the Claygate member would generally be expected to be water-bearing, and where these are laterally continuous they can give rise to moderate water entries into excavations. The clay and silty clay beds would also be expected to be saturated, with water pressures hydrostatic (which means they increase linearly with depth) except where they are modified: by non-hydrostatic pressures in adjacent silt/sand beds of higher permeability, by tree root activity or by the influence of man-made changes such as utility trenches (which can act either land drains or as sources of water and high groundwater pressures). Water entries into excavations from any thin silt or sand partings/laminations within these clays are also likely to be limited, even where these are laterally continuous. Natural groundwater flow rates, if any, in the silt/sand horizons within the Claygate Member are typically very low.

6.6 The boreholes drilled on site in June 2012 (see Section 9) recorded no sand or sandy silt horizons of sufficient thickness to warrant identifying them separately on the borehole logs. No groundwater entry was recorded in either of these boreholes; however, the lack of a ground water entry into small diameter boreholes in clayey strata does not necessarily mean that groundwater is absent, rather the low permeability of the clays merely means that the flow rate was too slow for groundwater entries to occur before the borehole was backfilled.

6.7 Perched groundwater would usually be expected, at least in winter and spring months, in any Made Ground and possibly also in any Head deposits which overlie the Claygate Member. Variations in groundwater levels and pressures will occur seasonally and with other man-induced influences; current standards require the worst credible groundwater scenario to be identified and used in geotechnical design calculations.

6.8 The groundwater catchment areas upslope of No.69 are likely to differ for each of the main stratigraphic units:

- Made Ground: Owing to the extensive terracing of the gardens of No.69 and its close neighbours, the catchment for any perched groundwater in the Made Ground is likely to be limited to the immediately adjoining areas of Made Ground, as well as No.69's own garden, except where the trenches for drains and other services provide greater interconnection.
- Head deposits: The groundwater catchment area for the Head deposits will be larger than the surface water catchment because it could extend beneath and beyond the carriageway of Redington Road. If any laterally extensive sheets/channels of sandy slopewash are present, then the catchment could be large.
- Claygate Member: The catchment for the underlying in-situ strata will comprise recharge from the overlying soils in the vicinity of the site plus, a much wider area determined by the lateral extent of any interconnected silt/sand horizons.

6.9 There are no groundwater abstraction licences within 2000m of the site.

6.10 There are no Source Protection Zones within 500m of the site.

7.0 STAGE 1 - SCREENING

7.1 The screening has been undertaken in accordance with the three screening flowcharts presented in LBC's CPG4 guidance document. Information to assist with answering these screening questions has been obtained from various sources including the Camden geological, hydrogeological and hydrological study (Arup, 2010), historic maps and data obtained from GroundSure (see Appendices C, D & E) and other sources as referenced.

7.2 Subterranean (groundwater) flow screening flowchart:

Question		Response, with justification of 'No' answers	Clauses where considered further
1a	Is the site located directly above an aquifer?	Yes – Claygate Member	Carried forward to Scoping: 4.1, 8.2, Sections 10.2 & 10.3
1b	Will the proposed basement extend beneath the water table surface?	Yes (almost certainly) though boreholes recorded no sand units so it is unlikely that there will be substantial groundwater inflows to the excavations.	Carried forward to Scoping: 8.2, Sections 10.2 & 10.3
2	Is the site within 100m of a watercourse?	No – Though site is close to a former tributary of the Westbourne (CGHHS Fig.11) and 1870 map shows a stream which passed just west of No.69's rear boundary. By 1893 it was culverted.	Appendix D (Section 5.9), Appendix E maps, 5.1-5.3 and 10.5.1,
3	Is the site within the catchment of the pond chains on Hampstead Heath?	No – Site lies to south of Golders Hill Chain catchment	
4	Will the proposed basement development result in a change in the proportion of hard surfaced/ paved areas?	No – Lightwell will be compensated by planter replacing part of parking area; surface water from thin strip of walk-on glass will run-off into immediately adjacent soil.	
5	As part of the site drainage, will more surface water (eg: rainfall and run-off) than at present be discharged to the ground (eg: via soakaways and/or SUDS)?	No – There will be no significant increase in hard surfaced/paved areas generating run-off.	
6	Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond (not just the pond chains on Hampstead Heath) or spring line?	No – No surface water features within 250m	Appendix D, Section 5.9

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7.3 Slope/ground stability screening flowchart:

Question		Response, with justification of 'No' answers	Clauses where considered further
1	Does the existing site include slopes, natural or man-made, greater than 7°? (approximately 1 in 8)	Yes – Parking area alongside drive and very locally in flower beds.	Carried forward to Scoping: 2.9, 8.3, Sec'n 10.4
2	Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 7°?	No – Re-profiling is understood to be limited to slight changes in GLs as shown on Hockley & Dawson Drg 13279-1/102.	
3	Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	Yes (possibly) – Figure 16 of Camden GHHS shows tiny area of slopes >7° in vicinity.	Carried forward to Scoping: 2.9, 8.3, Sec'n 10.4
4	Is the site in a wider hillside setting in which the general slope is greater than 7°?	(Yes) – As Q3 above, though our calculation of overall slope angle gave a maximum of 6.5°.	Carried forward to Scoping: 2.9, 8.3, Sec'n 10.4
5	Is the London Clay the shallowest strata at the site?	No – Claygate member is shallowest stratum.	4.1
6	Will any tree/s be felled as part of the proposed development and/or are any works proposed within any tree root protection zones where trees are to be retained?	Yes. 2m high fruit tree and 2m high Laurel, both within footprint of proposed basement. Possibly also 2m Cherry by front porch.	Carried forward to Scoping: 8.3, 10.4.10
7	Is there a history of seasonal shrink/swell subsidence in the local area, and/or evidence of such effects at the site?	(Yes) – No evidence seen in adjacent houses of foundation related movements but basement design will need to allow for vegetation in vicinity.	Carried forward to Scoping: 8.3, Section 10.4
8	Is the site within 100m of a watercourse or potential spring line?	Yes – Potential spring line 32m upslope.	Carried forward to Scoping: 8.3, 10.4.2
9	Is the site within an area of previously worked ground?	No – See BGS map extract (Figure 3 herein).	4.1
10	Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?	Yes – though boreholes indicate that basement will be constructed wholly within a sequence of clays.	Carried forward to Scoping: 6.1, 8.3, Sec'n 10.3
11	Is the site within 50m of the Hampstead Heath ponds?	No – Site is approx 560m from the nearest pond (on the Golders Hill chain).	
12	Is the site within 5m of a highway or a pedestrian right of way?	No – Front of house and proposed lightwell are set well back from footway.	
13	Will the proposed basement substantially increase the differential depth of foundations relative to neighbouring properties?	Yes	Carried forward to Scoping: 8.3, Section 10.4
14	Is the site over or within the exclusion zone of any tunnels, eg railway lines.	Unknown – No railway tunnels but presence of other tunnels must be checked by service search.	Carried forward to Scoping: 8.3, 10.4.12

7.4 Surface flow and flooding screening flowchart:

Question		Response, with justification of 'No' answers	Clauses where considered further
1	Is the site within the catchment of the pond chains on Hampstead Heath?	No – Site lies to south of Golders Hill Chain catchment.	
2	As part of the proposed site drainage, will surface water flows (eg volume of rainfall and peak run-off) be materially changed from the existing route?	No – Only change to surface water flow route will be the lightwell (rainfall to drainage system via gully) compensated by reduced area of paved parking run-off which currently goes to gully in front of garage. 8m^2 of walk-on glass over swimming pool will not alter route.	
3	Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	No – Lightwell will be compensated by planter replacing part of parking area; surface water from thin strip of walk-on glass will run-off into immediately adjacent soil.	
4	Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by the adjacent properties or downstream watercourses?	No – Run-off from garden to adjacent properties is minimal or nil (retaining wall on south boundary has up-stand which prevents run-off). The former watercourse downslope of the property has been culverted.	
5	Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No – There will be no significant change in surfaces generating run-off. None of the run-off reaches a watercourse.	
6	Is the site in an area known to be at risk from surface water flooding, such as South Hampstead, West Hampstead, Gospel Oak and King's Cross, or is it at risk from flooding, for example because the proposed basement is below the static water level of a nearby surface water feature?	No – The site is in Flood Zone 1, Redington Road did not flood in either 1975 or 2002 and there are no nearby surface water features.	Appendix D, Section 6

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8.0 STAGE 2 - SCOPING

8.1 The scoping stage is required to identify the potential impacts from the aspects of the proposed basement which have been shown by the screening process to need further investigation. A conceptual ground model is usually compiled at the scoping stage however, because the ground investigation has already been undertaken for this project, the conceptual ground model including the findings of the ground investigation is described under Stage 4 (see Section 10.1).

8.2 Subterranean (groundwater) flow scoping:

Issue (= Screening Question)		Potential impact and actions
1a	**Is the site located directly above an aquifer?**	**Potential impact: Infiltration could be reduced. Action: Ground investigation required (already done), and review.**
1b	**Will the proposed basement extend beneath the water table surface?**	**The anticipated groundwater regime is described in Section 6, Hydrogeological Setting. Potential impact: Local restriction of groundwater flows (perched groundwater or below groundwater table). Action: Ground investigation required (already done), and review.**

8.3 Slope/ground stability scoping:

Issue (= Screening Question)		Potential impact and actions
1	Does the existing site include slopes, natural or man-made, greater than 7°? (approximately 1 in 8)	Potential impact: Inappropriate excavations or additional loads could destabilise the slope. Action: Review potential impact of scheme on any slopes >7° and assess need for mitigation measures.
3	Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	Potential impact: Inappropriate excavations or additional loads could destabilise the slope. Action: Review potential impact of scheme on any neighbouring slopes >7° and assess need for mitigation measures.
4	Is the site in a wider hillside setting in which the general slope is greater than 7°?	Potential impact: Inappropriate excavations or additional loads could destabilise the slope. Action: Review potential impact of scheme on slopes >7° in the wider hillside setting and assess need for mitigation measures.
6	Will any tree/s be felled as part of the proposed development and/or are any works proposed within any tree root protection zones where trees are to be retained?	Potential impact: Structural damage caused by heave beneath proposed basement and/or existing foundations; damage to roots of trees to be retained. Action: Ground investigation required to assess soil's plasticity/volume change potential. Tree RPAs to be identified where applicable.
7	Is there a history of seasonal shrink/swell subsidence in the local area, and/or evidence of such effects at the site?	Potential impact: Weakened structures from past movement would be more susceptible to damage during works. Action: Review potential impact of future vegetation growth. No evidence of damage seen.
8	Is the site within 100m of a watercourse or potential spring line?	Potential impact: Groundwater entries can destabilise excavations. Action: Ground investigation required (as done).
10	Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?	Potential impact: Inadequate provision for dewatering can lead to collapse of excavations. Action: Ground investigation required (as done) to assess requirements for dewatering.
13	Will the proposed basement substantially increase the differential depth of foundations relative to neighbouring properties?	Potential impact: Loss of support to the ground beneath the foundations to Nos 67 and 71 if basement excavations are inadequately supported. Action: Ensure adequate temporary and permanent support by use of best practice underpinning methods.
14	Is the site over or within the exclusion zone of any tunnels, eg railway lines.	Potential impact: Stress changes on the tunnel lining. Action: Undertake services search to check for possible presence of utility tunnels.

8.4 None of the surface flow and flooding screening questions identified issues to be carried forward to Scoping.

9.0 STAGE 3 – GROUND INVESTIGATION

9.1 Two boreholes were drilled by CSI in June 2012 at the locations shown in Appendix B, prior to this BIA being commissioned. Borehole BH1 was located in the front garden, close to the porch and borehole BH2 was located in the rear lawn, within the footprint of the proposed basement. The ground level at BH2 was therefore approximately 3.5m below that of BH1.

9.2 While the Camden GHHS (Arup, 2010) recommends a minimum of three boreholes for most sites, the two boreholes provided are considered adequate in this case because the geology was found to comprise a sequence of clays with no water-bearing horizons of sufficient permeability to generate a groundwater entry during drilling, and so minimal (or nil) groundwater flows are anticipated.

9.3 The site's geology as found by the boreholes (see logs in Appendix B for full details) may be summarised as:

- Made Ground: Recorded only in BH1, where the ground had been built up for the path up to the front door and near the curved retaining wall which is just over 0.9m high in the area. This Made Ground comprised 1.5m of topsoil over very sandy, very silty clay with partings of silt/fine sand and occasional brick fragments.
- Head deposits: The presence of fine gravel in the 0.3-0.9m horizon in BH2 suggests that this was probably a Head deposit. Comprised "Firm, moist, mid brown/orange grey veined, sandy, very silty CLAY, with partings of orange and brown silt and fine sand, occasional fine gravel and crystals". No Head was identified in BH1 at the front, but there had been reworking of upper soils.
- Claygate Member: Can conveniently be divided into two units:
  - Upper, sandy unit: Recorded in BH1 from 1.5m to base of borehole at 5.2m, and in BH2 from 0.9m to 1.8m: "Stiff, mid brown/orange grey veined, sandy, very silty CLAY with partings of orange brown and red silt and fine sand and crystals" (selenite?), with occasional claystone nodules. These clays became very stiff below 3.8m in BH1.
  - Lower unit: Recorded only in BH2, from 1.8m to the base of borehole at 6.0m, this unit is characterised by an apparent lack of sand and comprised "very stiff (stiff above 2.2m) mid brown grey veined silty CLAY with partings of orange brown and red silt and fine sand and crystals". Below 3.3m the colour became mid grey and the red silt/fine sand partings disappeared.

9.4 Roots were recorded down to 2.1m in BH1 and 2.2m in BH2.

9.5 No groundwater entries were recorded and both boreholes were 'dry' and open (ie: stable) on completion.

10.0 STAGE 4 – BASEMENT IMPACT ASSESSMENT

10.1 Conceptual Ground Model

10.1.1 The desk study evidence together with the ground investigation findings suggest a conceptual ground model for the site characterised by:

- Made Ground: Present only patchily around the site where ground levels have been raised for landscaping purposes, so not providing a continuous layer for groundwater flow. Made Ground will also be present as backfill to the foundation excavations and trenches for services. The Made Ground recorded in borehole BH1 appeared to be locally derived clays; most of the remainder is expected to be similar so the Made Ground is likely to hold only small volumes of perched groundwater (possibly only during the winter and spring seasons). The backfill in the trenches for services, and especially any granular pipe bedding, may provide the primary route for any groundwater flow through the Made Ground. Perched groundwater in the backfill to footing trenches is typically static (until excavations are dug into/though the backfill).
- 'Head' Deposits: These locally-derived sandy, very silty clays were very similar to the underlying clays of the Claygate Member. The recorded thickness (0.9m including topsoil in BH2) was probably less than their original thickness owing to the landscaping excavations in this northern part of the garden. Although "partings" of silt and fine sand were recorded they are unlikely to be laterally continuous because of the mixing process which occurs when Head deposits are formed, though other thicker pockets, lobes or sheets of permeable granular materials can occur in Head deposits derived from source areas which include granular soils (eg: the nearby Bagshot Formation sands). Thus, perched groundwater sufficient to give at least small to moderate water entries into excavations may be found in the Head deposits, even though no such groundwater was recorded in the boreholes. Their consistency was "firm, moist" when the investigation was carried out in the (relatively wet) summer of 2012.
- Weathered in-situ Claygate Member: Stiff becoming very stiff, sandy, very silty CLAYS, in which the groundwater pressures may be fully hydrostatic (which means that the water pressure increases linearly with depth) or may be hydrostatic modified locally by under-drainage (via permeable layers which are drained further down the valley). Groundwater flow will generally be limited to seepage through any of the silt/sand partings which are sufficiently interconnected. Owing to the difference of ground levels between the two boreholes, the change to silty CLAYS below 1.8m in BH2 was probably below the level of the base of BH1 and so these silty CLAYS are expected to extend throughout the site.
- Owing to the apparent lack of significant water-bearing horizons in these clays, the large trees in and around No.69's garden may have generated significant desiccation of the clays within their root zones. In the absence of any laboratory test data, all the clays should be assumed to be of High volume change potential as defined in the NHBC Standards, Chapter 4.2 (see 10.2.5).

10.1.2 The hydrogeological regime outlined above will be affected by long-term climatic variations as well as seasonal fluctuations, all of which must be taken into account when selecting a design water level for the permanent works. No multi-seasonal monitoring data are available so a conservative approach will be needed.

10.2 Subterranean (Groundwater) Flow – Permanent Works

10.2.1 The existing foundations to the house probably bear onto either the lower part of the Head deposits or the sandy CLAYS of the Claygate Member. Based on current evidence from the two boreholes any groundwater flow through these strata is likely to be very limited. The extension of the Lower Ground Floor to beneath the full footprint of the front part of the house will involve only a very small increase (at the southeast corner of the house) in the cross-slope width of the obstruction which this level of the house already presents to any groundwater flow. The probability of this extension causing any detriment to groundwater flow is considered to be very low.

10.2.2 Construction of the proposed basement level for the swimming pool will be below the level of any of the existing foundations so will represent a potential obstruction to groundwater flow in the both the upper unit of sandy CLAYS of the Claygate Member and in the lower unit of very silty CLAYS. Once again, on present evidence from the boreholes, significant groundwater flows are not anticipated however the possibility remains of the basement intersecting more permeable materials within the Claygate Member. In the unlikely event that the basement excavations do encounter a laterally extensive deposit of permeable granular soils of narrow width (supporting continuous groundwater flow that would be fully blocked by the proposed works), then an engineered groundwater bypass should be designed and installed so as to permit continued flow beneath the basement. However, if any such permeable granular soils are of sufficient width to extend beyond the footprint of the basement then the groundwater should be able to flow around the new basement. This behaviour is acknowledged in the Camden GHHS which noted that even extensive excavations for basements in the City of London have not caused any serious problems in 'damming' groundwater flow, with groundwater simply finding an alternative route (Arup, 2010, paragraph 205).

10.2.3 As No.69 will have no basements on either side of it, then 'coffering' (extensive damming of groundwater by adjoining or closely spaced basements) will not be an issue. Accordingly, on present evidence, no mitigation measures are currently considered necessary in relation to groundwater flow.

10.2.4 The proposed basement will need to be fully waterproofed in order to provide adequate long-term control of moisture ingress from the groundwater. Detailed recommendations for the waterproofing system are beyond the scope of this report although it is noted that, as a minimum, it would be prudent for the system to be designed in compliance with the requirements of BS8102:2009.

10.2.5 Current geotechnical design standards require use of a 'worst credible' approach to selection of groundwater pressures. On sites such as this where high plasticity clays are present close to surface the groundwater may rise to ground level, at least in the wettest winters, unless mitigation measures such as land drainage can be installed. No acceptable disposal location exists for such water (because there is no accessible watercourse nearby and Thames Water will not allow disposal of groundwater to the mains drainage system). As a result, use of a provisional design groundwater level equal to ground level is recommended for short term (total stress) design situations, and equal to 0.5m below ground level for long-term (effective stress) design situations. This also means that the basement must be designed to resist buoyant uplift pressures from the maximum depth of groundwater which might act on the basement structure. This uplift pressure should be calculated from the maximum depth to the underside of the basement slab relative to the highest surrounding ground level multiplied by 10kN/m^2 (un-factored).

10.3 Subterranean (Groundwater) Flow – Temporary Works

10.3.1 Despite the lack of any groundwater entries into the two boreholes, it remains possible that groundwater control will be required during the basement construction works. Water entries should be manageable by sump pumping. An appropriate discharge location must be identified for the groundwater removed by sump pumping.

10.3.2 A careful watch should be maintained to check that fine soils are not removed with the groundwater; if any such erosion/removal of fines is noticed pumping should cease and the advice of a suitably experienced and competent ground engineer should be sought.

10.3.3 A leaking water supply pipe to the property could increase significantly the volume of water entries so it would be prudent to ensure the isolation stopcock is both accessible and operational before the start of the works.

10.4 Slope and Ground Stability

10.4.1 No evidence was seen during the site inspections of any current slope stability problems within No.69's site or in the surrounding area. The cause of the settlement of the side access path alongside No.69's north flank wall is not known, but no similar settlement appeared to have affected the adjacent path alongside No.71's south flank wall, and so the problem appeared to be a local issue, possibly associated with the drainage system. The drains alongside this wall should be water tested in order to check their integrity and a CCTV survey is recommended of the full drainage system, with any recommended repairs undertaken before or during the proposed works as appropriate.

10.4.2 Only minor changes to ground levels are proposed, as shown on Hockley & Dawson's drawing No.16279-1/102, so no significant re-profiling of the overall slope is planned. In general, other changes which have the potential to decrease the stability of slopes include increases in water pressures and/or the unloading effect of excavations which are potentially serious where the ground upslope of the proposed basement is already only marginally stable. The boreholes have shown that it is unlikely that the basement and the Lower Ground Floor extension will encounter permeable zones with significant groundwater flows (paragraphs 10.2.1 to 10.2.3). In the unlikely event that significant groundwater flow is encountered in soils which would be fully blocked by the basement, then it would be important to install a groundwater bypass to ensure that excess groundwater pressures cannot be generated (see paragraph 10.2.2).

10.4.3 Where retaining walls are to be constructed in a hillside setting such as this, the standards (BS8002:1994 and BSEN1997-1:2004, which is usually known as Eurocode 7) require the design to include analyses of the overall stability of the slope. These analyses should be undertaken for the upslope retaining walls to the proposed basement, as part of the detailed design phase in order to check that the unloading of the slope will not be detrimental to its stability.

10.4.4 The clays of the Claygate Member may be fissured, especially the very silty CLAYS of the lower unit; such fissures can cause seemingly strong, stable excavations to collapse with little or no warning. In addition to normal monitoring of the stability of the excavations a suitably competent person should check whether such fissuring is present and, if encountered, to assess what support is appropriate.

10.4.5 Some ground movement is inevitable when basements are constructed beneath existing houses. When underpinning methods are used the magnitude of the movements in the ground being supported by the new basement walls is dependent primarily on the quality of workmanship, when installing both the temporary support and the permanent structure. When best underpinning practices are implemented for structurally sound buildings founded on in-situ natural soils of adequate allowable bearing capacity, it is possible to keep ground movements and the resultant structural distortions to within acceptable limits, typically within Burland Category 1 (limiting strains of 0.05-0.075%) as presented in LB Camden's CPG4.

10.4.6 Under UK standard practice the contractor is responsible for designing and implementing the temporary works; London Basement's method statement for new basement construction should be consulted for that information. The 'Underpinning Stages' diagrams on Sheet 4 indicate that "The rear of excavations may remain unsupported for max. 48 hrs (or as site conditions allow) during works…"; this would not be appropriate for the rear face or the side faces of underpinning excavations where formed of firm Head deposit clays (as recorded in borehole BH2) because these might squeeze under the increased loads. Full face support placed at the earliest opportunity will be required in such ground as the excavation progresses in order to minimise ground movements. This will be particularly important when the excavations are within the zone of influence of the footings to the adjoining houses, services or, indeed, other parts of No.69.

10.4.7 The depths of excavation required for the swimming pool are illustrated on Hockley & Dawson's drawing No.16279-2/101, which shows that they will extend into the potential zone of influence of the foundations to the flank wall of No.71. These depths of excavation are also greater than the "2900mm proposed" given on London Basement's 'Underpinning Stages' diagrams (Sheet 4 in their method statement). These excavations must therefore be provided with sufficient temporary support as they are excavated, to ensure ground movements are minimised.

10.4.8 Design of the basement retaining walls must take into consideration:

- Earth pressures from the surrounding ground (see also paragraph 10.4.9 below);
- Dead and live loads from the superstructure;
- Loads from the flank walls to No.71 and the free-standing wall on the boundary between Nos 69 and 71;
- Loads from vehicles on the driveway and in the parking area;
- Normal surcharge allowances elsewhere;
- Swelling pressures from the underlying clays;
- A provisional design groundwater level at GL/0.5m bgl (see paragraph 10.2.5);
- Precautions to protect the concrete from sulphate attack.

10.4.9 The following geotechnical parameters should be used when calculating earth pressures:

Made Ground (clays):	Unit weight, γ_b:	17.0 kN/m^3
	Effective cohesion, c':	0 kPa
	Angle of internal friction, φ':	25°
Head Deposit Clays:	Unit weight, γ_b:	18.0 kN/m^3
	Effective cohesion, c':	0 kPa
	Angle of internal friction, φ':	25°
Claygate Member:		
Upper, sandy unit:	Unit weight, γ_b:	20.0 kN/m^3
	Effective cohesion, c':	0 kPa
	Angle of internal friction, φ':	26°
Lower unit:	Unit weight, γ_b:	20.0 kN/m^3
	Effective cohesion, c':	0 kPa
	Angle of internal friction, φ':	24°

These parameters should be used in conjunction with appropriate partial factors dependent upon the design method selected.

10.4.10 The adequacy of the proposed underpinning depths beneath the front of the house should be checked against the NHBC Standards Chapter 4.2 recommendations before a Building Control application is submitted. The trees most likely to be significant are the large oak in the front garden to No.71 and the high conifer (Cypress?) and unidentified deciduous tree in No.69's front garden. The basement will be sufficiently deep that it is unlikely that any of the trees in the rear garden will have significant root growth below the basement.

10.4.11 Excavation of the basement will cause immediate elastic heave in response to the stress reduction, followed by long term plastic swelling as the clays take up groundwater. The rate of plastic swelling will be determined largely by the availability of water and as a result, given the low permeability of the Claygate Member, can take many years to reach full equilibrium. The basement slab will need to be sufficiently stiff to enable it to accommodate the swelling pressures developed underneath it. Given the proposed depths of excavation of the basement for the swimming pool, its elongated footprint with its location beneath and beyond one corner of the house (and the potential for loading/unloading cycles when it is emptied for cleaning), a quantitative heave analysis using finite element methods is recommended as part of the design process in order to assess whether additional measures such as tension piles will be required to resist uplift.

10.4.12 No railway tunnels are known to pass below or close to the site. Other infrastructure tunnels, for sewers, cables or communications might be present so an appropriate services search should be undertaken, and if any such tunnels are identified then their potential influence on the scheme must be assessed.

10.5 Surface Flow and Flooding

10.5.1 There are no surface water features within 250m of the site and no rivers within 500m, as indicated by the EnviroInsight report (Appendix D, Sections 5.8 and 5.9). The site is known to lie close to the former alignment of one of the Westbourne's tributaries which has been culverted (as described in Section 5 above) so it is no longer able to receive surface water run-off. Whether the culvert remains connected hydraulically to the perennial surrounding groundwater is unknown.

10.5.2 The proposed extension to the Lower Ground Floor and the proposed new basement will not significantly alter the area of hard surfacing because the construction of a raised planter in the area which is currently paved parking will approximately offset the new paved area of the lightwell. As a result the run-off profiles will remain almost identical to the current situation. Rainfall landing on the long thin strip of walk-on glass ($8m^2$) over the proposed swimming pool will run-off into the immediately adjacent soil, but as only a very thin layer of soil is shown over the swimming pool's roof this will rapidly become saturated in heavy rainfall; reinstatement with an increased depth of lightweight soil is therefore recommended.

10.5.3 The site lies within the Environment Agency's Flood Zone 1 which means that it is considered to be at little or no risk of fluvial flooding. The EnviroInsight report (Appendix D, Section 6) also indicates that none of the following occur within 250m of the site:

- Flood defences
- Areas benefitting from flood defences
- Areas used for flood storage

10.5.4 The *'Floods in Camden'* report (LBC Floods Scrutiny Panel, 2003) and LBC's CPG4 guidance document record that Redington Road did not flood in either the 1975 or the 2002 local pluvial floods.

10.5.5 No drainage system can be guaranteed to have adequate capacity for all storm eventualities and all drainage systems only work at full capacity when they are properly maintained, including emptying gullies and regular checks of the sewers themselves for condition and blockages. That maintenance is the responsibility of Thames Water so is outside both the Applicant's and the Council's control. Thus the possibility remains that pluvial flooding could occur during an exceptional storm, although the probability is considered to be very low.

10.5.6 Non-return valves must be fitted on the drains serving the basement in order to ensure that water from the mains foul sewer system cannot enter the basement if part of the sewer system should ever operate under surcharge.

11.0 CONCLUSIONS

11.1 These conclusions consider only the primary findings of this assessment; the whole report should be read to obtain a full understanding of the matters considered.

11.2 The proposed basement is considered acceptable in relation to the likely limited subterranean (groundwater) flow in the natural strata based on the evidence from the two boreholes. In the unlikely event that significant continuous groundwater flow through permeable granular soils is encountered then a groundwater bypass below the basement would be required as a mitigation measure (10.2.1 to 10.2.3 and 10.4.2).

11.3 The basement will need to be fully waterproofed (10.2.4). Provisional design groundwater levels equal to ground level (short term) and 0.5m below ground level (long term) are proposed, which means that the basement must be able to resist buoyant uplift pressures (10.2.5).

11.4 Water entries into the basement excavations are likely to be manageable by sump pumping (10.3.1).

11.5 No evidence was seen for current slope stability problems, although the cause of the settlement of the path along No.69's north flank wall is not known. The drains beneath that path should be water tested and a CCTV survey should be undertaken of the whole drainage system; any defects found should be repaired (10.4.1). .

11.6 Analyses of the overall stability of the slope, including the excavations for the basement and the retaining walls on the upslope side should be undertaken as part of the design and in accordance with current design standards (10.4.3).

11.7 Best practice underpinning methods, especially in relation to the use of temporary support to the excavations, will be required in order to keep the inevitable ground movements within acceptable limits (10.4.4 to 10.4.7).

11.8 The location of the proposed basement beneath/beyond one corner of the house and the depth of excavations required for the swimming pool means that additional measures may be required to resist uplift pressures. Quantitative finite element analyses should be undertaken to assess the potential magnitude of the inevitable heave movements.

11.9 Various other guidance is provided in relation to the geotechnical design and construction of the basement's perimeter walls (Section 10.4).

11.10 There will be no significant change in run-off from hard surfacing but only a very thin layer of soil has been allowed above the swimming pool roof, and so this ground would saturate very rapidly; a greater depth of reinstatement soils for the lawn over the basement roof is therefore recommended (10.5.2).

11.11 Non-return valves must be fitted on the drains serving the basement (10.5.6).

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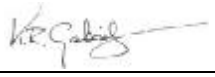
Report Status: FINAL		
Role	By	Signature
Lead author:	Keith Gabriel MSc DIC CGeol FGS UK Registered Ground Engineering Adviser	
Slope/ground stability aspects approved by:	Mike Summersgill MSc CEng MICE C.WEM FCIWEM	
Subterranean (Groundwater) flow aspects approved by:	Keith Gabriel MSc DIC CGeol FGS	
Surface flow and flooding aspects approved by:	Mike Summersgill MSc CEng MICE C.WEM FCIWEM	

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Appendix A

Photographs

Project:

69 REDINGTON ROAD , NW3 7RP

13117

Photo 1: Location of proposed lightwell, showing inclined parking area and path up to front door.

Photo 2: Northern side of rear garden, where proposed basement will extend out beneath the lawn. Note retaining walls below boundary fence and supporting terrace, and dry stone wall to flower bed.

Title:	Photographs - Sheet 1					**Sheet**	1
Date:	18/26 Feb 2013	**Checked:**	KRG	**Approved:**	KRG	**Scale :**	NTS

Project:

69 REDINGTON ROAD , NW3 7RP

13117

Photos 3/4: Rear garden, viewed from kitchen terrace

Photos 5/6/7: Rear garden, viewed from SE corner

Title:	Photographs - Sheet 2					**Sheet**	2
Date:	18/26 Feb 2013	**Checked:**	KRG	**Approved:**	KRG	**Scale :**	NTS

Project:

69 REDINGTON ROAD , NW3 7RP

13117

Photo 8: Oak tree at south end of terrace.

Photo 9: South end of retaining wall supporting terrace, showing outward displacement.

Title:	Photographs - Sheet 3					**Sheet**	3
Date:	18/26 Feb 2013	**Checked:**	KRG	**Approved:**	KRG	**Scale :**	NTS

Project:

69 REDINGTON ROAD , NW3 7RP

13117

Photo 10: Retaining wall in garden beyond rear boundary (No.39 Hollycroft Avenue).

Photo 11: Path alongside north flank wall, showing settlement relative to wall and new drain.

Title:	Photographs - Sheet 4					**Sheet**	4
Date:	18/26 Feb 2013	**Checked:**	KRG	**Approved:**	KRG	**Scale :**	NTS

Project:

69 REDINGTON ROAD , NW3 7RP

13117

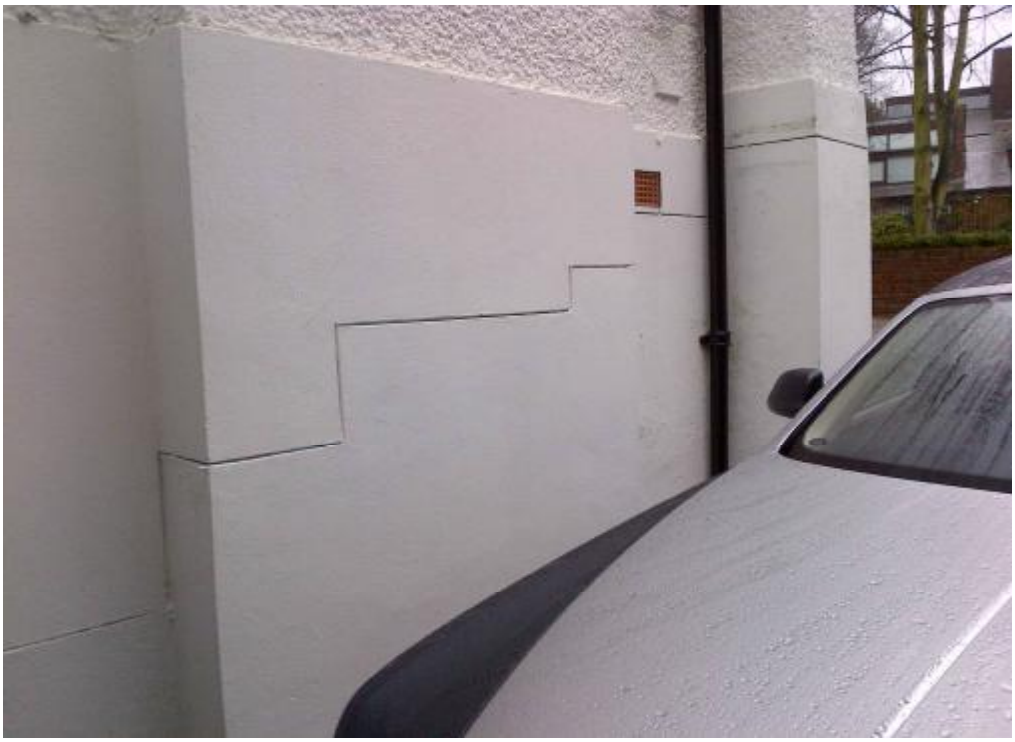

Photo 12: Stepped groove in render which probably marks position of damp proof course, with wall below that level retaining the inclined earth as seen in the crawl space beneath front part of house.

Title:	Photographs - Sheet 5					**Sheet**	5
Date:	18/26 Feb 2013	**Checked:**	KRG	**Approved:**	KRG	**Scale :**	NTS

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Appendix B

Ground Investigation Results by Chelmer Site Investigations

A Factual Report on the

Site Investigation undertaken for

London Basement

at

69 Redington Road
Camden
London NW3

CSI Ref: 3230

Dated: 11th June 2012

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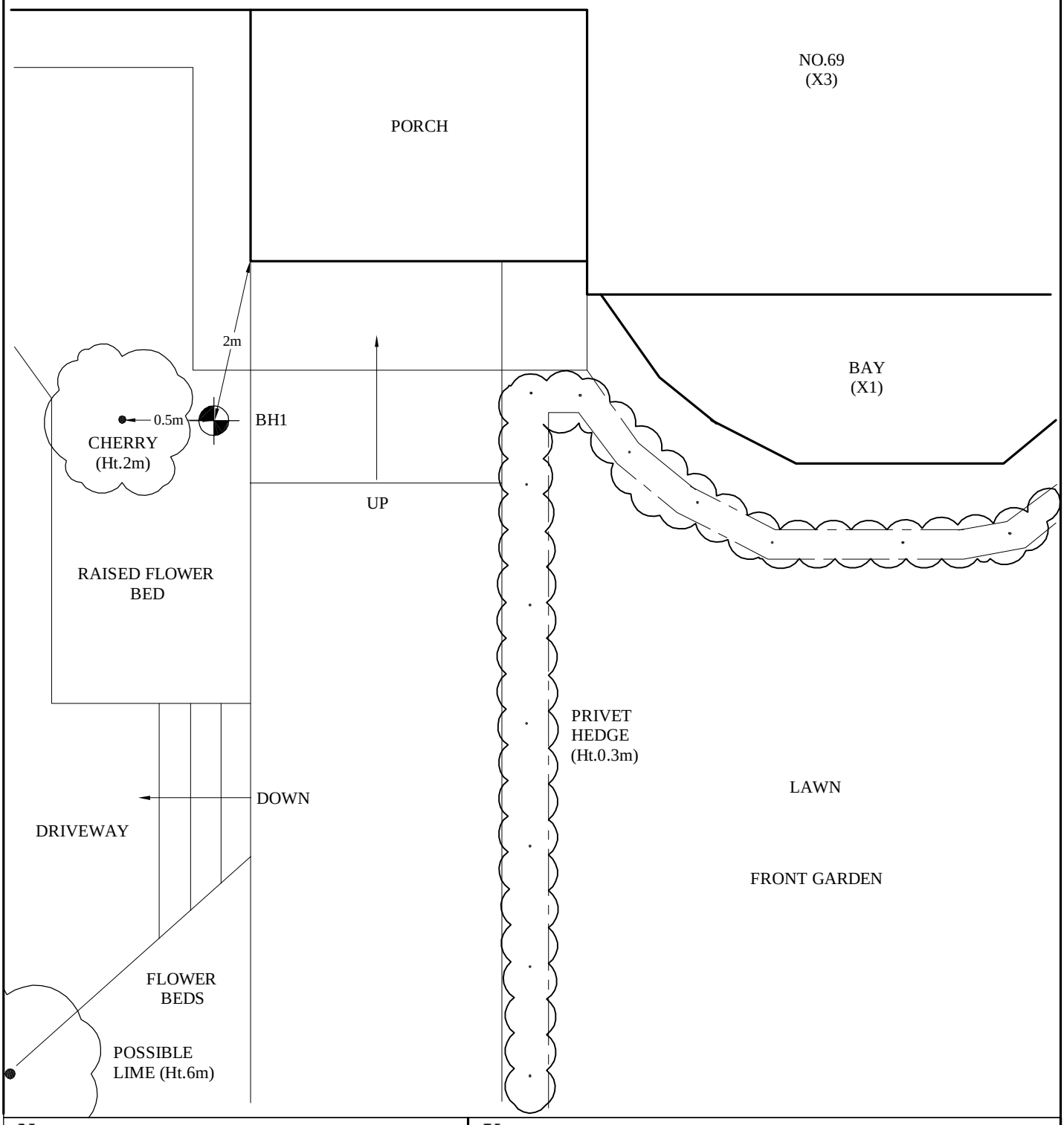
Client: London Basement	**Scale:** N.T.S.	**Sheet:** 1 of 2	**Date:** 11.6.12
Location: 69 Reddington Road, Camden, London NW3	**Job No:** 3230	**Weather:** Rain	**Drawn by: DB** / **Checked by: ME**



Notes:

On site tree identification for guidance only. Not authenticated.

Key:

Tree/Shrub | Borehole | Trial Pit | G Gully | Tree Stump | Rain Water/ Soil Pipe | MH Manhole

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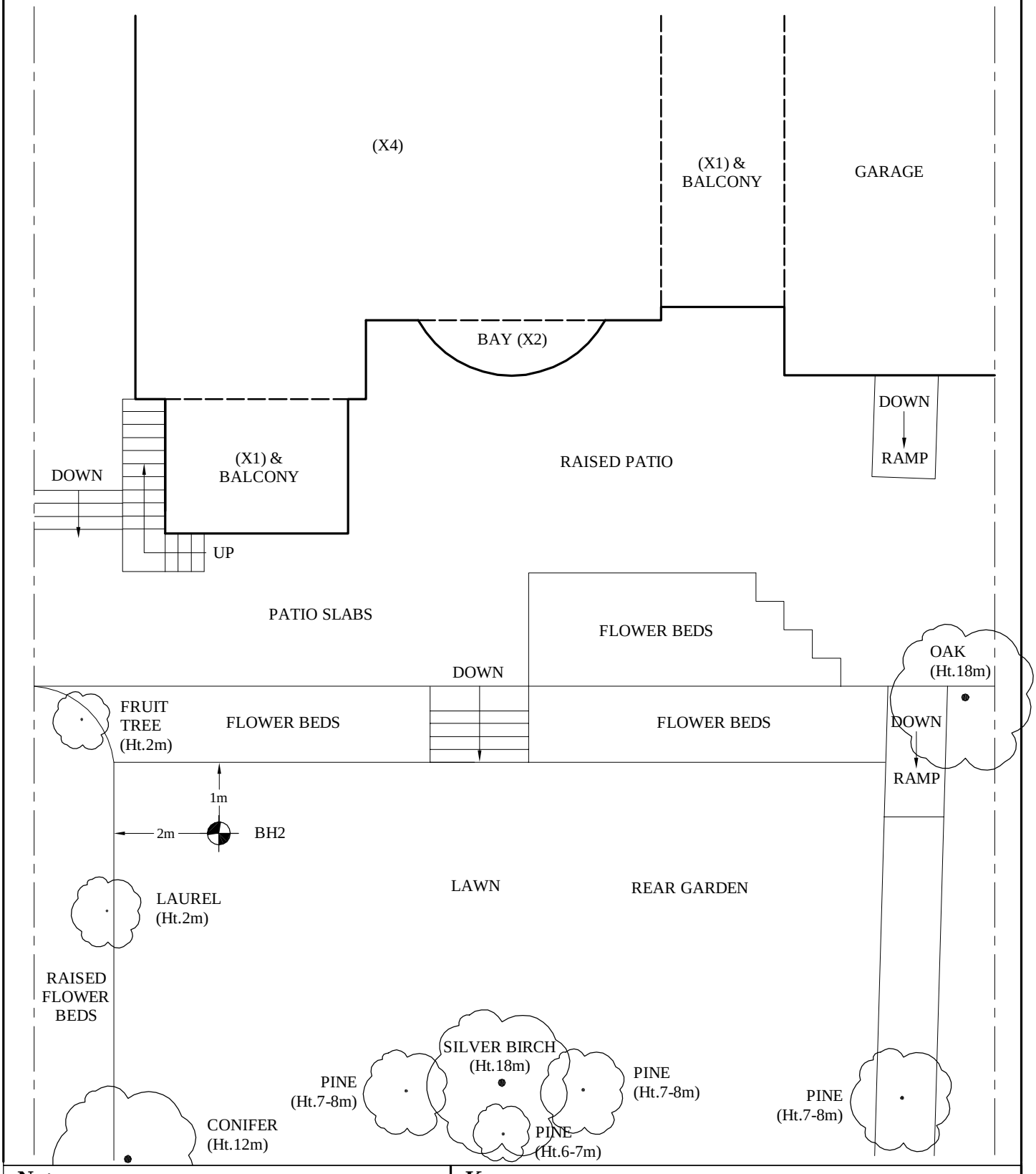
Client:	London Basement	**Scale:**	N.T.S.	**Sheet:**	2 of 2	**Date:**	11.6.12
Location:	69 Reddington Road, Camden, London NW3	**Job No:**	3230	**Weather:**	Rain	**Drawn by: DB**	**Checked by: ME**



Notes:

On site tree identification for guidance only. Not authenticated.

Key:

Tree/Shrub | Borehole | Trial Pit | G Gully | Tree Stump | Rain Water/ Soil Pipe | MH Manhole

Chelmer Site Investigations
Unit 15 East Hanningfield Industrial Estate
Old Church Road, East Hanningfield, Essex CM3 8AB
Telephone: 01245 400930 Fax: 01245 400933
Email: info@siteinvestigations.co.uk Website: www.siteinvestigations.co.uk

Client: London Basement	**Scale:** N.T.S.	**Sheet No:** 1 of 1	**Weather:** Rain	**Date:** 11.6.12	
Site: 69 Redington Road, Camden, London NW3	**Job No:** 3230	**Borehole No:** 1	**Boring method:** Hand auger		

Depth Mtrs.	Description of Strata	Thick-ness	Legend	Sample	Test Type	Test Result	Root Information	Depth to Water	Depth Mtrs
G.L.	Topsoil (300) over MADE GROUND: loose to medium compact mid brown/orange very sandy very silty clay with partings of orange and brown silt and fine sand with occasional fine gravel brick fragments and crystals.	1.5		D	M	02 03 02 04	Roots of live appearance to 2mmØ to 1.3m.		0.5
				D	M	06 09 12 13			1.0
1.5				D	V	86 92	Roots of live appearance to 1mmØ to 1.6m.		1.5
	Stiff mid brown/orange grey veined very sandy very silty CLAY with partings of orange brown and red silt and fine sand with occasional claystone nodules and crystals.	2.3		D	V	102 104	Hair and fibrous roots to 2.1m.		2.0
				D	V	108 118	No roots observed below 2.1m.		2.5
				D	V	120 126			3.0
				D	V	128 134			3.5
3.8	Very stiff as above.	1.4		D	V	140+ 140+			4.0
				D	V	140+ 140+			4.5
				D	V	140+ 140+			5.0
5.2	Borehole ends at 5.2m Obstruction thought to be claystone Too dense to hand auger.								

Drawn by: DB **Approved by:** ME

Remarks: Borehole dry and open on completion.

Key: T.D.T.D. Too Dense to Drive
D Small Disturbed Sample J Jar Sample
B Bulk Disturbed Sample V Pilcon Vane (kPa)
U Undisturbed Sample (U100) M Mackintosh Probe
W Water Sample N Standard Penetration Test Blow Count

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Client: London Basement	**Scale:** N.T.S.	**Sheet No:** 1 of 1	**Weather:** Rain	**Date:** 11.6.12	
Site: 69 Redington Road, Camden, London NW3	**Job No:** 3230	**Borehole No:** 2	**Boring method:** Hand auger		

Depth Mtrs.	Description of Strata	Thick-ness	Legend	Sample	Test Type	Test Result	Root Information	Depth to Water	Depth Mtrs
G.L.	Turf over TOPSOIL (300mm)	0.3							
0.3	Firm moist mid brown/orange grey veined sandy very silty CLAY with partings of orange and brown silt and fine sand occasional fine gravel and crystals.	0.6		D	V	68 72	Roots of live appearance to 2mmØ to 1.1m.		0.5
0.9	Stiff mid brown/orange grey veined sandy very silty CLAY with partings of orange brown and red silt and fine sand and crystals.	0.9		D	V	96 104	Roots of live appearance to 1mmØ to 1.7m.		1.0
				D	V	118 122			1.5
1.8	Stiff mid brown grey veined silty CLAY with partings of orange brown and red silt and fine sand and crystals.	0.5		D	V	126 132	Hair and fibrous roots to 2.2m.		2.0
2.2	Very stiff as above.	1.1		D	V	140+ 140+	No roots observed below 2.2m.		2.5
				D	V	140+ 140+			3.0
3.3	Very stiff mid grey very silty CLAY with partings of orange and brown silt and fine sand and crystals.	2.7		D	V	140+ 140+			3.5
				D	V	140+ 140+			4.0
				D	V	140+ 140+			4.5
				D	V	140+ 140+			5.0
				D	V	140+ 140+			5.5
6.0	Borehole ends at 6.0m			D	V	140+ 140+			6.0

Drawn by: DB **Approved by:** ME

Remarks: Borehole dry and open on completion.

Key: T.D.T.D. Too Dense to Drive
D Small Disturbed Sample J Jar Sample
B Bulk Disturbed Sample V Pilcon Vane (kPa)
U Undisturbed Sample (U100) M Mackintosh Probe
W Water Sample N Standard Penetration Test Blow Count

Chelmer Site Investigations,
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REPORT NOTES

Equipment Used

Hand tools, Mechanical Concrete Breaker and Spade, Hand Augers, 100mm/150mm diameter Mechanical Flight Auger Rig, GEO205 Flight Auger Rig, Window Sampling Rig, and Large or Limited Access Shell & Auger Rig upon request and/or access permitting.

On Site Tests

By Pilcon Shear-Vane Tester (Kn/m^2) in clay soils, and/or Mackintosh Probe in granular soils or made ground and/or upon request Continuous Dynamic Probe Testing and Standard Penetration Testing.

Note:

Details reported in trial-pits and boreholes relate to positions investigated only as instructed by the client or engineer on the date shown.

We are therefore unable to accept any responsibility for changes in soil conditions not investigated i.e. variations due to climate, season, vegetation and varying ground water levels.

Full terms and conditions are available upon request.

Chelmer Consultancy Services
Unit 15, East Hanningfield Industrial Estate, Old Church Road
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Email: info@siteinvestigations.co.uk Website: www.siteinvestigations.co.uk

Appendix C

Desk Study Data – Geological Data (GroundSure GeoInsight)

Gabriel GeoConsulting Ltd
Highfield House, Rolvenden Road,
Benenden, TN17 4EH

GroundSure Reference:	HMD-641815
Your Reference:	GGC13117
Report Date	6 Mar 2013
Report Delivery Method:	Email - pdf

GroundSure GeoInsight

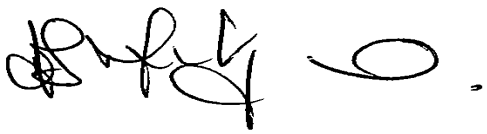
Address: 69,REDINGTON ROAD,LONDON, NW3 7RP

Dear Sir/Madam,

Thank you for placing your order with GroundSure. Please find enclosed the **GroundSure GeoInsight** as requested.

If you need any further assistance, please do not hesitate to contact our helpline on 08444 159000 quoting the above GroundSure reference number.

Yours faithfully,



Managing Director
Groundsure Limited

Enc.
GroundSure GeoInsight

GroundSure GeoInsight

Address: 69,REDINGTON ROAD,LONDON, NW3 7RP

Date: 6 Mar 2013

GroundSure Reference: HMD-641815

Your Reference: GGC13117

Brought to you by GroundSure

Aerial Photograph of Study Site

NW N NE

W E

SW S SE

Aerial photography supplied by Getmapping PLC.
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Site Name: 69,REDINGTON ROAD,LONDON, NW3 7RP
Grid Reference: 525596,186057
Size of Site: 0.11 ha

Overview of Findings

The GroundSure GeoInsight provides high quality geo-environmental information that allows geo-environmental professionals and their clients to make informed decisions and be forewarned of potential ground instability problems that may affect the ground investigation, foundation design and possibly remediation options that could lead to possible additional costs.

The report is based on the BGS 1:50,000 Digital Geological Map of Great Britain, BGS Geosure data; BRITPITS database; Shallow Mining data and Borehole Records, Coal Authority data including brine extraction areas, PBA non-coal mining and natural cavities database, Johnson Poole and Bloomer mining data and GroundSure's unique database including historical surface ground and underground workings.

For further details on each dataset, please refer to each individual section in the report as listed. Where the database has been searched a numerical result will be recorded. Where the database has not been searched '-' will be recorded.

Report Section	Number of records found within (X) m of the study site boundary
1. Geology	**Description**
1.1 Artificial Ground,	
1.1.1 Is there any Artificial Ground /Made Ground present beneath the study site?*	No
1.1.2 Are there any records relating to permeability of artificial ground within the study site* boundary?	No
1.2 Superficial Geology & Landslips	
1.2.1 Is there any Superficial Ground/Drift Geology present beneath the study site?*	No
1.2.2 Are there any records relating to permeability of superficial geology within the study site* boundary?	No
1.2.3 Are there any records of landslip within 500m of the study site boundary?	No
1.2.4 Are there any records relating to permeability of landslips within the study site* boundary?	No
1.3 Bedrock, Solid Geology & Faults	
1.3.1 For records of Bedrock and Solid Geology beneath the study site* see the detailed findings section.	
1.3.2 Are there any records relating to permeability of bedrock within the study site* boundary?	Yes
1.3.3 Are there any records of faults within 500m of the study site boundary?	No
1.3.4 Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level?	The property is not in a Radon Affected Area, as less than 1% of properties are above the Action Level
1.3.5 Is the property in an area where Radon Protection Measures are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment?	No radon protective measures are necessary

* This includes an automatically generated 50m buffer zone around the site

Source:Scale 1:50,000 BGS Sheet No:256

2. Ground Workings	on-site	0-50	51-250	251-500	501-1000
2.1 Historical Surface Ground Working Features from Small Scale Mapping	0	0	6	-	-
2.2 Historical Underground Workings Features from Small Scale Mapping	0	0	0	0	0
2.3 Current Ground Workings	0	0	0	0	0

3. Mining, Extraction & Natural Cavities	on-site	0-50	51-250	251-500	501-1000
3.1 Historical Mining	0	0	0	0	0
3.2 Coal Mining	0	0	0	0	0
3.3 Johnson Poole and Bloomer Mining Area	0	0	0	0	0
3.4 Non-Coal Mining*	0	0	0	0	0
3.5 Non–Coal Mining Cavities	0	0	0	0	0
3.6 Natural Cavities	0	0	0	0	0
3.7 Brine Extraction	0	0	0	0	0
3.8 Gypsum Extraction	0	0	0	0	0
3.9 Tin Mining	0	0	0	0	0
3.10 Clay Mining	0	0	0	0	0

*This includes an automatically generated 50m buffer zone around the site

4. Natural Ground Subsidence	on-site*	0-50	51-250	251-500	501-1000
4.1 Shrink-Swell Clay	Moderate	-	-	-	-
4.2 Landslides	Very Low	-	-	-	-
4.3 Ground Dissolution of Soluble Rocks	Null	-	-	-	-
4.4 Compressible Deposits	Negligible	-	-	-	-
4.5 Collapsible Deposits	Very Low	-	-	-	-
4.6 Running Sand	Low	-	-	-	-

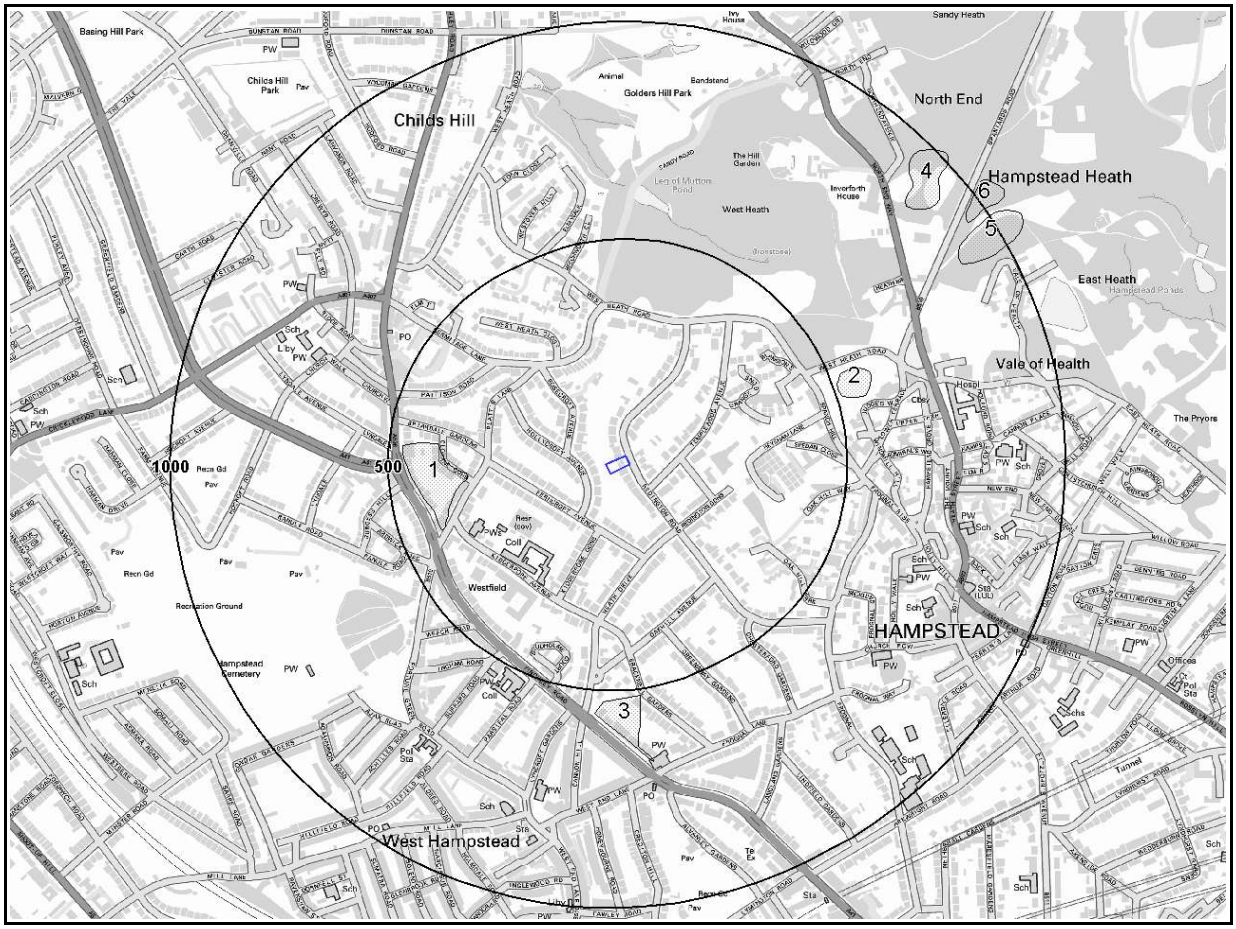
* This includes an automatically generated 50m buffer zone around the site

5. Borehole Records	on-site	0-50	51-250	251-500	501-1000
5.1 BGS Recorded Boreholes	0	0	0	-	-

6. Estimated Background Soil Chemistry	on-site	0-50	51-250	251-500	501-1000
6.1 Records of Background Soil Chemistry	1	2	0	-	-

1.1 Artificial Ground Map

NW N NE



W E

SW S SE

Artificial Ground Legend

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Site Outline

500
1000
Search Buffers (m)

Made Ground (undivided)

Disturbed Ground (undivided)

Worked Ground (undivided)

Landscaped Ground (undivided)

Infilled Ground

Reclaimed Ground

Geological information represented on the mapping is derived from the BGS Digital Geological map of Great Britain at 1:50,000 scale.

1.1 Artificial Ground

The following geological information represented on the mapping is derived from 1:50,000 scale BGS Geological mapping, Sheet No:256

1.1.1 Artificial/Made Ground

Are there any records of Artificial/Made Ground within 500m of the study site boundary? Yes

ID	Distance (m)	Direction	LEX Code	Description	Rock Description
1	319.0	W	WGR-OPEN	WORKED GROUND (UNDIVIDED)	VOID

1.1.2 Permeability of Artificial Ground

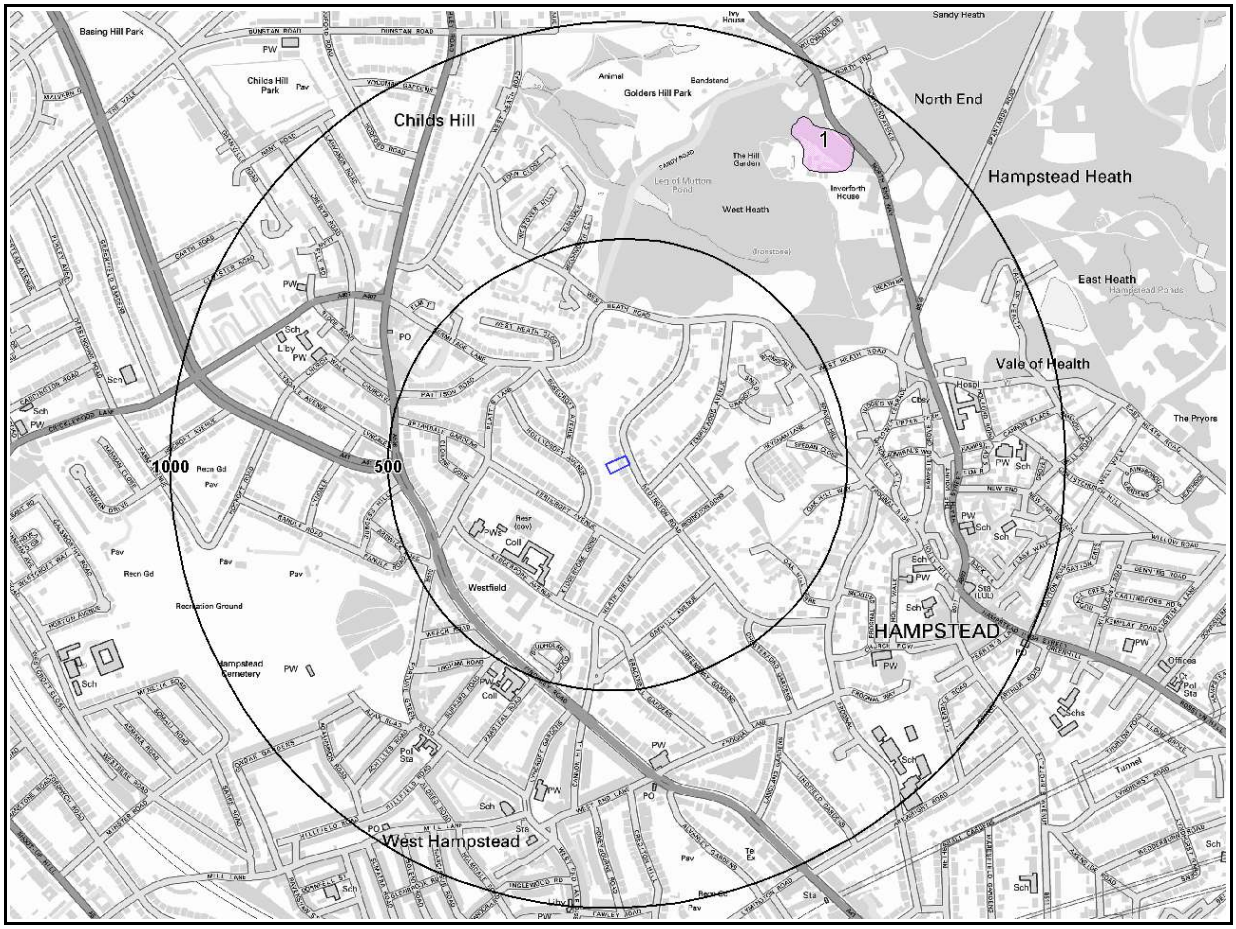
Are there any records relating to permeability of artificial ground within the study site* boundary? No

Database searched and no data found.

* This includes an automatically generated 50m buffer zone around the site.

1.2 Superficial Deposits and Landslips Map

NW N NE



W E

SW S SE

Superficial and Landslips Legend

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Site Outline

500
1000
Search Buffers (m)

Geological information represented on the mapping is derived from the BGS Digital Geological map of Great Britain at 1:50,000 scale.

1.2 Superficial Deposits and Landslips

1.2.1 Superficial Deposits/Drift Geology

Are there any records of Superficial Deposits/Drift Geology within 500m of the study site boundary? No

Database searched and no data found.

1.2.2 Permeability of Superficial Ground

Are there any records relating to permeability of superficial ground within the study site* boundary? No

Database searched and no data found.

1.2.3 Landslip

Are there any records of Landslip within 500m of the study site boundary? No

Database searched and no data found.

The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of Great Britain at 1:50,000 scale.

This Geology shows the main components as discrete layers, these are: Artificial / Made Ground, Superficial / Drift Geology and Landslips. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nationwide coverage.

1.2.4 Landslip Permeability

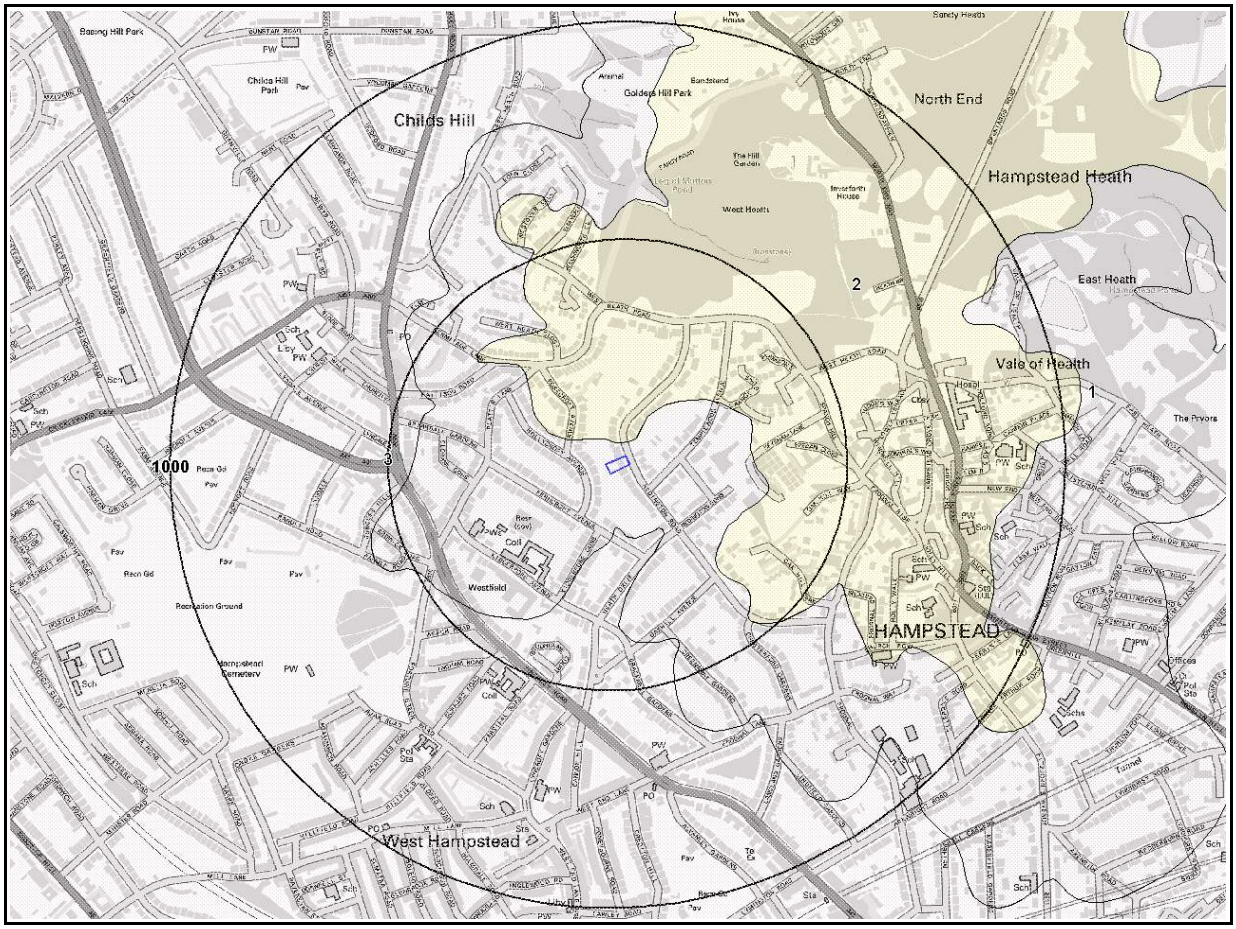
Are there any records relating to permeability of landslips within the study site* boundary? No

Database searched and no data found.

*This includes an automatically generated 50m buffer zone around the site.

1.3 Bedrock and Faults Map

NW N NE



W E

SW S SE

Bedrock & Faults Deposits Legend

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Site Outline

500
1000
Search Buffers (m)

Geological information represented on the mapping is derived from the BGS Digital Geological map of Great Britain at 1:50,000 scale.

1.3 Bedrock, Solid Geology & Faults

The following geological information represented on the mapping is derived from 1:50,000 scale BGS Geological mapping, Sheet No:256

1.3.1 Bedrock/Solid Geology

Records of Bedrock/Solid Geology within 500m of the study site boundary:

ID	Distance (m)	Direction	LEX Code	Rock Description	Rock Age
1	0.0	On Site	CLGB-CLSS	Claygate Member - Clay, Silt And Sand	Eocene
2	32.0	N	BGS-SAND	Bagshot Formation - Sand	Eocene
3	125.0	S	LC-CLSS	London Clay Formation - Clay, Silt And Sand	Eocene

1.3.2 Permeability of Bedrock Ground

Are there any records relating to permeability of bedrock ground within the study site* boundary? Yes

Distance (m)	Direction	Flow type	Maximum Permeability	Minimum Permeability
0.0	On Site	Mixed	High	Very Low
32.0	N	Intergranular	High	High

1.3.3 Faults

Are there any records of Faults within 500m of the study site boundary? No

Database searched and no data found.

The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of Great Britain at 1:50,000 scale.

This Geology shows the main components as discrete layers, these are: Bedrock/ Solid Geology and linear features such as Faults. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nationwide coverage.

1.3.4 Radon Affected Areas

Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level?

The property is not in a Radon Affected Area, as less than 1% of properties are above the Action Level

1.3.5 Radon Protection

Is the property in an area where Radon Protection are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment?

No radon protective measures are necessary

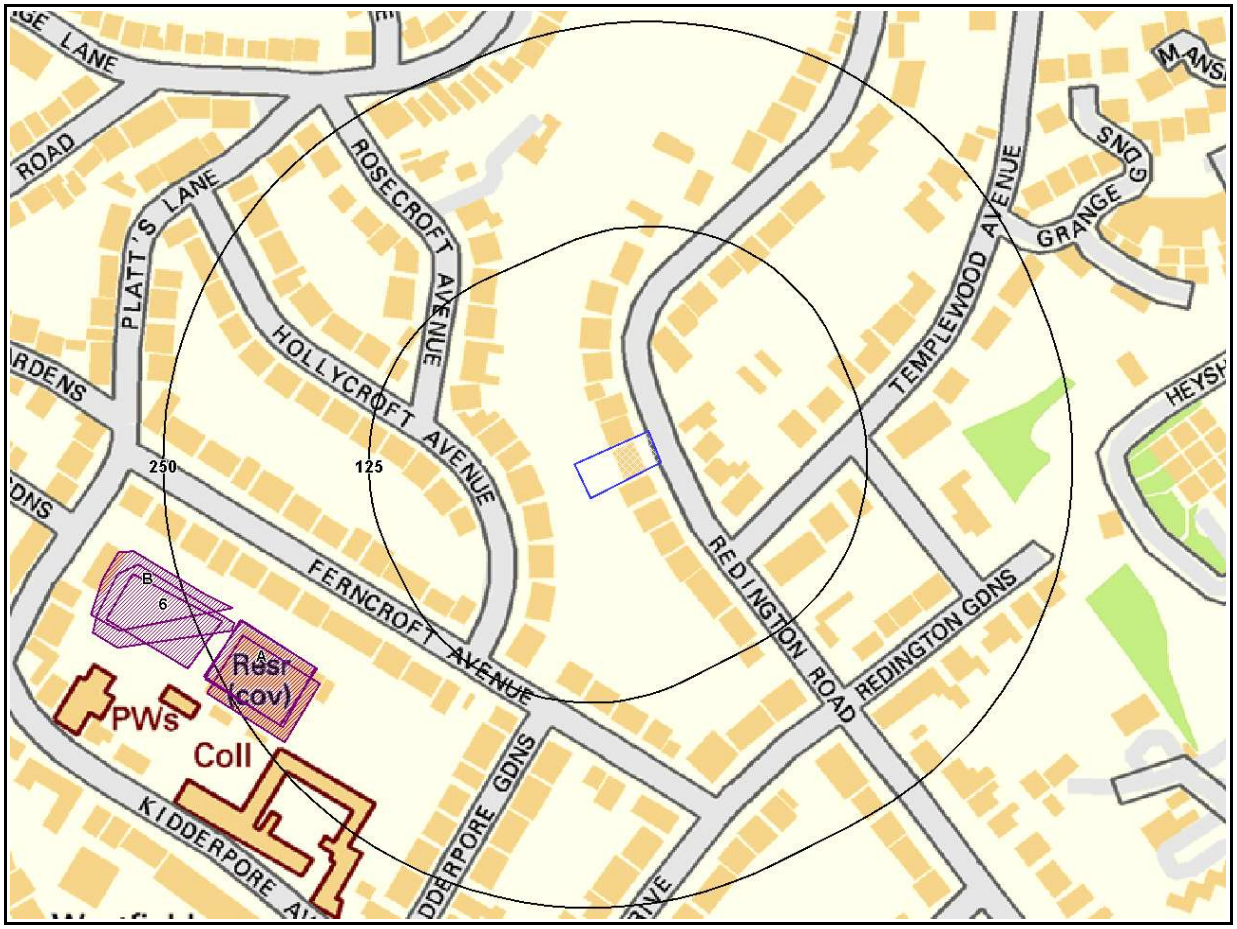
* This includes an automatically generated 50m buffer zone around the site.

2. Ground Workings Map

NW N NE

W E

SW S SE



Ground Workings Legend

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Site Outline

125
250
Search Buffers (m)

Historic Surface Ground Workings

Historic Underground Workings

Current Ground Workings

2. Ground Workings

2.1 Historical Surface Ground Working Features derived from Historical Mapping

This dataset is based on GroundSure's unique Historical Land Use Database derived from 1:10,560 and 1:10,000 scale historical mapping.

Are there any Historical Surface Ground Working Features within 250m of the study site boundary? Yes

The following Historical Surface Ground Working Features are provided by GroundSure:

ID	Distance (m)	Direction	NGR	Use	Date
1A	196.0	SW	525374,185926	Reservoir	1940
2A	196.0	SW	525373,185926	Reservoir	1912
3A	200.0	SW	525375,185917	Reservoir	1920
4B	226.0	SW	525314,185976	Unspecified Heap	1912
5B	228.0	SW	525314,185967	Unspecified Heap	1920
6	235.0	SW	525315,185958	Covered Reservoir	1894

2.2 Historical Underground Workings Features derived from Historical Mapping

This data is derived from the GroundSure unique Historical Land Use Database. It contains data derived from 1:10,000 and 1:10,560 historical Ordnance Survey Mapping and includes some natural topographical features (Shake Holes for example) as well as manmade features that may have implications for ground stability. Underground and mining features have been identified from surface features such as shafts. The distance that these extend underground is not shown.

Are there any Historical Underground Working Features within 1000m of the study site boundary? No

Database searched and no data found.

2.3 Current Ground Workings

This dataset is derived from the BGS BRITPITS database covering active; inactive mines; quarries; oil wells; gas wells and mineral wharves; and rail deposits throughout the British Isles.

Are there any BGS Current Ground Workings within 1000m of the study site boundary? No

Database searched and no data found.

3. Mining, Extraction & Natural Cavities Map

NW N NE

W E

SW S SE

Mining, Extraction & Natural Cavities Legend

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Site Outline

250
500
Search Buffers (m)

Historical Mining

Non-Coal Mining Cavities

Natural Cavities

Non-Coal Mining

Highly likely

Likely

Unlikely

Highly unlikely

Rare

3.Mining, Extraction & Natural Cavities

3.1 Historical Mining

This dataset is derived from GroundSure unique Historical Land-use Database that are indicative of mining or extraction activities.

Are there any Historical Mining areas within 1000m of the study site boundary? **No**

Database searched and no data found.

3.2 Coal Mining

This dataset provides information as to whether the study site lies within a known coal mining affected area as defined by the coal authority.

Are there any Coal Mining areas within 1000m of the study site boundary? **No**

Database searched and no data found.

3.3 Johnson Poole and Bloomer

This dataset provides information as to whether the study site lies within an area where JPB hold information relating to mining.

Are there any JPB Mining areas within 1000m of the study site boundary? **No**

The following information provided by JPB is not represented on Mapping:

Database searched. No results found.

3.4 Non – Coal Mining

This dataset provides information as to whether the study site lies within an area which may have been subject to non-coal historic mining.

Are there any Non-Coal Mining areas within 1000m of the study site boundary? **No**

Database searched and no data found.

3.5 Non – Coal Mining Cavities

This dataset provides information from the Peter Brett Associates (PBA) mining cavities database (compiled for the national study entitled "Review of mining instability in Great Britain, 1990" PBA has also continued adding to this database) on mineral extraction by mining.

Are there any Non-Coal Mining cavities within 1000m of the study site boundary? **No**

Database searched and no data found.

3.6 Natural Cavities

This dataset provides information based on Peter Brett Associates natural cavities database.

Are there any Natural Cavities within 1000m of the study site boundary? **No**

Database searched and no data found.

3.7 Brine Extraction

This dataset provides information from the Brine Compensation Board which has been discontinued and is now covered by the Coal Authority.

Are there any Brine Extraction areas within 1000m of the study site boundary? **No**

Database searched and no data found.

3.8 Gypsum Extraction

This dataset provides information on Gypsum extraction from British Gypsum records.

Are there any Gypsum Extraction areas within 1000m of the study site boundary? **No**

Database searched and no data found.

3.9 Tin Mining

This dataset provides information on tin mining areas and is derived from tin mining records. This search is based upon postcode information to a sector level. More detailed information on potential Tin Mining may be found in Section 3.4 – Non-Coal Mining Hazards.

Are there any Tin Mining areas within 1000m of the study site boundary? **No**

Database searched and no data found.

3.10 Clay Mining

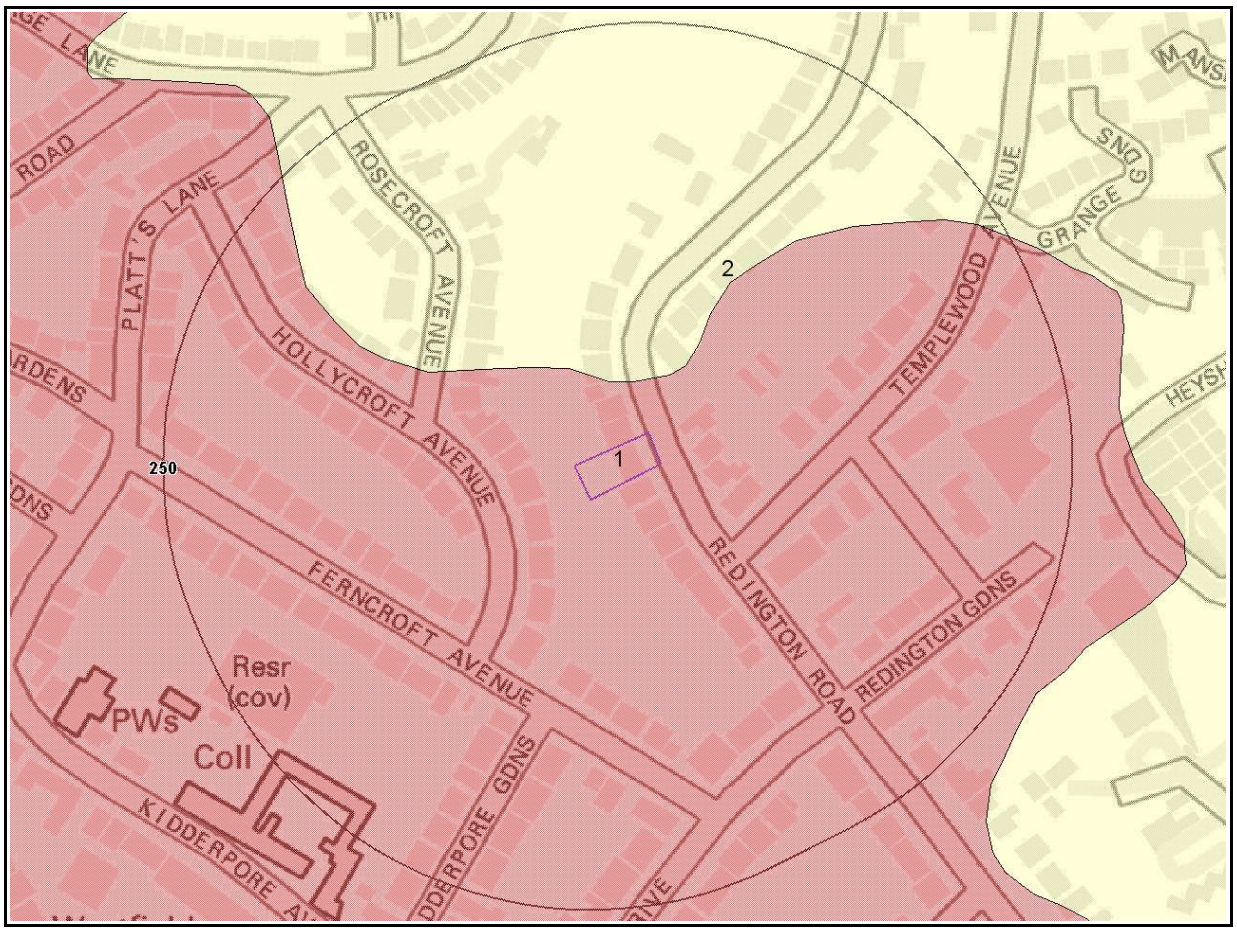
This dataset provides information on Kaolin and Ball Clay mining from relevant mining records.

Are there any Clay Mining areas within 1000m of the study site boundary? **No**

Database searched and no data found.

4. Natural Ground Subsidence
4.1 Shrink-Swell Clay Map

NW N NE



W E

SW S SE

Shrink-Swell Clay Legend

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Site Outline

125
250
Search Buffers (m)

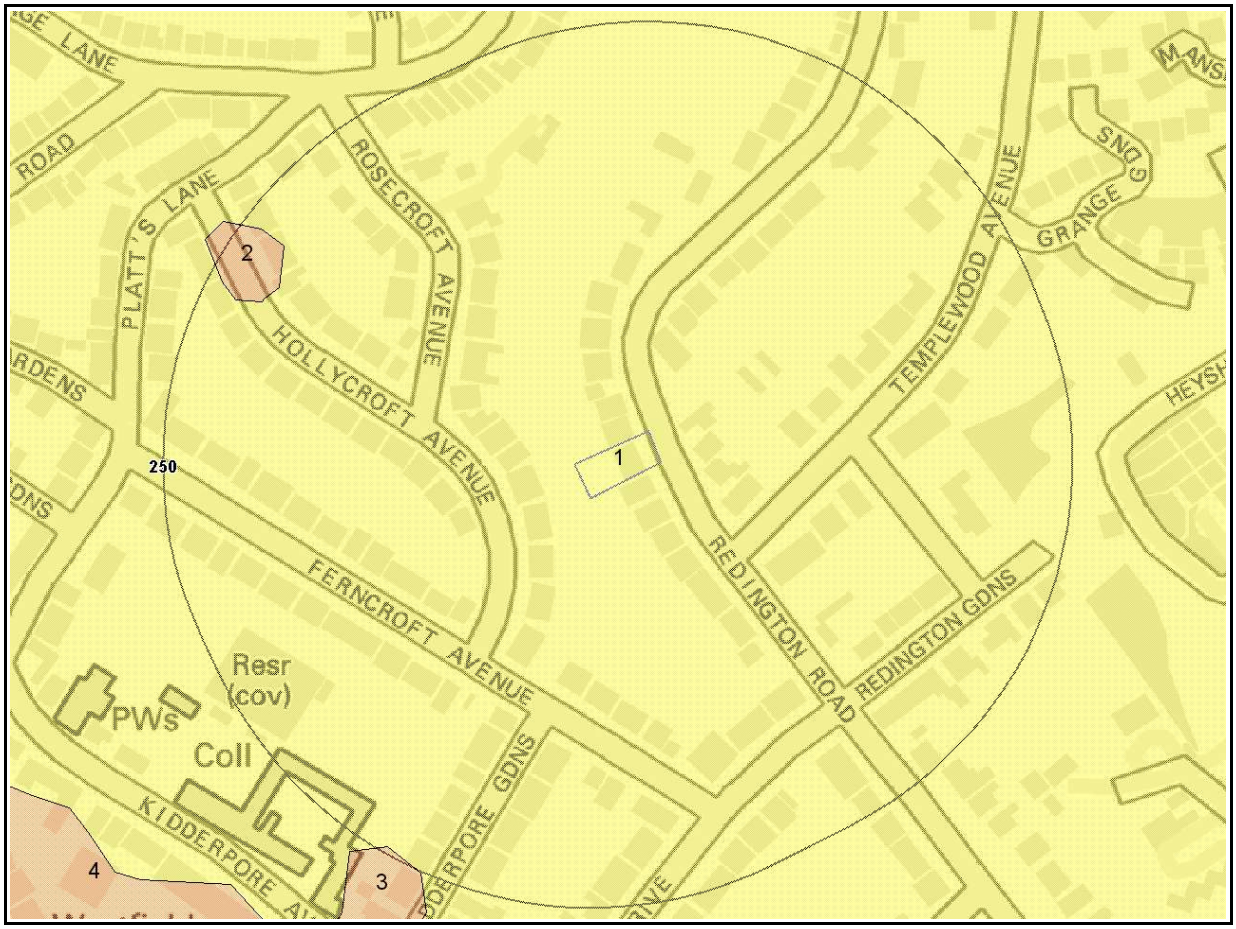
No Data / Null
Negligible
Very Low
Low
Moderate
High

4.2 Landslides Map

NW N NE

W E

SW S SE



Landslides Legend

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Site Outline

125
250
Search Buffers (m)

No Data / Null
Negligible
Very Low

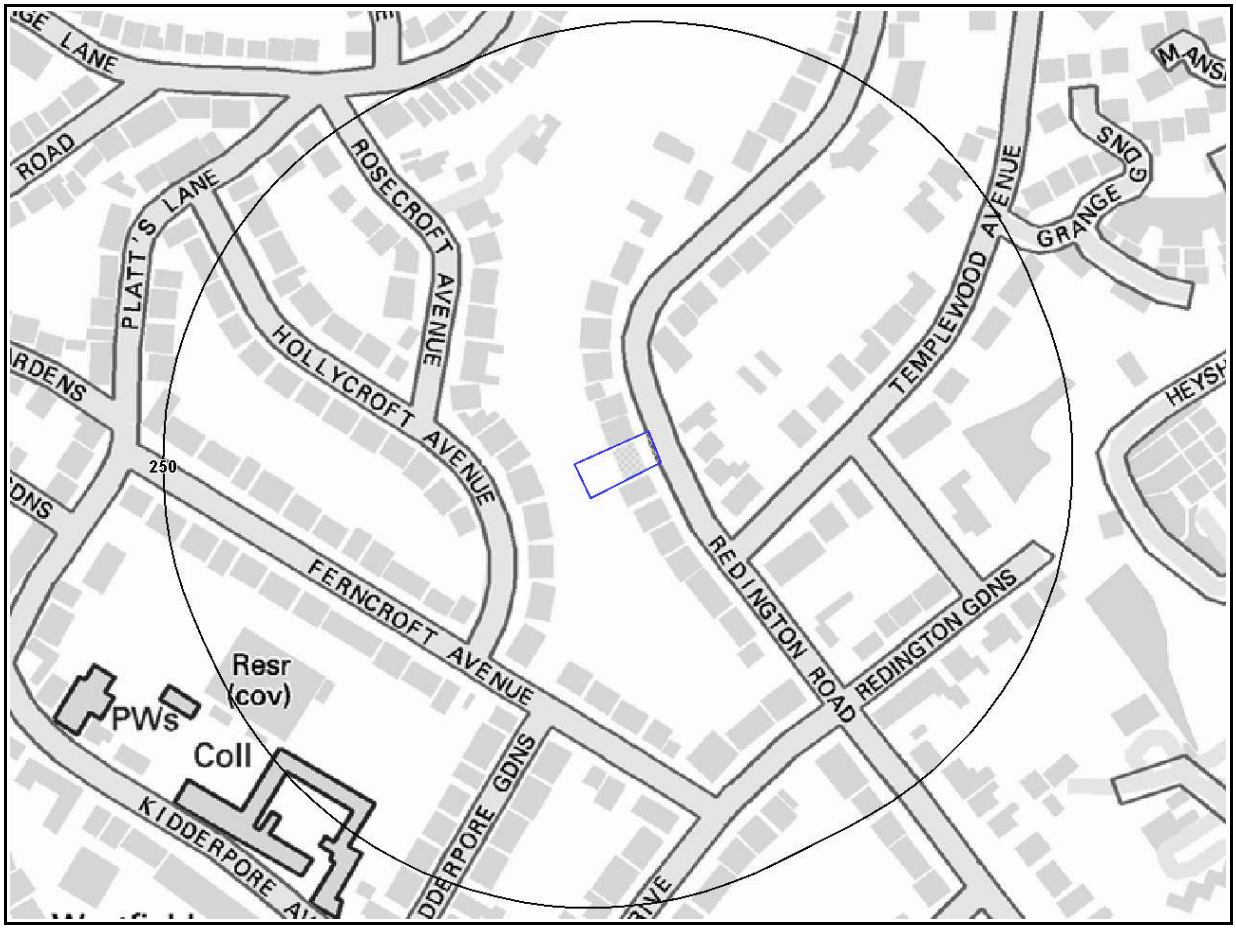
Low
Moderate
High

4.3 Ground Dissolution Soluble Rocks Map

NW N NE

W E

SW S SE



Ground Dissolution Soluble Rocks Legend

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Site Outline

125
250
Search Buffers (m)

No Data / Null

Negligible

Very Low

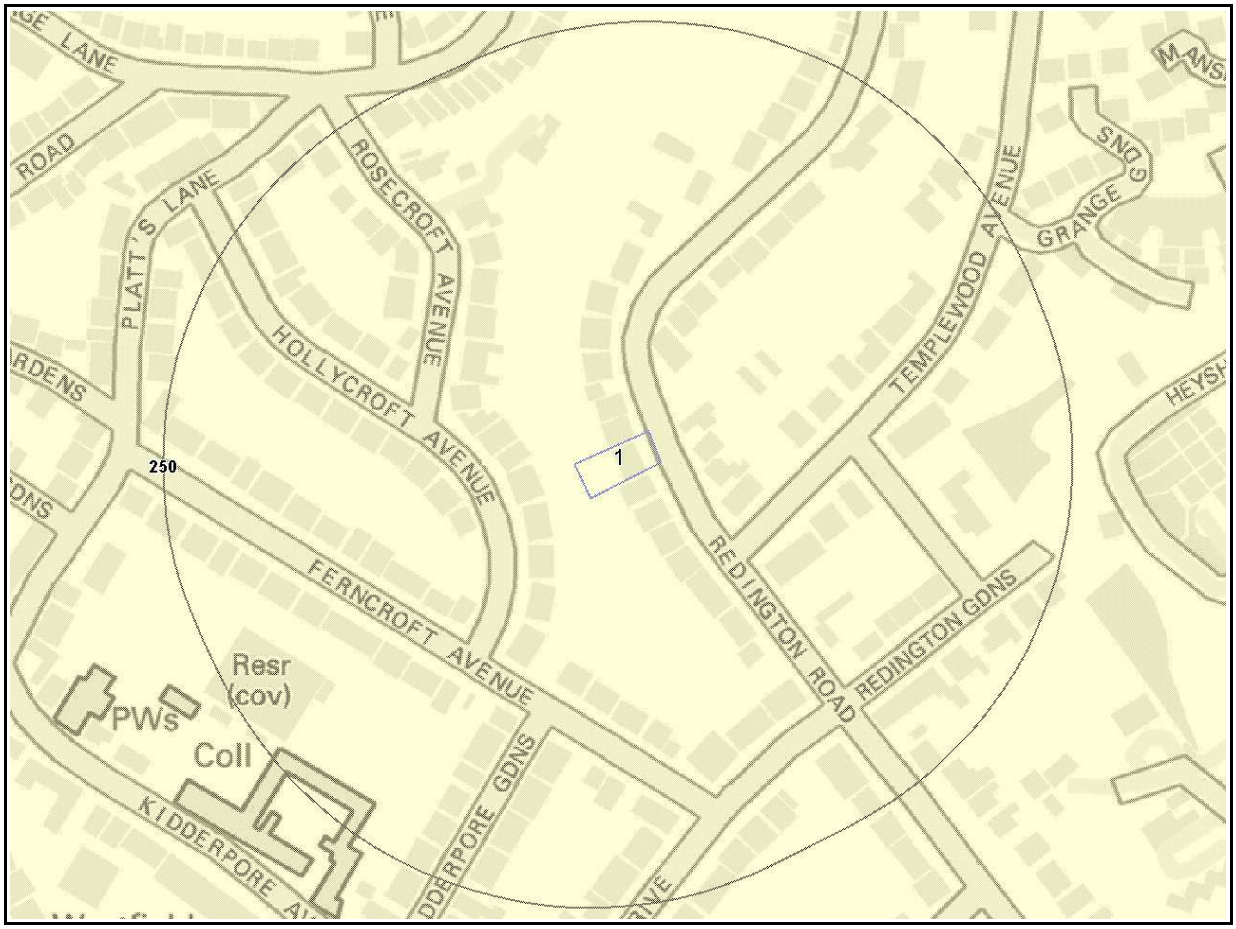
Low

Moderate

High

4.4 Compressible Deposits Map

NW N NE



W E

SW S SE

Compressible Deposits Legend

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Licence Number: 100035207

Site Outline

125
250
Search Buffers (m)

No Data / Null

Negligible

Very Low

Low

Moderate

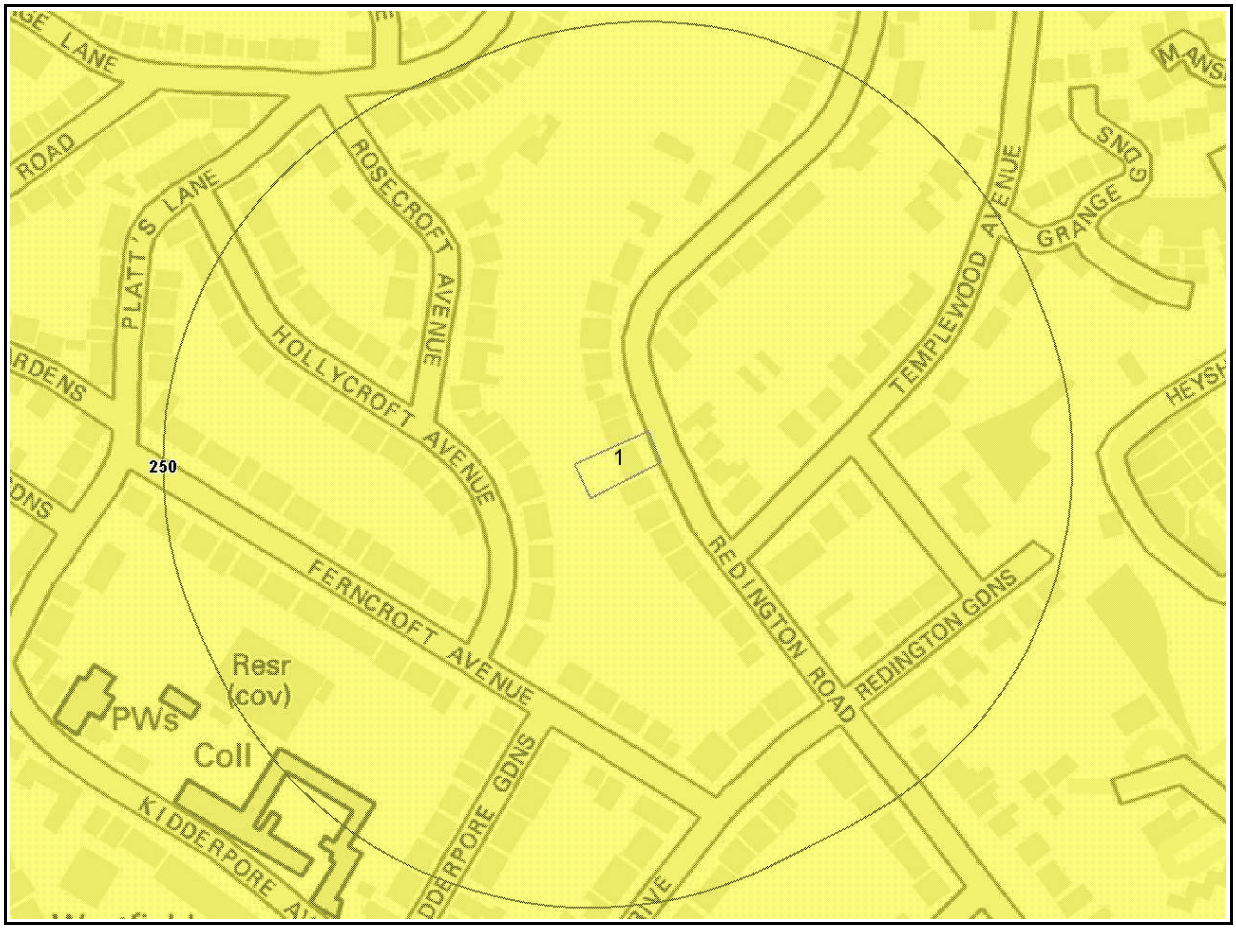
High

4.5 Collapsible Deposits Map

NW N NE

W E

SW S SE



Collapsible Deposits Legend

Enabled by Ordnance Survey

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Licence Number: 100035207

Site Outline

125
250
Search Buffers (m)

No Data / Null

Negligible

Very Low

Low

Moderate

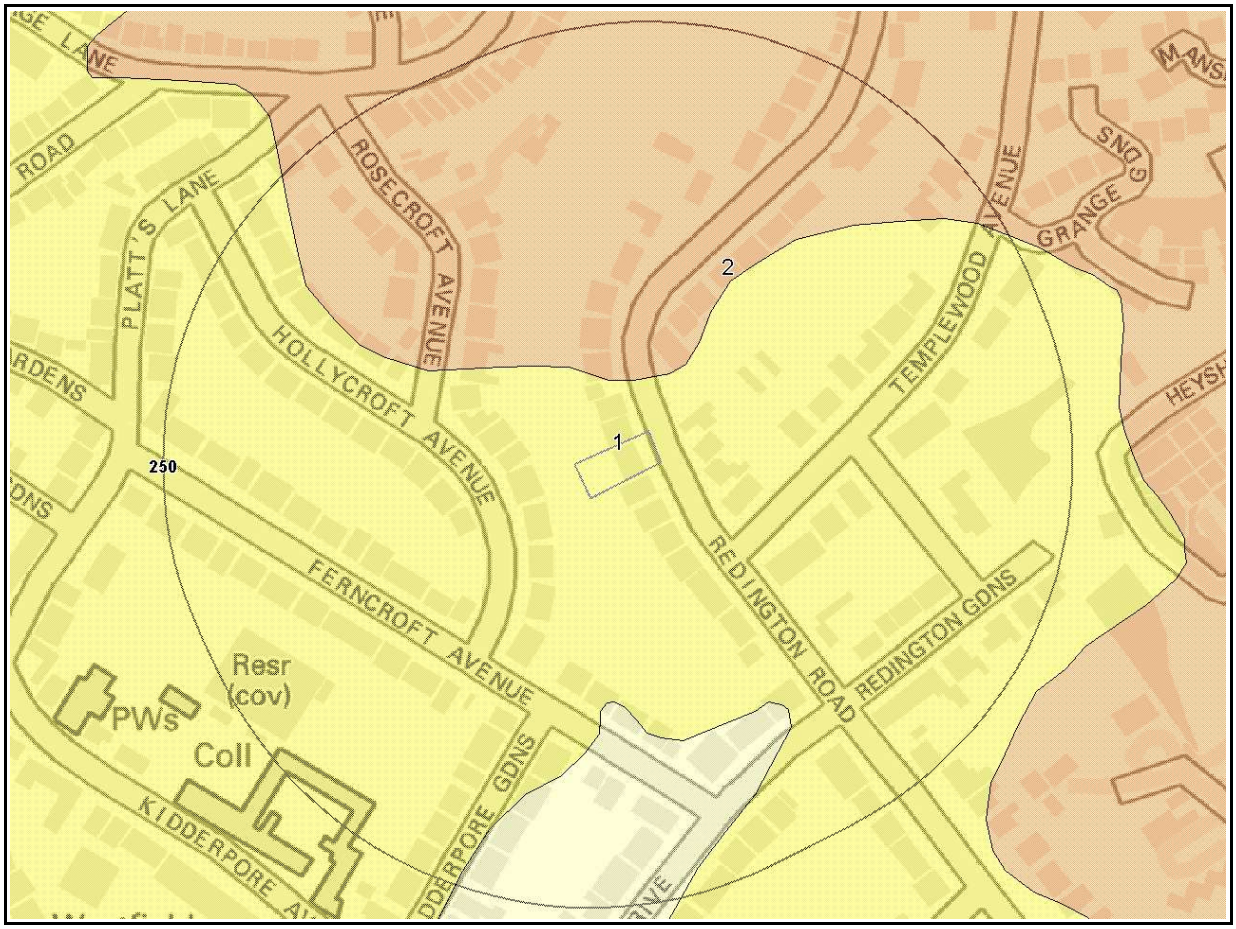
High

4.6 Running Sand Map

NW N NE

W E

SW S SE



Running Sand Legend

Enabled by Ordnance Survey

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Licence Number: 100035207

Site Outline

125
250
Search Buffers (m)

No Data / Null
Negligible
Very Low

Low
Moderate
High

4.Natural Ground Subsidence

The National Ground Subsidence rating is obtained through the 6 natural ground stability hazard datasets, which are supplied by the British Geological Survey (BGS).

The following GeoSure data represented on the mapping is derived from the BGS Digital Geological map of Great Britain at 1:50,000 scale.

What is the maximum hazard rating of natural subsidence within the study site* boundary? Moderate

4.1 Shrink – Swell Clays

The following Shrink Swell information provided by the British Geological Survey:

ID	Distance (m) *	Direction	Hazard Rating	Details
1	0.0	On Site	Moderate	Ground conditions predominantly high plasticity. Do not plant or remove trees or shrubs near to buildings without expert advice about their effect and management. For new build, consideration should be given to advice published by the National House Building Council (NHBC) and the Building Research Establishment (BRE). There is a probable increase in construction cost to reduce potential shrink-swell problems. For existing property, there is a probable increase in insurance risk during droughts or where vegetation with high moisture demands is present.
2	32.0	N	Negligible	Ground conditions predominantly non-plastic. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely likely due to potential problems with shrink-swell clays.

4.2 Landslides

The following Landslides information provided by the British Geological Survey:

ID	Distance (m)*	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Slope instability problems are unlikely to be present. No special actions required to avoid problems due to landslides. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with landslides.

4.3 Ground Dissolution of Soluble Rocks

The following Soluble Rocks information provided by the British Geological Survey:

Distance (m)*	Direction	Hazard Rating	Details
0.0	On site	Null-Negligible	Soluble rocks are not present in the search area. No special actions required to avoid problems due to soluble rocks. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with soluble rocks.

*This includes an automatically generated 50m buffer zone around the study site boundary.

4.4 Compressible Deposits

The following Compressible Ground information provided by the British Geological Survey:

ID	Distance (m)*	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.

4.5 Collapsible Deposits

The following Collapsible Rocks information is provided by the British Geological Survey:

ID	Distance (m)*	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.

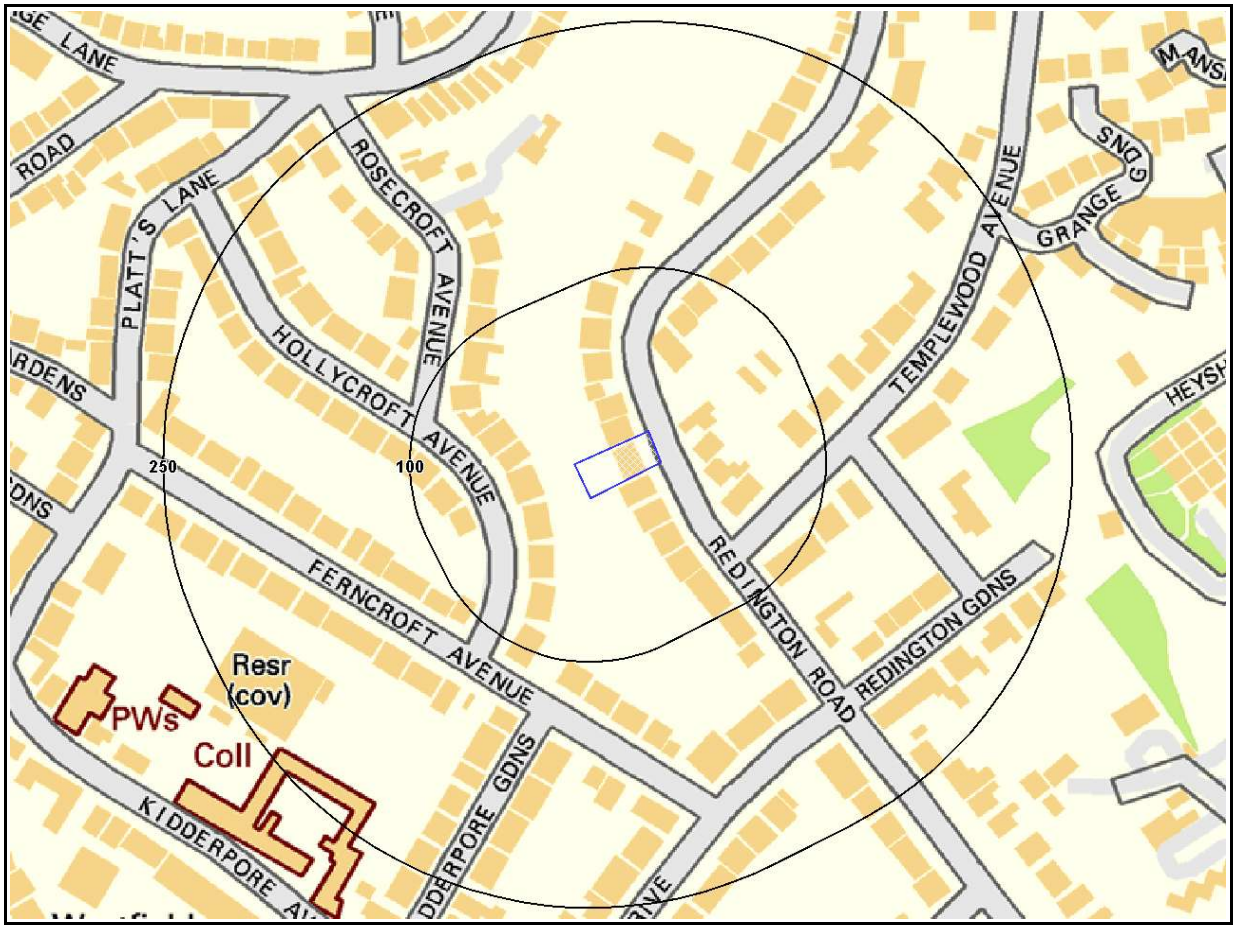
4.6 Running Sands

The following Running Sands information is provided by the British Geological Survey:

ID	Distance (m)*	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Very low potential for running sand problems if water table rises or if sandy strata are exposed to water. No special actions required, to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.
2	32.0	N	Low	Possibility of running sand problems after major changes in ground conditions. Normal maintenance to avoid leakage of water-bearing services or water bodies (ponds, swimming pools) should reduce likelihood of problems due to running sand. For new build consider possibility of running sand into trenches or excavations if water table is high or sandy strata are exposed to water. Avoid concentrated water inputs to site. Unlikely to be an increase in construction costs due to potential for running sand. For existing property no significant increase in insurance risk due to running sand problems is likely.

5. Borehole Records Map

NW N NE



W E

SW S SE

Borehole Records Legend

Enabled by Ordnance Survey

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Licence Number: 100035207

Site Outline

Borehole Locations

125
250
Search Buffers (m)

5.Borehole Records

The systematic analysis of data extracted from the BGS Borehole Records database provides the following information.

Records of boreholes within 250m of the study site boundary: **0**

Database searched and no data found.

6.Estimated Background Soil Chemistry

Records of background estimated soil chemistry within 250m of the study site boundary: 3

For further information on how this data is calculated and limitations upon its use, please see the GroundSure GeoInsight User Guide, available on request.

			Estimated Geometric Mean Soil Concentrations (mg/kg)				
Distance (m)*	Direction	Sample Type	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Nickel (Ni)	Lead (Pb)
0.0	On Site	London	No data	No data	No data	No data	No data
32.0	N	London	No data	No data	No data	No data	No data
33.0	S	London	No data	No data	No data	No data	No data

*As this data is based upon underlying 1:50,000 scale geological information, a 50m buffer has been added to the search radius.

7. Contacts

GroundSure Helpline
Telephone: 08444 159 000
info@4c.groundsure.com

British Geological Survey Enquiries
Kingsley Dunham Centre
Keyworth, Nottingham NG12 5GG
Tel: 0115 936 3143. Fax: 0115 936 3276.
Email: enquiries@bgs.ac.uk
Web: www.bgs.ac.uk
BGS Geological Hazards Reports and general geological enquiries

British Gypsum
British Gypsum Ltd, East Leake, Loughborough, Leicestershire, LE12 6HX
Tel: www.british-gypsum.com

The Coal Authority
200 Lichfield Lane, Mansfield, Notts NG18 4RG
Tel: 0845 762 6848
DX 716176 Mansfield 5 www.coal.gov.uk

Johnson Poole & Bloomer Limited
Harris and Pearson Building, Brettel Lane, Brierley Hill, West Midlands DY5 3LH
Tel: +44 (0) 1384 262 000
Email: enquiries.gs@jpb.co.uk
Website: www.jpb.co.uk

Ordnance Survey
Romsey Road, Southampton SO16 4GU
Tel: 08456 050505

Getmapping PLC
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Hampshire RG27 8NW
Tel: 01252 845444

Peter Brett Associates
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Berkshire RG1 8DN
Tel: +44 (0)118 950 0761 E-mail: reading@pba.co.uk

Acknowledgements

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This report has been prepared in accordance with the GroundSure Ltd standard Terms and Conditions of business for work of this nature.

Standard Terms and Conditions

1 Definitions

In these conditions unless the context otherwise requires:

"Beneficiary" means the Client or the customer of the Client for whom the Client has procured the Services.

"Commercial" means any building which is not Residential.

"Commission" means an order for Consultancy Services submitted by a Client.

"Consultancy Services" mean consultancy services provided by GroundSure including, without limitation, carrying out interpretation of third party and in-house environmental data, provision of environmental consultancy advice, undertaking environmental audits and assessments, Site investigation, Site monitoring and related items.

"Contract" means the contract between GroundSure and the Client for the performance of the Services which arises upon GroundSure's acceptance of an Order or Commission and which shall incorporate these conditions, the relevant GroundSure User Guide, proposal by GroundSure and the content of any subsequent report, and any agreed amendments in accordance with clause 11.

"Client" means the party that submits an Order or Commission.

"Data Provider" means any third party providing Third Party Content to GroundSure.

"Data Report" means reports comprising factual data with no professional interpretation in respect of the level of likely risk and/or liability available from GroundSure.

"GroundSure" means GroundSure Limited, a company registered in England and Wales under number 03421028 and whose registered office is at GroundSure Ltd, c/o Top Right Group Limited, The Prow, 1 Wilder Walk, London W1B 5AP. United Kingdom.

"GroundSure Materials" means all materials prepared by GroundSure as a result of the provision of the Services, including but not limited to Data Reports, Mapping and Risk Screening Reports.

"Intellectual Property" means any patent, copyright, design rights, service marks, moral rights, data protection rights, know-how, trade mark or any other intellectual property rights.

"Mapping" an historical map or a combination of historical maps of various ages, time periods and scales available from GroundSure.

"Order" means an order form submitted by the Client requiring Services from GroundSure in respect of a specified Site.

"Order Website" means online platform via which Orders may be placed.

"Report" means a Risk Screening Report or Data Report for commercial or residential property available from GroundSure relating to the Site prepared in accordance with the specifications set out in the relevant User Guide.

"Residential" means any building used as or suitable for use as an individual dwelling.

"Risk Screening Report" means one of GroundSure's risk screening reports, comprising factual data with interpretation in respect of the level of likely risk and/or liability, excluding **"Consultancy Services"**.

"Services" means the provision of any Report, Mapping or Consultancy Services which GroundSure has agreed to carry out for the Client/Beneficiary on these terms and conditions in respect of the Site.

"Site" means the landsite in respect of which GroundSure provides the Services.

"Third Party Content" means any data, database or other information contained in a Report or Mapping which is provided to GroundSure by a Data Provider.

"User Guide" means the relevant current version of the user guide, available upon request from GroundSure.

2 Scope of Services

2.1 GroundSure agrees to carry out the Services in accordance with the Contract and to the extent set out therein.

2.2 GroundSure shall exercise all the reasonable skill, care and diligence to be expected of experienced environmental consultants in the performance of the Services.

2.3 The Client acknowledges that it has not relied on any statement or representation made by or on behalf of GroundSure which is not set out and expressly agreed in the Contract.

2.4 Terms and conditions appearing on a Client's order form, printed stationery or other communication, including invoices, to GroundSure, its employees, servants, agents or other representatives or any terms implied by custom, practice or course of dealing shall be of no effect and these terms and conditions shall prevail over all others.

2.5 If a Client/Beneficiary requests insurance in conjunction with or as a result of the Services, GroundSure shall use reasonable endeavours to procure such insurance, but makes no warranty that such insurance shall be available from insurers or offered on reasonable terms. GroundSure does not endorse or recommend any particular insurance product, policy or insurer. Any insurance purchased shall be subject solely to the terms of the policy issued by insurers and GroundSure will have no liability therefor. The Client/Beneficiary should take independent advice to ensure that the insurance policy requested and/or offered is suitable for its requirements.

2.6 GroundSure's quotations/proposals are valid for a period of 30 days only. GroundSure reserves the right to withdraw any quotation at any time before GroundSure accepts an Order or Commission. GroundSure's acceptance of an Order or Commission shall be effective only where such acceptance is in writing and signed by GroundSure's authorised representative or where accepted via GroundSure's Order Website.

3 The Client's obligations

3.1 The Client shall ensure the Beneficiary complies with and is bound by the terms and conditions set out in the Contract and shall provide that Groundsure may in its own right enforce such terms and conditions against the Beneficiary pursuant to the Contracts (Rights of Third parties) Act 1999. The Client shall be liable for all breaches of the Contract by the Beneficiary as if they were breaches by the Client. The Client shall be solely responsible for ensuring that the Report/Mapping ordered is appropriate and suitable for the Beneficiary's needs.

3.2 The Client shall (or shall procure that the Beneficiary shall) supply to GroundSure as soon as practicable and without charge all information necessary and accurate relevant data including any specific and/or unusual environmental information relating to the Site known to the Client/Beneficiary which may pertain to the Services and shall give such assistance as GroundSure shall reasonably require in the performance of the Services (including, without limitation, access to a Site, facilities and equipment as agreed in the Contract).

3.3 Where Client/Beneficiary approval or decision is required, such approval or decision shall be given or procured in reasonable time as not to delay or disrupt the performance of any other part of the Services.

3.4 The Client shall not and shall not knowingly permit the Beneficiary to, save as expressly permitted by these terms and conditions, re-sell, alter, add to, amend or use out of context the content of any Report, Mapping or, in respect of any Services, information given by GroundSure. For the avoidance of doubt, the Client and Beneficiary may make the Report, Mapping or GroundSure's findings available to a third party who is considering acquiring the whole or part of the Site, or providing funding in relation to the Site, but such third party cannot rely on the same unless expressly permitted under clause 4.

3.5 The Client is responsible for maintaining the confidentiality of its user name and password if using GroundSure's internet ordering service and accepts responsibility for all activity that occurs under such account and password.

4 Reliance

4.1 Upon full payment of all relevant fees and subject to the provisions of these terms and conditions, the Client and Beneficiary are granted an irrevocable royalty-free licence to access the information contained in a Report, Mapping or in a report prepared by GroundSure in respect of or arising out of Consultancy Services. The Services may only be used for the benefit of the Client and those persons listed in clauses 4.2 and 4.3.

4.2 In relation to Data Reports, Mapping and Risk Screening Reports, the Client shall be entitled to make Reports available to (i) the Beneficiary, (ii) the Beneficiary's professional advisers, (iii) any person providing funding to the Beneficiary in relation to the Site (whether directly or as part of a lending syndicate), (iv) the first purchaser or first tenant of the Site (v) the professional advisers and lenders of the first purchaser or tenant of the Site. Accordingly GroundSure shall have the same duties and obligations to those persons in respect of the Services as it has to the Client and those persons shall have the benefit of any of the Client's rights under the Contract as if those persons were parties to the Contract. For the avoidance of doubt, the limitations of GroundSure's liability as set out in clauses 7 and 11.6 shall apply.

4.3 In relation to Consultancy Services, reliance shall be limited to the Client, Beneficiary and named parties on the Report.

4.4 Save as set out in clauses 4.2 and 4.3 and unless otherwise agreed in writing with GroundSure, any other party considering the information supplied by GroundSure as part of the Services, including (but not limited to) insurance underwriters, does so at their own risk and GroundSure has no legal obligations to such party unless otherwise agreed in writing.

4.5 The Client shall not and shall not knowingly permit any person (including the Beneficiary) who is provided with a copy of any Report, (except as permitted herein or by separate agreement with GroundSure) to,: (a) remove, suppress or modify any trade mark, copyright or other proprietary marking from the Report or Mapping; (b) create any product which is derived directly or indirectly from the data contained in the Report or Mapping; (c) combine the Report or Mapping with, or incorporate the Report or Mapping into any other information data or service; or (d) re-format or otherwise change (whether by modification, addition or enhancement) data or images contained in the Report or Mapping.

4.6 Notwithstanding clause 4.5, if the Client acts in a professional capacity, it may make reasonable use of a Report and/or findings made as a result of Consultancy Services to advise Beneficiaries. However, GroundSure shall have no liability in respect of any opinion or report given to such Beneficiaries by the Client or a third party.

5 Fees and Disbursements

5.1 GroundSure shall charge the Client fees at the rate and frequency specified in the Contract together, in the case of Consultancy Services, with all proper disbursements incurred by GroundSure in performing the Services. For the avoidance of doubt, the fees payable for the Services are as set out in GroundSure's written proposal, Order Website or Order acknowledgement form. The Client shall in addition pay all value added tax or other tax payable on such fees and disbursements in relation to the provision of the Services.

5.2 Unless GroundSure requires prepayment, the Client shall promptly pay all fees disbursements and other monies due to GroundSure in full without deduction, counterclaim or set off together with such value added tax or other tax as may be required within 30 days from the date of GroundSure's invoice or such other period as may be agreed in writing between GroundSure and the Client (**"Payment Date"**). GroundSure reserves the right to charge interest which shall accrue on a daily basis from 30 days after the date of Payment Date until the date of payment (whether before or after judgment) at the rate of five per cent per annum above the Bank of England base rate from time to time.

5.3 In the event that the Client disputes the amount payable in respect of GroundSure's invoice it shall notify GroundSure no later than 28 days after the date thereof that it is in dispute. In default of such notification the Client shall be deemed to have agreed the amount thereof. As soon as reasonably practicable following receipt of a notification in respect of any disputed invoice, a member of the management team at GroundSure shall contact the Client and the parties shall use all reasonable endeavours to resolve the dispute.

6 Intellectual Property and Confidentiality

6.1 Subject to the provisions of clause 4.1, the Client and the Beneficiary hereby acknowledge that all Intellectual Property in the Services and Content are and shall remain owned by either GroundSure or the Data Providers and nothing in these terms purports to transfer or assign any rights to the Client or the Beneficiary in respect of the Intellectual Property.

6.2 The Client shall acknowledge the ownership of the **Third Party** Content where such **Third Party** Content is incorporated or used in the Client's own documents, reports, systems or services whether or not these are supplied to a third party.

6.3 Data Providers may enforce any breach of clauses 6.1 and 6.2 against the Client or Beneficiary.

6.4 The Client acknowledges that the proprietary rights subsisting in copyright, database rights and any other intellectual property rights in respect of any data and information contained in any Report are and shall remain (subject to clause 11.1) the property of GroundSure and/or any third party that has supplied data or information used to create a Report, and that these conditions do not purport to grant, assign or transfer any such rights in respect thereof to a Client and/or a Beneficiary.

6.5 The Client shall (and shall procure that any recipients of the Report as permitted under clause 4.2 shall):

(i) not remove, suppress or modify any trademark, copyright or other proprietary marking belonging to GroundSure or any third party from the Services;

(ii) use the information obtained as part of the Services in respect of the subject Site only, and shall not store or reuse any information obtained as part of the Services provided in respect of adjacent or nearby sites;
(iii) not create any product or report which is derived directly or indirectly from the data contained in the Services (save that those acting in a professional capacity to the Beneficiary may provide advice based upon the Services);
(iv) not combine the Services with or incorporate such Services into any other information data or service; and
(v) not reformat or otherwise change (whether by modification, addition or enhancement), data contained in the Services (save that those acting in a professional capacity to the Beneficiary shall not be in breach of this clause 6.5(v) where such reformatting is in the normal course of providing advice based upon the Services),
in each case of parts (iii) to (v) inclusive, whether or not such product or report is produced for commercial profit or not.

6.6 The Client and/or Beneficiary shall and shall procure that any party to whom the Services are made available shall notify GroundSure of any request or requirement to disclose, publish or disseminate any information contained in the Services in accordance with the Freedom of Information Act 2000, the Environmental Information Regulations 2004 or any associated legislation or regulations in force from time to time.

6.8 Save as otherwise set out in these terms and conditions, any information provided by one party ("**Disclosing Party**") to the other party ("**Receiving Party**") shall be treated as confidential and only used for the purposes of these terms and conditions, except in so far as the Receiving Party is authorised by the Disclosing Party to provide such information in whole or in part to a third party.

7 Liability

THE CLIENT'S ATTENTION IS DRAWN TO THIS PROVISION

7.1 Subject to the provisions of this clause 7, GroundSure shall be liable to the Beneficiary only in relation to any direct losses or damages caused by any negligent act or omission of GroundSure in preparing the GroundSure Materials and provided that the Beneficiary has used all reasonable endeavours to mitigate any such losses.

7.2 GroundSure shall not be liable for any other losses or damages incurred by the Beneficiary, including but not limited to:
(i) loss of profit, revenue, business or goodwill, losses relating to business interruption, loss of anticipated savings, loss of or corruption to data or for any special, indirect or consequential loss or damage which arise out of or in connection with the GroundSure Materials or otherwise in relation to a Contract;
(ii) any losses or damages that arise as a result of the use of all or part of the GroundSure Materials in breach of these terms and conditions or contrary to the terms of the relevant User Guide;
(iii) any losses or damages that arise as a result of any error, omission or inaccuracy in any part of the GroundSure Materials where such part is based on any Third Party Content or any reasonable interpretation of Third Party Content. The Client accepts, and shall procure that any other Beneficiary shall accept, that it has no claim or recourse to any Data Provider in relation to Third Party Content; and/or
(iv) any loss or damage to a Client's computer, software, modem, telephone or other property caused by a delay or loss of use of GroundSure's internet ordering service.

7.3 GroudSure's total liability in contract, tort (including negligence or breach of statutory duty), misrepresentation, restitution or otherwise, arising in connection with the GroundSure Materials or otherwise in relation to the Contract shall be limited to £10 million in total (i) for any one claim or (ii) for a series of connected claims brought by one or more parties.

7.4 For the duration of the liability periods set out in clauses 7.5 and 7.6 below, GroundSure shall maintain professional indemnity insurance in respect of its liability under these terms and conditions provided such insurance is readily available at commercially viable rates. GroundSure shall produce evidence of such insurance if reasonably requested by the Client. A level of cover greater than GroundSure's current level of cover may be available upon request and agreement with the Client.

7.5 Any claim under the Contract in relation to Data Reports, Mapping and Risk Screening Reports, must be brought within six years from the date when the Beneficiary became aware that it may have a claim and in no event may a claim be brought twelve years or more after completion of such a Contract. For the avoidance of doubt, any claim in respect of which proceedings are notified to GroundSure in writing prior to the expiry of the time periods referred to in this clause 7.5 shall survive the expiry of those time periods provided the claim is actually commenced within six months of notification.

7.6 Any claim under the Contract in relation to Consultancy Services, must be brought within six years from the date the Consultancy Services were completed.

7.7 he Client accepts and shall procure that any other Beneficiary shall accept that it has no claim or recourse to any Data Provider or to GroundSure in respect of the acts or omissions of any Data Provider and/or any Third Party Content provided by a Data Provider.

7.8 Nothing in these terms and conditions:
(i) excludes or limits the liability of GroundSure for death or personal injury caused by GroundSure's negligence, or for fraudulent misrepresentation; or
(ii) shall affect the statutory rights of a consumer under the applicable legislation.

8 GroundSure right to suspend or terminate

8.1 In the event that GroundSure reasonably believes that the Client or Beneficiary as applicable has not provided the information or assistance required to enable the proper performance of the Services, GroundSure shall be entitled on fourteen days written notice to suspend all further performance of the Services until such time as any such deficiency has been made good.

8.2 GroundSure may additionally terminate the Contract immediately on written notice in the event that:
(i) the Client shall fail to pay any sum due to GroundSure within 28 days of the Payment Date; or
(ii) the Client (being an individual) has a bankruptcy order made against him or (being a company) shall enter into liquidation whether compulsory or voluntary or have an Administration Order made against it or if a Receiver shall be appointed over the whole or any part of its property assets or undertaking or if the Client is struck off the Register of Companies or dissolved; or
(iii) the Client being a company is unable to pay its debts within the meaning of Section 123 of the Insolvency Act 1986 or being an individual appears unable to pay his debts within the meaning of Section 268 of the Insolvency Act 1986 or if the Client shall enter into a composition or arrangement with the Client's creditors or shall suffer distress or execution to be levied on his goods; or
(iv) the Client or the Beneficiary breaches any material term of the Contract (including, but not limited to, the obligations in clause 4) incapable of remedy or if remediable, is not remedied within 14 days of notice of the breach.

9 Client's Right to Terminate and Suspend

9.1 Subject to clause 10.2, the Client may at any time after commencement of the Services by notice in writing to GroundSure require GroundSure to terminate or suspend immediately performance of all or any of the Services.

9.2 The Client waives all and any right of cancellation it may have under the Consumer Protection (Distance Selling) Regulations 2000 (as amended) in respect of the Order of a Report/Mapping. This does not affect the Beneficiary's statutory rights.

10 Consequences of Withdrawal, Termination or Suspension

10.1 Upon termination or any suspension of the Services, GroundSure shall take steps to bring to an end the Services in an orderly manner, vacate any Site with all reasonable speed and shall deliver to the Client/Beneficiary any property of the Client/ Beneficiary in GroundSure's possession or control.

10.2 In the event of termination/suspension of the Contract under clauses 8 or 9, the Client shall pay to GroundSure all and any fees payable in respect of the performance of the Services up to the date of termination/suspension. In respect of any Consultancy Services provided, the Client shall also pay GroundSure any additional costs incurred in relation to the termination/suspension of the Contract.

11 General

11.1 The mapping contained in the Services is protected by Crown copyright and must not be used for any purpose outside the context of the Services or as specifically provided in these terms.

11.2 GroundSure reserves the right to amend these terms and conditions. No variation to these terms shall be valid unless signed by an authorised representative of GroundSure.

11.3 No failure on the part of GroundSure to exercise and no delay in exercising, any right, power or provision under these terms and conditions shall operate as a waiver thereof.

11.4 Save as expressly provided in clauses 4.2, 4.3, 6.3 and 11.5, no person other than the persons set out therein shall have any right under the Contract (Rights of Third Parties) Act 1999 to enforce any terms of the Contract.

11.5 The Secretary of State for Communities and Local Government acting through Ordnance Survey may enforce breach of clause 6.1 of these terms and conditions against the Client in accordance with the provisions of the Contracts (Rights of Third Parties) Act 1999.

11.6 GroundSure shall not be liable to the Client if the provision of the Services is delayed or prevented by one or more of the following circumstances:
(i) the Client or Beneficiary's failure to provide facilities, access or information;
(ii) fire, storm, flood, tempest or epidemic;
(iii) Acts of God or the public enemy;
(iv) riot, civil commotion or war;
(v) strikes, labour disputes or industrial action;
(vi) acts or regulations of any governmental or other agency;
(vii) suspension or delay of services at public registries by Data Providers; or
(viii) changes in law.

11.7 Any notice provided shall be in writing and shall be deemed to be properly given if delivered by hand or sent by first class post, facsimile or by email to the address, facsimile number or email address of the relevant party as may have been notified by each party to the other for such purpose or in the absence of such notification the last known address.

11.8 Such notice shall be deemed to have been received on the day of delivery if delivered by hand, facsimile or email and on the second working day after the day of posting if sent by first class post.

11.9 The Contract constitutes the entire contract between the parties and shall supersede all previous arrangements between the parties.

11.10 Each of the provisions of the Contract is severable and distinct from the others and if one or more provisions is or should become invalid, illegal or unenforceable, the validity and enforceability of the remaining provisions shall not in any way be tainted or impaired.

11.11 These terms and conditions shall be governed by and construed in accordance with English law and any proceedings arising out of or connected with these terms and conditions shall be subject to the exclusive jurisdiction of the English courts.

11.12 If the Client or Beneficiary has a complaint about the Services, notice can be given in any format eg writing, phone, email to the Compliance Officer at GroundSure who will respond in a timely manner.

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East Hanningfield, Essex CM3 8AB
Telephone: 01245 400 930 Fax: 01245 400 933
Email: info@siteinvestigations.co.uk Website: www.siteinvestigations.co.uk

Appendix D

Desk Study Data – Environmental Data (GroundSure EnviroInsight)