Report

Desk Study Data for
Basement Impact Assessment

63 Hillfield Road,
London, NW6 1QB

for

Frank Rodrigues and Deirdre King

Photo courtesy of Vorbild Architecture

Ref: 18630/R1

May 2017

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Desk Study Data for Basement Impact Assessment

Site: **63 Hillfield Road, London, NW6 1QB**

Client: **Frank Rodrigues and Deirdre King**

Report Status: **FINAL**		
Role	**By**	**Signature**
Prepared by:	Roberta McAlister BSc MSc FGS	
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Foreword

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 the Client and shall not be relied upon by any third party without explicit written agreement from Gabriel GeoConsulting Ltd.

This report is specific to the proposed site use or development, as appropriate, and as described in the report; Gabriel GeoConsulting 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 from the Client 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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Appendices

1. INTRODUCTION

1.1 This desk study data has been compiled at the client's request in advance of the preparation of a Basement Impact Assessment (BIA) in support of a planning application which will be submitted to the London Borough of Camden, for works including the extension of the existing cellar beneath No.63 Hillfield Road, NW6 1DY into a full-height, single-storey basement with front and rear lightwells. Further details of the proposed basement and other associated works are given in Section 3. 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' (July 2015).

1.2 The assessment is currently being prepared by Keith Gabriel, a Chartered Geologist with an MSc degree in Engineering Geology (who has specialised in slope stability and hydrogeology), and Mike Summersgill, a Chartered Civil Engineer and Chartered Water and Environmental Manager with an MSc degree in Soil Mechanics (geotechnical and hydrology specialist). Both authors have previously undertaken assessments of basements in several London Boroughs.

1.3 A preliminary site inspection (walk-over survey) of the house and the surrounding area was undertaken on Wednesday 3rd May 2017. Photos from that visit are presented in Appendix A. Desk study data have been collected from various sources including borehole records (Appendix B) and geological data, environmental data and historic maps from Groundsure which are presented in Appendices C, D and E. Relevant information from the desk study is presented in Sections 2–6.

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

Vorbild Architecture:

- Drg No. 0775/A-(10)-010 Existing Site Plan
- Drg No. 0775/A-(10)-011 Existing Basement and Ground Floor Plan
- Drg No. 0775/A-(10)-012 Existing First and Second Floor Plan
- Drg No. 0775/A-(10)-013 Existing Loft and Roof Plan
- Drg No. 0775/A-(11)-010 Existing Section A-A
- Drg No. 0775/A-(11)-011 Existing Section B-B
- Drg No. 0775/A-(12)-010 Existing Elevations
- Drg No. 0775/A-(13)-001 Existing and Proposed OS Map
- Drg No. 0775/A-(13)-010 Proposed Site Plan
- Drg No. 0775/A-(13)-011 Proposed Basement and Ground Floor Plan
- Drg No. 0775/A-(13)-012 Proposed First and Second Floor Plan
- Drg No. 0775/A-(13)-013 Proposed Loft and Roof Plan
- Drg No. 0775/A-(14)-010 Proposed Section A-A
- Drg No. 0775/A-(14)-011 Proposed Section B-B
- Drg No. 0775/A-(15)-010 Proposed Elevations
- Planning Presentation, dated 20/03/2017

Two versions of the above drawings have been provided; the file name of the PDFs is "0775 - existing and proposed - REV A", whereas the .DWG file ("0775 2017-05-05 - no63 TENDER") is more up to date but does not contain any revision identifiers.

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

1.5 Instructions to prepare the Basement Impact Assessment (BIA) were confirmed by email from Frank Rodrigues on 28th April 2017 and in subsequent correspondence.

2. THE PROPERTY, TOPOGRAPHIC SETTING AND PLANNING SEARCHES

2.1 No.63 Hillfield Road is a part two-storey and part three-storey Victorian terraced house arranged over split levels and containing a cellar (see cover photo). Hillfield Road is located in the Fortune Green area of the London Borough of Camden (LBC), to the south of Hampstead Cemetery, and is not within any of the LBC's conservation areas. It is aligned approximately north-east/south-west, and leads onto Fortune Green Road at its north-eastern end. Hillfield Road splits towards its south-western end, with a short cul-de sac continuing towards the south-west while the other section turns southwards and connects to Mill Lane. Agamemnon Road leads northwards from near the centre of Hillfield Road and is joined from the east after a short distance by Achilles Road which is sub-parallel with Hillfield Road.

2.2 No.63 is situated on the north-western side of Hillfield Road, just north-east of the junction with Agamemnon Road. It is bounded by No.65 to the east and by both No.61 Hillfield Road and No.59 Achilles Road to the west. To the rear (north) it is bounded by the small driveway to the side of No.57 Achilles Road. No.63's setting is shown in Figure 1 below and Photo 1 in Appendix A.

Figure 1: Extract from 1:1,250 OS map (not to scale) with the site outlined in red.

2.3 Externally, to the front of No.63 there is a block-paved driveway which is separated from a similarly paved path to the front door by a narrow flower bed. The driveway is bordered to the west by another flower bed along most of the boundary with No.61. Timber fences are present on both the western and eastern boundaries of this forecourt (Photos 1 & 3); these fences have concrete gravel 'boards' at their bases which appeared to have been formed from vertically placed paving slabs. A third, very narrow flower bed is present along the east boundary with No.65. The front path and parking area is set approximately 0.48m below the ground floor level of the front of the house, with two large steps down from the front door, from where it slopes very gently towards the Hillfield Road public footway, which also slopes gently away from No.63 towards the carriageway. A dropped kerb is present in front of the parking area, where the footway slopes slightly more steeply close to the carriageway (Photo 2). There is a metal vent at ground level below the steps to the front door, and a tiny lightwell alongside the front bay. There is no direct access between the front and rear gardens of No.63.

2.4 To the rear of the property is a long, thin, split-level garden (Photo's 4 & 5), which can be accessed both from the western side of the conservatory at the rear of No.63, and via French doors in the rear (north) wall of the main part of the house. The lower level of the garden comprises a courtyard alongside the rear projection of the house. It is set approximately 0.35-0.53m below the ground floor level of the main part of the building. This area is mostly surfaced with concrete, which contains numerous cracks and two surface water gullies (one of which appeared to be blocked with leaves). A wooden fence marks the boundary between this courtyard and the rear courtyard to No.61, and a narrow flower bed is present between the concrete surfacing and this fence. A set of concrete steps opposite the external conservatory door, leads from this courtyard level up to the main rear garden, which is separated from the lower level by a retaining wall. That wall appears to have been built when the garden was excavated to allow construction of the conservatory, leaving a narrow gap/path along the remainder of the western side of the conservatory and the entire length of its northern side. There is a small, inaccessible gap between the eastern side of the conservatory and the boundary with No.65 (which is formed here by the flank wall of No.65's rear extension).

2.5 The main rear garden consists of three levels. The first level consists of a lawned area which slopes gently upwards away from the property (Photo 5), spanning the area between the retaining wall by the rear of the conservatory and approximately half way down the garden. On the garden's western boundary, a small, concrete-surfaced area is located at the top of the steps, which leads to a flower bed/planting area which extends along approximately one third of the western boundary and is separated from the lawn by a narrow concrete path. A raised flower bed/planting area and shed are located just beyond this, separated from the eastern flank wall of No.59 Achilles Road by a narrow gap. Another flower bed/planting area extends along approximately two thirds of the length of the garden's eastern boundary, at both first and second levels

of the main rear garden. The second level starts approximately half way down the main rear garden, consisting of a small paved patio area one step above the lawn. A wide raised planting area is located on the western side of this patio, within which stands a second shed close to the eastern flank wall of No.59 Achilles Road. The third level starts approximately two thirds of the way down the main rear garden, and consists mainly of dense vegetation. This vegetated area is separated from the patio by a chain link fence, and covers the entire rear third of the garden, except for a set of paved steps which lead up from the patio to the rear end of the garden at a shallow incline, along the garden's eastern boundary.

2.6 No major crack damage was noted in the interior of No.63, but some external crack damage was evident, in particular in the steps leading up to the front door (Photo 3). In addition, evidence of spalling (from frost damage) can be seen in the brickwork on the west flank wall of No.63's rear extension.

2.7 Reference to the first available historic Ordnance Survey (OS) maps, dated 1865 (1:2,500 scale) and 1873-74 (1:10,560 scale), as presented in Appendix F, show that the area remained undeveloped farmland, with a field boundary possibly crossing the rear end of No.63's site. Mill Lane and Fortune Green Lane were present to the south and north-east respectively. By 1894/1896, Hillfield Road and all the adjoining roads were present and the immediate area was fairly well developed, except for the north-eastern end of Hillfield Road beyond No.77 on the north-western side, which formed the grounds of a school, and beyond Aldred Road on the south-eastern side, which appeared to be empty. The reservoir located north-west of No.63, backing onto Hillfield Road and Agamemnon Road, had been built by this date, but the area to the north-west of that reservoir had not been developed.

2.8 By 1915, the roads around the north-west of the reservoir had been developed, and a college had been built adjacent to the school at the north-eastern end of Hillfield Road. Few changes have occurred in the area surrounding No.63 since 1915. Houses were constructed opposite the school at north-eastern end of Hillfield Road, beyond Aldred Road, between the publication of the 1915 and the 1935-38 maps. A small rear extension appears to have been added to No.65 between the 1935-38 and 1953, but no other footprints appear to have altered in the immediate vicinity of No.63 between the construction of the buildings and the most recent maps. The college at the north-eastern end of Hillfield Road became a police station between 1953-55 and 1971-75, and the school was demolished between 1991 and 1992. A housing development had been built on that site by 1994.

2.9 The London County Council Bomb Damage Map (LTS, 2005) for this area indicates that none of the properties on Hillfield Road (including No.63) suffered any bomb damage; nor did any others in the immediate vicinity of No.63. The bomb map for Hampstead indicates that no hits were recorded on properties on Hillfield Road or immediately adjacent to No.63. However, the closest recorded hit is mapped approximately at the location of No.10 Agamemnon Road, around 50m from the site of No.63 at its closest

point. The apparent lack of bomb damage in the immediate vicinity of No.63 should not be taken as conclusive proof of the absence of unexploded ordnance (UXO).

Topographic Setting:

2.10 No.63 Hillfield Road is located on a south-east facing slope which forms the flank of a promontory that projects out from the broadly south-west facing slope that leads up to Hampstead Heath. This feature is illustrated by the contours in Figure 2 below, in which the covered reservoir to the north-west of the site can be seen to occupy the top of this promontory, defined by the 80m contour. The slope on which No.63 sits leads down to the valley of the former principal course of the River Westbourne, one of the 'lost' rivers of London (see Figures 2 and 4, and paragraph 5.1).

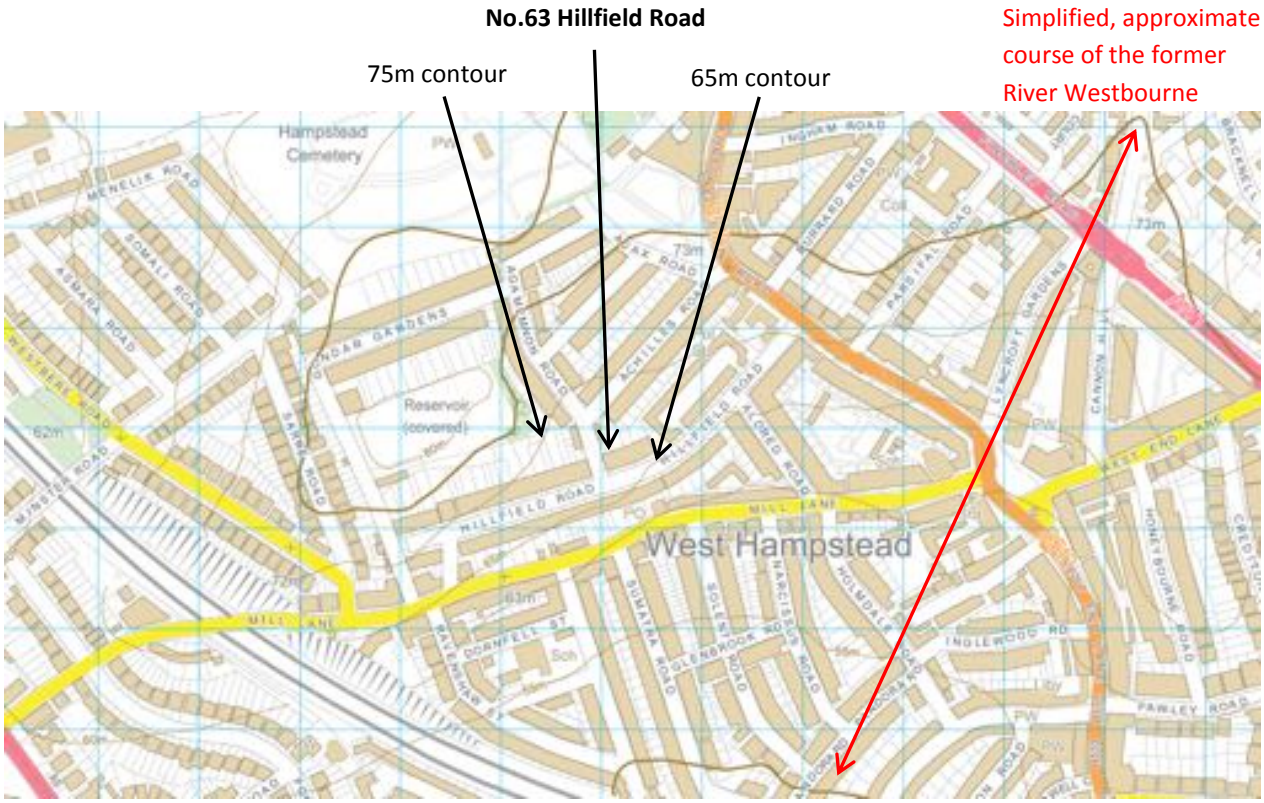

Figure 2: Extract from 1:5,000 scale Ordnance Survey map showing site location.

2.11 No.63 is located entirely between the 65m and 70m contours, as shown on Figure 2, with spot heights on the Hillfield Road carriageway at 65.9m AOD and 65.5m AOD to the west and east of No.63 respectively (see Figure 1). The contours on Figure 2 indicate an overall slope angle across the site of approximately 2.4° towards the south-south-east, measured between the 65m and 70m contour lines. Upslope of the site, overall slope angles range from 2.2° towards the south-south-east, to 9.5° towards the south-east, both measured between the 70m and 75m contours. Downslope of the site, overall slope angles range from 1.9° to 8.1° towards the south-south-east, measured between the 50m and 55m contours, and between the 60m and 65m

contours respectively. However, these higher angles are probably inappropriate, as no slope greater than 7° has been identified in this area in Figure 16 of the Camden geological, hydrogeological and hydrological study (Arup, 2010; see extract in Figure 3 below). No topographical survey has been carried out at No.63, so site-specific slope angles cannot be calculated. However, using two spot heights on the 1896 historical map (1:1,056 scale Town Plan), a slope angle of approximately 2.9° towards the south-south-east can be calculated on the section of Agamemnon Road just west of and parallel to the site of No.63 Hillfield Road.

Planning Searches:

2.12 A search was made of planning applications on Camden Council's website in order to obtain details of any other basements which have been planned, constructed or extended in the vicinity of the property. No basement-related applications were found for the property itself, or any of the properties in the immediate vicinity. However, there were several applications found relating to other extensions and alterations, the most relevant of which are listed below:

- **63 Hillfield Road:** Application (ref: 2017/1632/P) for a Certificate of Lawfulness for the "*erection of full width rear dormer, roof extension above the existing rear projecting wing and installation of x3 rooflights to the front elevation*" was registered on 31st March 2017. The supporting documents for this application include drawings.
- **Adjoining No.61 Hillfield Road:** Application (ref: 2008/4982/P) for "*extensions and alterations including the like for like re-construction of the previously demolished three-storey rear annexe, erection of a single storey ground floor rear extension and bin stores in the front and rear gardens, installation of three rooflights in the front roof slope, a dormer window and a rooflight in the rear roof slope to refurbish the three flats in the residential building*" was granted conditionally on 17th December 2008. The supporting documents for this application include drawings.
- **Adjoining No.65 Hillfield Road:** Application (ref: 9005535) for "*retention of existing single storey rear extension as shown on drawing no(s) B/RKL/1*" was granted conditionally on 24th April 1991. The supporting documents for this application include drawings.
- **Adjacent No.59 Achilles Road:** Application (ref: 32307/R1) for "*works of conversion to form three self-contained flats including the construction of ground floor extension at side and rear*" was conditionally granted on 17th July 1981. The supporting documents for this application include drawings.
- **Adjacent No.57 Achilles Road:** No relevant applications.

It should be noted that where the applications outlined above were granted planning permission, no information is available detailing whether or not construction subsequently went ahead, with the exception of No.61 where the rear projection has clearly been rebuilt.

3. PROPOSED BASEMENT

3.1 The proposed works at No.63 Hillfield Road for which planning permission will be sought, as shown in the scheme drawings by Vorbild Architecture (see paragraph 1.4), will comprise:

- A single-storey extension to the western side of the existing rear projection.
- The demolition of the conservatory at the rear of the property, and the construction of a part single-storey, part two-storey extension in its place. A terrace will also be formed to the rear of this extension at ground level, which will involve excavation into the main rear garden and the movement of the existing retaining wall towards the north.
- A loft extension to create a dormer on the rear (northern) side of the second floor of the main house, for increased ceiling height.
- The extension of the existing cellar beneath the footprint of the main house to create a full height basement, which will include vertical excavation for increased ceiling height, and lateral excavation to form a front lightwell and rear terrace/lightwell.
- Major internal alterations to convert the property from two to four residential units.

3.2 Vorbild Architecture's section drawings indicate a proposed finished floor level (FFL) in the basement at 2.80m below the ground floor's FFL throughout the basement. The basement slab is indicated on these drawings to be 350mm thick, thus, with an allowance of 200mm for insulation, cavity drainage and floor structure, the founding level (formation) of the slab will be approximately 3.35m below the ground floor's FFL. No structural drawings are available, so underpin bases may be founded slightly deeper, depending on the design chosen.

3.3 The existing cellar currently has two different ground/floor levels: approximately 1.0-1.2m below ground floor level (bGFL) in the deep crawl space on the western side of the cellar, and approximately 2.00m bGFL on the eastern side of the cellar (the latter as shown on Vorbild Architecture's existing section drawings). However, the level of the floor on the eastern side of the cellar is variable because it slopes gently from the rear (northern) wall down to the front (southern) wall. Excavation depths for the proposed basement are likely to vary between approximately 1.35m and 2.35m for the basement slab beneath the house, possibly slightly greater for the underpins.

3.4 The ground floor is set approximately 0.48m above the external ground level at the front of the property, so the proposed founding level and excavation depth for the front lightwell will be approximately 2.85m below ground level (bgl).

4. GEOLOGICAL SETTING

4.1 Mapping by the British Geological Survey (BGS) indicates that the site is underlain by the London Clay Formation. Figure 3 shows an extract from Figure 16 of the Camden GHHS (Camden Geological, Hydrogeological and Hydrological Study by Arup, November 2010) which illustrates the site geology of the Hampstead area.

Figure 3: Extract from Figure 16 of the Camden GHHS showing geology and slope angles >7° (Arup, 2010)

4.2 In urban parts of London, the London Clay Formation is typically overlain by Made Ground. 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 may have been removed.

4.3 The London Clay Formation is well documented (e.g. Ellison et al., 2004) as consisting of over-consolidated, firm to very stiff, grey to blueish grey, fissured, bioturbated, slightly calcareous, silty to very silty clay. It contains well-graded (ie: poorly sorted, with a range of particle sizes) beds of clayey silt to silty fine sand, pyrite, and variously sized carbonate concretions (claystones) which sometimes obstruct boreholes and piles. The London Clay Formation is known to have a weathered, oxidised zone at its top (usually between 3m and 6m thick where the London Clay is not overlain by other strata). This weathered zone and the transitional zone below are typically brown in colour, often becoming grey-brown or chocolate brown with depth, and contains selenite (a form of gypsum), which is aggressive to buried concrete. The clays of the London Clay Formation are typically of high or very high plasticity and high volume change potential. As a result, the clays undergo considerable volume changes in response to variations in natural moisture content (they shrink on drying and swell 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 trees whose roots abstract moisture from the clays. The clays will also

swell when unloaded by excavations such as those required for the construction of basements.

4.4 The London Clay Formation is known to reach thicknesses of between 90m and 130m below parts of London, for example beneath the nearby Hampstead Heath, and therefore exceeds the depth considered relevant to the proposed basement. As a result, the geology beneath the London Clay Formation is not considered further.

4.5 The results of the BGS classifications of six natural ground subsidence/stability hazards are provided in the Groundsure Geo Insight report (Appendix C); all indicated 'Negligible' or 'Very Low' hazard ratings, with the exception of 'Shrink – Swell Clay' for which a 'Moderate' hazard rating was given, which reflects the outcrop of the London Clay Formation at surface.

4.6 The Groundsure Geo Insight report (Appendix C, Sections 4, 5 & 9) records:

- Two historical surface ground working features within 250m of the site, which are the 'Reservoir'/'Covered Reservoir' located 75-81m to the west of the site, and the 'Cemetery' located 198-207m to the north-west of the site (see App.C, Section 4.1).
- No historical underground workings within 1000m of the site (see App.C, Section 4.2).
- No BGS current ground workings within 1000m of the site (see App.C, Section 4.3).
- No historical or active mines, natural cavities or extraction facilities within 1000m of the site (see App.C, Section 5).
- No historical or active railways or tunnel features within 250m of the site (see App.C, Sections 9.1-9.4).
- The site is within 5km of the route of the High Speed 2 rail project, but is not within 500m of the route of the Crossrail 1 rail project (see App.C, Section 9.5).

It should be noted that these databases are based on mapping evidence so inevitably will provide an incomplete record of underground workings.

4.7 A search of the BGS borehole database was undertaken for information on previous ground investigations and any wells in the vicinity of the site, along with a wider search of planning applications on the London Borough of Camden's website; the locations of which are presented on the location plan in Appendix B. The strata depths in a selection of these boreholes are summarised in Table 1. For full strata descriptions, reference should be made to the logs in Appendix B. General points of note from these boreholes were:

- BGS Boreholes TQ28NE/119 (BH1-BH4) were all drilled by Soil Mechanics Ltd, as part of a ground investigation at Kidderpore Avenue, to the north-east of the site. The boreholes display similar information; thus in Table 1, the minimum and maximum depths are recorded, giving the range of depths found across these four boreholes.

- BGS Boreholes TQ28NW/20 (BH1-BH4) were all drilled as part of a ground investigation to the north-west of the site, at Hampstead School. Again, these boreholes display similar information; thus in Table 1, only the minimum and maximum depths are recorded, giving the range of depths found across these four boreholes.
- Four boreholes (BH1-BH4) were all drilled as part of a ground investigation to the south-east of the site, at Emmanuel C of E Primary School. However, only BH1 and BH2 have been included in Table 1, as they were both drilled to 15.00m below ground level (bgl), whereas BH3A and BH4 were only drilled to 5.00m and 1.60m bgl respectively.
- All three boreholes drilled at 120 Mill Lane were terminated between 4.20m and 4.60m bgl due to 'refusal', which indicates that a hard material (perhaps claystone?) was present within the weathered London Clay Formation.
- The strata encountered in the boreholes from 120 Mill Lane were not assigned to a particular formation/unit in the logs, so these have been assigned in Table 1 based on the descriptions and previous experience.
- The description of the stratum assigned to 'Head Deposits' in BH1 at 10 Agamemnon Road is extremely similar to other descriptions of the weathered London Clay Formation, so this stratum was assigned to the weathered London Clay Formation in Table 1.

Table 1: Summary of Strata in BGS and other Boreholes							
Strata (abbreviated descriptions)	**Depths (m) and levels (m AOD) to base of strata in BGS Boreholes**						
	10 Agamemnon Road (BH1-BH2)	**120 Mill Lane (BH1-BH3)**		**Emmanuel C of E Primary School (BH1-BH2)**		**TQ28NE/ 119 (BH1-BH4)**	**TQ28NW/ 20 (BH1–BH4)**
GL (mAOD)	Depth	Depth	**Level 58.99-58.86**	Depth	**Level 47.50-47.30**	Depth	Depth
Date drilled	11th – 12th May 2016	19th April 2016		3rd August 2009		14th-21st March 1959	1960
Surfacing/ Made Ground	0.30-1.00	0.75-0.80	**58.21-58.06**	0.40-0.70	**46.90-46.80**	0.15-0.53	0.15-0.30
Firm, orange brown, silty CLAY with rare fine gravel (Head deposits?)	-	-/1.90	**-/57.06**	-	**-**	-	-
Soft/firm becoming firm/stiff, grey and brown mottled, sandy clayey SILT (Claygate Member)	-	-	**-**	-	**-**	4.27-5.79	-
Firm to stiff (rarely locally soft and rarely becoming very stiff), sometimes fissured, orangish brown to brown, sometimes mottled grey to bluish grey, silty CLAY with occasional pockets and partings of fine to medium (rarely coarse) sand and rare silt, rootlets, selenite crystals, claystone fragments and rare claystone bands (Weathered London Clay Fm)	7.10-7.20	>4.20->4.60	**<54.66-<54.36**	>15.00	**<32.50-<32.30**	-	7.01-7.16
Stiff to very stiff, fissured, grey/dark grey to blue, silty CLAY with occasional partings of silt to fine sand and selenite crystals (London Clay Fm)	>8.10					>10.67-15.39	>7.62-12.19
Seepage/Strike	-	-/1.00/2.00	**-/57.99/56.86**	-/9.70	**-/37.80**	-	-
Groundwater standing level	-	-	**-**	-	**-**	1.27-7.47	-

5. HYDROLOGICAL SETTING (SURFACE WATER)

5.1 Barton and Myers' map (2016) showing the 'lost' rivers of London indicates that the former principal course of the River Westbourne once flowed in the base of the valley which lies downslope of the site, as illustrated in Figure 4 below. The location of this course is confirmed by the small scale 1873-74 historical OS map, which clearly shows a stream just under 500m east of the site. The River Westbourne flowed from north-east to south-west in this area. Barton and Myers (2016) describe the River Westbourne as having been diverted into the Middle Level Interceptor Sewer when it was culverted, with storm flows having been diverted into the Ranelagh Sewer. The stream had disappeared by the survey for the 1894 OS map at 1:10,560 scale, most likely indicating it was culverted when development of the area began.

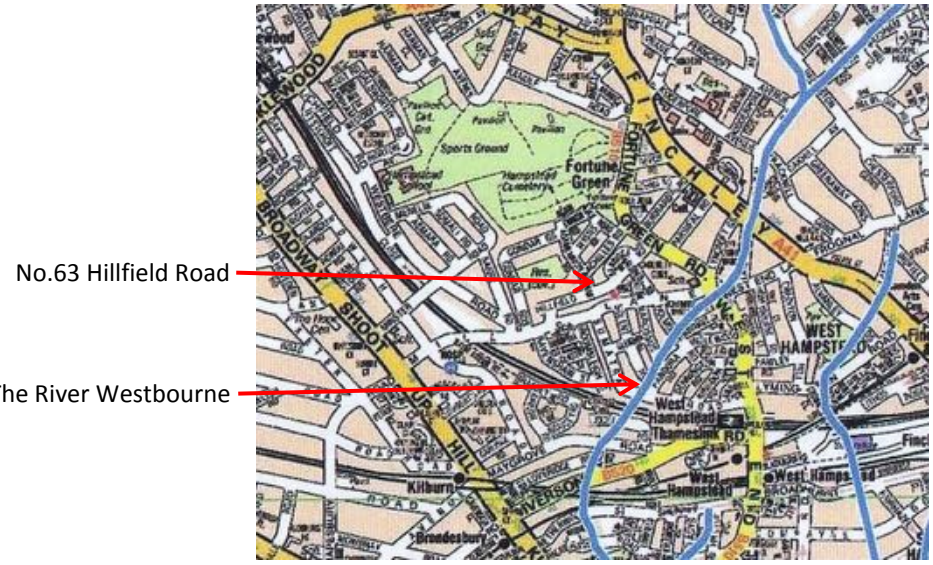

Figure 4: Extract from Map 21 of Barton & Myers' Lost Rivers of London (2016) – 'The course of the Westbourne through Hampstead to Maida Vale'.

5.2 Figure 12 of the Camden GHHS (Arup, 2010) shows that the closest surface water feature to the site is a small pond feature located approximately 700m to the north-west of the site. Figure 14 of the GHHS shows that the site is not within any of the Hampstead Heath surface water catchments, the closest of which is well over 1km to the north-east.

5.3 Some hydrological data for the site has been obtained from the Groundsure Enviro Insight report (see Appendix D), including:

- There are no 'Detailed River Network entries' (i.e. rivers) within 500m of the site, and no surface water features within 250m of the site (see App.D, Sections 6.10 & 6.11).
- There are no surface water abstraction licences within 2000m of the site (App.D, Section 6.4).

- There are no flood defences, areas benefitting from flood defences, or flood storage areas within 250m of the site (App.D, Sections 7.4, 7.5 & 7.6).

5.4 Mapping by the Environment Agency (EA) on the Government's 'Flood Map for Planning' website indicates that the site lies within Flood Zone 1, which is defined as land having a low probability of river and sea flooding, with a less than 0.1% (1 in 1000) chance of such flooding occurring each year, **not** taking into account the presence of any flood defences. The closest Flood Zone 2 (0.1-1% chance of river flooding) is located over 3km to the north-east of the site. According to the EA's 'Long Term Flood Risk Information mapping, also available on the Government's website, the site has a 'Very Low' risk of flooding from rivers and the sea (with a less than 1 in 1000 [0.1%] chance), which **does** allow for the beneficial effects of any flood defences and the possibility that they may be over-topped or breached. This mapping also shows that the site does not fall within an area at risk of reservoir flooding.

5.5 The gentle falls of the front driveway and Hillfield Road footway away from the front of the property (Photo 2), together with the slight fall of Hillfield Road towards the west in front of the property, are likely to ensure that most surface (rain) water falling at the front of the property drains away under normal conditions. The property's paved front driveway is separated from the adjoining front driveway of No.65 on the upslope side, and the adjoining front garden of No.61 on the downslope side, by concrete gravel boards (which appear to be made from paving slabs) topped by wooden fences (e.g. Photo 3). Because of this, only minimal surface water run-off is expected into No.63's front driveway from the adjoining properties. Thus, the catchment for No.63's front driveway are likely to be limited almost exclusively to direct rainfall and any roof areas which discharge onto it, such as the small porch.

5.6 The rear garden to No.63 is bounded to the east and west by wooden fences with wooden gravel boards, which are unlikely to prevent surface water run-off flowing from or to this area, apart from where No.63 directly adjoins the flank wall of No.59 Achilles Road. While the rear boundary of No.63 consists of wooden fences (Photo 6), the small fall away from the rear boundary of No.63 towards the side driveway of No.57 Achilles Road, along with the small fall towards the Achilles Road footway and carriageway, are likely to prevent surface water run-off flowing into the rear of the site under normal conditions (and may permit limited run-off flowing out from the rear of the site). Therefore, the surface water catchment under normal conditions for the rear garden is expected to be restricted to the site itself, plus any surplus overland run-off water seeping from the adjoining rear gardens (No's 61 & 65).

5.7 The front driveway of No.63 is surfaced with brick pavers (Photo 3), which will likely only allow a limited amount of infiltration between the bricks, although infiltration can occur within all three flower beds within this area. The courtyard which forms the lowest level of the rear garden is mainly surfaced with concrete in poor condition (Photo 4) and is positively drained by two gullies, so infiltration is likely to be minimal in all of this area except in the flower bed. One of these gullies did appear to be in need of

maintenance. A majority of the upper level main rear garden is soft landscaped and well vegetated (Photo 5), and where the surfaces are paved, run-off is likely to lead into a soft landscaped area, so infiltration is likely to occur throughout this area. However, any infiltration within the site's soft landscaped areas would become ineffective when the ground is saturated or frozen.

5.8 Both Figure 15 of the Camden GHHS (Arup, 2010) and Figure 3iv of the Camden Strategic Flood Risk Assessment (SFRA) (URS, July 2014; see Figure 5 below) show that Hillfield Road was subject to surface water flooding in 2002, along with several of the surrounding roads, but did not flood during the 1975 event. These figures record the whole length of affected roads as having flooded, though the floods are likely to have affected only a short length of the roads concerned; in the case of Hillfield Road, localised flooding likely occurred at its low points, which lie at the intersections of Hillfield Road with both Agamemnon Road and Mill Lane. Several double highway gullies were noted to be present in this area (see paragraph 5.15) which were probably installed in order to increase the capacity of the highway drainage system. Figure 3iv of the SFRA also shows that Hillfield Road is within an area where the LBC have recorded one property as having been affected by historic surface water flooding.

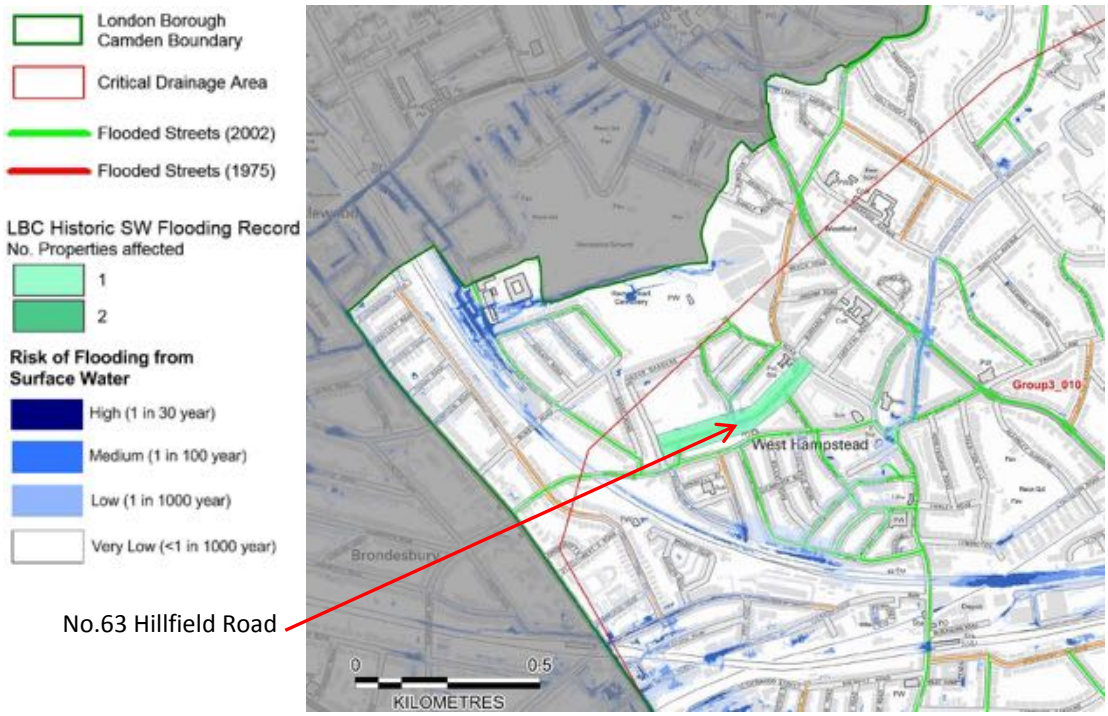

Figure 5: Extract from Figure 3 iv of the Camden Strategic Flood Risk Assessment (SFRA) (URS, July 2014) – 'Updated Flood Maps for Surface Water Flooding'.

5.9 The Environment Agency's (EA) new map of 'Flood Risk from Surface Water' is available on the Government's 'Long Term Flood Risk Information' website, an extract from which is presented in Figure 6 below. This map identifies four levels of risk (high, medium, low and very low), and it appears to be based primarily on topographic levels, flood depths and flow paths. The EA's definitions of these risk categories are:

'Very low' risk:	Each year, these areas have a chance of flooding of less than 1 in 1000 (0.1%).
'Low' risk:	Each year, these areas have a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%).
'Medium' risk:	Each year, these areas have a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%).
'High' risk:	Each year, these areas have a chance of flooding of greater than 1 in 30 (3.3%).

5.10 The EA's modelling (see Figure 6 below) indicates that the risk of flooding from surface water at 63 Hillfield Road ranges from 'Very Low' (which is the lowest, national background level of risk) to 'Low'. While the quality of this mapping is relatively low at a large scale, it is apparent that the front gardens and main upper level rear gardens of No.63 and the adjacent No's 61 and 65, and the footprints of these properties, are considered to be at 'Very Low' risk of surface water flooding, while the courtyards around the rear projections and extensions of No's 63 and 65 are considered at 'Low' risk. The area of 'Low' risk extends beneath the footprints of No's 67 and 69, and into the rear garden of No.67 (which also contains a small, localised area of 'Medium' risk). An area of 'High' risk is located around the rear projections of No's 67 and 69. The Hillfield Road footway and carriageway directly in front of No.63 are part of an area considered to have a 'Low' to 'Medium' risk, which extends further along Hillfield Road, and along Agamemnon Road and Achilles Road in the vicinity of No.63. The area of 'Low' to 'Medium' risk on Agamemnon Road and Achilles Road must reflect flow routes owing to the gradient on these roads and appears to extend into the front garden of No.59 Achilles Road. The area of 'Low' risk extends through the driveway at the side of No.57 Achilles Road, including a small area at the northernmost end of No.65's rear garden, through the rear of No.57's footprint and into the rear garden; this is the flow route from which the predicted flooding around No.63's rear projection would be derived.

5.11 It must be noted that there appears to be an error with this mapping; two different datasets appear to have been stitched together, creating a vertical line through the map just east of No.63. The EA advised that this data is the responsibility of Camden Council, who have not yet got back to the author, so it would appear that the mapping to the east of No.63 may not be as accurate as the mapping around No.63 and to the west.

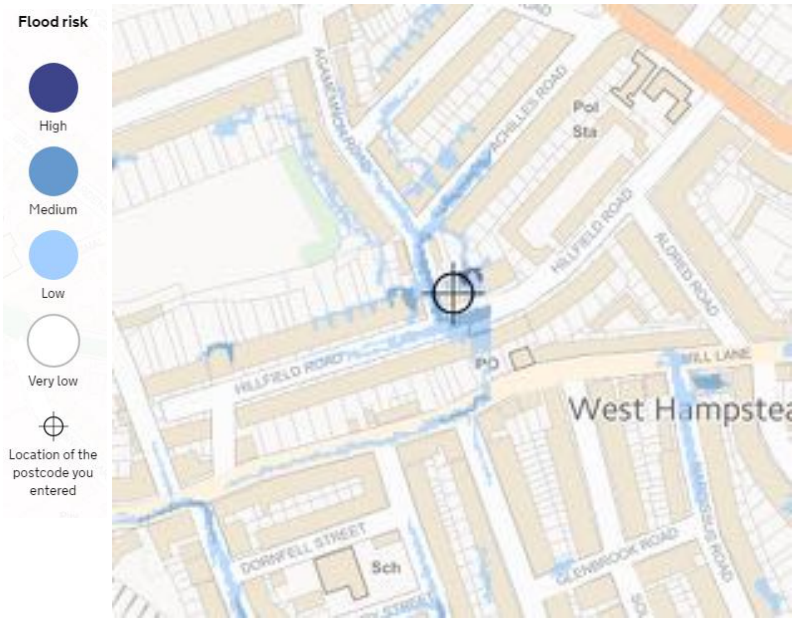

Figure 6: Extract from the Environment Agency's 'Flood risk from Surface Water' map, with the site located beneath the black crosshairs.

5.12 The surface water flood modelling presented in the Camden SFRA (URS, 2014) was compiled by the EA, so has likely been superseded by the current surface water flood risk mapping by the EA discussed in paragraphs 5.9-5.11 and presented in Figure 6. In any case, this mapping is extremely similar to that presented in Figure 6 for the area surrounding No.63.

5.13 Figure 6 of the SFRA (URS, 2014) illustrates the Critical Drainage Areas (CDAs) and Local Flood Risk Zones (LFRZs) within the borough. No.63 Hillfield Road is located within the Group 3_010 CDA, but is not located within any of the LFRZs identified within this CDA.

5.14 Recorded sewer flooding incidents were summarised and mapped by postcode in Figures 5a and 5b of the SFRA (URS, 2014), based on Thames Water's DG5 Flood Register. No external sewer flooding events were recorded within the 'NW6 1' sub-postcode (in which 63 Hillfield Road lies) in the 10 years prior to July 2014 (when the maps were published), and only one internal sewer flooding event was recorded.

5.15 Dual gullies have been installed at the junction between Agamemnon Road and Hillfield Road, and along Hillfield Road directly in front of No.67, probably in response to past flooding (the 2002 event, perhaps).

6. HYDROGEOLOGICAL SETTING (GROUNDWATER)

6.1 The London Clay Formation is classified by the Environment Agency as an 'Unproductive Stratum', as indicated by Figure 7 below. Under the old groundwater vulnerability classification scheme, which now applies only to superficial soils, the site lies within an area which is unclassified.

Figure 7: Extract from Figure 8 of the Camden GHHS (Arup, 2010) showing aquifer designations and Source Protection Zones (SPZs).

6.2 The Chalk Principal Aquifer which occurs at depth beneath the London Clay Formation is unlikely to be relevant to the proposed basement, so is not considered further.

6.3 While the London Clay Formation is classified as unproductive, it can still be water-bearing. Any partings, laminations or thicker beds of silt or sand are likely to contain free groundwater and, where these are laterally continuous, they can give rise to moderate water entries into excavations. In most cases, there will be only very limited or no natural flow in these silt/sand horizons. The water pressures within the clay at the depths of current interest are likely to be hydrostatic, which means they increase linearly with depth, except where they are modified by tree root activity or the influence of man-made changes such as utility trenches (which can act either as land drains or as sources of water and high groundwater pressures).

6.4 Perched groundwater would typically be expected in any overlying Made Ground, and possibly also in any Head Deposits which may be present, in at least the winter and early spring seasons. Variations in groundwater levels and pressures will occur in response to seasonal climatic changes and with other man-induced influences.

6.5 The groundwater catchment areas upslope of No.63 are likely to differ for each of the main stratigraphic units:

- Made Ground: The catchment for any perched groundwater in the Made Ground is likely limited to the immediately adjoining areas of Made Ground, except where the trenches for drains and other services provide greater interconnection.

- Head Deposits: The catchment for any potential Head Deposits will comprise recharge from both the overlying soils in the vicinity of the site and a wider subterranean area due to the expected lateral permeability.
- London Clay Formation: The catchment for the underlying London Clay will comprise recharge from the overlying soils in the vicinity of the site, plus a potentially wider area determined by the lateral extent of any interconnected silt/sand horizons.

6.6 Other hydrogeological data obtained from the Groundsure Enviro Insight report (Appendix D) include:

- There are no Source Protection Zones (SPZs) within 500m of the site (App.D, Sections 6.6 & 6.7, and Figure 7 above).
- There are three groundwater abstraction licences within 2000m of the site; these are all described as active, and are all located 1998m south-east of the site at the 'Swiss Cottage Open Space' borehole (App.D, Section 6.3).
- There are no potable water abstraction licences within 2000m of the site (App.D, Section 6.5).
- The BGS has classified the area within 50m of the site as 'Not Prone' to groundwater flooding, based on the presence of London Clay to surface (App.D, Section 7.7).

6.7 Groundwater flooding incidents recorded by the EA were presented on Figure 4e of the Camden SFRA (URS, 2014; see Figure 8 below). 23 incidents were reported in the entire borough, the closest of which was around 60m west of the site, on the north side of Hillfield Road. Figure 4e of the SFRA shows that Hillfield Road is not within an area where the LBC have recorded properties as having been affected by historic groundwater flooding. This figure also maps areas with an increased susceptibility to elevated groundwater, but these are all within the south-eastern part of the borough, remote from Hillfield Road, where River Terrace Deposits can be found overlying the London Clay Formation.

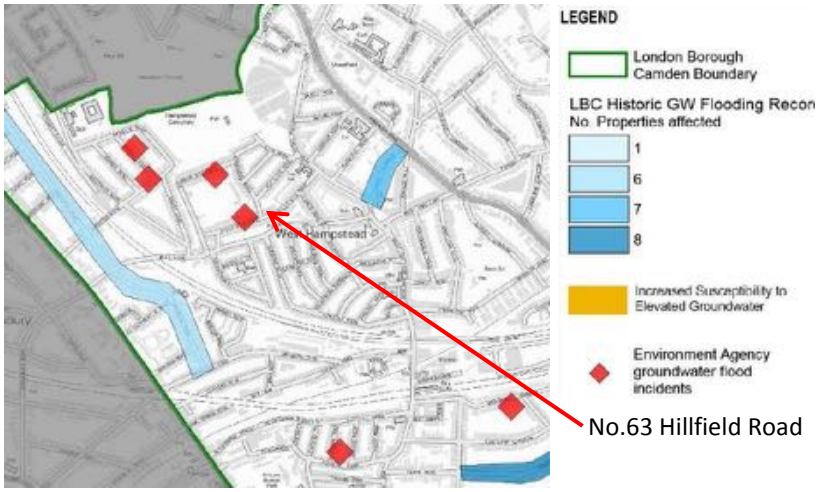

Figure 8: Extract from Figure 4e of the SFRA (URS, 2014) – 'Increased Susceptibility to Elevated Groundwater'. Ordnance Survey © Crown copyright 2014. All rights reserved. Licence No.100051531.

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APPENDIX A

Photographs

Project:

63 Hillfield Road, London, NW6 1QB

18630

Photo 1: Front elevation (looking north-west). No.63 Hillfield Road is a part three-storey, part two-storey mid-terrace house arranged over split levels, with an original cellar.
(Photo courtesy of Vorbild Architecture)

Photo 2: At the front of the house, the footway falls gently towards the Hillfield Road carriageway, away from the property.

Title:	**Photographs - Sheet 1**					Sheet	**A1**
Date:	3rd May 2017	Checked:	AG	Approved:	KRG	Scale :	NTS

Project:

63 Hillfield Road, London, NW6 1QB

18630

Photo 3 (left): Externally, at the front of the property, there is a block-paved driveway and path to the front door, which are open to the Hillfield Road carriageway, and bounded on both the eastern and western sides with wooden fences.

Photo 4 (right): To the rear of the property is a long, thin, multi-level garden. The lowest level of the garden comprises a courtyard alongside the rear projection; it is mainly surfaced with concrete. A set of steps alongside the single-storey extension lead to the upper levels of the rear garden.

Title:	**Photographs - Sheet 2**					Sheet	**A2**
Date:	3rd May 2017	Checked:	AG	Approved:	KRG	Scale :	NTS

Project:

63 Hillfield Road, London, NW6 1QB

18630

Photo 5 (left): The upper levels of the rear garden consists of a lawn area, a small patio area, and a raised planting area located within the northernmost part of the garden. There are a number of small-medium sized trees witin the rear garden, and medium-large sized trees within the raised planting area.

Photo 6 (below): The rear boundary to No.63's rear garden consists of a wooden fence with conrete king posts and wooden gravel boards. In front of the fence is a short ramp, formed of granite setts.

Title:	**Photographs - Sheet 3**					Sheet	**A3**
Date:	3rd May 2017	Checked:	AG	Approved:	KRG	Scale :	NTS