Report

Basement Impact Assessment

71 Goldhurst Terrace, London, NW6 3HA

for

Mr Jagdish Parihar

Ref: GGC18672/R1

March 2018

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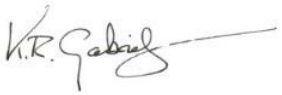
Basement Impact Assessment

Site: **71 Goldhurst Terrace, London, NW6 3HA**

Client: **Mr Jagdish Parihar**

Report Status: **FINAL**		
Role	**By**	**Signature**
Desk study, sitework, factual reporting, ground model, PDISP analyses and damage category assessment by:	Heather Baker MSci FGS	
PDISP analyses checked by:	Roberta McAlister BSc MSc FGS	
Slope/ground stability aspects approved by: Surface flow and flooding aspects approved by:	Mike Summersgill MSc CEng MICE C.WEM FCIWEM	
Factual report checked by: Impact Assessments by: & Subterranean (Groundwater) flow aspects approved by:	Keith Gabriel MSc DIC CGeol FGS UK Registered Ground Engineering Adviser	

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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1. INTRODUCTION

1.1 This Basement Impact Assessment has been prepared in support of a planning application to be submitted to the London Borough of Camden (LBC) for construction of a single-storey basement beneath No.71 Goldhurst Terrace, NW6 3HA. Further details of the proposed basement are given in Section 3. This 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 assessments have been prepared/approved 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 Desk Study: A preliminary site inspection (walk-over survey) of the house was undertaken on Friday 26th January 2018. Photos from that visit 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 inspection is presented in Sections 2–6.

1.4 The Screening, Scoping and basement impact assessments in accordance with CPG4 Stages 1–4, are presented in Sections 7–10 respectively. The findings of the ground investigation which was undertaken as part of this commission are presented in Appendix F and summarised in Section 9.

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

- **OPERA ARCHITECTS:**

Drg No. 17_27//1 Rev.02	Existing Set: Ground Floor/Cellar
Drg No. 17_27//2 Rev.02	Existing Set: Elevation Front-Rear
Drg No. 17_27//3 Rev.02	Existing Set: Section S-01
Drg No. 17_27//4 Rev.02	Existing Set: Section S-02
Drg No. 17_27//1 Rev.03	Proposed Set: Ground Floor
Drg No. 17_27//2 Rev.03	Proposed Set: Basement Floor
Drg No. 17_27//3 Rev.03	Proposed Set: Elevation Front-Rear
Drg No. 17_27//4 Rev.03	Proposed Set: Section S-01
Drg No. 17_27//5 Rev.03	Proposed Set: Section S-02

- **GREEN STRUCTURAL ENGINEERING (GSE):**
  Load Takedown, annotated on Opera Architect's Drg No. 17_27_PR_1 'Proposed Set: Ground Floor'.

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

1.6 Instructions to prepare this Basement Impact Assessment (BIA) were received initially on 3rd January 2018, and confirmed by email exchanges between 15th and 25th January 2018.

2. THE PROPERTY, TOPOGRAPHIC SETTING AND PLANNING SEARCHES

2.1 No.71 Goldhurst Terrace is a three-storey terraced house built of brickwork beneath a clay tiled roof, situated within the South Hampstead Conservation Area, in the London Borough of Camden. This part of Goldhurst Terrace extends from Finchley Road (the A41) to the north-east, to Fairhazel Gardens to the south-west, beyond which Goldhurst Terrace extends westwards to combine with Aberdare Gardens, and then joins with Priory Road. As shown in Figure 1, No.71 is situated on the east side of Goldhurst Terrace, between the adjoining No.69 to the north and adjoining No.73 to the south (see also Cover Photo and Photo 1, Appendix A). To the east, the site is bounded by the rear garden of No.39 Fairfax Place.

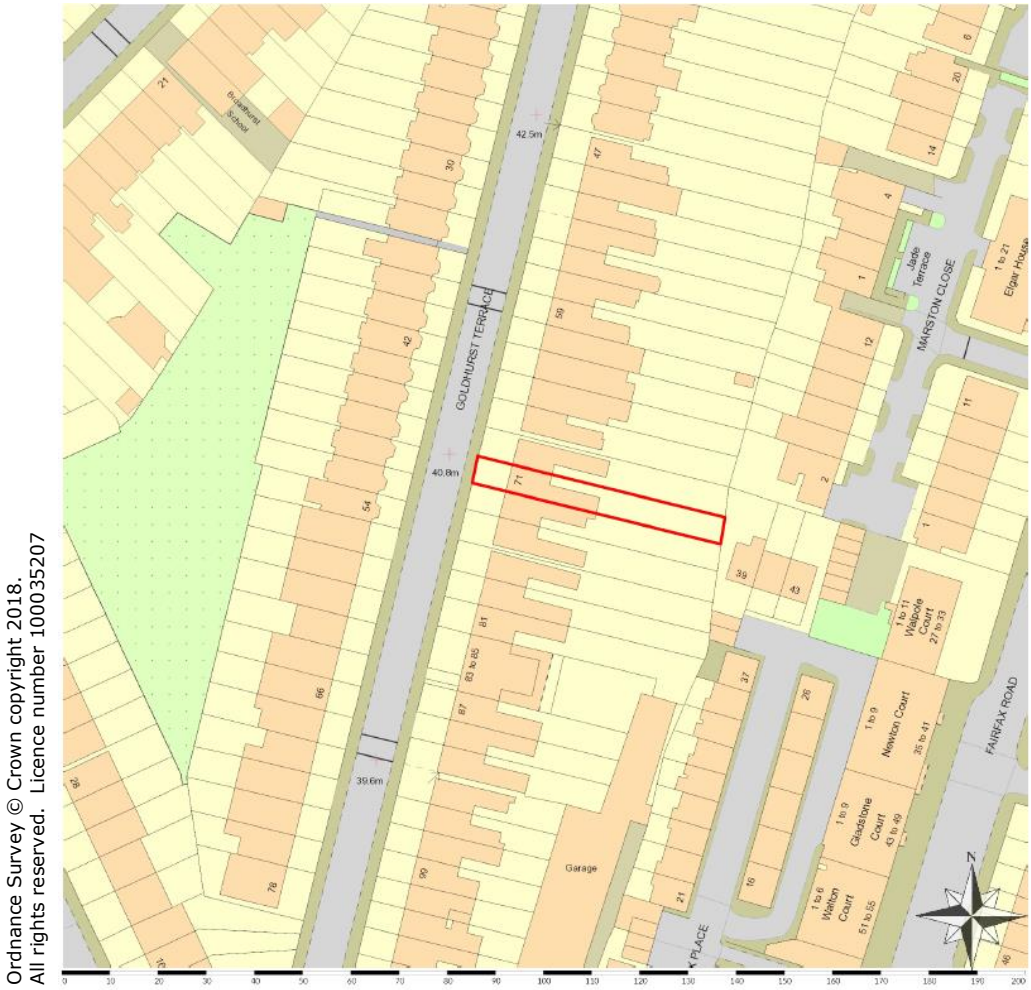

Figure 1: Extract from 1:1,250 OS map (not to scale) with the site outlined in red.

2.2 Most of the houses in Goldhurst Terrace are of a similar design, although vary from large semi-detached properties, to smaller terraced houses. According to Elrington at al (1989) "*Building began from the east end with 20 houses by Charles Kellond in Goldhurst Terrace, the most southerly of the roads, in 1879 and another 50 there between 1880 and 1885; 101 houses, some flats, and a riding school were added between 1886 and 1900, mostly by T. K. Wells of Kentish*

Town.". Like the majority of properties on Goldhurst Terrace, No.71 was subsequently divided into separate flats. Beneath the hallway there is a small cellar, accessed internally via a stairwell, which is currently used as a storage room and utility (probably a former coal store, as a blocked-up former chute remains in the front wall of the cellar and the adjoining No.73 still has an access hatch in the front path, close to the front wall of the house).

2.3 Externally, at the front of the property, there is a large parking area surfaced with concrete paving slabs (Photos 1 to 3) which slopes gently towards the Goldhurst Terrace carriageway. This is bounded by a low brick boundary wall between No.69 and No.71, by a double metal gate at its access point with the Goldhurst Terrace footway, and the boundary with No.73 is marked by wooden posts with metal chain links attached (Photo 2). The section of the boundary between No.71 and No.69 closest to the Goldhurst Terrace footway consists of a small raised planting area, bounded with a low brickwork on the No.71 side, containing established shrubs (Photo 3). Between this paved area and the front bay of No.71 there is a small walled plot covered by concrete flagstones overlain by rounded gravel. There is a path leading from the Goldhurst Terrace footway to the front door of No.71, also surfaced with concrete paving slabs which is raised slightly above the parking area, and the two are separated by a single row of bricks (see Photos 2 and 3).

2.4 The external areas to the rear of the property were fairly unkept, and included a narrow 'Courtyard' area surfaced with 'pea beach' over concrete tiles or in-situ concrete between the rear projection/single-storey extension and the 69/71 boundary. There is also a small, free standing wooden shed in this area (see Photo 5). Adjacent to the access door to the rear extension and extending the full width of the garden is an area of wooden decking over soil. Most of the garden beyond the wooden decking is laid to lawn, with concrete paving stones lining either side of the lawn, as shown in Photo 6. The full length of the rear garden, from rear wall of the extension to the rear boundary wall is an estimated 25.8m. Adjacent to the rear boundary wall there is a raised patio area, the level of which is unknown as this has not been included in the site drawings due to its distance from the proposed development. This area is accessed via a small wooden step ladder, and contains a substantial tree which appears to be displacing the wooden border of the planting area. The rear boundary with No.39 Fairfax Place is an old brickwork retaining wall which supports No.39's garden at a higher level, while the presumed boundaries with No.69 and No.73 are marked by wooden panel fencing (Photo 6).

2.5 During the site inspection no evidence was seen of major crack damage, although some minor cracking and displaced brickwork was evident around some of the windows, particularly among the brickwork lintels of the front bays. To the rear of the property there was evidence of a leaking soil & vent pipe in the corner of the courtyard between the rear wall and the northern flank wall of No.71; water from that leak was flowing through the rear wall, into the area underneath the main part of the house.

2.6 Reference to the earliest available historic Ordnance Survey (OS) map for 1871 (see Appendix E) shows that Goldhurst Terrace had not yet been constructed and the site was still open fields. Development was not recorded to the west of the site, however to the east large properties with landscaped gardens are recorded on both sides of 'Victoria Road', approximately 75m east of the site. Finchley Road and Belsize Road are recorded, with semi-detached properties lining both sides of the latter. On the 1871 1:2,500 map, approximately 270m south of the site, tunnels and railway workings are recorded at the same location as the existing railway tracks running into South Hampstead Station.

2.7 By the publication of the next OS map in 1894 (at 1:10,560 scale), No.71 had been fully constructed, as had the adjoining properties. The other properties along Goldhurst Terrace had been partially built at this time: on the south-east side of the road all properties between Fairhazel Gardens and Finchley Road had been constructed, but on the north-western side only those between approximately No.2 and No.84 had been built. The south-western branch of Goldhurst Terrace had also only been partially constructed. No.71's rear garden originally backed onto small houses(?) in Fairfax Yard, at the northern end of Fairfax Mews. To the north-east of No.71, at the intersection between Goldhurst Terrace and Finchley Road, 'baths' were recorded. There were also a number of railway lines and cuttings, as well as stations to the north, north-west and south. The 1896 1:1,056 map showed the property layout in closer detail. Attached to the rear wall there seems to be a small original rear projection. These were present on most, but not all, of the properties, and were of variable sizes and locations. They were probably outdoor toilet 'privies', although that is not stated on any of the publications. The property layout along Goldhurst Terrace also varied, with those at the northern end having external staircases to the front and rear, which gave external access to the cellar and a route beneath the house to the rear garden for mid-terrace properties. These external staircases were not recorded at No.71 or the adjoining properties, which are of a slightly different design.

2.8 No.71 remained unchanged throughout the later publications of OS maps. The small rear projection was not recorded on the 1915 or 1935 maps, however it reappeared on the 1953 map and is included on all maps at 1:1,250 and 1:2,500 scales up to 1991. This rear projection was removed when the 1993 extension was built (see paragraph 2.13). The 1915 1:2,500 map is the first to show evidence of the Great Central Railway Company's tunnel which was completed in 1898 and passes 175m to the east of the site (now owned by Network Rail). The alignment, which runs broadly north-south from Finchley Road to Marylebone (passing under Lord's cricket ground) is marked on maps from 1953, and is shown on the 'Railways & Tunnels Map' in Section 9 of Groundsure's GeoInsight report (see Appendix C, page 44).

2.9 The WW2 bomb map for the Borough of Hampstead shows the closest bomb to No.71 landing approximately 60m south-east of the site, onto No.26 Fairfax Place; another is recorded at the intersection of Fairfax Place and Fairhazel Gardens, some 200m south of No.71. A cluster of three bombs are recorded at the intersection between Greencroft Gardens and Fairhazel Gardens, and a further bomb was recorded as landing approximately 125m west of No.71 on Fairhazel Gardens.

2.10 The London County Council Bomb Damage Map for this area (London Topographical Society, 2005) indicates that No.71 did not suffer any damage. To the south-west, where Goldhurst Terrace intersects Fairhazel Gardens, No's 115 to 119 Goldhurst Terrace are recorded as "Damaged beyond repair" with No.121 recorded as "Seriously damaged, doubtful if repairable" and No's 123, 109 - 113 and 74 – 78 were recorded as having suffered "Blast damage, minor in nature". Fairhazel Mansions, 130m south-west of the site also suffered "Blast damage, minor in nature". Four properties at the southern end of Fairfax Mews were recorded as experiencing "Total destruction", with the neighbouring properties experiencing varying degrees of bomb damage. The closest V1 flying bombs were recorded 310 – 410m north-west of No.71, along Compayne Gardens and Broadhurst Gardens. This pattern of damage is somewhat consistent with what is shown on the WW2 bomb map for the Borough of Hampstead.

Topography:

2.11 Goldhurst Terrace is located on the east side of the valley of a former tributary of the Westbourne, one of the 'lost' rivers of London (see Section 5.1). The valley's position is illustrated clearly by the 40m and 50m contours in Figure 2. Between the 40m contour, which passes just to the south of the site, and the 45m contour which passes further upslope to the north-east of the site, the overall slope angle has been calculated as around 1.0°; this overall slope angle reduces to less than 1° downslope of the 40m contour.

2.12 Based on observations made during the site inspection, spot heights on the appended historic OS maps and spot heights taken from recent OS maps presented in Figures 1 and 2, this section of the Goldhurst Terrace carriageway falls gently from north to south. The gradients ease from approximately 3.0° at its north-eastern end, to less than 1° near the junction with Fairhazel Gardens (calculated using contour intervals and spot heights). A spot height of 40.8m AOD is given on the Goldhurst Terrace carriageway adjacent to No.71, and this continues to fall away to the south/south-west to a height of 39.2m AOD at the intersection of Fairhazel Gardens and Goldhurst Terrace. The site also falls from east to west, with heights of between 47.4m and 45.1m AOD given along the Fairfax Place and Fairfax Road carriageways, approximately 115m east of No.71.

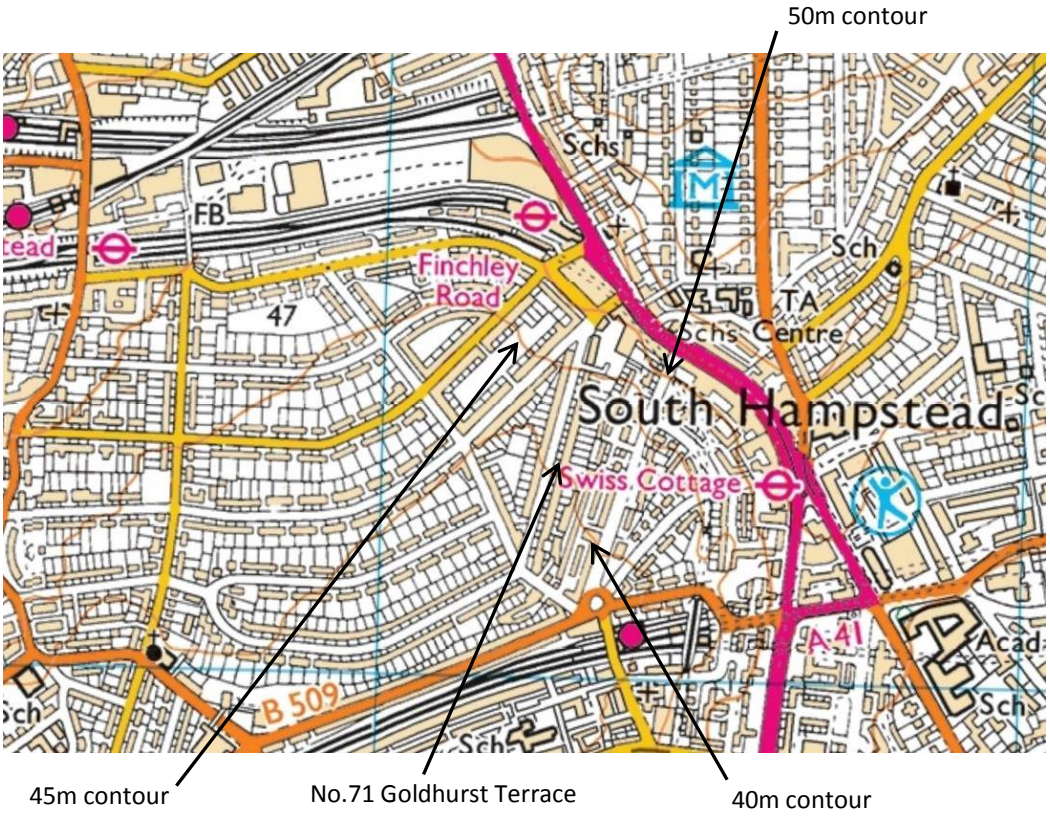

Figure 2: Enlarged extract from 1:25,000 Ordnance Survey map showing site location.

Planning Searches:

2.13 A search was made of planning applications on the Camden Council's website, in order to obtain details of any other basements which have been constructed or are planned in the vicinity of the property, the results of which are listed below. A number of previous applications were found for superstructure works at 71 Goldhurst Terrace.

- **No.71 Goldhurst Terrace:** Application (34070) for the "*Change of use and works of conversion to form 3 self-contained 2-bedroom flats and the erection of a single storey rear extension*" was granted planning permission on the 23rd August 1982, conditional on materials being in-keeping with the existing buildings. A very similar application (34750) was registered on 21st July 2005, but all available documents (drawings and a location plan) are the same as for application 34070.
- **No.71 Goldhurst Terrace**: Application (9301021) for the *"Erection of a single storey rear extension to existing flat"* was granted on 4th November 1993. There were no drawings available with this scheme, but the resulting extension can be seen in Photo 6 (Appendix A).
- **(Adjoining) No.69 Goldhurst Terrace**: Application (2008/2160/P) for the *"Erection of a single storey rear extension to ground floor self-contained flat and associated alterations, incorporation of a non-self contained room into existing*

ground floor contained flat" was granted planning permission on 30th March 2009.

- **No.67 Goldhurst Terrace**: Application (2013/6914/P) for the "*Excavation of single storey basement level extension including front and rear lightwells, excavation of a single storey ground floor rear extension…*" was granted on 28th July 2015. The basement impact assessment was prepared by the authors of this report.
- **No.67 Goldhurst Terrace**: Application (2016/5192/T) for the "*Notification of Intended Works to Tree(s) in a Conservation Area: FRONT GARDEN: 1x Cypress T1 – fell to ground level and remove*" received no objection to works on 27th October 2016. The associated arboricultural assessment was attached to the application which gave the Cypress tree a height of 17.0m on 9th September 2016.
- **Flat A, No.66 Goldhurst Terrace**: Application (2012/6105/P) for the "*Excavation of basement with front and rear lightwells to residential flat*" was granted planning permission on 20th December 2012. A Basement Impact Assessment (BIA) and Flood Risk Assessment (FRA) were both available with this application.
- **No.65 Goldhurst Terrace:** Application (2014/6247/P) for the "*Excavation to enlarge existing basement including enlarged front lightwell and relocated access stairs, and new rear lightwells*" was granted planning permission (subject to a Section 106 Legal Agreement) on 2nd October 2015. A short basement impact assessment, a SUDS report, Geo-Hydro Assessment and a Flood Risk Assessment were all included with the application.
- **No.63 Goldhurst Terrace**: Application (2016/4083/P) for the *"Excavation of basement with front and rear lightwells"* was registered on 30th August 2016 and granted planning permission. A four-part BIA was found with the application.
- **No.61 Goldhurst Terrace**: Application (2014/2046/P) for the "*Excavation of basement to residential flat including front and rear lightwells*" was granted planning permission on 24th May 2014. A BIA was available with the application.
- **No.58 Goldhurst Terrace**: Application (2011/3403/P) for the *"Enlargement of basement including creation of front and rear lightwells both with steel grille covers to provide additional habitable floorspace to existing basement/ground floor self contained flat (Class C)"* was granted planning permission on 26th August 2011. There is no ground investigation available with the scheme.
- **(Rear) No.2 Marston Close:** Application (2013/3833/P) for the "*Erection of a side extension at first and second floor levels over an existing single storey extension of dwelling*" was granted planning permission on 12th August 2013.

3. PROPOSED BASEMENT

3.1 Planning permission will be sought for the proposed works at No.71 Goldhurst Terrace, as shown in Opera Architects' drawings (see paragraph 1.5), which includes:

- Extension and enlargement of existing cellar to form a single-storey basement beneath the full footprint of the house and beneath the existing rear courtyard to the northern side of the property,
- Access to the basement will be via an internal stairwell adjacent to the southern wall and via an external stairwell between the northern boundary fence and rear projection,
- A partial extension of the ground floor rear extension, both to the rear and to the side, so decreasing the size of the courtyard between the rear projection and the northern boundary wall of the site,
- An open lightwell at basement level at the front of the property and a 'walk-on glass' skylight at ground floor level adjacent to the rear projection,
- An extension of the walled 'garden' alongside the front bay, to the same line as the front wall of the proposed front lightwell;
- Some alterations to internal wall structures at ground floor level. The upper floors of the property form separate flats, so are not part of this scheme (and have not been surveyed).

3.2 The finished floor level (FFL) for the proposed basement beneath the main part of the property is 3.10m below the FFL of ground floor, and is 2.90m beneath the rear projection and extension. A load takedown has been provided but currently no structural drawings are available for this scheme; however, based on previous experience of GSE's structural designs, a slab thickness of 200mm, underpin stem thickness of 300mm and underpin bases of 350mm have been assumed, giving a founding level for the basement **3.60m** below internal floor level in the main part of the house. Floor finishes of 0.15m have been allowed for. GSE also confirmed by email that the underpin bases will be 1500mm wide with a 250mm heel, and the basement slab will be cast between the underpin bases.

3.3 Based on a search of the LBC's planning applications (Section 2.13), there are no modern basements beneath the adjoining properties of No.69 and No.73 Goldhurst Terrace, although both are likely to have existing cellars. This means the perimeter walls of the basement will require underpinning.

3.4 The existing cellar, shown in Photo 4, is located adjacent to the party wall between No.71 and No.73 Goldhurst Terrace, and Opera's Drg No. shows that it extends approximately 6.1m back from the front wall (internal dimension, excluding steps), with an area of 9.00m^2. The FFL of the cellar below ground floor level is approximately 1.40m, so will require reduced excavation of approximately 2.20m for the underpins.

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 geology of the West Hampstead area.

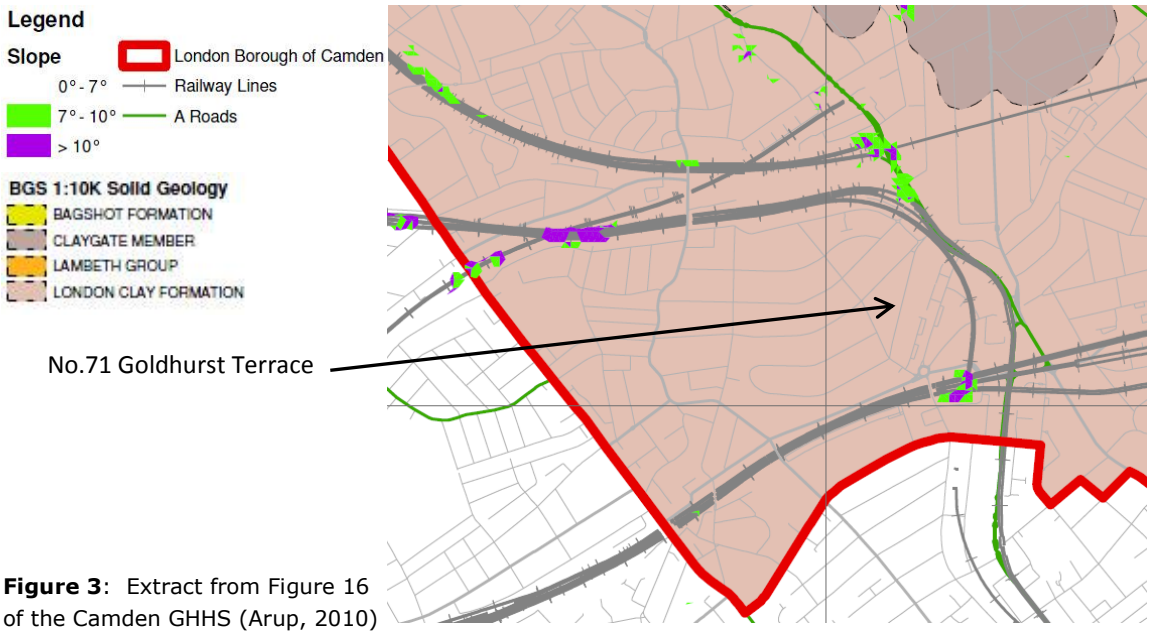

Figure 3: Extract from Figure 16 of the Camden GHHS (Arup, 2010)

4.2 In urban parts of London, the London Clay 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 1934 geological map (London IV.NE at 1:10,560 scale) records "London Clay in cuttings" to the south-east of the site, near Belsize Road, and "London Clay formerly dug" to the north-west of No.71, near the junction between Fairhazel Gardens and Greencroft Gardens. The map also appears to record "London Clay formerly dug, 6-10 FT deep", however part of the label is obscured. The lateral extent of these workings is not indicated.

4.4 The London Clay is well documented as being a firm to very stiff over-consolidated clay, which is typically of high or very high plasticity and high volume change 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.

4.5 The results of the BGS natural ground subsidence hazard classifications are provided in the Groundsure Geoinsight report (Appendix C, Section 6); all except "shrink-swell clays" indicated "Negligible hazard" to "Very low hazard". The shrink-swell clay hazard is classified as "Moderate", which reflects the presence of the London Clay Formation beneath the site.

4.6 The Groundsure GeoInsight report (Appendix C) records:

- No historical surface ground working features within 250m of the site (App C, Section 4.1) though this ignores the likelihood that the Great Central Railway Company (later LNER) constructed their tunnel in open excavations.
- There are 35 records of historical underground working features within 1000m of the site, these all consist of air shafts, tunnels and one 'unspecified' shaft, with multiple entries for a single feature. The closest are the Great Central Railway Co's air shaft at 169m north-east of the site, 194m south-east, and the associated tunnel (App C, Section 4.2).
- There are 18 records of historical 'mining' features within 1000m of the site, these are also air shafts with one 'unspecified' shaft which are also recorded as historical underground working features. Of these, four shafts are within 500m, in addition to those listed above these are 392m south and 469m south-east of the site (App C, Section 5.1)
- There is one tunnel recorded within 250m of the site, this are the London Underground's Metropolitan Line tunnels recorded 230m north-east of the site at a depth of 7m below ground level (App C, Section 9.1). This ignores the closer tunnel of the former Great Central Railway Company.

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 boreholes database was undertaken for information on previous ground investigations or any wells in the vicinity of the site, the locations of which are presented on the location plan in Appendix B. The strata depths in a selection of the closest boreholes are summarised in Table 1. For full strata descriptions reference should be made to the logs in Appendix B.

Table 1: Summary of Strata in BGS Boreholes						
Strata (abbreviated descriptions)	**Depths (m) and levels (m AOD) to base of strata**					
	TQ28SE/276	**TQ28SE/895**		**TQ28SE/ 2339**	**TQ28SE/520**	
GL (mAOD)	Depth	Depth	**Level 7.90**	Depth	Depth	**Level 45.72**
Date drilled	December 1955	April 1971		March 2007	May 1951	
Made Ground and/or Topsoil	0.46	0.79	**51.45**	0.8	0.91	**44.81**
Soft to firm, fissured, brown CLAY with occasional crystals (Weathered London Clay Formation)	1.52?	7.62	**44.59**	>5.0	2.10	**43.65**
Firm to very stiff, fissured, grey/ brownish-grey, silty CLAY (London Clay Formation)	>7.62	>12.19	**40.02**		>3.23	**42.52**

4.8 The search of planning applications on LBC's website found that permission had been granted for construction of basements beneath several of the properties around No.71 (see 2.13 above). Ground investigation results were available for some of those applications, the findings of which have been summarised in Table 2. For the location plan of these ground investigations and for full strata descriptions, reference should be made to the logs in Appendix B.

Table 2: Summary of Strata in Boreholes from Local Ground Investigations					
Strata (abbreviated descriptions)	**Depths (m) and levels (m AOD) to base of strata**				
	67 Goldhurst Terrace BH1	**63 Goldhurst Terrace BH1**	**78 Greencroft Gardens BH1**	**55 Greencroft Gardens BH1**	**65 Aberdare Gardens BH1**
Date Drilled	Feb 2014	August 2014	April 2014	May 2015	November 2011
Made Ground and/or topsoil	0.35	0.9	0.7	0.3	1.4
Firm to stiff, orange-brown/dark brown, silty CLAY with occasional gravel and carbon flecks/"slightly pungent" (Head Deposits?)	-	-	-	0.6	3.2
Stiff to very stiff, orange-brown, silty CLAY with silt and fine sand partings, claystone nodules and selenite crystals (Weathered London Clay)	8.40	>5.0	>6.2 (Claystone layer at 5.9 – 6.1m)	>8.00	>6.0
Very stiff, dark-grey, silty CLAY with silt and fine sand partings and selenite crystals (London Clay)	>10.0				
Groundwater Seepage	-	-	-	-	1.4 – 3.8

5. HYDROLOGICAL SETTING (SURFACE WATER)

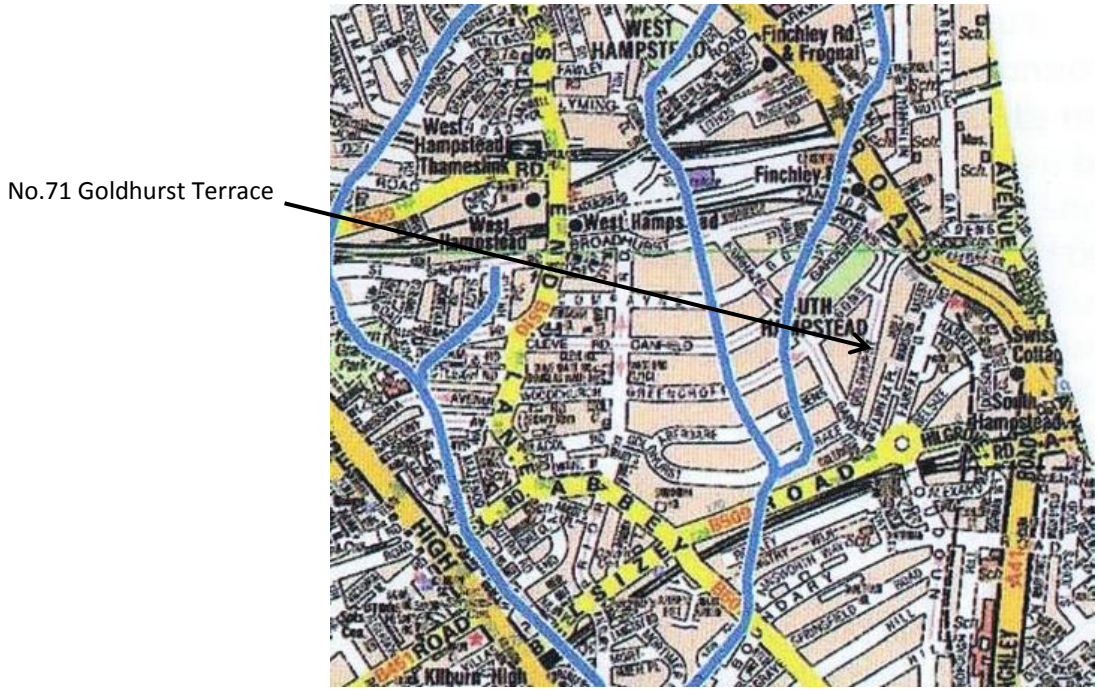

Figure 4: Extract from Map 21 of Barton & Myers' Lost Rivers of London (2016) – 'The course of the Westbourne through Hampstead to Maida Vale'.

5.1 Barton and Myers' map of the 'lost' rivers of London (Figure 4) indicates that this part of Goldhurst Terrace is situated to the north-east of the confluence between two branches of one of the former tributaries to the Westbourne. The closest branch of the Westbourne was approximately 150m west of No.71.

5.2 The 1871 1:2,500 and 1874 1:10,560 maps show a stream/ditch running roughly 150m west of the site on an alignment close to north-south, then along the (irregular) northern boundaries of the properties on the north side of Belsize Road, west and south-west of the northern branch of Goldhurst Terrace. On the 1874 1:10,560 map this appears to terminate approximately 600m south-west of No.71. This was likely to be the former eastern branch of the nearby Westbourne tributary, with the confluence between the eastern and western branches located just to the north of Belsize Road. This is the approximate location shown in Figure 4.

5.3 By 1894 the OS map (1:10,560) shows that all these streams/ditches to the west and south of the site had disappeared and that much of the surrounding area had been developed. Thus, by this date the Westbourne will have been fully culverted in this area, or had been diverted into the new sewer system.

5.4 In order to find out more about the possible alignment of the suspected culverts, enquiries were made to Thames Water, then the Environment Agency, and finally to LBC's Asset Management and Highways teams. None of these organisations had any record of any culverts in the vicinity of Goldhurst Terrace. The consensus opinion was therefore that either the stream/ditch was diverted into the mains sewers beneath the road network, or it might still be in an old culvert which no organisation is now maintaining.

5.5 Other surface water features recorded on the historic OS maps include a number of unlabelled ponds between 800m and 1.1km north/north-west of the site, although these are not recorded after 1896, and the Barrow Hill Reservoir (West Middlesex Water Works) roughly 1.3km south-east of No.71. This first appears uncovered in the 1874 (1:10,560 scale) map but in subsequent maps at this scale is recorded as being covered. The reservoir is still in use today. Regents Canal/Grand Union Canal, 1.5km south-east of the site is also recorded on all appended map publications at 1:10,560 scale between 1874 and 2014.

5.6 To the front of the property, the parking area/garden and the adjacent access path slope gently away from No.71 to the Goldhurst Terrace footway (see Photos 2 and 3), the footway in turn falls gently towards the Goldhurst carriageway. There is a slight change in level between the parking area and footway, and a step up onto the access path. There are a further two steps up to the front door to No.71.

5.7 The garden to the rear of the property is largely flat, with the exception of the raised patio adjacent to the boundary wall with No.39 Fairfax Place. The lawn and flower beds will permit infiltration of surface water, as will the wooden decking adjacent to the rear extension which is laid over soil, though the amount of infiltration is likely to be limited given that the site is underlain by London Clay. The courtyard area is covered by flint gravel with concrete tiles underneath, however there are numerous weeds and unkept vegetation (see Photo 5) which suggests the hard surfacing is in poor condition so may be allowing some infiltration. The flat roof of the extension channels water into downpipes which empty into drain gullies adjacent to the property.

5.8 The rear garden of the No.71 is bounded on both sides by wooden panel fencing, which will permit some seepage of surface water from the adjoining upslope properties. This means the surface water catchment area will include parts of the gardens upslope of No.71, as well as rainfall directly into the rear garden. Low brickwork walls and a raised planting bed separate No.71 and No.69 (upslope) to the front. Walls are absent from the boundary between No.71 and No.73, however the path leading to No.71 is raised slightly above that of No.73, as shown in Photo 2, preventing any surface water flow from the adjoining property.

5.9 Figure 5 below, together with the Floods in Camden report (2003), shows that Goldhurst Terrace was subject to surface water flooding in both the 1975 and 2002 flood events. The implications of those historical events are addressed in Section 10.8.

5.10 Maps on the Environment Agency's website show that the site lies within Flood Zone 1, which is defined as areas where flooding from rivers and the sea is very unlikely, with less than a 0.1 per cent (1 in 1000) chance of such flooding occurring each year. The EA's website also shows that this area does not fall within an area at risk of flooding from reservoirs.

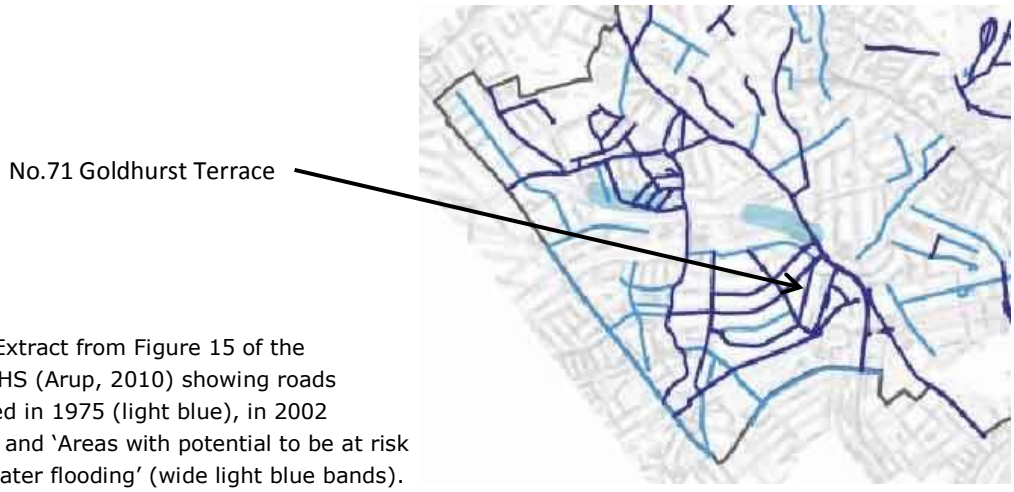

Figure 5: Extract from Figure 15 of the Camden GHHS (Arup, 2010) showing roads which flooded in 1975 (light blue), in 2002 (dark blue), and 'Areas with potential to be at risk of surface water flooding' (wide light blue bands).

5.11 The following hydrological data for the site has been obtained from the Groundsure Enviroinsight report (see Appendix D), including:

- There are no surface water features within 250m of the site and no 'Detailed River Network' entries within 500m of the site (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, no areas benefitting from flood defences, and no flood storage areas within 250m of the site (App.D, Sections 7.4, 7.5 & 7.6).

5.12 The Environment Agency (EA) published a new map of 'Flood Risk from Surface Water' in January 2014, and a more detailed version has since become available on the Government's 'Long Term Flood Risk Information' website, an extract from which is presented in Figure 8 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%).

5.13 The EA's modelling shows a 'Very Low' risk of surface water flooding for the entire site of No.71 Goldhurst Terrace, the neighbouring properties and along the Goldhurst Terrace carriageway outside the site. A 'Low' risk classification is given to the south-western end of the Goldhurst Terrace carriageway and at its intersection with Fairhazel Gardens, approximately 100m south-west of, and downslope from, No.71. A 'Low' risk of surface water flooding was also given to the Marston Close and Naseby Close carriageways upslope to the east of the property, and on the upslope side of No's 39/41/43 Fairfax Close which adjoin No.71's rear garden. There are isolated pockets of 'High' risk areas at the site of Fairhazel Mansions, well downslope of No.71 to the east of the junction between Goldhurst Terrace and Fairhazel Gardens, and to the rear of the properties on the east side of the upper end of Fairfax Place. The latter is upslope of No.71, but there is no plausible flow route from there to No.71's garden. An extract of the EA's most recent model is presented in Figure 6.

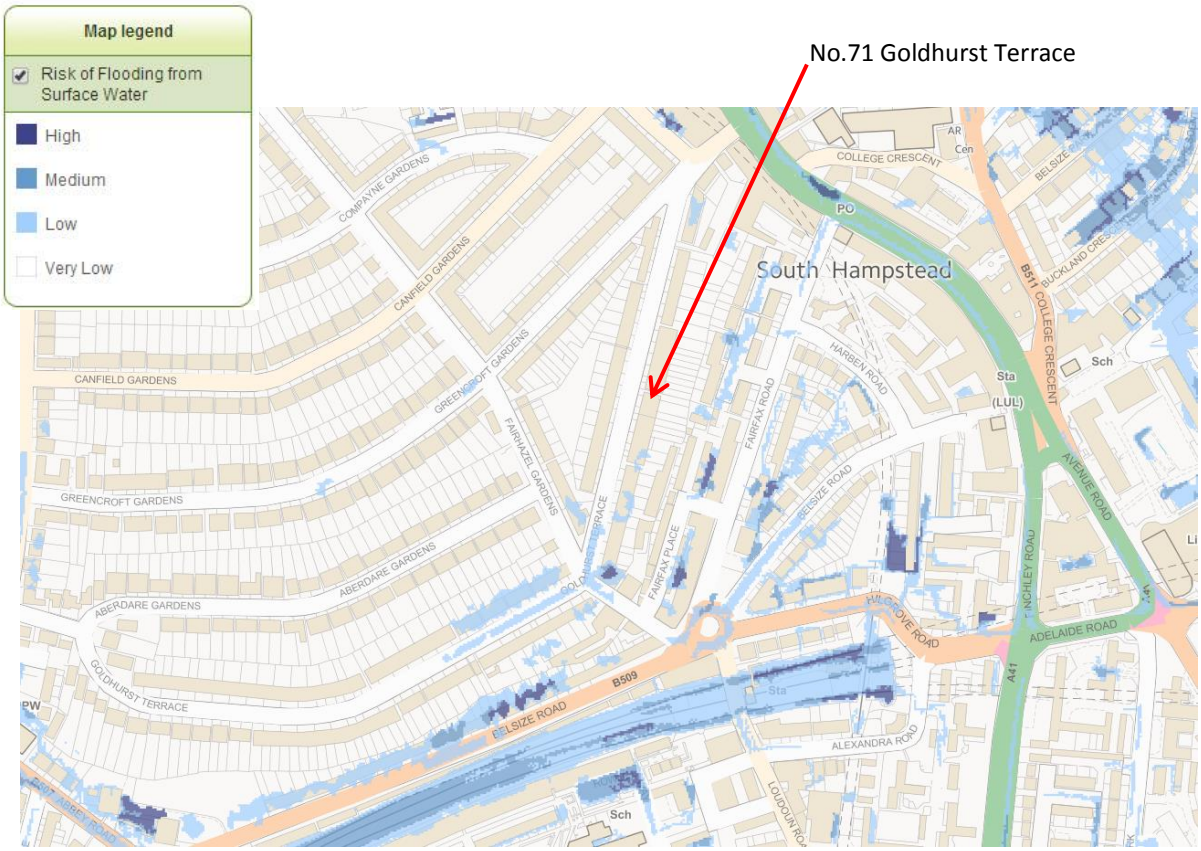

Figure 6: Extract from the Environment Agency's map of 'Risk of Flooding from Surface Water'. Ordnance Survey © Crown copyright 2018. All rights reserved. Licence No.100051531.

5.14 Surface water flood modelling has been undertaken by URS as part of a Strategic Flood Risk Assessment for the London Borough of Camden, and was published in July 2014; an extract from their model is presented in Figure 7. As per the Environment Agency modelling, this map identifies the same four levels of risk (high, medium, low

and very low), and shows a 'Very Low' risk of flooding for the site of No.71 and the surrounding area. Isolated areas are shown at 'High' risk, similar to those in the EA's model, such as at the junction between Fairhazel Gardens and Goldhurst Terrace, and other areas of flooding are shown along the Westbourne tributaries. The broad green marking/band along the road indicates that two of the properties on Goldhurst Terrace have been affected by historic surface water flooding; while the location of the two properties are not specified, it is understood that they were in the low area to the west of Fairhazel Gardens.

5.15 Figure 7 also shows that Goldhurst Terrace falls within Critical Drainage Area Group3_010, while Figure 6 in the Camden SFRA also shows that the site lies within the 'Goldhurst' Local Flood Risk Zone (LFRZ).

5.16 The implications from these flood models are discussed in Section 10.8.

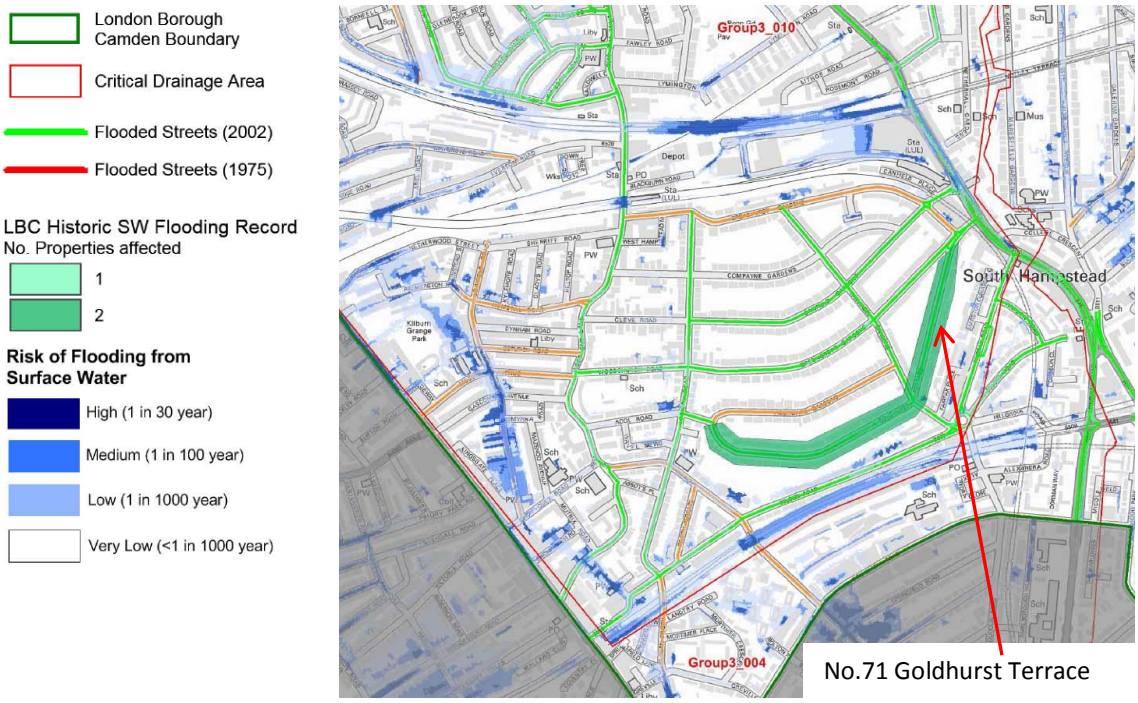

Figure 7: Extract from Figure 3v of the Camden Strategic Flood Risk Assessment (SFRA) (URS, July 2014) showing risk of flooding from surface water.

5.17 A 'Sewer Flooding History Enquiry' report has been obtained from Thames Water Utilities Ltd (TWU). In response to the question 'Is the requested address or area at risk of flooding due to overloaded public sewers?' (TWU's wording) the response given was: "*The flooding records held by Thames Water indicate that there have been no incidents of flooding in the requested area as a result of surcharging public sewers*". A copy of the report is available on request.

6. HYDROGEOLOGICAL SETTING (GROUNDWATER)

6.1 The London Clay Formation is classified by the Environment Agency as an 'Unproductive Stratum', as indicated by Figure 8. Under the old groundwater vulnerability classification scheme, which now applies only to superficial soils, the area is unclassified.

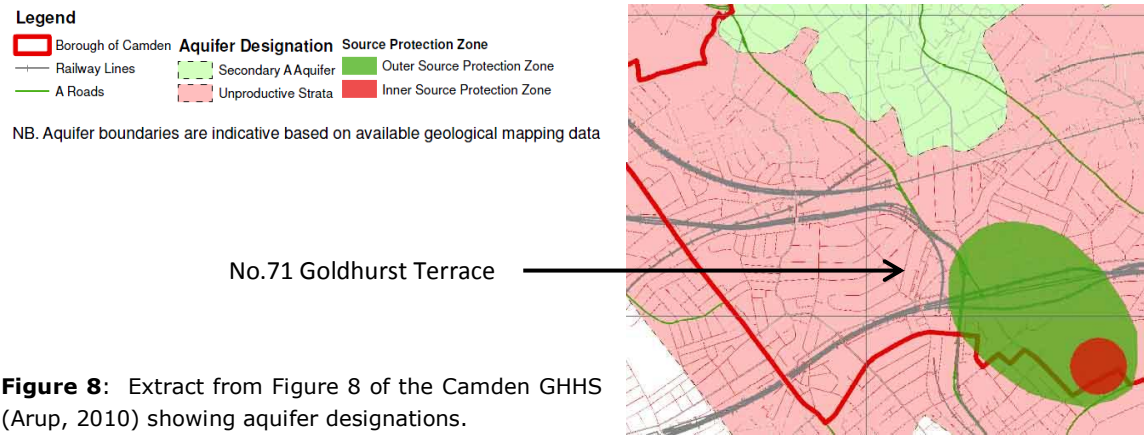

Figure 8: Extract from Figure 8 of the Camden GHHS (Arup, 2010) showing aquifer designations.

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

6.3 While the London Clay Formation is classified as an 'Unproductive Stratum', it can still be water-bearing. The water pressures within the clay in 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). Any silt or sand partings, laminations or thicker beds 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.

6.4 Perched groundwater would typically be expected in any Made Ground, and possibly also in any Head deposits which overlie the London Clay, 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 Details of what was found by the site-specific ground investigation in February 2018 are presented in Section 9.

6.6 The groundwater catchment areas upslope of No.71 are likely to differ for each of the main stratigraphic units:

- Made Ground: The catchment for any perched groundwater in the Made Ground is probably limited to the immediately adjoining areas of Made Ground, as well as infiltration within No.71's own rear garden, except where the trenches for drains and other services provide greater interconnection.

- London Clay Formation: The catchment for the underlying London Clay will comprise recharge from the overlying soils in the vicinity of the site, plus potentially a wider area determined by the lateral extent of any interconnected silt/sand horizons, though the contribution from the surrounding area is likely to be minimal given the general low permeability of the London Clay.

6.7 Other hydrogeological data obtained from the Groundsure Enviroinsight report (Appendix D) include:

- The nearest Source Protection Zone (SPZ) is a Zone 2, 'Outer Catchment' located 270m to the east of the site, so this is irrelevant to the proposed basement (Figure 8 above and Appendix D, Sections 6.6 & 6.7).
- The nearest groundwater abstraction licence is 437m east of the site at the Swiss Cottage Open Space Borehole. There are three active licences and one historical licence at this point, each with a maximum permitted abstraction quantity of 28.8 m^3/day. These abstract water from the Chalk below -56m AOD so will not affect the proposed basement. There are a further four licences within 2000m of the site, 1460 and 1467m to the south-east, 1566m to the south and 1920m south-east of the site respectively (App.D, Section 6.3). All are irrelevant to the proposed basement.
- There are two abstraction licences for potable water within 2000m of the site, these are 1460m (active) and 1467m (historical) south-east of the site at Barrow Hill Pumping Station (App.D, Section 6.5). These too are irrelevant to the proposed basement.
- The BGS has classified the area within 50m of the site as 'Not prone' to groundwater flooding, based on the presence of the London Clay at the surface (App.D, Section 7.7).

6.8 During the site inspection a moisture meter was used to assess the moisture in the walls of the cellar, due to previous experience of water in the cellar of adjoining No.69 Goldhurst Terrace (No.69's cellar was being actively bailed out at the time of a site inspection to the area on 4th March 2014, possibly due to a drainage defect within that property). The results of these readings for No.71 gave a very high moisture content of the front wall of the cellar, with a maximum recorded value of 75 (readings above 16 indicate an abnormal moisture level).

7. 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 site-specific ground investigation, 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?	No – Site underlain by London Clay	4.1
1b	Will the proposed basement extend beneath the water table surface?	No, not beneath the water table in an aquifer, though it will extend below the phreatic surface of any perched groundwater in the Made Ground/Head Deposits overlying the London Clay.	8.2, Sections 10.2 & 10.3
2	Is the site within 100m of a watercourse?	No – There are no surface water features within 250m of site. The former Westbourne tributary (possibly culverted on line) passes about 150m to the west of the site.	5.1 to 5.5, & 5.11
3	Is the site within the catchment of the pond chains on Hampstead Heath?	No – Site is approx 1.8km SW of Hampstead No.1 Pond	
4	Will the proposed basement development result in a change in the proportion of hard surfaced/ paved areas?	Yes – The rear section of the basement will cause a small increase in hard surfacing.	Carried forward to Scoping: 2.8, 8.2 & Sections 3 & 10.8.
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 – Soakaways would be inappropriate in London Clay; SuDS may be used, but volume of water discharged to ground will not increase.	
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 – There are no surface water features within 250m of the site. Ponds are recorded on 1894 OS map approx 800m NW, and there are no local springs (the nearest are on the London Clay-Claygate Member interface, 800m – 1km north.	5.5, 5.11 & Figure 3

While the answer to question Q1b above was no, the design of the basement must allow for the presence of groundwater in the clays. The temporary works during construction must also allow for the presence of groundwater. These matters are considered in Sections 10.1 to 10.3.

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)	No – The overall slope across the site is approximately 1.0°	2.11 & 2.12
2	Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 7°?	No – No significant re-profiling is proposed.	
3	Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	No – Max. overall slope angle in the vicinity of the property is 3°; (and there are no railway cuttings in the vicinity of the site).	2.11 & Figure 3
4	Is the site in a wider hillside setting in which the general slope is greater than 7°?	No – As Q3 above.	2.11, 2.12 & Figure 3
5	Is the London Clay the shallowest strata at the site?	Yes, it is the shallowest strata mapped by the BGS (though it may be overlain by Head Deposits).	Carried forward to Scoping: 4.1, 8.3, Sections 9, 10.4 & 10.5
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?	Unknown – There is a large tree of unknown species and height in the rear garden of No.69	Carried forward to Scoping: 8.3
7	Is there a history of seasonal shrink/swell subsidence in the local area, and/or evidence of such effects at the site?	Yes, in the general area, though these houses appear to have suffered less than others in the area, with only minor cracking observed around some of the window lintels of No.71.	Carried forward to Scoping: 2.9, 8.3, & Section 10.4
8	Is the site within 100m of a watercourse or potential spring line?	No – See Q2 & Q6 in subterranean flow screening above.	
9	Is the site within an area of previously worked ground?	No – See BGS map extract (Figure 3 herein).	4.1 & 4.6
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?	No – London Clay Formation is classified as an 'Unproductive Stratum'.	6.1
11	Is the site within 50m of the Hampstead Heath ponds?	No – Site is approx 1.8km from Hampstead No.1 Pond.	
12	Is the site within 5m of a highway or a pedestrian right of way?	Yes – Proposed front lightwell extends to within 4.2m of the Goldhurst Terrace footway in-front of the property.	Carried forward to Scoping: 8.3, Section 10.4
13	Will the proposed basement substantially increase the differential depth of foundations relative to neighbouring properties?	Yes – The adjoining No's 69 & 73 Goldhurst Terrace do not have modern basements (although they are both likely to have existing cellars similar to No.71).	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.	No – No tunnels were identified by the services search.	

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 is approx 1.8km from the nearest part of the catchment (Hampstead No.1 Pond).	
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 – Flow routes at surface should be unchanged. Only change to surface water flow route will be the lightwells (from where the surface water will have to be pumped into the drainage system)	
3	Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	Yes – The rear section of the basement will cause a slight increase in hard surfacing	Carried forward to Scoping: Section 3, 8.4 & Section 10.8
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 front and rear gardens to adjacent properties is minimal. The historic natural watercourse downslope of the property (Westbourne tributary) is thought to have been culverted.	5.1 to 5.8
5	Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No – There should be no significant change in surfaces generating run-off. None of the surface run-off from this property goes directly to a watercourse.	5.6 & 5.8
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?	Yes – Goldhurst Terrace was subject to surface water flooding in both the 1975 and 2002 flood events, though the construction in 1994 of the NW Storm Relief Sewer should have been beneficial.	5.9, 5.13-5.16 & Figures 5 - 7. Carried forward to Scoping: 8.4 & Section 10.8

7.5 Non-technical Summary – Stage 1:

The screening exercise in accordance with CPG4 has identified eight issues which need to be taken forward to Scoping (Stage 2); one is related to Groundwater, five are related to Ground Stability and two are related to Flooding potential. The presence of groundwater in the clays must also be allowed for in the design of the basement and the associated temporary works; these matters are considered in Sections 10.2 and 10.3.

8. 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
4	Will the proposed basement development result in a change in the proportion of hard surfaced/ paved areas?	**Potential impact:** Increased hard surfacing would decrease infiltration of surface water into the ground. **Action:** Review potential impacts of proposed changes, including appropriate types of SuDS for use as site-specific mitigation when relevant (ie: where reduced infiltration would be a problem).

8.3 Slope/ground stability scoping:

Issue (= Screening Question)		Potential impact and actions
5	Is the London Clay the shallowest strata at the site?	**Potential impact:** Continued seasonal shrink/swell below shallow foundations and heave following unloading by the basement excavations. **Action:** Ground investigation required, then appropriate design**.**
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:** Heave from removal of trees; slope(s) become less stable; damage to trees. **Action:** Arboricultural report required, potential implications to be assessed once tree in No.69's rear garden has been identified.
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. Future differential movement between No.71 and the adjoining No's 69 & 73 once the proposed basement has been constructed**.** **Action:** Review potential impact of seasonal water content changes in the clays, and any planned vegetation removal and future vegetation growth. Designer and contractor to take account of any weakening of the structure caused by past movements.
12	Is the site within 5m of a highway or a pedestrian right of way?	**Potential impact:** Construction of basement causes loss of support to footway/highway and damage to the services beneath them. **Action:** Ensure adequate temporary and permanent support by use of best practice underpinning methods.

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 the adjoining No's 69 & 73 if basement excavations are inadequately supported. Possible long term differential movement. **Action:** Ensure adequate temporary and permanent support by use of best practice underpinning methods. Consider the need for transition underpinning.

8.4 Surface flow and flooding scoping:

Issue (= Screening Question)		**Potential impact and actions**
3	Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	**Potential impact:** May increase flow rates to sewer, and thus increase the risk of flooding (locally or elsewhere). May change infiltration. **Action:** Assess net change in hard surfaced/ paved areas and review appropriate types of SuDS for use as site-specific mitigation.
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?	**Potential impact:** Flooding of the basement. **Action:** Assess flood risk and potential. Identify appropriate flood resistance measures.

8.5 Non-technical Summary – Stage 2:

The scoping exercise has reviewed the potential impacts for each of the items carried forward from the Stage 1 screening and has identified the following actions to be undertaken:

- A ground investigation is required (which has already been undertaken, see Section 9).
- An arboricultural report is required to identify and assess the potential implications of the tree in the rear garden of No.69 Goldhurst Terrace
- Designer and contractor to take account of the weakening of the structure caused by past movements.
- Ensure adequate temporary and permanent support by use of best practice underpinning methods.
- Consider the need for transition underpinning to mitigate differential foundation depths.
- Owing to Goldhurst Terrace being recorded as having flooded in 1975 and 2002, the future flood risk should be assessed.

These actions are considered in Stage 4, or in Stage 3 for the ground investigation.

9. STAGE 3 – GROUND INVESTIGATION

9.1 A site-specific ground investigation was undertaken on 7th February 2018, and comprised one 'windowless' sampler borehole (BH1) drilled to a depth of 6.0m below ground level (bgl) within the front garden/parking area and three hand dug trial pits (TPs 1 – 3). Logging of the recovered continuous 'core' samples from the 'windowless' sampler and the trial pit excavations was undertaken on site by Gabriel GeoConsulting Ltd (Alexander Goodsell and Heather Baker). The factual findings from the investigation are presented in Appendix F, including an exploratory hole location plan (Figure GI-01), borehole log (GI-02), trial pit logs (GI-03 to GI-05), and laboratory test results.

9.2 Trial pits TP1 to TP3 were dug in order to investigate the foundations to No.71, and the soils beneath the footings, at their respective locations.

- TP1 was dug to a depth of 1.00m within the front garden, alongside the front bay of No.71. The pit revealed brickwork with three corbels which projected 170mm resting at a depth of 270mm on 680mm of brick rubble concrete. The brick rubble concrete footing was founded at 0.95m bgl, within the Head Deposits/Soliflucted London Clay. Due to the location of incoming services it was not possible to investigate the front wall of No.71, however based on experience of properties in the area and the lack of evidence of differential movement of the front bay, it has been assumed that the footing of the front wall will be at least as deep as the footing of the front bay, as exposed in TP1.
- TP2 was dug to a depth of 0.75m within the north-western part of the rear garden 'Courtyard', alongside the rear wall of the house and close to the boundary fence with No.69. The pit revealed brickwork with three corbels which projected 170mm resting at a depth of 450mm on 0.25m of brick rubble concrete, which projected 350mm from the face of the wall. The brick rubble concrete footing was founded at 0.70m bgl on the Head Deposits/Soliflucted London Clay.
- TP3 was dug to a depth of 0.85m alongside the northern flank wall of the rear extension. The pit revealed brickwork to a depth of 300mm with no projection from the face of the wall, resting on 0.50m of brick rubble concrete. This footing was founded at 0.80m within the Head Deposits/Soliflucted London Clay.

9.3 In trial pits TP1 and TP2, Made Ground was recorded beneath the sand bedding for the surfacing, and in TP3 Made Ground was recorded beneath a layer of weak 'lean-mix' concrete underlying the sand bedding. Both TPs 2 & 3 found a layer of blue woven geosynthetic beneath the pea gravel at surface. In TP1 the Made Ground was soft to firm, dark brown, slightly sandy, slightly gravelly CLAY, and in TPs 2 & 3 the Made Ground was "soft to firm, very dark greyish brown becoming dark brown, variably gravelly sandy CLAY. The base of the Made Ground was recorded at 0.65m, 0.45m and 0.70m in TPs 1, 2 and 3 respectively. Below the Made Ground, "soft to firm, brown to light brown with some grey and orange mottling CLAY with rare flint

gravel" (slightly gravelly in TP1) was recorded to the base of each pit. In TP1 this clay had "a 'chewed up' appearance with occasional polished, gleyed shear surfaces", which corresponds to the same geological strata in BH1 (see Table 3)

9.4 The geological sequence as found in BH1 has been summarised in Table 3. For full strata descriptions refer to Appendix F, Figure GI-02.

Table 3: Summary of geology recorded in BH1

Unit	Depth Range (m)	Summary Description
Surfacing	GL – 0.25	0.15m: 50mm thick concrete PAVING SLABS bedded in SAND 0.10m: Brick Rubble
Made Ground	0.25 – 0.70	Soft to firm, dark brown, slightly sandy, slightly gravelly CLAY. Gravel consists of brick fragments, slate and rare flint with dead roots and rootlets.
Head Deposits /Soliflucted London Clay	0.70 – 1.00	Soft to firm, brown to light brown with some grey and orange mottling, slightly gravelly CLAY. Gravel consists of flint (<15mm) with decaying roots. Clay has 'chewed-up' appearance, with occasional polished, gleyed shear surfaces.
Weathered London Clay	1.00 – 6.00	Firm becoming stiff with depth, brown, grey and variably orange mottled CLAY with decaying roots. - At 1.00 - 1.20m: soft to firm - Below 1.60m: occasional fine sand partings - At 2.15 – 2.17m: fine to medium, orange/yellow sand parting - Below 2.35m: closely fissured, with white sand present on fissure surfaces Below 2.50m: Stiff becoming very stiff with depth, fissured brown to orange-brown CLAY with pockets of fine sand and selenite crystals. - Between 2.50 – 3.40m: white fine sand on fissure surfaces - At 3.65m: fine to medium yellow sand parting, 50mm thick.

9.5 Dead rootlets were observed to a depth of 5.7m in BH1. Abundant dead rootlets were found at 3.70-3.90m and a dead root with a diameter of 2mm was found at 4.50m bgl. It is possible that these dead roots are a relic of a large Cypress tree, 17m in height, that was removed from the front garden of No.67 Goldhurst Terrace between October 2016 and January 2018.

9.6 No groundwater entries were recorded in BH1, and the borehole was described as 'dry' and open on completion.