Cranbrook Basements

4 Hampstead Square, London, NW3 1AB

HYDROGEOLOGICAL REVIEW
JANUARY 2012

Draft

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1 INTRODUCTION

It is proposed to construct a single level basement under the footprint of a 3-storey building at 4 Hampstead Square, London NW3 1AB. GCG has received an instruction from Cranbrook Basements to undertake a review of the local hydrogeological conditions and the impact that the proposed basement may have on the flow of groundwater across the area.

This report reviews the available information about the site and the current scheme and aims to produce a hydrogeological impact assessment for the proposed basement construction on this site in accordance with the requirements of the London Borough of Camden. Their requirements are set out within their Development Policy DP27 and Camden Planning Guidance CPG4 - Basements and Lightwells as well as within the recent LB Camden guidance document entitled 'Camden geological, hydrogeological and hydrological study – Guidance for subterranean development'.

GCG have been supplied with information by Cranbrook Basements.

This report has been prepared for Cranbrook Basements as part of the requirements set by the DP27/CPG4 and LB Camden's 'Guidance for Subterranean Development'. It addresses the issues of the subterranean (ground water) flow screening chart that is shown in full details in Appendix A.

2 THE PROPERTY AND THE PROPOSED RE-DEVELOPMENT

The site lies within the Hampstead Town Administrative Boundary and is located east of Heath Street, London NW3 to the south of The Vale of Heath (figure 1). It includes an L-shaped building extending east-west along the southern part of the site and a front lawn to the north. The building is accessed through a paved path to the north of the building. A sycamore tree is immediately to the east of the path.

The current house on site is approximately 15m by 9m and it has different elevations, being 3 stories on the eastern part, 2-stories on the western part and 1-storied on the northern part. A plan of the existing ground floor layout is given in figure 2. No basement currently exists.

The site is bounded by 2 Hampstead Square to the east and 1,3 and 5 Hampstead Square to the south. Elm Road and Hampstead Square are further to the south, and to the north and east. An examination of historical Ordnance Survey maps starting from 1873 shows that the layout of the site and the surrounding area was already in place in the 1873 map. The site is not included in a Source Protection Zone and is also not in a sensitive land use or in a potentially contaminative industrial land use.

It is proposed to construct a single level basement under the whole footprint of the existing superstructure, with lightwells extending outside of it. Figure 3 shows a plan of the proposed basement and figure 4 a proposed east-west section. The basement will require 4 to 5m excavations below the existing ground level at the site. It is understood that the basement will be formed by underpinning the walls of the existing house.

3 TOPOGRAPHY AND GEOLOGY

The site is on a gently sloping hillside. The ground levels fall across the site from around +124.0 mOD at the northwest side to around +123.0 mOD at the southeast side. The site lies on the SE side of the hill that is topped by Whitestone Pond at an elevation of around +132.0 mOD. The ground continues to fall towards the lower part of the Heath at an approximate slope of 1:10.

The geology of the area is shown on the British Geological Survey 1:10560 sheet TQ28NE (figure 5). The site is underlain by Bagshot Formation Sand overlaying Claygate Member and London Clay. A section through Hampstead Heath suggests that the base of the Bagshot Formation slopes down northwards (figure 6). In a record borehole located in close vicinity to the site (BH8 in figure 5) the Bagshot Formation sand was found to be about 20 metres thick and the Claygate Member was found about 27 metres thick. The thickness of the London Clay underneath the Claygate Member was not proved, but the London Clay is shown to extend to at least about 62.5 metres below ground level (bgl). The ground surface is at an elevation of +122.2m OD and the top of the Claygate Member is at about +100.0m OD.

The Bagshot Formation thins southwards and eastwards and the Claygate Member outcrops at about 300 metres to the east of the site. The level at which the Claygate Member outcrops, scaled from the geological maps appears to be at about +105.0 mOD. As the base of the Bagshot Formation deepens in a north-west direction, the level of the top of the Claygate Member at the site can be expected to be a few meters deeper.

The soils of the Lambeth Group underlay the London Clay at about -20m OD (BGS England and Wales Sheet 256: North London, 1:50000) and it is probably about 20 metres thick. About 10-15 meters of Thanet Sand underlay the Lambeth Group and Chalk is thought to be present at about -40 mOD (BGS England and Wales Sheet 256: North London, 1:50000).

A site investigation was recently carried out under instructions from Cranbrook Basements by Chelmer Site Investigations. This comprised one borehole to 6m depth sunk in the lawn area immediately to the north of the existing house. Its locations is shown in figure 7. This borehole encountered 0.7m of Made Ground followed by Bagshot

Formation (see figure 8), which includes clayey silty sands and laminated clay silt. Wet clayey silty fine sand was found at about 4.3m depth bgl (below ground level), at an approximate elevation of +119m OD (assuming that at the location of the borehole the ground level at the site is approximately +123.5mOD.

Two BGS boreholes east and south-east from the site (figure 9) were also examined and indicated that there is not a significant variation in the geology across the site: BH TQ28NE91 east from the site with the ground surface at +124.0m OD encountered 1.8m layer of Made Ground followed by 19.6m of Bagshot Formation, proved to the full depth of the investigation. According to the description of the borehole log, water seems to be present at around +118.0m OD, which, taking into account the proximity of the borehole to our site, agrees with the findings of the recent SI. BH TQ28NE92 south-east from the site with the ground surface at +122.0m OD revealed 2.1m of Made Ground followed by 17m of Bagshot Formnation, which extended down to the base of the borehole. Water here seems to be present at around +110.0m OD.

In our records we have boreholes for a site approximately 170m south-east from 4 Hampstead Square, going down to 20m. A standpipe was installed in each of the boreholes to below the level of the observed water table. Figure 10 gives a marked up section through the two boreholes with the description of the soils encountered (BH1 is located at the south part of the site, whereas BH2 is located at the north part of it). Based on this it appears that the top of the Claygate Member is at around +100 mOD, i.e. some 19m below the base of the proposed excavation. The ground water level appears to be within the Bagshot Formation at around +111.0m OD north of the site falling to +109.0m OD towards the south. As aforementioned, since the base of the Bagshot Formation dips in a north-west direction, the top of the Claygate Member in the area of our site could be a few meters deeper than +100.0m OD.

4 HYDROGEOLOGICAL CONDITIONS AND HAZARDS

The proposed basement will extend to approximately 4m below the existing ground level and it is likely to be within the Bagshot Formation.

According to figure 11 taken from Barton (1962) ‘The lost Rivers of London’ no ancient rivers seem to be present directly under the area of the site. Numerous springlines surround the site at a distance greater than 100m. Theseflow into various drainage channels throughout the Heath and form tributaries of the four main rivers which can be found within the LB Camden: the Westbourne River to the southwest, the Brent River to the nortwest, the Tyburn River to the south and the Fleet River to the east. These can also be seen with blue color in the 1922 British Geological Survey Map (figure 12).

From the same British Geological Survey Map (1922) as well as from a number of historical Ordnance Survey maps starting from 1873 we can see that the closest watercourses to the site are 3 ponds: the Whitestone Pond circa 240m northwest from the site and two of the Hampstead Ponds, one approximately 350m and one approximately 630m northeast from the site. Furthermore, a well named Chalybeate Well is present approximately 320m east from the site right on the geological boundary between the Bagshot Formation and the Claygate Beds. Nevertheless, more springs and wells are

expected to be present east from the site along the junction of the Bagshot Formation and Claygate Member as well as along the junction of the Claygate Member and the London Clay.

The site is located above the Upper aquifer, designated as Secondary A Aquifer by the EA – Bagshot Formation (see figures 13 & 14). The site is also in an area of negligible susceptibility to flooding and it is more than 100m away from the Hampstead Chain Catchment (see figure 15).

The London Clay acts as a barrier to flow between the lower (Chalk) aquifer and superficial groundwater. The water head in the Chalk was about -45 mOD in 1965 (see figure 16), and has been rising since as the demand for water abstraction began to diminish after 1965; in 2010, the water level in the Chalk in the area of the site was approximately -25 mOD (see figures 17). The current policy, implemented by the Environment Agency, is to maintain water levels in the Chalk at about their present levels. Thus, the property is unlikely to be influenced directly by groundwater levels in the Chalk, even in the long-term. There are no known underground structures in the vicinity of the site that might indirectly induce local changes of water pressures in the London Clay, which could affect the development.

Standpipe readings seem to suggest that the water table in the area of the site is at about +110mOD. However, observations during borehole drillings suggest that there could be perched groundwater tables in the Bagshot Formation at higher levels. Near the site water has been encountered at about +118mOD and wet sand has been found at the site at around +119mOD.

Assuming that the ground level at the site is approximately +123.5mOD, the proposed basement excavation will extend to around+119.0m OD, which is at or just above the level at which water has been encountered.

From the above assumptions and on the basis of the available information, the proposed basement is likely to be above the shallower aquifer, but could intercept a perched groundwater table.

Given the nature of the Bagshot Formation horizontal water flow could be encountered at higher levels, but, according to the available data from the various site investigations in the area of the site, this water is likely to be localized.

Account for water ingress should be made when carrying out the underpinning and excavation operations.

5 LAND DRAINAGE REQUIREMENTS

As mentioned earlier, the proposed basement is likely to be above the Upper aquifer, but could intercept some perched water table. This is unlikely to have any significant impact on the local hydrology as, given the nature of the soils at the site, water will tend to deviate around the new basement and will continue to run underneath it.

Drainage could, if necessary, be provided beneath the basement slab in order to facilitate water flow underneath it.

6 CONCLUSIONS

The site is above the Secondary A Aquifer in the Bagshot Formation, which is believed to be about at around +110mOD, some 13mbgl at the site. Due to the nature of the soil, perched groundwater is likely to exist at shallower depths.

The proposed single level basement, extending to about 4-5m bgl is not likely to intercept the water table surface, although water of limited extent could be encountered during construction.

No known ponds springlines and wells are in close vicinity to the site and the site is outside the Hampstead pond chain chatchment area.

The proposed basement will be created under the footprint of the existing house at the site and will include a lighwell of limited size. As such it will not alter significantly the existing proportion of hard surfaces/paved areas.

In order to facilitate drainage underneath the proposed basement a drainage blanket could be provided underneath the basement slab.

In summary, the proposed basement construction is not believed to cause adverse changes to the local hydrogeology.

7 REFERENCES

Barton, N. 1992. *The lost rivers of London.* London: Historical Publications.

British Geological Survey. 1982. Geological Survey Sheet TQ28NE. 1: 10,560

British Geological Survey. 1922. London Sheet NI SE. 1:10,560

British Geological Survey. England and Wales Sheet 256: North London, 1:50,000

Camden Development Policies DP27. Basements and Lightwells

Camden Planning Guidance CPG4. Basements and Lightwells

Chelmer Site Investigations. 2011. *A factual report on the site investigation undertaken for Cranbrook Basements at 4 Hampstead Square, London, NW3.* 19th October 2011

CIRIA Special Publication 69. 1989. *The engineering implications of rising groundwater levels in the deep aquifer beneath London*

Environment Agency. 2010. *Management of the London Basin Chalk Aquifer*.

APPENDIX A

SUBTERRANEAN GROUND WATER FLOW SCREENING CHART

Question 1a: Is the site located directly above an aquifer?

Yes. The site is located above the Upper aquifer, designated as Secondary A Aquifer by the EA – Bagshot Formation (see Figures 13 & 14).

Question 1b: Will the proposed basement extend beneath the water table surface?

No. As mentioned in the previous section it is not likely that the water flowing across the site will be above the level of excavation. Localised groundwater, though, is could be encountered during underpinning of the existing foundation and during the proposed excavation.

Question 2: Is the site within 100m of a watercourse, well (used/diused) or potential spring line?

No. The surrounding ponds, springlines and wells are at a distance greater than 100m from the site.

Question 3: Is the site within the catchment of the pond chains on Hamstead Heath?

No. The site is more than 100m away from the Hampstead Chain Catchment (see Figure 15).

Question 4: Will the proposed basement development result in a change in the proportion of hard surfaced/paved areas?

No. The proposed basement (apart from the lightwells) is under the footprint of the existing building and therefore, it won't result in a change in the proportion of hard surfaced/paved areas.

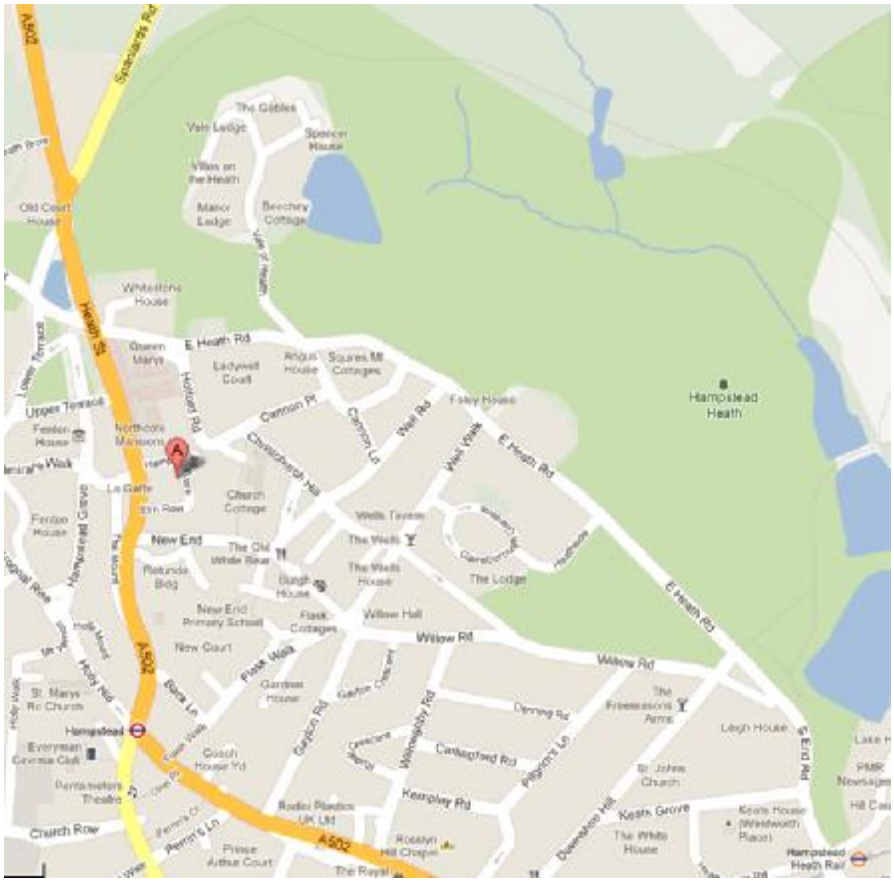
Question 5: As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)?

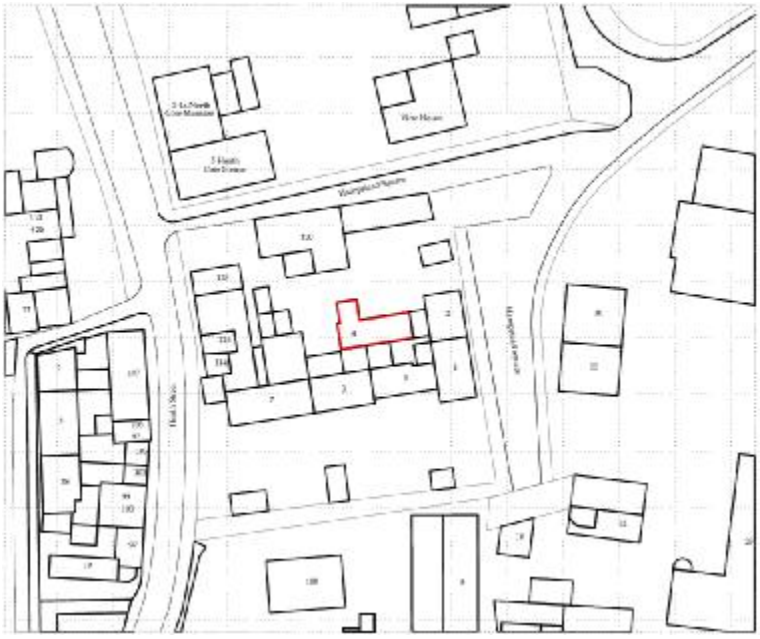
No. All surface water will be discharged to the sewer network through existing connections. The volume of water will not be greater than in the existing condition.

Question 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 known local water features in the immediate vicinity of this site.

FIGURES





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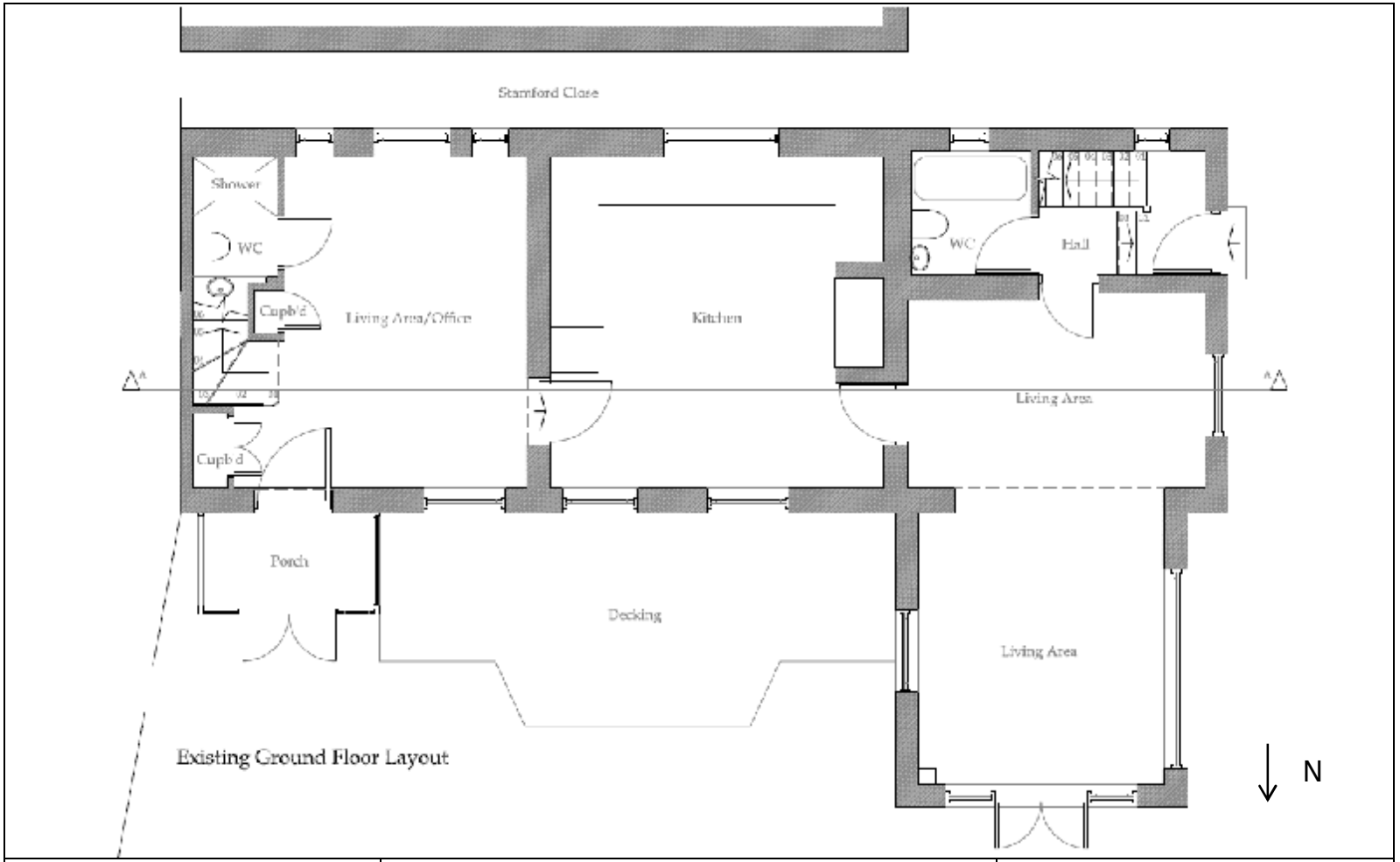
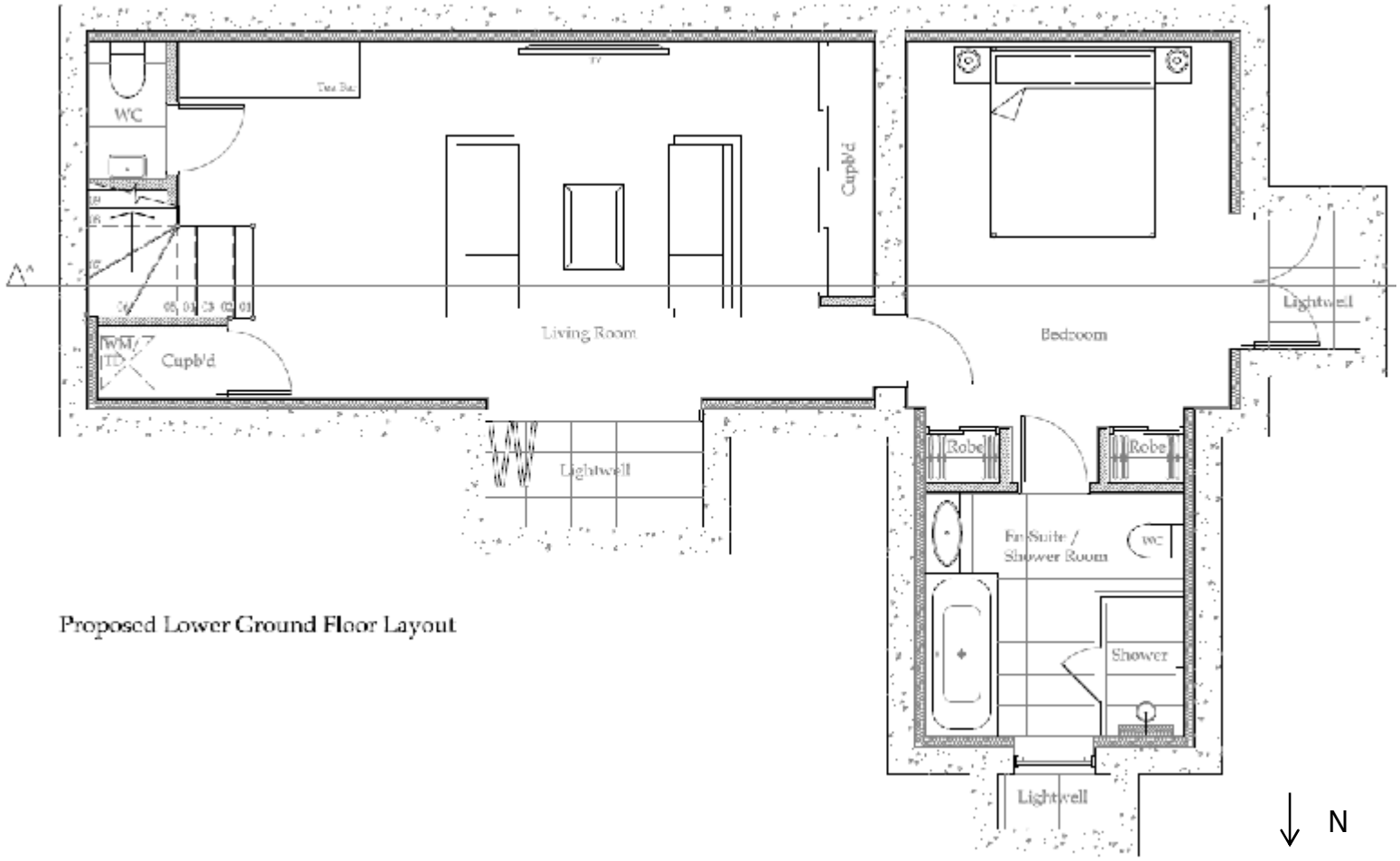
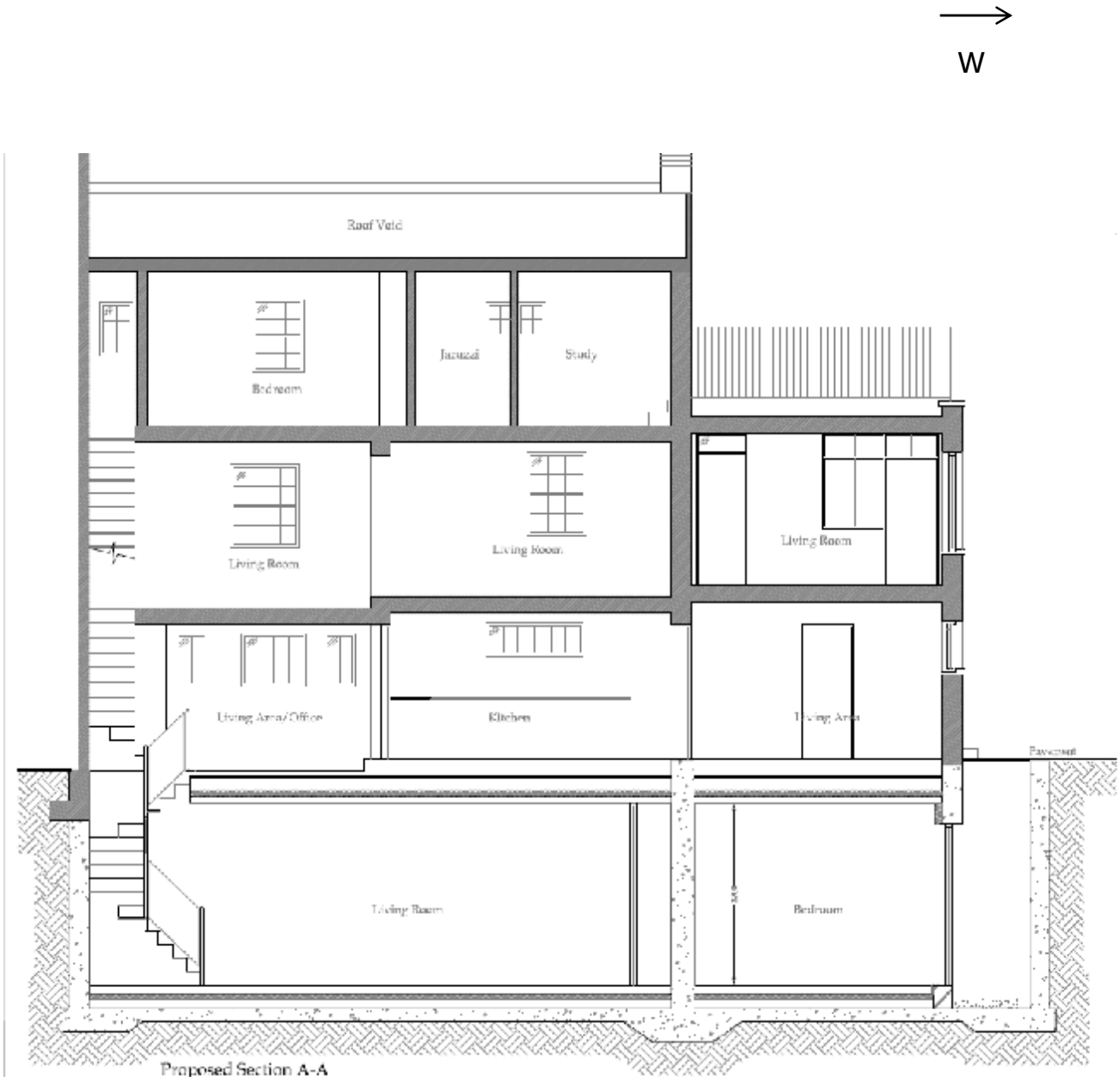
Geotechnical Consulting Group	Location of Site (Google Maps)	Figure 1
4 Hampstead Square		



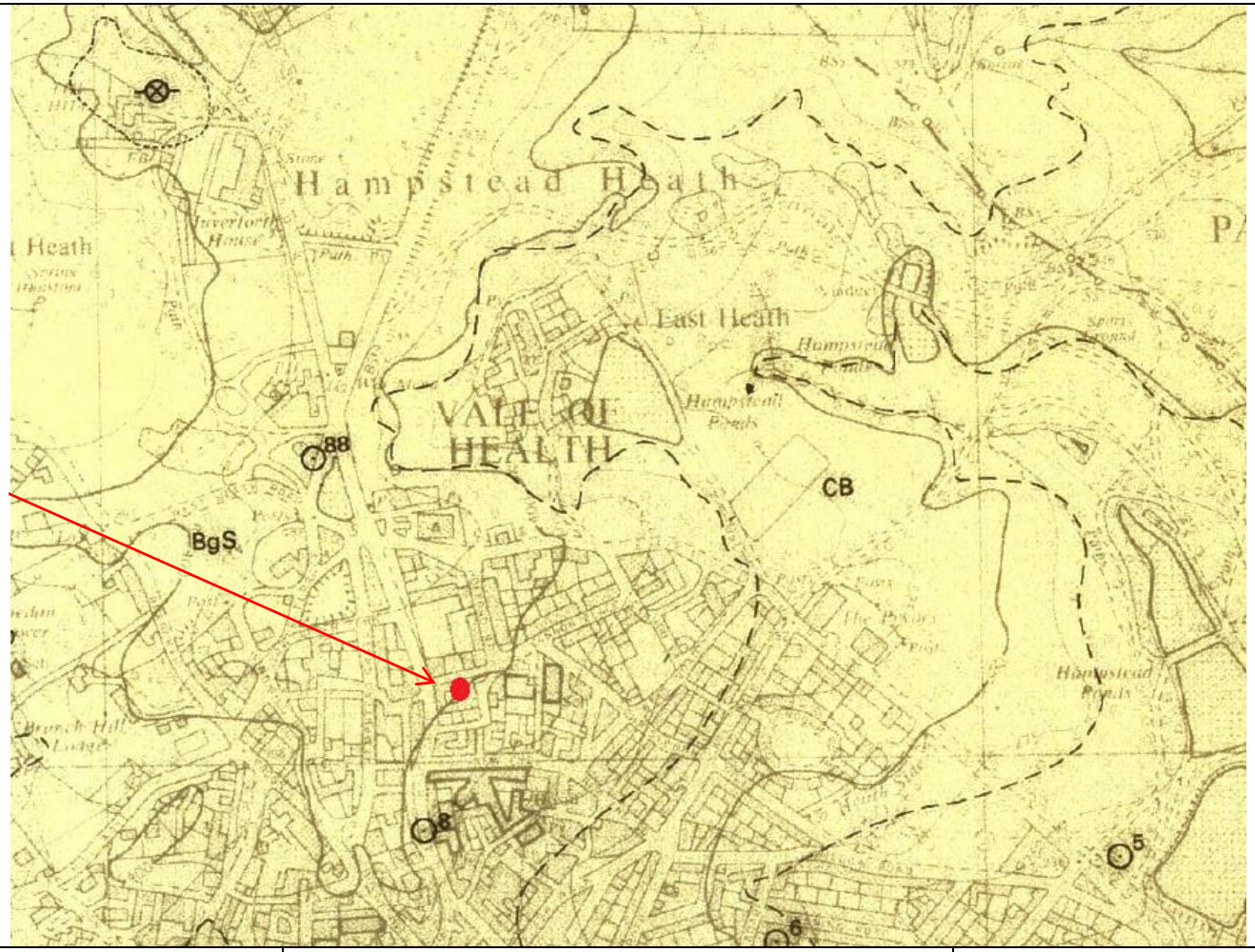
Geotechnical Consulting Group	Plan of the Existing Ground Floor	Figure 2
4 Hampstead Square		



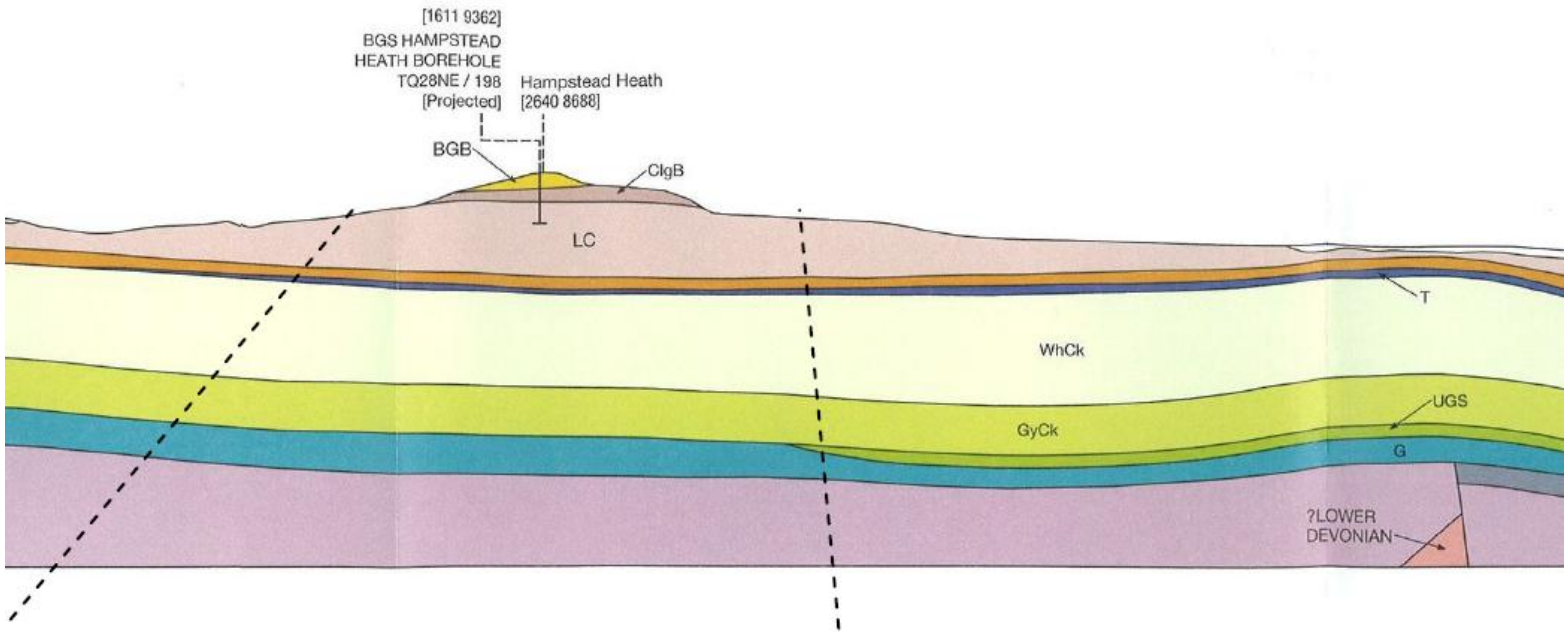
Geotechnical Consulting Group	Plan of the Proposed Basement	Figure 3
4 Hampstead Square		



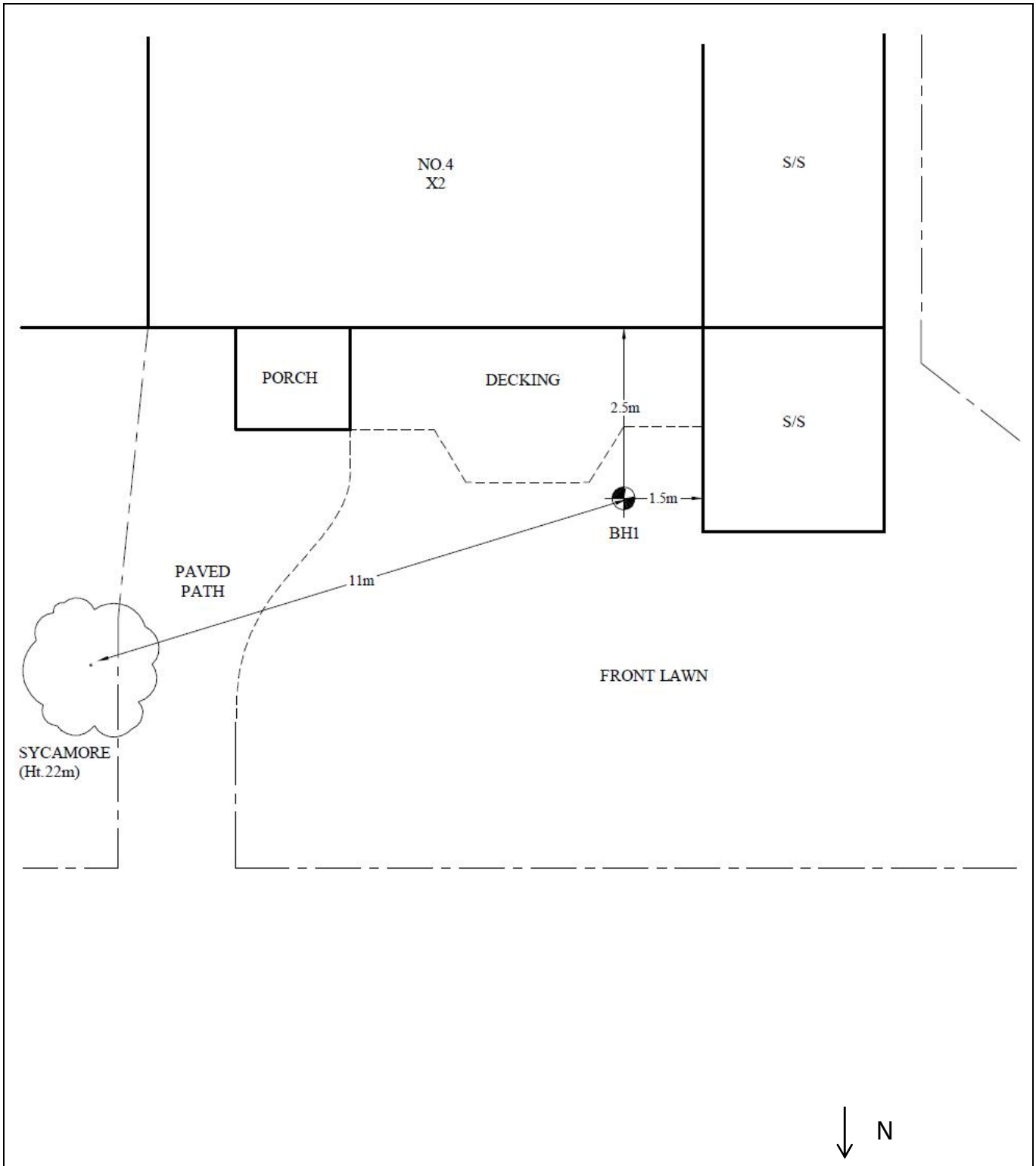
Geotechnical Consulting Group	Proposed Section	Figure 4
4 Hampstead Square		



Geotechnical Consulting Group	BGS Map 1:10560 (1982)	Figure 5
4 Hampstead Square		



Geotechnical Consulting Group	Section through Hempstead Heath (NW-SE)	Figure 6
4 Hampstead Square		

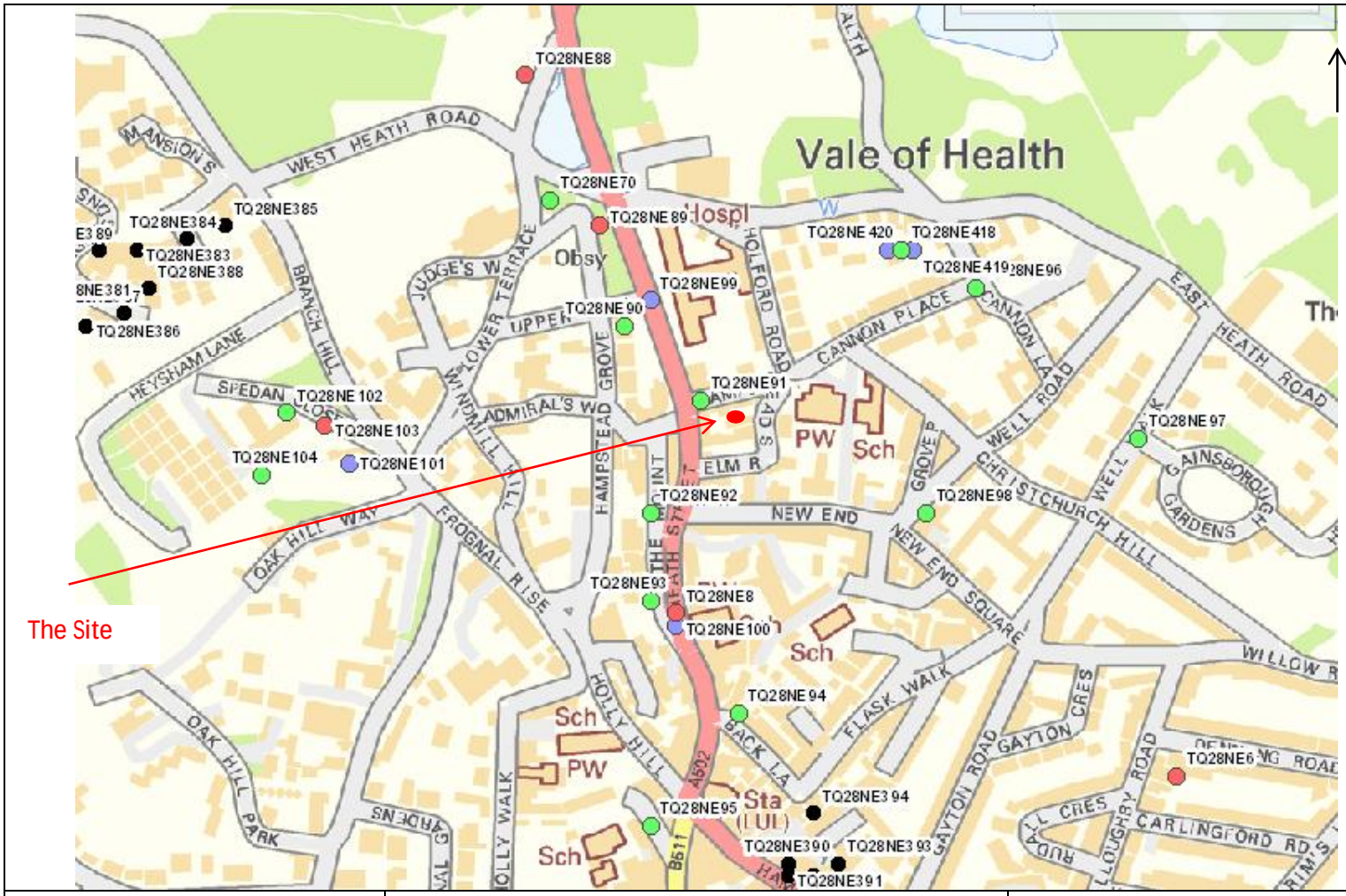


Geotechnical Consulting Group	Location of recent BH1 (Chelmer Site Investigations)	Figure 7
4 Hampstead Square		

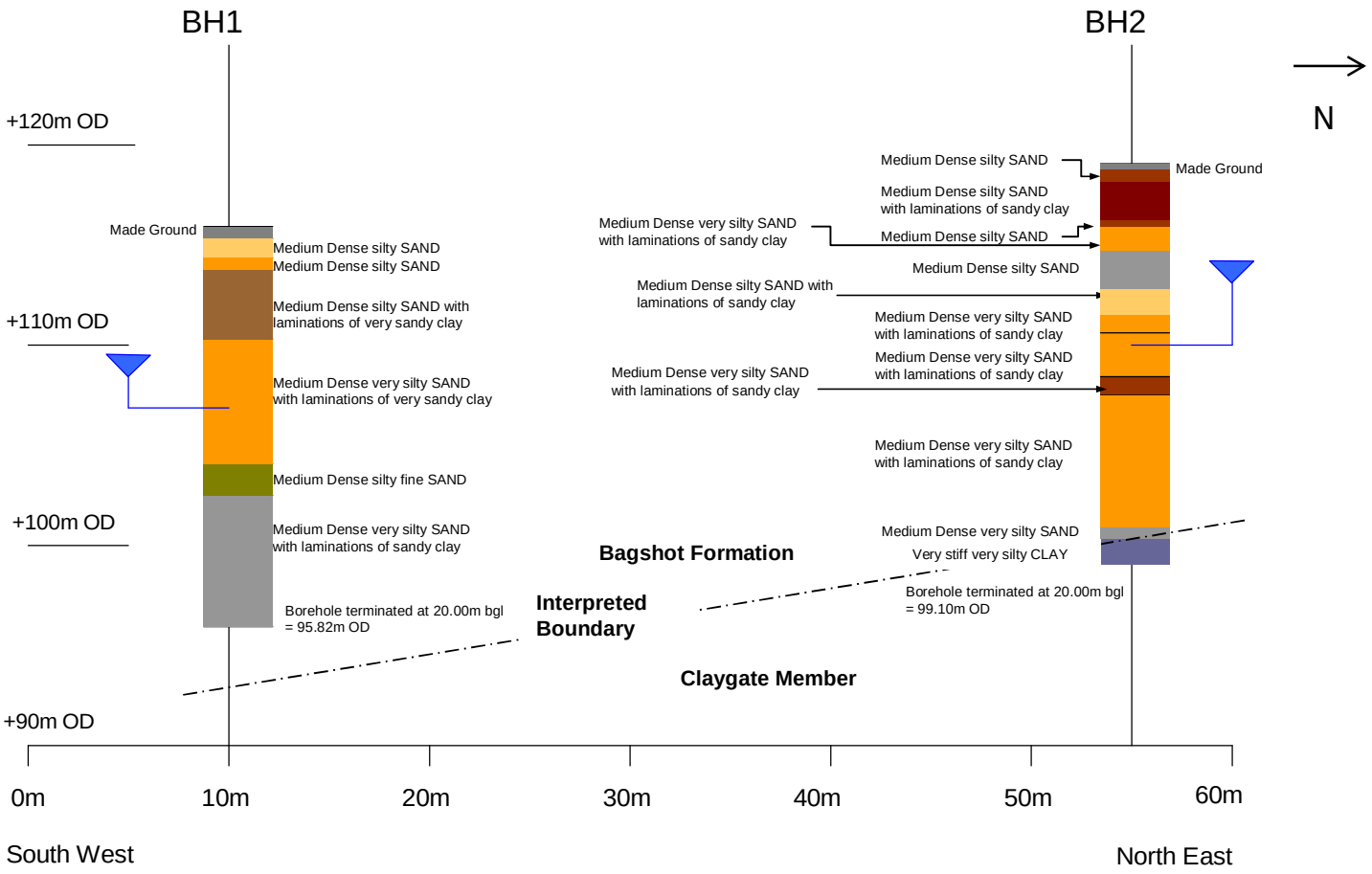
Client:	Cranbrook Basements	Scale:	N.T.S.	Sheet No:	1 of 1	Weather:	Fine	Date:	19.10.11
Site:	4 Hampstead Square, London NW3	Job No:	2829	Borehole No:	1	Boring method:	Hand auger		

Depth Mtrs.	Description of Strata	Thick-ness	Legend	Sample	Test Type	Test Result	Root Information	Depth to Water	Depth Mtrs
G.L.									
0.1	Turf over TOPSOIL	0.1							
	MADE GROUND: medium compact mid brown clayey silty fine and medium sand with brick and clinker fragments and lenses of clay.	0.6		D			Hair and fibrous roots to 1.1m.		0.5
0.7									
	Medium dense light to mid brown clayey silty fine and medium SAND with lenses of clay.	1.1		D	M	14 16 16 18	No roots observed below 1.1m.		1.0
				D	M	18 20 20 23			1.5
1.8									
	Medium dense light brown/beige clayey silty fine SAND.	2.5		D	M	21 23 23 27			2.0
				D	M	27 28 30 32			2.5
				D	M	28 30 31 33			3.0
				D	M	30 32 33 35			3.5
				D	M	32 34 35 38			4.0
4.3								*4.3*	
	Medium dense wet as above.	0.5		D	M	34 37 40 42			4.5
4.8									
	Stiff/medium dense to dense mid brown/ orange laminated CLAY SILT and fine SAND.	2.5		D	M	40 42 44 44			5.0
				D	M	42 44 46 46			5.5
				D	M	44 46 48 49			6.0
6.0	Borehole ends at 6.0m								

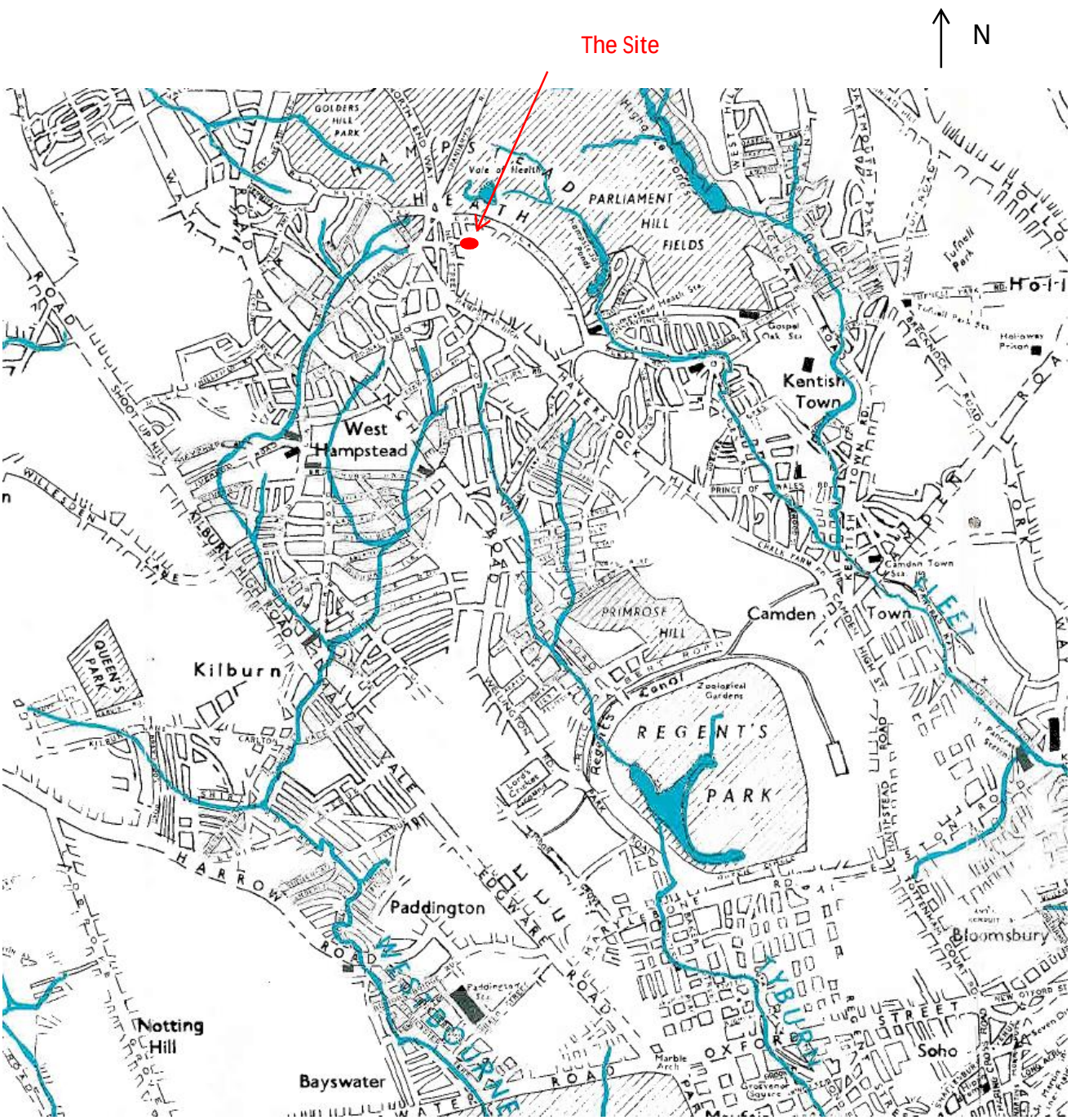
Geotechnical Consulting Group	BH1 (Chelmer Site Investigations)	Figure 8
4 Hampstead Square		



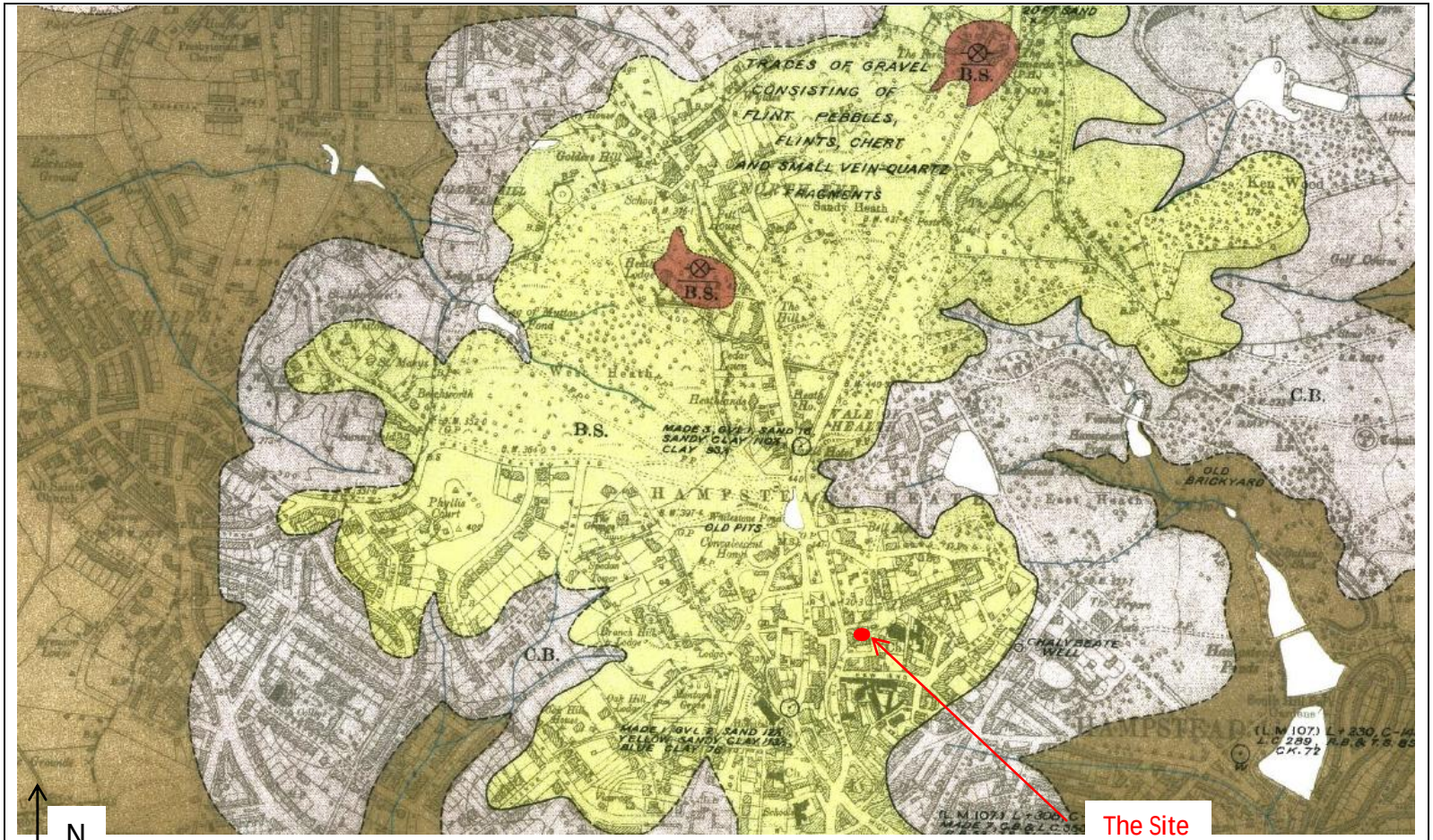
Geotechnical Consulting Group	Location of BGS Boreholes TQ28NE91 & TQ28NE92 (BGS Boreholes Scans)	Figure 9
4 Hampstead Square		



Geotechnical Consulting Group		Figure 10
4 Hampstead Square		



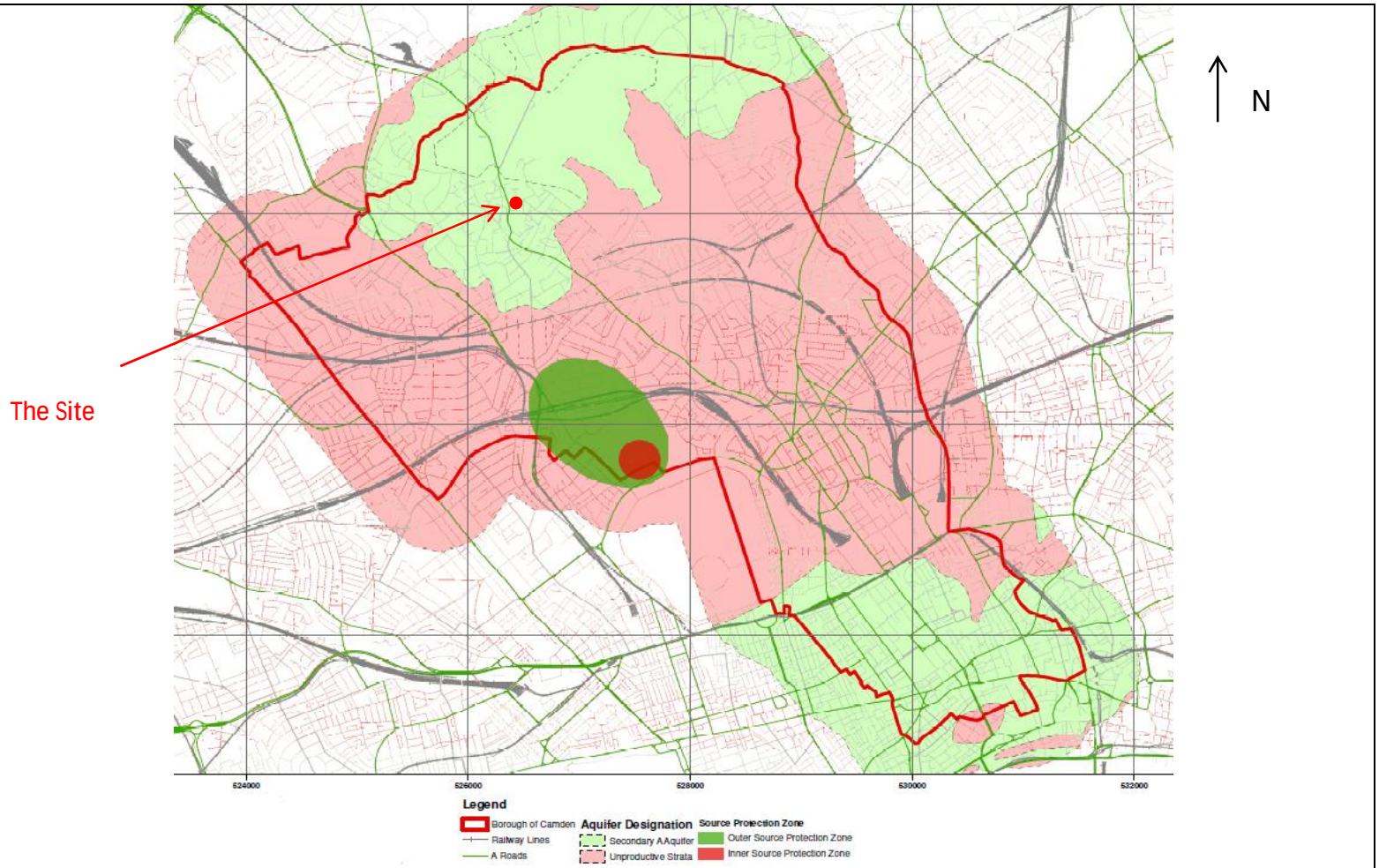
Geotechnical Consulting Group	Extract from The Lost Rivers of London Map (Burton N., 1962)	Figure 11
4 Hampstead Square		



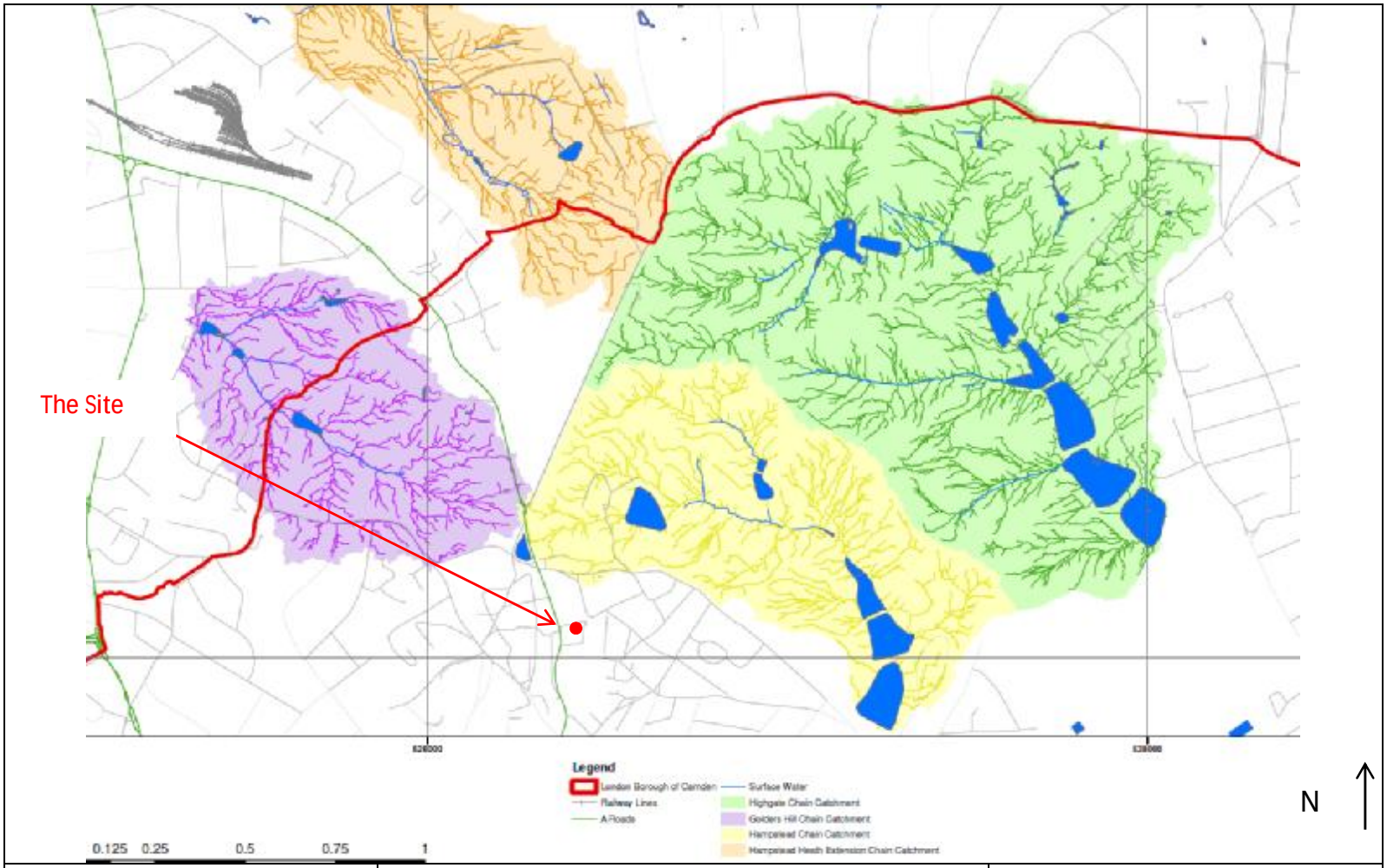
Geotechnical Consulting Group	BGS Map 1:10560 (1922)	Figure 12
4 Hampstead Square		

Strata	Superficial / bedrock	EA aquifer designation
River Terrace Deposits	Superficial	Secondary A
Bagshot Formation	Bedrock	Secondary A
Claygate Member		Secondary A
London Clay Formation		Unproductive Strata

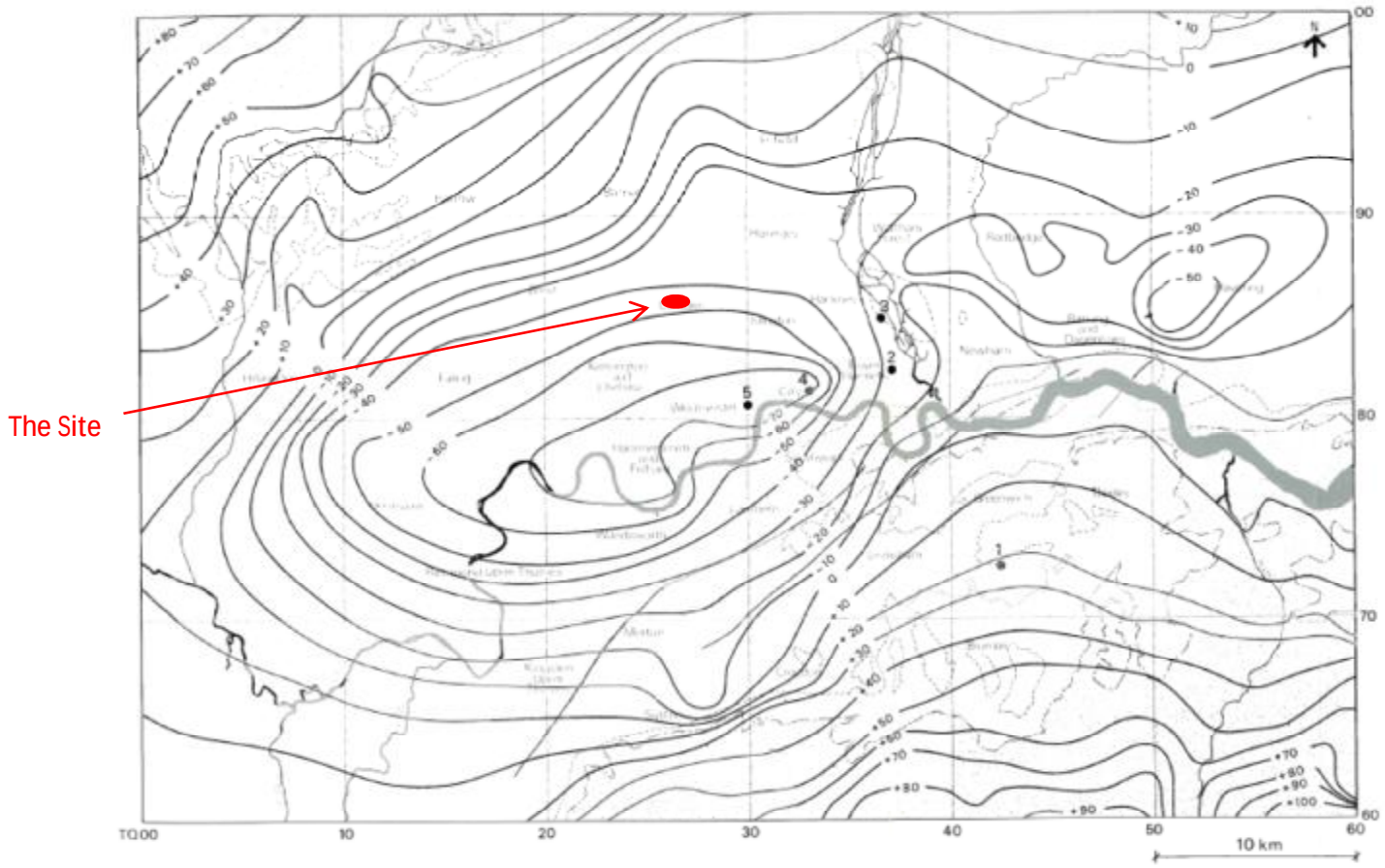
Geotechnical Consulting Group	EA Aquifer Designation of Outcropping Strata within LB Camden (LB of Camden: Guidance for Subterranean Development)	Figure 13
4 Hampstead Square		



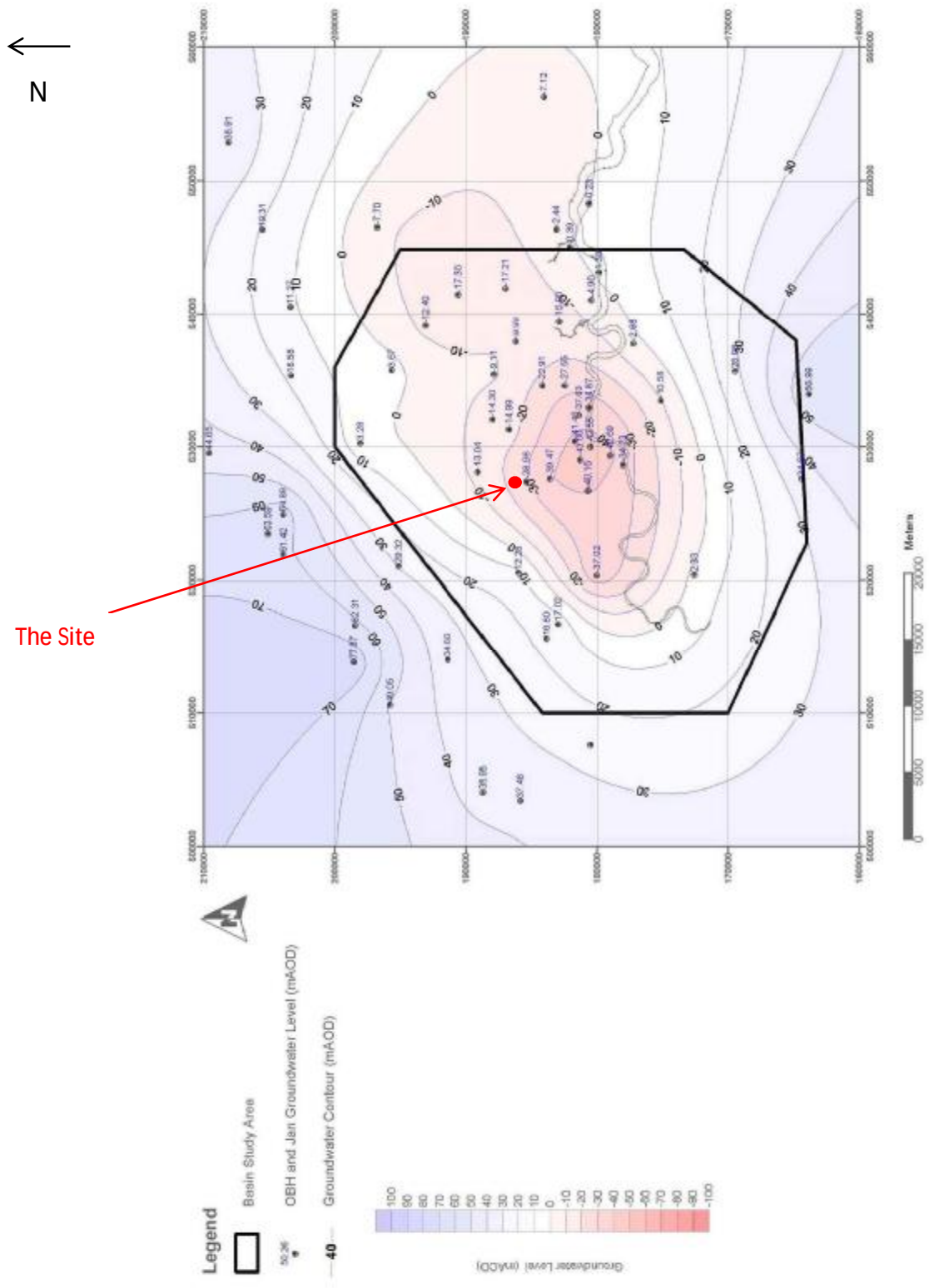
Geotechnical Consulting Group	Camden Aquifer Designation Map) (LB of Camden: Guidance for Subterranean Development)	Figure 14
4 Hampstead Square		



Geotechnical Consulting Group	Hampstead Heath Surface Water Catchments and Drainage (LB of Camden: Guidance for Subterranean Development)	Figure 15
4 Hampstead Square		



Geotechnical Consulting Group	Groundwater levels in the deep aquifer in 1965 (CIRIA, 1989)	Figure 16
4 Hampstead Square		



Geotechnical Consulting Group	Groundwater levels in the deep aquifer in 2010 (Environment Agency)	Figure 17
4 Hampstead Square		