TRIGRAM PARTNERSHIP

5 KEMPLAY ROAD, LONDON NW3 1TA

HYDROGEOLOGICAL REVIEW

December 2013

Revision 0

Attention is drawn to the statement overleaf which should be read prior to using this report. The report has been prepared for the exclusive use of Geotechnical Consulting Group LLP's client and contains privileged information. Use of this report and disclosure of its content by and to unauthorised parties is strictly forbidden

GEOTECHNICAL CONSULTING GROUP
52A Cromwell Road
London SW7 5BE
United Kingdom

Tel: +44 (0) 20 7581 8348
Fax: +44 (0) 20 7584 0157
Email: admin@gcg.co.uk

TRIGRAM PARTNERSHIP

5 KEMPLAY ROAD,
LONDON NW3 1TA

HYDROGEOLOGICAL REVIEW

December 2013

Revision 0

Table of Contents

TRIGRAM PARTNERSHIP

5 KEMPLAY ROAD,
LONDON NW3 1TA

HYDROGEOLOGICAL REVIEW

December 2013

Revision 0

1 INTRODUCTION

It is proposed to demolish the existing 2-storey semi-detached building and replace it with a larger 3-storey building and a new one level basement underneath the front part of its footprint at 5 Kemplay Road, NW3 1TA. Geotechnical Consulting Group LLP (GCG) has received an instruction from Trigram Partnership on behalf of Mr & Mrs Fournier, to undertake a review of the local hydrogeological conditions and the impact that the proposed basement may have on the groundwater in the area.

This report reviews the available information about the site & 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 (LBC).

GCG have been supplied with the required information by Trigram Partnership.

2 THE PROPERTY AND THE PROPOSED RE-DEVELOPMENT

The site lies within the LBC and is located to the south of Kemplay Road and to the northwest of Pilgrim's Lane (Figures 1 and 2). Hampstead Underground Station is about 350m to the northwest of the property and Hampstead Heath Rail Station about 350m to the southeast. The Northern Line Underground Tunnels are about 150m to the southwest of the property.

The site is of a rectangular shape with approximate plan dimensions of 27m x 10.5m, with its shortest side orientated in approximately east-west direction, and it fronts onto Kemplay Road roughly to the north. Currently, a two-storey semi-detached terraced house partially extended in the south and in the east, occupies the site, and is accessed through a paved drive way from Kemplay Road. One mature Rowan tree and some plants are present along the northern boundary in the front garden which is about 10m away from the proposed basement (Figure 3). The ground floor plan of the existing property is shown in Figure 4. At the back of the property, a paved patio, an awning with glass roof, a garden with shrubs around its eastern and southern boundary walls, and a garden shed in the southeast with a paved walkway from the back are present.

Four trial pits dug as part of the site specific ground investigation (MRH, Sept. 2013) revealed that the building is founded on concrete strip footings at approximately 0.9m bgl except its eastern side extension flank wall at about 0.65m bgl. Site specific survey information suggests that the ground floor level of the existing building is about +85m OD. Therefore, the foundation depths 0.9m bgl and 0.65m bgl correspond to elevations +84.1m OD and +84.35m OD.

The site is bounded by private properties in the east and west: 3 Kemplay Road, an older three-storey semi-detached house to the east, and 7 Kemplay Road, a two-storey semi-detached terraced house (adjoining 5 Kemplay Road) immediately to the west (see Figures 2 to 4). It is understood that 3 Kemplay Road has a cellar within its rear half extending to a depth of approximately 1.5m below its ground floor level. It is believed that ground floor level of 3 Kemplay Road is 0.5m lower than that of 5 Kemply Road. Therefore, the base of the cellar corresponds to an elevation of +83m OD.

The desk study report & historical maps produced by MRH Geotechnical (MRH, October 2013) suggests that the Kemplay Road and other surrounding roads were laid out by 1878 and the current building has been present since 1965.

It is proposed to redevelop the site by demolishing the existing two-storey building and replacing it with a larger three-storey building with a new one level basement underneath the front part of the building's footprint. Figure 5 shows the plans of the proposed redevelopment at basement and ground floor levels together with the extents of the proposed basement and No. 3's existing basement / cellar highlighted by red dotted lines. Figure 6 shows section views of the proposed redevelopment. The proposed basement is rectangular in shape with approximate plan dimensions 4.5m x 10m approximately covering 17% of length and 95% of width of the site. The longer axis of the proposed basement is orientated parallel Kemplay Road, approximately in east-west direction. The depth of excavation for the basement is anticipated to be about 3.2m below the ground floor level of existing building (which corresponds to +81.8m OD) except for the localised sump in the northwest which will be slightly deeper.

It is understood that the basement will be constructed using bottom-up construction methodology. It is anticipated that a sheet pile wall, with interlocking steel sheet piles driven into the ground using a vibration-free hydraulic ram, will be installed around the proposed basement prior to the excavation. The excavation will be supported by temporary propping in the short term (i.e. during excavation) and by the cast in-situ water-proofed Reinforced Concrete (R.C) retaining walls around the inside of sheet pile walls, with the ground floor slab and the basement slab providing lateral support, in the permanent condition. Therefore, the sheet pile wall is not required to extend significantly deeper than the excavation depth.

The superstructure beyond the basement will be supported by new mass concrete trench footings, offset from and parallel to the site boundaries (see Figures 5 & 6).

3 TOPOGRAPHY AND GEOLOGY

The site is located between the spring lines (which form at the junctions of Bagshot Sands with the Claygate Beds, and the Claygate Beds with the London Clay) flowing into Fleet, Tyburn and Westbourne Rivers (Barton, 1962, Figure 7) on ground that gently slopes down towards the River Thames located at about 6km from the site in the south or southeast.

Based on the survey information from site specific ground investigation, the ground within the site is relatively level with an elevation of about +85m OD except the entrance to the driveway at the front slightly sloping down towards the pavement on Kemplay Road.

The desk study report by MRH geotechnical suggests a drop in pavement level by about 0.5m from west to east across the whole width of the site, and rising ground at the driveway entrance with respect to the pavement, along Kemplay Road. Topography of the surrounding area, the pavements on Kemplay Road (to the north of the site running west to east) and Willoughby Road (to the east of the site running north to south), suggests that the pavement level falls to the east and to the south. It also suggests that the ground in No. 3's garden area is about 0.5m lower than that of No. 5 with its eastern boundary wall retaining 0.5m of the material.

The geology of the area is shown on the 1920 British Geological Survey 1:10560 sheet NI S.E. (Figure 8) and on the 1982 Geological Survey 1:10560 sheet TQ28NE. The site is underlain by Claygate Beds overlying the London Clay formation. Approximately 100m away to the southwest of the site, Bagshot Sands are shown to overlie the Claygate Beds. A BGS borehole shown on Figure 8, about 90m away from the site, indicates that the geology consists of about 2m of Made Ground, overlying nearly 108m of London Clay (including Claygate Beds). Lambeth Group, Thanet Sand and Chalk underlie the London Clay in the same order. The most recent, 1993, BGS 1:50000 North London, England and Wales, sheet 256 also shows that the site is underlain by Claygate Beds and then by the London Clay. Two boreholes have been obtained from the BGS records. The boreholes (TQ28NE6 and TQ28NE304) are about 100m away to the northwest and southwest of the site (Figure 9), extended to about 180m depth. They consistently show the presence of about 2m of Made Ground, over about 108m of London Clay (to around -15m OD) over about 15m of Lambeth Group (to around -30m OD), over about 10m of Thanet Sand (to around -40m OD) over the Chalk.

A site-specific ground investigation was carried out by MRH Geotechnical between the 17th and the 27th of September 2013. This comprised one borehole at the front in the driveway (BH1) and two boreholes in the rear garden (BH2 to BH3), each to a depth of about 10m bgl. Four trial pits, TP1 to TP4, were also excavated in order to reveal the type and depth of existing foundation. The locations of all the above are shown in Figure 10. Groundwater monitoring standpipes were installed in all the three boreholes, BH1 to BH3, one in each to a depth of 10m bgl.

These boreholes revealed a thin layer of Made Ground of between 0.25m to 1.2m thick underlain by Claygate Beds. The latter was proved to be about 4.1m to 5.7m thick,

extending down to about 6.9m bgl, where the top of the London Clay was encountered. All the three boreholes were terminated at 10m bgl within the London Clay stratum and did not prove the top of the underlying Lambeth Group.

Based on the site specific ground investigation data combined with the published BGS geological maps and nearby BGS boreholes, an assumed stratigraphy has been developed for the site, as follows:

Made Ground	0.25m to 1.2m thick	(to around +83.8m OD)
Claygate Beds	4.1 to 5.7m thick	(to around +77.8m OD)
London Clay	94m thick	(to around -15m OD)
Lambeth Group	15m thick	(to around -30m OD)
Thanet Sand	10m thick	(to around -40m OD)

Made Ground was described as soft to firm or compacted dark grey / black / dark brown sandy clay / clayey sand with occasional or traces of brick fragments. In TP1 to TP4, brick rubble, concrete, roots and clay or silt fill were found. Claygate Beds mainly comprised of thin layers of firm orange / brown / bluish grey silty and/or sandy clay in the first 3m or so, and then stiff grey silty clay in the last 1m or so. London Clay was described as very stiff fissured dark grey clay from below the Claygate Beds to the base of boreholes at 10m bgl.

Water seepages were encountered in two (i.e. BH2 & BH3) of the three boreholes during drilling, at about 3.1m bgl and 3.4m bgl, which correspond to about +81.48m OD and +81.30m OD. The other borehole, drilled in the front driveway (i.e. BH1), remained dry throughout the drilling. Standpipe installations in all these boreholes have been completed between the 17th and 18th of Sept. 2013. The groundwater monitoring at the end of field works on the 27th Sept. 2013 (about 10days after installation) indicated standing water levels of between 2.03m bgl and 2.63m bgl which correspond to +82.67m OD and +82.27m OD. The subsequent post-field works monitoring on 11th Nov. 2013 (about 3 weeks after installation) indicated standing water levels of between 2.23m bgl and 2.71m bgl which correspond to +82.47m OD and +82.19m OD.

4 HYDROGEOLOGICAL CONDITIONS AND HAZARDS

The proposed basement will generally extend to approximately 3.2m below the existing ground level (i.e. to around +81.8m OD). The excavation for basement will be likely to extent through Made Ground into the Claygate Beds terminating 4m above the top of the London Clay. As detailed in Section 3, the groundwater level is in the Claygate Beds and it varies between +82.67m OD and +82.27m OD, which lies about 0.9m above the base level of excavation of +81.80m OD.

According to Figure 7, taken from Barton (1962) ‘The lost Rivers of London’, no ancient rivers seem to be present directly under the area of the site. The nearest spring lines are at a distance greater than 100m. These spring lines flow into the Fleet River to the southeast and into the Tyburn River to the south and southeast towards the River Thames, as suggested by the geology and the underground topography.

The site is above the upper aquifer, which is designated as local aquifer within the Claygate Beds. The flood map from LBC guidance for subterranean development, shown in Figure 11, indicates no record of historical flooding and that the site falls outside the areas of potential surface water flooding.

The London Clay acts as a barrier to flow between the lower (Chalk) aquifer and superficial groundwater. Water infiltrating the London Clay will generally tend to flow vertically downwards at a very slow rate towards the lower aquifer (Chalk), which, in the area of the site, is currently at approximately -25mOD (data from Environmental Agency, 2012). The area of the site has been affected by water abstractions during the 19th and 20th Centuries and the water level in the lower aquifer has been rising since the second half of the last century, when the demand of water started to reduce. The water levels in the deeper aquifer in 2012 are shown in Figure 12. 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.

The existing house is founded on the Made Ground or Claygate Beds above the London Clay and above the ground water table. The mature Rowan (Scottish name for Mountain Ash species) tree in the front garden is about 10m height and is about 10m away from the basement. According to NHBC standards (NHBC, 2011 – see Table 12 in Appendix 4.2-A), Mountain Ash species are moderate water demand trees. Therefore, there could be a slight reduction in groundwater level locally around the tree depending on the local geology and the groundwater presence. Given that the tree is 10m away from the proposed basement and its roots are unlikely to extend beyond the Claygate Beds, it is unlikely to have any significant effect on the hydrogeology of the area and / or on the basement.

The new mass concrete trench footings, to support the superstructure beyond the basement, are likely to be founded on Claygate deposits but above the water table in the upper aquifer. The proposed basement will be deeper into the Claygate Beds, up to about 3.2m bgl (i.e. +81.8m OD), and is expected to intercept the water table. Claygate Beds are known to be unstable during excavation due to the presence of sand and / or silt contents, which require the excavations within this stratum to be fully supported during the excavation. The new trench footings are unlikely to interrupt any of the existing groundwater flow across the site whereas the basement is likely to interrupt the flow to some extent.

As discussed in Section 2, the basement will be formed by sheet pile wall with temporary propping providing lateral support in the short-term, and an RC retaining wall around the inside of the sheet pile wall, propped by the slabs in the long-term. Given the anticipated depth of the water table and the nature of soils at the site, water will tend to continue to flow below the toe level of the sheet pile wall which will be slightly deeper than the formation level but not expected to penetrate into the London Clay. However, the basement construction will impede the existing groundwater flow above the toe of sheet pile wall leading to increased water level on its upstream side and decreased water level

on its downstream side. To minimise the interruption to the flow (or build-up of hydraulic head on upstream side of the basement), every fourth sheet pile will be stopped at excavation. The gaps in the sheet pile wall below the excavation level could increase the groundwater ingress / flow into the excavation but it should be easily controlled by simple pumping methods during excavation. Appropriate moisture control measures will be required internally to keep the living space free from moisture ingress to acceptable standard.

There may be local variations in the sand and silt contents of the Claygate Beds which could form perched water tables at shallower depths. Also, there may be seasonal variations in groundwater levels due to precipitation in the area. As a result, water could be encountered above the measured levels during construction of the basement, but this is likely to be limited and localized and therefore should be easily controlled by simple pumping methods.

5 LAND DRAINAGE REQUIREMENTS

As mentioned earlier, the proposed basement is expected to intercept the upper aquifer. It will be constructed using sheet pile walls and water-proofed RC retaining walls. Any groundwater currently flowing across the site would be expected to continue to flow beneath and around the new basement, and away from the property. Therefore, the proposed basement construction is unlikely to have any significant impact on the local hydrology.

As mentioned earlier, any localised water encountered during the excavation could be easily controlled by simple means of pumping and should not obstruct the construction process.

In the permanent condition there will need to be a suitable internal construction to bring the structure to an acceptable standard with regard to moisture ingress.

The proposed redevelopment is not going to result in a significant change in the proportion of hard-surfaced / paved areas as the basement will be constructed under part of the existing building's footprint, and majority of the extension of the above-ground structure is over the already paved area with a small part of it over the unpaved rear garden area. All surface water will be discharged to the sewer network through existing connections. The volume of water will not be significantly greater than in the existing condition. Nevertheless, drainage measures should be adopted to deal with water run off on hard-standing areas and in the garden areas to ensure that these remain well drained and to avoid ponding.

Any rainwater falling in the garden areas and infiltrating the soils should be picked up by collector drains forming part of the land drainage system. The drainage system should include collector drains that intercept rain water from the paved and the garden areas and from the roof and discharge into the storm water system.

6 CONCLUSIONS

It is proposed to demolish the existing two-storey house and reconstruct a larger three-storey house by extending its footprint over the rear patio and small part of the rear garden with a new one level basement under front part of the building. The basement will be about 3.2m deep.

Record and site specific data on ground conditions suggest that the basement will be in the Claygate Beds above the water table, and above the London Clay.

The basement will be formed using sheet pile walls and water-proofed cast in-situ RC retaining walls.

Given the nature of the ground and the extent of the basement, this is unlikely to cause any adverse changes to the local hydrogeology.

Any localised water encountered during the excavation could be easily controlled by simple means of pumping and should not obstruct the construction process. In the permanent condition, there will need to be appropriate measures in place to bring the structure to an acceptance standard with regard to the moisture ingress.

The proportion of hard surfaced / paved areas will not change significantly and as a result the volume of water is not expected to be much greater than in the existing condition. In any case, drainage measures should be adopted to deal with water run off on hard-standing areas and in the garden areas to ensure that these remain well drained and to avoid ponding.

7 REFERENCES

Arup, November 2010. *London Borough of Camden: Camden geological, hydrogeological and hydrological study – Guidance for subterranean development*. Issue01.

Barton, N. 1962. *The lost rivers of London.* London: Historical Publications.

BGS boreholes website (http://mapapps.bgs.ac.uk/boreholescans/boreholescans.html)

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

British Geological Survey. 1920. *London Sheet NI SE*. 1:10,560

British Geological Survey. 1993, *England and Wales Sheet 256: North London*, 1:50,000

Environment Agency. 2012. *Management of the London Basin Chalk Aquifer*.

MRH, September 2013. *Ground Investigation report,* 5 Kemplay Road, London NW3 1TA (Job No. 131410)

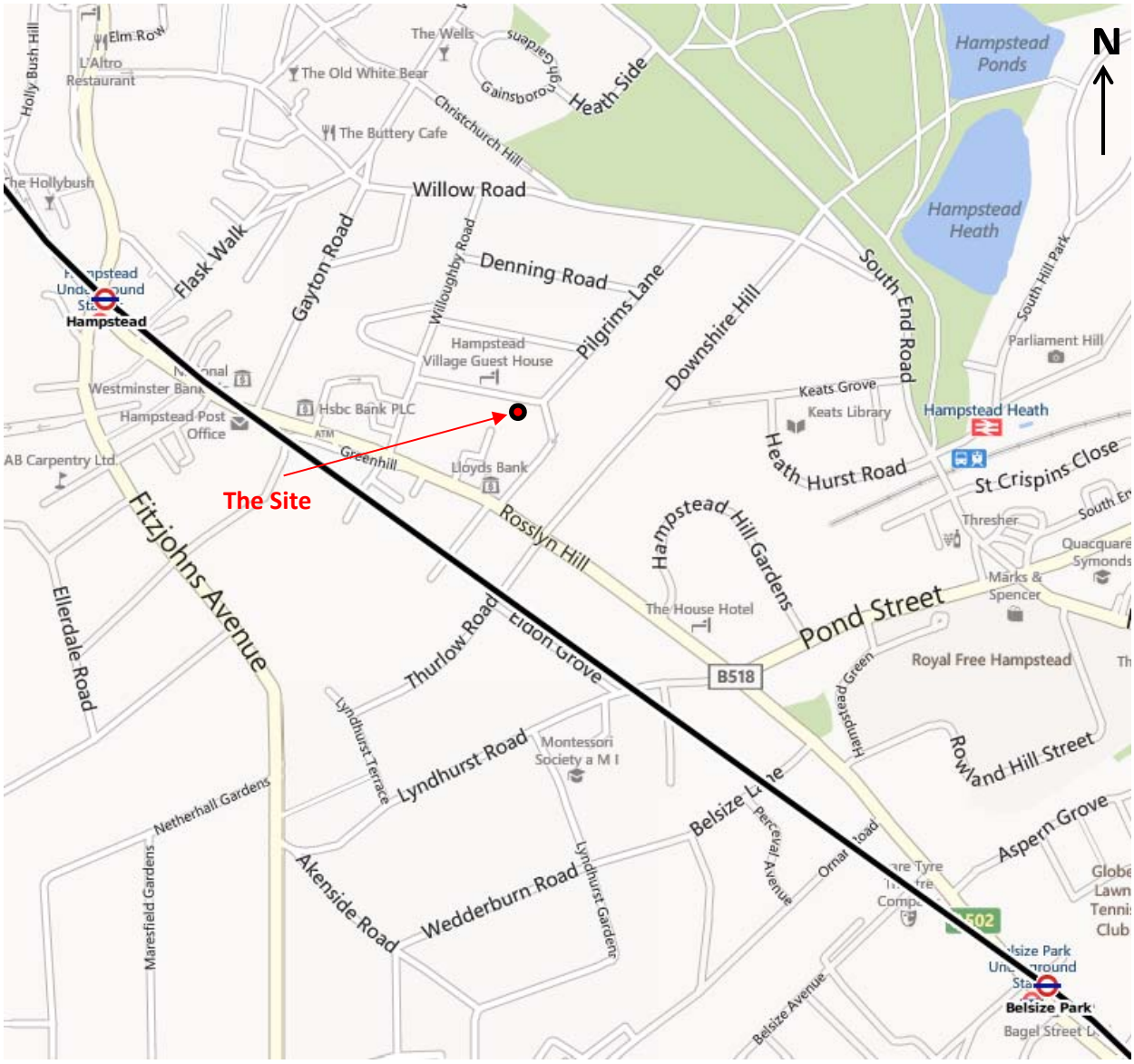
MRH, October 2013. *Desk study & Stage I Risk Assessment report*, 5 Kemplay Road, London NW3 1TA (Report No. 131410/DS)

NHBC, 2011. Chapter 4.2 *Building near trees*, National House Building Council.

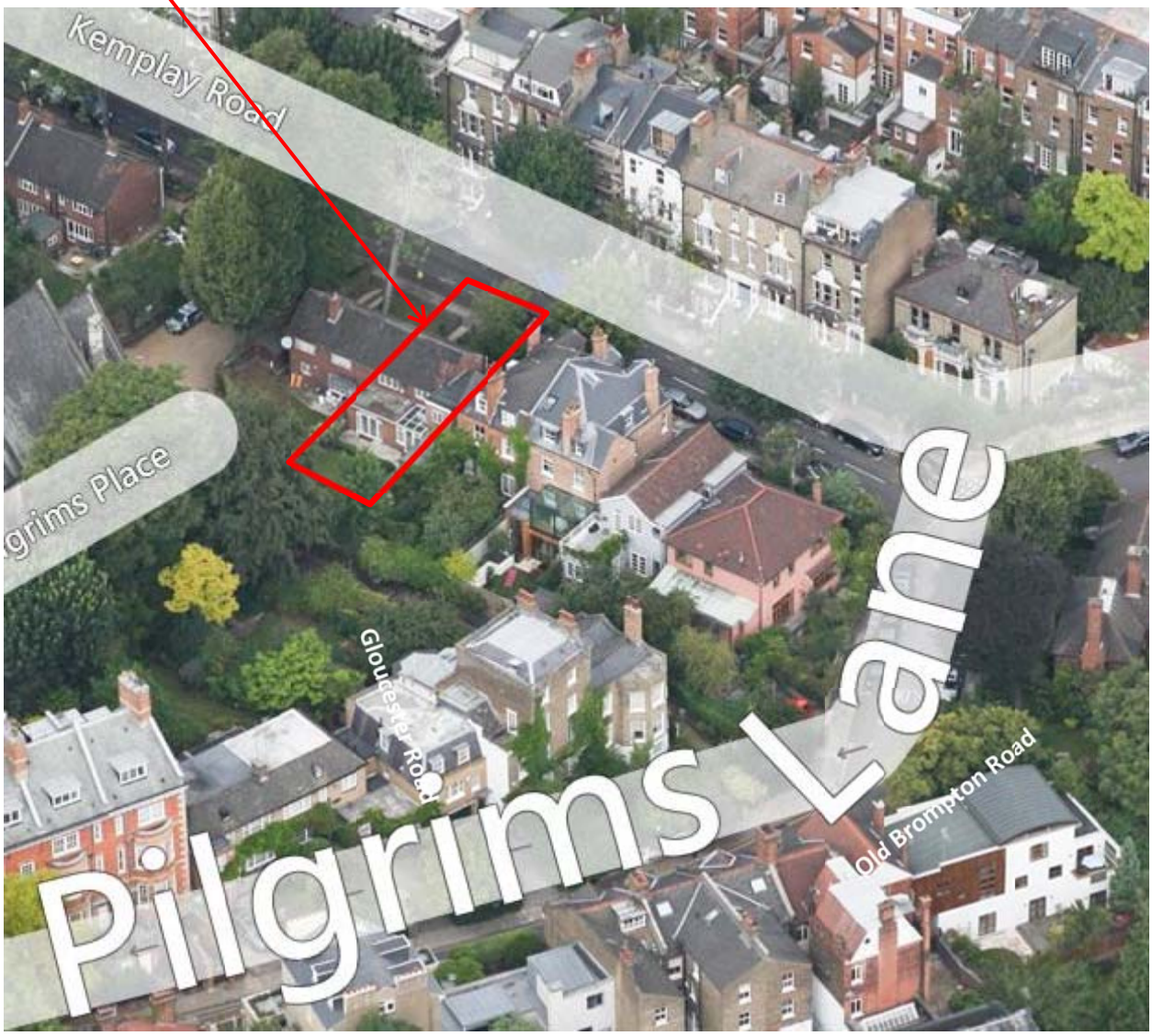
Trigram Partnership, Sept. 2013. *Existing ground floor plan and site layout*, 5 Kemplay Road, London NW3 1TA

Trigram Partnership, Nov. 2013. *Preliminary plan and section drawings of the proposed redevelopment, and borehole location plan*, 5 Kemplay Road, London NW3 1TA

FIGURES

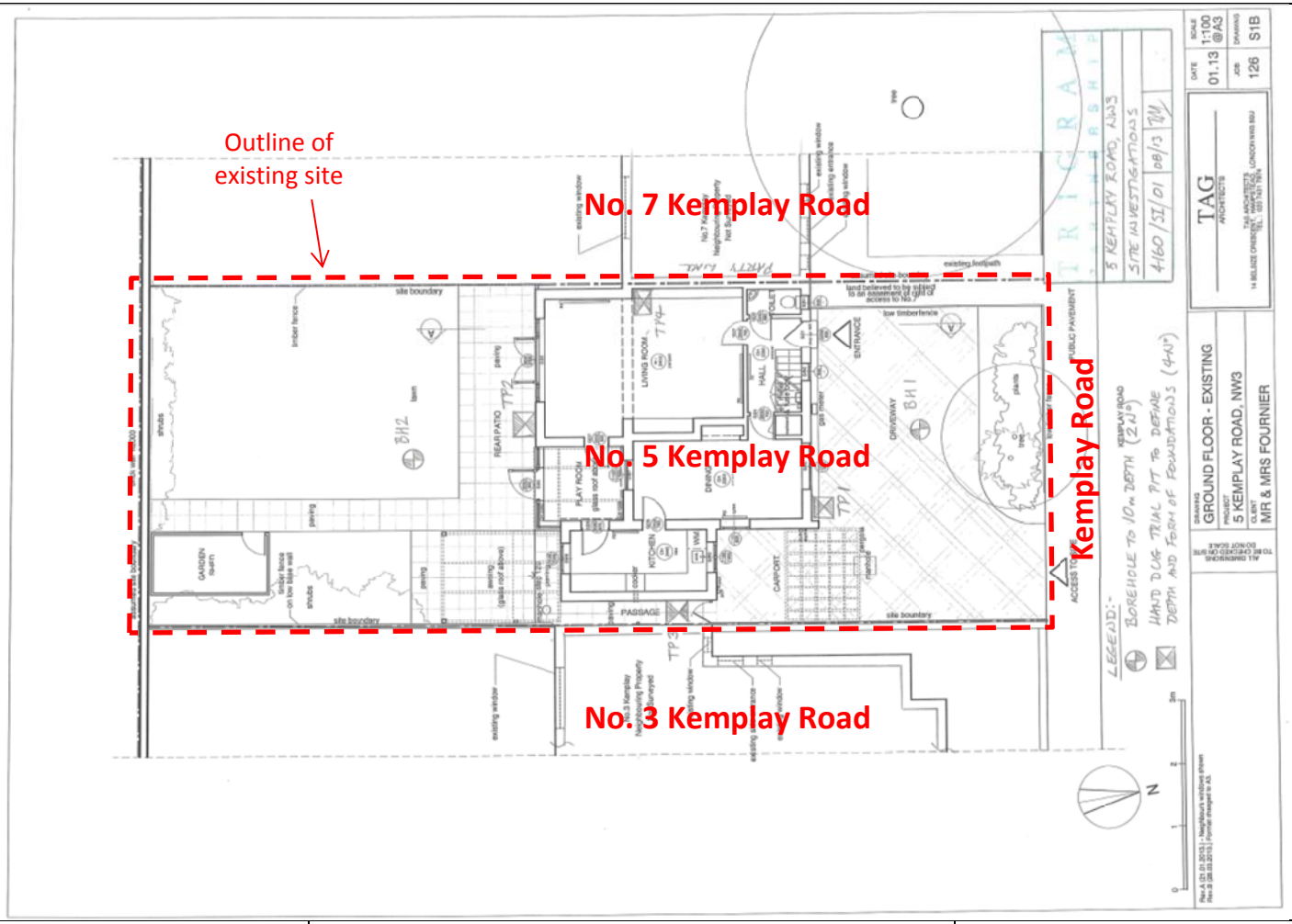


Geotechnical Consulting Group	Location of site – road map (Bing Maps)	Figure 1
5 Kemplay Road, London NW3 1TA		

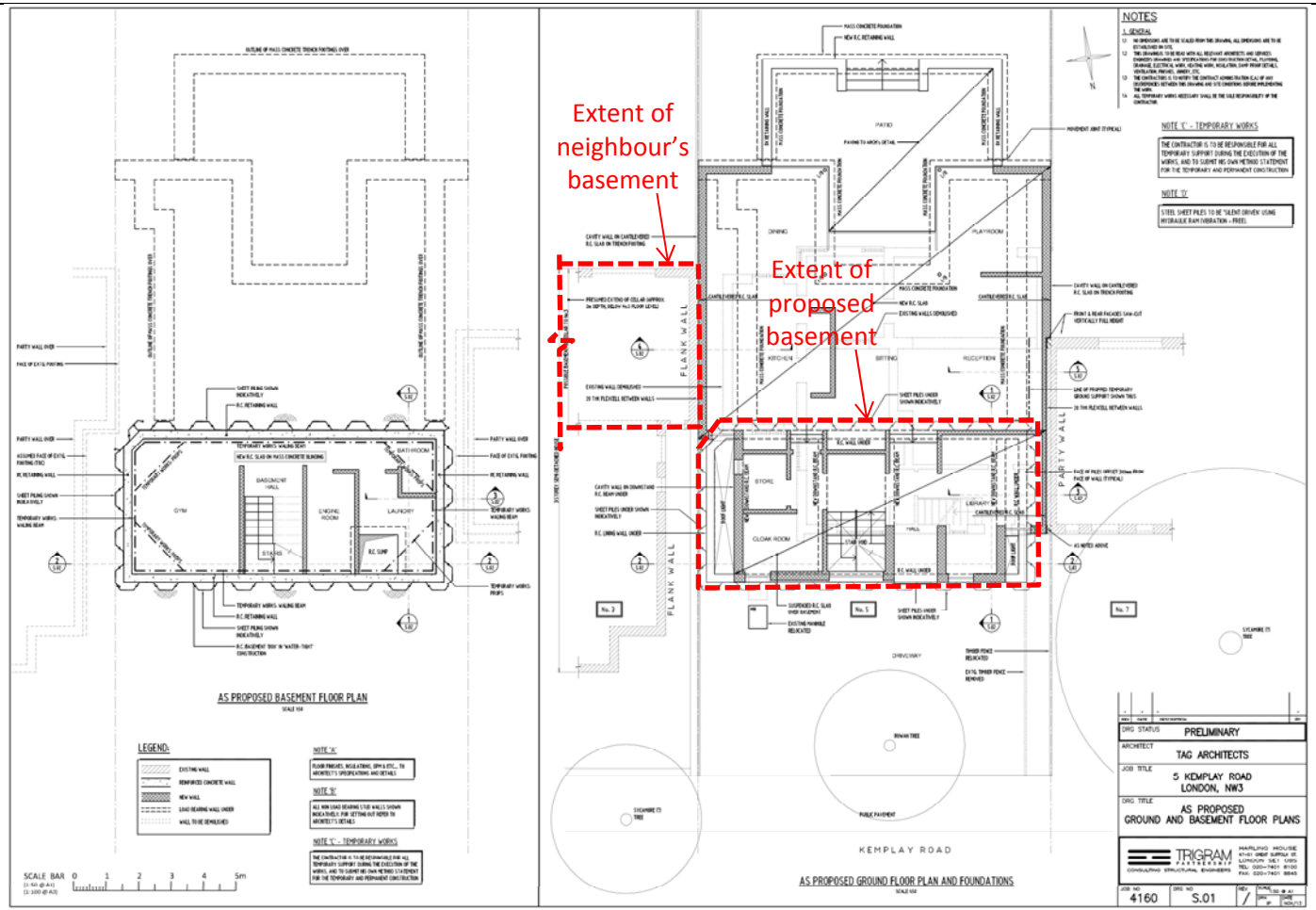


Geotechnical Consulting Group	Location of site – bird's eye view (Bing Maps)	Figure 2
5 Kemplay Road, London NW3 1TA		

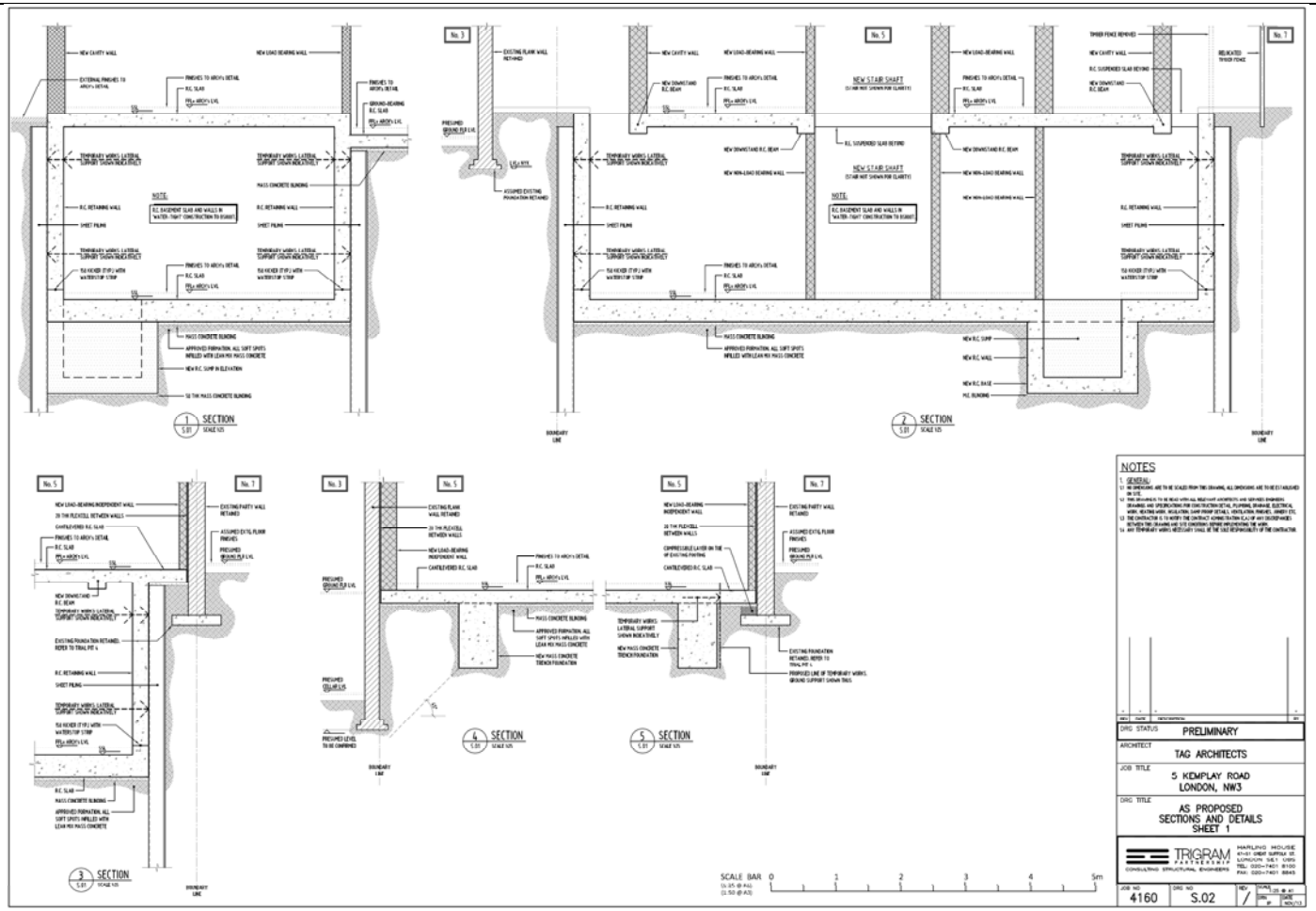
Geotechnical Consulting Group	5 Kemplay Road – street view (Google maps)	Figure 3
5 Kemplay Road, London NW3 1TA		



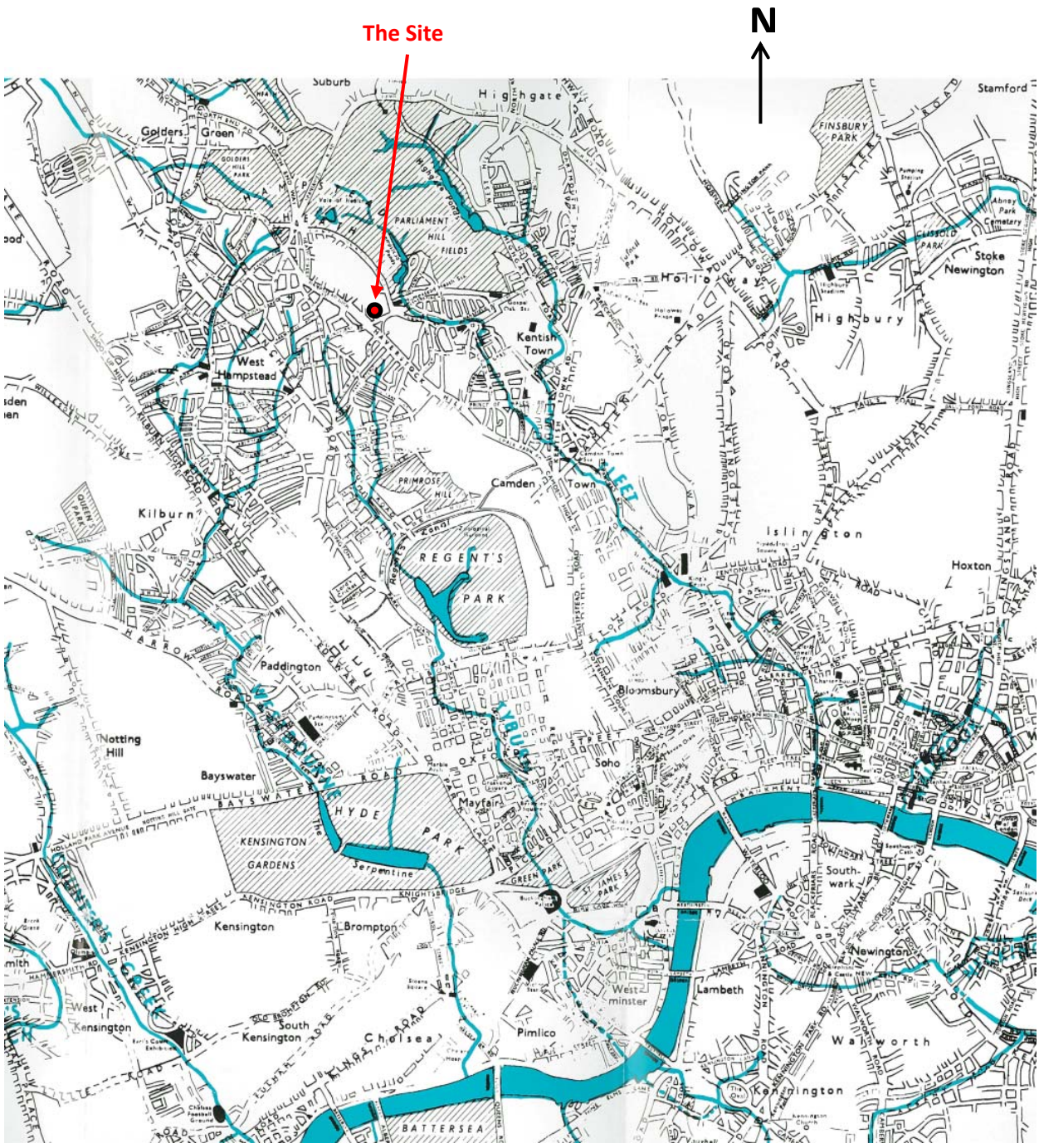
Geotechnical Consulting Group	Existing layout of the property (Trigram Partnership, Sept. 2013)	Figure 4
5 Kemplay Road, London NW3 1TA		



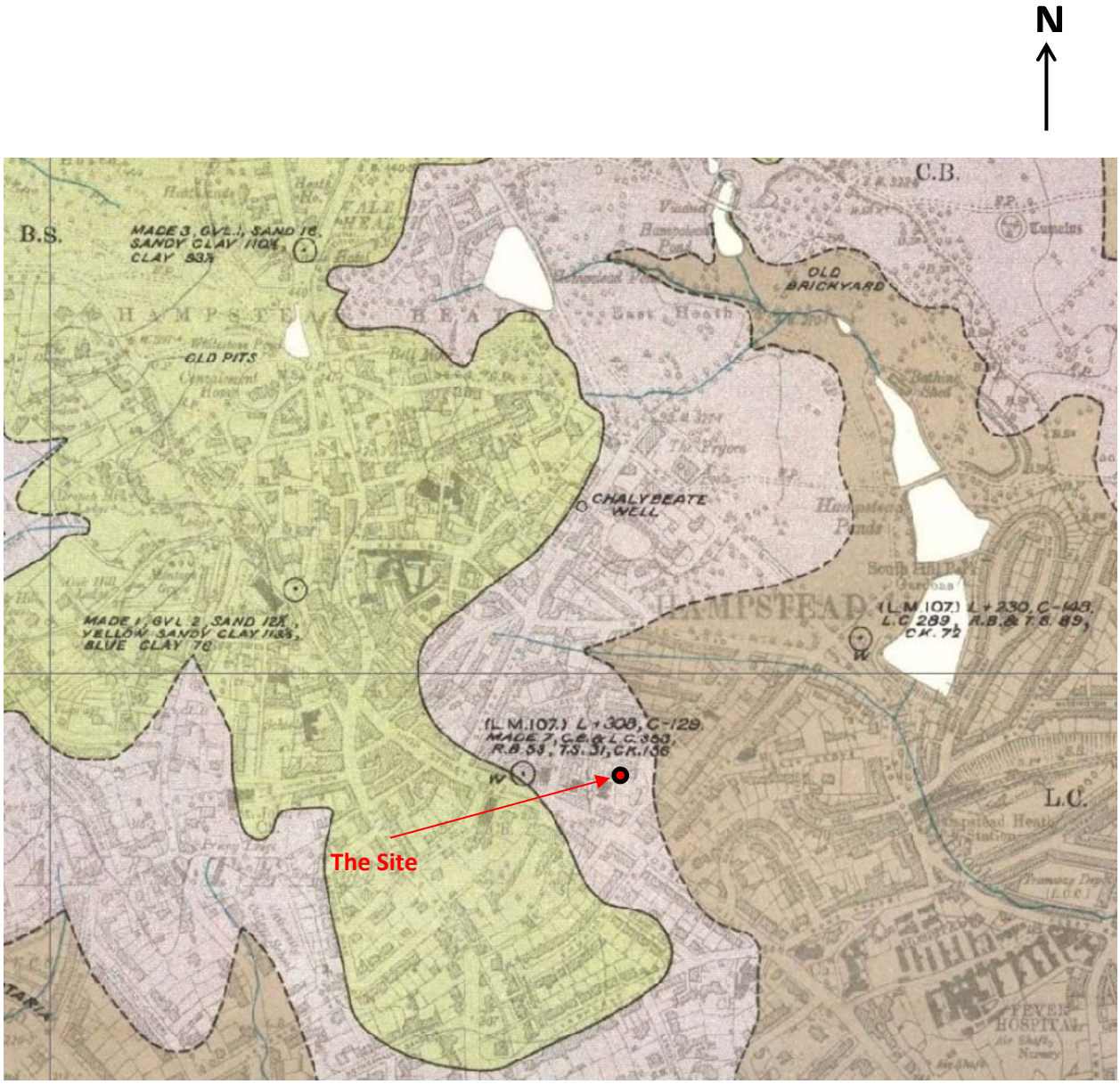
Geotechnical Consulting Group	Plans of proposed redevelopment at basement and ground floor level (Trigram Partnership, November 2013)	Figure 5
5 Kemplay Road, London NW3 1TA		



Geotechnical Consulting Group	Sections of proposed redevelopment detailing the foundations and basement (Trigram Partnership, November 2013)	Figure 6
5 Kemplay Road, London NW3 1TA		

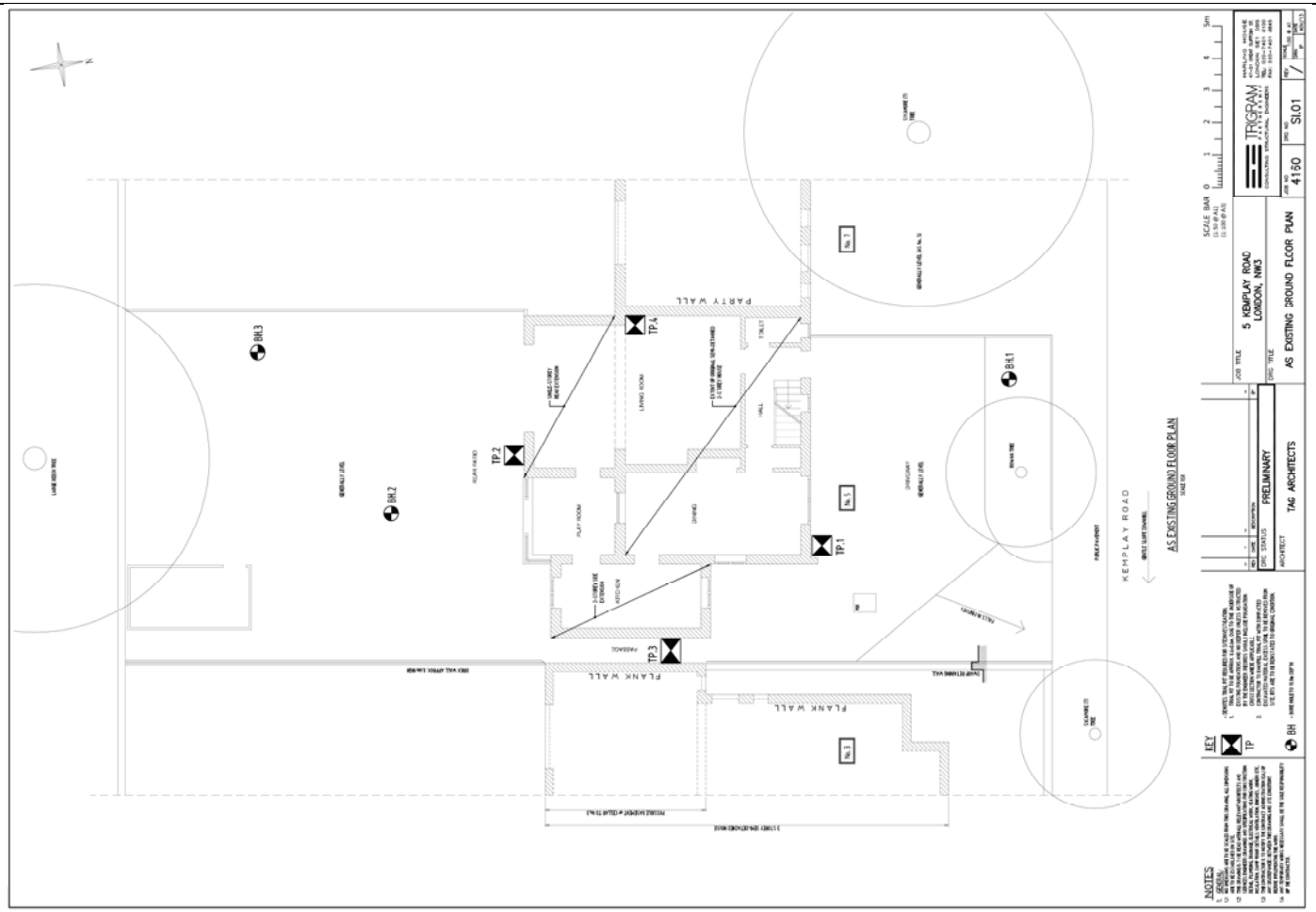


Geotechnical Consulting Group	Extract from The Lost Rivers of London Map (Barton, 1962)	Figure 7
5 Kemplay Road, London NW3 1TA		

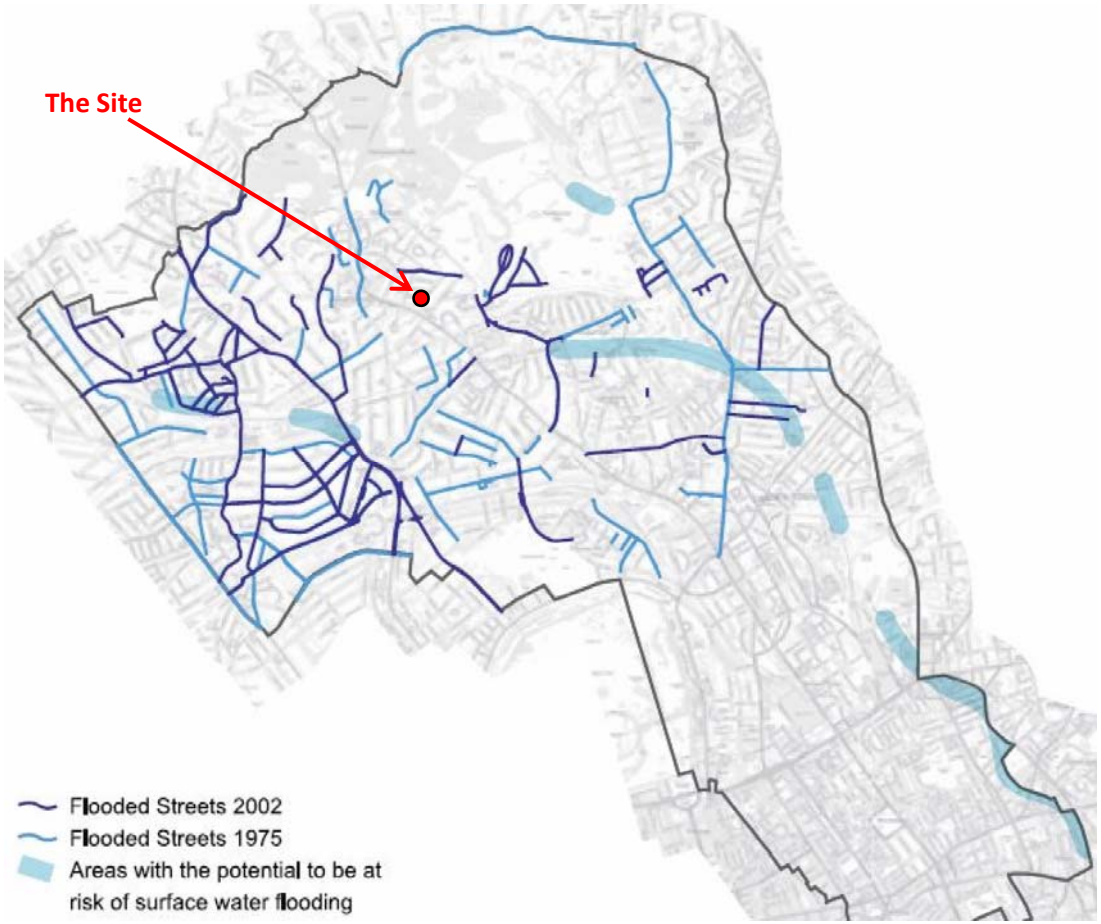


Geotechnical Consulting Group	1:10560 BGS Map Sheet NI S.E. (1920)	Figure 8
5 Kemplay Road, London NW3 1TA		

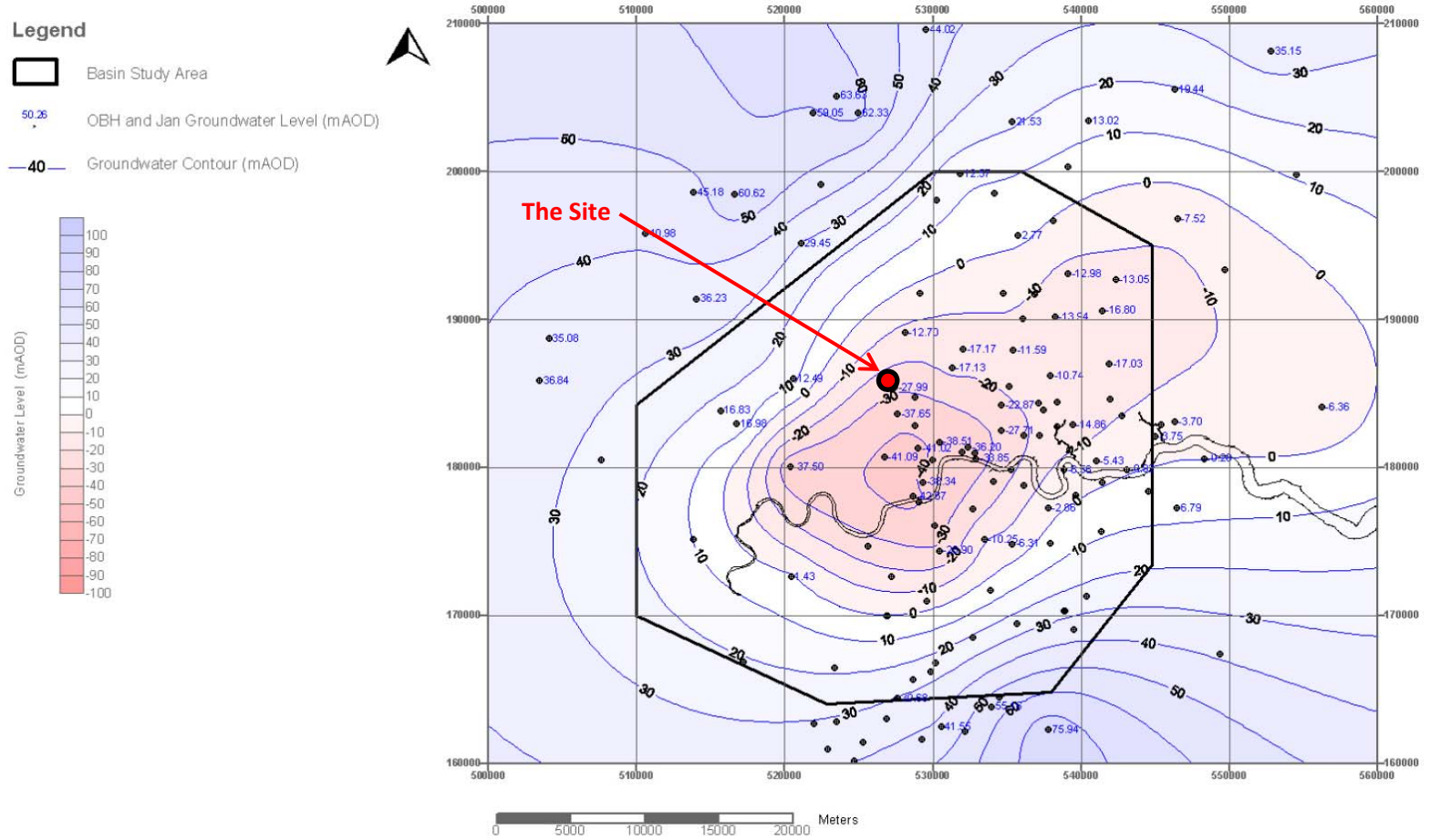
Geotechnical Consulting Group	Location of BGS Boreholes (http://mapapps.bgs.ac.uk/boreholescans/boreholescans.html)	Figure 9
5 Kemplay Road, London NW3 1TA		



Geotechnical Consulting Group	Exploratory holes location plan (Trigram Partnership, November 2013)	Figure 10
5 Kemplay Road, London NW3 1TA		



Geotechnical Consulting Group	Historical flooding and the areas with potential risk of surface water flooding (Arup, Nov. 2010, LBC guidance for subterranean development)	Figure 11
5 Kemplay Road, London NW3 1TA		



Geotechnical Consulting Group	Groundwater levels in the deep aquifer in 2012 (Environment Agency, 2012)	Figure 12
5 Kemplay Road, London NW3 1TA		