



Cranbrook Basements

6a North End, Camden
*Basement Impact Assessment –
Revision 1*




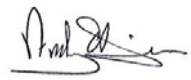
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Card Geotechnics Limited
4 Godalming Business Centre, Woolsack Way,
Godalming, Surrey, GU7 1XW
Telephone: 01483 310 600
www.cardgeotechnics.co.uk

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Authors	Andrew Brandon, Engineer <i>BEng (Hons) FGS</i> Adam Cadman, Senior Engineer <i>MSc BSc (Hons) FGS</i>		 		
Checked	Richard Ball, Principal Engineer <i>MSc BSc CEng MICE FGS</i>				
Approved	Andy O'Dea, Business Director <i>MSc BAI BA DIC CEnv MEnvSc FGS</i>				
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CONTENTS

1.	INTRODUCTION	4
2.	SITE CONTEXT	5
2.1	Site location	5
2.2	Site description	5
2.3	Proposed development	5
2.4	Site history	6
2.5	Topography	6
2.6	Published geology	6
2.7	Unpublished geology	7
2.7.1	BGS borehole records	7
2.7.2	Local ground investigations	8
2.8	Hydrogeology	11
2.9	Hydrology	12
2.10	Flood risk	12
3.	SCREENING (STAGE 1)	13
3.1	Introduction	13
3.2	Subterranean (Groundwater) flow	13
3.3	Slope/land stability	14
3.4	Surface flow and flooding	16
3.5	Conclusion	17
4.	SCOPING (STAGE 2)	19
4.1	Introduction	19
4.2	Existing Site Investigation	19
5.	GROUND AND GROUNDWATER CONDITIONS (STAGE 3)	20
5.1	Summary	20
5.2	Ground model	20
5.3	Geotechnical Parameters	21
5.4	Conceptual site model	22
5.4.1	Existing	22
5.4.2	Proposed	22
5.4.3	Critical sections	23
6.	SUBTERRANEAN (GROUNDWATER) FLOW (STAGE 4)	24
6.1	Introduction	24
6.2	Impact on groundwater flow	24
6.3	Recommendations for groundwater control	24
7.	LAND STABILITY (STAGE 4)	26
7.1	Introduction	26

7.2	Assumed construction sequence	26
7.3	Ground movements arising from basement excavation	27
7.3.1	Assessment of short-term heave/settlement	27
7.3.2	Assessment of long-term heave/settlement beneath basement slab	28
7.3.3	Settlement due to workmanship	28
7.4	Ground movement due to underpin wall deflection	29
7.4.1	General	29
7.4.2	Analysis	29
7.5	Damage Category Assessment	30
7.6	Construction monitoring	32
8.	SURFACE FLOW AND FLOODING (STAGE 4)	33
9.	NON-TECHNICAL SUMMARY	34
9.1	General	34
9.2	Cumulative impacts	34

FIGURES

- Figure 1 - Site location plan
- Figure 2 - Site layout plan
- Figure 3 - Conceptual Site Model
- Figure 4 - Short term (undrained) ground movement contour plot
- Figure 5 - Long term (drained) ground movement contour plot
- Figure 6 - Combined vertical ground movements for 6 North End
- Figure 7 - Building damage assessment plot for 6 & 8 North End

APPENDICES

- Appendix A - Proposed development and structural drawings
- Appendix B - Historical mapping
- Appendix C - BGS boreholes
- Appendix D - Chelmer Site Investigation - Factual report
- Appendix E - MRH Geotechnical - Borehole log
- Appendix F - CPG4 screening extracts
- Appendix G - Fastrack Geotechnical - borehole log
- Appendix H - Foundation inspection pit record
- Appendix I - WALLAP output

1. INTRODUCTION

Cranbrook Basements, acting on behalf of the landowner, is proposing to construct a single storey basement beneath the existing residential dwelling at 6A North End, London, NW3 7HL. Card Geotechnics Limited (CGL) has been instructed to undertake a Basement Impact Assessment (BIA) for the proposed development to assess the potential impact on surrounding structures and hydrological and hydrogeological features.

Camden Guidance CPG4¹ requires Basement Impact Assessments to be undertaken for new basements in the borough and sets out a 5 stage approach:

1. Screening
2. Scoping
3. Site investigation
4. Impact assessment
5. Review and decision making

This report is intended to address the screening, scoping and impact assessment processes set out in CPG4 and the Camden geological, hydrogeological, and hydrological study (CGHHS)². It identifies key issues relating to land stability, hydrogeology and hydrology as part of the screening process. A site investigation has already been carried out for Cranbrook Basements at the adjacent site “Hogarth House”. As such, the scoping process will form a review of this existing site investigation data (and other publically available ground investigation data in the immediate area) , an assessment of its suitability for use in the BIA and the establishment of a conceptual site model.

The report also provides an impact assessment of geoenvironmental and geotechnical impacts on adjacent structures and the surrounding area based on available site investigation data and structural details. This comprises an assessment of ground movements resulting from the basement excavation, including heave, underpin settlement and lateral movements around the basement perimeter.

¹ Camden Planning Guidance, CPG4, Basements and Lightwells, September 2013.

² Ove Arup and Partners, Camden geological, hydrogeological, and hydrological study. Guidance for subterranean development, November 2010.

2. SITE CONTEXT

2.1 Site location

The site is located at 6a North End, London, NW3 7HL, in the north of the London Borough of Camden and to the northwest of Hampstead Heath. The National Grid Reference for the approximate centre of the site is 526008, 186980. The site location is shown in Figure 1.

2.2 Site description

The site comprises a two-storey residential property with a garden adjacent to the western elevation and a garage in the northwest corner of the site, adjacent to the northern boundary of the garden. The property is effectively an apartment within the larger building that contains both 6a and 8 North End (6a North End shares party walls with neighbouring properties to the north, east and south). The first floor of 6a North End extends to the south, within the greater property, and is larger in plan than the existing ground floor. The northern party wall is shared with the L-shaped building *Hogarth House* (also known as 6 North End), which has a semi-detached garage attached to its eastern boundary. Planning permission has been granted for a new single storey basement beneath *Hogarth House*.

The eastern and southern party walls are shared with No. 8 North End and Pitt House (access via North End Avenue). The garage, located in the northwestern corner of the garden, shares its eastern party wall with another garage that is understood to belong to a neighbouring property.

The neighbouring property at No. 10 North End, some 11m northeast of the site, is understood to have a basement. Four houses with basements are currently being constructed 4 North End, adjacent to the western boundary of the site garden.

A site layout plan including the location of the surrounding buildings and associated basements is presented as Figure 2.

2.3 Proposed development

The proposed development is to comprise a single storey basement that will underlie the current footprint of 6a North End and extend out to the west, under the property garden. New lightwells will be formed at the eastern boundary of the garden, adjacent to the western elevation of the existing property.

Development drawings indicate the basement formation level will be approximately 4m below ground level (mbgl). The above ground structures are to be retained. It is understood that the existing foundations and party walls are to be underpinned.

Development plans and structural drawings provided by Cranbrook, showing the site in the existing and proposed condition, are included in Appendix A.

2.4 Site history

Ordnance Surveys maps dating back to 1870 have been reviewed to inform the BIA. The salient points are summarised below:

- Mapping from the 1870s indicates a building to have been present in the northern half of the site. The southern half of the site is shown to be undeveloped.
- Mapping from 1896 shows the site to be vacant.
- By 1915 the site is shown in its current plan, along with adjoining properties.

The historical maps are provided in Appendix B.

2.5 Topography

The site lies at an approximate elevation of 113mOD and is situated on a gentle northwards dipping hillside slope that peaks some 300m south-southeast of the site at around 130mOD. Hampstead Ponds are located approximately 1.3km to the southeast of the site at an approximate elevation of 75.0mOD. The area has a general slope of around 1:18 (5%), though this may steepen to 1:10 (10%) in areas and the site is near to the highest topographical point in the locale.

2.6 Published geology

With reference to the British Geological Survey (BGS) sheet³ for the local area, the site is shown to be underlain by the Bagshot Formation, which is in turn underlain by the Claygate Member over the London Clay Formation.

The Bagshot Formation generally comprises fine grained sand with thin clay horizons. The Claygate Member, which forms the upper unit of the London Clay Formation, is typically inter-bedded sands and clays. The Claygate Member is shown to outcrop approximately 250m to the northwest of the site, at an elevation of around 95mOD. Ground levels reduce

³ British Geological Survey Sheet 256 (1994) *North London – Solid and Drift Geology 1:50,000*

towards the north. Ground level at the site is approximately 113mOD and, as such, it is anticipated that the base of the Bagshot Formation may be present up to 18m below the site and in turn underlain by the Claygate Member.

The London Clay Formation is an over consolidated firm to very stiff, becoming hard with depth, fissured, blue to grey silty clay of low to very high plasticity. The upper and lower parts may contain silty or fine grained sand partings. It also contains within it, laminated structured, nodular claystone and rare sand partings. The London Clay Formation is anticipated to be present from around 60mOD.

BGS and Environment Agency (EA) records indicate that no worked ground or recorded landfill sites are present within 250m of the site.

2.7 Unpublished geology

2.7.1 BGS borehole records

Logs of historic boreholes are freely available from the British Geological Survey (BGS). Those within 200m of the site have been reviewed and are summarised in Table 1 below.

Relevant BGS borehole records and a location plan are provided in Appendix C.

Table 1. BGS Borehole Records with 200m.

Borehole Ref.	Distance from site	Direction	Ground level
TQ28NE423	10m	East	Unknown
TQ28NE424	10m	East	Unknown
TQ28NE257	35m	West	112.54mOD
TQ28NE258	55m	East	112.87mOD
TQ28NE20	75m	North	Unknown
TQ28NE256	100m	North	108.61mOD

The ground conditions encountered in the nearest borehole, TQ28NE423, are summarised in Table 2 below:

Table 2. Ground Conditions in borehole TQ28NE423.

Description	Depth to top of stratum (mbgl)	Thickness of stratum (m)
MADE GROUND. Concrete overlying grey brown clayey silty sand.	GL	0.80
Firm to stiff becoming stiff mottled brown, orange brown and light grey silty sandy CLAY with pockets and partings of orange brown silty fine sand. [BAGSHOT FORMATION]	0.80	4.40
Firm to stiff grey silty sandy CLAY with some partings and pockets of light brown silty fine sand. [CLAYGATE MEMBER]	5.20	4.80
Stiff grey silty sandy CLAY with some partings and pockets of light brown and beige silty fine sand. [CLAYGATE MEMBER]	10.00	3.70
Stiff dark grey brown fissured silty CLAY with occasional partings of light brown silty fine sand and scattered small gypsum crystals. [CLAYGATE MEMBER]	13.70	6.30

The ground conditions between BGS boreholes are relatively consistent with those described in Table 2.

2.7.2 Local ground investigations

Information on two ground investigations carried out adjacent to the site has been reviewed to inform the likely ground conditions underlying the 6a North End. Borehole locations are included in Figure 2 and the investigation reports are included in Appendices D and E.

2.7.2.1 Chelmer ground investigation

A ground investigation comprising a single hand augured borehole to a depth of 5.7m was completed by Chelmer Site Investigations⁴ in January 2012. The borehole was excavated in the garden of *Hogarth House*, immediately to the northeast of that building. The works comprised in-situ testing using either a hand shear vane or a Mackintosh dynamic probe at metre intervals. The full report is provided in Appendix D.

The investigation revealed the following ground conditions:

⁴ Chelmer Site Investigations (October 2011) *A factual report on the site investigation undertaken for Cranbrook Basements at 4 Hampstead Square*. CSI Ref: 2829

Table 3. Summary of ground conditions from Chelmer Site Investigation.

Strata description	Depth to top of strata (mbgl)	Thickness of strata (m)
TOPSOIL (Driller's description)	0.00	0.30
(MADE GROUND) Comprising medium compact mid brown silty very sandy gravelly clay with numerous brick and concrete fragments.	0.30	0.60
Stiff mid brown/orange silty very sandy CLAY. [BAGSHOT FORMATION]	0.90	2.30
Stiff mid brown grey veined silty CLAY with partings of orange and brown silt and fine sand and crystals (sic). [BAGSHOT FORMATION]	3.20	0.60
Dense mid brown orange silty fine SAND. [BAGSHOT FORMATION]	3.80	0.90
Stiff/medium dense to dense mid brown orange laminated CLAY, SILT and fine SAND. [BAGSHOT FORMATION]	4.70	0.60
Medium dense mid brown slightly clayey very silty fine SAND. [BAGSHOT FORMATION]	5.30	Proven to 5.70

Water seepage was noted at a depth of 5.40mbgl, within the Bagshot Formation. There was no standpipe installation and, therefore, no further water level monitoring was undertaken.

2.7.2.2 MRH Geotechnical ground investigation

A ground investigation comprising three boreholes and a trial pit was carried out at the adjacent site 4 North End in January 2011. The nearest borehole to 6a North End was borehole BH2, drilled close to the garden wall the forms the western boundary of 6a North End.

The works included the measurement of SPT N values and in-situ undrained shear strength. A copy of borehole BH2 is provided in Appendix E.

A summary of the ground conditions is presented in Table 8 below.

Table 4. Summary of ground conditions from BH2 of MRH Geotechnical investigation

Strata description	Depth to top of strata (mbgl)	Thickness of strata (m)
TOPSOIL /FILL.	0.0	0.35
Soft to firm brown sandy CLAY. [BAGSHOT FORMATION]	1.4	1.05
Firm brown sandy CLAY. [BAGSHOT FORMATION]	2.7	1.3
Medium dense clayey fine SAND. [BAGSHOT FORMATION]	3.3	0.6
Medium dense orange brown SILT. [BAGSHOT FORMATION]	3.6	0.3
Medium dense orange brown clayey fine SAND with lenses of clay. [BAGSHOT FORMATION]	4.2	0.6
Medium dense brown SILT. [BAGSHOT FORMATION]	4.6	0.4
Firm dark grey silty CLAY. [POSSIBLE CLAYGATE MEMBER]	7.7	3.1

Within BH2, water seepage was noted from 5.1mbgl, within the Bagshot Formation. A piezometer was installed in this borehole and recorded standing water at 6.32mbgl (upon completion of the borehole).

Most recent monitoring of the groundwater at 4 North End (2012) indicates a standing level of 108.32mOD, some 5.3mbgl.

Reference has been made to the hydrogeological report⁶ for *Hogarth House*. The report indicates that groundwater is likely to be present at around 110 to 109mOD and that, assuming ground level is around 113.5mOD, the proposed basement could potentially intercept groundwater level. However, the report goes on to detail that, given the nature of the ground and the depth of the proposed basement, this is unlikely to create a significant barrier to local or regional groundwater movement.

2.8 Hydrogeology

The Environment Agency⁵ (EA) has produced an aquifer designation system consistent with the requirements of the Water Framework Directive. The Bagshot Formation is classed as a 'Secondary A' aquifer. These aquifers comprise permeable layers capable of supporting water supplies at a local scale and in some cases forming a source of base flow for rivers.

The BGS borehole records TQ28NE423 and TQ28NE424, located approximately 10m to the east of the site, indicate groundwater seepages to have been encountered at depths of 5.10mbgl and 5.80mbgl, respectively. This corresponds to the boundary between the Bagshot Formation and Claygate Member, at an approximate elevation of 108.0mOD in these boreholes. Similar depths of groundwater were encountered in the additional BGS borehole records referenced in Table 1.

In the general area of the site, the high ground of Hampstead Heath is comprised of the predominantly granular Bagshot Beds. This stratum rests above the relatively impermeable Claygate Member and London Clay Formation. As such, rainwater percolates through the Bagshot Formation and becomes perched above the impermeable clays where it then travels downhill, forming springs around the base of Hampstead Heath.

A hydrogeological review⁶ has been carried out at the adjacent site *Hogarth House*. Salient points from this report are outlined below.

- The base of the Bagshot Formation is shown on geological mapping to dip to the north, suggesting groundwater is likely following topography at the site and flowing to the north.
- No ancient rivers are located directly under the site.
- Numerous spring lines surround the site but none within 100m.

The site is not within a groundwater source protection zone.

It is considered from the available local ground investigation information that groundwater seepage may occur from 5mbgl and, given the maximum basement excavation proposed is 4mbgl, only limited seepage might be encountered during basement construction.

⁵ <http://www.environment-agency.gov.uk/wiyby> (accessed 26th November 2013)

⁶ Geotechnical Consulting Group (2012). *Hogarth House, North End, London. Hydrogeological Review*. January 2012.

2.9 Hydrology

The nearest recorded surface water feature is located some 190m to the southwest of the site and is denoted on Ordnance Survey mapping as a *Pond* within the grounds of the *The Hill* Garden and *Pergola*.

A number of springs are shown to surround the site, although none within 250m of the site. The nearest spring is located some 350m northeast of the site. A number of spring networks feed into ponds, which are common in the local area. This network then feeds into watercourses including the River Westbourne, Brent, Tyburn and Fleet, most of which are now diverted underground. The closest pond is located approximately 330m to the west of the site.

With reference to Figure 14 of the Arup *Hampstead Heath Surface Water Catchments and Drainage of the Camden Geological, Hydrogeological and Hydrological report*², it can be seen that the site is not within the catchment of pond chains located on Hampstead Heath.

2.10 Flood risk

The site is not within an Environment Agency Flood Risk Zone. Furthermore, reference to Figure 15 (Flood Map) of the Arup CGHHS report² confirms the road adjacent to the site was not flooded during the flooding events of 1975 and 2002.

3. SCREENING (STAGE 1)

3.1 Introduction

A screening process has been adopted in accordance with CPG4, based on the flowcharts presented in that document. These are included in Appendix F for ease of reference. Responses to the questions posed by the flowcharts are presented below, and where ‘yes’ or ‘unknown’ may be simply answered with no analysis required, these answers have been provided.

3.2 Subterranean (Groundwater) flow

This section answers questions posed by Figure 1 in CPG4:

Table 5. Responses to Figure 1, CPG4 (see Appendix F).

Question	Response	Action required
1a. Is the site located directly above an aquifer?	Yes. The site is located above a Secondary A Aquifer (Bagshot Formation).	Investigation and assessment
1b. Will the proposed basement extend beneath the water table surface?	Not anticipated. BGS borehole records indicate that groundwater should be encountered approximately 1m below the proposed basement formation level. Some slight groundwater seepages may be encountered during excavations and underpinning depending on season and rainfall levels.	Confirm by investigation and assessment
2. Is the site within 100m of a watercourse, well or potential spring line?	No. The nearest surface water feature is located approximately 200m to the southwest of the site.	None
3. Is the site within the catchment of the pond chains on Hampstead Heath?	No. The site is not within the catchment of the chain ponds on Hampstead Heath.	None
4. Will the proposed basement development result in a change in the proportion of hard surfaced/paved areas?	No. The majority of the garden is understood to be paved, restricting infiltration. As such, the proposed basement with overlying garden will not change the current infiltration regime.	None
5. As part of site drainage, will more surface water than at present be discharged to 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 the existing condition.	None

Question	Response	Action required
6. Is the lowest point of the proposed excavation close to, or lower than, the mean water level in any local pond or spring lines?	No. The nearest surface water feature is at a significantly lower elevation than the lowest point of the proposed excavation.	None

In summary, it is considered unlikely that the basement excavation will encounter any more than slight groundwater seepages.

It is considered that the basement excavation will not affect any surface water feature, including the pond chains on Hampstead Heath, and that no additional run-off or water discharge to ground will be created by this development.

There are a number of existing and proposed basements at the neighbouring properties of No. 4, 6 and 10 North End. The combined effect of these basements on the local groundwater regime will need to be assessed.

3.3 Slope/land stability

This section answers questions posed by Figure 2 in CPG4.

Table 6. Responses to Figure 2, CPG4 (See Appendix F).

Question	Response	Action required
1. Does the site include slopes, natural or man made, greater than approximately 1:8?	No. Slopes are generally 1:18 with no greater than 1:10 locally.	None
2. Will the proposed re-profiling of the landscaping at site change slopes at the property boundary to greater than approximately 1:8?	No. No re-profiling or landscaping of significance is planned.	None
3. Does the development neighbour land including railway cuttings and the like with a slope greater than approximately 1:8?	No There are no significant artificial cuttings or embankments in the area.	None
4. Is the site within a wider hillside setting in which the general slope is greater than approximately 1:8?	No. Slopes are generally 1:18 with no greater than 1:10 locally.	None
5. Is the London Clay the shallowest stratum on site?	No. The Bagshot Formation is the shallowest stratum on site.	None

Question	Response	Action required
6. Will any trees be felled as part of the proposed development and/or are any works proposed within any tree protection zones where trees are to be retained?	No. No trees are present in the existing garden.	None
7. Is there a history of seasonal shrink-swell subsidence in the local area and/or evidence of such at the site?	No. Shrink/swell movements are considered unlikely due to the expected granular or low shrinkability cohesive deposits.	None
8. Is the site within 100m of a watercourse or a potential spring line?	No. The nearest surface water feature is located approximately 200m to the southwest of the site.	None
9. Is the site within an area of previously worked ground?	No. No known areas of worked ground are present and no significant Made Ground was encountered in BGS borehole records.	None
10. Is the site within an aquifer and if so will the proposed basement extend beneath the water table such that dewatering may be required during construction?	Yes. The site is located above a Secondary A Aquifer (Bagshot Formation). BGS borehole records indicate that groundwater should be encountered approximately 1m below the proposed basement level. Some slight groundwater seepages may be encountered during excavations and underpinning depending on season and rainfall levels. Running sands may be present if groundwater seepages are encountered within sand deposits.	Investigation and assessment
11. Is the site within 50m of the Hampstead Heath ponds?	No. The nearest pond is located some 330m to the west of the site.	None
12. Is the site within 5m of a highway or pedestrian right of way?	No. The site is located further than 5m from the nearest highway or pedestrian right of way (North End).	None
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Yes. The basement will increase the depth of foundations relative to the adjacent property (Hogarth House) to the north, two semi-detached domestic garages to the north and to 8 North End to the south. However, a single storey basement is proposed for Hogarth House and, as such, the proposed basement will not increase the differential depth of foundations with respect to this property.	Investigation and assessment
14. Is the site over (or within the exclusion zone of) any tunnels?	No. None present.	None

In summary, it is considered unlikely that the basement excavation will encounter any more than slight groundwater seepages, though this may result in running sands if encountered within sand deposits.

A number of basements are known to exist or be proposed in the immediate vicinity of 6a North End. The proposed basement excavation will increase the depth of foundations relative to the adjacent property Hogarth House, to the north of the site. However, it is understood that a basement is to be constructed under Hogarth House, thus negating any potential differential foundation depth with this one property. 10 North End is understood to have an existing single storey basement, indicating the proposed basement will not cause differential foundation depth with that property either.

It is understood 8 North End, and the garages associated with 6a North End and *Hogarth House*, do not have basements and that the proposed basement excavation will increase the differential foundation depth relative to these buildings. It is noted that the garage of No. 6a will have been underpinned during the redevelopment of No. 4 North End to the west. An assessment is required to investigate the impact of ground movements resulting from underpin retaining wall deflections and long term structural loading through perimeter walls, particularly the southern, eastern and western perimeter walls where these are shared with neighbouring properties.

3.4 Surface flow and flooding

This section covers the main surface flow and flooding issues as set out in CPG4, however detailed design of the site drainage will be completed by other parties.

Table 7. Responses to Figure 3, CPG4 (See Appendix F).

Question	Response	Action required
1. Is the site within the catchment of the pond chains on Hampstead Heath?	No. The site is not within the catchment of the chain ponds on Hampstead Heath.	None
2. As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off), be materially changed from the existing route?	No It is understood all surface water will be discharged to the sewer network through existing connections.	None
3. Will the proposed development result in a change in the proportion of hard surfaced/paved external areas?	No. The majority of the garden is understood to be paved, restricting infiltration. As such, the proposed basement with overlying garden will not change the current infiltration regime.	None

Question	Response	Action required
4. Will the proposed basement result in a change to the profile of the inflows of surface water being received by adjacent properties or downstream watercourses?	No. The proposed basement will not alter present surface water conditions.	None
5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No. The proposed basement will not alter present surface water conditions.	None
6. Is the site in an area known to be at risk from surface flooding, or is it at risk from flooding because the proposed basement is below the static water level of a nearby surface water feature?	No The site is not in a Flood Risk Zone, identified as a street that flooded in 1975 and 2002 and not within close proximity to any significant surface water feature.	None

In summary, the proposed basement will not alter present surface water conditions as no additional hardstanding or paved surfaces will be created and no existing surface water routes will be altered. The site is not within a Flood Risk Zone.

3.5 Conclusion

On the basis of this screening exercise, the basement impact assessment will address the following:

Table 8. Summary of Basement Impact Assessment requirements.

Item	Description
1.	<i>Subterranean (Groundwater flow)</i> The impact of the basement on groundwater flow regime and implications for construction.
2.	Short term and long term groundwater control methods and establishment of Design Groundwater Levels for retaining wall design in accordance with BS8102.
3.	<i>Slope stability</i> Movements associated with construction in the Bagshot Formation including foundation settlements and ground movements around the basement perimeter resulting retaining wall deflections.
4.	Impact assessment on adjacent residential properties and infrastructure.
5.	<i>Surface flow and flooding</i> Proposed basement will not notably impact on surface water or materially change infiltration to the ground.