Ground Investigation and Basement Impact Assessment Report

9 Ellerdale Road
London NW3 6BA

Client	Mrs Y Jing
Engineer	Price & Myers

J14075

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GEA Geotechnical & Environmental Associates

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EXECUTIVE SUMMARY

This executive summary contains an overview of the key findings and conclusions. No reliance should be placed on any part of the executive summary until the whole of the report has been read. Other sections of the report may contain information that puts into context the findings that are summarised in the executive summary.

BRIEF

This report describes the preliminary findings of a site investigation carried out by Geotechnical and Environmental Associates Limited (GEA) on the instructions of Price & Myers, on behalf of Mrs Y Jing, with respect to deepening of the existing single level basement beneath the southeastern half of the house and extension of the basement to occupy parts of the southern and western garden areas. The purpose of the investigation has been to research the history of the site with respect to possible contaminative uses, to determine the ground and hydrogeological conditions, to assess the extent of any contamination and to provide information to assist with the design of the basement and suitable foundations for the proposed development. The report also includes a Basement Impact Assessment in accordance with guidelines from London Borough of Camden in support of a planning application.

SITE HISTORY

The earliest map studied, dated 1879, shows the site to be undeveloped and occupied by fields which apparently belonged to Mount Farm, the farm buildings of which were located to the northeast of the site. By the time of the next map, dated 1896, the site was apparently occupied by the existing building at the centre of the site, with a smaller building present in the north of the site. Also at this time Ellerdale Road and Prince Arthur Road bounded the site to the west and southeast respectively, with a number of what is assumed to be residential dwellings then present. The site has remained essentially unchanged from the latest map, dated 1995, to the present day.

GROUND CONDITIONS

Below a nominal thickness of made ground, the Claygate Member was present to the full depth investigated of 10.45 m (89.59 m OD). The made ground in the southern garden area generally comprised yellow-brown and grey slightly silty sand with gravel, brick fragments, pockets of sand, ash, organic material and rootlets and extended to depths of between 0.80 m and 1.00 m in Borehole Nos 2 and 1 respectively. In the lower northern garden area, made ground comprised very dark brown and blackish gravelly sandy clay with brick, concrete and occasional coal fragments and extended to a depth of 0.80 m in Borehole No 4, while Borehole No 3 terminated on concrete at a depth of 1.0 m. The underlying Claygate Member comprised both pale greyish brown slightly clayey silty fine sand with partings of orange-brown silty sand and firm very silty sandy clay interbedded with firm greenish brown, orange-brown and pale grey silty very sandy clay with frequent partings of orange-brown and greenish brown fine silty sand and was encountered to the full depth investigated of 10.45 m (89.59 m OD).

RECOMMENDATIONS

The proposed basement will extend to a depth of approximately 3 m, about 96.7 m OD and formation level should therefore be within the Claygate Member. It may be possible to adopt spread foundations constructed from basement level. The groundwater level has been monitored at below the level of proposed basement, although the investigation has indicated that seepages of groundwater may be encountered at more shallow depths during basement construction and shallow inflows of perched water may also be encountered from within the made ground, particularly within the vicinity of existing foundations. In any case it would be prudent to continue the monitoring of standpipes to confirm this view. It would also be prudent to carry out a number of trial excavations, to depths as close to the full basement depth as possible, to provide an indication of the likely groundwater conditions.

Excavations for the proposed basement structure will require temporary support to maintain the stability of the excavation and surrounding structures at all times. It may be possible to support the basement excavation in the temporary condition using underpins or sheet piles; a bored pile wall may however be more appropriate in order to limit noise and vibrations.

The findings of the Basement Impact Assessment indicate that the proposed development is unlikely to result in any specific land or slope stability issues, groundwater or surface water issues, although a detailed analysis of ground movements may be required in due course.

Part 1: INVESTIGATION REPORT

This section of the report details the objectives of the investigation, the work that has been carried out to meet these objectives and the results of the investigation. Interpretation of the findings is presented in Part 2.

1.0 INTRODUCTION

Geotechnical and Environmental Associates Limited (GEA) has been commissioned by Price & Myers, on behalf of Mrs Y Jing, to carry out a desk study and ground investigation at 9 Ellerdale Road, London, NW3 6BA. This report also forms part of a Basement Impact Assessment (BIA), which has been carried out in accordance with guidelines from the London Borough of Camden (LBC) in support of a planning application. A contamination assessment did not form part of this report.

1.1 Proposed Development

It is understood that it is proposed to deepen the existing single level basement beneath the southeastern half of the house to 3 m depth, to a level of about 96.7 m OD and the footprint of the basement will also be extended to occupy the majority of the southern and western garden areas, as well as extending the northeastern corner adjacent to the existing double garage.

This report is specific to the proposed development and the advice herein should be reviewed once the development proposals are finalised.

1.2 Purpose of Work

The principal technical objectives of the work carried out were as follows:

- to check the history of the site with respect to previous contaminative uses;
- to determine the ground conditions and their engineering properties;
- to investigate the configuration of existing foundations;
- to assess the possible impact of the proposed development on the local hydrogeology; and
- to provide advice with respect to the design of suitable foundations and retaining walls.

1.3 Scope of Work

In order to meet the above objectives, a desk study was carried out followed by a ground investigation. The desk study comprised:

- a review of available historic Ordnance Survey (OS) maps;
- a review of readily available geology maps; and
- a walkover survey of the site carried out in conjunction with the fieldwork.

In the light of this desk study an intrusive ground investigation was carried out which comprised, in summary, the following activities:

- two boreholes advanced to a depth of 10.00 m by means of an opendrive percussive sampler;
- two window sampler boreholes, advanced to depths of 1.00 m and 4.00 m;
- installation of three groundwater monitoring standpipes within the boreholes to depths of between 4.00 m and 10.00 m;
- standard penetration tests (SPTs), carried out at regular intervals in the opendrive boreholes, to provide additional quantitative data on the strength of the soils;
- testing of selected soil samples for geotechnical purposes; and
- provision of a report presenting and interpreting the above data, together with our advice and recommendations with respect to the proposed development.

1.3.1 Basement Impact Assessment

The work carried out also includes a Hydrological and Hydrogeological Assessment and Land Stability Assessment (also referred to as Slope Stability Assessment), all of which form part of the BIA procedure specified in the London Borough of Camden (LBC) Planning Guidance CPG4[1] and their Guidance for Subterranean Development[2] prepared by Arup. The aim of the work is to provide information on land stability and groundwater and in particular to assess whether the development will affect the stability of neighbouring properties or groundwater movements and whether any identified impacts can be appropriately mitigated by the design of the development.

1.3.2 Qualifications

The work carried out also includes a Hydrological and Hydrogeological Assessment and Land Stability Assessment (also referred to as Slope Stability Assessment), all of which form part of the BIA procedure specified in the London Borough of Camden (LBC) Planning Guidance CPG4[3] and their Guidance for Subterranean Development[4] prepared by Arup. The aim of the work is to provide information on land stability and in particular to assess whether the development will affect the stability of neighbouring properties and whether any identified impacts can be appropriately mitigated by the design of the development.

The land stability element of the Basement Impact Assessment (BIA) has been carried out by Martin Cooper, a BEng in Civil Engineering, a chartered engineer (CEng), member of the Institution of Civil Engineers (MICE), and Fellow of the Geological Society (FGS) who has over 20 years specialist experience in ground engineering. The subterranean (groundwater) flow assessment has been carried out by John Evans, MSc in Hydrogeology, Chartered Geologist (CGeol) and Fellow of the Geological Society of London (FGS). The assessments have been made in conjunction with Steve Branch, a BSc in Engineering Geology and Geotechnics, MSc in Geotechnical Engineering, a chartered geologist (CGeol) and Fellow of

1 London Borough of Camden Planning Guidance CPG4 *Basements and lightwells*
2 Ove Arup & Partners (2010) *Camden geological, hydrogeological and hydrological study. Guidance for Subterranean Development.* For London Borough of Camden November 2010
3 London Borough of Camden Planning Guidance CPG4 *Basements and lightwells*
4 Ove Arup & Partners (2010) *Camden geological, hydrogeological and hydrological study. Guidance for Subterranean Development.* For London Borough of Camden November 2010

the Geological Society (FGS) with 25 years' experience in geotechnical engineering and engineering geology. All assessors meet the Geotechnical Adviser criteria of the Site Investigation Steering Group and satisfy the qualification requirements of the Council guidance.

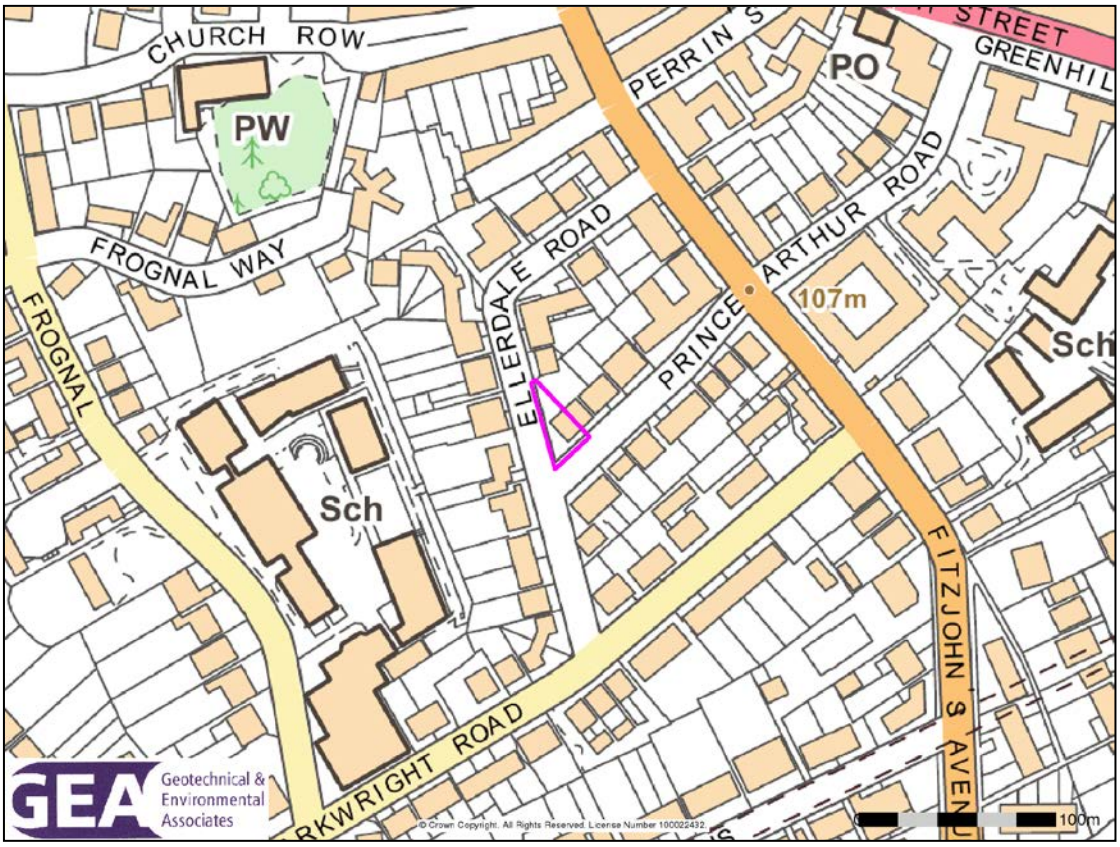
The surface water and flooding element of this BIA is provided for guidance only and should be confirmed by a suitably qualified engineer experienced in carrying out surface water assessments.

1.4 Limitations

The conclusions and recommendations made in this report are limited to those that can be made on the basis of the investigation. The results of the work should be viewed in the context of the range of data sources consulted and the number of locations where the ground was sampled. No liability can be accepted for information in other data sources or conditions not revealed by the sampling or testing. Any comments made on the basis of information obtained from the client or other third parties are given in good faith on the assumption that the information is accurate; no independent validation of such information has been made by GEA.

2.0 THE SITE

2.1 Site Description



The site is located in the London Borough of Camden and locally within Hampstead, northwest London, approximately 425 m to the southwest of Hampstead London Underground station and 410 m to the northeast of Finchley Road and Frognal railway

station. It fronts onto Ellerdale Road to the west and Prince Arthur Road to the southeast and is bordered by houses and associated garden areas fronting onto Ellerdale Road and Prince Arthur Road to the north and east respectively. The site may be additionally located by National Grid Reference 526376, 185464 and is shown on the map extract on the previous page.

A walkover of the site was carried out by a geotechnical engineer from GEA at the time of the fieldwork. The site forms a triangular-shaped area which measures approximately 40 m in maximum dimension. It is occupied by a two-storey and three-storey brick-built house with single level basement beneath the southeastern half of the house. The site and surrounding area slope gently down to the south and the house and southern garden areas are elevated approximately 2 m above pavement level with a stone retaining wall supporting the perimeter of site. During the site walkover a number of small cracks were noted in the stone retaining wall.

In the northern third of site a double garage and small private garden area are at pavement level, with the small garden area accessed from the house over the garage space and a number of semi-mature trees located in the western and southern borders of site including yew, prunus, eucalyptus and holly. The garden areas in general are paved with planted beds and borders, while the northern garden is surfaced with gravel. A number of mature lime trees are present on the pavement adjacent to the western boundary of site, although these have been heavily pruned in recent years.

2.2 Topography

The site lies between 95 m and 100 m above Ordnance Datum (OD) on ground that falls away to about 5 m OD at the River Thames, roughly 7.5 km to the south and rises to an elevation of 134 m OD on Hampstead Heath, some 1.5 km north of the site. More locally, the central section of Ellerdale Road, where it joins with Prince Arthur Road, slopes gently to the south, the site itself slopes south-westwards towards Ellerdale Road. A historical OS map denotes a datum level of 96.7 m OD immediately adjacent to the western boundary of site. A topographic survey of site (reference 002 dated 04/04/13) provided by the consulting engineers denotes site levels in relation to a local datum point. Combining the local datum points with the ordnance datum in the west gives the north of the site at a level of about 97 m OD and the paved area in the south at about 99 m OD.

2.3 Site History

The site history has been researched by reference to internet sources and historical Ordnance Survey (OS) maps obtained from the Envirocheck database.

The earliest map studied, dated 1879 shows the site to be undeveloped and occupied by fields which apparently belonged to Mount Farm, the farm buildings of which were located to the northeast of the site. By the time of the next map, dated 1896, the site was apparently occupied by the existing building at the centre of the site, with a smaller building present in the north of the site. Also at this time Ellerdale Road and Prince Arthur Road bounded the site to the west and southeast respectively, with a number of what is assumed to be residential dwellings then present. The site has remained essentially unchanged from the latest map, dated 1995 to the present day.

2.4 Other Information

A search of public registers and databases has been made via the Envirocheck database and relevant extracts from the search are appended. Full results of the search can be provided if required.

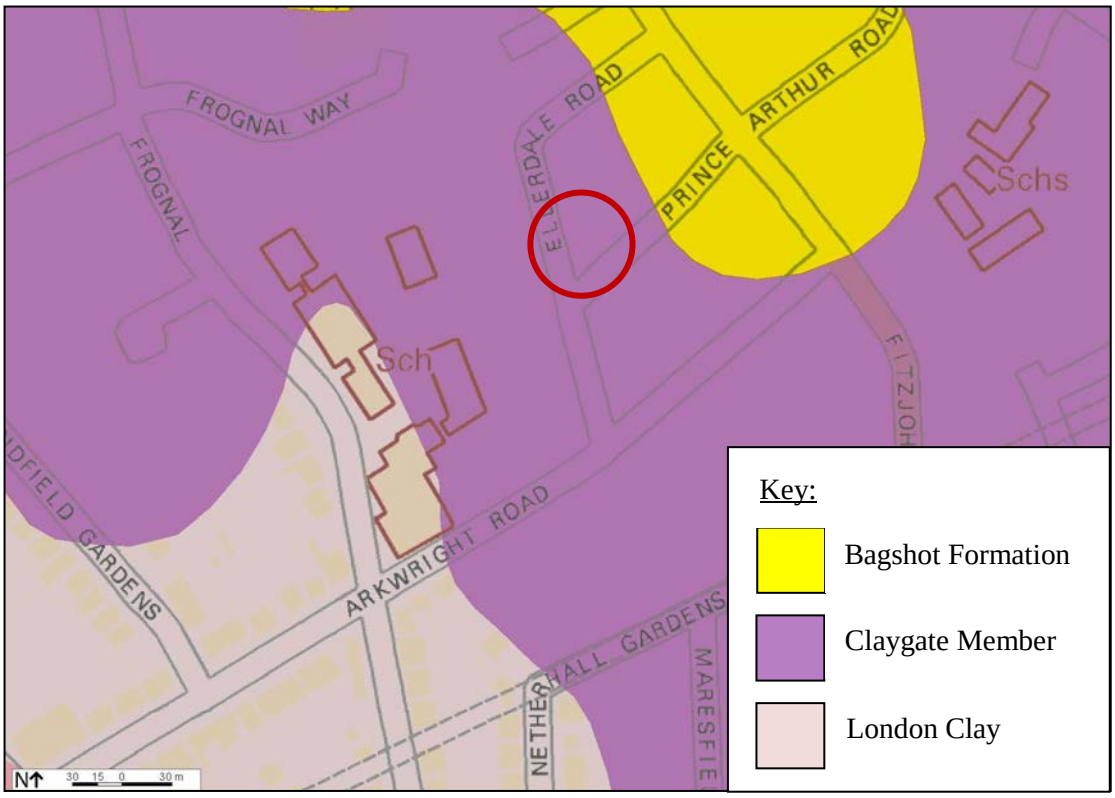
The site is not within an area shown by the Environment Agency (EA) to be at risk from flooding from rivers or the sea and is not located within a Source Protection Zone.

Reference to records compiled by the Health Protection Agency (formerly the National Radiological Protection Board) indicates that the site falls within an area where less than 1% of homes are affected by radon emissions and therefore radon protective measures will not be necessary.

2.5 Geology

The British Geological Survey map of the area (sheet 256) indicates the site to be underlain by the Claygate Member of the London Clay. The Claygate Member forms the youngest part of the London Clay Formation, the basal boundary of which is shown on the OS map to lie at approximately 85 m OD in this area. However, previous investigations by GEA in this area have indicated that the base of Claygate Member extends some 10 m lower, to about 75 m OD.

These records are corroborated by a BGS borehole drilled in Hampstead village, which extended through the full 33.4 m thickness of the Claygate Beds, with the base being penetrated at a level of approximately 73.76 m OD. The geology in this area is generally approximately horizontally bedded such that the strata boundaries roughly follow the contour lines.



A previous investigation by GEA carried out close to the site found that below a nominal thickness of made ground the Claygate Member was encountered, comprising an initial horizon of light brown mottled orange-brown fine silty sand over soft becoming firm light brown and orange-brown mottled silty very sandy clay, interbedded with silty clayey sand extending to between 86.00 m OD and 84.40 m OD, whereupon firm to stiff dark brown very silty sandy and fissured clay with occasional shell fragments and partings of fine pale brown silty sand extended to the deepest level investigated of 72.0 m OD.

2.6 Hydrology and Hydrogeology

The Claygate member in this area is classified as a Secondary 'A' Aquifer by the Environment Agency (EA). Published data for the permeability of the London Clay indicates the horizontal permeability to generally range between 1 x 10^{-10} m/s and 1 x 10^{-8} m/s, with an even lower vertical permeability. However, the Claygate Member is sandier in composition and permeability could be expected to be higher.

During the previous investigation carried out by GEA close to the site encountered groundwater during drilling at levels of between 95.40 m OD and 77.00 m OD, while subsequent monitoring recorded the groundwater within the Claygate Member at a shallowest level of 88.91 m OD.

The boundary between the Bagshot Formation and the underlying Claygate Member is located to the northeast of the site towards Fitzjohn's Avenue. Existing and historical spring lines are present at the interface of the sandy Bagshot Formation and the underlying less permeable Claygate, and to a lesser extent between the Claygate and the underlying essentially impermeable London Clay. These springs have been the source of a number of London's "lost" rivers, notably the Westbourne and Tyburn, which generally rose on Hampstead Heath. A southwards flowing tributary of the River Westbourne was apparently located about 180 m west of the site and a tributary of the River Tyburn was located about 320 m southeast of the site where it also flowed in a southerly direction.

The topographical maps show that there are no surface water features within 500 m of the site and the site is not within an area at risk from flooding as defined by the EA.

The site is largely covered by the existing building and hardstanding and therefore infiltration of rain water into the ground beneath the site is limited to the area of soft landscaping in the front and northern garden areas and therefore the majority of surface runoff is likely to drain into combined sewers in the road.

3.0 SCREENING

The London Borough of Camden guidance suggests that any development proposal that includes a subterranean basement should be screened to determine whether or not a full BIA is required.

3.1 Screening Assessment

A number of screening tools are included in the Arup document and for the purposes of this report reference has been made to Appendix E which includes a series of questions within a screening flowchart for three categories; groundwater flow; land stability; and surface water flow. Responses to the questions are tabulated below.

3.1.1 Subterranean (groundwater) Screening Assessment

Question	Response
1a. Is the site located directly above an aquifer?	*Yes the site is located above a Secondary 'A' Aquifer as designated by the EA.*
1b. Will the proposed basement extend beneath the water table surface?	Unlikely, proposed basement level is about 96.7 m OD and groundwater has been measured at a level of 88.91 m OD on an adjacent GEA site approximately 85 m south of the site. However minor seepages may be encountered from within the made ground and the Claygate Member. Monitoring should be undertaken prior to construction.
2. Is the site within 100 m of a watercourse, well (used/ disused) or potential spring line?	No.
3. Is the site within the catchment of the pond chains on Hampstead Heath?	No.
4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	No. Although the basement extension will extend slightly outside the footprint of the house and areas of planted beds and borders immediately adjacent to the house will be removed, a large area of paved surfacing is proposed to be removed to the southwest of the proposed basement as part of the redevelopment resulting in no net change in hardsurfaced areas.
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. See comment 4. above.
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 or spring line?	No.

The above assessment has identified the following potential issues that need to be assessed:

1a. The site is located above a Secondary 'A' Aquifer as designated by the EA.

3.1.2 Stability Screening Assessment

Question	Response
1. Does the existing site include slopes, natural or manmade, greater than 7°?	No.
2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7°?	No.
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	No.
4. Is the site within a wider hillside setting in which the general slope is greater than 7°?	No.
5. Is the London Clay the shallowest strata at the site?	*Yes.*
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?	*Yes, but it is not known if a tree protection zone is present.*
7. Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site?	*Yes. The area is prone to these effects as a result of the presence of the shrinkable Claygate Member and abundant mature trees.*
8. Is the site within 100 m of a watercourse or potential spring line?	No.
9. Is the site within an area of previously worked ground?	No.
10a. Is the site within an aquifer?	*Yes the site is located above a Secondary 'A' Aquifer as designated by the EA.*
10b. Will the proposed basement extend beneath the water table such that dewatering may be required during	Unlikely, proposed basement level is about 96.7 m OD and groundwater has been measured at a level of 88.91 m OD on

construction?	an adjacent GEA site approximately 85 m south of the site. However minor seepages may be encountered from within the made ground and the Claygate Member. Monitoring should be undertaken prior to construction.
11. Is the site within 50 m of Hampstead Heath ponds?	No.
12. Is the site within 5 m of a highway or pedestrian right of way?	*Yes - the site fronts onto a public road to both the southeast and west.*
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	No, although the depth will increase slightly a partial basement adjacent to neighbouring buildings is already in existence.
14. Is the site over (or within the exclusion zone of) any tunnels, eg railway lines?	No.

The above assessment has identified the following potential issues that need to be assessed:

Q5 The London Clay is the shallowest strata on the site.
Q6 Trees will be felled as part of the proposed development.
Q7 There is a history of seasonal shrink-swell associated with the underlying London Clay.
Q10a The site is located above a Secondary 'A' Aquifer as designated by the EA.
Q12 The site is within 5 m of a public highway.

The potential issues that need to be assessed, along with the possible effects of the basement construction on the local hydrology and hydrogeology and are discussed further in Part 2 of this report.

3.1.3 Surface Flow and Flooding Screening Assessment

This element of the BIA is provided for guidance only and should be confirmed by a suitably qualified hydrologist experienced in carrying out surface water assessments.

Question	Response
1. Is the site within the catchment of the pond chains on Hampstead Heath?	No.
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. The proposed basement will occupy a similar area to that already covered by hardstanding. The drainage is unlikely to be materially changed from existing.
3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	No, the proposed basement will cover approximately the same area as the existing areas of hardstanding.
4. Will the proposed basement development result in changes to the profile of the inflows (instantaneous and long term) of surface water being received by adjacent properties or downstream watercourses?	No.
5. Will the proposed basement result in changes to the quantity of surface water being received by adjacent properties or downstream watercourses?	No.
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 Kings Cross, or is it at risk of flooding because the proposed basement is below the static water level of a nearby surface water feature?	No.

The above assessment has identified no potential issues that need to be assessed further.

4.0 SCOPING AND SITE INVESTIGATION

The purpose of scoping is to assess in more detail the factors to be investigated in the impact assessment. Potential impacts are assessed for each of the identified potential impact factors.

The potential impacts of the proposed development on surface flow and flooding and subterranean flow will need to be dealt with in separate assessments, such that the following section focuses on the potential impacts that may have an impact on slope stability.

4.1 Potential Impacts

The following potential impacts have been identified.

Potential Impact	Consequence
The site is located above a Secondary 'A' Aquifer as designated by the EA.	The proposed basement has the potential to decrease rainfall recharge within the building footprint.
London Clay is the shallowest stratum on the site.	The London Clay is prone to seasonal shrink-swell and can cause structural damage.
Trees will be felled as part of the proposed development	Removal of trees in the vicinity of the proposed basement will change the quantity of water uptake in that area.
Seasonal shrink-swell can result in foundation movements.	If a new basement is dug to below the depth likely to be affected by tree roots this could lead to damaging differential movement between the subject site and adjoining properties.
Site within 5 m of a highway or pedestrian right of way.	Excavation of a basement may result in structural damage to the road or footway.

These potential impacts have been further assessed through the ground investigation, as detailed below.

4.2 Exploratory Work

The scope of the works was specified by the consulting engineers, with input from GEA and access restricted the investigation to the use of equipment that could reach the required borehole locations. In order to meet the objectives described in Section 1.2, two boreholes were drilled by means of opendrive sampling rig to a depth of 10 m. In addition, two boreholes were drilled using window sampling equipment at less accessible locations, to depths of 1 m and 4 m.

During boring disturbed samples were obtained from the boreholes for subsequent laboratory examination and testing. Standard Penetration Tests (SPTs) were carried out at regular intervals to provide additional quantitative data on the strength of soils encountered.

A selection of the samples recovered from the boreholes was submitted to a soil mechanics laboratory for a programme of geotechnical testing.

All of the above work was carried out under the supervision of a geotechnical engineer from GEA.

The borehole records and results of the geotechnical testing are appended, together with a site plan indicating the exploratory positions. An historical OS map denotes a datum level of 96.7 m OD immediately adjacent to the western boundary of site. A topographic survey of site (reference 002 dated 04/04/13) provided by the consulting engineers denotes site levels in relation to a local datum point. The Ordnance Datum (OD) levels shown on the borehole

records have been approximately determined from combining the local datum points with the ordnance datum in the west of 96.7 m OD.

4.3 Sampling Strategy

The borehole locations were specified by the consulting engineers and were positioned on site by GEA as close to the specified positions as possible, whilst avoiding areas of buried services.

Three groundwater monitoring standpipes were installed within the boreholes, to depths of between 4.0 m and 10.0 m, in order to facilitate future monitoring. Each has been monitored on two occasions, approximately one and five weeks after installation.

5.0 GROUND CONDITIONS

The investigation has confirmed the expected ground conditions in that, below a nominal thickness of made ground, the Claygate Member was present to the full depth investigated of 10.45 m (89.59 m OD).

5.1 Made Ground

Below the York paving surface, the made ground in the southern garden areas generally comprised yellow-brown and grey slightly silty sand with gravel, brick fragments, pockets of sand, ash, organic material and rootlets and extended to depths of between 0.80 m and 1.00 m in Borehole Nos 2 and 1 respectively. In the lower northern garden area, made ground comprised very dark brown and blackish gravelly sandy clay with brick, concrete and occasional coal fragments and extended to a depth of 0.80 m in Borehole No 4, while Borehole No 3 terminated on concrete at a depth of 1.0 m.

5.2 Claygate Member

The Claygate Member comprised both pale greyish brown slightly clayey silty fine sand with partings of orange-brown silty sand and firm very silty sandy clay interbedded with firm greenish brown, orange-brown and pale grey silty very sandy clay with frequent partings of orange-brown and greenish brown fine silty sand and was encountered to the full depth investigated of 10.45 m (89.59 m OD).

5.3 Groundwater

Groundwater was encountered as seepages during drilling within the Claygate Member at depths of 4 m (95.28 m OD) and 8 m (91.28 m OD) in Borehole No 1, 2 m (98.05 m OD), 7.5 m (92.55 m OD) and 8.2 m (91.85 m OD) in Borehole No 2 and at 2.5 m (94.55 m OD) in Borehole No 4.

Three groundwater monitoring standpipes were installed and groundwater has subsequently been monitored on two occasions. The first visit was approximately one week after installation and groundwater was recorded at depths of 7.52 m (91.76 m OD) and 7.65 m (92.40 m OD) in Borehole Nos 1 and 2 respectively. The second visit was approximately five weeks after installation where groundwater was monitored at depths of 7.48 m (91.80 m OD) and 7.64 m (92.41 m OD) in Borehole Nos 1 and 2 respectively. Groundwater was not encountered in Borehole No 4, which is only 4.0 m deep, on either occasion.

The groundwater monitoring results are tabulated below.

Date	Borehole No	Depth to water (m) [Level (m OD)]
19/03/14 (during fieldwork)	1	4.00 [95.28], 8.00 [91.28]
	2	2.00 [98.05], 7.50 [92.55], 8.20 [91.85]
	3	DRY
	4	2.50 [94.55]
02/04/14	1	7.52 [91.76]
	2	7.65 [92.40]
	4	DRY
28/04/14	1	7.48 [91.80]
	2	7.64 [92.41]
	4	DRY

The significance of the results is considered further in Part 2 of the report.

Part 2: DESIGN BASIS REPORT

This section of the report provides an interpretation of the findings detailed in Part 1, in the form of a ground model, and then provides advice and recommendations with respect to foundation options and contamination issues.

6.0 INTRODUCTION

It is understood that it is proposed to deepen the existing single level basement beneath the southeastern half of the house to 3 m depth, about 96.7 m OD, while the footprint of the basement will be extended to occupy the majority of the southern and western garden areas, as well as extending the northeastern corner adjacent to the existing double garage.

7.0 GROUND MODEL

The desk study has revealed that the site has not had a potentially contaminative historical use as the site has been developed with the existing house for its entire developed history, and on the basis of the fieldwork, the ground conditions at this site can be characterised as follows:

- below a nominal thickness of made ground, the Claygate Member is present;
- the made ground extends to depths of between 0.80 m and 1.00 m and generally comprises York paving over yellow-brown and grey slightly silty sand with gravel, brick fragments, pockets of sand, ash, organic material and rootlets in the south and to a depth of 0.80 m in the north comprising very dark brown and blackish gravelly sandy clay with brick, concrete and occasional coal fragments;
- the Claygate Member comprises both pale greyish brown slightly clayey silty fine sand with partings of orange-brown silty sand and firm very silty sandy clay interbedded with firm greenish brown, orange-brown and pale grey silty very sandy clay with frequent partings of orange-brown and greenish brown fine silty sand and was encountered to the full depth investigated of 10.45 m (89.59 m OD); and
- groundwater has been monitored within the Claygate Member at depths of 7.48 m (91.80 m OD), 7.64 m (92.41 m OD) in Borehole Nos 1 and 2 respectively. Groundwater was not encountered in Borehole No 4 which only extended to a depth of 4 m.

8.0 ADVICE AND RECOMMENDATIONS

The excavation for the proposed basement structure will require temporary support to maintain stability of the existing and surrounding structures and to prevent any excessive ground movements. Based on the groundwater observations to date, significant inflows of groundwater are unlikely to be encountered within the basement excavation. The existing foundations will need to be underpinned prior to construction of the proposed basement or will need to be supported by new retaining walls.

Formation level for the proposed development will be within the Claygate Member, which should provide an eminently suitable bearing stratum for spread foundations excavated from basement level. Alternatively, piled foundations would also provide a suitable solution.

8.1 Basement Construction

8.1.1 Basement Excavation

The basement will extend to a depth of about 3.00 m, about 96.7 m OD, and as such formation level should be within the Claygate Member. Groundwater was encountered during drilling within the Claygate Member at shallowest depths of 4.0 m (95.28 m OD), 2.0 m (98.05 m OD) and 2.5 m (94.55 m OD) in Borehole Nos 1, 2 and 4 respectively.

Following the fieldwork, groundwater was monitored at shallowest depths of 7.48 m (91.80 m OD), 7.64 m (92.41 m OD) in standpipes installed in Borehole Nos 1 and 2 respectively. Groundwater was not encountered in Borehole No 4 on either occasion. The findings appear to indicate the presence of pockets of perched water within the Claygate Member below a depth of about 2 m, but that these pockets yield relatively small volumes of water and, based on the lower levels of groundwater measured in the standpipes, are unlikely to be interconnected or form a general “groundwater table”. In view of the sand and silt content of the Claygate Member any inflows within the depth of the basement may be relatively rapid but may not be prolonged, and the standpipes have indicated a groundwater level below the level of proposed basement. Shallow inflows of perched water may also be encountered from within the made ground, particularly within the vicinity of existing foundations.

In any case it would be prudent to continue the monitoring of standpipes to confirm this view. It would also be prudent to carry out a number of trial excavations, to depths as close to the full basement depth as possible, to provide an indication of the likely groundwater conditions, if it is not possible to carry out trial excavations a suitable alternative would be simple rising head permeability tests.

The design of basement support in the temporary and permanent conditions needs to take account of the need to maintain the stability of the surrounding structures and the possible requirement to control ground water inflows.

There are a number of methods by which the sides of the basement excavation could be supported in the temporary and permanent conditions. The choice of wall may be governed to a large extent by whether it is to be incorporated into the permanent works and have a load bearing function.

The most suitable method of support will probably be to form the retaining walls by underpinning the existing party walls using a traditional ‘hit and miss’ approach. Careful workmanship will be required to ensure that movement of the surrounding structures is

restricted, but this method will have the benefit of minimising the plant required and maximising usable space in the new basement.

For the ground conditions at this site sheet piles could also be considered but the noise and vibrations associated with their installation is likely to be unacceptable to neighbouring properties. The use of a bored pile wall could have the advantage of being incorporated into the permanent works to provide support for structural loads. It may be possible to adopt a contiguous bored pile wall with the use of sump pumping and localised grouting to deal with any groundwater inflows; although additional monitoring should be carried out to confirm this view. A contiguous bored piled wall would have the disadvantage of reducing usable space in the basement, and in this respect a secant wall may be preferable as it would overcome the requirement for any secondary groundwater protection in the permanent works and maximise the basement area.

The ground movements associated with the basement excavation will depend on the method of excavation and support and the overall stiffness of the basement structure in the temporary condition. Thus, a suitable amount of propping will be required to provide the necessary rigidity. In this respect the timing of the provision of support to the wall will have an important effect on movements.

8.1.1 Basement Retaining Walls

The following parameters are suggested for the design of the permanent basement retaining walls.

Stratum	Bulk Density (kg/m^3)	Effective Cohesion (c' – kN/m^2)	Effective Friction Angle (φ' – degrees)
Made ground	1700	Zero	27
Claygate Member	1900	Zero	25

Groundwater may be encountered within the basement excavations during construction, although monitoring of the standpipes should be continued in order to establish equilibrium levels and trial excavations could be carried out to assess the nature of any groundwater inflows.

It is recommended that the basement is designed with a water level assumed to be two-thirds of the basement depth and the advice in BS8102:2009 should be followed in the design of basement retaining walls.

8.1.2 Basement Heave

The excavation of a 3.0 m depth of soil will result in an unloading of approximately 60 kN/m^2 in the south of the site. This unloading will lead to heave of the underlying Claygate Member, which will comprise an “immediate” elastic component that may be expected to occur within the construction period, together with long term swelling movement that would theoretically occur over a period of many years. The effects of heave will be mitigated to some extent by the loads applied by the new building, but the movements could be significant, particularly below the deeper part of the excavation. In addition, the variation in unloading across the excavation will lead to differential movement. It is therefore recommended that an analysis of these movements should be carried out once the basement design has been finalised.

8. 2 Spread Foundations

Provided that a dry excavation can be maintained at formation level it should be possible to adopt spread foundations to bear in the Claygate Member below basement level, at a depth of about 3.00 m (about 96.7 m OD).

Moderately sized pad or strip foundations bearing in the clayey sand of the Claygate Member below basement level may be designed to apply a net allowable bearing pressure of 100 kN/m^2. If trial excavations or monitoring of the standpipes indicate groundwater inflows to be problematic, piled foundations extending into the London Clay may be more appropriate.

8.3 Shallow Excavations

On the basis of the borehole findings it is considered likely that it will be generally feasible to form relatively shallow excavations terminating within the made ground or the Claygate Member without the requirement for lateral support, although localised instabilities may occur. Inflows of groundwater into shallow excavations are not generally anticipated, although seepages may be encountered from perched water tables within the made ground, although such inflows should be suitably controlled by sump pumping.

However, should deeper excavations be considered or if excavations are to remain open for prolonged periods it is recommended that provision be made for battered side slopes or lateral support. Where personnel are required to enter excavations, a risk assessment should be carried out and temporary lateral support or battering of the excavation sides considered in order to comply with normal safety requirements.

8.4 Basement Floor Slabs

Consideration will need to be given to designing the basement floor slab to accommodate heave movements and a suspended basement slab is likely to be required. It may be necessary to incorporate a void but this should be the subject of additional consideration once the proposals have been finalised.

8.5 Effect of Sulphates

Relatively low concentrations of soluble sulphate have been measured in selected soil samples and thus buried concrete maybe designed in accordance with Class DS-1 conditions of Table C1 of BRE Special Digest 1: SD1 Third Edition (2005). The measured pH conditions are slightly acidic and therefore on the basis of mobile groundwater conditions being assumed, for buried concrete an ACEC classification of AC-1 may be adopted.

The guidelines contained in the above digest should be followed in the design of foundation concrete.

9.0 BASEMENT IMPACT ASSESSMENT

The screening identified a number of potential impacts. The desk study and ground investigation information has been used to review the potential impacts, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

The table below summarises the previously identified potential impacts and the additional information that is now available from the site investigation in consideration of each impact.

Potential Impact	Site Investigation Conclusions
The site is located above a Secondary 'A' Aquifer as designated by the EA.	The site is located in an area designated as a Secondary 'A' Aquifer an the investigation has indicated that the basement will be above the measured level of groundwater at high winter levels and rainfall recharge would not be decreased by the development.
London Clay is the shallowest strata on the site.	Desiccation was not encountered during the investigation but may be present within close proximity to existing trees. However, the proposed basement will extend to a depth of 3.0 m such that new foundations are likely to bypass any desiccated soils encountered, although consideration will need to be given in the foundation design to protecting against the effects of continued growth of the trees.
Trees will be felled as part of the proposed development	Desiccation was not encountered during the investigation but may be present within close proximity of existing trees. However, the proposed basement will extend to a depth of 3.0 m such that new foundations are likely to bypass any desiccated soils encountered, although consideration will need to be given in the foundation design to protecting against the effects of continued growth of the trees.
Seasonal shrink-swell can result in foundation movements.	Desiccated soil was not encountered during the investigation, but may be present in close proximity to trees elsewhere on the site. The foundations of the new basement will extend to a depth of around 3.50 m in order to construct the proposed basement; therefore the foundations should bypass any desiccation present.
Location of public highway.	The proposed basement is to extend to within 5.0 m of the public paths and highways to the south and west of the site. Best practice in design and construction will ensure the stability of the highway.

The results of the site investigation have been used below to review the remaining potential impacts, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

The site is located above a Secondary 'A' Aquifer as designated by the EA.

The site is located in an area designated as a Secondary 'A' Aquifer although the basement level has been shown to be to be above measured high winter groundwater levels. The proposed basement development would not result in a decrease in rainfall recharge.

London Clay is the shallowest strata on the site / Trees will be felled

Desiccation was not encountered during the investigation but may be present within close proximity to existing trees. However, the proposed basement will extend to a depth of 3.0 m therefore new foundations are likely to bypass any desiccated soils encountered, although consideration will need to be given in the foundation design to protecting against the effects of continued growth of the trees.

Seasonal Shrink-Swell

The proposed development involves deepening the foundations to below what would be expected as a depth of influence of tree roots on the basis of the trees present on the site. Consideration will need to be given to the effects of clay swelling following the removal of some of the trees, but similarly the foundations are to be placed at depths that should not be affected. Subject to inspection of foundation excavations in the normal way to ensure that there is not significant unexpectedly deep root growth, it is not considered that the occurrence of shrink-swell issues in the local area has any bearing on the proposed development.

Location of public highway

The basement excavation will extend to within 5.0 m from the pathways and highways to the south and east and therefore the basement excavation may affect the highway. The proposed development will include retaining walls that will be designed to maintain the stability of the surrounding ground, thus protecting the adjacent road and associated infrastructure beyond. There is nothing unusual or exceptional in the proposed development or the findings of the investigation that give rise to any concerns with regard to stability over and above any development of this nature.

9.1 BIA Conclusion

A Basement Impact Assessment has been carried out following the information and guidance published by the London Borough of Camden. Information from a Site Investigation has been used to assess potential impacts identified by the screening process.

It is concluded that the proposed development is unlikely to result in any specific land or slope stability issues, groundwater or surface water issues, although a detailed analysis of movements may be required in due course.

10.0 OUTSTANDING RISKS AND ISSUES

This section of the report aims to highlight areas where further work is required as a result of limitations on the scope of this investigation, or where issues have been identified by this investigation that warrant further consideration. The scope of risks and issues discussed in this section is by no means exhaustive, but covers the main areas where additional work is considered to be required.

The ground is a heterogeneous natural material and variations will inevitably arise between the locations at which it is investigated. This report provides an assessment of the ground conditions based on the discrete points at which the ground was sampled, but the ground conditions should be subject to review as the work proceeds to ensure that any variations from the Ground Model are properly assessed by a suitably qualified person.

An issue that requires careful consideration at this site is the extent to which groundwater will affect the basement excavation in the temporary condition and the level of the water table to be adopted in the permanent design. It would be prudent to carry out additional groundwater monitoring of the existing standpipes as a minimum requirement, but it is important that the contractor is able to deal with inflows of groundwater that may be locally more significant than anticipated. It would therefore be prudent to carry out a number of trial excavations, to depths as close to the full basement depth as possible. A rising head test could be carried out

within the standpipe to more accurately assess the level of groundwater and to gain some understanding of the rate at which groundwater may enter the basement excavation.

Consideration will also need to be given to measures to protect against heave as a result of the basement excavation. It is likely that the floor slab for the proposed basement will need to be suspended over a void to accommodate the anticipated heave unless the slab can be suitably reinforced to cope with these movements. It is recommended that heave movements are checked by further analysis once the loadings and final levels are known.

APPENDIX

Borehole Records

Geotechnical Laboratory Test Results

Envirocheck Extracts

Historical Maps

Site Plan

Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** 9 Ellerdale Road, London, NW6 3BA	**Number** **BH1**

Excavation Method	**Dimensions**	**Ground Level (mOD)**	**Client**	**Job Number**
Opendrive Window Sampler		99.28	Mrs Y Jing	J14075
	Location Front garden area	**Dates** 19/03/2014	**Engineer** Price & Myers	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.60)	MADE GROUND (90 mm thick york paving over yellow-brown and grey slightly silty sand with gravel, crushed paving slab and mortar and brick fragments)		
				98.68	0.60			
0.80	D1				(0.40)	MADE GROUND (dark brown very silty clay with gravel, occasional sand, ash and rootlets)		
1.00-1.45	SPT N=8		0,1/1,2,2,3	98.28	1.00	Loose pale greenish brown, orange-brown and dark grey mottled very silty very clayey fine SAND		
1.50	D2				(1.30)			
2.00-2.45	SPT N=10		1,2/2,2,2,4					
				96.98	2.30	Firm medium strength greenish brown, orange-brown and pale grey silty very sandy CLAY with frequent partings of orange-brown and greenish brown fine silty sand		
2.50	D3							
3.00-3.45	SPT N=13		2,2/3,3,3,4		(2.00)			
3.50	D4							
4.00-4.45	SPT N=14		Water strike(1) at 4.00m. 1,2/3,4,3,4					▽1
				94.98	4.30	Medium dense pale greyish brown slightly clayey silty fine SAND with occasional partings of orange-brown silty sand with pockets of firm very silty sandy clay from 5.6 m for 100 mm		
4.50	D5							
5.00-5.45	SPT N=11		1,2/2,3,3,3		(1.70)			
5.50	D6							
6.00-6.45	SPT N=16		1,3/3,4,4,5	93.28	6.00	Poor recovery due to collapse of granular soils during sampling		
					(0.50)			
				92.78	6.50	Medium dense dark orange-brown, orange-brown, pale greenish grey and pale grey mottled very silty clayey fine SAND with frequent pockets of firm silty very sandy clay and occasional partings of dark grey silt		
6.60	D7							
7.00-7.45	SPT N=17		3,3/3,4,5,5		(1.50)			
7.50	D8							
8.00-8.45	SPT N=13		Water strike(2) at 8.00m. 2,2/2,3,4,4	91.28	8.00	Medium dense pale brown, dark grey and dark orange-brown silty clayey SAND		▽2
8.50	D9							
9.00-9.45	SPT N=13		2,2/2,3,4,4		(2.00)			
9.50	D10							
10.00-10.45	SPT N=19		2,3/3,6,5,5	89.28	10.00			

Remarks
Poor recovery between 6.0 m and 6.5 m due to granular soil collapse during drilling
Groundwater monitored at 7.52 m on 02/04/14
Groundwater monitored at 7.48 m on 28/04/14
Groundwater encountered during drilling at 4 m and 8 m depth

Scale (approx)	**Logged By**
1:50	CA

Figure No.
J14075.BH1

Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** 9 Ellerdale Road, London, NW6 3BA	**Number** **BH2**

Excavation Method	**Dimensions**	**Ground Level (mOD)**	**Client**	**Job Number**
Opendrive Window Sampler		100.05	Mrs Y Jing	J14075
	Location Side of House	**Dates** 20/03/2014	**Engineer** Price & Myers	**Sheet** 1/2

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.80)	MADE GROUND (blackish very dark brown gravelly clayey sand with roots, occasional brick fragments, ash and organic material)		
0.50	D1			99.25	0.80			
0.90	D2			99.05	(0.20) 1.00	Brown slightly clayey gravelly fine SAND Gravel is coarse and rounded		
1.50	D3					Loose to medium dense dark orange-brown and pale grey clayey fine SAND with partings of orange-brown sand		
2.00-2.45	SPT N=9		Water strike(1) at 2.00m. 1,2/2,2,2,3					▽1
2.50	D4				(3.50)			
3.00-3.45	SPT N=8		1,1/2,2,2,2					
3.50	D5							
4.00-4.45	SPT N=12		1,2/3,3,3,3					
4.60	D6			95.55	4.50	Firm medium strength grey and orange-brown firm initially very sandy CLAY with orange-brown clayey sand at 5.0 m depth for 100 mm		
5.50	D7				(2.00)			
6.00-6.45	SPT N=16		1,3/3,4,4,5					
6.60	D8			93.55	6.50	Medium dense dark orange-brown and grey clayey SAND Sand is fine to coarse with grey silt partings and orange-brown sandy clay partings at 7.6 m for 100 mm, firm grey and orange-brown mottled sandy clay at 8.65 m depth for 50 mm and 8.75 m for 100 mm, becoming very clayey at 9.8 m for 200 mm		
7.50	D9		Water strike(2) at 7.50m.					▽2
8.00-8.45	SPT N=17		2,3/3,4,5,5					▽3
8.50	D10		Water strike(3) at 8.20m.		(3.95)			
9.50	D11							
10.00-10.45	SPT N=13		2,2/3,3,3,4					

Remarks
Groundwater monitored at 7.65 m depth on 02/04/14
Seepage encountered during drilling at 2.0 m
Groundwater encountered during drilling at 7.5 m and 8.2 m depth
Groundwater monitoring standpipe installed to 9 m depth
Groundwater monitored at 7.64 m depth on 28/04/14

Scale (approx)	**Logged By**
1:50	CA

Figure No.
J14075.BH2

Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** 9 Ellerdale Road, London, NW6 3BA	**Number** **BH2**

Excavation Method	**Dimensions**	**Ground Level (mOD)**	**Client**	**Job Number**
Opendrive Window Sampler		100.05	Mrs Y Jing	J14075
	Location Side of House	**Dates** 20/03/2014	**Engineer** Price & Myers	**Sheet** 2/2

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				89.60	10.45	Complete at 10.45m		

Remarks	**Scale (approx)**	**Logged By**
	1:50	CA
	Figure No.	J14075.BH2

Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** 9 Ellerdale Road, London, NW6 3BA	**Number** **BH3**

Excavation Method	**Dimensions**	**Ground Level (mOD)**	**Client**	**Job Number**
Window Sampler		97.10	Mrs Y Jing	J14075
	Location Northern garden area	**Dates** 20/03/2014	**Engineer** Price & Myers	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.50)	MADE GROUND (gravel over very dark brown sandy gravelly CLAY with whole and fragments of brick and charcoal)		
				96.60	0.50	Brick backfill		
					(0.35)			
				96.25	0.85	Concrete		
				96.10	(0.15) 1.00	Terminated at 1.00m		

Remarks
Window sample terminated on concrete

Scale (approx)	**Logged By**
1:50	CA

Figure No.
J14075.BH3

GEA Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** 9 Ellerdale Road, London, NW6 3BA	**Number** **BH4**

Excavation Method	**Dimensions**	**Ground Level (mOD)**	**Client**	**Job Number**
Window Sampler		97.05	Mrs Y Jing	J14075
	Location Northern garden area	**Dates** 20/03/2014	**Engineer** Price & Myers	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.50)	MADE GROUND (200 mm gravel over very dark brown and blackish gravelly sandy clay with brick, concrete, occasional coal fragments and roots)		
0.40	D1			96.55	0.50			
					(0.30)	MADE GROUND (light brown gravelly CLAY with occasional brick fragments, reworked clay and roots)		
				96.25	0.80			
					(0.20)	Firm dark brown, pale grey and blackish mottled slightly gravelly very sandy CLAY with roots		
1.00	D2			96.05	1.00			
					(1.80)	Dark orange-brown clayey fine to coarse SAND with pockets of grey and orange-brown mottled sandy clay at 1.5 m depth for 50 mm and at 1.7 m depth for 50 mm		
2.00	D3							
			Water strike(1) at 2.50m.					▽1
				94.25	2.80	Firm dark orange-brown and grey mottled very sandy CLAY with partings of grey sand at 3.6 m depth for 100 mm and occasional black mottling		
3.00	D4							
					(1.20)			
4.00	D5			93.05	4.00	Terminated at 4.00m		

Remarks
Seepage encountered during drilling at 2..5 m depth
Borehole terminated at 4.0 m depth
Groundwater not encountered during monitoring on 02/04/14 and 28/04/14

Scale (approx)	**Logged By**
1:50	CA

Figure No.
J14075.BH4

GEA Geotechnical & Environmental Associates

Tyttenhanger House
Coursers Road
St Albans
AL4 0PG

Standard Penetration Test Results

Site : 9 Ellerdale Road, London, NW6 3BA

Client : Mrs Y Jing

Engineer : Price & Myers

Job Number J14075

Sheet 1 / 1

Borehole Number	Base of Borehole (m)	End of Seating Drive (m)	End of Test Drive (m)	Test Type	Seating Blows per 75mm		Blows for each 75mm penetration				Result	Comments
					1	2	1	2	3	4		
BH1	1.00	1.15	1.45	SPT	0	1	1	2	2	3	N=8	
BH1	2.00	2.15	2.45	SPT	1	2	2	2	2	4	N=10	
BH1	3.00	3.15	3.45	SPT	2	2	3	3	3	4	N=13	
BH1	4.00	4.15	4.45	SPT	1	2	3	4	3	4	N=14	
BH1	5.00	5.15	5.45	SPT	1	2	2	3	3	3	N=11	
BH1	6.00	6.15	6.45	SPT	1	3	3	4	4	5	N=16	
BH1	7.00	7.15	7.45	SPT	3	3	3	4	5	5	N=17	
BH1	8.00	8.15	8.45	SPT	2	2	2	3	4	4	N=13	
BH1	9.00	9.15	9.45	SPT	2	2	2	3	4	4	N=13	
BH1	10.00	10.15	10.45	SPT	2	3	3	6	5	5	N=19	
BH2	2.00	2.15	2.45	SPT	1	2	2	2	2	3	N=9	
BH2	3.00	3.15	3.45	SPT	1	1	2	2	2	2	N=8	
BH2	4.00	4.15	4.45	SPT	1	2	3	3	3	3	N=12	
BH2	6.00	6.15	6.45	SPT	1	3	3	4	4	5	N=16	
BH2	8.00	8.15	8.45	SPT	2	3	3	4	5	5	N=17	
BH2	10.00	10.15	10.45	SPT	2	2	3	3	3	4	N=13	

SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Unconfined Compressive Strength			Chemical Tests			
Borehole No	Sample No	Depth (m)	Type	Description	MC (%)	LL (%)	PL (%)	PI	<425 µm (%)	Bulk (Mg/m³)	Dry (Mg/m³)	N/A	N/A	UCS (kPa)	pH	2:1 W/S SO4 (g/L)	W/S Mg (mg/L)	Other tests and comments
BH1	D2	1.50	D	Yellow brown clayey silty fine SAND														Particle Size Distribution
BH1	D3	2.50	D	Mottled orange, brown and grey slightly fine sandy silty CLAY	22	50	19	31	100						6.0	0.08		
BH1	D4	3.50	D	Mottled light brown, purple and grey slightly	22	43	19	24	100									
BH1	D6	5.50	D												6.6	0.05		
BH2	D4	2.50	D	Yellow brown and grey clayey silty fine SAND														Particle Size Distribution
BH2	D6	4.60	D	Orange brown mottled grey slightly fine sandy silty CLAY	21	47	19	28	100									
BH2	D7	5.50	D	Orange brown mottled grey slightly fine sandy silty CLAY	24	43	17	26	100						6.8	0.04		
BH2	D9	7.50	D	Yellow brown clayey silty fine SAND														Particle Size Distribution

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

Checked and Approved by

SB

S Burke (Snr Tech)

Date: 09/04/2014

Project Number:

GEO / 21012

Project Name:

9 ELLERDALE ROAD, LONDON, NW6 3BA

Project Number J14075

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BS1377 : Part 2 : Clause 9 : 1990

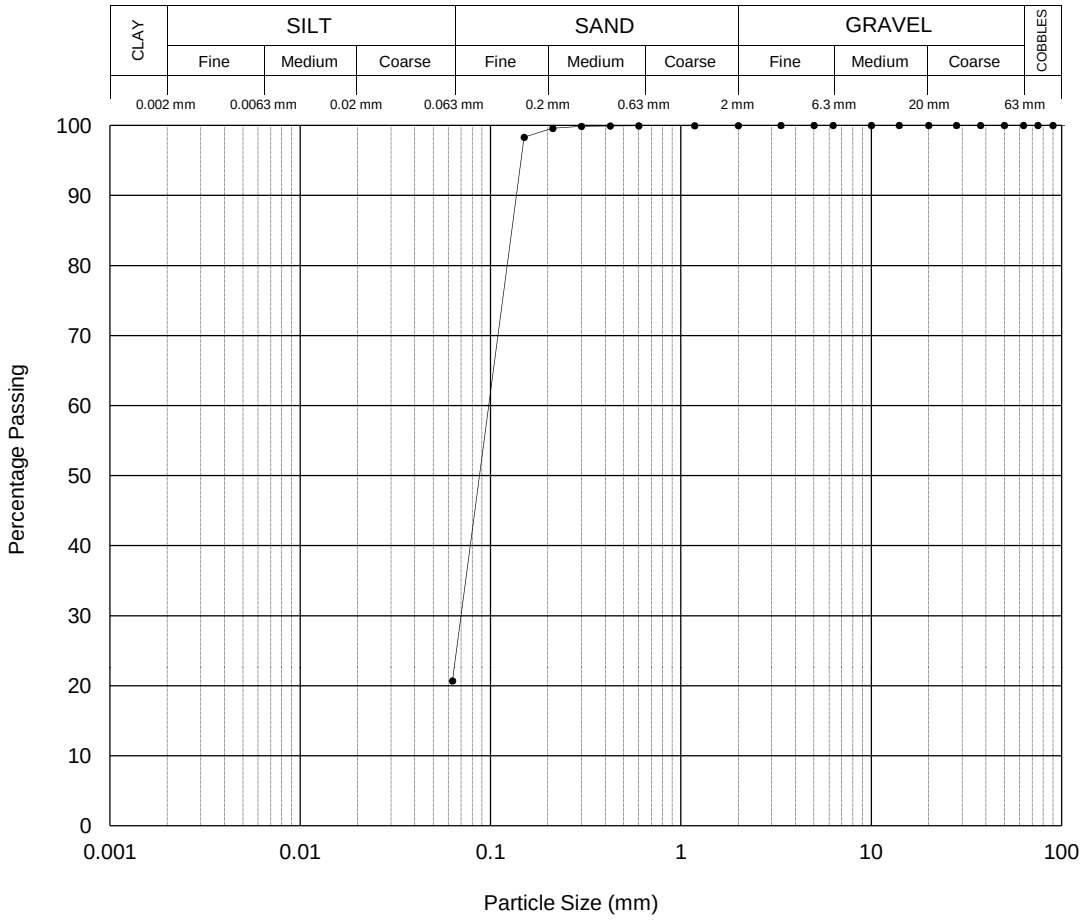
Determination of Particle Size Distribution

BH No.	BH1
Sample Ref.	D2
Depth (m):	1.50

Description:
Yellow brown clayey silty fine SAND

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method

Sieve	
Sieve (mm)	% pass
200	100
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	100
14	100
10	100
6.3	100
5	100
3.35	100
2	100
1.18	100
0.6	100
0.425	100
0.3	100
0.212	100
0.15	98
0.063	21



Particle Proportions	
Cobbles	0.0 %
Gravel	0.0 %
Sand	79.3 %
Silt & Clay	20.7 %

Checked and Approved by

SB

S Burke (Snr Tech)

Date: 10/04/2014

Project Number:

GEO / 21012

Project Name:

9 ELLERDALE ROAD, LONDON, NW6 3BA

Project Number J14075

GEOLABS

UKAS TESTING 1982

BS1377 : Part 2 : Clause 9 : 1990

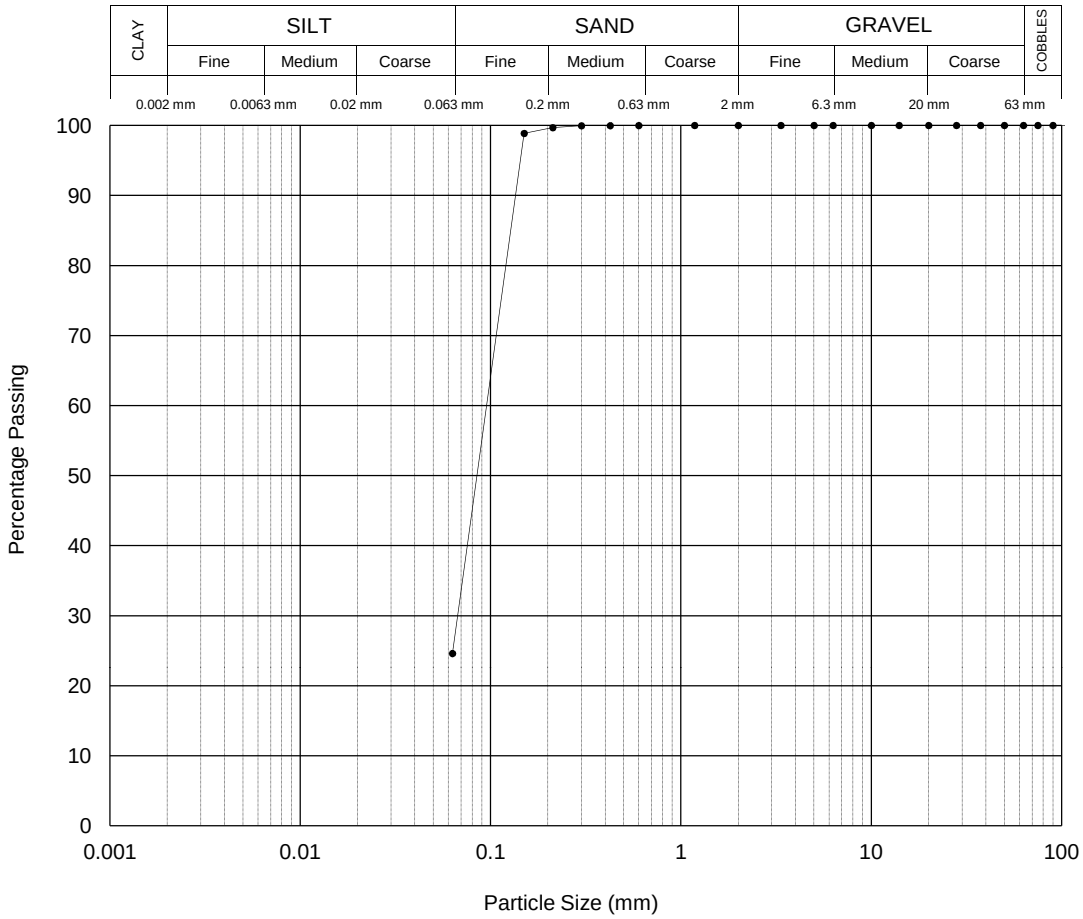
Determination of Particle Size Distribution

BH No.	BH2
Sample Ref.	D4
Depth (m):	2.50

Description:
Yellow brown and grey clayey silty fine SAND

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method

Sieve	
Sieve (mm)	% pass
200	100
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	100
14	100
10	100
6.3	100
5	100
3.35	100
2	100
1.18	100
0.6	100
0.425	100
0.3	100
0.212	100
0.15	99
0.063	25



Particle Proportions	
Cobbles	0.0 %
Gravel	0.0 %
Sand	75.4 %
Silt & Clay	24.6 %

Checked and Approved by

SB

S Burke (Snr Tech)

Date: 10/04/2014

Project Number:

GEO / 21012

Project Name:

9 ELLERDALE ROAD, LONDON, NW6 3BA

Project Number J14075

GEOLABS

UKAS TESTING 1982

BS1377 : Part 2 : Clause 9 : 1990

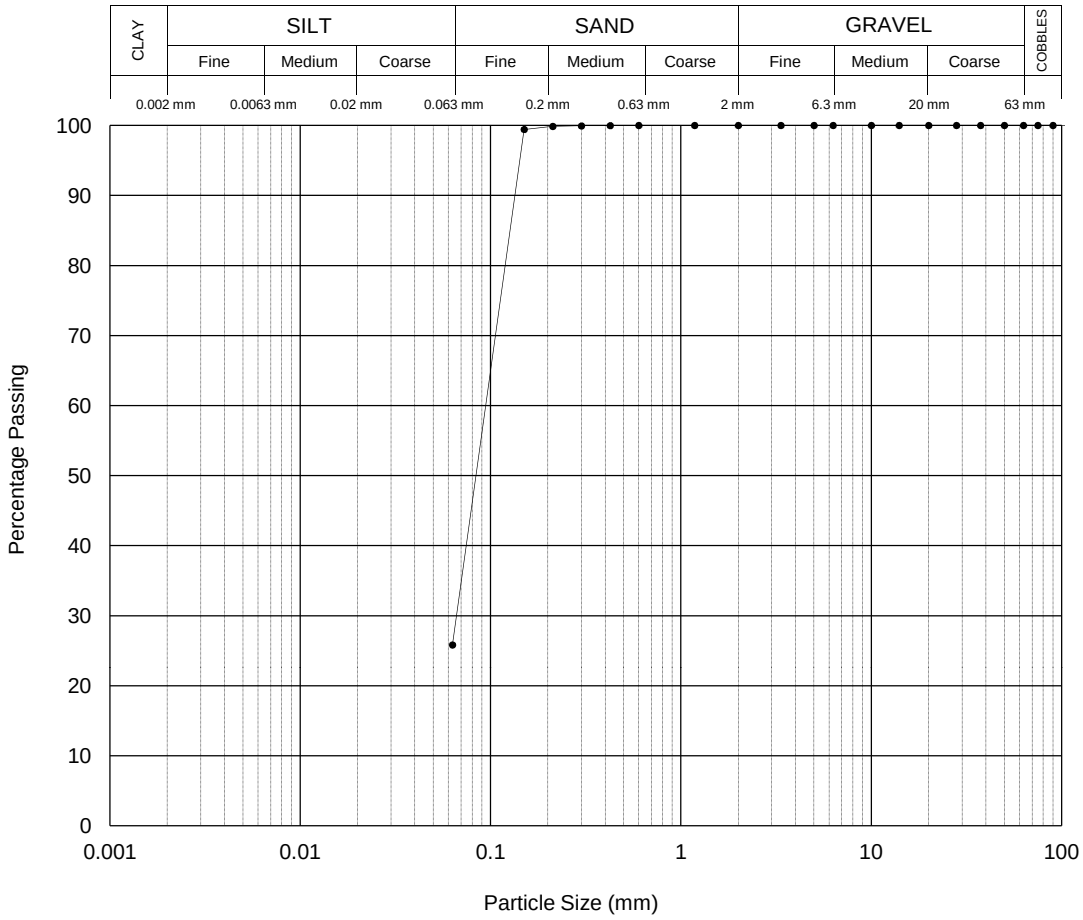
Determination of Particle Size Distribution

BH No.	BH2
Sample Ref.	D9
Depth (m):	7.50

Description:
Yellow brown clayey silty fine SAND

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method

Sieve	
Sieve (mm)	% pass
200	100
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	100
14	100
10	100
6.3	100
5	100
3.35	100
2	100
1.18	100
0.6	100
0.425	100
0.3	100
0.212	100
0.15	99
0.063	26



Particle Proportions	
Cobbles	0.0 %
Gravel	0.0 %
Sand	74.2 %
Silt & Clay	25.8 %

Checked and Approved by

SB

S Burke (Snr Tech)

Date: 10/04/2014

Project Number:

GEO / 21012

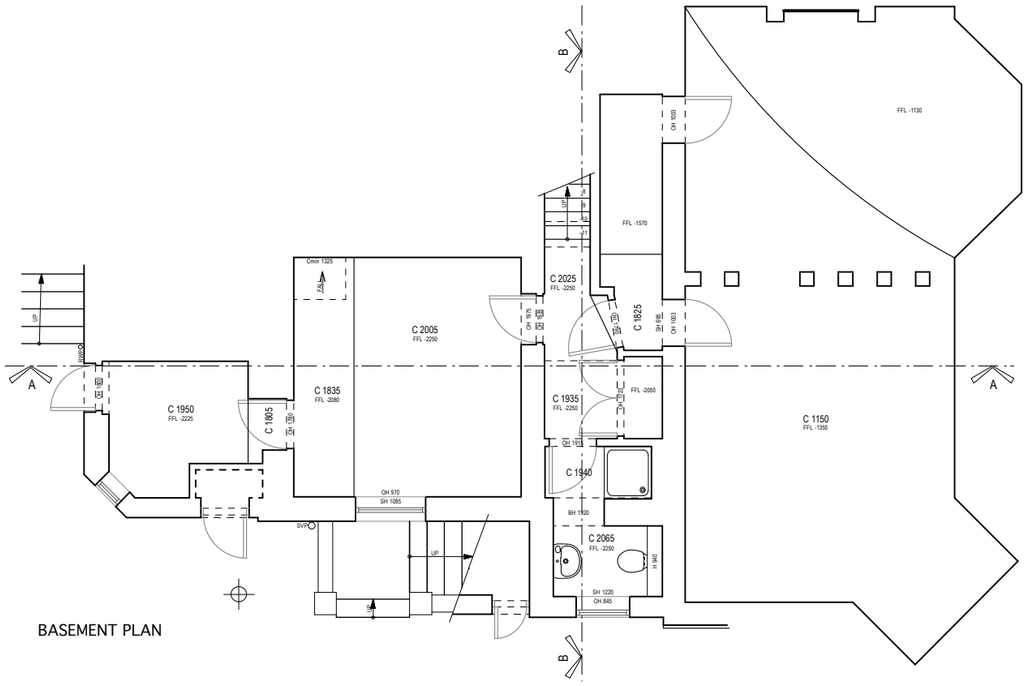
Project Name:

9 ELLERDALE ROAD, LONDON, NW6 3BA

Project Number J14075

GEOLABS

UKAS TESTING 1982



BASEMENT PLAN

NOTES:
Do not scale from this drawing. All dimensions to be verified on site. Not for construction. Drawing to read in conjunction with other relevant consultants information and specification.

Project Title

9 Ellerdale Road, NW3

Drawing Scale 1:100 @ A3 Date 04.04.13

Drawing Status Outline Proposals

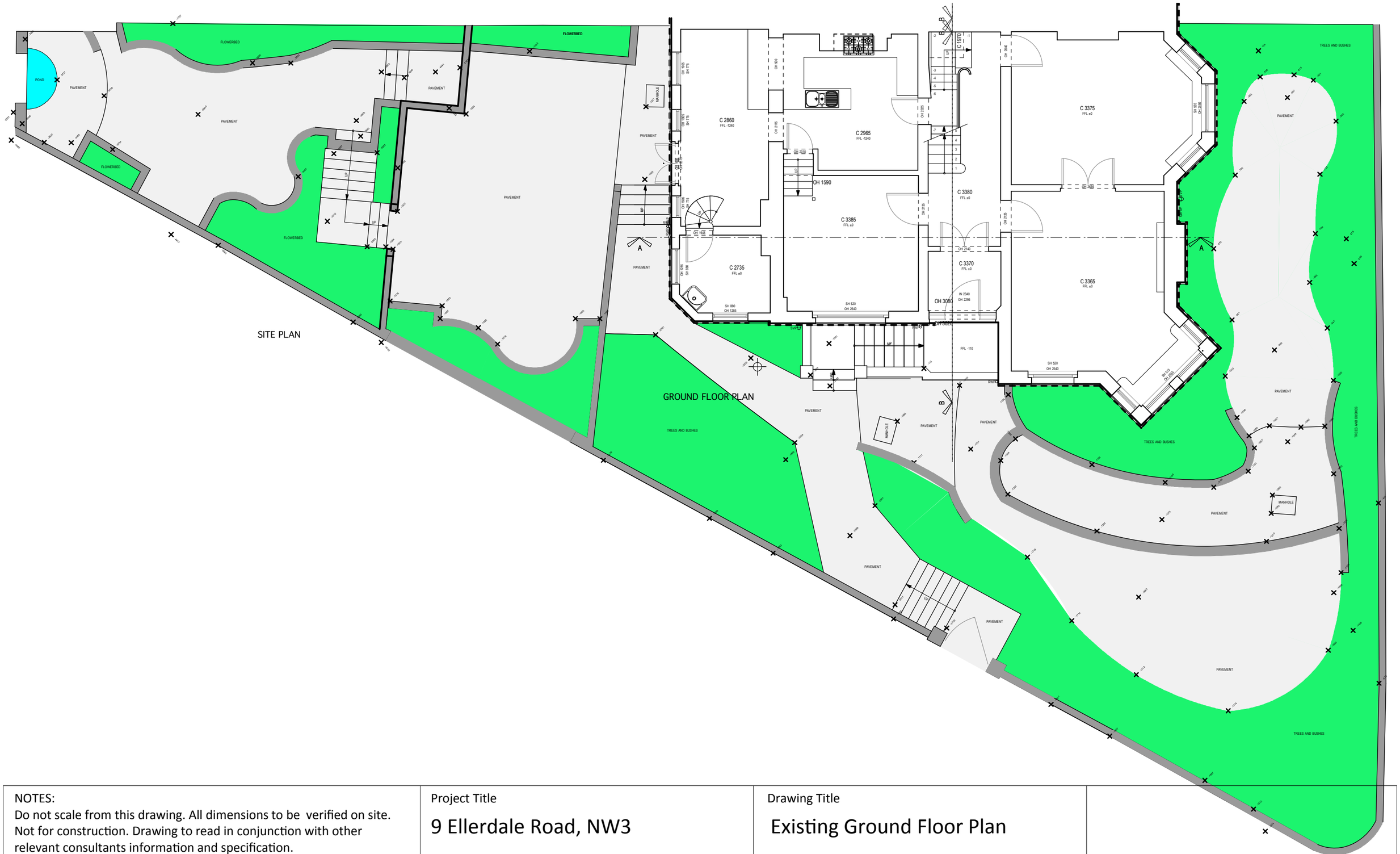
Drawing Title

Existing Basement Plan

Drawing Number

001

Lee J Davidson RIBA
Chartered Architect
Email: ribalee@gmail.com
Tel: 07884 006 129



NOTES:
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Project Title

9 Ellerdale Road, NW3

Drawing Scale 1:100 @ A3 Date 04.04.13

Drawing Status Outline Proposals

Drawing Title

Existing Ground Floor Plan

Drawing Number

002

Lee J Davidson RIBA
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SECTION A-A

NOTES:
Do not scale from this drawing. All dimensions to be verified on site.
Not for construction. Drawing to read in conjunction with other relevant consultants information and specification.

Project Title

9 Ellerdale Road, NW3

Drawing Scale 1:100 @ A3 Date 04.04.13

Drawing Status Outline Proposals

Drawing Title

Existing Section A-A

Drawing Number

004

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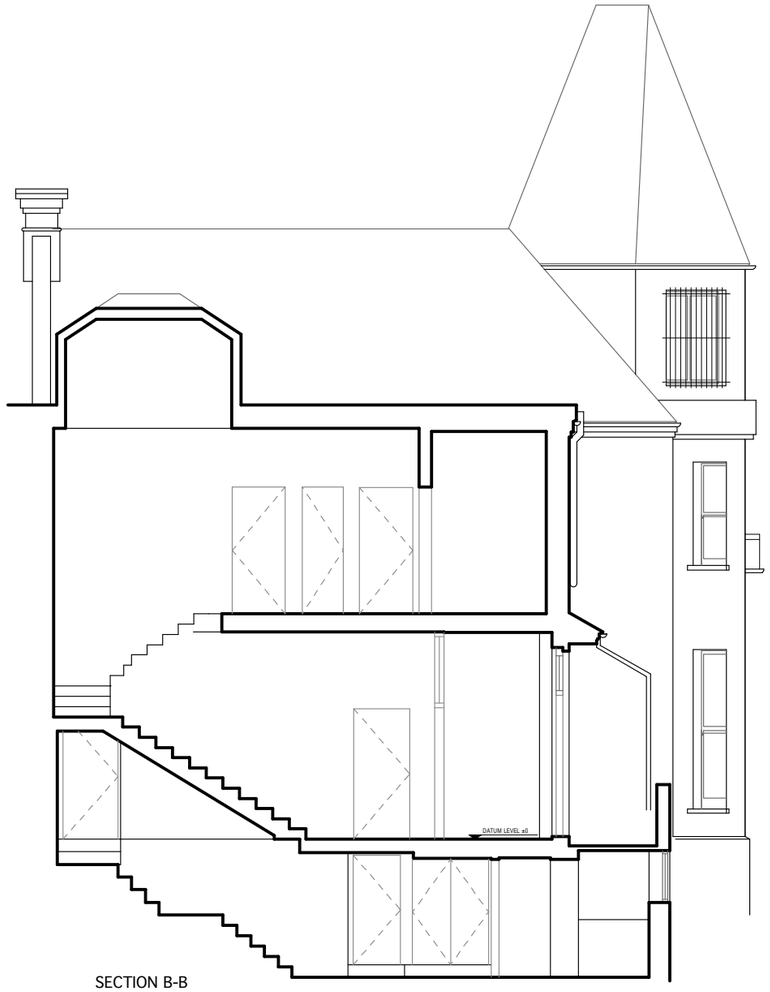

SECTION B-B

NOTES: Do not scale from this drawing. All dimensions to be verified on site. Not for construction. Drawing to read in conjunction with other relevant consultants information and specification.	Project Title 9 Ellerdale Road, NW3 Drawing Scale 1:100 @ A3 Date 04.04.13 Drawing Status Outline Proposals	Drawing Title Existing Section B-B Drawing Number 005	Lee J Davidson RIBA Chartered Architect Email: ribalee@gmail.com Tel: 07884 006 129

FRONT ELEVATION

NOTES:
Do not scale from this drawing. All dimensions to be verified on site. Not for construction. Drawing to read in conjunction with other relevant consultants information and specification.

Project Title

9 Ellerdale Road, NW3

Drawing Scale 1:100 @ A3 Date 04.04.13

Drawing Status Outline Proposals

Drawing Title

Existing Front Elevation

Drawing Number

006

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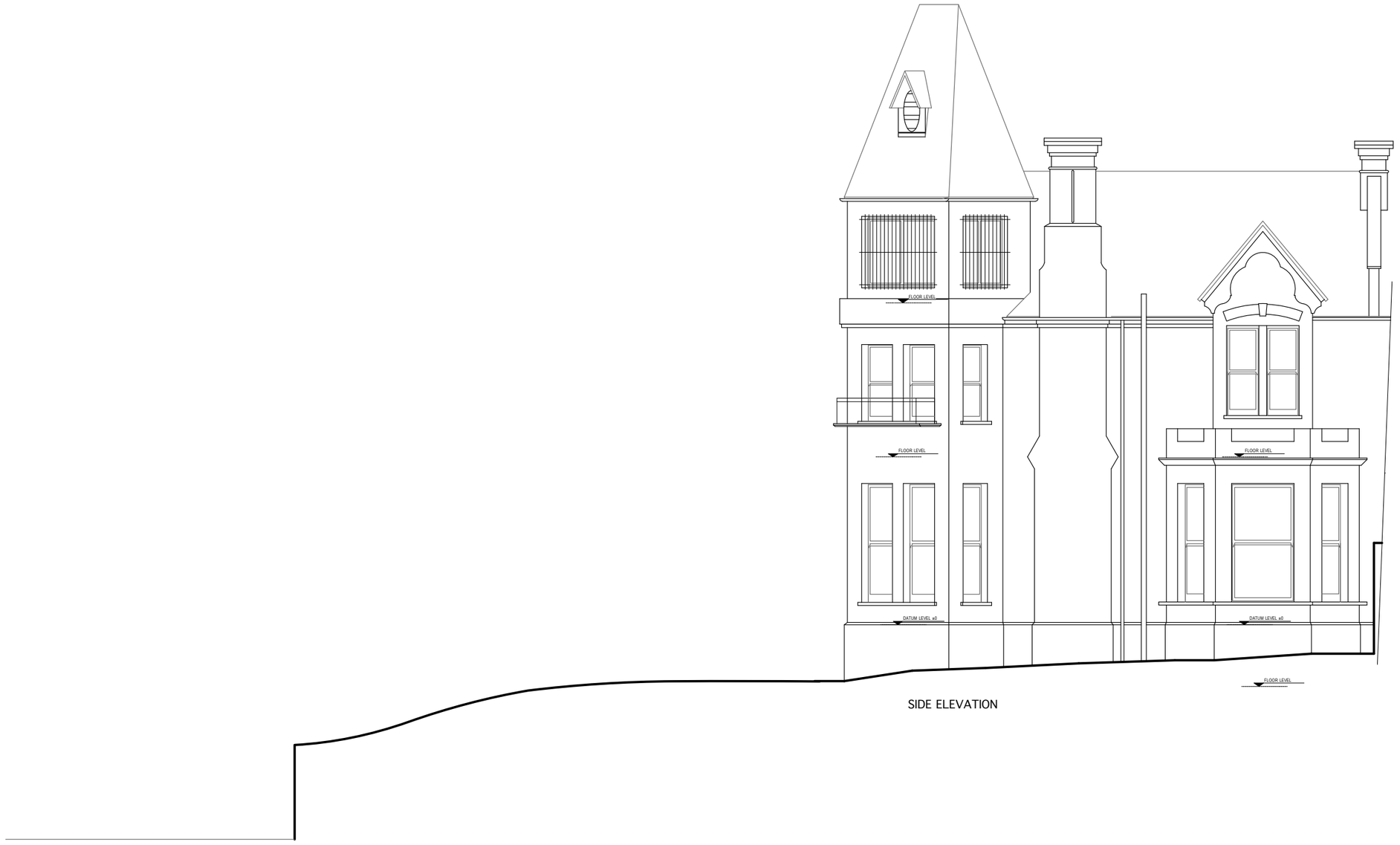

SIDE ELEVATION

NOTES:
Do not scale from this drawing. All dimensions to be verified on site. Not for construction. Drawing to read in conjunction with other relevant consultants information and specification.

Project Title

9 Ellerdale Road, NW3

Drawing Scale 1:100 @ A3 Date 04.04.13

Drawing Status Outline Proposals

Drawing Title

Existing Side Elevation

Drawing Number

007

Lee J Davidson RIBA
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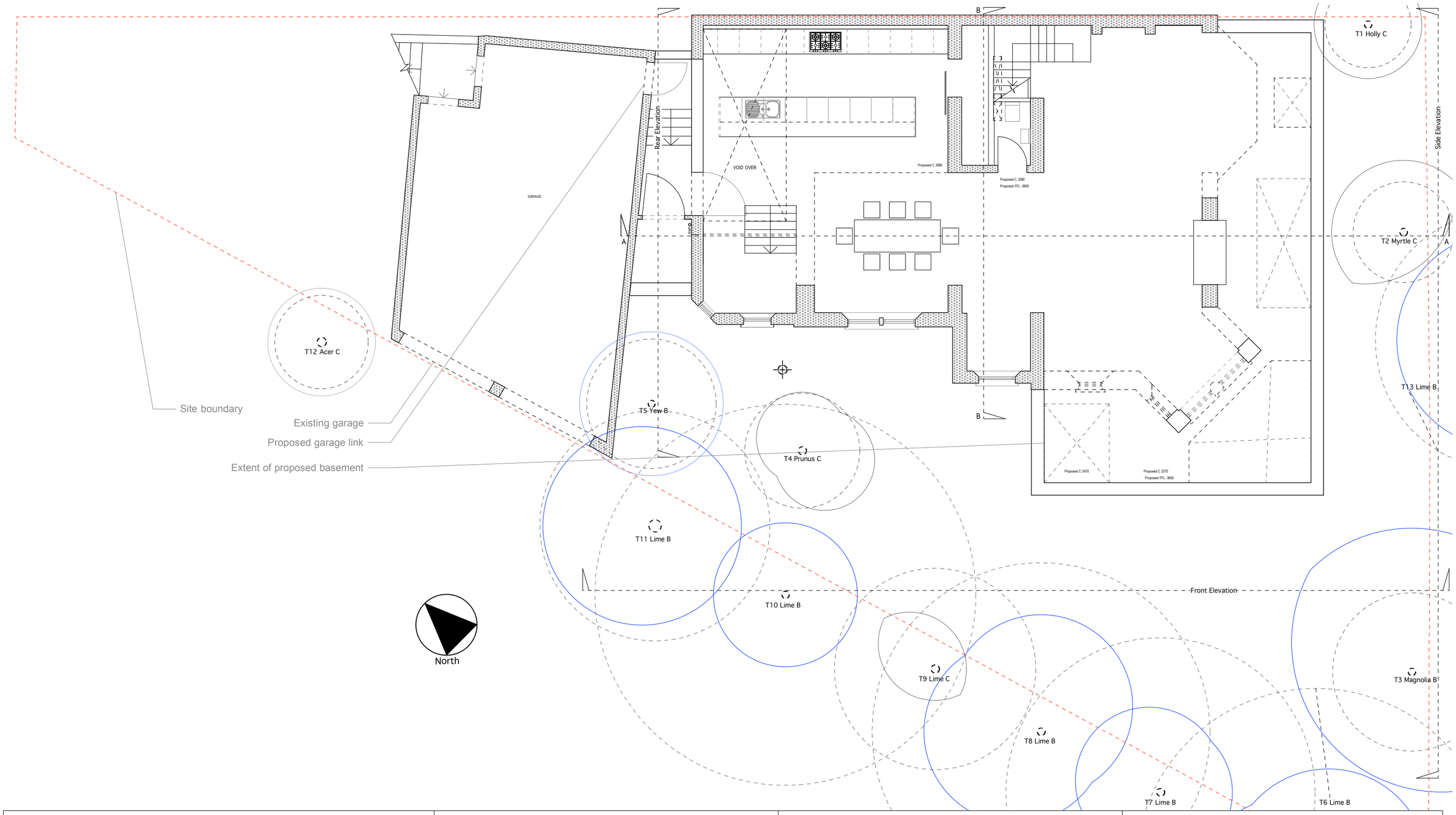

NOTES:
Do not scale from this drawing. All dimensions to be verified on site.
Not for construction. Drawing to read in conjunction with other relevant consultants information and specification.

Project Title

9 Ellerdale Road, NW3

Drawing Scale 1:100 @ A3 Date 18.05.13

Drawing Status Planning

Drawing Title

Proposed Basement Plan

Drawing Number

011

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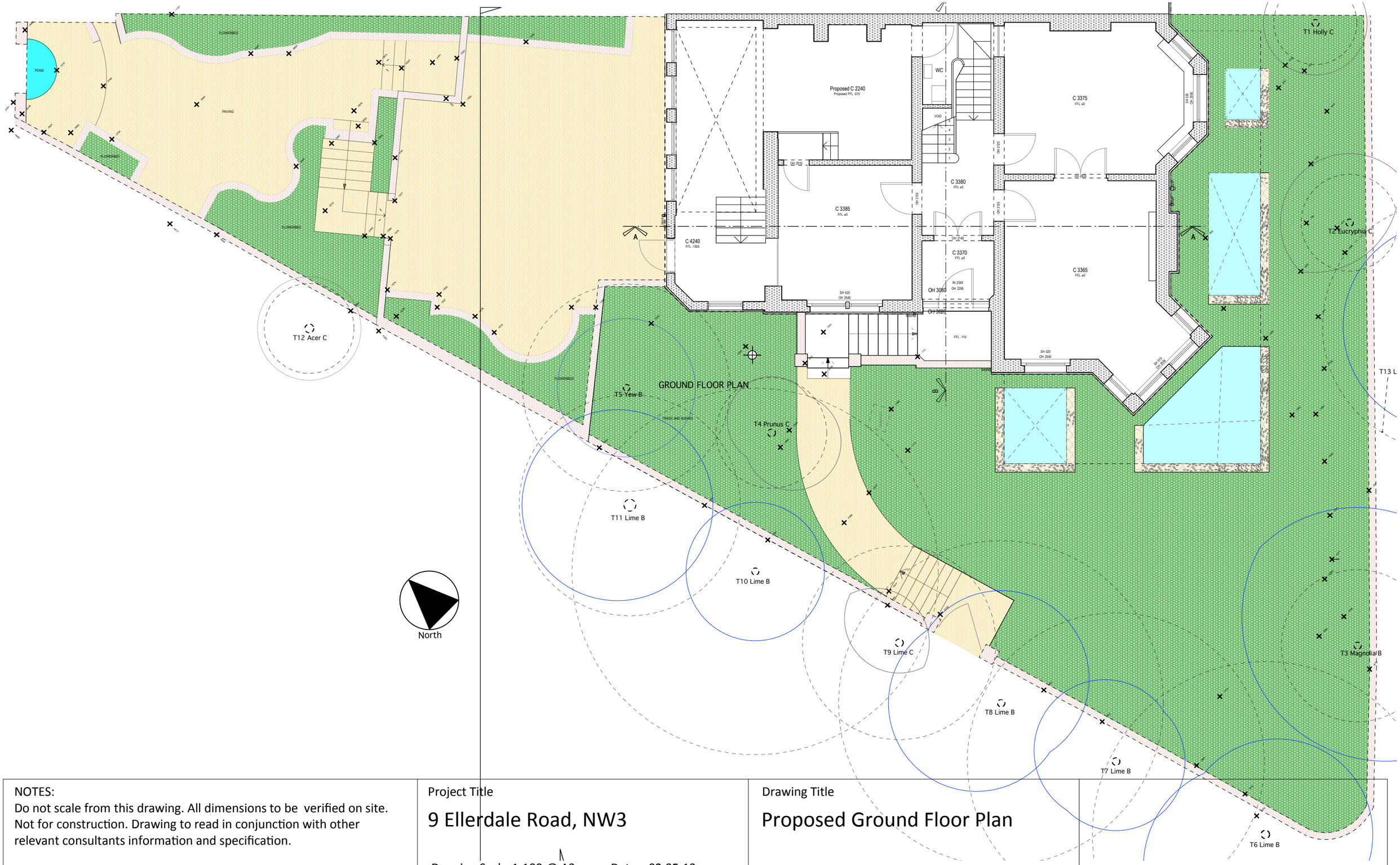

NOTES:
Do not scale from this drawing. All dimensions to be verified on site.
Not for construction. Drawing to read in conjunction with other relevant consultants information and specification.

Project Title

9 Ellerdale Road, NW3

Drawing Scale 1:100 @ A3 Date 02.05.13

Drawing Status Planning Draft

Drawing Title

Proposed Ground Floor Plan

Drawing Number

012

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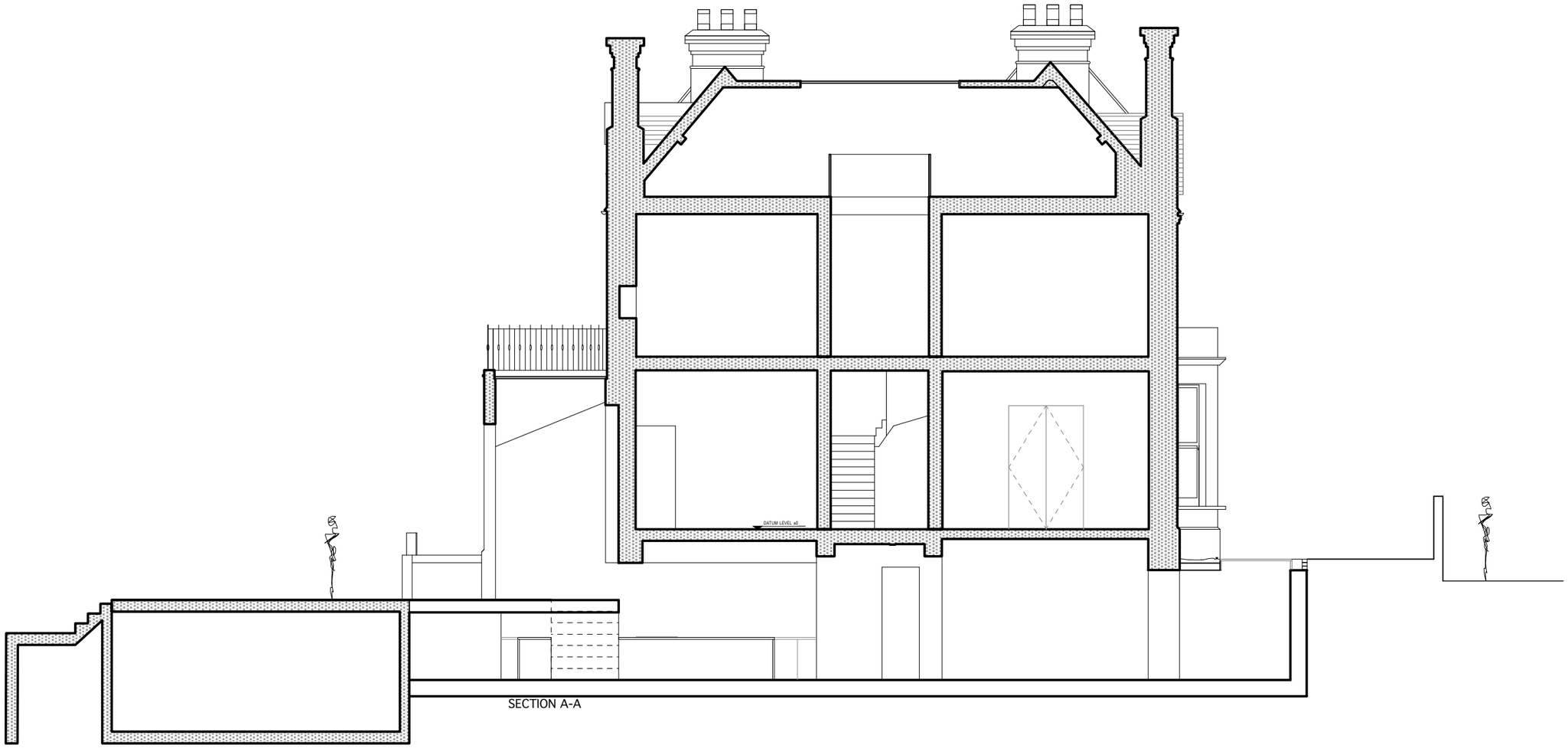

SECTION A-A

NOTES:
Do not scale from this drawing. All dimensions to be verified on site. Not for construction. Drawing to read in conjunction with other relevant consultants information and specification.

Project Title

9 Ellerdale Road, NW3

Drawing Scale 1:100 @ A3 Date 04.04.13

Drawing Status Planning

Drawing Title

Proposed Section A-A

Drawing Number

014

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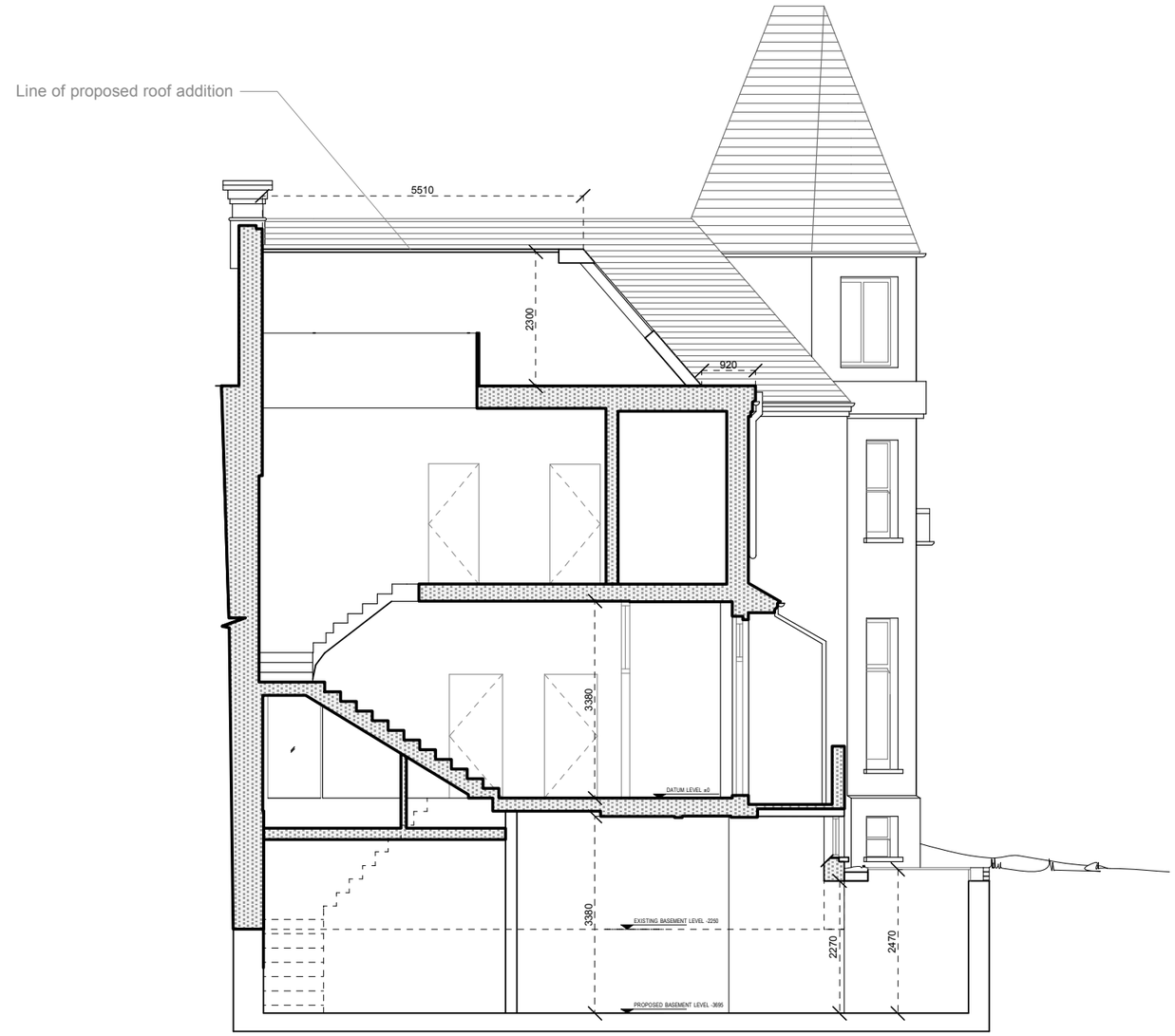
Tel: 07884 006 129



SECTION B-B

NOTES:
Do not scale from this drawing. All dimensions to be verified on site. Not for construction. Drawing to read in conjunction with other relevant consultants information and specification.

Project Title

9 Ellerdale Road, NW3

Drawing Scale 1:100 @ A3 Date 18.05.13

Drawing Status Planning

Drawing Title

Proposed Section B-B

Drawing Number

015

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WORKS CURRENTLY IN PROGRESS TO 18 PRINCE AURTHUR ROAD

REAR ELEVATION AND LONG SECTION THROUGH GARAGE LINK

NOTES:
Do not scale from this drawing. All dimensions to be verified on site. Not for construction. Drawing to read in conjunction with other relevant consultants information and specification.

Project Title

9 Ellerdale Road, NW3

Drawing Scale 1:100 @ A3 Date 18.05.13

Drawing Status Planning

Drawing Title

Proposed Rear Elevation

Drawing Number

018

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GEA Geotechnical & Environmental Associates

Tyttenhanger House
Coursers Road
St Albans
Herts AL4 0PG

Landfill Map

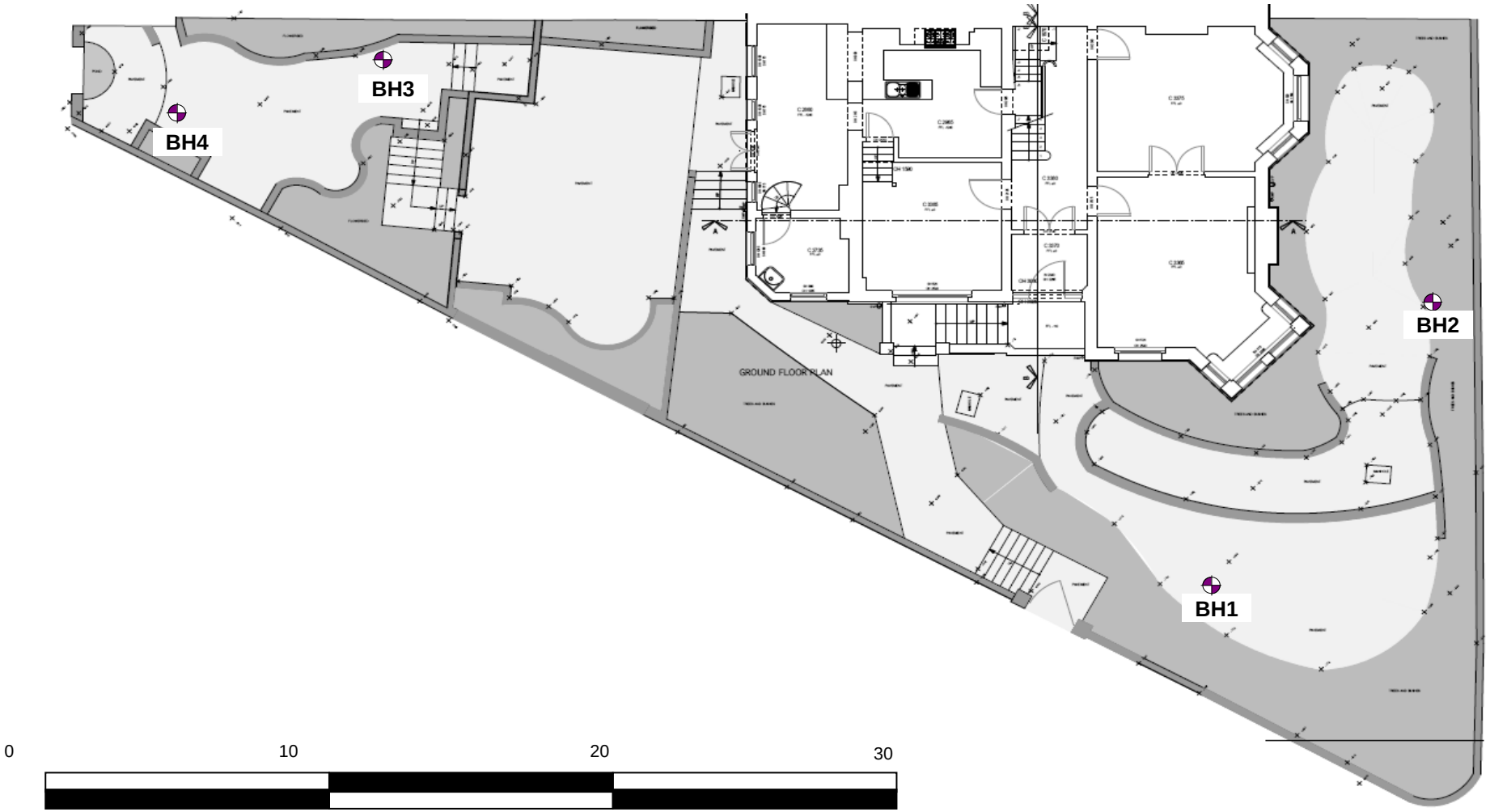
Site 9 Ellerdale Road, London, NW3 6BA

Client Mrs Y Jing

Engineer Price & Myers

Job Number J14075

Sheet 1 / 1



Geotechnical & Environmental Associates (GEA) is an engineer-led and client-focused independent specialist providing a complete range of geotechnical and contaminated land investigation, analytical and consultancy services to the property and construction industries**.**

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on all of the services that we offer.

GEA Geotechnical & Environmental Associates