

Ground Investigation Report and Basement Impact Assessment

Nice Place & Far End
Compton Avenue
London N6

Client Selected Assets Company Inc.

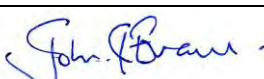
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EXECUTIVE SUMMARY

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 findings of a site investigation carried out by Geotechnical and Environmental Associates Limited (GEA), on the instructions of Pastor Real Estate Ltd and latterly Selected Assets Company Inc., with respect to the proposed development to include partial demolition of 'Far End', whilst retaining the front and side facades and complete demolition of 'Nice Place' to allow for the construction of two new three-storey houses with a connected double level basement, extending to a maximum depth of about 6.70 m. In addition it is also proposed to construct a new single storey outbuilding in the east of the rear garden of 'Nice Place'. The purpose of the investigation carried out in 2011 has been to research the history of the site, to assess the ground conditions, to provide a preliminary assessment of the presence of contamination and to provide information for the design of suitable foundations and retaining walls. Subsequently in 2014 a Basement Impact Assessment was required for the purpose of planning consent and the report has been revised accordingly. The site is located within the London Borough of Haringey but for the purpose of the Basement Impact Assessment the approach followed by the London Borough of Camden CPG4 has largely been adopted as it is now widely known and is considered to provide a robust approach to the issues of potential concern.

SUMMARY OF DESK STUDY FINDINGS

At the time of the earliest Ordnance Survey map, dated 1870, the site was undeveloped within an area of woodland known as Bishop's Wood, to the north of Hampstead Heath. The site was first developed some time between 1920 and 1936 with two detached properties, the southernmost of which appears to be the existing Far End. Annotation on the map dated 1952 indicates that the northern property was known as Bishop's Lodge, whilst by the same time, several extensions had been constructed adjacent to the western elevation of Far End. By 1975, Bishop's Lodge had been extended to form the existing layout, although it did not become known as Nice Place until sometime between 1991 and 1992. The site and surrounding area have remained essentially unchanged since that time until the present day.

GROUND CONDITIONS

Beneath a moderate thickness of made ground, the Claygate Formation was encountered and was underlain by the London Clay, which was proved to the maximum depth investigated. Made ground was encountered to depths of between 0.20 m (103.75 m OD) and 1.60 m (101.63 m OD) and generally comprised light brown and brown very silty sandy clay with roots, rootlets and occasional brick fragments. The underlying Claygate Beds initially comprised firm brown mottled orange-brown and grey very silty very sandy clay with pockets of orange-brown fine sand to depths of between 3.30 m (100.15 m OD) and 4.10 m (98.51 m OD). In Borehole Nos 1, 2, 3, 6 and 7, this horizon was noted to be stiff to depths of between 1.20 m (101.41 m OD) and 3.30 m (100.18 m OD) and has been assessed as being desiccated. Below the initial horizon, firm becoming stiff dark greenish grey silty sandy clay was encountered to the maximum depth investigated in the opendrive sampler boreholes, of 7.45 m (95.16 m OD), and to depths of between 7.80 m (95.43 m OD) and 14.50 m (89.45 m OD) in the cable percussion boreholes. Below these depths, the London Clay was encountered and comprised stiff becoming very stiff brownish grey silty fissured clay with occasional shell fragments, which was proved to the maximum depth investigated, of 25.00 m (78.23 m OD).

Contamination testing has revealed elevated concentrations of total PAH, including benzo(a)pyrene, and a single elevated concentration of lead within the made ground. Inflows of groundwater were encountered in the Claygate Member at depths of between 4.00 m (98.73 m OD) and 9.20 m (94.75 m OD). Monitoring of the standpipes installed in four of the boreholes was carried out on two occasions over a one month period in August 2011 and the visits recorded groundwater at depths of between 1.01 m (102.22 m OD) and 2.46 m (101.49 m OD). The standpipes were monitored again about three years later in April 2014, and groundwater was measured at depths of 1.34 m (102.61 m OD) and 1.42 m (102.23 m OD and 101.81 m OD).

RECOMMENDATIONS

Excavations for the proposed basement structure will require temporary support to maintain stability and to prevent any excessive ground movements. Based on the groundwater observations to date, groundwater is likely to be encountered within the 6.5 m deep basement excavation and therefore some form of bored pile wall is likely to be the best of option of supporting the basement excavation. Spread foundations excavated from basement level to bear within the firm clay of the Claygate Member may be designed to provide an allowable bearing pressure of 150 kN/m², provided that groundwater inflows can be sufficiently controlled. On the basis of the chemical testing, remedial measures, in order to protect end users should not be required.

BASEMENT IMPACT ASSESSMENT

It has been concluded that the majority of the impacts identified can be mitigated by appropriate design and standard construction practice. Groundwater is expected to be present at shallow depth beneath the site although inflows from within the Claygate Member would be expected to occur at a very slow rate such that they could be suitably controlled by sump pumping. The proposed works are not considered likely to have any detrimental effect on the local groundwater regime.

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 (GEA) were commissioned in 2011 by Pastor Real Estate Ltd and latterly Selected Assets Company Inc., to carry out a ground investigation at Nice Place & Far End, Compton Avenue, Highgate, N6 4LH. Following the initial ground investigation, development of the site did not proceed. Since the previous investigation new planning guidance¹, has been issued and a Basement Impact Assessment (BIA) has therefore now been commissioned for the purpose of the planning application and this report has been updated accordingly.

Although the site is located within the London Borough of Haringey, for the purpose of the Basement Impact Assessment the Haringey guidance has been supplemented by the approach followed by the London Borough of Camden CPG4 as it is now widely known and is considered to provide a robust approach to the issues of potential concern.

The following documents have been supplied by the consulting engineers and are commented on within this report where appropriate.

- ❑ An arboriculture report for the site (report ref: DPA69635, dated May 2011), carried out by DPA Arboricultural Consultants;
- ❑ Phase 1&2 Geotechnical Report & Structural Desk Study at Nice Place and Far End, Compton Avenue, London, N6 4LH Rev C (ref 110161/TB dated June 2014), carried out by Conisbee Consulting Engineers; and
- ❑ Flood Risk Assessment and Sustainable Drainage Strategy (ref 110161/TG, dated 18th June 2014), also carried out by Conisbee Consulting Engineers.

1.1 Proposed Development

It is understood that the proposed development is to include partial demolition of 'Far End' whilst retaining the existing front and side facades and complete demolition of 'Nice Place' to allow for the subsequent construction of two new three-storey detached houses with a connected double level basement. The basement will be separated by a dividing wall between the two houses. The proposed basement will extend beyond the footprint of both existing buildings and into the rear gardens, and extend to a maximum depth of about 6.70 m, with a formation level of roughly 96.50 m OD, which will include a swimming pool. In addition, it is also proposed to construct a new single storey outbuilding in the east of the rear garden of 'Nice Place'.

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

¹ Haringey Basement Development Guidance Note, June 2012

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 provide advice with respect to the design of suitable foundations and retaining walls;
- ❑ to investigate the configuration of existing foundations;
- ❑ to provide an indication of the degree of soil contamination present;
- ❑ to provide a preliminary assessment of the impact of the proposed development on groundwater, surface water and land stability; and
- ❑ to assess the risk that any such contamination may pose to the proposed development, its users or the wider environment.

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 readily available geological and hydrogeological maps;
- ❑ a review of historical Ordnance Survey (OS) maps and environmental searches sourced from the Envirocheck database; and
- ❑ a walkover survey of the site carried out in conjunction with the fieldwork.

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

- ❑ four cable percussion boreholes, drilled to a maximum depth of 25.00 m using a standard cable percussion rig;
- ❑ an additional three boreholes drilled to a maximum depth of 7.45 m using an opendrive percussive sampler (Terrier rig) to provide additional information on the shallow soils;
- ❑ standard penetration tests (SPTs), carried out at regular intervals in the cable percussion boreholes, to provide additional quantitative data on the strength of the soils;
- ❑ groundwater monitoring standpipes installed in four of the boreholes and two monitoring visits carried out over a one month period;
- ❑ a series of seven hand-dug trial pits to expose the foundations of the existing structures;

- ❑ six insitu California Bearing Ratio (CBR) tests carried out in order to provide parameters for the design of new roads and pavements;
- ❑ testing of selected soil samples for geotechnical and contamination purposes; and
- ❑ provision of a report presenting and interpreting the above data, together with our advice and recommendations with respect to the proposed development.

The report includes a contaminated land assessment which has been undertaken in accordance with the methodology presented in Contaminated Land Report (CLR) 11² and involves identifying, making decisions on, and taking appropriate action to deal with, land contamination in a way that is consistent with government policies and legislation within the United Kingdom. The risk assessment is thus divided into three stages comprising Preliminary Risk Assessment, Generic Quantitative Risk Assessment, and Site-Specific Risk Assessment. The contamination results gathered during the ground investigation in 2011 have been reviewed to bring the subsequent analysis in line with current contaminated land assessment methodologies for 2014.

1.3.1 Basement Impact Assessment

The work carried out includes information required for a Hydrological and Hydrogeological Assessment and Land Stability Assessment (also referred to as Slope Stability Assessment), which form part of the BIA procedure specified in the Haringey development guidance and in the London Borough of Camden (LBC) Planning Guidance CPG4³ and their Guidance for Subterranean Development⁴ prepared by Arup. The aim of this work is to provide information on the groundwater conditions specific to this site and land stability, in particular to assess whether the development will affect the stability of neighbouring properties and whether any identified impacts can be appropriately mitigated.

1.3.2 Qualifications

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 the Geological Society (FGS) with almost 30 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.

2 *Model Procedures for the Management of Land Contamination* issued jointly by the Environment Agency and the Department for Environment, Food and Rural Affairs (DEFRA) Sept 2004
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

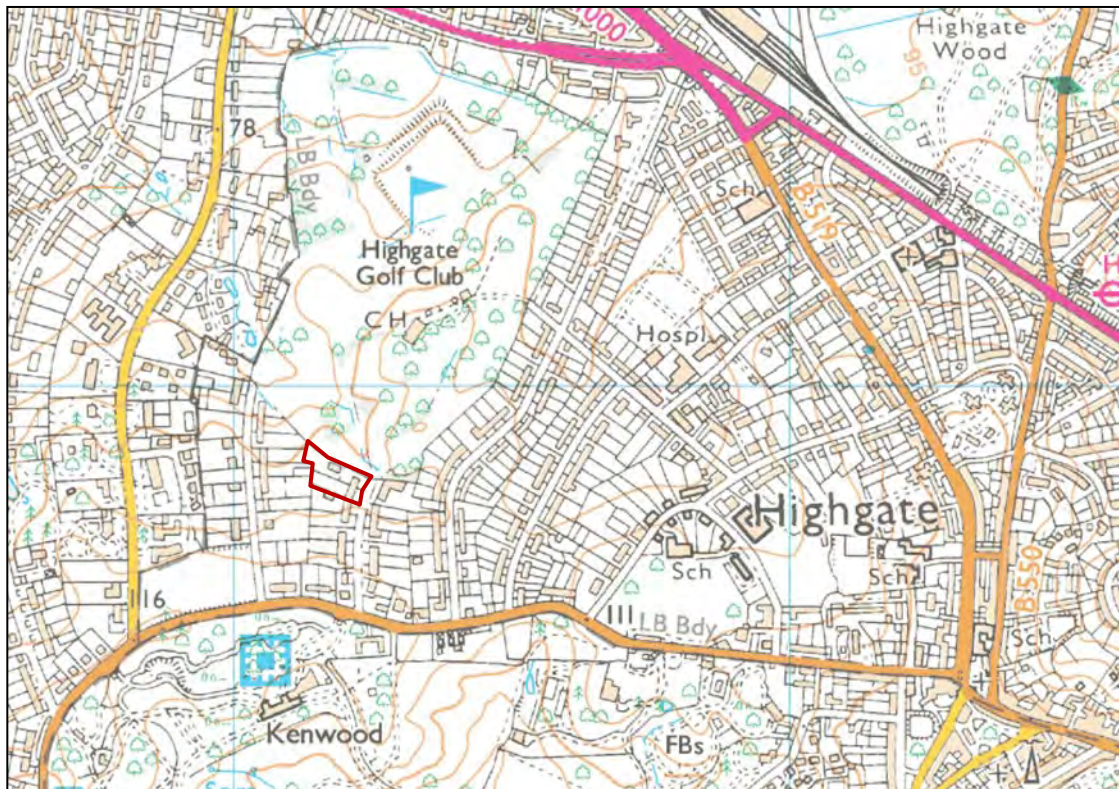
1.4 Limitations

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, the number of locations where the ground was sampled and the number of soil, gas or groundwater samples tested; 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 approximately 1.3 km to the southwest of Highgate London Underground station to the north of Hampstead Heath. It fronts onto Compton Avenue to the east, and is bounded by detached houses and associated private gardens to the west and south and by the southern part of Highgate Golf Course to the north. The site may be additionally located by National Grid Reference 527196 187734, as shown by the location map below.



The site comprises a roughly rectangular shaped area with maximum dimensions of 50 m by 120 m and is occupied by two three-storey detached houses known as Nice Place and Far End, on separate plots. The two houses, along with areas of block-paved and concrete driveways are situated in the eastern half of the site with the remainder being occupied by the private gardens to each property.

With the exception of a single storey outbuilding located in the garden of Nice Place, which is understood to house a swimming pool, the gardens are laid to lawn with planted bedding and borders and a number of semi-mature and mature deciduous trees including oak, maple, sycamore, hawthorn and silver birch ranging between 4 m and 21 m in height. The buildings and paved areas are for the majority at a constant level, with the lawn areas sloping gently down to the north.

2.2 Topography

The site lies between 100 m to 105 m above ordnance datum (OD) on ground that falls away to roughly 65 m OD at Big Wood, north of Golders Green, roughly 1.7 km to the northwest and to about 65 m OD at Highgate Ponds about 1.5 km to the southeast and further beyond to the River Thames some 8 km also to the southeast. More locally, Compton Avenue slopes down from 114.3 m OD in the south, indicated by an historical OS map, to 103.5 m OD in the north adjacent to the site, while the site itself slopes gently up from roughly 100.5 m OD in the northeast to 104.7 in the south over a distance of approximately 140 m, giving a slope angle of less than 2°.

2.3 Site History

The history of the site and surrounding area has been researched by reference to historical Ordnance Survey (OS) maps sourced from the Envirocheck database.

At the time of the earliest Ordnance Survey map, dated 1870, the site was undeveloped within an area of woodland known as Bishop's Wood, to the north of Hampstead Heath. The site was first developed some time between 1920 and 1936 with two detached properties, the southernmost of which appears to be the existing Far End.

Annotation on the map dated 1952 indicates that the northern property was known as Bishop's Lodge, whilst by the same time, several extensions had been constructed adjacent to the western elevation of Far End. By 1975, Bishop's Lodge had been extended to form the existing layout, although it did not become known as Nice Place until some time between 1991 and 1992.

The site and surrounding area have remained essentially unchanged since that time until the present day.

2.4 Other Information

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

The search has revealed that there are no existing or historical landfills, waste management, transfer, treatment or disposal sites within 500 m of the site.

The site is not indicated as being at risk from flooding, nor is it located within a Groundwater Source Protection Zone as defined by the Environment Agency (EA).

The search has indicated that the site is located in an area where less than 1% of homes are affected by radon emissions; which is the lowest classifications given by the Health Protection Agency (HPA) and therefore no radon protective measures will be necessary.

2.5 Geology

The British Geological Survey map of the area (Sheet 256 and online database) 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. A previous investigation carried out by GEA along Sheldon Avenue, around 220 m southeast of the site indicated the base of the Claygate beds at around 101 m OD. The geology in this area is generally horizontally bedded such that the strata boundaries roughly follow the contour lines and the geology map indicates that the base of the Claygate is likely to be at about 100 m OD.

According to the British Geological Society memoir, the Claygate Member comprises alternating beds of clayey silt, very silty clay, sandy silt and glauconitic silty fine sand. The lower part of the Claygate Member is generally more bioturbated and a bed of calcareous concretions is present near the base in many places. The uppermost Unit D of the London Clay Formation comprises bioturbated glauconitic sandy clayey silt to sandy silt.

2.6 Hydrology and Hydrogeology

The Claygate member in this area is classified as a Secondary 'A' Aquifer by the Environment Agency (EA).

The boundary between the Claygate Member and underlying London Clay is located to the north of the site on Highgate Golf Course. A number of spring lines issue on Hampstead Heath at the interface of the Bagshot Beds and the Claygate Member, and to a lesser extent at the boundary between the Claygate Member and the underlying essentially impermeable London Clay. These springs have been the source of a number of London's "lost" rivers, notably the Fleet, Westbourne and Tyburn, which all rose on Hampstead Heath at the base of the Bagshot Beds. However, there are no known documented springs on the site.

The topographical maps show that the nearest surface water feature is located 16 m to the east of the site, which appears to be a small headwater stream located within Highgate Golf Course which flows south-north for a short distance before flowing underground and re-emerging roughly 50 m north where it then flows to the northwest disappearing below ground level until it is assumed it joins with a pond and series of streams just north of Courtenay Avenue. The site is not within an area at risk from flooding as defined by the EA.

The site is partially covered by the existing houses, outbuildings and areas of hardstanding surrounding Nice Place in the north. Infiltration of rainwater into the ground beneath the site is limited to the area of soft landscaping in the front garden of Far End and both rear gardens and given the general topography of the site the majority of surface runoff is likely to drain towards the north and west following the topographic gradient, although infiltration into the underlying Claygate Member is likely to be limited where the soil is dominated by clay so a high proportion of surface water runoff will occur from site generally.

2.7 Preliminary Contamination Risk Assessment

Part IIA of the Environmental Protection Act 1990, which was inserted into that Act by Section 57 of the Environment Act 1995, provides the main regulatory regime for the identification and remediation of contaminated land. The determination of contaminated sites is based on a "suitable for use" approach which involves managing the risks posed by contaminated land by making risk-based decisions. This risk assessment is carried out on the basis of a source-pathway-receptor approach.

2.7.1 Source

The desk study research has indicated that the site has only been occupied by the existing residential property throughout its developed history. On this basis the site is not deemed to have had a contaminative history. There are no historical or existing landfill sites within 500 m of the site and therefore there is not a risk to the site from landfill gas.

2.7.2 Receptor

The future occupants of the residential dwellings will represent a relatively high sensitivity receptor. The site is underlain by a Secondary 'A' Aquifer and therefore groundwater is considered to be a relatively sensitive receptor. Buried services are likely to come into contact with any contaminants present within the soils through which they pass and site workers are likely to come into contact with any contaminants present during demolition and construction works.

2.7.3 Pathway

As the site is underlain by predominantly cohesive soils of the Claygate Member and underlying London Clay, there will be limited potential contaminant exposure pathways, although end users could conceivably come into contact with soils within private garden areas. This pathway is considered to already be in existence. In addition there will be a limited potential for contaminants to move onto or off the site, except horizontally within any made ground or topsoil layer or upon the interface with the underlying Claygate Member, in association with perched groundwater movements. A pathway for ground workers to come into contact with any contamination will exist during construction work and services will come into contact with any contamination within the soils in which they are laid.

2.7.4 Preliminary Risk Appraisal

On the basis of the above it is considered that there is a LOW risk of there being a significant contaminant linkage at this site which would result in a requirement for major remediation work. Furthermore as there is no evidence of filled ground within the vicinity of the site and no landfill sites, there is not considered to be a significant potential for hazardous soil gas to be present on or migrating towards the site.

3.0 SCREENING

The London Borough of Haringey guidance refers to the needs for screening and scoping stages and the more detailed London Borough of Camden guidance has been adopted in this respect to provide a logical sequence and method to the assessment.

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?	<i>Yes the site is located above a Secondary 'A' Aquifer as designated by the EA.</i>
1b. Will the proposed basement extend beneath the water table surface?	<i>Yes. The proposed basement level is about 96.50 m OD and may extend below the water table.</i>
2. Is the site within 100 m of a watercourse, well (used/disused) or potential spring line?	<i>Yes, the nearest surface water feature is 16 m east of the site.</i>
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?	<i>Yes, the footprint of the existing buildings and new areas of hardstanding will approximately double and a small hard surfaced area also proposed in the northwest of site.</i>
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, site drainage to be designed to generally maintain the existing situation, although the Claygate Member is not generally suitable for surface water soakaway or similar SUDS designs
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?	<i>Yes, the watercourse, which may be a springline, to the northeast is at an elevation of c.100m OD which is above the level of the proposed basement.</i>

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.
- 1b. The proposed basement level is about 96.50 m OD and may extend below the water table.
2. The lowest point of the proposed excavation is lower than the mean water level of the local pond in the northwest.
4. The footprint of the existing buildings and new areas of hardstanding will approximately double and a small hard-surfaced area also proposed in the northwest of site

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.

Question	Response
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?	<i>Yes, an 18 m high oak, 15 m high hornbeam, two holly trees, 4 m and 7 m in height and a 9 m high cypress are due to be removed from the rear gardens, with a 3 m high lime and 4 m high maple from the front garden of Nice Place. All other trees are to remain, see plan appended.</i> <i>The basement excavation will also fall within the protection zones of a number of mature trees, most notably within the front and rear gardens of Far End and at the northern boundary with Highgate Golf Course.</i>
7. Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site?	<i>Yes. The area is prone to these effects as a result of the presence of shrinkable London Clay and abundant mature trees.</i>
8. Is the site within 100 m of a watercourse or potential spring line?	<i>Yes, the nearest surface water feature is 16 m east of the site.</i>
9. Is the site within an area of previously worked ground?	No.
10a. Is the site within an aquifer?	<i>Yes the site is located above a Secondary 'A' Aquifer as designated by the EA</i>
10b. Will the proposed basement extend beneath the water table such that dewatering may be required during construction?	<i>Yes. The proposed basement level is about 96.50 m OD and may extend below the water table.</i>
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?	<i>Yes - the site fronts onto a private road to the east.</i>
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Possibly, a single storey basement is proposed close to a neighbouring property to the south.
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.
- Q8 The site is within 100 m of a watercourse
- Q10a The site is located above a Secondary 'A' Aquifer as designated by the EA
- Q10b The proposed basement may extend beneath the water table
- Q12 The site is within 5 m of a public highway.
- Q13 The proposed basement will significantly increase the differential depth of foundations relative to neighbouring properties.

The potential issues that need to be assessed, along with the possible effects of the basement construction on the local hydrology and hydrogeology, 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?	<i>Yes. The footprint of the existing buildings and new areas of hardstanding will approximately double and a small hard surfaced area is also proposed in the northwest of site and an increased demand on the drainage is likely to result.</i>
3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	<i>Yes. The footprint of the existing buildings and new areas of hardstanding will approximately double and a small hard surfaced area also proposed in the northwest of site</i>
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?	Possibly, the site is in an area of subsurface streams that flow in a northwesterly direction on to Highgate Golf Course, given the depth of the proposed basement it is possible some impact will occur.
5. Will the proposed basement result in changes to the quantity of surface water being received by adjacent properties or downstream watercourses?	Possibly, ditto.
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 the following potential issues that need to be assessed further.

- Q2. Surface water flows (eg volume of rainfall and peak run-off) may be materially changed from the existing route
- Q3. The proposed basement development may result in a change in the proportion of hard surfaced / paved areas
- Q4. The proposed basement development may result in changes to the profile of the inflows (instantaneous and long term) of surface water being received by adjacent properties or downstream watercourses
- Q5. The proposed basement may result in changes to the quantity of surface water being received by adjacent properties or downstream watercourses

A full review by GEA of the Flood Risk Assessment and Sustainable Drainage Strategy (ref 110161/TG, dated 18th June 2014) carried out by Conisbee Consulting Engineers was not possible due to the relevant qualifications not being held. A partial reference to the document has detailed that there is only one viable option available for the disposal of surface water from site, which is to discharge directly into the public sewer network. The report also details that a surface water pump station will be required at this site.

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 level may be below the water table and this could increase flow paths and/or raise groundwater levels locally.
The proposed basement will extend beneath the water table	
The site is within 100 m of a watercourse	The proposed basement could impact upon the groundwater flow regime to a nearby watercourse, by creating a barrier to the existing groundwater profile.
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	
The proposed basement development result in a change in the proportion of hard surfaced / paved areas	The proportional increase in hardstanding could potentially reduce rates of recharge reducing groundwater flow to a nearby watercourse.
Surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route	
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 the depth likely to be affected by tree roots this could lead to damaging differential movements
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.
The proposed basement will significantly increase the differential depth of foundations relative to neighbouring properties	If not designed and constructed appropriately, the excavation of a basement may result in structural damage to neighbouring buildings and structures.

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

4.2 Exploratory Work

In order to meet the objectives described in Section 1.2, four cable percussion boreholes were drilled, to depths of 25.00 m. In addition, a further three boreholes were drilled using an opendrive percussive sampler in order to provide additional coverage of the site in less accessible parts of the site. Standard penetration tests (SPTs) were carried out at regular intervals in order to provide quantitative data on the strength of the underlying soils.

Groundwater monitoring standpipes were installed in four of the boreholes to depths of between 7.0 m and 10.0 m, and have been monitored on two occasions over a one month period.

The boreholes were supplemented by a series of seven hand-dug trial pits in order to expose the existing foundations and allow the inspection of the footings and bearing stratum. A series of insitu CBR tests was also undertaken in order to provide parameters for the design of new roads and pavements.

The fieldwork was carried out under the supervision of a geotechnical engineer from GEA. A selection of the disturbed and undisturbed samples recovered from the boreholes and trial pits was submitted to a soil mechanics laboratory for a programme of geotechnical testing and an analytical laboratory for a programme of contamination testing.

4.3 Sampling Strategy

The borehole and trial pit locations were specified by the consulting engineers and positioned on site by GEA, along with the CBR locations, to obtain optimum coverage of the site with due regard to the proposed development, whilst avoiding buried services.

The analytical suite of testing was selected to identify a range of typical industrial contaminants for the purposes of general coverage. For this investigation the analytical suite for the soil included a range of metals, speciation of total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), total cyanide and monohydric phenols. The contamination analyses were carried out at an MCERTs accredited laboratory with the majority of the testing suite accredited to MCERTS standards. A summary of the MCERTS accreditation and test methods are included with the attached results and further details are available upon request.

The borehole, trial pit and CBR records and the results of the laboratory analyses are appended, together with a site plan indicating the exploratory positions. The Ordnance Datum (OD) levels shown on the borehole and trial pit records have been interpolated from spot heights shown on a site survey (drawing ref. 110161/SSK 04 dated 19/05/11) provided by the consulting engineers.

5.0 GROUND CONDITIONS

The investigation has generally encountered the expected ground conditions in that, beneath a variable thickness of topsoil or made ground, the Claygate Member was encountered overlying the London Clay, which was proved to the full depth of the investigation, of 25.00 m (78.23 m OD).

The precise location of the boundary between the Claygate Member and London Clay is often difficult to define due to its gradational contact, and the close similarities in composition and geotechnical properties of each stratum.

5.1 Topsoil / Made Ground

Topsoil was encountered in a single location to a depth of 0.30 m (103.65 m OD) and comprised light brown very silty sandy clay with roots and rootlets. Made ground was encountered in all other locations and generally comprised light brown to brown very silty sandy clay with variable amounts of gravel, brick, concrete, roots and rootlets and was encountered to depths of between 0.20 m (103.75 m OD) to 1.60 m (101.63 m OD).

No visual or olfactory evidence of contamination was observed in the made ground; however a number of samples were analysed for a range of contaminants as a precautionary measure and the results are summarised in Section 4.5.

5.2 Claygate Member

The Claygate Member initially comprised firm brown mottled orange-brown and grey very silty very sandy clay with pockets of orange brown fine sand to depths of between 2.50 (101.45 m OD) and 3.50 m (99.23 m OD). In Borehole Nos 1, 2, 3, 6 and 7, this horizon was noted to be stiff to depths of between 1.20 m (101.41 m OD) and 3.30 m (100.18 m OD) and has been assessed as desiccated.

The results of laboratory testing indicate the clay to be of moderate volume change potential.

No visual or olfactory evidence of contamination was observed in this stratum.

5.3 London Clay

The London Clay was found to initially comprise firm becoming stiff dark greenish grey silty sandy clay was encountered to the maximum depth investigated of 7.45 m (95.16 m OD) in the open-drive sampler boreholes, and to depths of between 7.80 m (95.43 m OD) and 14.50m (89.45 m OD) in the cable percussion boreholes. Below these depths, stiff becoming very stiff brownish grey silty fissured clay with occasional shell fragments and claystones and was proved to the maximum depth investigated, of 25.00 m (78.23 m OD).

The results of laboratory testing indicate the clay to be of generally moderate volume change potential.

5.4 Groundwater

Slow inflows or seepages of groundwater were encountered in the Claygate Member during drilling of the boreholes at depths of between 4.00 m (98.73 m OD) and 9.20 m (94.75 m OD).

Groundwater monitoring standpipes were installed in four of the boreholes to depths of between 7.00 m (95.65 m OD) and 10.00 m (93.95 m OD) and were monitored on two occasions as part of the ground investigation in 2011. The standpipes were monitored again about three years later in April 2014, and groundwater was measured at depths of 1.34 m (102.61 m OD) in Borehole No 1 and 1.42 m (102.23 m OD and 101.81 m OD) in Borehole Nos 2 and 5 respectively.

Date	Borehole No	Depth to water (m) [Level (m OD)]
19/07/2011 (during fieldwork)	1	2.46 [101.49]
	2	2.08 [101.57]
	3	1.83 [100.90]
	5	1.01 [102.22]
19/08/2011	1	2.27 [101.68]
	2	2.22 [101.71]
	3	2.01 [101.08]
	5	1.26 [101.97]

Date	Borehole No	Depth to water (m) [Level (m OD)]
28/04/2014	1	1.34 [102.61]
	2	1.42 [102.23]
	3	Not accessible
	5	1.42 [101.81]

The results of the groundwater monitoring suggest that groundwater levels reflect the topographic fall across the site; however groundwater flow will be severely limited within the low permeability clay strata and the water in each monitoring borehole is very unlikely to be in hydraulic continuity.

5.5 Soil Contamination

The use of a risk-based approach, which is presented in Part 2 of this report, means that it is not appropriate to determine the significance of contamination test results by simply comparing individual contaminant concentrations to a single “trigger” or “target” concentration. The significance of the results is therefore considered in more detail in Part 2, whilst the table below sets out the range of values measured within six samples and indicates the statistically weighted average concentrations.

Determinant	Maximum concentration recorded (mg/kg)	Minimum concentration recorded (mg/kg)	Number of samples below detection limit	Normalised upper bound US ₉₅
Arsenic	16	5.9	None	14
Cadmium	0.27	0.1	3	0.2
Chromium	35	11	None	29.3
Copper	170	8.7	None	96.7
Mercury	1.1	0.1	2	0.8
Nickel	39	5.8	None	27.7
Lead	1500	25	None	790
Selenium	0.47	0.2	3	0.4
Zinc	520	26	None	296.5
Total Cyanide	<0.5	<0.5	All	0.5
Total Phenols	<0.3	<0.3	All	0.3
Sulphide	31	1.0	None	17.4
TPH	10	10	All	10
Total PAH	23	2	2	14.0
Benzo(a)pyrene	1.5	0.1	2	0.9
Naphthalene	0.78	0.1	3	0.6
Total organic carbon %	5.2	0.45	None	3.5

Note: The use of the normalised upper bound for 95th percentile confidence aims to remove some of the uncertainty associated with calculation of an arithmetic sample mean of a relatively small number of samples. The US₉₅ value is the upper bound of the range within which it can be stated with 95% confidence that the true mean concentration of the data set will fall.

Figure in **bold** indicates concentration in excess of risk-based soil guideline values, as discussed in Part 2 of this report

The results of the contamination testing indicate elevated concentrations of lead and total PAH including Benzo(a)pyrene.

A sample of made ground from Borehole 2 at a depth of 0.2 m has been found to have a significantly acidic pH level of 3.9 and this is considered within Section 7.7 of this report.

These results will be discussed further in the following section.

5.5.1 Generic Quantitative Risk Assessment

The use of a risk-based approach has been adopted to provide an initial screening of the test results to assess the need for subsequent site-specific risk assessments. To this end the table below indicates those contaminants of concern that have values in excess of a generic human health risk based guideline values which are either that of the CLEA⁵ Soil Guideline Value where available, or is a Generic Guideline Value calculated using the CLEA UK Version 1.06 software assuming a residential end use. The key generic assumptions for this end use are as follows:

- ❑ that groundwater will not be a critical risk receptor;
- ❑ that the critical receptor for human health will be young female children aged zero to six years old;
- ❑ that the exposure duration will be six years;
- ❑ that the critical exposure pathways will be direct soil and indoor dust ingestion, consumption of homegrown produce, consumption of soil adhering to homegrown produce, skin contact with soils and indoor dust, and inhalation of indoor and outdoor dust and vapours; and
- ❑ that the building type equates to a two-storey small terraced house.

It is considered that these assumptions are acceptable for this generic assessment of this site. The tables of generic screening values derived by GEA and an explanation of how each value has been derived are included in the Appendix.

Where contaminant concentrations are measured at concentrations below the generic screening value it is considered that they pose an acceptable level of risk and thus further consideration of these contaminant concentrations is not required. However where concentrations are measured in excess of these generic screening values there is considered to be a potential that they could pose an unacceptable risk and thus further action will be required which could include:

- ❑ additional testing to zone the extent of the contaminated material and thus reduce the uncertainty with regard to its potential risk;
- ❑ site specific risk assessment to refine the assessment criteria and allow an assessment to be made as to whether the concentration present would pose an unacceptable risk at this site; or
- ❑ soil remediation or risk management to mitigate the risk posed by the contaminant to a degree that it poses an acceptable risk.

5 Updated Technical Background to the CLEA Model (Science Report SC050021/SR3) Jan 2009 and Soil Guideline Value reports for specific contaminants; all DEFRA and Environment Agency.

The concentrations of the contaminants of concern highlighted by a comparison of the measured concentrations against the generic screening values are tabulated below. This assessment is based upon the potential for risk to human health.

Contaminant of Concern	Maximum concentration recorded (mg/kg)	Location(s) of elevated concentration(s) [depth (m)]	Normalised upper bound US ₉₅ (mg/kg)	Generic Risk-Based Screening Value (mg/kg)
Lead	1500	TP3 [0.3]	79	450
Total PAH	23	BH6 [0.3], BH7 [0.3]	14	6.3
Benzo(a)pyrene	1.5	BH7 [0.3]	0.9	0.94

Elevated concentrations of lead were measured in a single sample of the made ground from Trial Pit No 3 which was located adjacent to the rear elevation of Far End. The exact source of the contamination is not known, however the trial pit was located adjacent to an iron drainage downpipe from which flecks of wet or peeling paint may have entered the surrounding soils.

Total PAH including Benzo(a)pyrene have been measured at concentrations elevated above their respective guideline values in two samples tested that are located within the rear garden of Nice Place. The source of the contamination is not known, it may be the result of leakage or spillages of fuel for the nearby outbuilding although no tanks were noted on site.

The implications of the contaminants of concern are assessed in detail in Section 7.8.

5.6 Existing Foundations

A series of seven manually excavated trial pits has shown the existing buildings to be supported on relatively shallow spread foundations comprising concrete footings, bearing within the firm clay of the Claygate Member at depths of between 0.88 m (102.53 m OD) and 1.40 m (102.82 m OD). Logs and photographs are included within the appendix.

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 the proposed development is to include retention of the existing front and side facades of 'Far End', whilst the remaining elevations along with the neighbouring house of 'Nice Place' will be demolished to allow for the subsequent construction of two new three-storey detached houses with a connected double level basement. The basement will be separated by a dividing wall between the two houses. The proposed basement will extend beyond the footprint of both existing buildings and into the rear gardens, and extend to a maximum depth of about 6.70 m, with a formation level of roughly 96.50 m OD, which will include a swimming pool. In addition, it is also proposed to construct a new single storey outbuilding in the east of the rear garden of 'Nice Place'.

Proposed construction methodology and sequencing are detailed in drawings provided by the consulting engineers appended to this report.

The front and side facades of 'Far End' will be supported by means of a steel structure supported on piled raft foundations with approximately 300 mm diameter piles. The double level basement beneath the two houses will be constructed by means of a 600 mm diameter contiguous piled retaining wall.

Anticipated loads of the proposed development are not known at this stage, but are expected to be light to moderate.

7.0 GROUND MODEL

The desk study has revealed that the site has not had a potentially contaminative history, having apparently been occupied by residential properties for the entirety of its developed history. On the basis of the investigation carried out, the ground conditions at this site can be characterised as follows.

- ❑ Beneath a surface covering of covering of topsoil or moderate thickness of made ground, the Claygate Member is present, which in turn is underlain by London Clay;
- ❑ the made ground was encountered to depths of between 0.20 m (103.75 m OD) and 1.60 m (101.63 m OD) and generally comprised light brown to brown very silty sandy clay with variable amounts of gravel, brick, concrete, roots and rootlets;
- ❑ the Claygate Member initially comprises firm brown mottled orange-brown and grey very silty very sandy clay with pockets of orange brown fine sand to depths of between 3.30 m (100.15 m OD) and 4.10 m (98.51 m OD);
- ❑ in five locations, this horizon was noted to be stiff to depths of between 1.20 m (101.41 m OD) and 3.30 m (100.18 m OD) and has been assessed as desiccated;

- ❑ below the initial horizon, the Claygate Member comprises firm becoming stiff dark greenish grey silty sandy clay, which was encountered to depths of between 7.80 m (95.43 m OD) and 14.50 m (89.45 m OD);
- ❑ the London Clay comprises stiff becoming very stiff brownish grey silty sandy clay with occasional shell fragments and claystones, and was proved to the maximum depth investigated, of 25.00 m (78.23 m OD);
- ❑ slow inflows or seepages of groundwater were encountered in the Claygate Member during drilling of the boreholes at depths of between 4.00 m (98.73 m OD) and 9.20 m (94.75 m OD) and subsequent monitoring has recorded groundwater at depths of between 1.01 m (102.22 m OD) and 2.46 m (101.49 m OD); and
- ❑ elevated concentrations of total PAH, including benzo(a)pyrene and a single elevated concentration of lead within the made ground.

8.0 ADVICE AND RECOMMENDATIONS

Excavations for the proposed basement structure will require temporary support to maintain stability and to prevent any excessive ground movements and it is unlikely to be feasible to construct the basement without the requirement for some level of groundwater control.

Formation level for the proposed development is likely to be within the Claygate Member, which should provide an eminently suitable bearing stratum for spread foundations excavated from basement level. Alternatively, if the loads of the proposed development are high, or if groundwater cannot be adequately controlled, such that spread foundations become unfeasible, piled foundations extending into the London Clay would provide a suitable solution.

8.1 Basement Construction

8.1.1 Basement Excavations

It is understood that it is proposed to excavate a double level basement, which will extend beneath both proposed buildings, to a depth of 6.70 m, a level of approximately 96.50 m OD and more locally close to the southern boundary, to a depth of about 4.00 m, 99.15 m OD; formation level should therefore be within the Claygate Member.

Groundwater inflows were encountered at depths of between 4.00 m (98.73 m OD) and 9.20 m (94.75 m OD) and subsequent monitoring has indicated groundwater at levels of between 101.49 m OD and 102.61 m OD. On this basis groundwater is likely to be encountered within the basement excavation at variable depths, although monitoring of the standpipes should be continued to establish equilibrium levels and determine the extent of any seasonal fluctuations. It would also be prudent to carry out rising head tests within the standpipes to establish the rate of rise in groundwater and permeability of the underlying Claygate Member. Groundwater is however likely to be present within the Claygate Member as discrete pockets of water rather than in continuous layers. Each individual pocket may therefore be of relatively low volume and individual inflows may cease once the pocket is emptied. However, as the basement excavation will cover a much larger area than that covered by the investigation, it is possible that larger pockets or inter-connected layers of groundwater could be encountered. It would therefore be prudent, once access is available, 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. It is likely that the rate of inflow will be relatively slow within the Claygate Member, although it is recommended

that the chosen contractor has a contingency plan in place to deal with more significant or prolonged inflows as a precautionary measure if a watertight temporary retention scheme is not adopted.

The design of basement support in the temporary and permanent conditions needs to take account of the need to maintain the stability of the excavation and surrounding structures, namely the neighbouring house to the south and the retained façade of Far End, and to protect against groundwater inflows.

A sheet piled wall could be used as a temporary measure, prior to the construction of a permanent retaining wall, although the noise and vibrations associated with the installation of sheet piles maybe unacceptable, unless a “silent” installation method is adopted. Consideration could be given to using pressing techniques, although pressing techniques that use water jetting should be treated with caution in view of the risk of causing heave or settlement of the surrounding structures.

Alternatively consideration could be given to the use of a bored pile wall, which would have the advantage of being incorporated into the permanent works and will be able to provide support for structural loads. Although the monitoring carried out to date would suggest that groundwater will be encountered within the excavation, it may be possible to adopt a contiguous bored pile wall with the use of localised grouting and sump pumping if necessary in order to deal with any groundwater inflows. If however trial excavations indicate that groundwater cannot be adequately controlled through localised grouting and sump pumping, then a secant bored pile wall will be required, which has the advantage of maximising the usable space within the basement area as it could overcome the requirement for any secondary groundwater protection in the permanent works.

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.

8.1.2 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
London Clay	1950	Zero	25

Groundwater is likely to be encountered within the excavation and at this stage, it is recommended that the basement is designed with a water level assumed to be 1.0 m below ground level. It may however be possible to review this requirement following additional investigation by means of trial excavations and further monitoring and the advice in BS8102:2009⁶ should be followed in this respect.

6 BS8102 (2009) *Code of practice for protection of below ground structures against water from the ground*

8.1.3 Basement Heave

The proposed construction of the basement will result in an unloading of the London Clay at formation level. The excavations will result in an approximate unloading of around 120 kN/m², which will result in an elastic heave and long term swelling of the Claygate Member and London Clay. These movements will be mitigated to some extent by the applied structural loads, although it is likely that the basement floor slab will need to be designed to accommodate heave movements, and some form of anchoring may be required. Given the area of the proposed basement, the movements associated with the 6.7 m deep excavation could be significant and it is recommended that a detailed heave analysis is undertaken once the proposed levels and loads are finalised.

8.2 Spread Foundations

The excavation of the basement will result in a formation level in the Claygate Member and it should be possible to adopt moderate width pad or strip foundations in the firm clay, designed to apply a net allowable bearing pressure of 150 kN/m² below the level of the proposed basement floor. It is unlikely that it will be possible to attain the required depths without encountering groundwater inflows, and if inflows are such that spread foundations cannot be utilised, then recourse should be made to the use of a piled foundation solution.

For the new outbuilding within the garden of Nice Place, which does not include a basement, due to the presence of several mature deciduous trees, spread foundations are unlikely to be an economical foundation solution. Furthermore, the arboriculture report on the site indicates that these trees have extensive root protection zones and therefore piled foundations will be required.

8.3 Piled Foundations

For the ground conditions at this site some form of bored pile is likely to be the most appropriate type. A conventional rotary augered pile is unlikely to be appropriate as the temporary casing is likely to be required to depths of beyond 15.00 m, consideration could be given to the use of bored piles installed using continuous flight auger (cfa) techniques which would not require the provision of casing.

The following table of ultimate coefficients may be used for the preliminary design of bored piles, based on the measured SPT and Cohesion / depth graph in the appendix.

Ultimate Skin Friction		kN/m ²
Made Ground	GL to 0.5 m	Ignore
Claygate Member and London Clay ($\alpha = 0.5$)	0.5 m to 25.0 m	Increasing linearly from 30 to 120
Ultimate End Bearing		kN/m ²
London Clay	15.0 m to 25.0 m	Increasing linearly from 1485 to 2160

In the absence of pile tests, guidance from the London District Surveyors Association (LDSA) suggests that a factor of safety of 2.6 should be applied to the above coefficients in the computation of safe theoretical working loads.

For the proposed buildings with a basement, on the basis of the above coefficients, applying a factor of safety of 2.6, it has been estimated that a 450 mm diameter pile founding at a depth of 18.5 m below the level of the proposed basement (25 m below ground level), should provide a safe working load of about 1000 kN.

For the single storey outbuilding, a 300 mm diameter pile founding at a depth of 15 m below existing ground level should provide a safe working load of about 325 kN. In the design of these piled foundations the effect of potential future shrinkage and swelling of the clay should be taken into account. In designing for compressive loads it should be assumed that further desiccation, and hence shrinkage of the clay, could continue where trees are to remain. Pile shaft adhesion within the theoretical maximum future desiccated thickness should therefore be ignored, and this thickness should be determined by reference to the NHBC guidelines in line with the advice given above for spread foundations. Heave of the clay soils could also occur due to future swelling as a result of trees being removed. This would exert a tensile uplift force on the piles, unless piles are effectively isolated from the surrounding soil by means of a slip layer or sleeve around the pile shaft.

On completion of construction the uplift forces would, to some extent, be counteracted by the applied loads. However, since the full structural loads may well be less than the potential uplift forces the piles would, in the absence of sleeving, need to be sufficiently "anchored" below the desiccated zone to withstand the uplift forces. Adequate reinforcement would need to be provided to accommodate the resulting tension.

The above examples are not intended to constitute any form of recommendation with regard to pile size or type, but merely serve to illustrate the use of the above coefficients. Specialist piling contractors should be consulted with regard to the design of an appropriate piling scheme and their attention should be drawn to the presence of groundwater inflows and potential instability of uncased pile bores within the Claygate Member.

8.4 Pavement Design

Formation level for the proposed roads and hardstandings is likely to be within the Claygate Member and on the basis of the insitu testing and published data, new roads and pavements should be designed on the basis of a California Bearing Ratio (CBR) of 2% to 3%. The results of the geotechnical testing indicate that the shallow soils should not be considered to be frost susceptible.

Prior to construction it would be prudent to proof roll formation level and infill any soft spots with suitably compacted granular material.

8.5 Shallow Excavations

On the basis of the trial pit findings it is considered likely that it will be feasible to form relatively shallow excavations terminating within the made ground and upper horizons of the Claygate Member without the requirement for lateral support, although localised instabilities may occur. 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.

Perched groundwater is likely to be encountered within shallow excavations for services which exceed a depth of 1.0 m, as well as the occurrence of some perched water, particularly in the vicinity of existing foundations; in this situation sump pumping should be sufficient for dealing with any such occurrences.

8.6 Basement Floor Slab

Following the excavation of the basement, it is likely that the floor slab for the proposed basement will need to be suspended over a void or layer of suitable compressible material to accommodate the anticipated heave unless the slab can be suitably reinforced to cope with these movements. In addition, consideration may also need to be given to designing the basement to cope with water pressure below the slab. Further consideration will need to be given to these issues once the levels and magnitude of any slab loading are known.

8.7 Effect of Sulphates

Chemical analyses of selected samples have revealed generally low concentrations of soluble sulphate, corresponding to Class DS-2 and ACEC AC-3z of Table C2 of BRE Special Digest 1 Part C (2005), based on mobile groundwater conditions. The guidelines contained in the above digest should be followed in the design of foundation concrete.

8.8 Site Specific Risk Assessment

The chemical analyses have highlighted the presence of elevated concentrations of total PAH including Benzo(a)pyrene within two samples of made ground and a single concentration of lead, which exceed the adopted generic screening values. These concentrations could thus pose a potentially unacceptable risk to human health through direct contact, accidental ingestion or inhalation of soil or soil derived dust.

Elevated concentrations of lead were measured in a single sample of the made ground from Trial Pit No 3 which was located adjacent to the rear elevation of Far End. The exact source of the contamination is not known, however the trial pit was located next to an iron drainage downpipe from which flecks of wet or peeling paint may have entered the surrounding soils. The sample of made ground was recovered from an area that will be excavated as part of the basement and therefore does not pose a risk to future end users.

Total PAH including Benzo(a)pyrene have been measured at concentrations elevated above their respective guideline values in two samples tested that are located within the rear garden of Nice Place. The source of the contamination is not known, it may be the result of leakage or spillages of fuel for the nearby outbuilding although no tanks were noted on site.

The contamination is considered to be non-volatile or of a low volatility and to be of a generally low solubility. The contamination does not therefore present a significant vapour risk or a significant risk of leaching and migration within any groundwater.

In addition to the above, a sample of topsoil, recovered from the existing garden area, was found to be contaminant free and therefore remedial measures, with respect to protecting end users are not thought to be required. The contamination may however pose a risk to site workers during the construction phase.

8.8.1 Site Workers

Elevated concentrations of potentially toxic lead and hydrocarbons have been measured within the made ground. Site workers should be made aware of the contamination and a programme of working should be identified to protect workers handling any soil. The method of site working should be in accordance with guidelines set out by HSE⁷ and CIRIA⁸ and the requirements of the Local Authority Environmental Health Officer.

7 HSE (1992) HS(G)66 *Protection of workers and the general public during the development of contaminated land* HMSO

8 CIRIA (1996) *A guide for safe working on contaminated sites* Report 132, Construction Industry Research and Information Association

8.9 Waste Disposal

Any spoil arising from excavations or landscaping works, which is not to be re-used in accordance with the CL:AIRE guidance, will need to be disposed of to a licensed tip. Under the European Waste Directive, waste is classified as being either Hazardous or Non-Hazardous and landfills receiving waste are classified as accepting hazardous or non-hazardous wastes or the non-hazardous sub-category of inert waste in accordance with the Waste Directive. Waste going to landfill is subject to landfill tax at either the standard rate of £64 per tonne (about £120 per m³) or at the lower rate of £2.50 per tonne (roughly £5 per m³). However, the classifications for tax purposes and disposal purposes differ and currently all made ground and topsoil is taxable at the 'standard' rate and only naturally occurring rocks and soils, which are accurately described as such in terms of the 2011 Order, would qualify for the 'lower rate' of landfill tax.

Based upon on the technical guidance provided by the Environment Agency it is considered likely that the made ground from this site, as represented by the six chemical analyses carried out, would be classified as NON-HAZARDOUS waste under the waste code 17 05 04 (soils and stones not containing dangerous substances) and would be taxable at the standard rate. It is likely that the natural soils, if separated out, could be classified as an INERT waste also under the waste code 17 05 04. This material would be taxable at the lower rate, if accurately described as naturally occurring clay in terms of the 2011 Order on the waste transfer note. As the site has never been developed or used for the storage of potentially hazardous materials, it is likely that WAC leaching tests would not be required for such inert waste going to landfill. This would however need to be confirmed by the receiving landfill site.

Under the requirements of the European Waste Directive all waste needs to be pre-treated prior to disposal. The pre-treatment process must be physical, thermal, chemical or biological, including sorting. It must change the characteristics of the waste in order to reduce its volume, hazardous nature, facilitate handling or enhance recovery. The waste producer can carry out the treatment but they will need to provide documentation to prove that this has been carried out. Alternatively, the treatment can be carried out by an approved contractor. The Environment Agency has issued a position paper which states that in certain circumstances, segregation at source may be considered as pre-treatment and thus excavated material may not have to be treated prior to landfilling if the soils can be "segregated" on site by sufficiently characterising the soils insitu prior to excavation.

The above opinion with regard to the classification of the excavated soils and its likely landfill taxable rate is provided for guidance only and should be confirmed by the receiving landfill once the soils to be discarded have been identified.

The local waste regulation department of the Environment Agency (EA) should be contacted to obtain details of tips that are licensed to accept the soil represented by the test results. The tips will be able to provide costs for disposing of this material but may require further testing.

If consideration were to be given to the re-use of the soil as a structural fill on this or another site, in accordance with the Code of Practice for the definition of waste, it would be necessary to confirm its suitability for use, its certainty of use and to confirm that only as much material is to be used as is required for the specific purpose for which it was being used. A materials management plan could then be formulated and a tracking system put in place such that once placed the material would no longer be regarded as being a waste and thus waste management licensing and landfill tax would not apply.

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 investigation has indicated that the basement will extend below the water table. Although the Claygate Member is classified as a Secondary 'A' aquifer, the investigations carried out at the site have shown this stratum to predominantly comprise silty sandy clay of relatively low permeability. Consequently there is very little potential for groundwater flow beneath the site and the Claygate Member cannot support baseflow to watercourses. Therefore the proposed basement would not present an effective barrier to flow or impact upon groundwater sensitive features.
The proposed basement will extend beneath the water table	
The site is within 100 m of a watercourse	
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	
the proposed basement development result in a change in the proportion of hard surfaced / paved	The sealing of the ground surface to rainfall, by increasing the building area, would result in decreased recharge to the underlying ground, although the low permeability of the underlying Claygate Member would result in a low recharge in any case and consequently there would be no effect on groundwater.
surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route	
London Clay is the shallowest stratum on the site.	The London Clay is prone to seasonal shrink-swell and can cause structural damage. Desiccation was not encountered during the investigation but may be present within close proximity to existing trees. The proposed basement will extend to a depth of 6.7 m in general and 4 m locally adjacent to the southern boundary, 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.
Trees will be felled as part of the proposed development	
Seasonal shrink-swell can result in foundation movements.	
Site within 5 m of a highway or pedestrian right of way.	The investigation has not indicated any specific problems, such as weak or unstable ground, voids, high water table, that would make working within 5 m of public infrastructure particularly problematic at this site, although best practice in design and construction will ensure the stability of the highway.
The proposed basement will significantly increase the differential depth of foundations relative to neighbouring properties	The proposed basement will extend to a significant depth relative to the existing foundations of the neighbouring properties and will need to be designed to ensure the stability of the site and any potentially sensitive structures that are in close proximity to the site.

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 proposed basement will extend beneath the water table

The site is within 100 m of a watercourse

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

Although the Claygate Member is classified as a Secondary 'A' aquifer, the investigations carried out at the site have shown this stratum to predominantly comprise silty sandy clay of relatively low permeability.

The proposed basement development result in a change in the proportion of hard surfaced / paved

Surface water flows (e.g. volume of rainfall and peak run-off) may be materially changed from the existing route

The sealing of the ground surface to rainfall, by increasing the building area, would result in decreased recharge to the underlying ground

London Clay is the shallowest strata on the site

Trees will be felled as part of the proposed development

Seasonal shrink-swell can result in foundation movements

Desiccation was not encountered during the investigation but may be present within close proximity to existing trees. The proposed basement will extend to a depth of 6.7 m in general and 4 m locally adjacent to the southern boundary, 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.

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 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.

The proposed basement will significantly increase the differential depth of foundations relative to neighbouring properties

The proposed basement will extend to a significant depth relative to the existing foundations of the neighbouring properties and will need to be designed to ensure the stability of the site and any potentially sensitive structures that are in close proximity to the site.

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.

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

SPT Results

Trial Pit Logs

Laboratory Test Results

SPT / Cohesion Depth Graph

CBR Test Results

Chemical Analyses

Generic Risk Based Screening Values

Envirocheck Report Summary

Historical Maps

Site Photographs

Proposed development drawings

Tree survey extracts

Site Plan

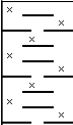
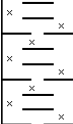
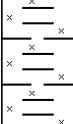
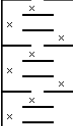
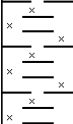
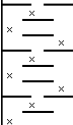
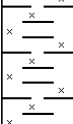
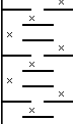
GEA Geotechnical & Environmental Associates					Tyttenhanger House Coursers Road St Albans AL4 0PG		Site Nice Place & Far End, Compton Avenue, Highgate, N6 4LH		Borehole Number BH1		
Boring Method Cable Percussion		Casing Diameter 150mm cased to 10.50m			Ground Level (mOD) 103.95		Client Pastor Real Estate Ltd		Job Number J11150		
		Location Far End			Dates 18/07/2011		Engineer Conisbee Consulting Engineers		Sheet 1/3		
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water		
0.40	D1			1,2/2,2,2,2	103.75	(0.20)	Made ground (block paving over coarse sand subbase)				
					103.55	(0.20)	Soft becoming firm orange brown very silty clayey fine SAND with roots and rootlets				
	0.40				'Stiff' orange brown silty very sandy CLAY with roots. Desiccated Soil						
											
1.00	D2										
1.20-1.65	SPT N=8										
1.20	D3						(2.10)				
2.00-2.45	U1										
2.50	D4						101.45	2.50		Soft becoming firm dark greenish grey silty sandy CLAY with partings of orange brown sand	
3.00-3.45	SPT N=6					1,1/1,1,2,2		(0.80)			
3.00	D5				100.65	3.30	Firm becoming stiff very silty sandy CLAY with partings of silt				
4.00-4.45	U2										
4.50	D6										
5.00-5.45	SPT N=10			2,2/2,2,3,3							
5.00	D7										
6.00-6.45	U3										
6.50	D8										
7.50-7.95	SPT N=12			2,3/3,2,3,4							
7.50	D9										
9.00-9.45	U4					(11.20)					
9.50	D10			slow(1) at 9.20m, rose to 8.80m in 20 mins, sealed at 10.50m.							
Remarks Excavating services inspection pit from GL to 1.20m for 1hr. Standpipe installed in borehole to 10.00 m, see separate sheet for details and for the results of monitoring visits.								Scale (approx) 1:50	Logged By CA		
								Figure No. J11150.BH1			

 Geotechnical & Environmental Associates					Tyttenhanger House Coursers Road St Albans AL4 0PG		Site Nice Place & Far End, Compton Avenue, Highgate, N6 4LH		Borehole Number BH1
Boring Method Cable Percussion		Casing Diameter 150mm cased to 10.50m		Ground Level (mOD) 103.95		Client Pastor Real Estate Ltd		Job Number J11150	
		Location Far End		Dates 18/07/2011		Engineer Conisbee Consulting Engineers		Sheet 2/3	
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.50-10.95 10.50	SPT N=16 D11			2,3/4,4,4,4					
12.00-12.45	U5					(11.20)			
12.50	D12								
13.50-13.95 13.50	SPT N=19 D13			3,4/4,4,5,6					
					89.45	14.50	Stiff becoming very stiff greyish brown silty fissured CLAY with occasional shell fragments		
15.00-15.45	U6								
15.50	D14								
16.50-16.95 16.50	SPT N=23 D15			4,4/5,5,6,7					
18.00-18.45	U7								
18.50	D16								
19.50-19.95 19.50	SPT N=27 D17			4,4/5,7,7,8		(10.50)			
Remarks								Scale (approx) 1:50	Logged By CA
								Figure No. J11150.BH1	

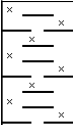
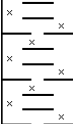
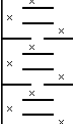
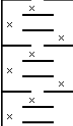
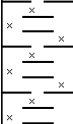
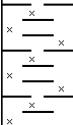
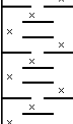
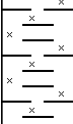
GEA Geotechnical & Environmental Associates				Tyttenhanger House Coursers Road St Albans AL4 0PG		Site Nice Place & Far End, Compton Avenue, Highgate, N6 4LH		Borehole Number BH1	
Boring Method Cable Percussion		Casing Diameter 150mm cased to 10.50m		Ground Level (mOD) 103.95		Client Pastor Real Estate Ltd		Job Number J11150	
		Location Far End		Dates 18/07/2011		Engineer Conisbee Consulting Engineers		Sheet 3/3	
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
21.00-21.45	U8							x — x x — x	

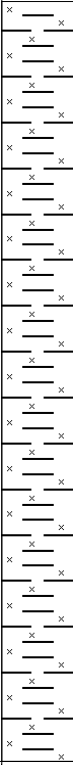
 Geotechnical & Environmental Associates				Tyttenhanger House Coursers Road St Albans AL4 0PG		Site Nice Place & Far End, Compton Avenue, Highgate, N6 4LH		Number BH2	
Excavation Method Opendrive percussive sampler.		Dimensions 107mm to 1.00m		Ground Level (mOD) 103.65		Client Pastor Real Estate Ltd		Job Number J11150	
		Location Far End		Dates 13/07/2011		Engineer Conisbee Consulting Engineers		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.20	D1			103.35	(0.30) 0.30	Topsoil (light brown very silty sandy clay with roots and rootlets)			
0.70	D2				(1.20)	'Stiff' light brown mottled orange brown silty very sandy CLAY with pockets of orange brown sand and roots of up to 2mm in diameter to 1.5m. Desiccated soil			
1.00-1.45	SPT N=12		1,2/3,3,3,3						
1.50	D3			102.15	1.50	Firm orange brown mottled grey silty sandy CLAY with pockets of orange brown fine grained sand			
2.00-2.45	SPT N=12		1,2/3,2,3,4		(1.40)				
2.50	D4								
3.00-3.45	SPT N=10		1,2/2,3,2,3	100.75	2.90 (0.50)	Firm dark brown mottled light brown silty very sandy CLAY with pockets of dark orange brown fine grained sand			
3.50	D5			100.25	3.40	Firm becoming stiff dark greenish grey silty very sandy CLAY with occasional bands of silty very clayey fine grained sand			
4.00-4.45	SPT N=12		2,2/2,3,3,4						
4.50	D6								
5.00-5.45	SPT N=16		seepage(1) at 5.00m. 2,2/3,4,4,5		(4.05)				
5.50	D7								
6.00-6.45	SPT N=15		2,2/3,4,4,4						
6.50	D8								
7.00-7.45	SPT N=16		2,3/3,4,4,5						
				96.20	7.45	Complete at 7.45m			
Remarks Standpipe installed in borehole to 7.0 m, see separate sheet for details and for the results of monitoring visits.							Scale (approx) 1:50		Logged By CA
							Figure No. J11150.BH2		

 Geotechnical & Environmental Associates					Tyttenhanger House Coursers Road St Albans AL4 0PG		Site Nice Place & Far End, Compton Avenue, Highgate, N6 4LH		Borehole Number BH3
Boring Method Cable Percussion		Casing Diameter 150mm cased to 10.50m		Ground Level (mOD) 103.48		Client Pastor Real Estate Ltd		Job Number J11150	
		Location Nice Place		Dates 15/07/2011		Engineer Conisbee Consulting Engineers		Sheet 1/3	
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.60	D1				103.13	(0.35) 0.35	Made ground (block paving over coarse sand subbase)		
1.10 1.20-1.65	D2 U1				102.48	(0.65) 1.00	Made ground (dark brown silty sandy clay with gravel and occasional brick fragments)		
1.70 2.00-2.45 2.00	D3 SPT N=10 D4			1,2/2,3,2,3		(2.30)	'Stiff' light brown mottled orange brown silty very sandy CLAY. Desiccated soil		
3.00-3.45	U2				100.18	3.30	Firm to stiff dark greenish grey very silty sandy CLAY		
3.50 4.00-4.45 4.00	D5 SPT N=10 D6			1,2/2,2,3,3					
5.00-5.45	U3								
5.50 6.00-6.45 6.00	D7 SPT N=12 D8			2,2/3,3,3,3		(6.20)			
7.50-7.95	U4								
8.00 9.00-9.45 9.00	D9 SPT N=16 D10			3,3/4,4,4,4 slow(1) at 9.10m, rose to 8.90m in 20 mins, sealed at 10.50m.	93.98	9.50	Stiff brownish grey very silty fissured CLAY with occasional shell fragments		
Remarks Excavating services inspection pit from GL to 1.20m for 1hr								Scale (approx) 1:50	Logged By CA
								Figure No. J11150.BH3	

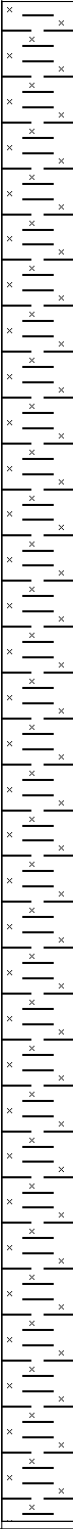
 Geotechnical & Environmental Associates				Tyttenhanger House Coursers Road St Albans AL4 0PG		Site Nice Place & Far End, Compton Avenue, Highgate, N6 4LH		Borehole Number BH3	
Boring Method Cable Percussion		Casing Diameter 150mm cased to 10.50m		Ground Level (mOD) 103.48		Client Pastor Real Estate Ltd		Job Number J11150	
		Location Nice Place		Dates 15/07/2011		Engineer Conisbee Consulting Engineers		Sheet 2/3	
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.50-10.95	U5								
11.00	D11								
12.00-12.45 12.00	SPT N=20 D12			3,4/4,5,5,6					
13.50-13.95	U6								
14.00	D13								
15.00-15.45 15.00	SPT N=24 D14			4,4/5,6,6,7					
16.50-16.95	U7								
17.00	D15								
18.00-18.45 18.00	SPT N=28 D16			4,5/6,7,7,8		(15.50)			
19.50-19.95	U8								
Remarks							Scale (approx) 1:50		Logged By CA
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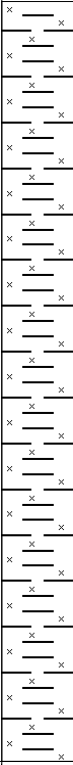
 Geotechnical & Environmental Associates					Tyttenhanger House Coursers Road St Albans AL4 0PG		Site Nice Place & Far End, Compton Avenue, Highgate, N6 4LH		Borehole Number BH4
Boring Method Cable Percussion		Casing Diameter 150mm cased to 9.00m		Ground Level (mOD) 103.45		Client Pastor Real Estate Ltd		Job Number J11150	
		Location Nice Place		Dates 14/07/2011		Engineer Conisbee Consulting Engineers		Sheet 1/3	
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.50	D1				103.15	(0.30) 0.30	Made ground (block paving over coarse sand subbase)		
0.90	D2				102.75	(0.40) 0.70	Made ground (dark brown silty sandy clay with occasional gravel, brick fragments and partings of sand)		
1.20-1.65	U1						Soft becoming firm light brown mottled orange brown silty sandy CLAY		
1.70	D3								
2.00-2.45	SPT N=8 D4			1,1/2,2,2,2		(2.60)			
2.00									
3.00-3.45	U2				100.15	3.30			
3.50	D5						Firm dark greenish grey silty very sandy CLAY		
4.00-4.45	SPT N=11 D6			2,2/2,3,3,3					
4.00									
5.00-5.45	U3								
5.50	D7								
6.00-4.45	SPT N=14 D8			2,3/3,3,4,4		(5.20)			
6.00									
7.50-7.95	U4			Seepage(1) at 7.40m, rose to 7.30m in 20 mins, sealed at 9.00m.					
7.90	D9								
8.20	D10				94.95	8.50	Claystone encountered between 7.9 m and 8.2 m		
9.00-9.45	SPT N=17 D11			3,3/4,4,4,5			Stiff becoming very stiff grey brown very silty fissured CLAY with occasional shell fragments. Fissured		
9.00									
Remarks Chiselling on a claystone from 7.90m to 8.20m for 30 mins.								Scale (approx) 1:50	Logged By CA
								Figure No. J11150.BH4	

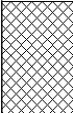
 Geotechnical & Environmental Associates				Tyttenhanger House Coursers Road St Albans AL4 0PG		Site Nice Place & Far End, Compton Avenue, Highgate, N6 4LH		Borehole Number BH4	
Boring Method Cable Percussion		Casing Diameter 150mm cased to 9.00m		Ground Level (mOD) 103.45		Client Pastor Real Estate Ltd		Job Number J11150	
		Location Nice Place		Dates 14/07/2011		Engineer Conisbee Consulting Engineers		Sheet 2/3	
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.50-10.95	U5								
11.00	D12								
12.00-12.45 12.00	SPT N=20 D13			3,4/4,5,5,6					
13.50-13.95	U6								
14.00	D14								
15.00-15.45 15.00	SPT N=24 D15			4,4/5,6,6,7					
16.50-16.95	U7								
17.00	D16					(16.50)			
18.00-18.45 18.00	SPT N=29 D17			5,6/7,7,7,8					
19.50-19.95	U8								
Remarks							Scale (approx) 1:50		Logged By CA
							Figure No. J11150.BH4		

 Geotechnical & Environmental Associates					Tyttenhanger House Coursers Road St Albans AL4 0PG		Site Nice Place & Far End, Compton Avenue, Highgate, N6 4LH		Borehole Number BH4
Boring Method Cable Percussion		Casing Diameter 150mm cased to 9.00m		Ground Level (mOD) 103.45		Client Pastor Real Estate Ltd		Job Number J11150	
		Location Nice Place		Dates 14/07/2011		Engineer Conisbee Consulting Engineers		Sheet 3/3	
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
20.00	D18								
21.00-21.45 21.00	SPT N=36 D19			6,7/7,9,9,11					
22.50-22.95	U9					(16.50)			
23.00	D20								
24.50-24.95 24.50	SPT N=36 D21			7,7/8,9,9,10					
					78.45	25.00	Complete at 25.00m		
Remarks								Scale (approx) 1:50	Logged By CA
								Figure No. J11150.BH4	

 Geotechnical & Environmental Associates					Tyttenhanger House Coursers Road St Albans AL4 0PG		Site Nice Place & Far End, Compton Avenue, Highgate, N6 4LH		Borehole Number BH5
Boring Method Cable Percussion		Casing Diameter 150mm cased to 9.00m		Ground Level (mOD) 103.23		Client Pastor Real Estate Ltd		Job Number J11150	
		Location Nice Place		Dates 13/07/2011		Engineer Conisbee Consulting Engineers		Sheet 1/3	
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.50	D1				102.93	(0.30) 0.30	Made Ground (block paving over coarse sand sub-base)		
1.00	D2					(1.30)	Made Ground (dark brownish grey silty sandy clay with occasional brick fragments and gravel)		
1.20-1.65 1.20	SPT N=5 B1			1,1/1,1,1,2	101.63	1.60	Soft becoming firm light brown mottled orange brown silty sandy CLAY with partings of fine orange brown sand		
1.70	D3								
2.00-2.45	U1								
2.50	D4					(1.80)			
3.00-3.45 3.00	SPT N=8 D5			1,2/2,2,2,2	99.83	3.40	Firm becoming stiff dark greenish grey silty sandy CLAY		
3.70	D6								
4.00-4.45	U2								
4.50	D7								
5.00-5.45 5.00	SPT N=13 D8			2,2/3,3,3,4		(4.40)			
6.00-6.45	U3								
6.50	D9								
7.50	D10			seepage(1) at 7.50m, sealed at 9.00m.	95.43	7.80	Stiff becoming very stiff dark brownish grey silty fissured CLAY		
7.50-7.95	SPT N=19	1.50	7.30	3,3/4,5,5,5					
9.00-9.45	U4								
9.50	D11								
Remarks Excavating services inspection pit from GL to 1.20 m for 1hr. Standpipe installed in borehole to 9.0 m, see separate sheet for details and for the results of monitoring visits.								Scale (approx) 1:50	Logged By CA
								Figure No. J11150.BH5	

 Geotechnical & Environmental Associates				Tyttenhanger House Coursers Road St Albans AL4 0PG		Site Nice Place & Far End, Compton Avenue, Highgate, N6 4LH		Borehole Number BH5	
Boring Method Cable Percussion		Casing Diameter 150mm cased to 9.00m		Ground Level (mOD) 103.23		Client Pastor Real Estate Ltd		Job Number J11150	
		Location Nice Place		Dates 13/07/2011		Engineer Conisbee Consulting Engineers		Sheet 2/3	
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.50-10.95 10.50	SPT N=20 D12			3,3/4,5,5,6					
12.00-12.45	U5								
12.50	D13								
13.50-13.95 13.50	SPT N=24 D14			4,4/5,6,6,7					
15.00-15.45	U6								
15.50	D15								
16.50-16.95 16.50	SPT N=27 D16			4,5/5,6,8,8					
18.00-18.45	U7					(17.20)			
18.50	D17								
19.50-19.95 19.50	SPT N=33 D18			4,5/7,8,9,9					
Remarks							Scale (approx) 1:50		Logged By CA
							Figure No. J11150.BH5		

 Geotechnical & Environmental Associates					Tyttenhanger House Coursers Road St Albans AL4 0PG		Site Nice Place & Far End, Compton Avenue, Highgate, N6 4LH		Borehole Number BH5
Boring Method Cable Percussion		Casing Diameter 150mm cased to 9.00m		Ground Level (mOD) 103.23		Client Pastor Real Estate Ltd		Job Number J11150	
		Location Nice Place		Dates 13/07/2011		Engineer Conisbee Consulting Engineers		Sheet 3/3	
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
21.00-21.45	U8								
21.50	D19								
22.50-22.95 22.50	SPT N=39 D20			5,7/8,9,10,12		(17.20)			
24.50-24.95	U9								
25.00	D21				78.23	25.00	Complete at 25.00m		
Remarks								Scale (approx) 1:50	Logged By CA
								Figure No. J11150.BH5	

 Geotechnical & Environmental Associates				Tyttenhanger House Coursers Road St Albans AL4 0PG		Site Nice Place & Far End, Compton Avenue, Highgate, N6 4LH		Number BH6	
Excavation Method Opendrive percussive sampler.		Dimensions 107mm to 1.00m		Ground Level (mOD) 102.73		Client Pastor Real Estate Ltd		Job Number J11150	
		Location Nice Place		Dates 13/07/2011		Engineer Conisbee Consulting Engineers		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.30	D1				(0.80)	Made Ground (dark brown silty sandy clay with roots and rootlets, and occasional angular gravel, and brick fragments)			
0.80	D2			101.93	0.80	'Stiff' light orange brown silty sandy CLAY with roots to 1.6m. Desiccated soil			
1.00-1.45	SPT N=12		2,2/2,3,3,4		(1.00)				
1.50	D3			100.93	1.80	Firm light orange brown very silty sandy CLAY with pockets of orange brown fine grained sand			
2.00-2.45	SPT N=11		2,2/2,3,3,3						
2.50	D4				(1.70)				
3.00-3.45	SPT N=15		2,2/3,4,4,4			Firm becoming stiff dark greenish grey silty very sandy CLAY with bands of fine grained sand			
3.50	D5			99.23	3.50				
4.00-4.45	SPT N=11		Water strike(1) at 4.00m. 2,2/2,3,3,3						
4.50	D6								
5.00-5.45	SPT N=11		1,2/2,2,3,4						
5.50	D7				(3.95)				
6.00-6.45	SPT N=18		2,2/3,5,5,5						
6.50	D8								
7.00-7.45	SPT N=12		2,2/2,3,3,4	95.28	7.45				
						Complete at 7.45m			
Remarks Standpipe installed in borehole to 7.0 m see separate sheet for details and for the results of monitoring visits.								Scale (approx) 1:50	
								Logged By CA	
								Figure No. J11150.BH6	

GEAGeotechnical & Environmental Associates				Tyttenhanger House Coursers Road St Albans AL4 0PG		Site Nice Place & Far End, Compton Avenue, Highgate, N6 4LH		Number BH7	
Excavation Method Opendrive percussive sampler.		Dimensions 107mm to 1.00m		Ground Level (mOD) 102.61		Client Pastor Real Estate Ltd		Job Number J11150	
		Location Nice Place		Dates 13/07/2011		Engineer Conisbee Consulting Engineers		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description		Legend	Water
0.30	D1		1,2/2,3,3,3	102.11 101.91 101.41	(0.50) 0.50 (0.20) 0.70 (0.50) 1.20 (1.80) 3.00 (1.10) 4.10 (3.35) 7.45	Made Ground (dark brown silty sandy clay with gravel, roots and rootlets, traces of brick and cobble sized rubble)			Water
						Light orange brown very silty fine grained SAND with roots			
0.70	D2					"Very stiff" light orange brown very silty sandy CLAY. Desiccated soil			
1.00-1.45	SPT N=11					Firm light orange brown grey very silty very sandy CLAY with pockets of orange brown fine sand			
1.50	D3								
2.00-2.45	SPT N=13								
2.50	D4								
3.00-3.45	SPT N=12					2,2/2,3,3,4			
3.50	D5								
4.00-4.45	SPT N=13					2,1/3,3,3,4			
4.50	D6	2,3/2,3,4,4	2,2/2,3,3,4	98.51	</				



Geotechnical &
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Tythenhanger House
Coursers Road
St Albans
AL4 0PG

Standard Penetration Test Results

Site : Nice Place & Far End, Compton Avenue, Highgate, N6 4LH

Client : Pastor Real Estate Ltd

Engineer: Conisbee Consulting Engineers

Job Number

J11150

Sheet

1 / 2

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	1.20	1.35	1.65	SPT	1	2	2	2	2	2	N=8	
BH1	3.00	3.15	3.45	SPT	1	1	1	1	2	2	N=6	
BH1	5.00	5.15	5.45	SPT	2	2	2	2	3	3	N=10	
BH1	7.50	7.65	7.95	SPT	2	3	3	2	3	4	N=12	
BH1	10.50	10.65	10.95	SPT	2	3	4	4	4	4	N=16	
BH1	13.50	13.65	13.95	SPT	3	4	4	4	5	6	N=19	
BH1	16.50	16.65	16.95	SPT	4	4	5	5	6	7	N=23	
BH1	19.50	19.65	19.95	SPT	4	4	5	7	7	8	N=27	
BH1	22.50	22.65	22.95	SPT	5	6	6	7	8	9	N=30	
BH2	1.00	1.15	1.45	SPT	1	2	3	3	3	3	N=12	
BH2	2.00	2.15	2.45	SPT	1	2	3	2	3	4	N=12	
BH2	3.00	3.15	3.45	SPT	1	2	2	3	2	3	N=10	
BH2	4.00	4.15	4.45	SPT	2	2	2	3	3	4	N=12	
BH2	5.00	5.15	5.45	SPT	2	2	3	4	4	5	N=16	
BH2	6.00	6.15	6.45	SPT	2	2	3	4	4	4	N=15	
BH2	7.00	7.15	7.45	SPT	2	3	3	4	4	5	N=16	
BH3	2.00	2.15	2.45	SPT	1	2	2	3	2	3	N=10	
BH3	4.00	4.15	4.45	SPT	1	2	2	2	3	3	N=10	
BH3	6.00	6.15	6.45	SPT	2	2	3	3	3	3	N=12	
BH3	9.00	9.15	9.45	SPT	3	3	4	4	4	4	N=16	
BH3	12.00	12.15	12.45	SPT	3	4	4	5	5	6	N=20	
BH3	15.00	15.15	15.45	SPT	4	4	5	6	6	7	N=24	
BH3	18.00	18.15	18.45	SPT	4	5	6	7	7	8	N=28	
BH3	21.00	21.03		SPT	30						30*/25mm	
BH3	24.50	24.65	24.95	SPT	5	6	7	9	9	10	N=35	
BH4	2.00	2.15	2.45	SPT	1	1	2	2	2	2	N=8	
BH4	4.00	4.15	4.45	SPT	2	2	2	3	3	3	N=11	
BH4	6.00	4.15	4.45	SPT	2	3	3	3	4	4	N=14	
BH4	9.00	9.15	9.45	SPT	3	3	4	4	4	5	N=17	
BH4	12.00	12.15	12.45	SPT	3	4	4	5	5	6	N=20	
BH4	15.00	15.15	15.45	SPT	4	4	5	6	6	7	N=24	
BH4	18.00	18.15	18.45	SPT	5	6	7	7	7	8	N=29	
BH4	21.00	21.15	21.45	SPT	6	7	7	9	9	11	N=36	
BH4	24.50	24.65	24.95	SPT	7	7	8	9	9	10	N=36	
BH5	1.20	1.35	1.65	SPT	1	1	1	1	1	2	N=5	
BH5	3.00	3.15	3.45	SPT	1	2	2	2	2	2	N=8	
BH5	5.00	5.15	5.45	SPT	2	2	3	3	3	4	N=13	
BH5	7.50	7.65	7.95	SPT	3	3	4	5	5	5	N=19	
BH5	10.50	10.65	10.95	SPT	3	3	4	5	5	6	N=20	
BH5	13.50	13.65	13.95	SPT	4	4	5	6	6	7	N=24	
BH5	16.50	16.65	16.95	SPT	4	5	5	6	8	8	N=27	
BH5	19.50	19.65	19.95	SPT	4	5	7	8	9	9	N=33	



Geotechnical &
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Tytenhanger House
Coursers Road
St Albans
AL4 0PG

Standard Penetration Test Results

Site : Nice Place & Far End, Compton Avenue, Highgate, N6 4LH

Client : Pastor Real Estate Ltd

Engineer: Conisbee Consulting Engineers

Job Number
J11150

Sheet
2 / 2

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		
BH5	22.50	22.65	22.95	SPT	5	7	8	9	10	12	N=39	
BH6	1.00	1.15	1.45	SPT	2	2	2	3	3	4	N=12	
BH6	2.00	2.15	2.45	SPT	2	2	2	3	3	3	N=11	
BH6	3.00	3.15	3.45	SPT	2	2	3	4	4	4	N=15	
BH6	4.00	4.15	4.45	SPT	2	2	2	3	3	3	N=11	
BH6	5.00	5.15	5.45	SPT	1	2	2	2	3	4	N=11	
BH6	6.00	6.15	6.45	SPT	2	2	3	5	5	5	N=18	
BH6	7.00	7.15	7.45	SPT	2	2	2	3	3	4	N=12	
BH7	1.00	1.15	1.45	SPT	1	2	2	3	3	3	N=11	
BH7	2.00	2.15	2.45	SPT	2	2	3	3	4	3	N=13	
BH7	3.00	3.15	3.45	SPT	2	2	2	3	3	4	N=12	
BH7	4.00	4.15	4.45	SPT	2	1	3	3	3	4	N=13	
BH7	5.00	5.15	5.45	SPT	2	3	2	3	4	4	N=13	
BH7	6.00	6.15	6.45	SPT	2	2	2	3	3	4	N=12	
BH7	7.00	7.15	7.45	SPT	2	2	3	3	3	4	N=13	



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Tyttenhanger House
Coursers Road
St Albans
Herts AL4 0PG

Site
Nice Place & Far End, Compton
Avenue, Highgate, N6 4LH

**Trial Pit
Number**
TP1

Excavation Method
Manual

Dimensions
600x500x900

Ground Level (mOD)
103.95

Client
Pastor Real Estate Limited

Job Number
J11150

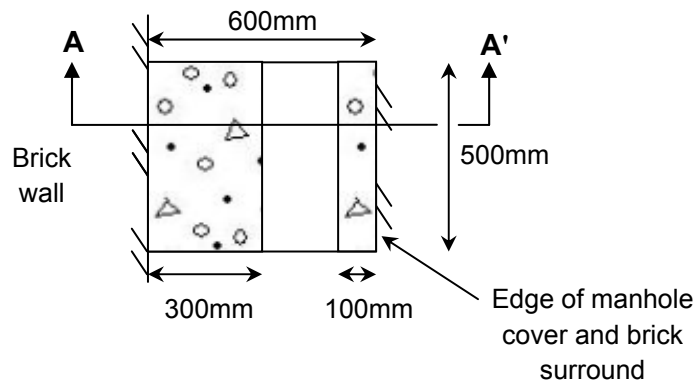
Location
Far End

Dates
19/07/11

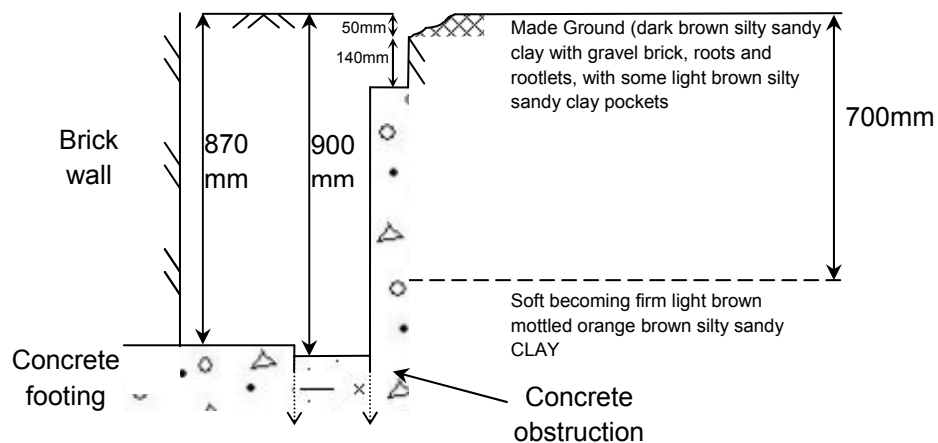
Engineer
Conisbee Consulting Engineers

Sheet Number
Sheet 1 / 1

PLAN



SECTION A-A



Depth of foundation not proved due to a concrete obstruction

Remarks

- (1) Ground water not encountered
- (2) Sides remained stable during excavation

Scale

1 : 20

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Associates

Tyttenhanger House
Coursers Road
St Albans
Herts AL4 0PG

Site
Nice Place & Far End, Compton Avenue,
Highgate, N6 4LH

**Trial Pit
Number**
TP2

Excavation Method
Manual

Dimensions
730x500x1370

Ground Level (mOD)
104.80

Client
Pastor Real Estate Limited

Job Number
J11150

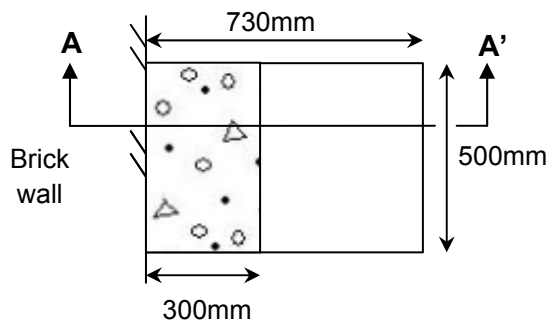
Location
Far End

Dates
19/07/11

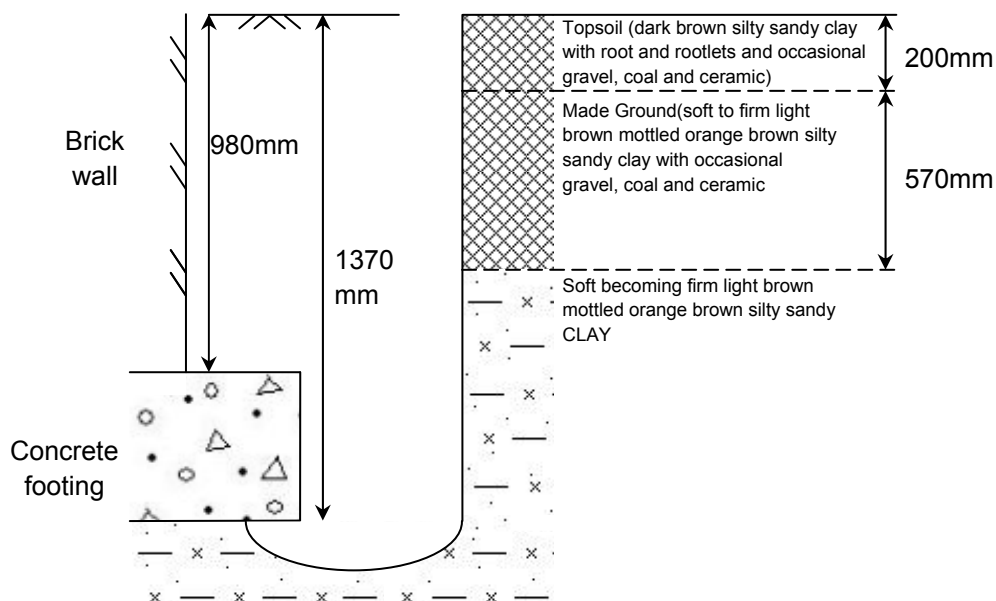
Engineer
Conisbee Consulting Engineers

Job Number
Sheet 1 / 1

PLAN



SECTION A-A



Remarks

- (1) No standing water encountered
- (2) No collapse during excavation
- (3) No services encountered

Scale

1 : 20

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CA