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Your Ref:

Our Ref: Ref: 15/23902-2
October 2015

17 BRANCH HILL

LONDON, NW3 7NA

BASEMENT IMPACT ASSESSMENT

Prepared for

Engineers HRW

CONTENTS

1.0 NON TECHNICAL EXECUTIVE SUMMARY

1.1 Brief

At the request of Engineers HRW, a Basement Impact Assessment has been carried out at 17 Branch Hill, London, NW3 in support of a planning application for a proposed development to the property which includes the demolition of the existing structure and the construction of a single family dwelling with a height of 2 storeys at entrance level and a lower 3 storeys at garden level as the natural grade of the land falls to the rear of the site. The garden will be split into 2 levels each having on-grade access from the Ground and Lower Ground floors. The maximum depth of the proposed lower ground floor level will be approximately 2.52m below existing lower ground floor level (116.56mOD is the existing level, 114.04mOD is the proposed).

1.2 Desk Study Findings

From a review of the historical maps it would appear that small buildings first occupied the site in 1896 and the current building appeared between 1915 and 1934. The surrounding area has been predominantly residential of the years

1.3 Ground Conditions

The investigation has confirmed the expected ground conditions in that, below a moderate to significant thickness of Made Ground, the Bagshot Formation was encountered which was proved to the full depth investigated. The Made Ground extended to a depth of 0.80m below ground level (119.10mOD) in Borehole 1 and 0.75m below ground level (116.55mOD) in Borehole 2 and to the full depth of investigation of 0.12m below ground level (117.28mOD) in Trial Pit 1. The material generally comprised of a soft brown silty sand with brick and concrete fragments and rubble. The Bagshot beds were encountered beneath the Made Ground in both boreholes and generally comprised of loose becoming medium dense clayey silty fine sand locally becoming stiff silty sandy clay. These soils extended down to the full depths of investigation of 15.00m below ground level (104.90mOD) in Borehole 1 and 6.00m below ground level (111.30mOD) in Borehole 2. Groundwater was recorded at a depth of 7.11m below ground level (112.79mOD) in the monitoring standpipe placed in Borehole 1 after a period of approximately two weeks.

1.4 Recommendations

Formation level of the 2.5 deep basement is likely to be within the Bagshot Formation. Groundwater was encountered below the depth of the proposed basement, although it would be prudent to continue to monitor the standpipes for as long as possible in order to determine equilibrium level and the extent of any seasonal variations. The chosen contractor should also have a contingency plan in place to deal with any perched groundwater inflows as a precautionary measure.

Trial excavations to the proposed basement depth could be carried by the main contractor to confirm the stability and composition of the soil and to further investigate the presence of any groundwater inflows.

2.0 INTRODUCTION

2.1 Project Objectives

At the request of Engineers HRW, a Basement Impact Assessment has been carried out at the above site in support of a planning application.

A Basement Impact Assessment was previously carried out at the site for the scheme by Site Analytical Services Limited in May 2015 (Report Reference 15/22714-2). A report comprising an assessment of the BIA has been carried out by Campbell Reith in May 2015 (Ref 12066-49 Revised D1).

Specific concerns were raised about the previous BIA by Campbell Reith in relation to satisfying the requirements of Camden Development Policy DP27. This revised BIA aims to satisfy these concerns.

The recommendations and comments given in this report are based on the information contained from the sources cited and may include information provided by the Client and other parties, including anecdotal information. It must be noted that there may be special conditions prevailing at the site which have not been disclosed by the investigation and which have not been taken into account in the report. No liability can be accepted for any such conditions.

2.2 Planning Policy Context

The information contained within this BIA has been produced to meet the requirements set out by Camden Planning Guidance – Basements and Lightwells (CPG4) including Camden Development Policies DP27 – Basements and Lightwells (July 2015) in order to assist London Borough of Camden with their decision making process.

As recommended by the Guidance for Subterranean Development (Ref 1) the BIA comprises the following steps

1. Initial **screening** to identify where there are matters of concern
2. **Scoping** to further define the matters of concern
3. **Site Investigation and study** to establish baseline conditions
4. **Impact Assessment** to determine the impact of the basement on baseline conditions
5. **Review and Decision Making** (to be undertaken by LBC)

2.3 Qualifications

The qualifications required by Camden are fulfilled as documented in Table A below. All assessors meet the qualification requirements of the Council guidance.

<table>
<tr><th rowspan="2">Subject</th><th rowspan="2">Qualifications Required by CPG4</th><th colspan="2">Relevant persons and qualifications/experience</th></tr>
<tr><th>Name/Qualifications</th><th>Experience</th></tr>
<tr><td rowspan="4">Surface flow and flooding</td><td rowspan="4">A hydrologist or a Civil Engineer specialising in flood risk management and surface water drainage, with either:
The 'CEng' (Chartered Engineer) qualification from the Engineering Council; or a Member of the Institution of Civil Engineers ('MICE')
The CWEM (Chartered Water and Environmental Manager) qualification from the Chartered Institution of Water and Environmental Management</td><td>Mr Neil Smith Eur Ing, BSc (Eng), MSc, CEng, FICE, FGS</td><td>40+ years' experience in geotechnics and hydrogeology, British Geotechnical Association Member, International Society for Soil Mechanics and Geotechnical Engineering</td></tr>
<tr><td>Mr Brett Scott CEng BEng (Hons) MICE</td><td>20+ years of hydrogeological experience and building basements in Camden.</td></tr>
<tr><td>Ms Roni Savage BEng (hons) MSc SiLC CGEOL MCIWM</td><td>25+ years of hydrogeological experience</td></tr>
<tr><td>Mr Andrew Smith BSc(Hons) FGS MCIWEM</td><td>10+ years of hydrogeological experience</td></tr>
<tr><td>Subterranean (ground water flow)</td><td>A hydrogeologist with the 'CGeol' (Chartered Geologist) qualification from the Geological Society of London</td><td>Ms Roni Savage BEng (hons) MSc SiLC CGEOL MCIWM</td><td>25+ years of hydrogeological experience</td></tr>
<tr><td rowspan="2">Land Stability</td><td rowspan="2">A Civil Engineer with the 'CEng (Chartered Engineer) qualification from the Engineering Council or specialising in ground engineering; or
A Member of the Institution of Civil Engineers ('MICE') and a Geotechnical Specialist as defined by the Site Investigation Steering Group</td><td>Mike Brice BSc MSc DIC CGeol</td><td>30+ years of hydrological/geotechnical experience and Member British Geotechnical Association)</td></tr>
<tr><td>Mr Brett Scott CEng BEng (Hons) MICE</td><td>20+ years of hydrogeological experience and building basements in Camden.</td></tr>
</table>

Table A – Qualification Summary (note all relevant signatures are at the end of the BIA)

3.0 SITE DETAILS

(National Grid Reference: TQ 260 862)

3.1 Site Location

The site is located to the west of Branch Hill in the London Borough of Camden at approximate postcode NW3 7NA. The site comprises of a detached modern house with a driveway at the front and a rear garden area.

The surrounding land use is primarily residential and recreational with Hampstead Heath present to the north and north-east of the site.

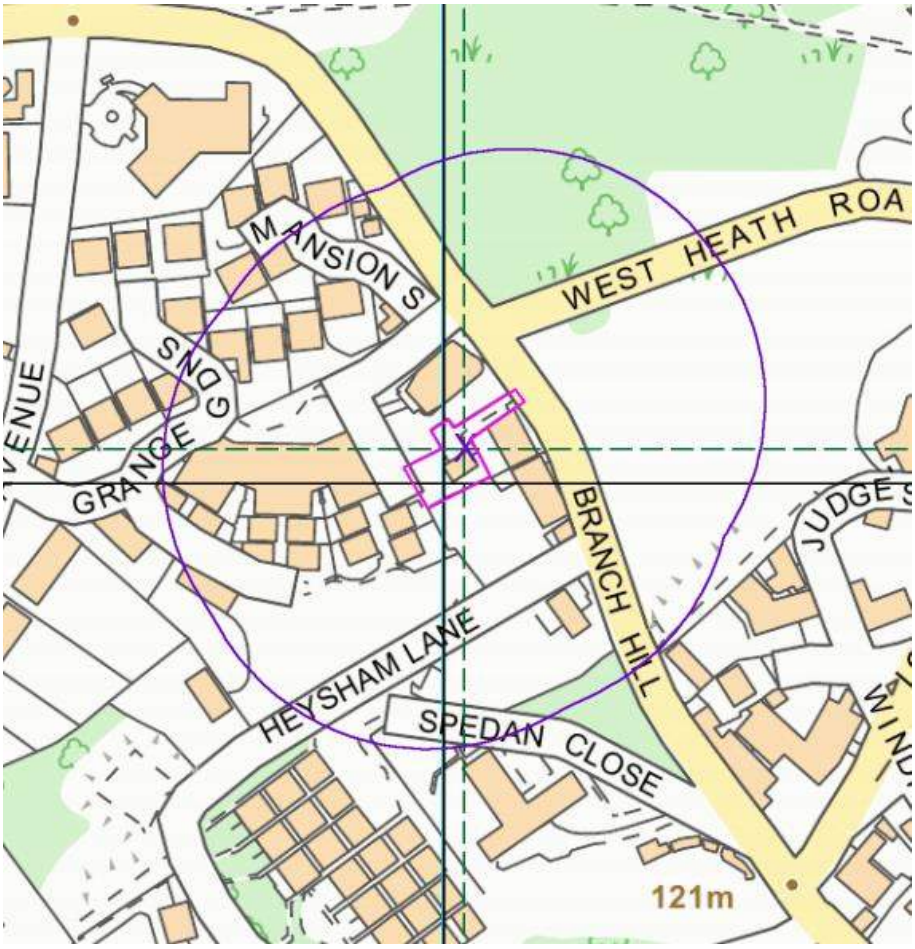

Figure 1. Site Location Plan

3.2 Site Layout and History

The site was attended on 10th October 2014 for the purposes of conducting the site walkover.

The site is roughly L-shaped and comprises of a large three storey residential house along with a swimming pool and garden space occupying the western part of the site and a driveway to the east.

The ground levels over the site fall to the south-west at shallow angles of between 3-5 degrees from 120mOD at the entrance driveway adjacent to Branch Hill, 119mOD at the front of the building and 117mOD within the rear garden area. The house is cut into this slope and is 2-storeys high at entrance/driveway level and 3-storeys high at the rear of the site where there is an additional lower ground floor level.

There is also a general slope in the wider hillside setting from north to south down towards the Thames Basin up to approximately 5 degrees.

Despite the differences in height, these slope angles are all less than 1 in 8 (7 degrees). Also with reference to the Camden Geological, Hydrogeological and Hydrological Study, (Figure 3 below), the neighbouring properties also have slopes less than 7 degrees.

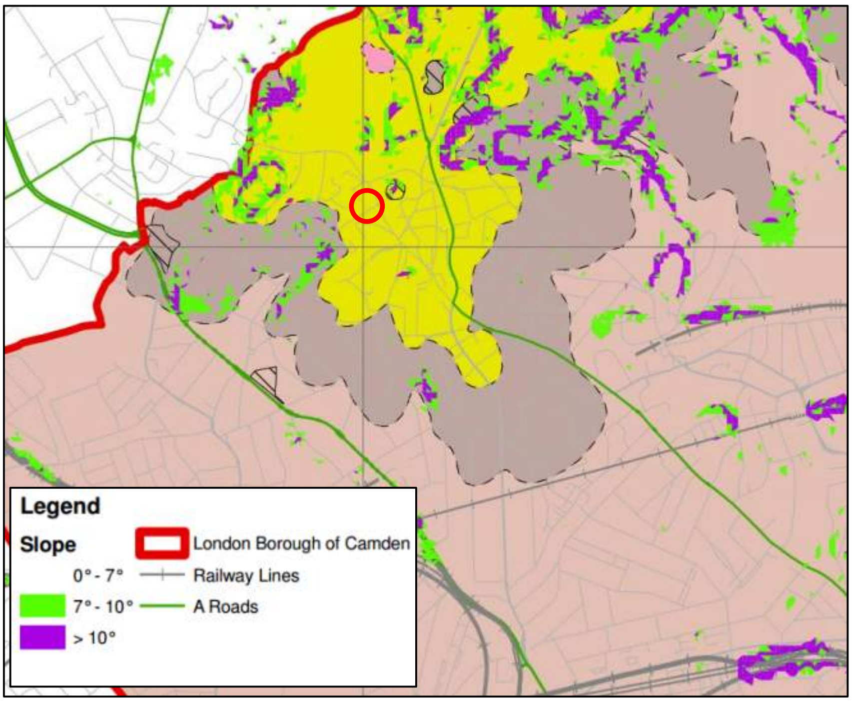

Figure 3. Exact from Figure 17 of the Camden CPG4 showing slope angles within the borough

There are 19 trees surveyed on or around the site, of which 10 are B category (Moderate Quality), 7 are C category (Low Quality) and 2 are U category (Unsuitable for Retention) which are detailed in the Arboricultural Assessment and Protection Method Statement for the site dated 27th June 2015 by Landmark Trees (Report Ref: SHH/17BRH/AIA/02a). The tree species found on site comprise mainly sycamore, with some Austrian pine, common yew, elder, purple plum, Himalayan cedar, silver birch and Leyland cypress.

As part of the development there are recommended works for two on-site trees (T16 and T18 - Sycamores) and one off-site tree (T1, Cypress, Leyland).

The existing property on the site is detached and set back from the main road with a private driveway. There are therefore no residential properties within 10m of the existing building although there is a brick shed associated with the ‘The Chestnuts’ located approximately 1m to the south of the No. 17. This building does not contain a basement.

From a review of the historical maps it would appear that small buildings first occupied the site in 1896 and the current building appeared between 1915 and 1934. The surrounding area has been predominantly residential of the years

3.3 Previous Reports

The results from a Phase 1 Preliminary Risk Assessment and Phase 2 Intrusive Investigation are presented under separate cover in Site Analytical Services Limited reports (Project No’s. 14/22714-1 and 14/22714 respectively) dated November 2014. A previous Basement Impact was submitted to Camden Council in May 2015 (Reference 22714-2). This revised BIA aims to

3.4 Geology

The 1:50000 Geological Survey map of Great Britain (England and Wales) covering the area is detailed in Figure 4 below and indicates the site to be underlain by the Bagshot Formation with the Claygate Member and London Clay Formation at depth. The boundary to the underlying Claygate Member is approximately 100m to the south-west.

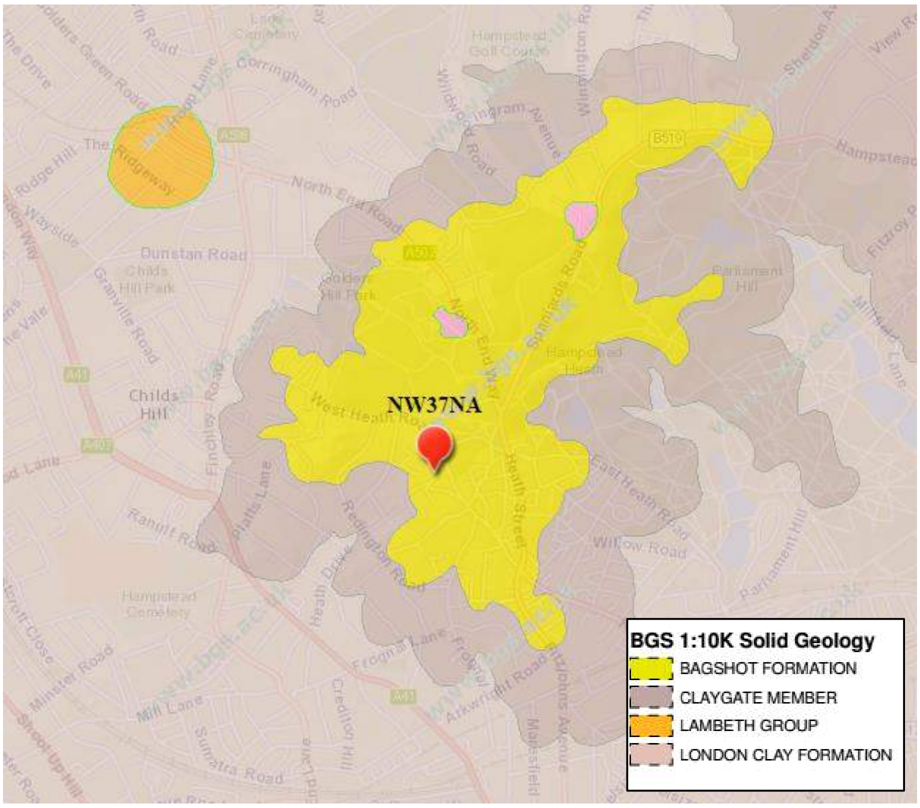

Figure 4. Geology of the Site (Ref. BGS Geoindex)

The British Geological Survey’s online records indicate there are five boreholes located within 100m of the site, however these records are withheld by the BGS and unable to view online.

3.5 Hydrology and drainage

3.5.1 Surface Water

According to Mayes (1997) rainfall in the local area averages around 610mm and significantly less than the national average of around 900mm.

Evapotranspiration is typically 450 mm/yr resulting in about 160 mm per year as ‘hydrologically effective’ rainfall which is available to infiltrate into the ground or runoff as surface water flow.

With reference to Camden Geological, Hydrogeological and Hydrological Study (1999), Talling (2011) and Barton (1992) springs that sourced tributaries of the ‘lost river’ River Westbourne are located approximately 10m south and 150m south of the site (Figure 5). Both spring lines are shown on the annotated historical OS map dated 1879 (Figure 6).

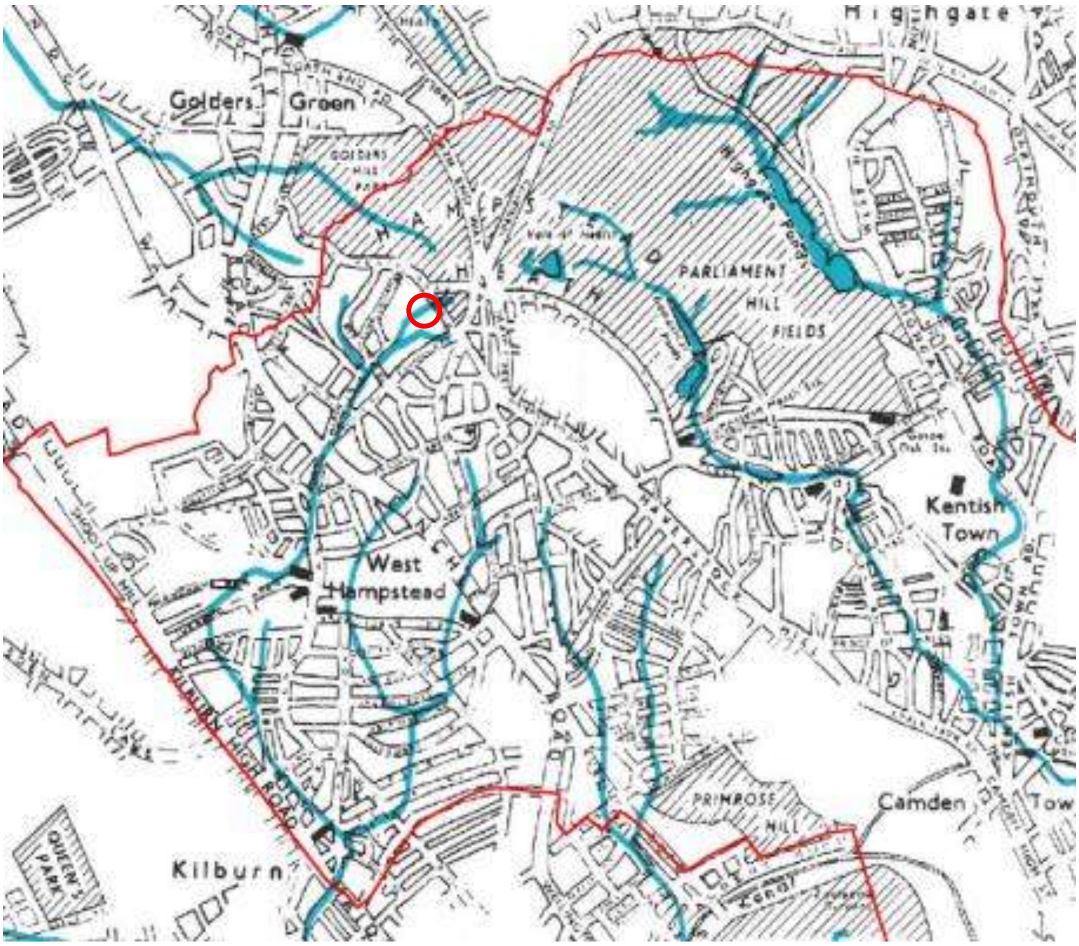

Figure 5. Location of site (circled) relative to the ‘Lost Rivers’ of London
(Source: Barton, 1992)

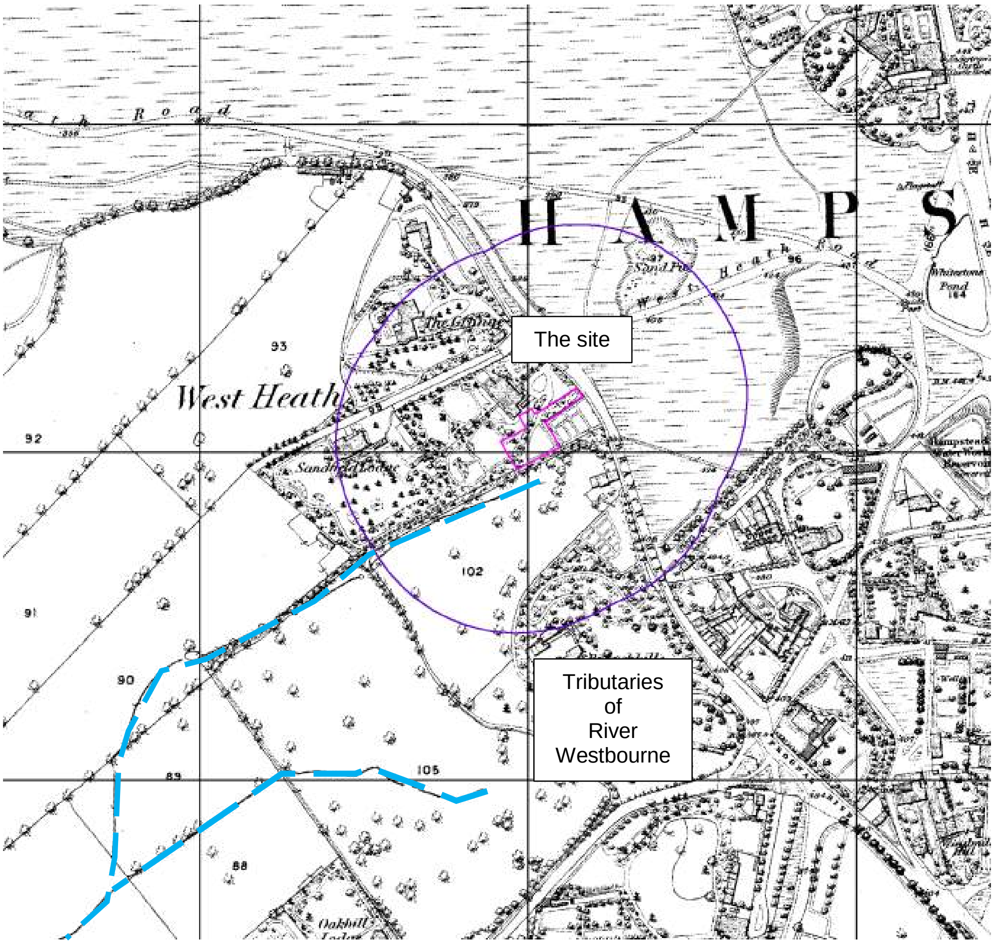

Figure 6. Location of River Tyburn and River Westbourne with respect to the site from OS map dated 1871 (Purple boundary indicates 100m distance)

The Westbourne flowed in a southerly direction, combining with the other tributaries in West Hampstead and then flowing through Kilburn and Paddington before issuing into the Serpentine in Hyde Park. From there the river flowed south through Chelsea before flowing into the River Thames opposite Battersea Park.

The watercourses have since been largely lost through a culverting system as the urban extent of the Borough has grown over time.

The nearest surface water is Whitestone Pond located approximately 250m east of the site.

The area located immediately around the site is highly developed with more than 80% of the surface covered with hardstanding. Most of the rainfall in the area will run-off hard surface areas and be collected by the local sewer network.

Surface drainage from the site is assumed to be directed to drains flowing downhill to the south down Branch Hill.

3.5.2 Flood Risk

3.5.2.1 River or Tidal flooding

According to Environment Agency Flood maps the site lies within Flood Zone 1, which is defined as areas where flooding from rivers and the sea is very unlikely, with less than a 0.1 per cent (1 in 1000) chance of such flooding occurring each year. The EA's website also shows that this area does not fall within an area at risk of flooding from reservoirs. Based on this information a flood risk assessment will not be required.

3.5.2.2 Surface water flooding

Figure 7 shows that Branch Hill did not flood during either the 1975 or the 2002 flood events. The closest road to the property which flooded in either of these events is Windmill Hill located 140m to the south-east which flooded in 1975.

Figure 7. Extract from Figure 15 of the Camden CPG4 showing roads which flooded in 1975 (light blue), in 2002 (dark blue) and 'areas with potential to be at risk from surface water flooding' (wide light blue bands)

Further modelling of surface water flooding has been undertaken by the Environment Agency and was published on its website in January 2014; an extract from their model is presented in Figure 8. Whilst this map identifies four levels of risk (high, medium, low and very low) it is understood that it is based at least in part on depths of flooding. This modelling shows a 'Very Low' risk of flooding (the lowest category for the national background level of risk) for No.17 and the surrounding area.

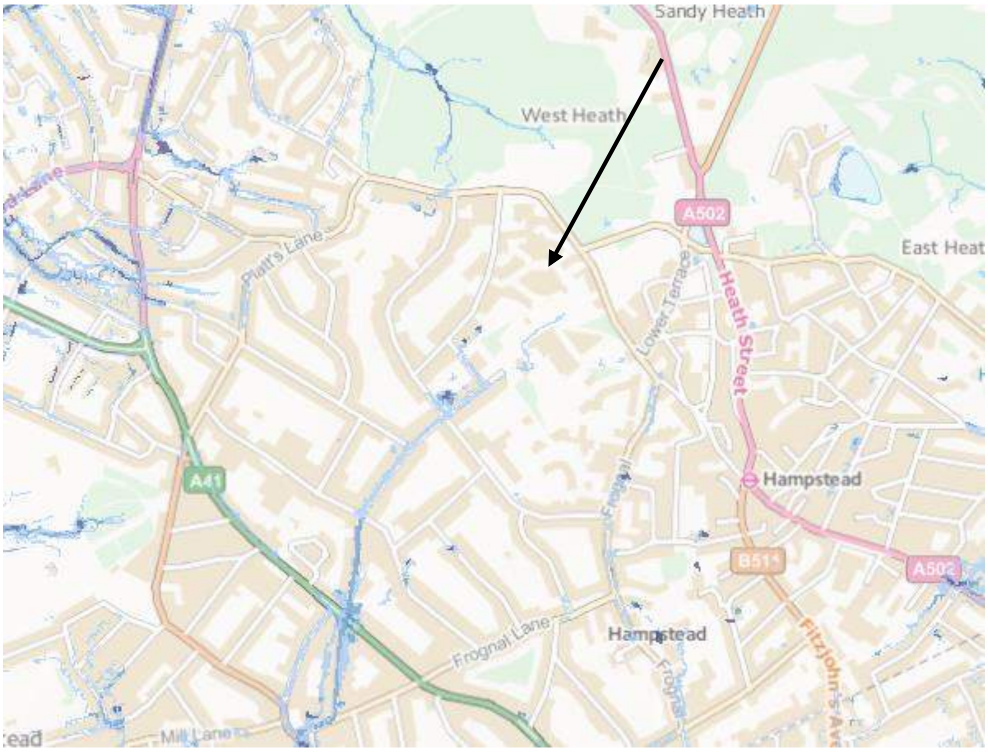

Figure 8. Extract from the Environment Agency's 'Risk of Flooding from Surface Water'. Ordnance Survey Crown copyright 2015. All rights reserved.

As detailed in Table 2 below, the scheme will not result in an increase in impermeable areas, rather an increase in permeable areas of 45.0m2.

Element	Existing (m2)	Proposed (m2)
Impermeable (hardstanding - building footprint, concrete areas)	571	526
Permeable (softscaping - grassed areas, (including green roof), permeable and porous paving)	269	314
Total (should be the site area and remain the same)	840	840

Table 2. Existing and Proposed Permeable Areas.

Given the limited scope of the scheme and no increase in impermeable areas, the scheme is considered compliant with the surface water management and flood risk elements of NPPF and Camden policy. Also as there is no increase in impermeable areas there is no formal additional SUDS required in accordance with Camden policy.

3.5.2.3 Sewer flooding

The London Regional Flood Risk Appraisal (2009) advises that foul sewer flooding is most likely to occur where properties are connected to the sewer system at a level below the hydraulic level of the sewage flow, which in general are often basement flats or premises in low lying areas. There is no record of sewer flooding having occurred at 26 Lyndhurst Road and therefore the risk of sewer flooding is considered low.

3.6 Hydrogeological setting

The Environment Agency Groundwater Protection Policy uses aquifer designations that are consistent with the Water Framework Directive. These designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) and also their role in supporting surface water flows and wetland ecosystems.

The Bagshot Formation and underlying Claygate Member are permeable, capable of storing and transmitting groundwater and are considered to be Secondary A Aquifers. The underlying London Clay Formation is classed as unproductive strata or a non-aquifer. These are deposits with a low permeability that have negligible significance for water supply or river base flow.

The Chalk Principal Aquifer which occurs at depth beneath the London Clay is not considered relevant to the proposed basement so is not considered further.

The beds of silty sand and sandy silt within the Bagshot Formation would generally be expected to be waterbearing and where these are laterally continuous they can give rise to moderate to high water entries into excavations. The more cohesive beds would also be expected to be saturated, with water pressures controlled by the water levels/ pressures in adjacent silt/sand beds, by tree root activity, or by the influence of man-made changes such as utility trenches (which can act either land drains or as sources of water and high groundwater pressures). Natural groundwater flow rates, if any, in the silt/sand horizons within the Bagshot Formation are typically low to moderate. Variations in groundwater levels and pressures will occur seasonally and with other man-induced influences.

The presence of interbedded sands, silts and clays of the Bagshot Formation gives rise to various springs. Indeed springs that sourced tributaries of the River Westbourne are located approximately 10m south and 150m south of the site. The Bagshot Formation beneath the site is likely to be controlled by the local topography and is therefore likely to be in a southerly direction, in the direction that the former river flowed.

Based on the available data, the site is in considered to be at low risk from all sources of flooding. The replacement dwelling and basement can be constructed and operated safely in flood risk terms without increasing flood risk elsewhere and is therefore considered NPPF compliant.

Other hydrogeological data obtained from the Phase 1 Preliminary Risk Assessment (PRA) (SAS Report Ref: 15/22714-1) for the site include:

- The underlying soil classification of the site is of high leaching potential.
- There are no groundwater source protection zones within one kilometre of the site.
- There are no groundwater abstractions within one kilometre of the site.
- There are no sensitive land uses (within one kilometre of the site.

3.7 Proposed Development

The proposal is for the complete demolition of the existing structure and to replace it with a single family dwelling with a height of 2 storeys at entrance level and a lower 3 storeys at garden level as the natural grade of the land falls to the rear of the site. The garden will be split into 2 levels each having on-grade access from the Ground and Lower Ground floors. The maximum depth of the proposed lower ground floor level will be approximately 2.52m below existing lower ground floor level (116.56mOD is the existing level, 114.04mOD is the proposed).

A plan showing the proposed developments is detailed in Figure 9 below.

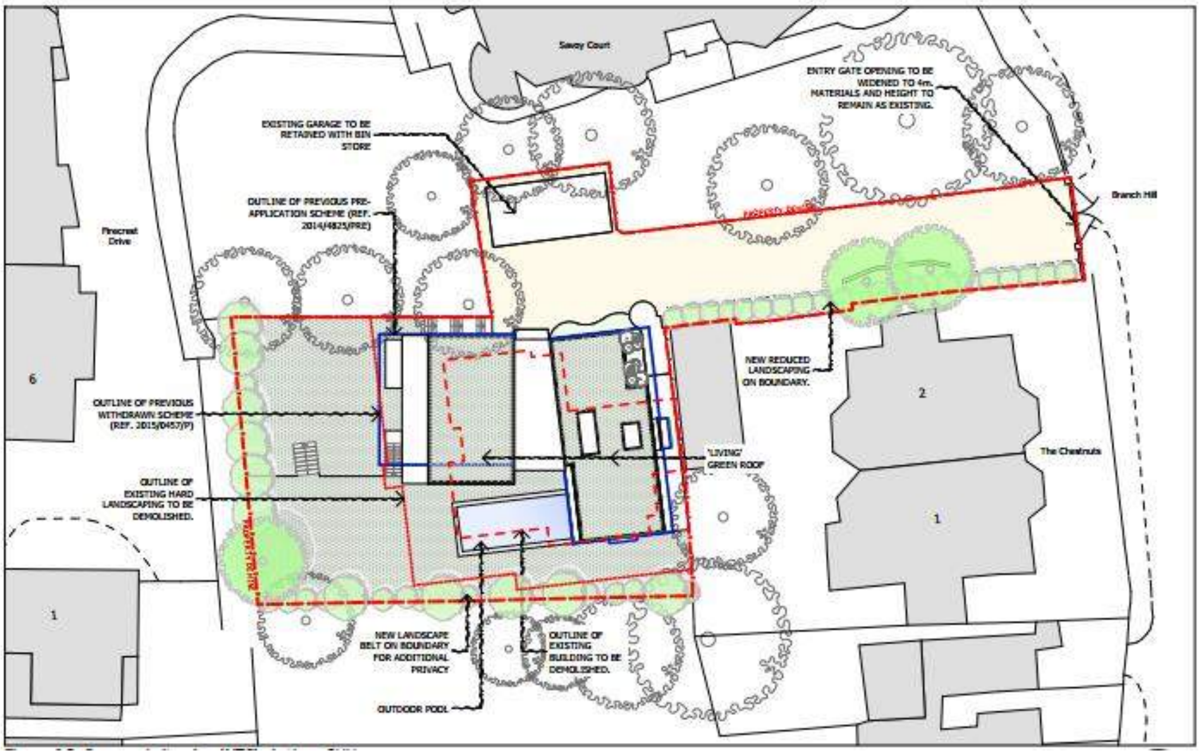

Figure 9. The proposed developments at the site.

3.8 Results of Basement Impact Assessment Screening

A screening process has been undertaken for the site and the results are summarised in table 3 below:

Table 3: Summary of screening results

Item	Description	Response	Comment
Sub-terranean (Ground water Flow)	1a. Is the site located directly above an aquifer.	Yes	The site lies above the Bagshot Formation. These deposits have been designated as Secondary A Class; permeable layers capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.
	1b. Will the proposed basement extend beneath the water table surface.	Unknown – to be confirmed by Ground Investigation	Given the presence of an aquifer below the site it is possible that groundwater will be encountered during any excavations for the proposed basement, however this will be confirmed by the ground investigation.
	2. Is the site within 100m of a watercourse, well (used / disused) or potential spring line.	Yes	The nearest surface water is Whitestone Pond located approximately 250m east of the site. However, according to publications regarding Lost Rivers of London (Barton, 1992) and (Talling, 2011), the site is within 10m of one of the tributaries of the former River Westbourne.
	3. Is the site within the catchment of the pond chains on Hampstead Heath?	No	With reference to the Camden Geological, Hydrogeological and Hydrological Study, the site is not within the catchment of the pond chains on Hampstead, nor the Golder's Hill Chain.
	4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas.	No	the scheme will not result in an increase in impermeable areas, rather an increase in permeable areas of 45.0m2.
	5. As part of 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	Existing drainage paths are to be utilised where possible. Whether soakaways/SUDS are used on the proposed development is to be confirmed (beyond the scope of this report). An appropriately qualified engineer should be engaged to ensure mandatory requirements are met.

	6. Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond or spring line.	No	The nearest surface water is Whitestone Pond located approximately 250m east of the site.
Slope Stability	1. Does the existing site include slopes, natural or man-made greater than 7 degrees (approximately 1 in 8).	No	The site is set on two levels, with the ground floor of the property being at a lower level than the site entrance and driveway. The areas between these two levels slopes to the south-west but this this is at shallow angles of between 3-5 degrees.
	2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7 degrees (approximately 1 in 8).	No	Re-profiling of landscaping at the site is proposed although proposed slope angles will be below 7 degrees.
	3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 degrees (approximately 1 in 8).	No	The surrounding area drops to the south-east but from survey information and with reference to Figure 17 from Camden CPG 4 this is at angles of less than 7 degrees.
	4. Is the site within a wider hillside setting in which the general slope is greater than 7 degrees (approximately 1 in 8).	No	There is a general slope in the area towards the south down to the south-east, but this is at an angle of less than 7 degrees (this is a different answer from the original BIA but is based on further detailed study of the site by SAS and the engineers).
	5. Is the London Clay the shallowest strata at the site.	No	The 1:50000 Geological Survey of Great Britain (England and Wales) indicates the site is underlain by the Bagshot Formation with the Claygate Member and London Clay Formation at depth.
	6. Will any trees be felled as part of the development and/or are any works proposed within any tree protection zones where trees are to be retained.	Yes	As part of the development there are recommended works for two on-site trees (T16 and T18 - Sycamores) and one off-site tree (T1, Cypress, Leyland). This is a different answer from the original BIA but is based on further detailed study of the site by SAS and the engineers.
	7. Is there a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site.	No	The site lies above the Bagshot Formation, a predominantly granular material.

	8. Is the site within 100m of a watercourse or a potential spring line.	No	The nearest surface water is Whitestone Pond located approximately 250m east of the site. However, according to publications regarding Lost Rivers of London (Barton, 1992) and (Talling, 2011), the site is within 10m of one of the tributaries of the former River Westbourne.
	9. Is the site within an area of previously worked ground.	No	The site is not in the vicinity of any recorded areas of worked ground, the nearest recorded on the geological map are close to Finchley Road and to the south of West Heath Road. This is a different answer from the original BIA but is based on further detailed study of the site by SAS and the engineers.
	10. Is the site within an aquifer. If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction.	Unknown – to be confirmed by Ground Investigation	According to the results of the most recent ground investigation the site lies above a Secondary A Aquifer (Bagshot Formation). The depth to the groundwater level is unknown however and will be determined by the site investigation.
	11. Is the site within 50m of the Hampstead Heath Ponds	No	With reference to the Camden Geological, Hydrogeological and Hydrological Study, the site is not within the catchment of the pond chains on Hampstead, nor the Golder's Hill Chain.
	12. Is the site within 5m of a highway or pedestrian right of way.	No	The development is at least 30m west of Branch Hill.
	13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties.	Yes	The existing property on the site is detached and set back from the main road with a private driveway. There are therefore no residential properties within 10m of the existing building although there is a brick shed associated with the 'The Chestnuts' located approximately 1m to the south of No. 17. This building does not contain a basement.
	14. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines.	No	A full statutory service search was out of scope of this report and must be completed prior to any excavations. However TFL have confirmed they do not have any assets below the site (See appendix A)
Surface Water and Flooding	1. Is the site within the catchment of the ponds chains on Hampstead Heath	No	With reference to the Camden Geological, Hydrogeological and Hydrological Study, the site is not within the catchment of the pond chains on Hampstead, nor the Golder's Hill Chain

	2. As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route.	No	On completion of the development the surface water flows will be routed similarly to the existing condition, with rainwater run-off collected in a surface water drainage system and discharged to a combined sewer. Any groundwater flows will not be impeded by the basement. The scheme offers betterment and reduces flood risk overall by in increasing permeable areas on the site.
	3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas.	No	The scheme will not result in an increase in impermeable areas, rather an increase in permeable areas of 45.0m2.
	4. Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses.	No	All surface water for the site will be contained within the site boundaries and collected as described above; hence there will be no change from the development on the quantity or quality of surface water being received by adjoining sites.
	5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses.	No	The surface water quality will not be affected by the development as in the permanent condition collected surface water will generally be from roofs, domestic hard landscaping or collected from beneath the landscaping layer over the basement.
	6. Is the site in an area identified to have surface water flood risk according to either the Local Flood Risk Management Strategy or the Strategic Flood Risk Assessment or is it at risk from flooding, for example because the proposed basement is below the static water level of nearby surface water feature.	No	Branch Hill did not flood during either the 1975 or the 2002 flood events. Also according to modelling by the Environment Agency, there is a 'Very Low' risk of surface water flooding (the lowest category for the national background level of risk) for No.17 and the surrounding area. There are no surface water features within 100m of the site which could create a flood risk for the proposed basement.

3.9 Non Technical Summary of Chapter 3.0

The site is located to the west of Branch Hill in the London Borough of Camden at approximate postcode NW3 7NA. The site comprises of a detached modern house with a driveway at the front and a rear garden area. The proposal is for the complete demolition of the existing structure and to replace it with a single family dwelling with a height of 2 storeys at entrance level and a lower 3 storeys at garden level as the natural grade of the land falls to the rear of the site.

The ground levels over the site fall to the south-west at shallow angles of between 3-5 degrees from 120mOD at the entrance driveway adjacent to Branch Hill, 119mOD at the front of the building and 117mOD within the rear garden area. The house is cut into this slope and is 2-storeys high at entrance/driveway level and 3-storeys high at the rear of the site where there is an additional lower ground floor level.

The 1:50000 Geological Survey map of Great Britain (England and Wales) covering the area indicates the site to be underlain by the Bagshot Formation with the Claygate Member and London Clay Formation at depth. The boundary to the underlying Claygate Member is approximately 100m to the south-west. The Bagshot Formation is permeable, capable of storing and transmitting groundwater and is considered to be a Secondary A Aquifer; The underlying London Clay Formation is classed as unproductive strata or a non-aquifer.

With reference to Camden Geological, Hydrogeological and Hydrological Study (1999), Talling (2011) and Barton (1992) springs that sourced tributaries of the ‘lost river’ River Westbourne are located approximately 10m south and 150m south of the site. The watercourses have since been largely lost through a culverting system as the urban extent of the Borough has grown over time.

The nearest surface water is Whitestone Pond located approximately 250m east of the site.

According to Environment Agency Flood maps the site lies within Flood Zone 1, which is defined as areas where flooding from rivers and the sea is very unlikely, with less than a 0.1 per cent (1 in 1000) chance of such flooding occurring each year. Branch Hill did not flood during either the 1975 or the 2002 flood events. Modelling of surface water flooding by the Environment Agency shows a ‘Very Low’ risk of flooding (the lowest category for the national background level of risk) for No.17 and the surrounding area.

The scheme will not result in an increase in impermeable areas, rather an increase in permeable areas of 45.m2. This is a significant increase in permeable areas of c. 25%.

The Screening Exercise has identified the following potential issues which will be carried forward to the Scoping Phase

Subterranean Groundwater Flow

- Is the site located directly above an aquifer
- Will the proposed basement extend beneath the water table surface
- Is the site within 100m of a watercourse, well (used / disused) or potential spring line.

Slope Stability

- Will any trees be felled as part of the development and/or are any works proposed within any tree protection zones where trees are to be retained.
- Is the site within an aquifer. If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction.
- Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties.

4.0 SCOPING PHASE

4.1 Introduction

This purpose of the scoping phase is to assess in more detail the factors to be investigated in the impact assessment. Potential impacts are assessed for each of the identified impact factors and recommendations are stated.

A conceptual ground model is usually complied at the scoping stage however, because the ground investigation has already been undertaken for this project, the conceptual ground model including the findings of the ground investigation is described under Chapter 4.

Subterranean (Groundwater Flow)

Potential Issue (Screening Question)		Potential impacts and actions
1a	Is the site located directly above an aquifer	**Potential impact:** Infiltration could be reduced. **Action:** Ground Investigation required, then review.
1b	Will the proposed basement extend beneath the water table surface?	**Potential impact:** Local restriction of groundwater flows (perched groundwater or below groundwater table). **Action:** Ground investigation required, the review.
2	Is the site within 100m of a watercourse, well (used / disused) or potential spring line.	**Potential impact:** The flow from a spring, well or watercourse may increase or decrease if the groundwater flow regime is affected by the proposed basement **Action:** Review hydrogeology of the site and undertake a ground investigation

Slope Stability

6	Will any trees be felled as part of the development and/or are any works proposed within any tree protection zones where trees are to be retained?	**Potential Impact:** Ground movements will occur during and after the basement construction. **Action:** Following the results of the ground investigation an approved Arboriculturalist should be appointed.
10	Is the site within an aquifer. If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction.	**Potential impact:** Infiltration could be reduced. **Action:** Ground Investigation required, then review.
13	Will the proposed basement substantially increase the differential depth of foundations relative to neighbouring properties?	**Potential impact:** Loss of support to the ground beneath the new foundations to neighbouring properties if basement excavations are inadequately supported.

		Action: Ensure adequate temporary and permanent support by use of best practice methods.

These potential impacts have been further assessed through the ground investigation, as detailed in Section 4 below.

4.2 Non-Technical Summary of Chapter 4.0

The scoping exercise has reviewed the potential impacts for each of the items carried forward from Stage 1 screening, and has identified the following actions to be undertaken:

- A ground investigation is required (which has already been undertaken).
- Review of site's hydrogeology and groundwater control requirements.

All these actions are covered in Stage 4, or Stage 3 for the ground investigation.

5.0 SITE INVESTIGATION DATA

5.1 Records of site investigation

A site-specific ground investigation was undertaken by Site Analytical Services Limited (SAS) in October 2014 and included one rotary percussive borehole (Borehole 1) drilled to 15m below ground level, one continuous flight auger borehole (Borehole 2) drilled to 6m below ground level and one hand dug trial pit (Trial Pit 1) excavated to 1.5m depth.

The factual findings from the investigation are presented in Appendix B, including a site plan, exploratory hole logs, groundwater monitoring and laboratory test results.

5.2 Ground conditions

The boreholes and trial pit revealed ground conditions that were consistent with the geological records and known history of the area and comprised Made Ground up to 0.80m in thickness resting on deposits of the Bagshot Formation.

5.2.1 Made Ground

The Made Ground extended to a depth of 0.80m below ground level (119.10mOD) in Borehole 1 and 0.75m below ground level (116.55mOD) in Borehole 2 and to the full depth of investigation of 0.12m below ground level (117.28mOD) in Trial Pit 1. The material generally comprised of a soft brown silty sand with brick and concrete fragments and rubble.

5.2.2 Bagshot Formation

The Bagshot beds were encountered beneath the Made Ground in both boreholes and generally comprised of loose becoming medium dense clayey silty fine sand locally becoming stiff silty sandy clay. These soils extended down to the full depths of investigation of 15.00m below ground level (104.90mOD) in Borehole 1 and 6.00m below ground level (111.30mOD) in Borehole 2.

5.3 Groundwater

Groundwater was not encountered during the excavation of the trial pit and the soils remained essentially dry throughout. Groundwater was encountered in both boreholes during boring, at 7.20m below ground level (112.70mOD) in Borehole 1 and 5.00m below ground level (112.30mOD) in Borehole 2.

It must be noted that the speed of excavation is such that there may well be insufficient time for further light seepages of groundwater to enter the boreholes and trial pit and hence be detected, particularly within more cohesive soils.

Isolated pockets of groundwater may also be present perched within any less permeable material found at shallower depth on other parts of the site especially within any Made Ground.

Borehole 1 was equipped with a water-monitoring standpipe piezometer with the response zone between 1-8m depth.

Groundwater was recorded at a depth of 7.11m below ground level (112.79mOD) in the monitoring standpipe placed in Borehole 1 after a period of approximately two weeks.

It should be noted that the comments on groundwater conditions are based on observations made at the time of the investigation (October 2014) and that changes in the groundwater level could occur due to seasonal effects and also changes in drainage conditions.

5.4 Foundations

Trial Pit 1 was excavated adjacent to the rear wall of the existing property on the site in order to expose the foundations and founding soils. In the event the trial pit was terminated at 0.12m below ground level (117.28mOD) due to the presence of a concrete obstruction.

5.5 In-Situ and Laboratory Testing

The results of the laboratory and in-situ tests are presented in the factual report contained in Appendix A.

5.5.1 Standard Penetration Tests

The results of the Standard Penetration Tests carried out in the natural soils are shown on the exploratory hole records in Appendix A. SPT ‘N’ values range between 9 and 34.

5.5.2 Undrained Triaxial Compression Test Results

A single Quick Undrained Triaxial Compression test was carried out on an undisturbed 100mm diameter sample taken from Borehole 1 at 2.25m depth. The results show the sample to be of a stiff consistency. The result show the sample to be of a high strength in accordance with BS 5930 2015.

5.5.3 Classification Tests

Atterberg Limit tests were conducted on three selected samples taken from the cohesive sections of the natural soils in Boreholes 1 and 2 and showed the samples tested to fall into Class CI, according to the British Soil Classification System.

These are fine grained silty clay soils of intermediate plasticity and as such generally have a low permeability and a medium susceptibility to shrinkage and swelling movements with changes in moisture content, as defined by the NHBC Standards, Chapter 4.2. The results indicated Plasticity Index values between 23% and 28%, with all of the samples being below the 40% boundary between soils assessed as being of medium swelling and shrinkage potential and those assessed as being of high swelling and shrinkage potential.

Particle size distribution tests were also carried out on six selected samples of essentially granular natural soil using wet sieving methods

5.5.4 Sulphate and pH Analyses

The results of the sulphate and pH analyses show the natural soil samples tested to have water soluble sulphate contents of up to 0.07g/litre associated with slightly acidic pH values. The samples of Made Ground tested indicated water soluble sulphate contents of up to 0.11g/litre associated with slightly alkaline pH values.

5.6 Non-Technical Summary of Chapter 5.0

The boreholes and trial pit revealed ground conditions that were consistent with the geological records and known history of the area and comprised Made Ground up to 0.80m in thickness resting on deposits of the Bagshot Formation.

Groundwater was recorded at a depth of 7.11m below ground level (112.79mOD) in the monitoring standpipe placed in Borehole 1 after a period of approximately two weeks.

Trial Pit 1 was excavated adjacent to the rear wall of the existing property on the site in order to expose the foundations and founding soils. In the event the trial pit was terminated at 0.12m below ground level (117.28mOD) due to the presence of a concrete obstruction.

6.0 FOUNDATION DESIGN

6.1 Introduction

The proposal is for the complete demolition of the existing structure and to replace it with a single family dwelling with a height of 2 storeys at entrance level and a lower 3 storeys at garden level as the natural grade of the land falls to the rear of the site. The garden will be split into 2 levels each having on-grade access from the Ground and Lower Ground floors.

The maximum depth of the proposed lower ground floor level will be approximately 2.52m below existing lower ground floor level (116.56mOD is the existing level, 114.04mOD is the proposed).

6.2 Site Preparation Works

The main contractor should be informed of the site conditions and risk assessments should be undertaken to comply with the Construction Design Management (CDM) regulations. Site personnel are to be made aware of the site conditions. It is recommended that extensive searches of existing man-made services are undertaken over the site prior to final design works.

6.3 Ground Model

On the basis of the fieldwork, the ground conditions at the site can be characterised as follows:

- Made Ground extends to depths of between 0.80m to 0.75m depth below ground level (116.55 to 117.28mOD)

- The Bagshot beds comprising loose becoming medium dense clayey silty fine sand locally becoming stiff silty sandy clay extending down to the full depths of investigation of 15.00m below ground level (104.90mOD) and 6.00m below ground level (111.30mOD).

- Groundwater was encountered at a depth of 7.11m (112.79mOD) in the monitoring standpipe installed in Borehole 1 after a period of approximately two weeks.

6.4 Construction Method Statement

A full Construction Method Statement (CMS) has been provided by the Structural Engineers for the project (Engineers HRW) and is included as Appendix C to this report.

The CMS has been prepared in compliance with the London Borough of Camden's DP27 and CPG4 Basements and Lightwells requirements for basement extensions. It includes a construction methodology statement prepared and signed off by a Chartered Structural Engineer (MIStruct.E) and includes proposals for temporary supports and sequence of construction.

The proposed development of the site involves the demolition of the existing building and construction of a new three storey property inclusive of lower ground (rear garden level). Generally, the proposed depth of excavation below the existing ground level to the front of the property (high level) is to be a maximum of 4.0m, however in the area of the proposed study/ games room to the rear of the property this will decrease to around 2.5m (circa 2.8m below existing garden level to the rear of the property). The existing ground level is to be raised in this area resulting in a final retained height of 5.5m against the northern boundary. The existing retained height at the boundary retaining wall is approximately 3.5m. For the higher retained levels a contiguous pile wall is proposed.

Elsewhere temporary trench sheeting is proposed to allow sequential construction of the retaining wall. This due to the possibility of running sands. As the new lower ground floor to the rear is deeper than the existing floor level a small amount heave of the underlying clay soils is to be allowed for. This is to be achieved by supporting the building on piles and constructing the floor slabs on compressible fill.

6.5 Spread Foundations

A result of the inherent variability of uncontrolled fill, (Made Ground) is that it is usually unpredictable in terms of bearing capacity and settlement characteristics. Foundations should therefore, be taken through any Made Ground and either into, or onto a suitable underlying natural strata of adequate bearing characteristics.

Based on the ground and groundwater conditions encountered in Borehole 2 drilled at lower ground floor level, it should be possible to support the proposed new development on conventional strip or basement raft foundations taken down below the Made Ground and any weak superficial soils and placed in the natural firm and stiff silty sandy clay deposits which were encountered at levels of about 116.3mOD to 118.0mOD across the site.

Using theory from Terzaghi (1943), strip foundations placed within natural soils may be designed to allowable net bearing pressures of approximately 250kN/m2 at 2.50m depth (114mOD) in order to allow for a factor of safety of 2.5 against general shear failure. The actual allowable bearing pressure applicable will depend on the form of foundation, its geometry and depth in accordance with classical analytical methods, details of which can be obtained from "Foundation Design and Construction", Seventh Edition, 2001 by M J Tomlinson (see references) or similar texts.

Any soft or loose pockets encountered within otherwise competent formations should be removed and replaced with well compacted granular fill.

In addition, foundations may need to be taken deeper should they be within the zones of influence of both existing or recently felled trees and any proposed tree planting. The depth of foundation required to avoid the zone likely to be affected by the root systems of trees is shown in the recommendations given in NHBC Standards, Chapter 4.2, April 2010, “Building near Trees" and it is considered that this document is relevant in this situation.

6.6 Piled Foundations

In the event that the use of conventional spread foundations proves either impracticable or uneconomical due to the size and depth of foundation required, then a piled foundation will be required. In these ground conditions, it is considered that some form of bored and in-situ cast concrete piled foundation with reinforced concrete ground beams should prove satisfactory.

The construction of a piled foundation is a specialist activity and the advice of a reputable contractor, familiar with the type of soil and groundwater conditions encountered at this site should be sought prior to finalising the foundation design. The actual pile working load will depend on the particular type of pile chosen and method of installation adopted.

To achieve the full bearing value a pile should penetrate the bearing stratum by at least five times the pile diameter.

Where piles are to be constructed in groups the bearing value of each individual pile should be reduced by a factor of about 0.8 and a calculation made to check the factor of safety against block failure.

Driven piles could also be used and would develop much higher working loads approximately 2.5 to 3 times higher than bored piles of a similar diameter at the same depth. However, the close proximity of adjacent buildings will in all probability preclude their use due to noise and vibration.

6.7 Retaining Walls

Several methods of retaining wall construction could be considered. These may include retaining structures cast in an underpinning sequence, or the use of temporary or sacrificial works to facilitate the retaining structure’s construction. The excavation of the basement must not compromise the integrity of adjacent structures.

The full design of temporary and permanent retaining structures is beyond the scope of this report. However, the following design parameters for each element of soil recorded in the relevant exploratory holes are provided in Table 6 below to assist the design of these structures.

Stratum	**Depth to top (mOD)**	**Bulk Density (Mg/m3) (ɣ)**	**Effective Angle of Internal Friction (Φ)**
Made Ground	117.30 to 119.90	1.80	27
Bagshot Formation	116.55 to 119.10	1.85	35

Table 6. Retaining Wall Design Parameters

The designer should use these parameters to derive the active and passive earth pressure coefficients ka and kp. The determination of appropriate earth pressure coefficients, together with factors such as the pattern of the earth pressure distribution, will depend upon the type/geometry of the wall and overall design factors.

6.8 Chemical Attack on Buried Concrete

The results of the chemical analyses show show the natural soil samples to have water soluble sulphate contents of up to 0.07g/litre associated with slightly acidic to acidic pH values. The samples of Made Ground tested indicated water soluble sulphate contents of up to 0.11g/litre associated with slightly alkaline to alkaline pH values.

In these conditions, it is considered that deterioration of buried concrete due to sulphate or acid attack is unlikely to occur. The final design of buried concrete according to Tables C1 and C2 of BRE Special Digest 1:2005 should be in accordance with Class DS-1 conditions.

6.9 Non-Technical Summary of Chapter 6.0

The proposal for the site is for the complete demolition of the existing structure and to replace it with a single family dwelling with a height of 2 storeys at entrance level and a lower 3 storeys at garden level as the natural grade of the land falls to the rear of the site. The garden will be split into 2 levels each having on-grade access from the Ground and Lower Ground floors.

The boreholes and trial pit revealed ground conditions that were consistent with the geological records and known history of the area and comprised Made Ground up to 0.80m in thickness resting on deposits of the Bagshot Formation.

Groundwater is not expected to be encountered in the basement excavation, but it would be prudent for the chosen contractor to have a contingency plan in place to deal with any perched groundwater inflows as a precautionary measure.

In accordance with general basement flood policy and basement design, the proposed development will utilise the flood resilient techniques recommended in the NPPF Technical Guidance where appropriate and also the recommendations that have previously been issued by various councils

Based on the ground and groundwater conditions encountered in the boreholes and trial pit, it should be possible to support the proposed new development on conventional strip or basement raft foundations taken down below the Made Ground and any weak superficial soils and placed in the natural firm sandy silty clay deposits which occur at depths of approximately 2.50m below ground level over the site.

In the event that the use of conventional spread foundations proves either impracticable or uneconomical due to the size and depth of foundation required, then a piled foundation will be required.

Several methods of retaining wall construction could be considered. These may include retaining structures cast in an underpinning sequence, or the use of temporary or sacrificial works to facilitate the retaining structure's construction. The excavation of the basement must not compromise the integrity of adjacent structures.

7.0 BASEMENT IMPACT ASSESSMENT

7.1 Summary

The screening identified a number of potential impacts. 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	Impact sufficiently addressed without further justification?
The site is directly above an aquifer.	The most recent soils investigation has proven that the site lies above the Bagshot Formation. These are generally aquifers formerly classified as minor aquifers.	No – see below for further details.
The proposed basement extends beneath the water table surface.	Groundwater was encountered at a depth of 7.11m below ground level (112.79mOD) in the monitoring standpipe installed in Borehole 1 after a period of approximately two weeks. This is below the depth of the proposed basement at 114.79mOD and therefore the influence of the development on groundwater is expected to be minimal.	Yes
The site within 100m of a watercourse, well (used / disused) or potential spring line.	The basement will not extend beneath the water table and therefore will not cause any change in the groundwater flow regime. Groundwater is present at about 2.00m below formation level of the proposed basement. As such seasonal changes are unlikely to have a significant influence on the basement or slope stability.	Yes
Trees will be felled as part of the development	It is understood that as part of the development there are recommended works for two on-site trees (T16 and T18 - Sycamores) and one off-site tree (T1, Cypress, Leyland) however as the trees are mainly on flat land they will not present a significant negative impact on slope stability. Desiccation of the shallow soils has not been found in the investigation.	Yes
The proposed basement will significantly increase the differential depth of foundations relative to neighbouring properties.	The development will result in the extension of the foundation depth of the basement relative to neighbouring properties.	No – see below for further details.

7.2 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 Site is located directly above a Secondary A Aquifer

Groundwater was encountered at a depth of 7.11m (112.79mOD) in the monitoring standpipe installed in Borehole 1 after a period of approximately two weeks. This is below the depth of the proposed basement at 114.79mOD although it would be prudent to continue to monitor the standpipes for as long as possible in order to determine equilibrium level and the extent of any seasonal variations. The chosen contractor should also have a contingency plan in place to deal with any perched groundwater inflows as a precautionary measure.

It is anticipated that the natural Bagshot Formation will be encountered at the depth of the proposed basement and therefore 'running sand' conditions is possible if any perched water is encountered between the cohesive/granular elements. Trial excavations to the proposed basement depth could be carried by the main contractor to confirm the stability of the soil across the site. Further details of how running sand conditions are to be dealt with are contained in the Construction Method Statement (Appendix C to this report, summarised in Section 6.4)

The largely granular Made Ground and the presence of large sandy lenses within the Bagshot Formation means the natural flow of groundwater below the site will be able to continue to flow around the new basement. This behaviour is acknowledged in the Camden GHHS which noted that even extensive excavations for basements in the City of London have not caused any serious problems in 'damming' groundwater flow, with groundwater simply finding an alternative route (Arup, 2010, paragraph 205). On this basis, it is not considered that the proposed basement would result in a significant change to the groundwater flow regime in the vicinity of the proposal. Also, given limited scope of the scheme and no increase in impermeable areas, the scheme is also considered compliant with the surface water management and flood risk elements of NPPF and Camden policy.

The proposed basement will need to be fully waterproofed in order to provide adequate long-term control of moisture ingress from the groundwater. Detailed recommendations for the waterproofing system are beyond the scope of this report although it is noted that, as a minimum, it would be prudent for the system to be designed in compliance with the requirements of BS8102:2009.

Due care and attention should be paid to ensure that no contamination incidents occur as a result of the development. No change to the existing drainage arrangements is proposed and therefore existing rates of rainfall infiltration and groundwater recharge will remain unchanged.

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

The existing property on the site is detached and set back from the main road with a private driveway. There are therefore no residential properties within 10m of the existing building although there is a brick shed associated with the 'The Chestnuts' located approximately 1m to the south of No. 17. This building does not contain a basement.

Given the existing property is detached and there are no residential properties within 10m of the site a ground movement assessment was deemed unnecessary for this study. It is understood that ground movements and/or instability will be managed through the proper design and construction of mitigation measures during the works. This will require close collaboration with the appointed contractor's temporary works coordinator. The Party Wall Act (1996) will apply to this development because neighbouring houses lie within a defined space around the proposed building works. The party wall process should be followed and adhered to during this development.

7.3 Advice on Further Work and Monitoring

A monitoring plan should be set out at design stage and should include a monitoring strategy, instrumentation and monitoring plans and action plans. Trigger levels on movements will need to be defined. Precise levelling or reflective survey targets should be installed at the garden walls and neighbouring buildings. Monitoring should take place in advance of the proposed works as a base-line survey, during the works and for a period following the completion of the works, to understand the long term effects.

It would be prudent to continue to monitor the standpipes for as long as possible in order to determine equilibrium level and the extent of any seasonal variations. The chosen contractor should also have a contingency plan in place to deal with any perched groundwater inflows as a precautionary measure.

Trial excavations to the proposed basement depth could be carried by the main contractor to confirm the depth of made ground and stability of the soil specifically at the locations of the excavations and to further investigate the presence of any groundwater inflows.

7.4 Non-Technical Summary of Chapter 7.0

It is anticipated that the natural Bagshot Formation will be encountered at the depth of the proposed basement and therefore 'running sand' conditions is possible. Trial excavations to the proposed basement depth could also be carried by the main contractor to confirm the stability of the soil across the site.

It is not considered that the proposed basement would result in a significant change to the groundwater flow regime in the vicinity of the proposal. Also, given limited scope of the scheme and no increase in impermeable areas, the scheme is also considered compliant with the surface water management and flood risk elements of NPPF and Camden policy.

Given the existing property is detached and there are no residential properties within 10m of the site a ground movement assessment was deemed unnecessary for this study.

It would be prudent to continue to monitor the standpipes for as long as possible in order to determine equilibrium level and the extent of any seasonal variations. The chosen contractor should also have a contingency plan in place to deal with any perched groundwater inflows as a precautionary measure.

8.0 REFERENCES

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

2. Environment Agency, 2006. Groundwater levels in the Chalk-Basal Sands Aquifer in the London Basin

3. Tomlinson, M J, 2001. “Foundation Design and Construction”, Seventh Edition, Prentice Hall (ISBN 0-13-031180-4).

4. British Standards Institution, 2015. Code of Practice for Site Investigations, BS5930, BSI, London

5. British Standards Institution, 1986. Code of practice for foundations, BS 8004, BSI, London.

6. British Standards Institution, 2009. Code of Practice for Protection of Below Ground Structures Against Water from the Ground. BS 8102, BSI, London

7. CIRIA, 2000. Sustainable Urban Drainage Systems: Design Manual for England and Wales. CIRIA C522, Construction Industry Research and Information Association, London

8. Environment Agency Status Report 2010. Management of the London Basin Chalk Aquifer. Environment Agency

9. NHBC Standards, Chapter 4.1, "Land Quality - managing ground conditions", September 1999.

10. NHBC Standards, Chapter 4.2, "Building near Trees", April 2010.

Appendix A. Response from TFL about the development

Transport for London

London Underground

London Underground
Infrastructure Protection

3rd Floor
Albany House
55 Broadway
London SW1H 0BD

www.tfl.gov.uk/tube

Your ref:
Our ref: 20403-SI-2-131015

Andy Smith
Site Analytical Services
andys@siteanalytical.co.uk

13 October 2015

Dear Andy,

17 Branch Hill London NW3 7NA

Thank you for your communication of 12th October 2015.

I can confirm that London Underground has no assets within 50 metres of your site as shown on the plan you provided.

If I can be of further assistance, please contact me.

Yours sincerely

Shahina Inayathusein
Information Manager
Email: locationenquiries@tube.tfl.gov.uk
Direct line: 020 7918 0016

Appendix B. Ground Investigation Report

Site Analytical Services Ltd.

Site Investigations, Analytical & Environmental Chemists, Laboratory Testing Services.

Units 14 + 15, River Road Business Park,
33 River Road, Barking, Essex IG11 0EA

Directors: J. S. Warren, M.R.S.C., P. C. Warren, J. I. Pattinson, BSc (Hons). MSc
Consultants: G. Evans, BSc., M.Sc., P.G. Dip., FGS., MIEnvSc. A. J. Kingston, BSc C.Eng. MIMM
F. J. Gibbs, F.I.B.M.S. F.I.F.S.T., F.R.S.H. K. J. Blanchette

Tel: 0208 594 8134
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E-Mail: services@siteanalytical.co.uk

Your Ref:

Our Ref: Ref: 14/22714
May 2015

Report on a Ground Investigation

At

17 Branch Hill, London, NW3 7NA

For

Engineers Haskins Robinson Waters

CONTENTS

1.0 INTRODUCTION

1.1 Outline and Limitations of Report

At the request of Engineers Haskins Robinson Waters, acting on behalf of Mr Adam Kaye, a ground investigation was carried out in connection with a proposed residential development at the above site. A Phase 1 Preliminary Risk Assessment (Desk Study) is presented under separate cover in Site Analytical Services Limited Report Reference 14/22714-1.

The information was required for the design and construction of foundations and infrastructure for the proposed development which includes the demolition of the existing building and construction of a new three storey residential property with a basement. Information was also required to assess whether any remediation was required for the protection of the end-user from the presence of potential contamination within the soils encountered.

The recommendations and comments given in this report are based on the ground conditions encountered in the exploratory holes made during the investigation and the results of the tests made in the field and the laboratory. It must be noted that there may be special conditions prevailing at the site remote from the exploratory hole locations which have not been disclosed by the investigation and which have not been taken into account in the report. No liability can be accepted for any such conditions.

1.2 Remit and Approach

Environmental assessors use a source-pathway-receptor conceptual site model when determining the risk posed by potentially contaminated sites. For potential risk to arise each stage of the SPR linkage must be present, plausible and significant.

2.0 SITE DETAILS

(National Grid Reference: TQ 260 862)

2.1 Site Location

The site is located to the west of Branch Hill in the London borough of Camden at approximate postcode NW3 7NA. The site comprises of a detached modern house with a driveway at the front and a rear garden area.

The surrounding land use is primarily residential and recreational. There is a large forested area to the north and open space to the east. The surrounding area has a suburban street pattern.

2.2 Geology

The 1:50000 Geological Survey of Great Britain (England and Wales) covering the area (Sheet 256, 'North London', Solid and Drift Edition) indicates the site to be underlain by the Bagshot Formation resting on the Claygate Member with the London Clay Formation at depth.

2.3 Previous Investigations

A Phase 1 Preliminary Risk Assessment (PRA) (SAS Report Ref: 14/22714-1 dated November 2014) was undertaken across the site by Site Analytical Services Limited. The Phase 1 PRA should be read in full in conjunction with this Phase 2 report.

In order to make an assessment of potentially unacceptable risks relating to sensitive receptors on and off-site, a Phase 2 site investigation was recommended.

2.4 Proposed development

It is proposed to demolish the existing building on-site and construct a new three storey residential property with a lower ground floor level.

Proposed plans of the development are included in Appendix D to this report.

3.0 SCOPE OF WORK

3.1 Site Works

The exploratory investigation included for an inspection of the site and near surface soils in order to:-

- Determine the presence, extent and significance of potential contaminants in the sub-surface strata associated with current and former activities at the site and surrounds identified during the Phase 1 PRA.

- Assess the significance of potential impacts on sensitive receptors at or adjacent to the site.

- Assess the potential environmental liabilities and consequences associated with the site.

- Identify requirements for further works, including the design of any additional investigative/monitoring works and remedial measures if deemed necessary.

The proposed scope of works was agreed by the client prior to the commencement of the investigations. To achieve this, the following works were undertaken:-

- The drilling of one rotary percussive borehole to a depth of 15.0m below ground level (104.90mOD) (Borehole 1) and one continuous flight auger borehole to a depth of 6.00m below ground level (111.30mOD)(Borehole 2).

- The installation of a groundwater monitoring standpipe to a depth of 10m below ground level (109.00mOD) in Borehole 1.

- The excavation by hand of one trial pit to expose existing foundations of the retaining wall at the site (Trial Pit 1). In the event the trial pit was terminated at 0.12m below ground level (117.28mOD) due to the presence of a concrete obstruction.

- Sampling and in-situ testing as appropriate to the ground conditions encountered in the boreholes and trial pit.

- Laboratory testing to determine the engineering properties of the soils encountered in the exploratory holes.

- Interpretative reporting on foundation options for the proposed building and infrastructure.

- A study into the possibility of the presence of toxic substances in the soil, together with limited comment on any remediation required.

3.2 Ground Conditions

The locations of the exploratory holes are shown on the site sketch plan, Figure 1.

The site is set on two levels, with the ground floor set lower than the site entrance and driveway. The drop in elevation from east to west across the site is approximately 2m. The ground level for Borehole 1 was approximately 2m higher than Borehole 2.

The boreholes and trial pit revealed ground conditions that were generally consistent with the geological records and known history of the area and comprised Made Ground up to 0.80m in thickness with the Bagshot Formation at depth.

For detailed information on the ground conditions encountered in the boreholes and trial pit, reference should be made to the exploratory hole records presented in Appendix A.

The Made Ground extended to a depth of 0.80m below ground level (119.10mOD) in Borehole 1 and 0.75m below ground level (116.55mOD) in Borehole 2 and to the full depth of investigation of 0.12m below ground level (117.28mOD) in Trial Pit 1. The material generally comprised of a soft brown silty sand with brick and concrete fragments and rubble.

The Bagshot beds were encountered beneath the Made Ground in both boreholes and generally comprised of loose becoming medium dense clayey silty fine sand locally becoming stiff silty sandy clay. These soils extended down to the full depths of investigation of 15.00m below ground level (104.90mOD) in Borehole 1 and 6.00m below ground level (111.30mOD) in Borehole 2.

3.3 Groundwater

Groundwater was not encountered during the excavation of the trial pit and the soils remained essentially dry throughout. Groundwater was encountered in both boreholes during boring, at 7.20m below ground level (112.70mOD) in Borehole 1 and 5.00m below ground level (112.30mOD) in Borehole 2.

It must be noted that the speed of excavation is such that there may well be insufficient time for further light seepages of groundwater to enter the boreholes and trial pit and hence be detected, particularly within more cohesive soils.

Isolated pockets of groundwater may also be present perched within any less permeable material found at shallower depth on other parts of the site especially within any Made Ground.

Groundwater was subsequently found to have stabilised at a depth of 7.11m below ground level (112.79mOD) in the monitoring standpipe placed in Borehole 1 after a period of approximately two weeks.

It should be noted that the comments on groundwater conditions are based on observations made at the time of the investigation (October 2014) and that changes in the groundwater level could occur due to seasonal effects and also changes in drainage conditions.

4.0 IN-SITU AND LABORATORY TESTS

4.1 Standard Penetration Tests

The results of the Standard Penetration Tests carried out in the natural soils are shown on the exploratory hole records in Appendix A. SPT ‘N’ values range between 9 and 34.

The results of the tests are shown on the appropriate borehole records and summary sheets presented in Appendix A.

4.2 Undrained Triaxial Compression Test Results

A single Quick Undrained Triaxial Compression test was carried out on an undisturbed 100mm diameter sample taken from Borehole 1. The results show the sample to be of a stiff consistency.

The results of the test is presented on Table 1, contained in Appendix B.

4.3 Classification Tests

Atterberg Limit tests were conducted on three selected samples taken from the cohesive sections of the natural soils in Boreholes 1 and 2 and showed the samples tested to fall into Class CI, according to the British Soil Classification System.

These are fine grained silty clay soils of intermediate plasticity and as such generally have a low permeability and a medium susceptibility to shrinkage and swelling movements with changes in moisture content, as defined by the NHBC Standards, Chapter 4.2. The results indicated Plasticity Index values between 23% and 28%, with all of the samples being below the 40% boundary between soils assessed as being of medium swelling and shrinkage potential and those assessed as being of high swelling and shrinkage potential.

The test results are given in Table 2, contained in Appendix B.

Particle size distribution tests were also carried out on six selected samples of essentially granular natural soil using wet sieving methods and the results are presented in both tabular and graphical format, contained in Appendix B.

4.4 Sulphate and pH Analyses

The results of the sulphate and pH analyses made on three soil samples selected to be close to anticipated foundation level are presented on Table 3, whilst further analyses on soil samples are given within the contamination test results, both contained in Appendix B. The results presented on Table 3 show the soil samples tested to have water soluble sulphate contents of up to 0.07g/litre associated with slightly acidic pH values. The samples of Made Ground tested indicated water soluble sulphate contents of up to 0.11g/litre associated with slightly alkaline pH values.

5.0 CONTAMINATION TESTING

5.1 Exploratory Hole Locations

The sampling strategy employed during the Phase 2 site investigation was designed to provide adequate coverage across the site. A selection of samples submitted for a broad screen of total potential contaminants.

A total of two exploratory holes were excavated across the site providing a density equivalent to a circa 25m grid. The holes were sited in order to provide site wide coverage, whilst also targeting potential sources of contamination, as detailed in Table A.

Table A : Summary of Borehole Sites

Site Area/Activity	Exploratory Hole Location(s)	Surface
General site coverage where made ground of unknown origin.	BH1, BH2	Hardstanding

Samples were obtained from 0.25m and 0.50m in BH1 and from 0.50m and 0.75m in BH2 made at the locations indicated on the site sketch plan (Figure 1). Samples were analysed from this depth range below ground level as it is felt that these soils will be representative of those of highest end-user exposure through the dermal contact, dust inhalation, soil ingestion and vegetable consumption pathways.

5.2 Interpretation of Findings

The hazard caused by the presence of a substance or element is not absolute but depends on the proposed end use of the site.

It is understood that the site is to be developed for residential purposes with areas of private gardens. As such the Soil Guideline Values for residential use and Category 4 screening levels for residential use with home-grown produce have been used in the following soil assessment.

Site data has been assessed against current generic assessment criteria (GAC) / guideline values in accordance with current industry practice and statutory guidance; chemical toxicology (TOX), Soil Guideline Value (SGV) reports developed using the new Contaminated Land Exposure Assessment (CLEAv1.06) framework, CLR 11 (Environment Agency, 2009) and SP1010: Development of Category 4 screening levels for assessment of land affected by contamination (DEFRA, 2014).

However, it must be remembered that GAC are not binding standards but can be useful in forming judgements regarding the level of risk i.e. unacceptable or acceptable. Exceedance of GAC does not automatically result in the requirement for remedial / risk management work but would warrant further assessment.

5.3 Category 4 Screening Levels, Soil Guideline Values, CLR Documents & Chartered Institute of Environmental Health Values

Under Part 2A of the Environmental Protection Act 1990, land is determined as contaminated if it is deemed to be causing significant harm, or where there is a Significant Possibility of Significant Harm to human health.

From January 2009 revised Soil Guidance Values for certain contaminants were issued in the Contaminated Land Reports (CLR) by the Environment Agency in conjunction with Department of the Environment, Food, Agriculture and Rural Affairs. These values and the CLEA methodology used to derive them have superseded CLEA and TOX reports for soil contaminants.

The CLR Documents are a series of contaminated land guidance documents developed by various past and present government agencies involved with protection of the environment.

These documents aim to provide a set of generic Soil Guideline Values and a site specific modelling programme based upon tolerable predicted uptakes from experimental data for a variety of common industrial toxic contaminants. In instances of carcinogenic and mutanagenic substances the guideline values are set on the basis of "As Low As Reasonably Practicable" (ALARP), as theoretically mutation can occur on exposure to a single particle of the contaminant.

Revised Statutory Guidance to support Part 2A of the Environmental Protection Act 1990 was published in April 2012, which introduced a new four-category system for classifying land under Part 2A for cases of a Significant Possibility of Significant Harm to human health, where Category 1 includes land where the level of risk is clearly unacceptable and Category 4 includes land where the level of risk posed is acceptably low.

'Category 4 Screening Levels' (C4SLs) have been introduced in March 2014 to provide a simple test for deciding when land is suitable for use and definitely not contaminated land. The Category 4 Screening Levels consist of estimates of contaminant concentrations in soils that are considered to present an 'acceptable' level of risk, within the context of Part 2A.

The methodology for deriving both the previous Soil Guideline Values and the new Category 4 Screening Levels is based on the Environment Agency's Contaminated Land Exposure Assessment (CLEA) methodology.

At the time of writing this report Category 4 Screening Levels are only in place for Arsenic (37mg/kg), Benzene (0.87mg/kg), Benzo(a)pyrene (5mg/kg), Cadmium (26mg/kg), Chromium VI (21mg/kg and Lead (200mg/kg) - for a residential scenario with home-grown produce.

At the time of writing this report Soil Guideline Values are only in place for Selenium (350mg/kg), Nickel (130mg/kg), Mercury (1-170mg/kg), Ethylbenzene (350mg/kg), Xylenes (230-250mg/kg), Toluene (610mg/kg) and Phenols (420mg/kg) - for a residential scenario.

The Environment Agency has also released a new version of the CLEA software and its handbook to help assessors estimate risks. The Chartered Institute of Environmental Health Generic Assessment Criteria for Human Health Risk Assessment adopt the Environment Agency's CLEA UK (Beta) Model and as such have derived guideline values that are compatible with current English legislation, policy and technical guidance.

Generic Assessment Criteria for Human Health Risk Assessment for Trivalent Chromium (Chromium III) has been produced by Chartered Institute of Environmental Health at 627mg/kg for a residential scenario.

Assessment criteria for selected individual Polycyclic Aromatic Hydrocarbons have been produced by Chartered Institute of Environmental Health; however no values have been attached to Total Polycyclic Aromatic Hydrocarbons. Sixteen individual Polycyclic Aromatic Hydrocarbons with attached screening values include Dibenzo(a,h)anthracene (0.76-0.90mg/kg), Fluorene (160-780mg/kg) and Naphthalene (1.5-8.7mg/kg) for a residential scenario.

The concentrations of the phytotoxic substances Total Copper, Total Zinc and Boron have been assessed against the Chartered Institute of Environmental Health Generic Assessment Criteria for Human Health Risk Assessment of 2330mg/kg, 3750mg/kg and 291mg/kg respectively which assumes a residential scenario.

The concentrations of Total Petroleum Hydrocarbons have been assessed against assessment criteria for individual Aromatic and Aliphatic carbon band ranges produced by Chartered Institute of Environmental Health for a residential scenario.

As no generic UK derived guidance is currently available for acceptable concentrations of Total Cyanide a screening value of 20mg/kg (Thiocyanate) has been used as a preliminary screening tool to identify where potential risks may exist.

As described in Using Soil Guideline Values – Environment Agency 2009, chemical data from the analysis of samples generated during the intrusive investigation have been used to create a data set for the site. The entire data set, as opposed to individual results has been analysed on the assumption that the samples from the site investigation are to some degree representative of the contaminant concentration throughout the area or volume of soil investigated. The most appropriate method for assessing a given dataset is dependent upon a range of specific factors together with the quantity and quality of the data generated.

In accordance with the recommendations provided within Guidance on comparing soil contamination data with a critical concentration – CIEH/CL:AIRE, 2008, we have selected the one sample t-test at a 95% confidence level as the most appropriate statistical tool for generating site representative soil concentration values and have assumed that the data is normally distributed. We have assumed that this statistical test is required to draw conclusions about the condition of the land under scrutiny as part of a planning scenario as opposed to the Part 2A scenario. Under a planning scenario, comparison is made between a value larger than the sample mean, in this case the Upper Confidence Limit and the critical concentration.

In instances where the Upper Confidence Limit exceeded the given critical value, then the Grubbs Test has been used to identify upper outliers to assess whether the highest value belongs to the general population of the dataset or is representative of an outlier.

5.4 Assessment of Soil Analyses

It is understood that the site is to be developed for residential properties with private gardens. As such the Soil Guideline Values for residential use and Category 4 screening levels for residential use with home-grown produce have been used in the following soil assessment. The samples selected for contamination assessment were sub-contracted to i2 Analytical Limited (a UKAS and MCERTS accredited laboratory) and their report is contained in Appendix B.

5.5 Discussion

5.5.1 Human health risk assessment (on site residents and neighbouring residents)

Concentrations of the zootoxic heavy metals Total Arsenic, Total Cadmium and Hexavalent Chromium in the samples analysed did not exceed the Category 4 Screening Levels for a residential scenario with home-grown produce. As such there is not considered to be any potentially significant level of end-user risk associated with the concentrations of these contaminants encountered.

The concentrations of Total Lead encountered in the samples from 0.25m depth in BH1 at 220mg/kg and 0.50m in BH2 at 410mg/kg were in excess of the Category 4 Screening Levels of 200mg/kg for a residential scenario with home-grown produce. It was therefore decided to undertake statistical analysis of the data set, using the arithmetic mean and standard deviation for Lead. Following a test scenario from a planning perspective, it was concluded that the true mean of the sample population was in excess of the Category 4 Screening value of 200mg/kg, and as such the potential risks to end-users of the site cannot be discounted at this stage.

The concentrations of Total Selenium, Total Mercury and Total Nickel encountered did not exceed the Soil Guideline Values for residential use in the samples analysed. As such there is not considered to be any potentially significant level of end-user risk associated with the concentrations of these contaminants encountered.

The concentrations of Trivalent Chromium encountered did not exceed CIEH Generic screening value for residential use.

The concentrations of Total Cyanide were below the screening value of 20mg/kg and the concentrations of Total Phenol were below the Soil Guideline Value for residential use and as such there are not considered to be any significant risks to end-users of the site from these contaminants.

The concentrations of Benzo(a)pyrene encountered in the samples from site did not exceed the Category 4 Screening Levels for a residential scenario with home-grown produce. As such there is not considered to be any potentially significant level of end-user risk associated with the concentrations of these contaminants encountered.

The concentrations of individual Polycyclic Aromatic Hydrocarbons encountered did not exceed CIEH Generic screening values for residential use.

The concentrations of Petroleum Hydrocarbons encountered within individual Aromatic and Aliphatic carbon band ranges in the samples analysed did not exceed the generic screening values produced by Chartered Institute of Environmental Health for a residential scenario.

The concentrations of Benzene encountered did not exceed the Category 4 Screening Levels for a residential scenario with home-grown produce. Concentrations of the other BTEX substances (Toluene, Ethylbenzene and Xylenes) encountered did not exceed the Soil Guideline Values for residential use in the samples analysed. As such there is not considered to be any potentially significant level of end-user risk associated with the concentrations of these contaminants encountered.

There was no MTBE detected within the samples analysed.

5.5.2 Asbestos Containing Materials

The Made Ground at each exploratory location was screened for the presence of asbestos containing material. Loose Chrysotile fibres were encountered in the Made Ground in BH1 at 0.25m and Chrysotile insulation lagging in the sample from 0.50m depth in BH2.

In both cases, risks associated with the asbestos containing material would be deemed high should they remain in-situ. Any activities that would result in the asbestos containing material being disturbed would be considered as a potential risk and should be taken into consideration should any future development be proposed for the site.

5.5.3 Landscape Planting

The concentrations of the phytotoxic substances Total Copper, Total Zinc and Boron encountered in the samples obtained were below the CIEH Generic screening values for residential use and are not considered to be a significant risk to human health on-site.

The concentrations of the phytotoxic substances Total Nickel, Total Copper and Total Zinc did not exceed the landscape planting generic assessment levels and therefore are not expected to affect sensitive plant species on-site.

5.5.4 Buildings and Construction Materials

Concrete Cast In-Situ

The range of concentrations of water soluble sulphate within the Made Ground at the site were within BRE (2005) Design Class DS-1 for concrete cast in-situ. This should be taken into account should any concrete structures be installed within the soils represented by these samples.

Potable Water Supply Pipes

If at any point in the future it be intended to install new water supply pipes within the Made Ground then consideration to the pipe materials used and/or the trench construction in accordance with UKWIR (2010). Based upon the analysis undertaken, the concentrations of TPH returned by several of the samples of Made Ground may preclude the use of standard PE pipe materials at the site.

5.5.5 Controlled water (Unproductive aquifer)

Controlled waters have been identified as a potential receptor at the site due to the designation of the underlying Bagshot Formation as Secondary A Aquifer. We have assumed that any leachate generated from the Made Ground at the site would be high risk due to a groundwater source protection zone on site as the receptor. We have based our assessment on the following:-

- The 1:50000 Geological Survey of Great Britain (England and Wales) covering the area (Sheet 256, 'North London', Solid and Drift Edition) indicates the site to be underlain by the Bagshot Formation resting on the Claygate Member with the London Clay Formation at depth.

- The bedrock geology underlying the site is classified as Secondary Aquifer A class; materials with permeable layers capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

- The underlying chalk (principal aquifer) is afforded protection from any potential mobile contamination from the superficial strata at the site by the presence of a layer of impermeable London Clay.

- The site is not located within a source protection zone.

- There are no groundwater abstraction licences listed within one kilometre of the site.

- The nearest surface water is 299m north of the site. Due to the distance from the site the potential for contamination from the site is seen as low risk.

- There are no fluvial or tidal floodplains located within one kilometre of the site.

- There are no sensitive land uses within one kilometre of the site.

A large portion of the existing and the proposed site is under permanent hardstanding that would reduce to a minimum any surface water infiltration into the underlying soil and therefore any potential leachate from contamination within Made Ground on-site. It is considered that there remains a low risk for the slight contamination encountered to enter the underlying Secondary A Aquifer under site.

5.6 Conclusions

The findings of the Phase 2 site investigation have demonstrated that in the context of a residential use of the site with private gardens, the contaminants of concern with respect to end-user protection were elevated concentrations of Lead encountered in both boreholes on site and asbestos containing materials encountered, with the critical receptors being the end-users / residents (0-6 year old child) of the site and site construction workers. It is considered that the concentrations of all other determinants analysed for were not present in sufficient quantities to pose any significant risks to end-users.

Additional potential receptors include adjacent residents, site construction workers and potable water supply pipes.

Risks to other identified receptors (i.e. landscape planting, controlled water and buildings and construction materials) are not considered to represent a significant risk at the concentrations encountered.

It may be possible that the extent of remediation required on the site could be minimised if further investigation of the site was undertaken. Thereby the extent of contamination could be more accurately identified and removed, treated or encapsulated to avoid potential risks to end-users of the site.

There remains the potential for some level of end-user risk posed by the concentrations of contaminants encountered. It is anticipated that the protection of the end-user may be achieved by the following:

Areas of proposed hardstanding (e.g. building footprint, roadways etc.)

In areas of permanent hardstanding such as the building footprint and roadways etc., the development itself would adequately break exposure pathways to human health and therefore further remedial measures may not be required in these areas.

Sensitive end use areas (soft-landscaping etc.)

In areas of sensitive end use such as soft-landscaping etc. soils should be removed from the site to mitigate the risks to end-users and break exposure pathways. It would be recommended that the soils be excavated down to at least 600mm and replaced with a clean cohesive fill material of at least 600mm.

Any materials brought onto the site (soils and / or clay) should be validated either at source or once laid at site. Given the nature of the ground conditions, appropriate health and safety practices should be adhered to in order to protect site workers. Any waste material leaving site for off-site disposal (soil and / or water) should be handled in accordance with the current Waste Management and Duty of Care Regulations.

The above conclusions have been drawn on the results of the tests carried out on the soil samples analysed and address remediation issues for the protection of the end-user only. It is recommended that any remedial measures suggested in this report should be subject to formal approval by local Environmental Health and/or Planning Departments and approval should be obtained prior to any works being undertaken. The comments made in this report do not address any third party liability.

6.0 FOUNDATION DESIGN

6.1 General

It is proposed to demolish the existing building on the site and construct a new three storey residential property with a lower ground floor level, relocated swimming pool and parking areas. The maximum depth of the proposed lower ground floor level is approximately 2.52m below existing lower ground floor level (116.56mOD is the existing level, 114.04mOD is the proposed). Exact details of the structures, layouts and loadings were not available at the time of preparation of this report, although anticipated foundation loads for the proposed new buildings are expected to be in the order of 100-150kN/m^2 and ground slab loadings are expected to be of the order of 10-15kN/m^2.

6.2 Site Preparation Works

The CDM Co-ordinator should be informed of the site conditions and risk assessment undertaken to comply with the Construction Design Management (CDM) regulations. Site personnel are to be made aware of the site conditions. It is recommended that extensive searches of existing man made services are undertaken over the site prior to final design works.

6.3 Conventional Spread Foundations

A result of the inherent variability of uncontrolled fill, (Made Ground) is that it is usually unpredictable in terms of bearing capacity and settlement characteristics. Foundations should therefore, be taken through any Made Ground and either into, or onto a suitable underlying natural strata of adequate bearing characteristics.

Based on the ground and groundwater conditions encountered in Borehole 2 drilled at lower ground floor level, it should be possible to support the proposed new development on conventional strip or basement raft foundations taken down below the Made Ground and any weak superficial soils and placed in the natural firm and stiff silty sandy clay deposits which were encountered at levels of about 116.3mOD to 118.0mOD across the site.

Using theory from Terzaghi (1943), strip foundations placed within natural soils may be designed to allowable net bearing pressures of approximately 250kN/m^2 at 2.50m depth (114mOD) in order to allow for a factor of safety of 2.5 against general shear failure. The actual allowable bearing pressure applicable will depend on the form of foundation, its geometry and depth in accordance with classical analytical methods, details of which can be obtained from “Foundation Design and Construction”, Seventh Edition, 2001 by M J Tomlinson (see references) or similar texts.

Any soft or loose pockets encountered within otherwise competent formations should be removed and replaced with well compacted granular fill.

In addition, foundations may need to be taken deeper should they be within the zones of influence of both existing or recently felled trees and any proposed tree planting. The depth of foundation required to avoid the zone likely to be affected by the root systems of trees is shown in the recommendations given in NHBC Standards, Chapter 4.2, April 2010, “Building near Trees" and it is considered that this document is relevant in this situation.

6.4 Piled Foundations

In the event that the use of conventional spread foundations proves either impracticable or uneconomical due to the size and depth of foundation required, then a piled foundation will be required. In these ground conditions, it is considered that some form of bored and in-situ cast concrete piled foundation with reinforced concrete ground beams should prove satisfactory.

The construction of a piled foundation is a specialist activity and the advice of a reputable contractor, familiar with the type of soil and groundwater conditions encountered at this site should be sought prior to finalising the foundation design. The actual pile working load will depend on the particular type of pile chosen and method of installation adopted.

To achieve the full bearing value a pile should penetrate the bearing stratum by at least five times the pile diameter.

Where piles are to be constructed in groups the bearing value of each individual pile should be reduced by a factor of about 0.8 and a calculation made to check the factor of safety against block failure.

Driven piles could also be used and would develop much higher working loads approximately 2.5 to 3 times higher than bored piles of a similar diameter at the same depth. However, the close proximity of adjacent buildings will in all probability preclude their use due to noise and vibration.

6.5 Basement Retaining Walls

Several methods of retaining wall construction could be considered. These may include retaining structures cast in an underpinning sequence, or the use of temporary or sacrificial works to facilitate the retaining structure’s construction. The excavation of the basement must not compromise the integrity of adjacent structures.

The full design of temporary and permanent retaining structures is beyond the scope of this report. However, the following design parameters for each element of soil recorded in the relevant exploratory holes are provided in Table B below to assist the design of these structures.

Stratum	**Depth to top (m)**	**Bulk Density (Mg/m3) (γ)**	**Effective Angle of Internal Friction (Φ)**
Bagshot Beds	0.75 to 0.80 (116.55 to 119.10mOD)	1.85	35

Table B. Retaining Wall Design Parameters

The designer should use these parameters to derive the active and passive earth pressure coefficients ka and kp. The determination of appropriate earth pressure coefficients, together with factors such as the pattern of the earth pressure distribution, will depend upon the type/geometry of the wall and overall design factors.

The amount of movement will depend upon a number of factors including the construction timetable, ultimate loads and critically, the depth of the final excavation. Consideration should therefore be given to providing heave protection measures to the floor slab and foundations to mitigate this.

The main phase of uplift or heave will come immediately following the excavation of the basement when the greatest elastic rebound of the soil (caused by the loss of the overburden pressure) will occur. Heave can be reduced by proceeding with the excavation in stages and observing and recording any movement that occurs over a set period of time using strain gauges or similar following the guidance from Boscardin and Cording (1989).

It may be advantageous to delay the construction until an adequate proportion of the uplift has occurred. Once this monitoring period has elapsed and a suitably qualified engineer is confident that the majority of uplift has occurred, basement construction can commence.

These processes and other ways of dealing with ground movements are described at length in BS8004 (British Standard Code of Practice for Foundations).

6.6 Floor Slabs

It is understood from the structural engineer that a raft foundation is the preferred option for the development. Within the zone of influence of trees, either retained or removed, the raft should incorporate either underfloor voids or suitable depths of compressible material in accordance with NHBC requirements, for soils with medium volume change potential.

6.7 Excavations

Shallow excavations for foundations and services are likely to require nominal side support in the short term and groundwater is unlikely to be encountered in significant quantities once any accumulated surface water has been removed.

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

6.8 Chemical Attack on Buried Concrete

The results presented on Table 3 show the soil samples to have water soluble sulphate contents of up to 0.07g/litre associated with slightly acidic to acidic pH values. The samples of Made Ground tested indicated water soluble sulphate contents of up to 0.11g/litre associated with slightly alkaline to alkaline pH values.

In these conditions, it is considered that deterioration of buried concrete due to sulphate or acid attack is unlikely to occur. The final design of buried concrete according to Tables C1 and C2 of BRE Special Digest 1:2005 should be in accordance with Class DS-1 conditions.

p.p. SITE ANALYTICAL SERVICES LIMITED

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7.0 REFERENCES

1. Beckett M.J. and Sims D.L. (1984). "The Development of Contaminated Land", Symposium on Hazardous Waste Disposal and the Re-use of Contaminated Land. Society of Chemical Industry.

2. British Standards Institution, 2001. Investigation of Potentially Contaminated Sites - Code of Practice, BS 10175, BSI, London

3. British Standards Institution, 1986. Code of practice for foundations, BS 8004, BSI, London.

4. British Standards Institution, 1990. Methods for test for soils for civil engineering purposes, BS1377, BSI, London

5. British Standards Institution, 1994. Code of practice for earth retaining structures, BS8002, BSI, London

6. British Standards Institution, 2007. Code of Practice for Site Investigations, BS EN 1997-2, BSI, London

7. British Standards Institution, 2004. Geotechnical Design, BS EN 1997-1 BSI, London

8. Building Research Establishment Special Digest 1, 2005, "Concrete in Aggressive Ground – Third Edition."

9. CIEH/CL:AIRE, 2008. Guidance on comparing soil contamination data with a critical concentration. London: Chartered Institute of Environmental Health.

10. DEFRA and Environment Agency, 2004. Model procedures for the management of land contamination. Contaminated Land Report 11. Bristol: Environment Agency.

11. DEFRA, 2006b. Environmental Protection Act 1990: Part 2A. Contaminated Land. Defra Circular 01/2006. London: Department for Environment, Food and Rural Affairs.

12. DEFRA, 2008a. Improvements to contaminated land guidance. Outcome of the “Way Forward” exercise on soil guideline values. Defra: Department for Environment, Food and Rural Affairs.

13. DEFRA, 2008b. Guidance on the legal definition of contaminated land. London: Department for Environment, Food and Rural Affairs.

14. Driscoll, R (1983) "The influence of vegetation on the shrinking and swelling of clay soils in Great Britain", Geo-technique 33, 93-107

15. Environment Agency, 2000a. Secondary model procedure for the development of appropriate soil sampling strategies for land contamination. R&D Technical Report P5-066/TR. Bristol: Environment Agency.

16. Environment Agency, 2000b. Technical aspects of site investigation, Volumes 1 and 2. R&D Technical Report P5-065/TR. Bristol: Environment Agency.

17. Environment Agency, 2005. Sampling and testing of wastes to meet landfill Waste Acceptance Criteria. Bristol: Environment Agency

18. Environment Agency, 2009a. Updated technical background to the CLEA model. Science Report SC050021/SR3. Bristol: Environment Agency.

19. Environment Agency, 2009b. Human health toxicological assessment of contaminants in soil. Science Report Final SC050021/SR2. Bristol: Environment

20. Environment Agency, 2009c. CLEA software version 1.06. Bristol: Environment Agency.

21. Environment Agency, 2009d. CLEA software (version 1.06) handbook. Science Report SC050021/SR4. Bristol: Environment Agency.

22. Eurocode 1: Actions on structures – BS EN 1991-1-1:2002: General actions – Densities, self weight and imposed loads, BSI, London

23. Nathanail C.P., McCaffrey, C., Ashmore, M.H., Cheng, Y.Y., Gillet, A., Ogden, R. & Scott, D., 2009. The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd edition). Land Quality Press, Nottingham.

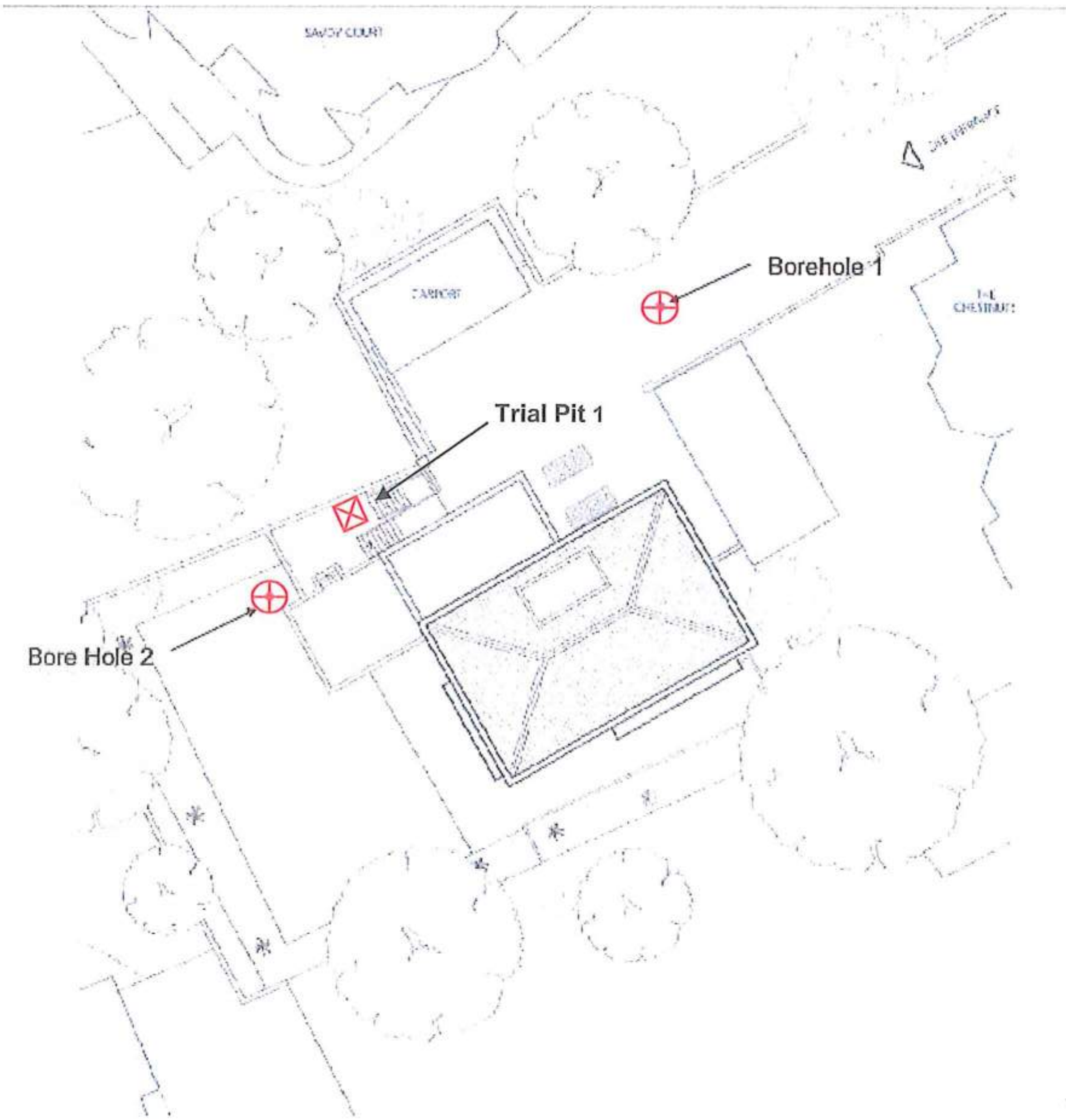
24. NHBC Standards, Chapter 4.1, "Land Quality - managing ground conditions", September 1999.

25. NHBC Standards, Chapter 4.2, "Building near Trees", April 2010.

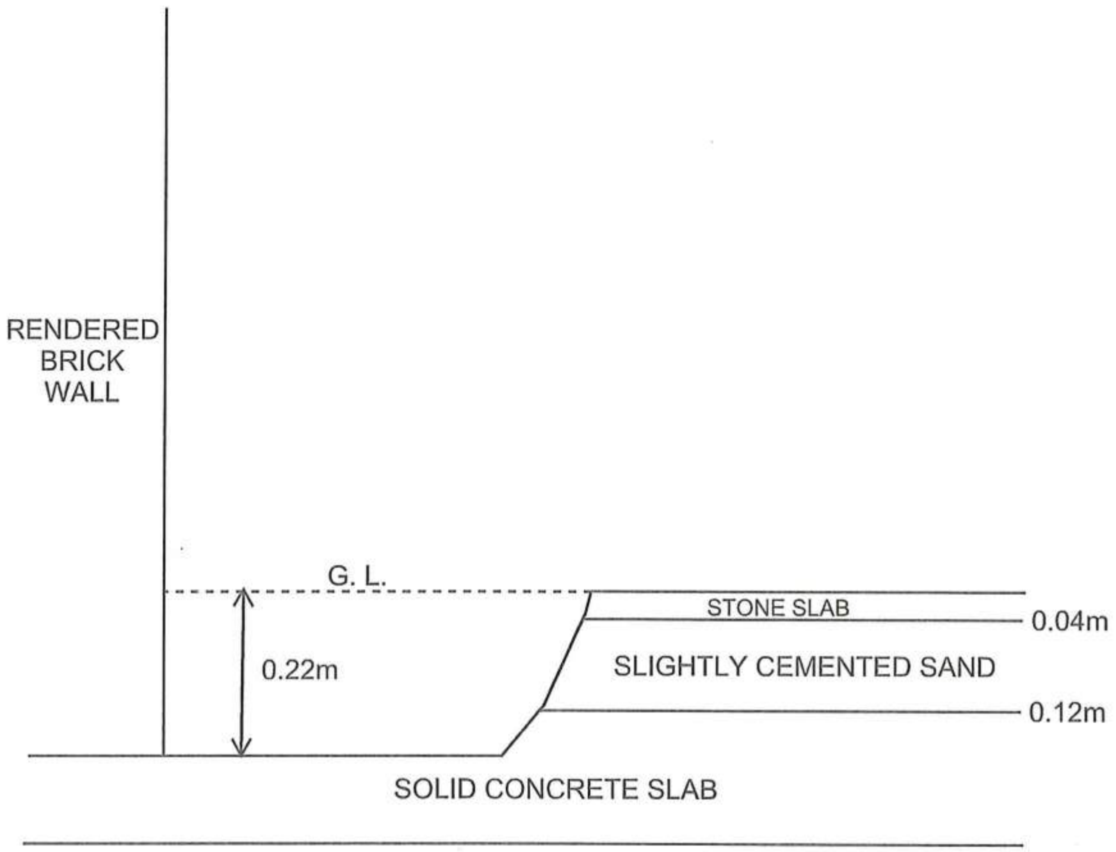
26. Stroud M.A. and Butler F.G. (1975) Symposium on the Engineering Behaviour of Glacial Materials; the Midland Soil Mechanics and Foundation Engineering Society; pgs 124 et seq.

27. Tomlinson, M J, 2001. “Foundation Design and Construction”, Seventh Edition, Prentice Hall (ISBN 0-13-031180-4).

Site Analytical Services Ltd.		REF: 14/22714
LOCATION:	17 Branch Hill, London, NW3 7NA	FIG: 1
TITLE:	Site Sketch Plan DATE: Nov' 2014	SCALE: NTS



SAS	**Site Analytical Services Ltd.**	REF: 14/22714
	LOCATION: Branch Hill, Hampstead, London, NW3	FIG: 2
	TITLE: Trial Pit 1 DATE: October 2014	SCALE: NTS



TRIAL PIT TERMINATED AT 0.22m BELOW GROUND LEVEL DUE TO CONCRETE

APPENDIX `A'

Borehole / Trial Pit Logs

Site Analytical Services Ltd.

Site	Borehole Number
17 BRANCH HILL, LONDON, NW3 7NA	BH1

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
ROTARY PERCUSSION	128mm cased to 0.00m	119.90	MR ADAM KAYE	1422714
	Location	**Dates**	**Engineer**	**Sheet**
	TQ 260 862	10/10/2014	ENGINEERS HASKINS ROBINSON WATERS	1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					119.85	(0.05) 0.05	Brick paving		
					119.80	(0.05) 0.10	Soft sand underlay		
0.25	D1					(0.70)	MADE GROUND: Brick rubble, concrete cobbles with brick and concrete crush and silty sand.		
0.50	D2								
0.75	D3				119.10	0.80	Loose yellowish brown clayey silty fine grained SAND		
1.00-1.45	CPT N=9		DRY	1,2/2,2,3,2					
1.00	D4					(1.10)			
1.75	D5				118.00	1.90	Stiff mottled brown silty sandy CLAY		
2.00-2.45	U1			60 blows		(0.80)			
					117.20	2.70	Medium dense mottled brown/yellow laminated clayey silty fine grained SAND.		
2.75	D6								
3.00-3.45	SPT N=9		DRY	1,2/2,2,3,2					
3.00	D7								
3.75	D8								
4.00-4.45	SPT N=15		DRY	1,2/3,3,4,5					
4.00	D9								
4.75	D10								
5.00-5.45	SPT N=17		DRY	1,3/4,4,4,5					
5.00	D11								
6.00	D12								
6.50-6.95	SPT N=18		DRY	2,3/4,5,4,5		(7.80)			
6.50	D13								
									▼1
7.50	D14								
									∇1
8.00	D15			Water strike(1) at 8.00m, rose to 7.20m in 20 mins.					
8.00-8.45	SPT N=11		7.20	2,3/2,3,3,3					
9.00	D16								
9.50-9.95	SPT N=12		7.20	2,3/3,3,3,3					
9.50	D17								

Remarks
D = Disturbed Sample
U = Undisturbed 100mm diameter sample
C = Dynamic cone penetration test
S = Standard cone penetration test
Groundwater was encountered at 8.00m and rose to 7.20m after a 20 minute rest period.

Scale (approx)	Logged By
1:50	

Figure No.
1422714.BH1

Site Analytical Services Ltd.

Site	Borehole Number
17 BRANCH HILL, LONDON, NW3 7NA	BH1

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
ROTARY PERCUSSION	128mm cased to 0.00m	119.90	MR ADAM KAYE	1422714
	Location	**Dates**	**Engineer**	**Sheet**
	TQ 260 862	10/10/2014	ENGINEERS HASKINS ROBINSON WATERS	2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(7.80)			
10.50	D18				109.40	10.50	Medium dense bright orange to mottled grey slightly clayey silty fine grained SAND		
11.00-11.45 11.00	SPT N=28 D19		7.20	3,4/6,7,7,8		(1.50)			
12.00	D20				107.90	12.00	Dense dark grey clayey silty fine grained SAND		
12.50-12.95 12.50	SPT N=32 D21		7.20	5,6/7,8,8,9					
						(3.00)			
13.75	D22								
14.55-15.00 14.55	SPT N=34 D23		7.20	4,7/8,8,9,9					
					104.90	15.00	Complete at 15.00m		

Remarks	Scale (approx)	Logged By
	1:50	
	Figure No. 1422714.BH1	

Site Analytical Services Ltd.

Site	Borehole Number
17 BRANCH HILL, LONDON, NW3 7NA	BH1

Installation Type	Dimensions	Client	Job Number
Single Installation	Internal Diameter of Tube [A] = 128 mm	MR ADAM KAYE	1422714

Location	Ground Level (mOD)	Engineer	Sheet
TQ 260 862	119.90	ENGINEERS HASKINS ROBINSON WATERS	1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
					Bentonite Seal
			118.90	1.00	
					Slotted Standpipe
	∇1				
	∇1				
			109.90	10.00	
					Bentonite Seal
			108.90	11.00	
					General Backfill
			104.90	15.00	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	10 min	15 min	20 min	Depth Sealed (m)
10/10/14		8.00						7.20	

Groundwater Observations During Drilling

Date	Start of Shift: Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	End of Shift: Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type : Standpipe

Date	Instrument [A]: Time	Depth (m)	Level (mOD)	Remarks

Remarks
Lockable cover set in concrete.

Site Analytical Services Ltd.

Site	Borehole Number
17 BRANCH HILL, LONDON, NW3 7NA	BH2

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
CONTINUOUS FLIGHT AUGER	100mm cased to 0.00m	117.30	MR ADAM KAYE	1422714
	Location	**Dates**	**Engineer**	**Sheet**
	TQ2 60 862	10/10/2014	ENGINEERS HASKINS ROBINSON WATERS	1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.25)	MADE GROUND: Grass surface over soft silty sand with small gravel sized brick rubble.		
0.25	D1				117.05	0.25			
						(0.50)	MADE GROUND: Brown silty sand with brick fragments.		
0.50	D2								
0.75	D3				116.55	0.75	Medium firm becoming stiff mottled light brown/grey/orange silty sandy CLAY.		
1.00 1.00	D4 V1 74								
1.50 1.50	D6 V2 97					(1.95)			
2.00 2.00	D7 V3 129								
2.50 2.50	V4 130+ D8				114.60	2.70	Stiff mottled light brown/grey/orange silty sandy CLAY .		
3.00 3.00	V5 130+ D9								
3.50 3.50	D10 V6 130+					(2.30)			
4.00 4.00	D1 V7 130+								
4.50 4.50	D12 V8 130+								∇1
5.00 5.00-5.11	D13 M1 100/110			Water strike(1) at 5.00m.	112.30	5.00	Wet light brown/yellow/orange/grey silty SAND		
						(1.00)			
6.00-6.10 6.00	M2 100/100 D14				111.30	6.00	Complete at 6.00m		

Remarks
Groundwater encountered at 5.00m
M = Mackintosh Probe - Blows/penetration (mm)
V = Vane test - result in kPa
D = Disturbed sample

Scale (approx)	Logged By
1:50	

Figure No.
1422714.BH2

Site Analytical Services Ltd.

Standard Penetration Test Results

Site : 17 BRANCH HILL, LONDON, NW3 7NA

Client : MR ADAM KAYE

Engineer: ENGINEERS HASKINS ROBINSON WATERS

Job Number: 1422714

Sheet: 1 / 1

Borehole Number	Base of Borehole (m)	End of Seating Drive (m)	End of Test Drive (m)	Test Type	Seating Blows per 75mm		Blows for each 75mm penetration				Result	Comments
					1	2	1	2	3	4		
BH1	1.00	1.15	1.45	CPT	1	2	2	2	3	2	N=9	
BH1	3.00	3.15	3.45	SPT	1	2	2	2	3	2	N=9	
BH1	4.00	4.15	4.45	SPT	1	2	3	3	4	5	N=15	
BH1	5.00	5.15	5.45	SPT	1	3	4	4	4	5	N=17	
BH1	6.50	6.65	6.95	SPT	2	3	4	5	4	5	N=18	
BH1	8.00	8.15	8.45	SPT	2	3	2	3	3	3	N=11	
BH1	9.50	9.65	9.95	SPT	2	3	3	3	3	3	N=12	
BH1	11.00	11.15	11.45	SPT	3	4	6	7	7	8	N=28	
BH1	12.50	12.65	12.95	SPT	5	6	7	8	8	9	N=32	
BH1	14.55	14.70	15.00	SPT	4	7	8	8	9	9	N=34	

Site Analytical Services Ltd.

Site	17 BRANCH HILL, LONDON, NW3 7NA	**Trial Pit Number**	TP1
Excavation Method	HAND DUG PIT	**Dimensions**	300mm x 300mm
Ground Level (mOD)	117.40	**Client**	MR ADAM KAYE
Job Number	1422714	**Location**	TQ 260 862
Dates	10/10/2014	**Engineer**	ENGINEERS HASKINS ROBINSON WATERS
Sheet	1/1		

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				117.36	(0.04) 0.04	Stone slab		
				117.28	(0.08) 0.12	Slightly cemented SAND		
				117.18	(0.10) 0.22	Solid concrete slab		
						Complete at 0.22m		

Plan

Remarks

Pit terminated at request of the engineer due to the presence of concrete

Scale (approx)	Logged By	Figure No.
1:50		1422714.TP1

APPENDIX `B'

Laboratory Test and Groundwater Monitoring Data

Site Analytical Services Ltd.

Ref: 14/22714

UNDRAINED TRIAXIAL COMPRESSION TEST

LOCATION 17 Branch Hill, London, NW3 7NA

BH/TP No.	MOISTURE CONTENT %	BULK DENSITY Mg/m^3	LATERAL PRESSURE kN/m^2	COMPRESSIVE STRENGTH kN/m^2	COHESION kN/m^2	ANGLE OF SHEARING RESISTANCE degrees	DEPTH m
BH1	15	2.12	50	276	138		2.25

Table 1

Ref: 14/22714

PLASTICITY INDEX & MOISTURE CONTENT DETERMINATIONS

LOCATION 17 Branch Hill, London, NW3 7NA

BH/TP No.	Depth m	Natural Moisture %	Liquid Limit %	Plastic Limit %	Plasticity Index %	Passing 425 µm %	Class
BH2	1.00	25	44	21	23	100	CI
	2.50	20	45	17	28	100	CI
	3.50	22	44	19	25	100	CI

Site Analytical Services Ltd.

Ref: 14/22714

SULPHATE & pH DETERMINATIONS

LOCATION 17 Branch Hill, London, NW3 7NA

BH/TP No.	DEPTH BELOW GL m	SOIL SULPHATES AS SO_4 TOTAL %	SOIL SULPHATES AS SO_4 WATER SOL g/l	WATER SULPHATES AS SO_4 g/l	pH	CLASS	SOIL - 2mm %
BH2	2.00		0.07		4.0	DS-1	100
	4.00		0.04		4.2	DS-1	100
	6.00		0.04		5.3	DS-1	100

Classification – Tables C1 and C2 : BRE Special Digest 1 : 2005

Table 3

Site Analytical Services Ltd.

Ref: 14/22714

GROUNDWATER MONITORING

LOCATION	17 Branch Hill, London, NW3 7NA
MONITORING DATE	24th October 2014

BOREHOLE REF:	**BH1**

Water Level	(m.bgl)	7.11
Depth to base of well	(m.bgl)	8.31

Table 4

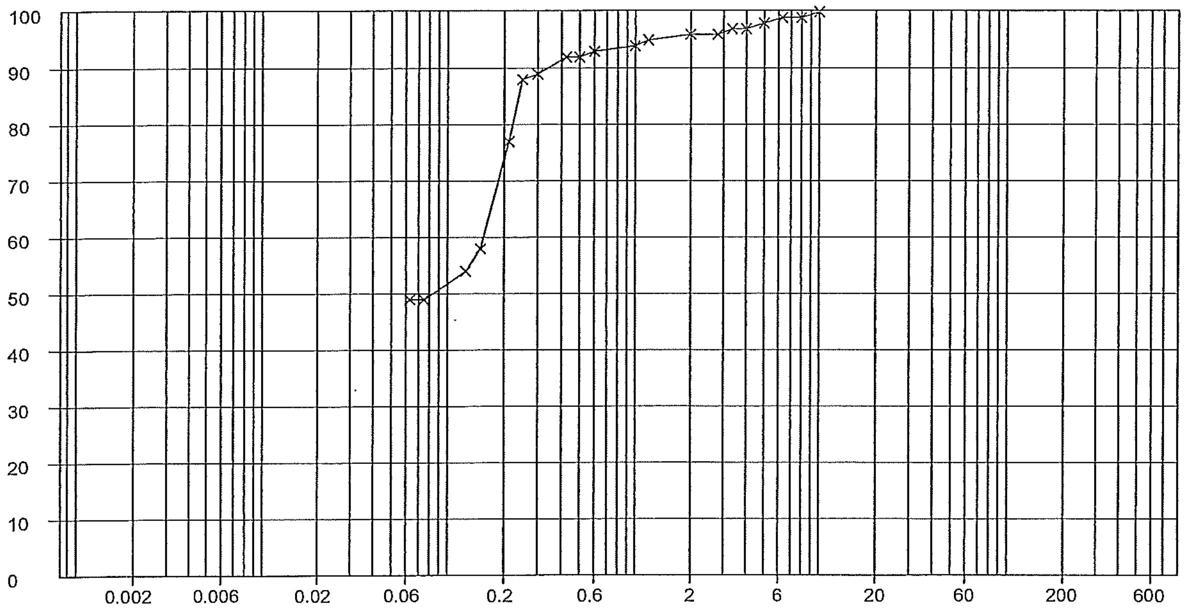
Site Analytical Services Ltd.

Laboratory Test Results

Site : 17 BRANCH HILL, LONDON, NW3 7NA	**Job Number** 1422714
Client : MR ADAM KAYE	**Sheet** 1/6
Engineer: ENGINEERS HASKINS ROBINSON WATERS	

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Description
BH1	1.00	D4	



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

Sieve / Particle Size	% Passing
10 mm	100.0
8 mm	99.0
6.3 mm	99.0
5 mm	98.0
4 mm	97.0
3.35 mm	97.0
2.8 mm	96.0
2 mm	96.0
1.18 mm	95.0
1 mm	94.0
600 µm	93.0
500 µm	92.0
425 µm	92.0
300 µm	89.0
250 µm	88.0
212 µm	77.0
150 µm	58.0
125 µm	54.0
75 µm	49.0
63 µm	49.0

Grading Analysis	
D85	239.0 µm
D60	155.6 µm
D10	<63.0 µm
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	-
Gravel	4.0%
Sand	47.0%
Silt	-
Clay	-

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 1990:7.4.5 Particle size tests

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

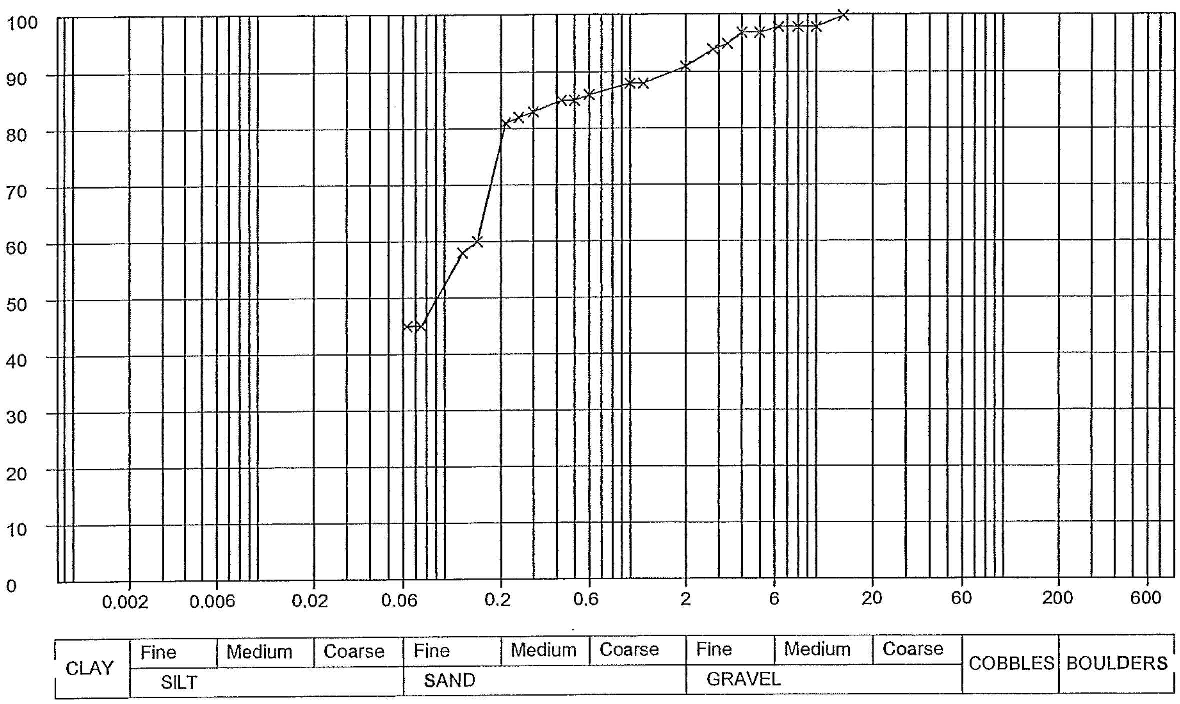
Site Analytical Services Ltd.

Laboratory Test Results

Site : 17 BRANCH HILL, LONDON, NW3 7NA	**Job Number** 1422714
Client : MR ADAM KAYE	
Engineer: ENGINEERS HASKINS ROBINSON WATERS	**Sheet** 2/6

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Description
BH1	3.00	D8	



Sieve / Particle Size	% Passing
14 mm	100.0
10 mm	98.0
8 mm	98.0
6.3 mm	98.0
5 mm	97.0
4 mm	97.0
3.35 mm	95.0
2.8 mm	94.0
2 mm	91.0
1.18 mm	88.0
1 mm	88.0
600 µm	86.0
500 µm	85.0
425 µm	85.0
300 µm	83.0
250 µm	82.0
212 µm	81.0
150 µm	60.0
125 µm	58.0
75 µm	45.0
63 µm	45.0

Grading Analysis	
D85	500.0 µm
D60	150.0 µm
D10	<63.0 µm
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	-
Gravel	9.0%
Sand	46.0%
Silt	-
Clay	-

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 1990:7.4.5 Particle size tests

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

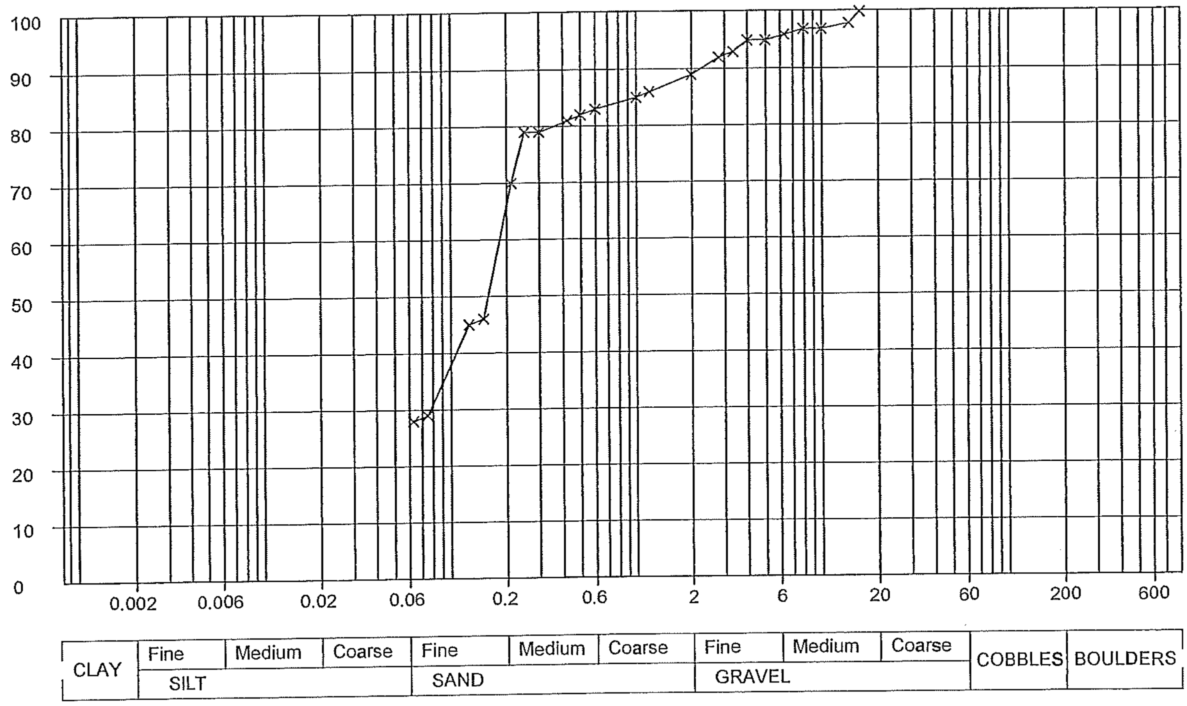
Site Analytical Services Ltd.

Laboratory Test Results

Site : 17 BRANCH HILL, LONDON, NW3 7NA	Job Number 1422714
Client : MR ADAM KAYE	Sheet 3/6
Engineer: ENGINEERS HASKINS ROBINSON WATERS	

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Description
BH1	5.00	D12	



Sieve / Particle Size	% Passing
16 mm	100.0
14 mm	98.0
10 mm	97.0
8 mm	97.0
6.3 mm	96.0
5 mm	95.0
4 mm	95.0
3.35 mm	93.0
2.8 mm	92.0
2 mm	89.0
1.18 mm	86.0
1 mm	85.0
600 µm	83.0
500 µm	82.0
425 µm	81.0
300 µm	79.0
250 µm	79.0
212 µm	70.0
150 µm	46.0
125 µm	45.0
75 µm	29.0
63 µm	28.0

Grading Analysis	
D85	1.0 mm
D60	183.5 µm
D10	<63.0 µm
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	-
Gravel	11.0%
Sand	61.0%
Silt	-
Clay	-

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 1990:7.4.5 Particle size tests

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

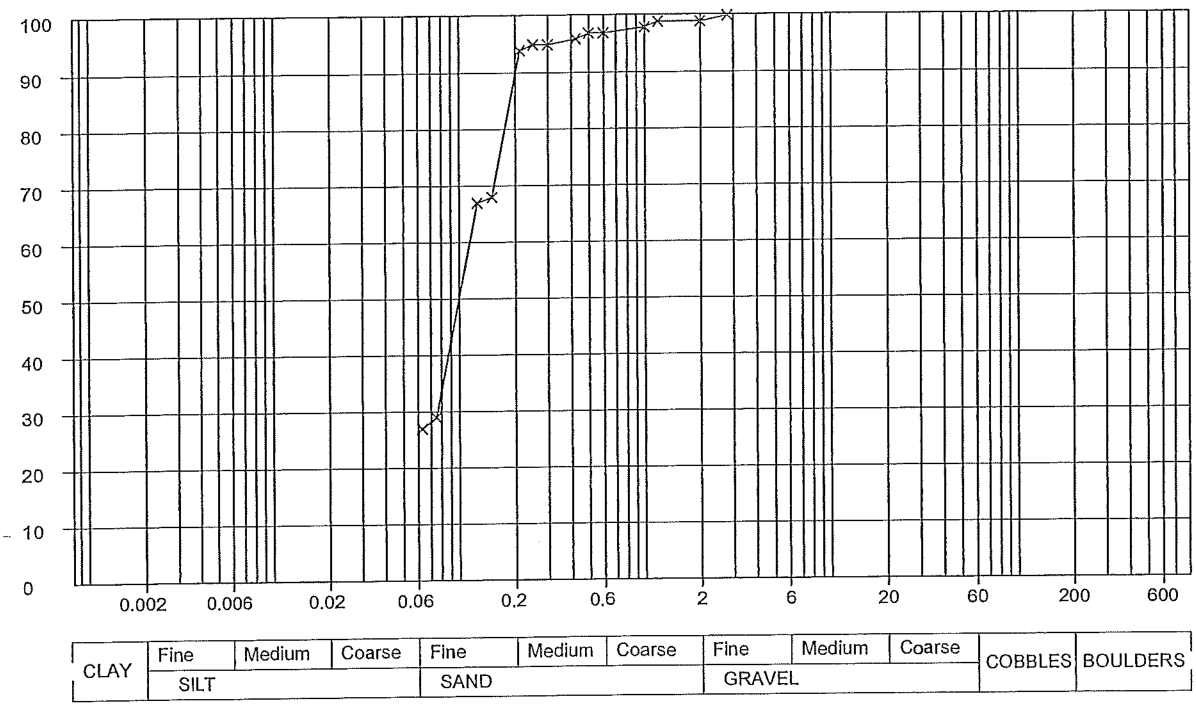
Site Analytical Services Ltd.

Laboratory Test Results

Site : 17 BRANCH HILL, LONDON, NW3 7NA	Job Number 1422714
Client : MR ADAM KAYE	Sheet 4/6
Engineer: ENGINEERS HASKINS ROBINSON WATERS	

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Description
BH1	9.50	D21	



Sieve / Particle Size	% Passing
2.8 mm	100.0
2 mm	99.0
1.18 mm	99.0
1 mm	98.0
600 µm	97.0
500 µm	97.0
425 µm	96.0
300 µm	95.0
250 µm	95.0
212 µm	94.0
150 µm	68.0
125 µm	67.0
75 µm	29.0
63 µm	27.0

Grading Analysis	
D85	188.1 µm
D60	113.8 µm
D10	<63.0 µm
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	-
Gravel	1.0%
Sand	72.0%
Silt	-
Clay	-

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 1990:7.4.5 Particle size tests

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

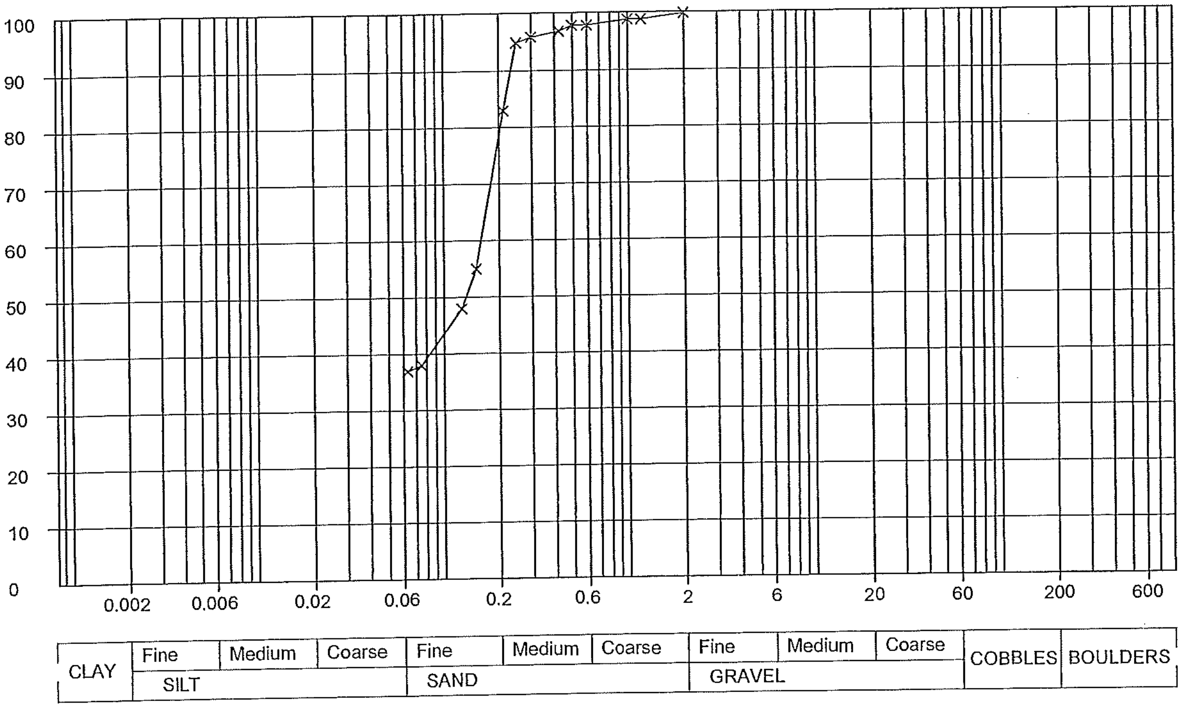
Site Analytical Services Ltd.

Laboratory Test Results

Site : 17 BRANCH HILL, LONDON, NW3 7NA	Job Number 1422714
Client : MR ADAM KAYE	Sheet 5/6
Engineer: ENGINEERS HASKINS ROBINSON WATERS	

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Description
BH1	13.75	D29	



Sieve / Particle Size	% Passing
2 mm	100.0
1.18 mm	99.0
1 mm	99.0
600 µm	98.0
500 µm	98.0
425 µm	97.0
300 µm	96.0
250 µm	95.0
212 µm	83.0
150 µm	55.0
125 µm	48.0
75 µm	38.0
63 µm	37.0

Grading Analysis	
D85	217.9 µm
D60	159.6 µm
D10	<63.0 µm
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	-
Gravel	-
Sand	63.0%
Silt	-
Clay	-

Method of Preparation: BS 1377:PART 1:1990:7.3 Initial preparation 1990:7.4.5 Particle size tests

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

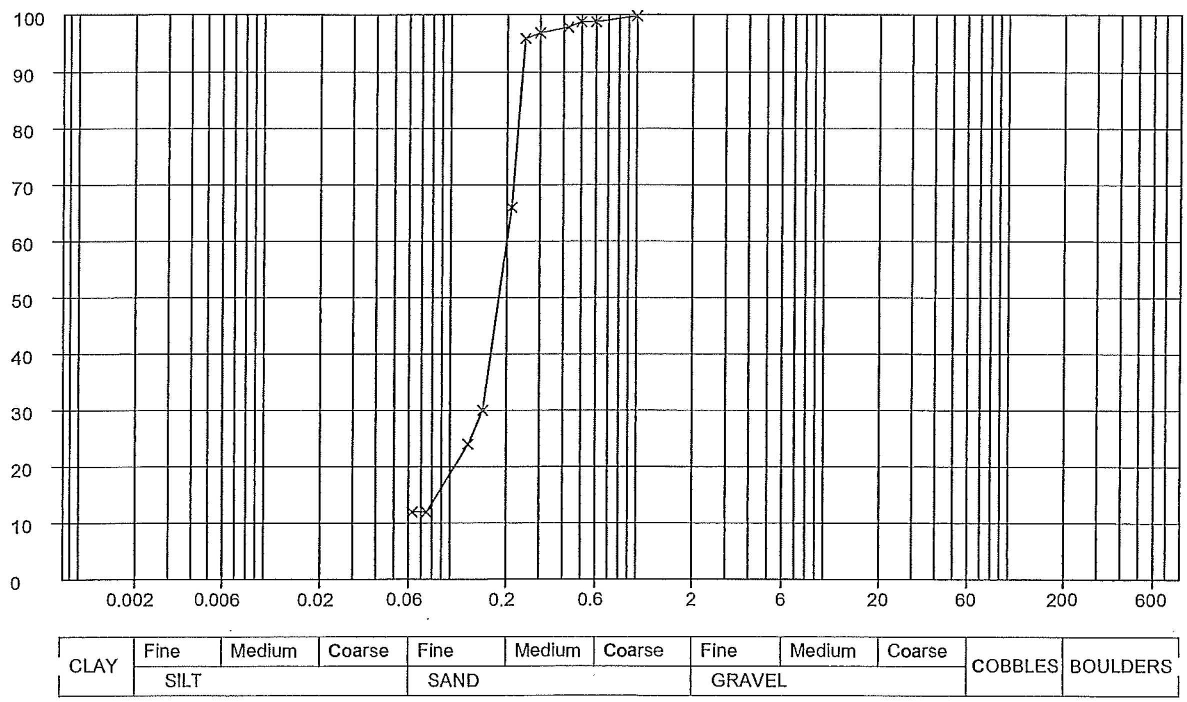
Site Analytical Services Ltd.

Laboratory Test Results

Site : 17 BRANCH HILL, LONDON, NW3 7NA	**Job Number** 1422714
Client : MR ADAM KAYE	**Sheet** 6/6
Engineer : ENGINEERS HASKINS ROBINSON WATERS	

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Description
BH2	5.00	D12	



Sieve / Particle Size	% Passing
1 mm	100.0
600 µm	99.0
500 µm	99.0
425 µm	98.0
300 µm	97.0
250 µm	96.0
212 µm	66.0
150 µm	30.0
125 µm	24.0
75 µm	12.0
63 µm	12.0

Grading Analysis	
D85	235.3 µm
D60	200.1 µm
D10	<63.0 µm
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	-
Gravel	-
Sand	88.0%
Silt	-
Clay	-

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 1990:7.4.5 Particle size tests

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

4041 mCERTS

Environmental Science

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Analytical Report Number : 14-61886

Project / Site name:	17 Branch Hill	**Samples received on:**	23/10/2014
Your job number:	14-22714	**Samples instructed on:**	23/10/2014
Your order number:	20925	**Analysis completed by:**	30/10/2014
Report Issue Number:	1	**Report issued on:**	30/10/2014
Samples Analysed:	4 soil samples		

Signed: CCStone

Dr Claire Stone
Quality Manager
For & on behalf of i2 Analytical Ltd.

Signed: TPl

Thurstan Plummer
Organics Technical Manager
For & on behalf of i2 Analytical Ltd.

Other office located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

4041 mCERTS

Analytical Environmental Science

Analytical Report Number: 14-61886

Project / Site name: 17 Branch Hill

Your Order No: 20925

Lab Sample Number				384687	384688	384689	384690	
Sample Reference				BH1	BH1	BH2	BH2	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				0.25	0.50	0.50	0.75	
Date Sampled				23/10/2014	23/10/2014	23/10/2014	23/10/2014	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Moisture Content	%	N/A	NONE	9.3	8.2	15	16	
Total mass of sample received	kg	0.001	NONE	0.64	0.61	0.58	0.62	
Whole Sample Crushed		N/A	NONE	Crushed	Crushed	Crushed	Crushed	
Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	Chrysotile- Loose fibres	Chrysotile- Insulation lagging	-	-	
Asbestos in Soil Screen	Type	N/A	ISO 17025	Detected	Detected	Not-detected	Not-detected	
General Inorganics								
pH	pH Units	N/A	MCERTS	9.1	9.0	8.6	8.4	
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	
Complex Cyanide	mg/kg	1	NONE	< 1	< 1	< 1	< 1	
Free Cyanide	mg/kg	1	NONE	< 1	< 1	< 1	< 1	
Total Sulphate as SO_4	mg/kg	100	ISO 17025	1300	940	330	620	
Water Soluble Sulphate (Soil Equivalent)	g/l	0.0025	MCERTS	0.16	0.21	0.065	0.050	
Water Soluble Sulphate (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.081	0.11	0.033	0.025	
Sulphide	mg/kg	1	MCERTS	< 1.0	9.4	< 1.0	< 1.0	
Total Organic Carbon (TOC)	%	0.1	MCERTS	0.2	< 0.1	0.9	< 0.1	
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	
Acenaphthylene	mg/kg	0.1	MCERTS	< 0.10	0.31	< 0.10	< 0.10	
Acenaphthene	mg/kg	0.1	MCERTS	< 0.10	0.29	< 0.10	< 0.10	
Fluorene	mg/kg	0.1	MCERTS	< 0.10	0.45	< 0.10	< 0.10	
Phenanthrene	mg/kg	0.1	MCERTS	1.2	4.3	< 0.10	< 0.10	
Anthracene	mg/kg	0.1	MCERTS	0.46	1.2	< 0.10	< 0.10	
Fluoranthene	mg/kg	0.1	MCERTS	4.3	7.2	0.71	< 0.10	
Pyrene	mg/kg	0.1	MCERTS	3.7	5.8	0.61	< 0.10	
Benzo(a)anthracene	mg/kg	0.1	MCERTS	2.4	3.0	0.31	< 0.10	
Chrysene	mg/kg	0.05	MCERTS	2.2	3.0	0.36	< 0.05	
Benzo(b)fluoranthene	mg/kg	0.1	MCERTS	2.9	3.9	0.46	< 0.10	
Benzo(k)fluoranthene	mg/kg	0.1	MCERTS	1.7	1.6	0.31	< 0.10	
Benzo(a)pyrene	mg/kg	0.1	MCERTS	2.6	3.1	0.43	< 0.10	
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	MCERTS	1.2	1.4	< 0.10	< 0.10	
Dibenz(a,h)anthracene	mg/kg	0.1	MCERTS	0.20	0.23	< 0.10	< 0.10	
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	1.4	1.7	< 0.05	< 0.05	
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	1.6	MCERTS	24.2	37.4	3.19	< 1.60	

4041 mCERTS

Environmental Science

Analytical Report Number: 14-61886
Project / Site name: 17 Branch Hill
Your Order No: 20925

Lab Sample Number				384687	384688	384689	384690	
Sample Reference				BH1	BH1	BH2	BH2	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				0.25	0.50	0.50	0.75	
Date Sampled				23/10/2014	23/10/2014	23/10/2014	23/10/2014	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	12	11	18	6.4	
Boron (total)	mg/kg	1	MCERTS	8.4	6.6	9.2	13	
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	0.3	< 0.2	
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	26	21	42	50	
Copper (aqua regia extractable)	mg/kg	1	MCERTS	29	25	38	14	
Lead (aqua regia extractable)	mg/kg	1	MCERTS	220	180	410	19	
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	0.3	< 0.3	
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	16	14	15	15	
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	87	120	190	44	
Monoaromatics								
Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
p & m-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
o-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
Petroleum Hydrocarbons								
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	< 8.0	
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	< 8.0	
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	2.7	< 2.0	< 2.0	
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	16	33	< 10	< 10	
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	24	37	< 10	< 10	
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	40	73	< 10	< 10	

Analytical Report Number : 14-61886
Project / Site name: 17 Branch Hill

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and topsoil/loam soil types. Data for unaccredited types of solid should be interpreted with care.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
384687	BH1	None Supplied	0.25	Brown sandy topsoil with rubble.
384688	BH1	None Supplied	0.50	Brown sandy topsoil with rubble.
384689	BH2	None Supplied	0.50	Brown clay and topsoil with gravel.
384690	BH2	None Supplied	0.75	Brown clay and topsoil with gravel.

Analytical Report Number : 14-61886

Project / Site name: 17 Branch Hill

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
BTEX and MTBE in soil	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073S-PL	W	MCERTS
Complex cyanide in soil	Determination of complex cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	NONE
Crush Whole Sample	Either: Client specific preparation instructions - sample(s) crushed whole prior to analysis; OR Sample unsuitable for standard preparation and therefore crushed whole prior to analysis.	In house method, applicable to dry samples only.	L019-UK	D	NONE
Free cyanide in soil	Determination of free cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	NONE
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	D	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
pH in soil	Determination of pH in soil by addition of water followed by electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L005-PL	W	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Stones not passing through a 10 mm sieve is determined gravimetrically and reported as a percentage of the dry weight. Sample results	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil	Determination of water soluble sulphate by extraction with water followed by ICP-OES. Results reported corrected for extraction ratio (soil equivalent) as g/l and mg/kg; and upon the 2:1	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS

4041 MCERTS

Analytical Environmental Science

Analytical Report Number : 14-61886

Project / Site name: 17 Branch Hill

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Total organic carbon in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L023-PL	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	ISO 17025
TPHCWG (Soil)	Determination of pentane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method	L076-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

APPENDIX `C'

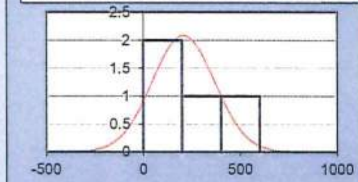
Statistical Analysis

Test Results

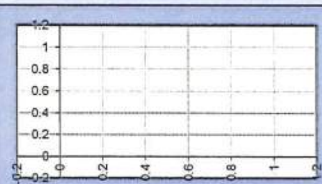
Client/client ref: 17 Branch Hill Site ref: 14/22714 Date: 07-Nov-2014
Project ref: Data description: User details: A Davidson

Dataset:	Pb
Sample mean, $\overline{x}$	207.25
Sample standard deviation, s	160.68
Sample size, n	4
Critical concentration, Cc	200

Use Normal distribution to test fc

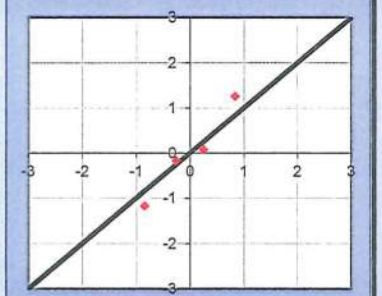


Outliers & non-detects	
Outliers present?	NO
Significance level	5%
Outliers removed?	0
Non-detects	0

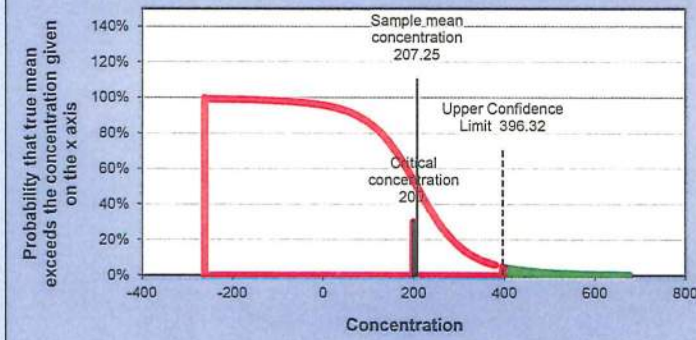


Normality test

Significance level:	5%
Normal distribution	
Use:	Auto: One-sample t-test



Test scenario:	Planning: is true mean lower than critical concentration (μ < Cc)?
Null hypothesis:	The true mean concentration is equal to or greater than the critical concentration: $\mu \geq$ Cc
Alternative hypothesis:	The true mean concentration is less than the critical concentration: μ < Cc



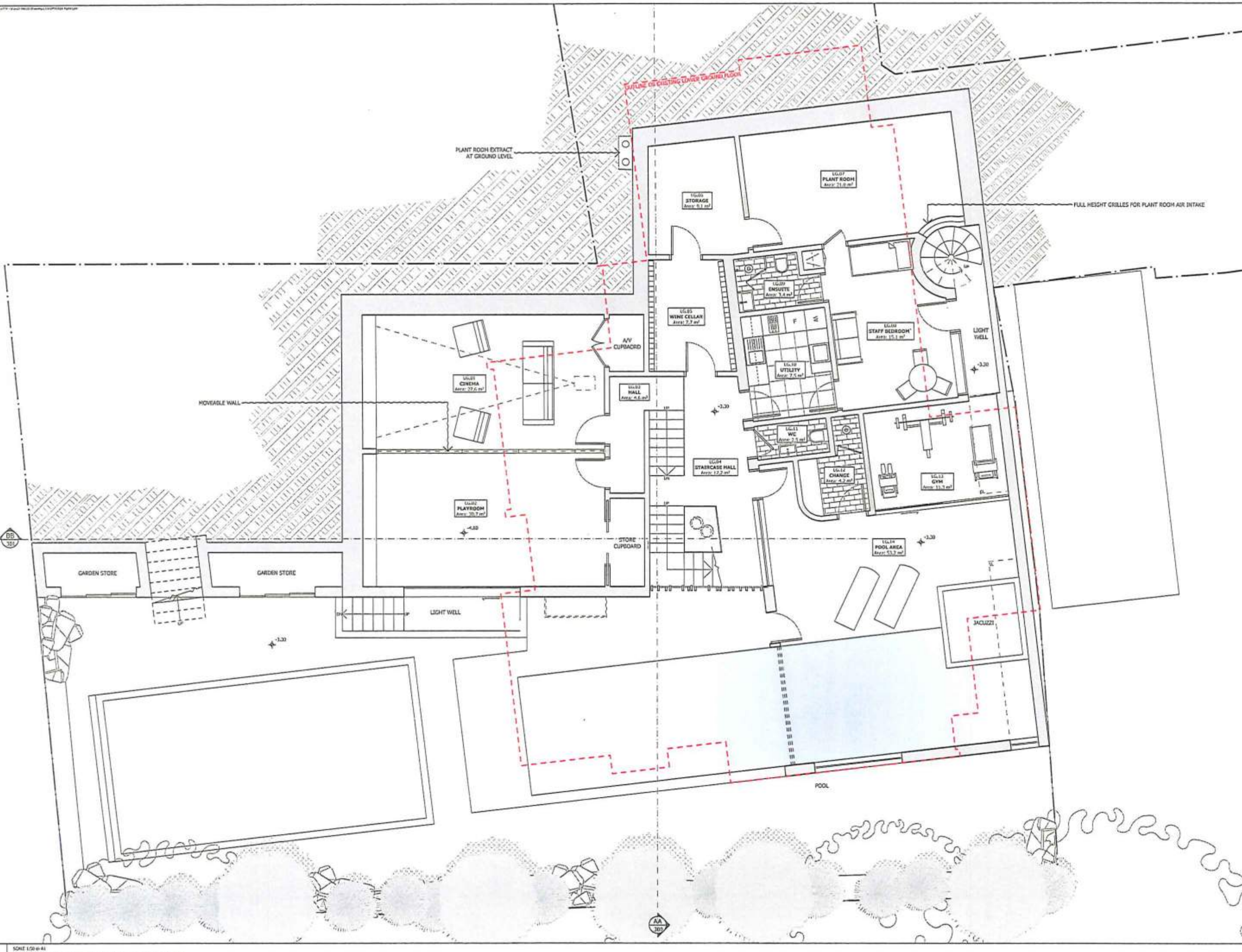
Evidence against Null hypothesis:	47%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	No

$\mu \geq$ Cc

Back to data | Back to summary | Go to outlier test | Go to normality test

APPENDIX `D'

Proposed plans of the development



1 LOWER GROUND FLOOR - PROPOSED

DO NOT SCALE FROM THIS DRAWING

Figured dimensions only are to be taken from this drawing. All dimensions are to be checked on site before any work is put in hand.
If in doubt, ask.

All SHH drawings to be read in conjunction with relevant SHH Finishes, Sanitaryware, Lighting & Ironmongery schedules.

Any discrepancies to be highlighted to SHH prior to procurement and in good time.

Legends & Notes:

Rev	Date	Description	Appr.
	18.12.2015	Issued for Information	

SHHARCHITECTS|INTERIORDESIGNERS

RIBA Chartered Practice | MEMBER

Phone +44 (0) 20 8600 4171 Email info@shh.co.uk
shh.co.uk

Project:

The Kaye's Residence
17 Branch Hill, Hampstead
NW3 7NA

Client:
Adam Kaye & Lucy Ronson

Drawing Title:
020 General Arrangements

Lower Ground Floor

(Project number)DWG number_Revision: (779)020_P01

Checked:

Appendix C. Construction Method Statement

engineersHRW

17 BRANCH HILL
LONDON NW3 7NA

STRUCTURAL ENGINEER'S
DESIGN STATEMENT FOR PLANNING

This report was written/compiled by Brett Scott BEng (Hons) CEng MIStructE and reviewed by Simon Robinson BSc (Hons) CEng MIStructE of Engineers Haskins Robinson Waters Limited

Signed ………………………………………………………. Date ……………………

Job Number: 1281

This planning feasibility report has been prepared for and on behalf of our clients, Adam Kaye and Lucy Ronson, based on the planning proposals by SHH Architects (drawing references listed in section 8.3.2). It is for the use of the client, the client's professional advisers and London Borough of Camden and is for their use only. The report should not be used for any purposes other than for which it was considered. The report should be read in conjunction with Engineers HRW Structural drawings 1281/GA/10, 11, 12, 13, 1281/SE/21, 21, HRW Sketches 1281/SK/08, 09 and SAS Site Investigation Reports and Basement Impact Assessment dated November 2014.

1.0 Introduction

1.0.1 Engineers HRW have been asked to consider the structural issues surrounding the proposed construction works to support the planning application.

1.0.2 The proposals comprise the almost full demolition of the existing residence on the site to allow construction of a new three storey property inclusive of lower ground (rear garden level) and basement levels.

1.0.3 This report has been prepared in compliance with the London Borough of Camden's DP27 and CPG4 Basements and Lightwells requirements for basement extensions. It includes a construction methodology statement prepared and signed off by a Chartered Structural Engineer (MIStruct.E) and includes proposals for temporary supports and sequence of construction. A site specific soils investigation report is also attached.

2.0 Site Information

The site is situated in the Hampstead district of London and access is from Branch Hill along a private drive. It is behind "The Chestnuts" formerly a hotel but now two private houses. The overall site is circa 30.0m long x 19.0m wide excluding drive and car parking. To the north is Savoy Court, a modern five storey apartment block. The ground slopes steeply to the south and west across the property. This site has been stepped by use of retaining walls to the lower ground floor and the external ground level at the rear of the existing property is approximately 3.0 m below the level at the front of the property.

There are boundary retaining walls to most of the site. The Chestnuts has a single storey masonry shed lean-to structure on the north east boundary.

The adjacent properties have large trees, some subject to TPO, close to the boundary. See Landmark Trees Report SHH/17BRH/AIA/01 dated July 2014 for recommendations for protection of the trees.

2.1 Existing Building

The existing building to be demolished on the site consists a three storey (inclusive of lower ground floor) building set back from Branch Hill. It is of recent construction and the structure appears to be traditionally constructed above ground floor, with load-bearing external solid brickwork walls, assumed timber floors and timber roof. The ground and lower ground floors are assumed to be constructed in reinforced concrete.

2.2 Geotechnical Ground Conditions

2.2.1 Geology

A detailed Geotechnical Site Investigation has been carried out and full report is attached. The British Geological Survey maps indicate the site is located on the alluvial Bagshot Formation consisting clay and fine grained sand underlain by the Claygate member of the London Clay Formation. The suitably qualified site investigation consultant has commented on hydrological issues and groundwater flows in the SAS Basement Impact Assessment. The exploratory holes revealed that ground conditions are generally consistent with the geological records and known history of the area and comprised MADE GROUND approx. 0.8m in thickness over the typical BAGSHOT Formation. These soils extended for the full depth of the investigation of 15.0m and comprised of loose becoming medium dense clayey silty fine sand locally becoming stiff silty sandy clay.

2.2.2 Groundwater

The geological build up noted above could suggest that perched ground water may be present locally within the made ground. Groundwater was encountered at a depth of 7.2m below ground level (112.70mOD). Groundwater was subsequently found to have stabilised at a depth of 7.11m below ground level (112.79mOD) in the monitoring standpipe. The ground water is therefore below existing and proposed floor levels. The SAS Basement Impact Assessment states that it is considered that the proposed development will have minimal impact on any nearby watercourses.

2.2.3 Contamination

The site investigation identifies concentrations of lead in excess of Level 4 and asbestos within the made ground. It is recommended that remediation is carried out, consisting of removing the top 600mm of soil from the site and replaced with clean cohesive fill. It may be possible that the extent of remediation required could be reduced by further investigation.

2.3 Flood Risk

2.3.1 Tidal Flood Risk

The site is not situated within a tidal flood zone as designated by the Environment Agencies Tidal Flood Map.

2.3.2 Surface Water Flood Risk

The site risk category as defined by the Environment Agencies Surface Water Flood Map is very low.

3.0 Proposed Structural Works

3.1 Introduction

The proposed development of the site involves the demolition of the existing building and construction of a new three storey property inclusive of lower ground (rear garden level). Generally, the proposed depth of excavation below the existing ground level to the front of the property (high level) is to be a maximum of 4.0m, however in the area of the proposed study/ games room to the rear of the property this will decrease to around 2.5m (circa 2.8m below existing garden level to the rear of the property). The existing ground level is to be raised in this area resulting in a final retained height of 5.5m against the northern boundary. The existing retained height at the boundary retaining wall is approximately 3.5m.

3.2 Demolition Works

It is proposed that all demolition works will be carried out in accordance with BS 6187 'Code of practice for demolition' and an appropriately skilled and experienced contractor is to be appointed. The works are to be carefully sequenced and undertaken and the contractor is to provide full temporary works and supervision to ensure that the stability of the remaining structure and surrounding structures are maintained at all times.

3.2.1 Outline Method statement / Sequence of Demolition Works of Existing Building

Generally the demolition works are to be carried out from top to bottom and temporary works are to be introduced as required. See engineersHRW sketches 1281/SK/008 and 009 for initial proposals.

1. Prior to demolition works the contractor is to undertake a detailed survey of the existing structure, site and the surrounding areas and provide a full method statement and temporary works proposals to the Structural Engineer for comment.

2. The existing roof and first floor structure is to be demolished down to ground level.

3. Elements not contributing to the lateral restraint of the existing retaining walls to be demolished down to the lower floor level.

4. Permanent contiguous bored piles walls and lateral restraint installed.

5. Elements of the existing lower ground floor slab and walls to be removed as required.

3.3 New Lower Ground Floor Structure

3.3.1 The new lower ground floor structure is to consist a reinforced concrete box constructed partly within the existing walls and within a propped contiguous wall. The propped contiguous bored pile wall approach is to deal with the multiple levels and existing basement walls. Temporary propping is proposed to be installed during the demolition and excavation works and as the internal concrete box is formed. The piles will be propped below floor levels to allow construction of the new horizontal slab elements that prop the walls of the reinforced concrete box in the permanent condition. For the lower height retaining walls temporary trench sheeting is to be adopted to allow for the possibility of running sands. The walls will be constructed sequentially to avoid extensive propping.

3.3.2 As the new lower ground floor to the rear is deeper than the existing floor level heave of the underlying clay soils is to be allowed for. This is achieved by supporting the building on piles and constructing the floor slabs on compressible fill.

3.3.3 The presence of groundwater was observed during the site investigation (refer to section 2.2.2). It is below the deepest excavation however perched water may be present. In the permanent condition the reinforced concrete box within the contiguous piled wall perimeter will be designed to resist vertical and lateral water pressures.

3.3.4 The concrete structure will be designed to BS8110 with full top and bottom reinforcement to all sections. The concrete in itself is not a watertight / waterproof construction and in order to achieve a Grade 3 'habitable' basement in accordance with BS8102 a combination of external tanking system with an internal drained cavity system will be provided. However the final waterproofing system is yet to be agreed with the architect.

3.3.5 The RC basement structure is classified as a "robust" structure and any accidental lateral loading applied to the new basement structure can be resisted / absorbed by the new RC structure.

4.0 Control of Movement

The proposed basement scheme and method of construction are of a typical form for which we are confident that resulting ground movements can be controlled in both the temporary and permanent condition.

4.0.1 Vertical Movement

Vertical movement resulting from heave of the strata below the basement slab following excavation will be allowed for by adopting a compressible filler beneath the lower ground floor.

4.0.2 Horizontal Movement

Horizontal deflection adjacent to existing structures to the perimeter of the basement void will be limited by propping of the contiguous piled walls in both the temporary and permanent conditions. The adjacent structures are limited to retaining walls and the adjacent single storey lean-to garden building. In the temporary condition steel props will be installed between waling beams to mass concrete bases as excavation progresses. In the permanent condition the concrete walls will be propped by the reinforced concrete slabs forming the lower ground and ground floor.

5.0 New Superstructure

5.1 Superstructure - Overall Stability / Load Transfer

5.1.1 The proposed reinforced concrete frame will take stability from the columns and walls, whilst the steel structure constructed off the first floor slab and providing support for the roof will rely on steel braced bays to the perimeter to provide stability.

5.1.2 Reinforced concrete columns will carry vertical loads down the structure and back to the ground through the lower ground floor to the piled foundation. In some locations reinforced concrete transfer beams form part of the load path where column free spaces are required below.

5.1.3 The new reinforced concrete lower ground floor structure will be designed to resist upwards and lateral water pressures resulting from groundwater, as well as vertical loads from above and horizontal ground forces imposed via the propping action of low level slabs to the perimeter concrete wall.

5.2 Superstructure - Disproportion Collapse

5.2.1 The proposed reinforced concrete shear core structure is an inherently robust structural form. Compliance with disproportionate collapse requirements will be ensured by the tying of reinforcement through the structure to include peripheral ties, horizontal ties, vertical ties, internal ties and corner column ties.

6.0 Temporary Works

6.0.1 Temporary Works

The contractor will be responsible for the design, erection and maintenance of all temporary works in accordance with all relevant British Standards. The contractor will be contractually obligated to appoint a qualified temporary works engineer to provide adequate temporary works and supervision to ensure that the stability of the existing structure, excavations and surrounding structures are maintained at all times.

6.0.2 Submissions

The contractor will be required to submit full proposals, method statements and calculations to the engineer and all appropriate parties (party wall surveyors, etc.) for approval prior to the start of any works on site.

The contractor will also be required to appoint a Temporary Works Co-ordinator for the duration of the contract in accordance with the specification and BS 5975.

6.0.3 Monitoring

All items of temporary works and surrounding structures should be monitored in a manner and frequency commensurate with the construction activity taking place. The extent will limited to the existing retaining walls and the adjacent garden lean-to building. As a minimum the monitoring should include a daily full visual survey of all temporary works and surrounding structures and a weekly measured survey using fixed survey points during the main basement works, subject to proposed construction sequence, party wall agreement, etc.

7.0 Method Statement / Sequence of Works

Outline construction sequence and temporary works assumed in the design as described below will be superseded by the contractor’s proposals.

1. The existing building is to be demolished top to bottom and temporary works installed as noted in section 3.2.1

2. Existing foundations and any other obstructions that may have a detrimental impact on the foundation works to be undertaken are to be carefully grubbed up and backfilled.

3. The lower ground floor will contiguous piled wall and internal basement slab piles are then to be bored and cast. The contiguous piled wall will be constructed on a hit one miss three basis which will mean fresh piles are cast at a nominal spacing of 1.8 centre to centre. This will ensure bore stability during construction and limit the numbers of piles bored next to adjacent properties in one go.

4. The capping beam is to be cast to the perimeter contiguous piled wall, installing any temporary works as required next to the adjacent properties.

5. Further to the capping beam and pile concrete achieving full strength excavation of the basement can commence, installing temporary propping to capping beams as necessary. A sump / pumping system should be put in place to remove any water seepage into the basement void when excavations descend below the stabilised water level as observed in the SI.

6. Safe slopes may then be formed within the basement void to the underside of the pool / spa / gym and lift pit formations to allow construction of low level reinforced concrete slabs and walls.

7. The basement slab can then be constructed, followed by the contiguous pile lining walls and lower ground floor slab. When the basement box concrete has achieved full design strength remove temporary propping.

8. Construct superstructure.

8.0 Design Criteria

8.1 Code of Practice

Structural use of Concrete BS 8110-1:1997

Structural use of Concrete BS 8110-3:1985

Code of practice for foundations BS 8004

Structural use of Steel BS 5950-1:2000

Structural use of Timber BS 5628-2:2002

Structural Use of Masonry BS 5628-1:2005

Loading for Buildings BS 6399: Part 1:1996, Part 2:1997

8.2 Loading – Imposed loadings to BS 6399

Domestic areas = 1.5 kN/m2

External areas = 3.0 kN/m2 (10.0 kN/m2 for construction loading)

Roof (flat with access) = 0.75 kN/m2

Roof (pitched) = 0.6 kN/m2

8.3 List of relevant drawings

8.3.1 engineersHRW Sketches and Drawings

1281/SK/08 P2
1281/SK/09 P2

1281/GA/10 P2
1281/GA/11 P2
1281/GA/13 P2
1281/SE/20 P2
1281/SE/21 P2

8.3.2 Architects Drawings

(779)020_P02 Lower Ground Floor Plan
(779)021_P01 Ground Floor Plan
(779)023_P01 First Floor Plan
(779)204_P01 North Elevation
(779)205_P01 East Elevation
(779)206_P01 South Elevation
(779)207_P01 West Elevation
(779)300_P01 Proposed Section AA
(779)301_P01 Proposed Section BB
(779)311_P01 Existing Section BB
(779)313_P01 Existing Section DD

9.0 Conclusion

As noted above a preliminary feasibility assessment of the proposed scheme has been undertaken although detailed calculation checks, investigations and full design will need to be completed. At this stage we are satisfied that the proposed scheme is viable and that if carried out in a carefully defined sequence such as noted above, it can be completed without compromising the structural stability of any adjacent properties or structures. Note that site is largely bounded by gardens so the adjacent structures are limited to retaining walls and a lean-to garden building.