APPENDIX G – Site Investigation Results

Ground Investigation Report

26 Wedderburn Road
Hampstead
London
NW3 5QG

Client	Consolidated Developments Limited
Engineer	Engenuiti

J12105

July 2012




GEA Geotechnical & Environmental Associates

Document Control

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CONTENTS

EXECUTIVE SUMMARY

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

BRIEF

This report describes the findings of a ground investigation carried out by Geotechnical and Environmental Associates Limited (GEA) on the instructions of Engenuiti, on behalf of Consolidated Developments Limited, with respect to the extension of the existing house through extension of the existing basement and the construction of a new lightwell. The purpose of the investigation has been to determine the ground conditions, to assess the extent of any contamination and to provide information to assist with the design of suitable foundations and retaining walls. A desk study, basement impact assessment and contamination testing did not form part of the project brief.

GROUND CONDITIONS

The investigation has generally confirmed the expected ground conditions in that, below a moderate thickness of made ground, the Claygate Member was encountered to the maximum depth investigated of 6.0 m. The made ground was encountered to depths of between 0.85 m and 1.80 m and generally comprised greyish brown clayey silty sand with rare gravel and occasional fragments of brick and charcoal. The underlying Claygate Member initially comprised firm light orange-brown mottled greenish grey silty sandy clay with abundant partings of fine sand and silt, inter-bedded with layers of soft orange-brown mottled greenish grey clayey sandy silt to depths of between 3.50 m and 4.80 m, below which dark grey silty sandy clay with abundant partings of fine sand and silt, inter-bedded with layers of soft dark grey clayey sandy silt was encountered and proved to the full depth investigated. The clay of the Claygate Member was noted to be stiff in each borehole to depths of between 2.00 m and 3.70 m. All of the boreholes were advanced on close proximity of trees and therefore the apparent strength is thought to represent desiccation.
Groundwater was encountered in Borehole Nos 1 and 2 at a depth of 4.0 m during drilling, whilst Borehole No 3 was recorded to be dry. Subsequent groundwater monitoring has been carried out on two occasions and groundwater has been measured at depths of between 1.45 m and 2.80 m.

RECOMMENDATIONS

Excavations for the proposed basement structure will require temporary support to maintain stability and prevent any excessive ground movements and, since groundwater is likely to be encountered within the 3 m deep excavation, it is unlikely to be feasible to construct the basement without the requirement for some level of groundwater control. It may be possible to adopt moderately loaded spread foundations bearing on the Claygate Beds, with a net allowable bearing pressure of 75 kN/m^2 below basement level, although problems may be encountered in forming excavations if groundwater is encountered and piles may therefore be a more suitable solution. The most appropriate method of supporting the basement will probably be a bored pile wall, although sheet piling could also be considered. Further investigations will be required in this respect to provide parameters for pile design. The stability of the existing property and neighbouring structures will need to be ensured at all times.

Part 1: INVESTIGATION REPORT

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

1.0 INTRODUCTION

Geotechnical and Environmental Associates Limited (GEA) have been commissioned by Engenuiti, on behalf of Consolidated Developments Limited, to carry out a ground investigation at 26 Wedderburn Road, Hampstead, NW3 5QG.

A desk study, contamination testing or consideration of the implications of the proposed basement on groundwater or land stability ("Basement Impact Assessment") did not form part of the brief for this project.

1.1 Proposed Development

It is understood that it is proposed to extend the existing house through the extension of the existing basement and the construction of a new lightwell. The maximum depth of the proposed new basement will be 3.0 m.

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

1.2 Purpose of Work

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

- to determine the ground conditions and their engineering properties; and
- to provide advice with respect to the design of shallow foundations and retaining walls.

1.3 Scope of Work

- In order to meet the above objectives, the ground investigation comprised, in summary, the following activities:
- three open-drive sampler boreholes advanced to depths of 6.0 m;
- standard penetration tests (SPTs), carried out at regular intervals in a single borehole, to provide quantitative data on the strength of the soils;
- the installation of three groundwater monitoring standpipes in the boreholes to depths of 6.0 m and two subsequent groundwater monitoring visits;
- laboratory testing of selected soil samples for geotechnical purposes; and
- provision of a report presenting and interpreting the above data, together with our advice and recommendations with respect to the proposed development.

1.4 Limitations

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

2.0 THE SITE

2.1 Site Description

The site is located in a residential area in the London Borough of Camden, approximately 700 m to the northwest of Belsize Park London Underground Station. It is irregular in shape, measuring approximately 20 m by 30 m and occupies a corner plot bounded by Wedderburn Road to the south and Arkenside Road to the west.

The site is bounded to the north by No 5 Arkenside Road, a three-storey semi-detached property, and is partially adjoined to the east by No 24 Wedderburn Road, a three-storey property with a partial basement in the northeast of the house.

The local topography slopes down towards the south and the site is on a number of different levels and is currently occupied by a three-storey building, with some single and two-storey extensions. The property is divided into four apartments with a shared driveway and three garages in the northern part of the site. The entrance to Flat Nos 26a to 26c Wedderburn Road is through a gate which is accessed from Arkenside Road. There are external steps that lead up to the front door at first floor level which is a shared entrance to Flat Nos 26a to 26c Wedderburn Road and there is a separate entrance to No 26 Wedderburn at ground floor level. No 26 Wedderburn Road occupies the entire ground floor of the building, together with the partial basement and the garden areas. The garden area to the south comprises a patio area with shrub borders and the west comprises a paved pathway and flower beds. There are a number of semi-mature trees along the eastern, southern and western perimeter of the site, reaching heights of up to 12 m.

2.2 Other Information

The Geological Survey map of the area indicates that the site should be directly underlain by the Claygate Member, overlying the London Clay. The boundary between the Claygate Member and London Clay is shown approximately 70 m to the south of the site and the Bagshot Formation is shown to outcrop approximately 200 m to the north of the site. The geology in this area is generally horizontally bedded such that the boundary between the geological formations roughly follows the ground surface contour lines.

Groundwater is likely to be present within the Claygate Member, and other investigations carried out around the area of Hampstead Heath indicate that spring lines are present at the interface of the Bagshot Beds and the Claygate Member, and at a lower level at the boundary between the Claygate Member and the underlying essentially impermeable London Clay. These springs have been the source of a number of London's "lost" rivers, notably the Fleet, Westbourne and Tyburn, which all rose on Hampstead Heath, to the north and northwest of the current site, at the base of the Bagshot Beds.

Historically the Tyburn River[1] flowed approximately 100 m west of the site. The stream flowed in a southerly direction, towards Regent's Park where it flowed into a large lake that is still present today.

The direction of groundwater flow within the Claygate Member beneath the site is likely to be controlled by the local topography and therefore generally in a southerly direction.

Ordnance Datum levels have not been provided or measured at the site. However, it is known that the road level on Arkenside Road at the junction with Wedderburn Road is 81.5 m OD. A nearby investigation, carried out by GEA roughly 80 m to the north of the site on Lyndhurst Road, indicates the Claygate Member to extend to a depth of 8.60 m (83.10 m OD). However, the contours and spot heights shown on the OS and geological maps would suggest that the Claygate Member extends to a depth of approximately 77.00 m OD, where it is in turn underlain by London Clay. Groundwater was measured at a depth of 5.00 m (86.70 m OD) at this nearby site, although this may not represent equilibrium level.

There is a railway tunnel located approximately 70 m to the south of the site.

1 Nicholas Barton (2000) *London's Lost Rivers.* Historical Publications Ltd

3.0 EXPLORATORY WORK

The scope of the works was specified by the consulting engineers. In order to meet the objectives described in Section 1.2 and the site constraints, three boreholes were drilled to a depth of 6.0 m using an open-drive lined percussive sampler rig under the supervision of a geotechnical engineer from GEA.

Standard penetration tests (SPTs) were carried out at regular intervals in a single borehole to provide quantitative data on the strength of soils encountered.

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

A groundwater monitoring standpipe was installed in each borehole to a depth of 6.0 m, and the standpipes have been monitored on two occasions to date, over a period of approximately five weeks.

The borehole records and results of the laboratory analyses are appended, together with a site plan indicating the exploratory positions.

3.1 Sampling Strategy

The borehole locations were specified by the consulting engineers. However, in view of restricted access and drain runs, one of the boreholes was repositioned on site by GEA with the agreement of the consulting engineer.

Laboratory geotechnical classification and strength tests were undertaken on samples of the natural soils.

Contamination testing did not form part of the project brief.

4.0 GROUND CONDITIONS

The investigation has generally confirmed the expected ground conditions in that, below a moderate thickness of made ground, the Claygate Member was encountered to the maximum depth investigated of 6.0 m.

4.1 Made Ground

The made ground was encountered to depths of between 0.85 m and 1.80 m and generally comprised greyish brown clayey silty sand with rare gravel and occasional fragments of brick and charcoal.

No significant evidence of contamination was noted within the soils during the fieldwork.

4.2 Claygate Member

The Claygate Member initially comprised firm light orange-brown mottled greenish grey silty sandy clay with abundant partings of fine sand and silt, inter-bedded with layers of soft orange-brown mottled greenish grey clayey sandy silt to depths of between 3.50 m and 4.80 m, below which dark grey silty sandy clay with abundant partings of fine sand and silt, inter-bedded with layers of soft dark grey clayey sandy silt was encountered and proved to the

full depth investigated. The clay of the Claygate Member was noted to be stiff in each borehole to depths of between 2.0 m and 3.7 m. All of the boreholes were advanced in close proximity of trees and therefore the apparent strength is thought to represent desiccation.

Laboratory plasticity index tests have indicated the Claygate Member to be of moderate volume change potential.

4.3 Groundwater

Groundwater was encountered in Borehole Nos 1 and 2 at a depth of 4.0 m during drilling, and was measured in standpipes at depths of 2.43 m and 2.04 m respectively, approximately two to three hours after installation. Water was not encountered in Borehole No 3 during drilling and the standpipe was recorded to be dry to a depth of 6.0 m, approximately 30 minutes after installation at this location.

Groundwater monitoring has subsequently been carried out on two occasions, approximately two weeks and five weeks after installation. The results of the monitoring visits are shown in the table below:

Date	Borehole No	Depth to water (m)
15/05/2012	1	1.60
	2	2.31
	3	2.80
20/06/2012	1	1.45
	2	2.00
	3	2.80

The results of the groundwater monitoring suggest that groundwater flows in a generally southerly direction, as expected from the local topography.

At the request of the consulting engineer simple rising head tests were carried out at the time of the second groundwater monitoring visit to give a preliminary assessment of groundwater inflows into the basement excavation. The results of these tests are appended.

A slight odour was noted in Borehole No 1 during bailing of the water. This borehole is located within the vicinity of a number of drains and it is possible that the drains are leaking.

In Borehole No 2, water was bailed out of the standpipe for 25 minutes, but it was only possible to reduce the level of the groundwater in the pipe by 400 mm of water due to the rate of groundwater inflow.

Part 2: DESIGN BASIS REPORT

This section of the report provides an interpretation of the findings detailed in Part 1, in the form of a ground model, and then provides advice and recommendations with respect to the basement excavation and the design of suitable foundations and retaining walls.

5.0 INTRODUCTION

It is understood that it is proposed to extend the existing house through extension of the existing basement and the construction of a new lightwell. The maximum depth of the proposed new basement will be 3.0 m.

6.0 GROUND MODEL

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

- the investigation has generally confirmed the expected ground conditions in that, below a moderate thickness of made ground, the Claygate Member was encountered to the maximum depth investigated of 6.0 m;
- the made ground extends to depths of between 0.85 m and 1.80 m and generally comprises greyish brown clayey silty sand with rare gravel and occasional fragments of brick and charcoal;
- the Claygate Member initially comprises firm light orange-brown mottled greenish grey silty sandy clay with abundant partings of fine sand and silt, inter-bedded with layers of soft orange-brown mottled greenish grey clayey sandy silt to depths of between 3.50 m and 4.80 m, below which dark grey silty sandy clay with abundant partings of fine sand and silt, inter-bedded with layers of soft dark grey clayey sandy silt is present and was proved to the full depth investigated;
- the clay of the Claygate Member was noted to be stiff and suspected of being desiccated to depths of 2.00 m and 3.70 m;
- plasticity index tests have indicated the Claygate Member to be of moderate volume change potential;
- groundwater was encountered in Borehole Nos 1 and 2 at a depth of 4.0 m during drilling, and was measured in standpipes at depths of 2.43 m and 2.04 m respectively, approximately two to three hours after installation. Water was not encountered in Borehole No 3 during drilling and the standpipe was recorded to be dry to a depth of 6.0 m, approximately 30 minutes after installation at this location; and
- groundwater monitoring has been carried out on two occasions, approximately two and five weeks after installation, and groundwater was measured at depths of 1.45 m and 2.80 m.

7.0 ADVICE AND RECOMMENDATIONS

Formation level for the proposed 3.0 m deep basement extension is likely to be within the firm clay of the Claygate Member, which should provide an eminently suitable bearing stratum for spread foundations. The groundwater levels and likely rates of inflow indicate that groundwater inflows will occur into the basement excavation which may make excavation of spread foundations problematic. Piled foundations are likely to be a more appropriate solution, although further investigations in the form of a deep borehole will be required for pile design parameters.

Excavations for the proposed basement structure will require temporary support to prevent any excessive ground movements and the stability of the existing property and neighbouring structures will need to be ensured at all times. The existing foundations will need to be underpinned prior to construction of the proposed new basement, or will need to be supported by new retaining walls.

7.1 Basement Construction

7.1.1 Basement Excavation

The proposal is to extend the existing basement to a depth of 3.0 m below ground level. The investigation has indicated that formation level for the basement will be within the Claygate Member. Groundwater was encountered at shallow depth during drilling of Borehole Nos 1 and 2, probably from within sand and silt partings of the Claygate Member, and monitoring has indicated a groundwater at depths of between 1.45 m and 2.80 m. On this basis groundwater is likely to be encountered within the basement excavation, although further monitoring should be carried out to establish equilibrium levels and the extent of any seasonal fluctuations.

Whilst monitoring should be continued, it is not possible to draw entirely meaningful conclusions from the measurements made in the standpipes, as the level of the water table is not necessarily as significant as the volume of water that may flow into the excavation. For example, a high level of water measured in a standpipe may not be significant if this represents only a small volume of water. The Claygate Member includes layers and pockets of sand and the occurrence of groundwater into the basement will, to a large extent, be determined by the presence of these more highly permeable materials. Shallow inflows of perched water may also be encountered from within the made ground, particularly within the vicinity of existing foundations, although such inflows are unlikely to be significant and should be adequately dealt with through sump pumping.

Rising head tests were carried out in the three standpipes to give a preliminary assessment of groundwater inflows into the proposed basement excavation. The testing indicated inflow rates of 1.79×10^{-6} m/s and 2.92×10^{-6} m/s in Borehole Nos 1 and 3 respectively, whilst in Borehole No 2 it was not possible to lower the water level in the standpipe for a test to be completed. On this basis it is likely that inflows of groundwater will be variable and could be locally high, probably, as noted above, being controlled by the occurrence of more permeable layers. It would be prudent to carry out a number of trial excavations, to depths as close to the full basement depth as possible, to confirm this view and for a more accurate assessment of the rate of groundwater inflows over a larger area.

The design of basement support in the temporary and permanent conditions needs to take

account of the need to maintain the stability of the excavation and surrounding structures and to protect against groundwater inflows.
Based on the groundwater observations to date it is unlikely to be possible to form the retaining walls by concrete underpinning the existing foundations without some form of groundwater control. The Claygate Member will soften and lose strength in the presence of groundwater inflows. A bored pile wall may be the most reliable method of supporting the basement excavation, and would have the benefit of providing support for structural loads in the permanent condition. On the basis of the groundwater monitoring observations to date a secant piled wall may be required. Alternatively, a sheet piled wall could be used as a temporary measure, prior to the construction of a permanent structure following the completion of the basement excavations. It is recommended that the advice of a specialist piling contractor should be sought in this respect and consideration should also be given to the noise and vibrations associated with the installation of sheet piles, unless a "silent" installation method is adopted. Care would need to be taken if water jetting of sheet piles is adopted, in view of the risk of causing settlement of the adjacent buildings and structures.

If it is not possible to carry out trial excavations, the contractor should have a contingency in place to deal with any groundwater inflows.

The ground movements associated with the basement excavation will depend on the method of excavation and support and the overall stiffness of the basement structure in the temporary condition. Thus, a suitable amount of propping will be required to provide the necessary rigidity. In this respect the timing of the provision of support to the wall will have an important effect on movements. Consideration will need to be given to a retention system that maintains the stability at all times of neighbouring properties. Excavation of a 3 m deep basement will result in settlement and lateral displacement behind the basement wall; the stability of the existing house and adjacent buildings will need to be ensured at all times and the retaining walls will need to be designed to accommodate the loads from these foundations unless they are underpinned.

7.1.2 Basement Retaining Walls

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

Stratum	Bulk Density (kg/m^3)	Effective Cohesion (c' – kN/m^2)	Effective Friction Angle (□' – degrees)
Made ground	1700	Zero	27
Claygate Member	1850	Zero	25

Groundwater has been measured at depths of between 1.45 m and 2.80 m to date and is likely to be encountered within the 3.0 deep basement excavation. At this stage, it is recommended that the basement is designed with a water level assumed to be at a depth of 1 m below ground level. It may however be possible to review this requirement following additional investigation by means of trial excavations and further monitoring and the advice in BS8102:2009[5] should be followed in this respect.

7.1.3 Basement Heave

The excavation of an approximately 3 m thickness of soil will result in an unloading of approximately 54 kN/m^2. This unloading will result in heave of the underlying Claygate Member, which will comprise short term elastic movement and longer term swelling that will continue over a number of years. These movements will be mitigated to some extent by the

continued pressure applied by the existing house which will be retained although it is considered that a more detailed analysis of the possible heave should be carried out once the basement design has been finalised.

7.2 Spread Foundations

All new foundations or underpins should bypass the made ground and desiccated clay. Moderate width strip or pad foundations bearing in the firm clay of the Claygate Beds at a depth of 3.0 m may be designed to apply a net allowable bearing pressure of 75 kN/m^2. This value incorporates an adequate factor of safety against bearing capacity failure and should ensure that settlement remains within normal tolerable limits.

However, groundwater is likely to be encountered within the 3 m deep basement excavation and there may be difficulties in controlling groundwater to allow such foundations to be excavated. The volume of groundwater anticipated in the basement excavation should be further investigated, as discussed in Section 7.1.

The depth of the basement excavation should be such that foundations will be placed below the depth of actual or potential desiccation but this should be checked once the proposals have been finalised. Notwithstanding NHBC guidelines, all foundations should extend beyond the zone of desiccation. In this respect it would be prudent to have all foundation excavations inspected by a suitably experienced engineer. Due allowance should be made for future growth of the trees.

The requirement for compressible material alongside foundations should be determined by reference to the NHBC guidelines.

If the required founding depths become uneconomic or it is not possible to construct spread foundations above the water table, piled foundations would provide a suitable foundation option and additional investigation will be required to provide pile design parameters.

7.3 Basement Floor Slab

A ground bearing slab will need to be suitably reinforced to cope with any movements associated with heave of the underlying clay soils and consideration will also need to be given to the possible requirement to design the basement with respect to a theoretical ground water level of 1.0 m below ground level. It may therefore be necessary to incorporate a void below the slab to accommodate these movements. Further consideration will need to be given to these issues once the levels and magnitude of any slab loading are known.

7.4 Shallow Excavations

On the basis of the borehole findings and service pits, it is considered that shallow excavations for foundations and services that extend through the made ground or Claygate Member should remain generally stable in the short term, although some instability may occur. Where personnel are required to enter excavations, a risk assessment should be carried out and temporary lateral support or battering of the excavation sides considered in order to comply with normal safety requirements. Any inflows of ground water into shallow excavations should be suitably controlled by sump pumping, although this should be confirmed by trial excavations to the full depth of the proposed basement.

7.5 Effect of Sulphates

Chemical analyses on two samples; a sample of made ground and a sample of Claygate Member have revealed low concentration of soluble sulphate and near-neutral pH, corresponding to Class DS-1 and AC-1s of Table 2 of BRE Special Digest 1 Part C (2005), assuming static groundwater conditions. The guidelines contained in the above digest should be followed in the design of foundation concrete.

8.0 OUTSTANDING RISKS AND ISSUES

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

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

Further groundwater monitoring should be carried out to establish equilibrium levels and the extent of any seasonal fluctuations. It would be prudent to carry out a number of trial excavations, to depths as close to the full basement depth to provide an indication of the likely groundwater conditions.

It is recommended that heave movements are checked by further analysis once the loadings and final levels are known.

All foundations should extend beyond the zone of desiccation. In this respect it would be prudent to have all foundation excavations inspected by a suitably experienced engineer.

Additional investigations in the form of deep boreholes will be required if piled foundations are to be installed.

These areas of doubt should be drawn to the attention of prospective contractors and further investigation will be required or sufficient contingency should be provided to cover the outstanding risk.

APPENDIX

Borehole Records

SPT Summary Sheet

Geotechnical Laboratory Test Results

Soakage Test Results

Site Plan

GEA Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** 26 Wedderburn Road, Hampstead, NW3 5QG	**Number** **BH 1**
Excavation Method Open-drive sampler borehole	**Dimensions**	**Ground Level (mOD)**	**Client** Consolidated Developments Limited	**Job Number** J12105
	Location	**Dates** 15/05/2012	**Engineer** Engenuiti	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.05) 0.05	Paving slab		
					(0.10) 0.15	Sand sub-base		
0.50	D1				(0.20) 0.35	Concrete		
					(0.55) 0.90	Made Ground (brown silty sand with rare gravel, fine rootlets and rare fragments of charcoal)		
1.10	D2					'Stiff' light orange-brown mottled greenish grey silty sandy CLAY with abundant partings of fine sand and silt and rare carbonaceous material and fine rootlets - suspected desiccated soil		
1.60	D3				(1.50)			
2.00-2.45	SPT N=5		1,1/1,1,2,1					
2.00	D4							
2.30	D5				2.40			
2.50	D6				(0.20) 2.60	Soft light orange-brown mottled greenish grey clayey sandy SILT with claystone gravel. Rootlets encountered to a depth of 2.4 m		
2.80	D7				(0.30) 2.90			
3.00	D8				(0.20) 3.10	Firm light orange-brown mottled greenish grey sandy silty CLAY with abundant partings of fine sand and silt		
3.40	D9				(0.40) 3.50	Soft light orange-brown mottled greenish grey clayey sandy SILT with fine claystones		
3.60	D10				(0.20) 3.70	Firm becoming stiff brown mottled bluish grey silty sandy CLAY with abundant partings of fine sand and silt		
4.00	D11		Water strike(1) at 4.00m.					▽1
4.00-4.45	SPT N=8		1,2/2,2,2,2			Firm grey silty sandy CLAY with abundant partings of orange-brown fine sand and silt		
4.50	D12				(1.30)	Soft dark grey clayey sandy SILT		
5.00	D13				5.00	Stiff dark grey silty sandy CLAY with abundant partings of fine sand and silt		
5.20	D14				(1.00)			
5.80	D15							
6.00-6.45	SPT N=10		2,2/2,2,3,3		6.00			
						Complete at 6.00m		

Remarks
Service pit hand-dug to a depth of 1.2 m
Standpipe installed to a depth of 6.0 m
Water measured in the standpipe at a depth of 2.43 m, approximately 3 hours after installation on 15/05/2012
Groundwater was measured at a depth of 1.6 m on 30/05/2012 and 1.45 m on 20/06/2012

Scale (approx)	Logged By
1:50	HD

Figure No.
J12105.BH 1

GEA Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** 26 Wedderburn Road, Hampstead, NW3 5QG	**Number** **BH 2**
Excavation Method Open-drive sampler borehole	**Dimensions**	**Ground Level (mOD)**	**Client** Consolidated Developments Limited **Job Number** J12105
	Location	**Dates** 15/05/2012	**Engineer** Engenuiti **Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.40	D1				(0.85)	Made Ground (greyish brown clayey silty sand with roots and rootlets and occasional fragments of brick and rare charcoal)		
					0.85			
1.20	D2					'Stiff' light orange-brown mottled greenish grey silty sandy CLAY with abundant partings of fine sand and silt. Rootlets encountered to a depth of 2.0 m - suspected desiccated soil to a depth of 2.0 m		
1.60	D3				(1.45)			
2.00	D4							
					2.30			
2.50	D5				(0.50)	Soft light orange-brown mottled greenish grey clayey sandy SILT		
					2.80			
2.90	D6				(0.20)	Firm light orange-brown mottled greenish grey silty sandy CLAY with abundant partings of fine sand and silt		
					3.00			
3.10	D7				(0.30)			
					3.30	Soft light orange-brown mottled grey clayey sandy SILT with claystone gravel		
3.50	D8				(0.30)			
					3.60			
					(0.20)	Firm light orange-brown mottled greenish grey sandy silty CLAY with abundant partings of fine sand and silt		
					3.80			
4.00	D9		Water strike(1) at 4.00m.			Firm brown mottled grey sandy CLAY with abundant partings of fine sand and silt		▽1
						Soft dark grey clayey sandy SILT		
4.80	D10				(2.00)			
					5.80			
					(0.20)	Firm dark grey sandy silty CLAY with occasional partings of fine sand and silt		
6.00	D11				6.00			
						Complete at 6.00m		

Remarks
Service pit hand-dug to a depth of 1.2 m
Standpipe installed to a depth of 6.0 m
Water measured in the standpipe at a depth of 2.04 m, approximately 2 hours after installation on 15/05/2012
Groundwater measured at a depth of 2.31 m on 30/05/2012 and 2.0 m on 20/06/2012

Scale (approx)	Logged By
1:50	HD

Figure No.
J12105 .BH 2

GEA Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	Site 26 Wedderburn Road, Hampstead, NW3 5QG	Number BH 3
Excavation Method Open-drive sampler borehole	**Dimensions**	**Ground Level (mOD)**	**Client** Consolidated Developments Limited	**Job Number** J12105
	Location	**Dates** 15/05/2012	**Engineer** Engenuiti	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.40)	Made Ground (greyish brown clayey silty sand with rootlets and rare fragments of brick and charcoal)		
0.30	D1				0.40			
0.60	D2				(0.50)	Made Ground (greyish sandy clay with brick and rootlets)		
1.00	D3				0.90			
					(0.90)	Made Ground (brown mottled orange-brown clayey sand with rootlets, occasional gravel and fragments of charcoal and brick)		
1.50	D4							
1.90	D5				1.80			
2.30	D6				(0.70)	'Stiff' light orange-brown mottled greenish grey silty sandy CLAY with rootlets and rare carbonaceous material - suspected desiccated soil		
2.70	D7				2.50			
3.00	D8				(1.20)	'Stiff' light orange-brown mottled greenish grey sandy CLAY with abundant partings of fine sand and silt with rootlets - suspected desiccated soil		
3.50	D9							
3.75	D10				3.70			
4.00	D11				(0.10)	Soft light orange-brown mottled grey clayey sandy SILT with rootlets		
4.50	D12				3.80			
					(1.00)	Firm light orange-brown mottled greenish grey sandy CLAY with abundant partings of fine sand and silt. Rootlets encountered to a depth of 4.0 m		
5.00	D13				4.80			
5.50	D14				(1.20)	Firm dark grey silty sandy CLAY with abundant partings of fine sand and silt		
6.00	D15				6.00			
						Complete at 6.00m		

Remarks
Groundwater not encountered during drilling
Standpipe installed to a depth of 6.0 m
The standpipe was recorded to be dry, appoximately 30 minutes after installation on 15/05/2012
Groundwater measured at a depth of 2.8 m on 30/05/2012 and 2.8 m on 20/06/2012

Scale (approx)	Logged By
1:50	HD

Figure No.
J12105 .BH 3

GEA Geotechnical & Environmental Associates

Tyttenhanger House
Coursers Road
St Albans
AL4 0PG

Standard Penetration Test Results

Site : 26 Wedderburn Road, Hampstead, NW3 5QG

Client : Consolidated Developments Limited

Engineer: Engenuiti

Job Number J12105

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		
BH 1	2.00	2.15	2.45	SPT	1	1	1	1	2	1	N=5	
BH 1	4.00	4.15	4.45	SPT	1	2	2	2	2	2	N=8	
BH 1	6.00	6.15	6.45	SPT	2	2	2	2	3	3	N=10	

Project Name:	26 Wedderburn Road, Hampstead, NW3 5QG	**Samples Received:**	18/05/2012
		Project Started:	25/05/2012
Client:	GEA	**Testing Started:**	12/06/2012
Project No:	J12105 **Our job/report no:** 12788	**Date Reported:**	13/06/2012

K4 SOILS

Borehole No:	Sample No:	Depth (m)	Description	Moisture content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 0.425 mm (%)	Remarks
BH1	D2	1.10	Orange brown and grey mottled slightly silty sandy CLAY with scattered rootlets	27	54	23	31	100	
BH1	D3	1.60	Orange brown and grey slightly sandy silty CLAY	26					
BH1	D5	2.30	Orange brown and grey slightly sandy silty CLAY	31					
BH1	D7	2.80	Orange brown and grey mottled silty sandy CLAY	28	51	30	21	100	
BH1	D9	3.40	Orange brown and grey mottled silty sandy CLAY with scattered rootlets	27					

UKAS TESTING 2519

Summary of Test Results

BS 1377 : Part 2 : Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method.

BS 1377 : Part 2 : Clause 5 : 1990 Determination of the plastic limit and plasticity index.

BS 1377 : Part 2 : Clause 3.2 : 1990 Determination of the moisture content by the oven-drying method.

Checked and Approved

Initials: K.P

Date: 13/06/2012

Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU

Test Results relate only to the sample numbers shown above. Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

Project Name:	26 Wedderburn Road, Hampstead, NW3 5QG		
Client:	GEA	Project no:	J12105
		Our job no:	12788

K4 SOILS

Borehole No:	Sample No:	Depth m	Description	pH	Sulphate content (g/l)
BH1	D3	1.60	Orange brown and grey slightly sandy silty CLAY	7.6	0.14
BH3	D2	0.60	Dark brown and brown slightly gravelly sandy CLAY with occasional fm brick and ash fragments (gravel is fmc and sub-angular to angular)	8.0	0.08

Date 13/06/2012

Summary of Test Results

BS 1377 : Part 3 :Clause 5 : 1990

Determination of sulphate content of soil and ground water : gravimetric method

Checked and Approved

Initials : kp

Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU

GEA Geotechnical & Environmental Associates
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Borehole Soakage Test

Site	26 Wedderburn Road, Hampstead, NW3
Client	Consolidated Developments Ltd
Engineer	Engenuity

Job Number: J12105
Sheet: 1

Borehole No: 1
Test No: 1

Date: 20 June 2012

Test Data

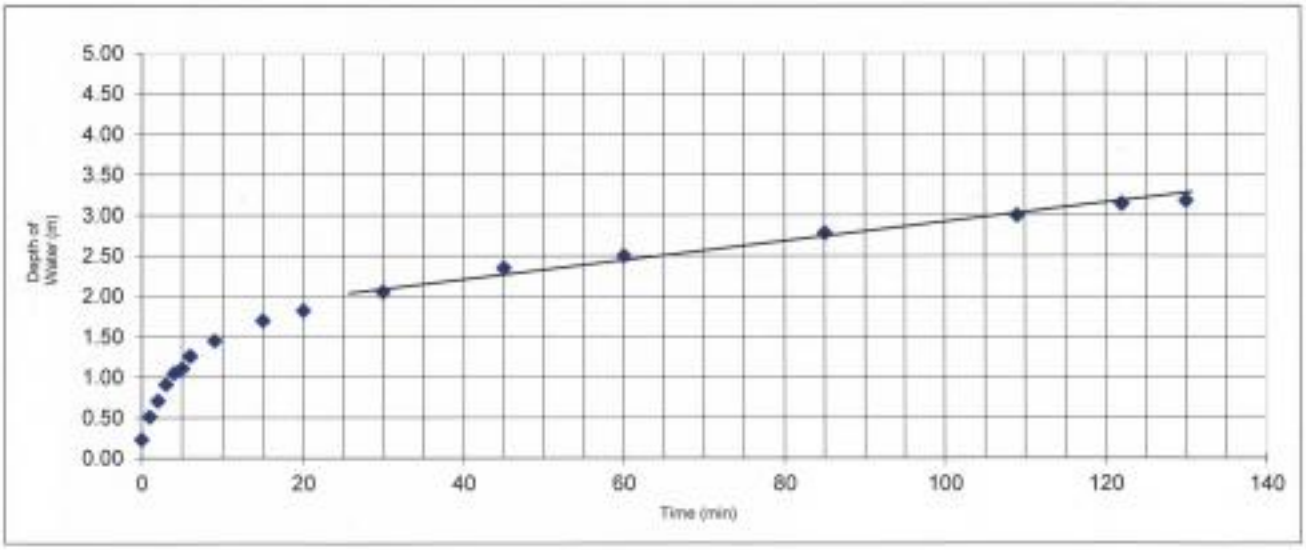
	Start of test:	End of test:
Borehole depth (m):	5.60	5.60
Casing depth (m):	0.00	0.00
Water level (m):	5.37	2.42

Time (mins)	Depth to Water (m)	Depth of Water (m)
0	5.37	0.23
1	5.09	0.51
2	4.89	0.71
3	4.69	0.91
4	4.55	1.05
5	4.49	1.11
6	4.34	1.26
9	4.15	1.45
15	3.90	1.70
20	3.78	1.82
30	3.55	2.05
45	3.25	2.35
60	3.10	2.50
85	2.82	2.78
109	2.60	3.00
122	2.46	3.14
130	2.42	3.18

Soakage Calculation

Borehole Diameter (m)		0.100
Borehole Area (m^2)		0.008
Borehole Perimeter (m)		0.314
From Plot:	D1 (m)	2.00
	D2 (m)	2.60
	T1 (min)	30
	T2 (min)	90
Soakage Volume (m^3)		-0.005
Soakage Area (m^2)		0.730
Time (min)		60

Soakage rate (m/sec)	-1.79E-06
Soakage rate (m/day)	-0.15



REMARKS

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Borehole Soakage Test

Site	26 Wedderburn Road, Hampstead, NW3	Job Number	J12105
Client	Consolidated Developments Ltd	Sheet	1
Engineer	Engenuiti		

Borehole No: 2
Test No: 1

Date: 20 June 2012

Test Data

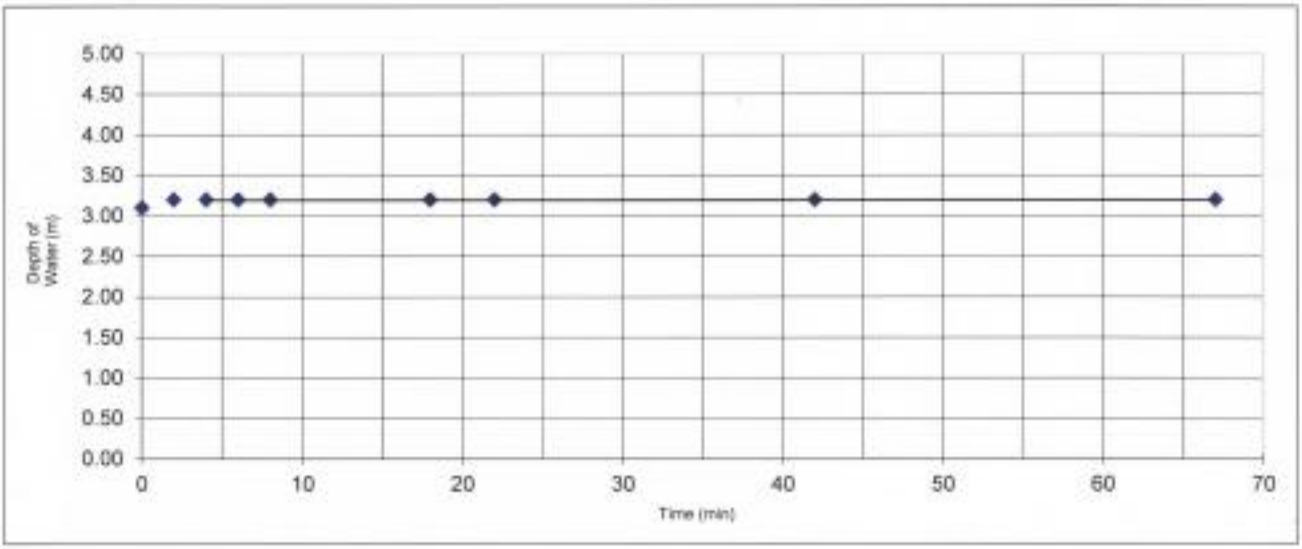
	Start of test:	End of test:
Borehole depth (m):	5.50	5.50
Casing depth (m):	0.00	0.00
Water level (m):	2.40	2.30

Time (mins)	Depth to Water (m)	Depth of Water (m)
0	2.40	3.10
2	2.30	3.20
4	2.30	3.20
6	2.30	3.20
8	2.30	3.20
18	2.30	3.20
22	2.30	3.20
42	2.30	3.20
67	2.30	3.20

Soakage Calculation

Borehole Diameter (m)		0.100
Borehole Area (m^2)		0.008
Borehole Perimeter (m)		0.314
From Plot:	D1 (m)	3.20
	D2 (m)	3.20
	T1 (min)	15
	T2 (min)	45
Soakage Volume (m^3)		0.000
Soakage Area (m^2)		1.013
Time (min)		30

Soakage rate (m/sec)
Soakage rate (m/day)



REMARKS

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Borehole Soakage Test

Site	26 Wedderburn Road, Hampstead, NW3	**Job Number**	J12106
Client	Consolidated Developments Ltd	**Sheet**	1
Engineer	Engenuiti		

Borehole No: 3
Test No: 1

Date: 20 June 2012

Test Data

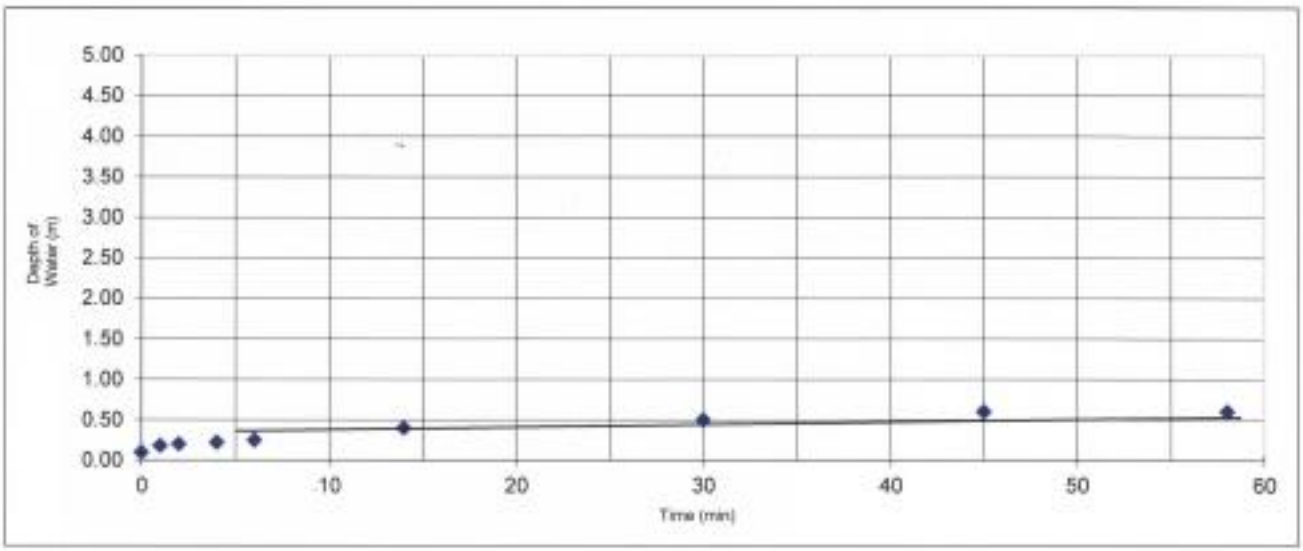
	Start of test:	End of test:
Borehole depth (m):	5.80	5.80
Casing depth (m):	0.00	0.00
Water level (m):	5.70	5.20

Time (mins)	Depth to Water (m)	Depth of Water (m)
0	5.70	0.10
1	5.62	0.18
2	5.60	0.20
4	5.58	0.22
6	5.55	0.25
14	5.40	0.40
30	5.30	0.50
45	5.20	0.60
58	5.20	0.60

Soakage Calculation

Borehole Diameter (m)		0.100
Borehole Area (m^2)		0.008
Borehole Perimeter (m)		0.314
From Plot:	D1 (m)	0.40
	D2 (m)	0.50
	T1 (min)	15
	T2 (min)	45
Soakage Volume (m^3)		-0.001
Soakage Area (m^2)		0.149
Time (min)		30

Soakage rate (m/sec)	-2.92E-06
Soakage rate (m/day)	-0.25



REMARKS

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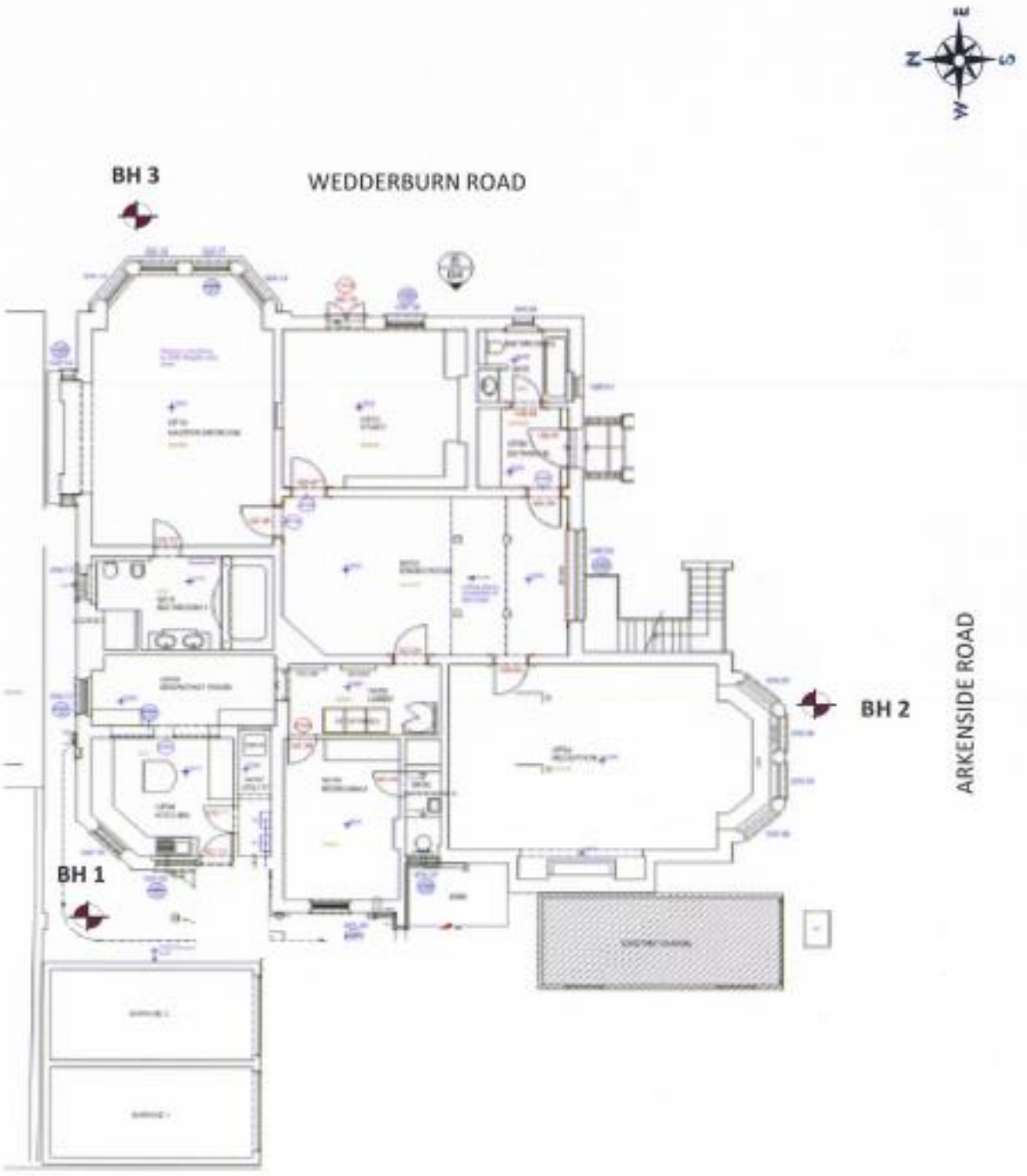
Site Plan

Site	26 Wedderburn Road, Hampstead, NW3 5QG
Client	Consolidated Developments Limited
Engineer	Engenuiti

Job Number J12105

Sheet 1 / 1



NOTE: NOT TO SCALE

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

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where information can be found
on all of the services that we offer.

GEA Geotechnical & Environmental Associates

Clive Fussell

From: Hannah Dashfield [Hannah@gea-ltd.co.uk]
Sent: 09 August 2012 14:41
To: Clive Fussell
Subject: Wedderburn Road - Groundwater monitoring results

Clive,

My colleague Louise carried out the groundwater monitoring yesterday and the results are shown below;

BH1: 1.7 m

BH2: 2.75 m

BH3: 2.9 m

All depths are relative to ground level at each location.

Please do not hesitate to contact us if you have any further questions.

Kind Regards,

Hannah

Hannah Dashfield BEng (Hons), FGS
Geotechnical Engineer

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