LISTERS
Geotechnical Consultants

Ground Investigation

The Garden House
Vale Of Health
Hampstead
LONDON
NW3 1AN

Report No: 05-08-011
September 2005

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Description	Legend	Depth	Water Level	Description		Tests		Field Observations
				Type	Depth	Type	Depth	
Double layer slate DPC Concrete slabs Render on brickwork Sand/ cement gully		GL						
Concrete		100						
Orange brown/ grey silty sand and orange brown/ grey silty sandy CLAY with roots				D1	U/S (1470)			
		1700 END						

1470
1200
270

Sample test key:
D – Disturbed sample
U – Undisturbed sample
B – Bulk disturbed sample
W – Water sample
M – Mackintosh
Pen – Penetrometer
V – Vane

Remarks

Trial hole dry

Project
GARDEN HOUSE
HAMPSTEAD HEATH
LONDON
NW3 1AN

Title
TRIAL HOLE 06

This drawing is to be read in conjunction with all other Engineer's drawings and all other project information. Any discrepancy between the Engineer's drawings and other project information is to be reported to the Engineer immediately

Client
MR A VLACHOS

Scale 1:20 @ A4 | Drawn C. SMITH | Date MAR 2012 | Logged By M. BIGGS | Checked | Approved

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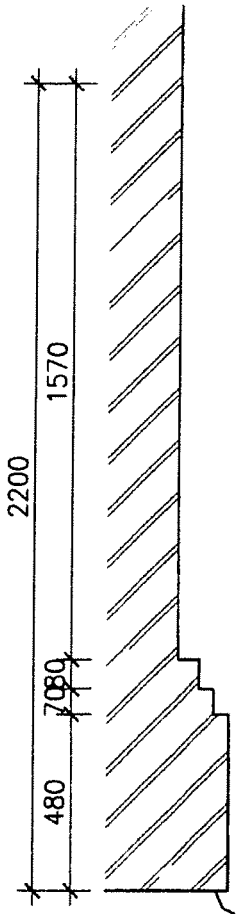
Borehole/Trial Hole Log No
34891/1/TH06

Drawing Status
☒ INFORMATION ☐ APPROVAL ☐ COSTING
☐ TENDER ☐ CONSTRUCTION ☐ AS CONSTRUCTED

DO NOT SCALE

Description	Legend	Depth	Water Level	Description		Tests		Field Observations
				Type	Depth	Type	Depth	
		GL						
MADE GROUND (Loose very dark brown silty sandy Topsoil with pieces of brick, flower pot and mortar lumps with roots)		700						
Fine brown/ grey slightly sandy clayey SILT		2000		D1	U/S (2200)			
Orange brown/ grey slightly sandy clayey SILT Becoming more clayey		2600 END						



Sample test key:
D – Disturbed sample
U – Undisturbed sample
B – Bulk disturbed sample
W – Water sample
M – Mackintosh
Pen – Penetrometer
V – Vane

Remarks

Trial hole extended below underside of foundations by hand auger

Trial hole dry

Project
GARDEN HOUSE
HAMPSTEAD HEATH
LONDON
NW3 1AN

Title
TRIAL HOLE 07

This drawing is to be read in conjunction with all other Engineer's drawings and all other project information. Any discrepancy between the Engineer's drawings and other project information is to be reported to the Engineer immediately.

Client
MR A VLACHOS

Scale	Drawn	Date	Logged By	Checked	Approved
1:20 @ A4	C. SMITH	MAR 2012	M. BIGGS		

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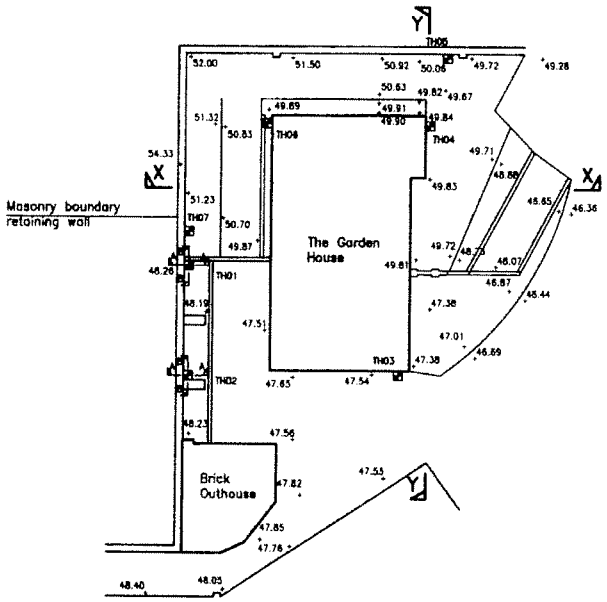
Borehole/Trial Hole Log No.
34891/I/TH07

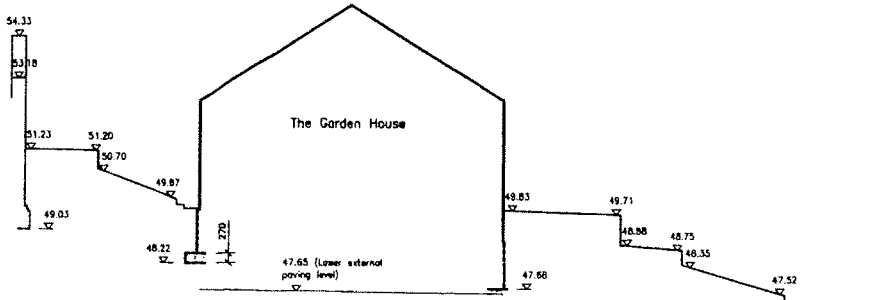
Drawing Status
☒ INFORMATION ☐ APPROVAL ☐ COSTING
☐ TENDER ☐ CONSTRUCTION ☐ AS CONSTRUCTED

DO NOT SCALE

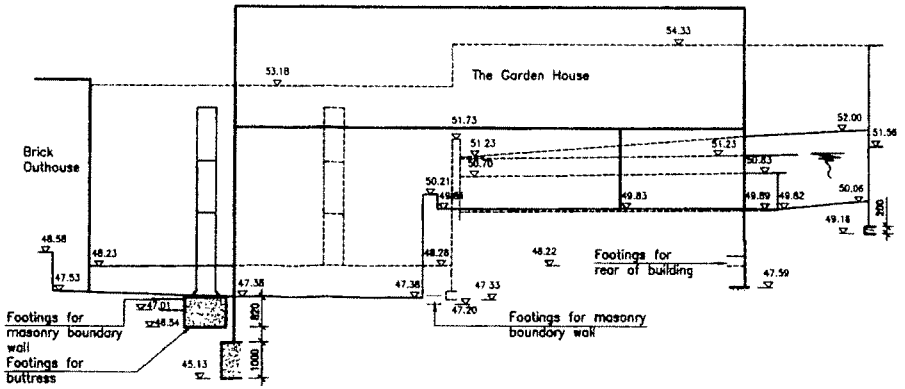
DO NOT SCALE



PARTIAL SITE LAYOUT PLAN
SCALE 1:200



CROSS SECTION X – X
SCALE 1:100



CROSS SECTION Y – Y
SCALE 1:100

Detail of masonry boundary wall shown dotted

REV	DATE	DESCRIPTION	DRAWN	CHKD

REVISIONS

This drawing is to be read in conjunction with all other Engineer's drawings and all other project information. Any discrepancy between the Engineer's drawings and other project information is to be reported to the Engineer immediately.

ISO 9001 REGISTERED

Project
THE GARDEN HOUSE
HAMPSTEAD HEATH
LONDON
NW3 1AN

Title
EXISTING PLAN AND SECTIONS

Client
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Scale	Drawn	Date
AS SHOWN @ A2	C. SMITH	MAR 2012
Job Manager	Checked	Approved
D. CLARKE		

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Drawing No. 34891/1/01

Revision

Drawing Status
- [x] INFORMATION
- [ ] APPROVAL
- [ ] COSTING
- [ ] TENDER
- [ ] CONSTRUCTION
- [ ] AS CONSTRUCTED

APPENDIX D

Reports of Listers Geotechnical Consultants, INGealtoir / RPS Design

CONTENTS

APPENDICES

Appendix 'A' - Site Work
Appendix 'B' - Laboratory Test Work
Appendix 'C' - Envirocheck Report
Appendix 'D' - Pile Design Data

SUMMARY

INTRODUCTION

A ground investigation has been undertaken at The Garden House, Vale of Health, Hampstead, London, NW3 1AN. A Site Location Plan is provided in Appendix A. The Ordnance Survey National Grid reference for the centre of the site is 526530, 186430.

The scope of the investigation was to undertake a desk study and walkover survey, provide an assessment of the geotechnical engineering properties of the ground and the extent of any soil contamination on the site and undertake a contaminated land risk assessment based on the Contaminated Land Exposure Assessment (CLEA) and Environment Agency R&D P20 guidelines.

Verbal instructions to undertake the investigation were received from the Clients Agent (INGealtóir).

To our knowledge the site has not been subject to a previous investigation.

SITE INFORMATION AND WALKOVER SURVEY

The site is accessed via a small covered alleyway between two residential terraced houses in the Vale of Health, Hampstead. Once opened out the site is an irregular shape with maximum dimensions of 35 metres east to west and 25 metres north to south, having an approximate area of 1000m^2.

The site slopes from west to east, towards one of the Hampstead Heath Ponds, which marks the eastern boundary of the site. The other boundaries of the site are all marked by residential housing and private gardens.

On the site itself, a brick built residential house occupies the eastern half and a heavily overgrown garden covers the rest of the site. Levels across the site vary greatly and are retained by a number of small brick walls and the house. The house is fed by mains electricity, gas and water, and there are no fuel storage tanks at the site.

In the southwest corner of the main site is a small wooden shed, currently being used for storing garden equipment and bicycles. Also in this corner, prior to carrying out the works was a small spring, that appeared to be constantly flowing

GEOLOGY

Published Geology

Reference to published geological information on the area indicates that strata of the Claygate Member of the London Clay Formation underlie the site.

This is described in the published geological memoir as 'a finely interbedded and finely laminated sequence of clay, silt and fine grained sand with numerous interbeds of planar and lenticular bedded fine-grained, finely laminated sands up to 1 metre thick'.

PROPOSALS

It is proposed to demolish the existing building and redevelop the site to accommodate a detached residential steel framed building with a 6m deep basement.

DESK STUDY AND BACKGROUND INFORMATION

General

A desk study review of the site and its history has been undertaken to establish the former land usage and the potential for any historically derived sources of chemical contamination. A copy of the desk study information is presented in Appendix C of this report.

It should be noted that the information provided in the desk study is obtained from independent third party sources. It is provided in good faith, but no guarantee can be provided as to its accuracy. The desk study information is not necessarily exhaustive and further information relevant to the site may be available from other sources. The Client should make independent enquiries on information provided in the desk study information that may impact on the proposed development.

The desk study comprises a review of the following consultations and information sources:-

1. Environment Agency (EA)
2. English Nature
3. National Radon Protection Board (NRPB)
4. Centre for Ecology & Hydrology
5. British Geological Survey (BGS)
6. Contemporary Trade Directories
7. Historical Ordnance Survey maps

Information from the above referenced sources has been utilised to develop a conceptual model of the site for use in the geotechnical appraisal and source-pathway-receptor risk assessment.

History of the Site

The history of the site has been established by reviewing the historical Ordnance Survey maps of the area, collected as part of the desk study information. This has established the following:-

1873-79

It can be seen at this time that the site is located within the Vale of Health, which is an area of marsh land to the north of Hampstead. The layout of the area is similar to the modern day layout, at this time, with terraced buildings to the west and north of the site area and the Heath and ponds to the east and south. The site is covered with 'Grottoes', which were small wooden enclosures designed for recreational purposes.

1896

Further construction has occurred to the southwest of the site, but the site area still remains undeveloped.

1951-54

The site area and its immediate environs remain unchanged until between 1896 and 1951. However, between 1951 and 1954, the house seen during the fieldwork appears to have been constructed on site.

1999

No significant change is seen between 1954 and 1999 to the site area or its immediate environs.

Internet Research

Information about the site and immediate area were gained from 'www.british-history.ac.uk', it revealed the following:-

Inhabited from 1714 by a harness maker, Samuel Hatch, the area largely consisted of a low marshy boggy area within the Hampstead Heath called Gangmoor. The first recorded inhabitant of the area lead to its first name, 'Hatchett's Bottom'.

In 1777 the Hampstead Water Company carried out extensive works to the area, enlarging several ponds and generally draining the area. Around this time the site and immediate area were used for the construction of several almshouses and the main industry in the area was laundry, with the largest collection of wash posts in the area.

Around the turn of the century the area began to become more developed and was first recorded as the 'Vale of Health' in 1801. The name being changed by a builder, John Rudd, who had built several

villas on the site. Property development continued and by approximately 1850-1860 the layout of the Vale was broadly similar to its layout today.

Surface Water

The nearest surface watercourse is the Hampstead pond that forms the eastern boundary of the site. There is no River Quality Designation for this water course.

There are no current surface water abstraction licenses located within 1000m of the site.

Hydrogeology

Information obtained from the Environment Agency indicates that the site is located on a Minor Aquifer (Claygate Member).

There are no current groundwater abstraction licenses located within 1000m of the site.

The site does not appear to lie within a Source Protection Zone.

There have been no recorded pollution incidents to controlled waters within 500m of the site.

Landfill, Waste Treatment and Industrial Usage Sites

Reference to records from the B.G.S, The Environment Agency and the local authority indicates that there are no waste transfer, landfill or scrapyard site within 2000 metres from the site area.

There have been no applications for Integrated Pollution Control Licenses within 2000m of the site.

There are no trade directory entries that have been found within 500 metres of the site.

Potentially Sensitive Land Uses

There is a Site of Special Scientific Interest between 500 metres and 1000 metres of the site. It is considered unlikely that this will effect the proposed work.

Radon Gas

Reference to information obtained from the NRPB indicates that the site lies within an area where <1% of homes exceed the domestic trigger level of 200 Bq/m^3. The BGS recommends that radon protection measures are not necessary.

Conceptual Model

A preliminary risk assessment has been carried out using the source-pathway-receptor principle. As such, potential sources of contamination and potential receptors have been assessed using the Contaminated Land Exposure Assessment (CLEA) Guidelines. The fact that a pathway must exist between a potential source and potential receptor for there to be a risk, has been taken into account

The results of the desk study and walkover indicate that there are no potential point sources of contamination on the site and there does not appear to have been any in the past. As such, there is unlikely to be a significant pollutant linkage. However, Made Ground is likely to occur on the site and this should be tested as it may contain contaminants, given the long human history of the site.

EXPLORATION AND TESTING

General

A total of nine exploratory holes were formed at the site, inclusive of two cable percussion boreholes using a cut down drilling rig and seven hand auger boreholes between the 30th August and 28th September 2005.

Sampling Strategy

The positions of the exploratory holes were selected by Listers Geotechnical Consultants to provide a wide coverage of information on the site area itself. As the desk study and walkover survey had not indicated any point sources of potential contamination the exploratory holes were non-targeted and spread across the site to provide the maximum geotechnical and geoenvironmental information. The position of all exploratory holes undertaken at the site as part of this investigation can be seen on the Exploratory Hole Location Plan included in Appendix A.

Methodology

Boreholes BH 1 to 2 were drilled utilising a modular cut-down cable percussion rig, at a diameter of 150mm, to a maximum depth of 12.50m bgl. Metal casing was extended to a maximum depth of 12.00m bgl, to avoid the collapse of the loose deposits within the boreholes. Disturbed samples were collected at regular intervals throughout the borehole for future laboratory inspection and testing. Standard Penetration Tests and undisturbed tube samples were taken at one metre intervals down to the base of the hole. The boreholes were unable to be extended below 12.50m due to the presence of groundwater at depth necessitating installation of additional casing.

On completion of the boring, both boreholes were utilised for the installation of a 50mm diameter slotted uPVC standpipe from six metres below ground borehole to within 2.0m bgl. From 2.0m bgl to ground a plain pipe was added. The slotted section of the standpipe was surrounded with pea gravel, while expansive bentonite clay was added round the plain pipe and below the slotted section to seal the borehole. The standpipe was finished with a stopcock cover that was then concreted flush with ground level.

Hand Augers 1 to 5 were put down using a Dutch portable hand auger to a maximum depth of 1.20m below existing ground level. The 55mm diameter auger was rotated and pushed down into the soil by means of a T-handle to obtain selected disturbed soil samples at regular intervals.

Engineering conclusions given in this report are based on data obtained from these sources but it should be noted that variations, which affect these conclusions, may occur between and beyond the test locations. Also water levels may vary with time.

GROUND CONDITIONS

The site and laboratory test work reveals that the general succession of strata can be represented by Made Ground or and Alluvium overlying strata of the Claygate Member. It may be summarised as follows:

Made Ground - encountered in BH's 1 and 2 from ground level to depth of between 0.10m bgl and 1.00m bgl. It consisted of concrete over brick cobbles near the existing house and dark brown Topsoil over soft brown clay with brick fragments in the garden area.

Alluvium - strata considered to be Alluvium was encountered from beneath the Made Ground in each borehole to depths ranging from 3.00m to 3.20m bgl. It is considered that these deposits are residues of marshy deposits that existed in the area prior to the area being drained by the Water Company in 1777. The strata consisted of very soft to firm brown very fine sandy clay with a localised fetid odour

Classification tests on selected samples reveal moisture contents range from 30 to 36 percent, while the liquid limit of the material ranged from 31 to 32%. The liquid limit is the moisture content at which a plastic soil starts behaving like a liquid. As can be seen the majority of samples in this case were above the liquid limit and hence extremely weak.

One undrained triaxial compression test undertaken on an undisturbed sample revealed a shear strength of 18kN/m^2.

Loss on ignition tests revealed an organic content of approximately 4%.

Claygate Member - encountered in both cable percussion boreholes from beneath the Alluvial Deposits and to the full depth of the investigation at 12.50m. It consisted of soft to firm, becoming stiff with depth, brown fine sandy clay with

many thin beds of fine sand and clayey silt. Groundwater was associated with these sand beds.

Classification tests on selected samples reveal moisture contents range from 24 to 36 percent, while the liquid limit of the material ranged from 31 to 55%. The liquid limit is the moisture content at which a plastic soil starts behaving like a liquid. As can be seen, in certain beds with a higher silt content, the samples were often above the liquid limit.

Undrained triaxial compression tests undertaken on undisturbed samples reveal shear strengths range from 29kN/m^2 to 132kN/m^2.

'N' values derived from standard penetration tests in the boreholes range from 7 to 21, generally increasing with depth.

Sulphate and pH Tests

Soluble sulphate tests carried out on samples recovered from the exploratory holes recorded values ranging from 0.02g/l to 0.557g/l, in conjunction with pH values ranging from 6.4 to 7.8.

GROUNDWATER

Groundwater was encountered in both cable percussion boreholes during the fieldwork; there were two separate strikes in both boreholes. The first was recorded at 2.50m bgl in BH 1 and 2.80m bgl in BH 2, each water strike rose up to between depths of 0.40m and 0.60m in twenty minutes. The second water strike was recorded at 10.70m bgl in BH 1 and 9.60m bgl in BH 2, each water strike rose up to between 0.60m and 0.80m in twenty minutes.

Long term monitoring carried out as part of the project has revealed standing groundwater levels within boreholes of between 0.38m bgl and 0.83m bgl. This means that the groundwater is likely to be flowing in an easterly direction towards the pond and that groundwater is likely to be in direct hydraulic continuity with this surface water course.

GROUND GAS

Ground gas monitoring carried out as a part of this investigation has revealed oxygen levels of between 18.4% and 20.0% by volume, carbon dioxide levels of between 0.1% and 0.7% by volume, and methane levels less than 0.1% by volume.

GROUND CONTAMINATION

General

Four soil and two groundwater samples collected on site during this investigation were tested for a range of determinants. The suite of testing carried out on the samples was decided upon following consultation of R&D Publication CLR 8, 'Potential Contaminants for the Assessment of Land', published in March 2002 as part of the Contaminated Land Exposure Assessment (CLEA), a joint venture between the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency.

The test suite carried out on four samples included a range of metals and inorganic substances, speciated Polyaromatic Hydrocarbons (PAH), Benzene, Toluene, Ethylbenzene and Xylene (BTEX), speciated Total Petroleum Hydrocarbons (TPH), with diesel and gasoline range determination.

The soil samples were tested using a solution obtained from immersion in aqua-regia, giving 'Total' values.

The results of the tests from this investigation are included in Appendix B.

Currently in the UK, no statutory limits exist for the presence of contaminants in soils or groundwater. Therefore, below is a summary of the results of the soil samples tested compared primarily to the Soil Guideline Values (SGV's) set out in CLEA R&D Publications CLR 10 SGV 1 to 10, published in March 2002 by DEFRA and the EA.

These SGV's are baseline ground contamination standards calculated using a probabilistic 'Monte Carlo-type' exposure model, designed in conjunction with DEFRA and the EA, based on a science-based human-health risk assessment procedure. The SGV's are based on proposed final land use of the site, in this case the SGV's for 'Residential with plant uptake' have been used.

Where SGV's are not available the Scotland and Northern Ireland Forum For Environmental Research model (SNIFFER) has been used to derive site specific assessment criteria (SSAC) using data sourced from available TOX reports, published by DEFRA, The Total Petroleum Hydrocarbon Working Group (TPHWG) literature and toxicological and physical data obtained from a US EPA website (http://risk.lsd.ornl.gov/cgi-bin/tox/TOX_select?select=nrad). Where appropriate, data has been converted for use within the UK .

The site is located on a Minor aquifer, supplying base-flow to the Hampstead Ponds. Accordingly the leachate test results have been compared to the Environmental Quality Standards (EQS) as set out in the EC Dangerous Substances Directive (76/464/EEC).

Results of Total Soil Tests

Of all the determinants tested a number recorded values slightly higher than their relevant environmental standard value.

The following contaminants were recorded above their relevant environmental standard value on this site:-

Arsenic

Of the four samples tested, the values obtained ranged from <2mg/kg to 24mg/kg. The one sample with an elevated arsenic result was BH 2 @0.50m. The relevant SGV for arsenic has been set at 20mg/kg.

Lead

Of the four samples tested, the values obtained ranged from 11mg/kg to 830mg/kg. The one sample with an elevated lead result was BH 2 @0.50m. The relevant SGV for arsenic has been set at 450mg/kg.

Polyaromatic Hydrocarbons (PAH's)

Of the four samples tested, one exploratory hole (BH 2) recorded one sample from it with an elevated PAH value.

No CLEA SGV exists for Total PAH's, although two PAH's have had toxicological data published, these are Benzo(a)pyrene and Naphthalene. Using this toxicological data, published by DEFRA, in conjunction with physio-chemical data from the above mentioned sources, a Site Specific Assessment Criterion (SSAC) for Benzo[a]pyrene (the most toxic of all PAH's) of 1.5mg/kg has been established for this site, with direct soil ingestion being the pathway of concern. A SSAC for Naphthalene has been calculated at 44mg/kg. As such, an approximate SSAC for Total PAH would be in the order of 67mg/kg, based on an arithmetic calculation of the number of chemicals within the PAH suite (15 No.); the SSAC of the most toxic, B(a)P, as above plus the SSAC for Naphthalene.

Total PAH results were recorded between <2mg/kg and 88mg/kg; benzo(a)pyrene was recorded between <0.1mg/kg and 8.1mg/kg. The one sample with an elevated PAH result was BH 2 @0.50m

Results of Groundwater Tests

Of the two samples tested no determinants were encountered above their relevant EU Environmental Quality Standard.

ENVIRONMENTAL RISK ASSESSMENT

The following qualitative risk assessment has been carried out using the source-pathway-receptor principle. As such, potential sources of contamination have been assessed using the CLEA and R&D P20 Guidelines. The fact that a pathway must exist between a potential source and potential receptor for there to be a risk, has been taken into account. The potential human receptors evaluated for their individual risk are:-

1. End users of site (residents, workers)
2. Construction workers
3. Surrounding properties
4. Controlled Waters (Groundwater and Hampstead Ponds)

General

The results of the contamination testing have revealed slightly elevated levels of Lead, Arsenic and PAH's in one sample taken from cable percussion borehole BH 2, the results from the garden area and other cable percussion borehole were all below published SGV and other relevant environmental standards.

The soil from BH 2 is to be removed as part of the proposed development. Waste Acceptance Criteria Testing has been carried out and is discussed latter. As the results of the desk study and walkover survey had indicated that no potential pollution sources exist at the site and the results of the chemical laboratory testing had verified these conclusions in the garden area of the site; it is considered that there is no elevated risk to any of the above recognised human health receptors from the proposed development.

In addition, as both of the groundwater samples have indicated that the chemical concentrations within the groundwater below the site are below EU EQS's, and indeed UK Drinking Water Standards, it is considered that neither of the above recognised Controlled Water receptors are at any elevated risk.

Any finalised remedial measures will need to be approved by the relevant local authorities (Environment Agency, Environmental Health) prior to development. These should be accompanied with a copy of this report and any subsequent investigation reports.

GAS PROTECTION

On the basis of the gas monitoring results collected to date it is considered that there is no need for special precautions to protect the buildings from the ingress of methane or carbon dioxide.

Reference to BR 211 'Radon protection measures for new dwellings' indicates the site is within an area where the property is at no risk from emissions of radon. As such, no basic radon protection measures are required.

GEOTECHNICAL ENGINEERING CONCLUSIONS

GROUND CONDITIONS

The ground encountered within the cable percussion boreholes was highly saturated. Reference to the laboratory testing indicates many samples taken from the Alluvium had liquidity indices above one. This means that the moisture content of the soil was above the liquid limit; the liquid limit of a soil is the moisture content where the soil starts to behave like a liquid (as oppose to a plastic solid).

The general soil profile across the site was found to comprise a thin layer of Made Ground or Topsoil over what was described as Alluvial Deposits. These 'Alluvial Deposits' are believed to be the residual sediments left by the marshy ground drained in 1777. They consisted of very soft to firm brown sandy clay with a localised fetid odour. These strata extended to a depth of approximately 3.00m bgl.

Beneath the 'Alluvial Deposits' strata recognised as belonging to the Claygate Member, were encountered. They consisted of soft to firm and stiffer sandy clays with many beds of clayey silt and fine sand.

Two groundwater strikes were encountered in each borehole. The first was encountered at a depth of between 2.50m bgl and 2.80m bgl, rising up to 1.90m and 2.40m respectively and being sealed off at 5.80m and 5.90m bgl respectively. The second strike was encountered at between 9.60m and 10.70m bgl respectively and was not sealed off in either borehole as the casing could not be advanced deep enough with the cut down rig.

This groundwater strike information would indicate that the soil from ground level down to approximately 2.50m bgl (the first water strike) is largely cohesive, and so less permeable. Then from approximately 2.50m bgl to 5.80m bgl (where the first strike was sealed off) the ground is interpreted as being more granular, and so more permeable. From approximately 5.80m bgl down to between 9.60m and 10.70m, where no water strikes were recorded, there is another cohesive less permeable layer. Then below that to the full depth of the investigation (12.50m bgl) is another more granular, more permeable layer.

SITE EXCAVATION

Conventional hydraulic plant should be satisfactory for excavating foundation and service trenches within the material encountered.

In line with recent HSE guidelines, all excavations requiring personnel access should be adequately supported to avoid the risk of collapse. Unsupported excavations are likely to be unstable, given the high water table and presence of the granular soils at the site.

Shallow groundwater will be encountered with any excavation put down at the site and it is proposed to construct a cofferdam using hard-soft secant piles around the extent of the proposed basement. The proposed dimensions of the basement excavation are approximately 19 metres by 19 metres in plan by 6 metres deep.

FOUNDATION SOLUTIONS

Pile Foundations

Conventional shallow foundations are not considered viable at this site due to the high water table, proposed basement structure and low shear strength of the soil.

A pile design data sheet is included in the Appendix. The ultimate shaft friction has been calculated for both the Alluvial Deposits and Claygate Member strata using lower bound shear strength values and the end bearing has been calculated using the result of the triaxial test carried out within these strata. As a guide to use of the table, a 12m long, 450mm diameter, cast in situ bored pile would have a safe working load of the order of approximately 210kN. This incorporates an overall factor of safety of 2.5.

Higher loads will be possible if the London Clay is founded upon. It was not possible to drill deep enough to encountered the London Clay strata during the fieldwork, due to the poor ground conditions and limited size of the exploratory equipment possible. The Claygate Member strata are estimated to be approximately 20-30 metres deep in this area.

A specialist piling contractor should be consulted as to the efficiency and suitability of piles installed using their particular systems in these ground and site conditions, and also their environmental impact with regard to the proximity of surface water courses and residential development.

BASEMENT AND RETAINING WALL DESIGN

It is proposed to construct a double storey basement below the proposed building, with approximate dimensions of 19m x 19m x 6m in depth. At the time of writing this report it was proposed to construct a cofferdam around the basement excavation using a hard-soft secant piled wall, strutted at 2m intervals. These factors should be taken into account:-

Retaining Wall Design Parameters

For the design of both temporary and permanent retaining structures at the sides of the basement groundwater should be assumed to be at ground surface and the following design parameters should be used:-

	Made Ground and Alluvial Deposits	Claygate Member
C'	10kN/m^2	10kN/m^2
ϕ'	16°	16°
c_u	30kN/m^2	50kN/m^2
γ_b	20kN/m^3	20kN/m^3

Basement Heave

Assuming an empirically derived M_v value of 0.035m^2/MN within the London Clay, a 19m x 19m x 6m deep nominal basement volume, a bulk density of 20kN/m^3 within the Alluvial Deposits and no effect below 10m bgl, total free heave within the centre of the excavation is expected to be less than 40mm. This calculation does not take the load imposed by the proposed structure into account.

The heave is due to the release of approximately 120kN/m^2 overburden pressure derived from the soil at 6.00m bgl, from the weight of the excavated soil. Should this pressure be replaced by the weight of the proposed building, no resultant heave should take place.

'Piping' or 'Boiling'

'Boiling' of the base of an excavation only generally takes place in silts and fine sands. In this instance the base of the excavation is to be constructed within a cohesive soil of low permeability, between 5.80m and 9.60m depth, therefore boiling is unlikely to take place. A preliminary calculation has been carried out to establish the Factor of Safety against boiling of the soil at the base of the excavation. This has been calculated as 3.8 against the occurrence of boiling.

Overall Stability of Strutted Excavations

Using the equation by Bjerrum and Eide the overall factor of safety of the proposed excavation (19m x 19m x 6m) against bottom heave has been calculated at 2.7, assuming no surface surcharge; and a Factor of Safety of 1.9, assuming 50kN/m^2 surface surcharge. This is assuming an undrained shear strength of 50kN/m^2 in the soils at the base of the secant pile wall.

If an undrained shear strength of 30kN/m^2 is assumed a FoS against bottom heave of 1.625 is calculated, assuming no surface surcharge; and a Factor of Safety of 1.14, assuming 50kN/m^2 surface surcharge. The undrained shear strength within the clays at the base of the proposed pile wall have been recorded between 30kN/m^2 and 130kN/m^2, with the average figure being 60kN/m^2.

A better estimation of the surcharge loadings at the edge of the excavation should be carried out, as if bottom heave took place catastrophic settlement would take place at the edges of the excavation, affecting the existing buildings in the area.

Settlement of Adjacent Structures

When excavating a basement, loss of lateral support to the adjacent soil (along with other factors, as explained above) will lead to settlement of the ground surrounding that excavation. Significant settlement is generally assumed to take place within a line marked by a slope of 1 (horizontal) and 2 (vertical) (or 64°) from the base of the excavation. Tomlinson (2001) estimates this settlement to be in the region of 0.30% of the depth of the excavation in soft normally consolidated clays (18mm in this case). As such it is recommended that existing foundations within a zone of influence of approzimately 2.92 metres from the edge of the excavation (assuming a final basement depth of 6.00m bgl) be supported by underpinning.

It is recommended; given the sensitivity of the surrounding buildings and ground conditions; that static monitoring points are set up around the excavation to monitoring any ground movements that takes during the sitework.

Disposal of Waste Material

The excavation of a basement will produce a considerable amount of waste soil.

After July 16th 2005, the implementation of the next stage of the Landfill Directive means that landfill operators will require Waste Acceptance Criteria (WAC) testing to classify any waste. WAC testing has been carried out on two representative samples of the strata to be disposed of, collected from site. The laboratory testing results are presented in Appendix B. Analytical results relevant to the materials being disposed of should be provided to landfill operators to confirm whether it meets their license agreements and to confirm tipping costs.

Waste from the site may be classified as 'inert' waste and may therefore be deposited at an inert landfill site. This should be confirmed by the relevant landfill.

SUBSURFACE CONCRETE

With respect to BRE Special Digest 1 'Concrete in Aggressive Ground' (2005), chemical tests on selected soil samples have recorded maximum soluble sulphate concentrations ranging from 0.02g/l to 0.557g/l, total sulphate (SO_4). The pH values ranging from 6.4 to 7.8. This would correspond to a Design Sulphate Class of **DS-2**.

In terms of BRE Digest 1 'Concrete in Aggressive Ground' (2005) the former land use on the site means that it should be considered as natural land.

The groundwater beneath the site should be considered as mobile.

The chemical test results should be assessed in accord with BRE Digest 1 and appropriate action taken for any new sub-surface concrete requirements. Reference to this document indicates that these results correspond to AC-2 class (ACEC) 'Aggressive Chemical Environment for Concrete' in the ground.

REFERENCES

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3. Contaminated Land Exposure Assessment (CLEA) R&D Publication CLR 8, 'Potential Contaminants for the Assessment of Land', March 2002.
4. Contaminated Land Exposure Assessment (CLEA.) R&D Publication CLR 10. SGV 1 to 10, March 2002.
5. Transport and Road Research Laboratory, Report 1132, 'The Structural Design of Bituminous Roads'. 1984.
6. Health and Safety Executive (HSE), "Protection of Workers and the General Public during Development of Contaminated Land" HS(G) 66. HMSO London 1991.
7. Tomlinson, M.J. "Foundation Design and Construction – Seventh Edition". 2001.

LISTERS .....

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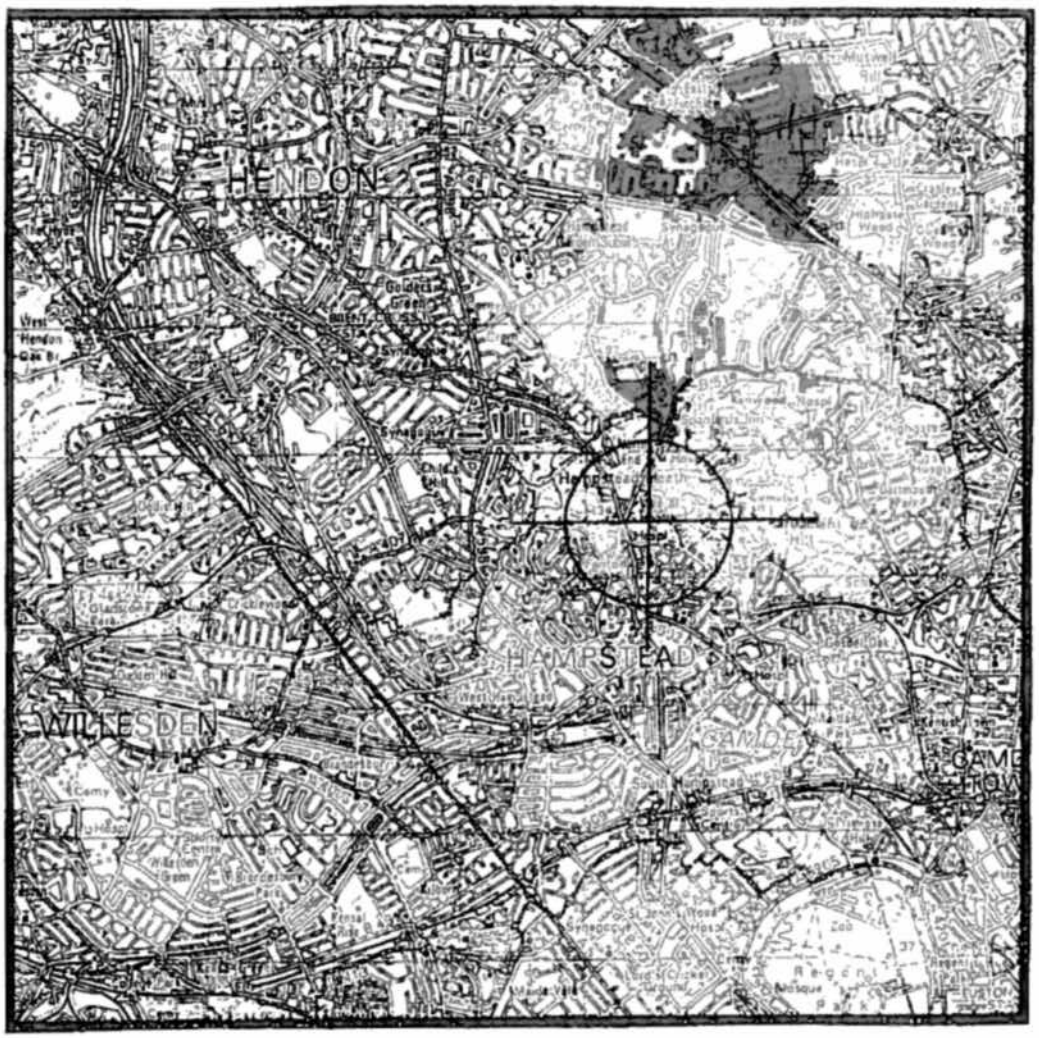
Signed.....

For and on behalf of Listers Geotechnical Consultants

APPENDIX 'A'

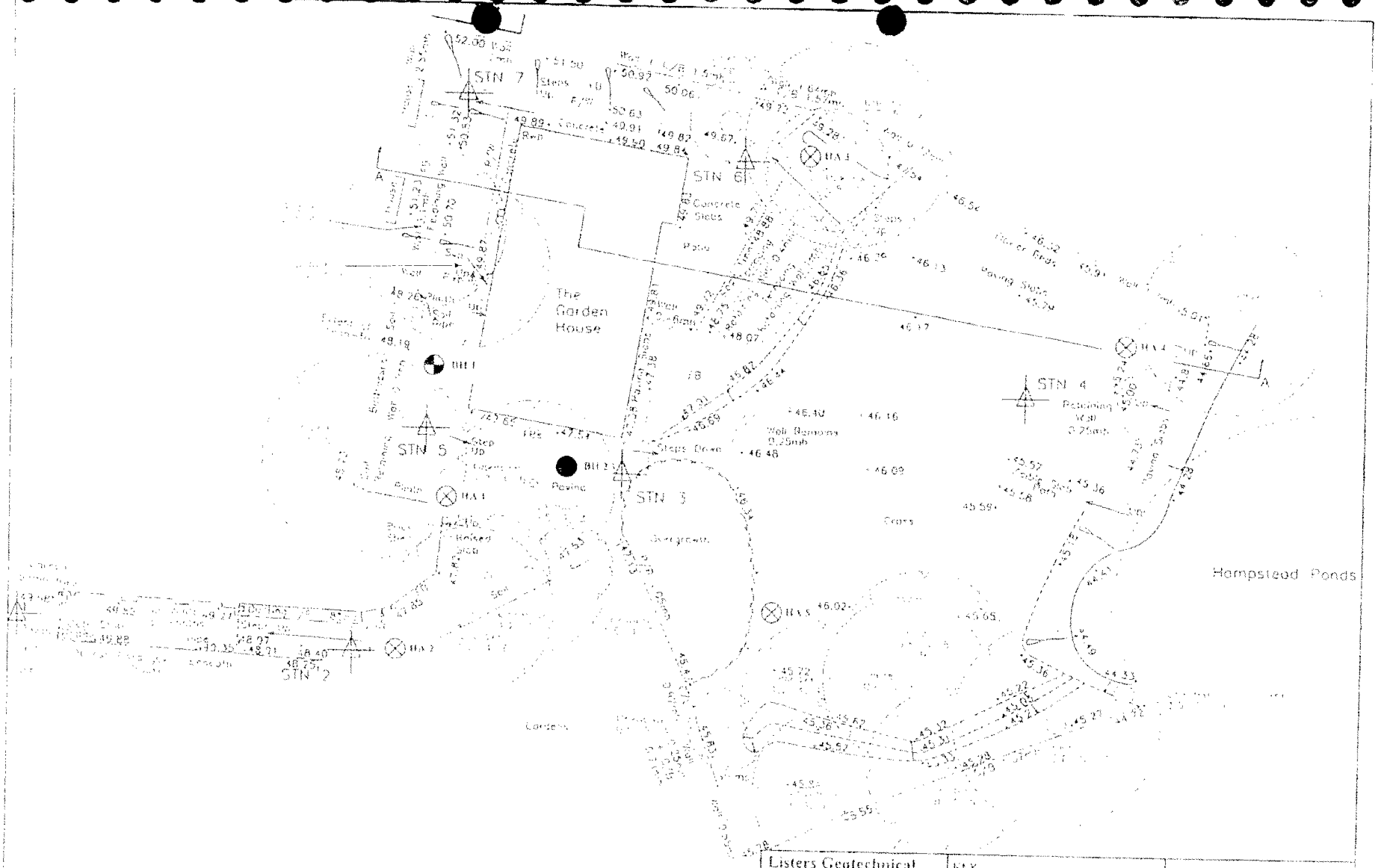
Site Work

Geotechnical *Consultants*



Scale 1:50,000

Date	SITE LOCATION MAP	Report No.
September 2005		05.08.011

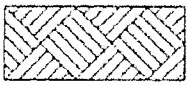

STN 7
STN 6
STN 5
STN 4
STN 3
STN 2
The Garden House
BH 1
BH 2
HA 1
HA 2
HA 3
HA 4
HA 5
Hampstead Ponds
Listers Geotechnical Consultants
KEY
Exploratory Hole Location Plan
Site: The Garden House, Vale of Health
Date: September 2005
Job Ref. No: 115.93.01
SCALE: NTS

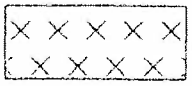
1.0 SOIL/ROCK SYMBOLS

1.1 Soils

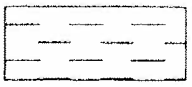

Made Ground


Sand


Topsoil


Silt


Boulders and Cobbles


Clay


Gravel

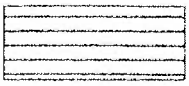

Peat

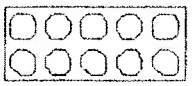
1.2 Rocks, Sedimentary


Chalk


Siltstone

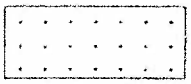

Limestone


Mudstone


Conglomerate


Breccia


Coal


Sandstone

Date	SOIL/ROCK SYMBOLS	Report No.
September 2005		05.08.011

Geotechnical [L] *Consultants*

LOCATION: The Garden House
Vale of Health, Hampstead Heath

HAND AUGER HA1
Date of Excavation: 28/09/2005

Description of Strata	Strata Change: Legend	Strata Change: Depth -m	Strata Change: Depth -m	Samples: Depth -m	Samples: Type	Insitu Test	Water Level -m
		0.00					
MADE GROUND Dark brown TOPSOIL with occasional fine to medium gravel and rootlet			0.15				
MADE GROUND Very soft light brown slightly sandy slightly silty CLAY with occasional sub-rounded angular gravel of flint and brick and occasional roots			0.50	0.50	D		
ALLUVIUM Very soft light brown slightly sandy slightly silty CLAY with occasional sub-rounded angular flint gravel and rootlet			0.60				
ALLUVIUM Very soft brown very sandy silty CLAY with many lenses of grey sand and fine to medium gravel			0.70	0.70	D		Dry
Hand auger terminated at 0.70m		1.00					

Borehole Diameter: 55mm

Remarks:
1. Method of excavation: Dutch portable hand auger.
2. Depth of visible roots: 0.60m.
3. No groundwater encountered.

▽	Water Strike
▼	Water (Standing Level)
W	Water Sample
B	Bulk Sample
D	Small Disturbed Sample
V	Vane Test
P	Penetrometer Test
M	Mexe Penetrometer
CBR	CBR Sample
UT	Under Foundations

Date
September 2005

HAND AUGER LOG

Report No.
05.08.011

Geotechnical **[L]** *Consultants*

LOCATION: The Garden House
Vale of Health, Hampstead Heath

HAND AUGER HA2
Date of Excavation: 28/09/2005

Description of Strata	Strata Change: Legend	Strata Change: Depth -m	Strata Change: Depth -m	Samples: Depth -m	Samples: Type	Insitu Test	Water Level -m
		0.00					
TOPSOIL Brown Topsoil with occasional rootlet and sub-rounded gravel			0.10				
MADE GROUND Soft brown mottled grey slightly sandy slightly silty CLAY with occasional rootlet, fine to medium gravel and red brick				0.50	D		
- at 0.60m encountered tree root			0.60				
Hand auger terminated at 0.60m							Dry
		1.00					

Borehole Diameter: 55mm

Remarks:
1. Method of excavation: Dutch portable hand auger.
2. Depth of visible roots: 0.60m.
3. No groundwater encountered.

▽	Water Strike
▼	Water (Standing Level)
W	Water Sample
B	Bulk Sample
D	Small Disturbed Sample
V	Vane Test
P	Penetrometer Test
M	Mexe Penetrometer
CBR	CBR Sample
UF	Under Foundations

Date: September 2005

HAND AUGER LOG

Report No.: 05.08.011

Geotechnical [L] *Consultants*

LOCATION: The Garden House
Vale of Health, Hampstead Heath

HAND AUGER HA3
Date of Excavation: 28/09/2005

Description of Strata	Strata Change: Legend	Strata Change: Depth -m	Strata Change: Depth -m	Samples: Depth -m	Samples: Type	Insitu Test	Water Level -m
TOPSOIL Brown Topsoil with occasional fine to medium gravel and rootlet		0.00	0.10				
MADE GROUND Very soft black/brown slightly sandy slightly silty CLAY with occasional fine to medium gravel and rootlet			0.30				
ALLUVIUM Soft brown/grey very sandy CLAY with occasional sub-rounded and angular gravel and rootlet				0.50	D		
ALLUVIUM Very soft olive grey very sandy CLAY with occasional fine to medium gravel			0.60				Dry
		1.00		1.00	D		
Hand auger terminated at 1.20m			1.20				

Borehole Diameter: 55mm

Remarks:
1. Method of excavation: Dutch portable hand auger.
2. Depth of visible roots: 0.80m
3. No groundwater encountered.

▼	Water Strike
▽	Water (Standing Level
W	Water Sample
B	Bulk Sample
D	Small Disturbed Sample
V	Vane Test
P	Penetrometer Test
M	Mexe Penetrometer
CBR	CBR Sample
UF	Under Foundations

Date
September 2005

HAND AUGER LOG

Report No
05.08.011

Geotechnical [L] *Consultants*

LOCATION: The Garden House
Vale of Health, Hampstead Heath

HAND AUGER HA4
Date of Excavation: 28/09/2005

Description of Strata	Strata Change: Legend	Strata Change: Depth -m	Strata Change: Depth -m	Samples: Depth -m	Samples: Type	Insitu Test	Water Level -m
		0.00					
TOPSOIL Brown TOPSOIL with occasional rootlet			0.05				
MADE GROUND Soft brown slightly sandy slightly silty CLAY with occasional rootlet, red brick and fine to medium gravel			0.20				
ALLUVIUM Very soft orange/brown CLAY with occasional sub-rounded and angular gravel and rootlet				0.50	D		
			0.70				Dry
ALLUVIUM Very soft grey/brown very sandy and very silty CLAY		1.00		1.00	D		
			1.10				
Hand auger terminated at 1.10m							

Borehole Diameter: 55mm

Remarks:
1. Method of excavation: Dutch portable hand auger
2. Depth of visible roots: 1.10m.
3. No groundwater encountered.

SZ	Water Strike
▼	Water (Standing Level)
W	Water Sample
B	Bulk Sample
D	Small Disturbed Sample
V	Vane Test
P	Penetrometer Test
M	Mexe Penetrometer
CBR	CBR Sample
UF	Under Foundations

Date: September 2005

HAND AUGER LOG

Report No. 05.08.011

Geotechnical [L] *Consultants*

LOCATION: The Garden House
Vale of Health, Hampstead Heath

HAND AUGER HA5
Date of Excavation: 28/09/2005

Description of Strata	Strata Change: Legend	Strata Change: Depth -m	Strata Change: Depth -m	Samples: Depth -m	Samples: Type	Insitu Test	Water Level -m
		0.00					
TOPSOIL TOPSOIL with occasional rootlet			0.10				
MADE GROUND Very soft grey/brown slightly sandy slightly silty CLAY with occasional fine to medium flint and brick gravel				0.50	D		
			0.60				
ALLUVIUM Very soft grey/brown very silty slightly sandy CLAY with occasional sub-rounded gravel							Dry
		1.00	1.00	1.00	D		
Hand auger terminated at 1.00m							

Borehole Diameter: 75mm

Remarks:
1. Method of excavation: Dutch portable hand auger.
2. Depth of visible roots: 0.10m.
3. Groundwater encountered at 0.90m.

▽	Water Strike
▼	Water (Standing Level)
W	Water Sample
B	Bulk Sample
D	Small Disturbed Sample
V	Vane Test
P	Penetrometer Test
M	Mexe Penetrometer
CBR	CBR Sample
UF	Under Foundations

Date
September 2005

HAND AUGER LOG

Report No.
05.08.011

Geotechnical [L] *Consultants*

LOCATION: The Garden House
Vale of Health, Hampstead Heath

BOREHOLE NO. BH1

Date of Boring: 30/08/2005

Description of Strata	Strata Change: Legend	Strata Change: Depth -m	Strata Change: Depth (Thickness) -m	Samples: Depth -m	Samples: Type	SPT/CPT N-Value Penetrometer	Water Level -m
MADE GROUND Concrete		0.00	0.10	0.10	D		
ALLUVIUM Very soft to soft brown very fine sandy CLAY		1.00	(2.40)	1.00 1.45	U D	(8,0)	
		2.00		2.00	U	(10)	▼
			2.50	2.45 2.50	D D		▽
ALLUVIUM Loose brown clayey SAND - groundwater entry at 2.50m, sealed at 5.80m		3.00	3.00	3.00 3.45	B D	7	
CLAYGATE MEMBER Soft to firm laminated brown fine sandy CLAY with ma thin beds of fine sand and clayey silt		4.00		4.00 4.45	B D	10	
		5.00		5.00 5.45	B D	12	
		6.00		6.00 6.45	U D	(35)	
		7.00		7.00 7.45	U D	(35)	
		8.00	(9.50)	8.00 8.35	U D	(50)	
		9.00		9.00 9.45	U D	(50)	
- firm by 10.00m		10.00		10.00 10.45	U D	(50)	▼
- groundwater entry at 10.70m, not sealed		11.00		11.00 11.45	B D	21	▽
		12.00				18	
End of borehole at 12.50 m			12.50	12.45	D		

Borehole Diameter: 150mm **Ground Level:** 0.00m

Lining Tubes: to 11.00m **Instrumentation:** Standpipe installed to 6.00m

Chiselling:

Remarks:
1. Method of excavation: Cable percussion.
2. Groundwater struck at 2.50m rising to 1.90m in 15 mins and again at 10.70m rising to 9.50m in 15 mins.
3. Hand dug service pit

▽ Water Strike
▼ Water (Standing Level)
W Water Sample
B/J Bulk/Jar Sample
SPT Standard Penetration Test
CPT Cone Penetration Test
* Extrapolated value
U Undisturbed sample
D Small disturbed sample
P Penetrometer Test

No. of blows shown in brackets

Date	BOREHOLE LOG	Report No.
September 2005		05.08.011

Geotechnical Consultants

LOCATION: The Garden House
Vale of Health, Hampstead Heath

BOREHOLE NO. BH2

Date of Boring: 02/09/2005

Description of Strata	Strata Change: Legend	Strata Change: Depth -m	Strata Change: Depth (Thickness) -m	Samples: Depth -m	Samples: Type	SPT/CPT N-Value (Penetrometer)	Water Level -m
MADE GROUND Concrete		0.00	0.05	0.05	B		
MADE GROUND Brick COBBLES		1.00	1.00	1.00	B	9	
				1.45	D		
ALLUVIUM Soft to firm very wet brown very fine sandy CLAY		2.00	(2.20)	2.00	B	9	
				2.45	D		▼
- groundwater entry at 2.80m, sealed at 5.90m		3.00	3.20	3.00	B	9	▽
				3.45	D		
CLAYGATE MEMBER Firm laminated brown fine sandy CLAY with many thin beds of fine sand andclayey silt		4.00		4.00	B	11	
				4.00	B		
				4.45	D		
		5.00		5.00	B	10	
				5.45	D		
- becoming firm to stiff by 6.00m		6.00		6.00	U	(38)	
				6.45	D		
		7.00	(8.30)	7.00	U	(48)	
				7.45	D		
		8.00		8.00	U	(50)	
				8.45	D		
- becoming stiff by 9.00m		9.00		9.00	U	(50)	▼
				9.45	D		▽
- groundwater strike at 9.60m, not sealed		10.00		10.00	B	19	
				10.45	D		
		11.00		11.00	B	18	
			11.50	11.45	D		
End of borehole at 11.50 m		12.00					

Borehole Diameter: 150mm **Ground Level:** 0.00m

Lining Tubes: to 12.00m **Instrumentation:** Standpipe installed to 6.00m

Chiselling:

Remarks:
1. Method of excavation: Cable percussion.
2. Groundwater struck at 2.80m rising to 2.40m in 15 mins and again at 9.60m rising to 8.80m in 15 mins
3. Hand dug service pit.

▽ Water Strike
▼ Water (Standing Level)
W Water Sample
B/J Bulk/Jar Sample
SPT Standard Penetration Test
CPT Cone Penetration Test
* Extrapolated Value
U Undisturbed sample
D Small disturbed sample
P Penetrometer Test

No. of blows shown in brackets

Date
September 2005

BOREHOLE LOG

Report No.
05.08.011

Ingealtoir

CONSULTING STRUCTURAL ENGINEERS

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REPORT CONCERNING THE IMPLICATIONS OF THE LOCAL GEOLOGY WITH REGARD TO THE PROPOSED CONSTRUCTION OF THE HOUSE AT:
'THE GARDEN HOUSE', VALE OF HEALTH, HAMPSTEAD HEATH, LONDON NW3.

1.0 TERMS OF APPOINTMENT:

1.1 INGealtoir, Consulting Structural Engineers, were instructed by MR Alex Vlachos to prepare a report concerning the implications of the local geology on the proposed construction of a new house at 'The Garden House', Vale of Health, London NW3.

1.2 The report has been requested by London Borough Planning Department, as a condition of recommendation for statutory planning approval.

1.3 The scope of this report will consider the strategy for forming the proposed house on the site and the implications for the existing adjacent buildings, as a result of substructure works and foundation works. The report will also contain an appendix prepared by civil engineers Messers. RPS Design in respect of the effects new building on the long-term hydrology in the vicinity.

1.4 The copyright of this report is retained by INGealtoir. The report may not be assigned to a third party and may only be relied upon by the person instructing us.

2.0 GENERAL DESCRIPTION OF SITE:

2.1 The property is a backland site, approximately 1000m^2 area, accessed from the Vale of Health, Hampstead Heath, London NW3.

2.2 The general topography of the site is characterised by a slope down from west to east. The eastern border of the site is formed by one of the ponds within Hampstead Heath.

2.3 The site is currently occupied by a two-storey house, built in the 1950s.

2.4 The northwest corner of the site forms an earth bank to the adjoining properties.

2.5 A terrace of early 20th century houses, with lower ground floor levels adjoins the western side of the property. The houses are approximately 4/5m from the boundary wall. The brick wall forming the boundary is retaining approximately 1.60m of soil in the adjoining gardens.

2.6 A block of low-rise flats adjoins the northern boundary of the site.

2.7 There no building structures on the southern side of the property.

2.8 A continual flow of water has been noted running across the south entrance passage to site, suggesting a spring in this part of the site.

3.0 SUMMARY OF GEOTECHNICAL INVESTIGATIVE WORKS:

3.1 A geotechnical survey has been carried out on the site. The survey comprised a borehole investigation establishing the geological character of the subsoil and a suite of tests assessing the contaminated land risk. These tests were carried out based on the CLEA standards and Environment Agency R&D P20 guidelines.

3.2 The two deep boreholes on the site were sunk to a depth of 12.0m. The limited access to the site dictated that this was the maximum depth achievable using a stripped down modular boring rig.

3.3 Standpipes have been installed in order to monitor the levels of ground water across the site.

3.4 A report of the results of the testing, carried out by Listers Geotechnical Consultants Ltd. is appended (Appendix 3).

3.5 Desk study established that the site was an area of marshland, which was drained in the late eighteenth century.

3.6 The borehole results support this information. The top 3.0m below ground level were found to be composed up of an alluvial/organic deposit, characteristic of the residue of drained marshland.

3.7 Claygate Beds were encountered below this level and continued to the bottom of the borehole at 12.00m.

3.8 Claygate Beds are characterised by layers of water bearing sands/silts between layers of impervious clay.

3.9 The size of the sand/silt layers varies considerably across the area. The borehole results appear to suggest that a layer of sandy silt occurs roughly between 3.0 and 5.5m and again below 9.8m and 10.7m below ground level.

3.10 Water was encountered in both the sand/silt layers.

3.11 The absence of water in the intervening layer, between 5.5m and 9.7m suggests this material is substantially cohesive in character.

3.12 The geological survey indicated that the Claygate Bed deposit lies on top of the London Clay formation, which persists to 70/80m below ground level. The London Clay stratum was not encountered in the boreholes.

3.13 The contamination tests revealed slightly elevated levels of Lead, Arsenic and hydrocarbons in borehole 2. This location of this borehole is in the area of the proposed basement. The results of tests on samples retrieved from the garden area were all below published SGV and other relevant environmental criteria.

4.0 PROPOSED BASEMENT STRUCTURAL SOLUTION:

4.1 The proposed works on the site involve construction of a single-family house. The house incorporates a basement storey, which contains a 2.0m deep swimming pool. The basement is arranged on three levels.

4.2 The super structure of the house is conceived in the modernist style and is formed from a series of rectangular volumes. The design incorporates receding facades, often of an open glazed character, and a series of flat roofs.

4.3 The principal concern of the strategy for the design of the proposed basement is to ensure that the enabling works, facilitating excavation can be carried out safely with minimal risk of damage to adjacent properties.

4.4 The geotechnical report highlights that the ground conditions, which can be assumed to persist across the adjoining properties, are generally saturated. A high liquid limit has been identified in the sand/silt layers of both the alluvial made ground and the Claygate fraction. This suggests that the subsoil beneath surrounding houses would be sensitive to changes in moisture content, which could result in significant changes in the shear strength properties of the soil.

4.5 The outline report, (Appendix 2) prepared by civil engineering consultants Messers. RPS Design Ltd concludes that de-watering of the excavations in the Garden House site could result in altering the established settlement characteristics of the adjacent houses and in possible subsidence.

4.6 In order to avoid such an impasse, the most appropriate strategy for retaining the existing soil, while the area for the proposed basement is excavated, is to form an impervious, enclosed cofferdam. The cofferdam wall would be constructed using hard/soft secent piles. The continuous piled wall would be propped at the top using an RC ring beam and at an intermediate level, say between 2-3m below ground and at the base of the excavation using the permanent works raft slab.

4.7 The excavation would proceed in stages with the first stage to the 2/3m level. The second stage would be to formation level, following installation of the intermediate level of waling/propping.

4.8 The intermediate stage of propping would be formed using a horizontal lattice arrangement of proprietary of steel props and waling members.

4.9 The area of the basement would be excavated to the 6.0m formation level. Considerations of removal of over burden and subsequent heave are addressed in the conclusion section of the geotechnical report prepared by Listers GC Ltd. The maximum estimated heave derived from the release of 120kN/m^2 of overburden pressure is less than 40mm. This majority of this movement would take place in the period immediately following excavation. The effects of the long-term heave would also be ameliorated by the weight of the building.

4.10 The removal of overburden suggests that a safe bearing pressure of 120kN/m^2 could be assumed as a design parameter for the basement acting as a raft slab.

4.11 Excavation for the basement will result in removal of lateral support to the adjacent body of soil. The liquid character of the subsoil above the formation level of 6.0m suggests that there is a significant risk of settlement of foundations to neighbouring buildings within a 3.0m margin around the excavated area. It is recommended that any building structure foundations within this band are underpinned as an enabling measure.

4.12 The foundations strategy for the remainder of the house outside the curtailage of the raft would be a pile/ground beam arrangement. The piles would be bottomed at the same level as the cofferdam wall piles.

4.13 The basement structural scheme and construction sequence is shown on INGealtoir drg. 05060/sk/01 attached in Appendix 1.

5.0 CONCLUSIONS:

5.1 This report concludes that, based on the information contained in the geotechnical report and the supporting comments prepared by civil engineers, Messers. RPS Design, that the proposed construction of the new house on the site is feasible with minimal risk of damage to adjoining properties and to the long-term hydrology in the immediate vicinity.

5.2 The geotechnical survey indicates that the subsoil conditions beneath the site are made ground to 3.0m overlying Claygate Beds to 12.5m. The conditions are essentially saturated.

5.3 In order to minimise the risk of damage to adjoining houses, it is recommended that de-watering is not carried out as part of the construction process for the basement.

5.4 The recommended strategy involves the use of a watertight, enclosed cofferdam. This avoids changes in the moisture content and allows the ground water to flow around the buried construction.

5.5 Performance criteria for the design of the piles, forming the cofferdam, are presented in the geotechnical report. It is recommended however that test piles are carried out in order to confirm the results of the geotechnical testing.

5.6 If it is found that it is not possible to safely 'bottom out' the coffer dam piles in the band of cohesive material between 5.8 and 9.6m below ground level, it will be necessary for the piles to continue down to the level of the London Clay.

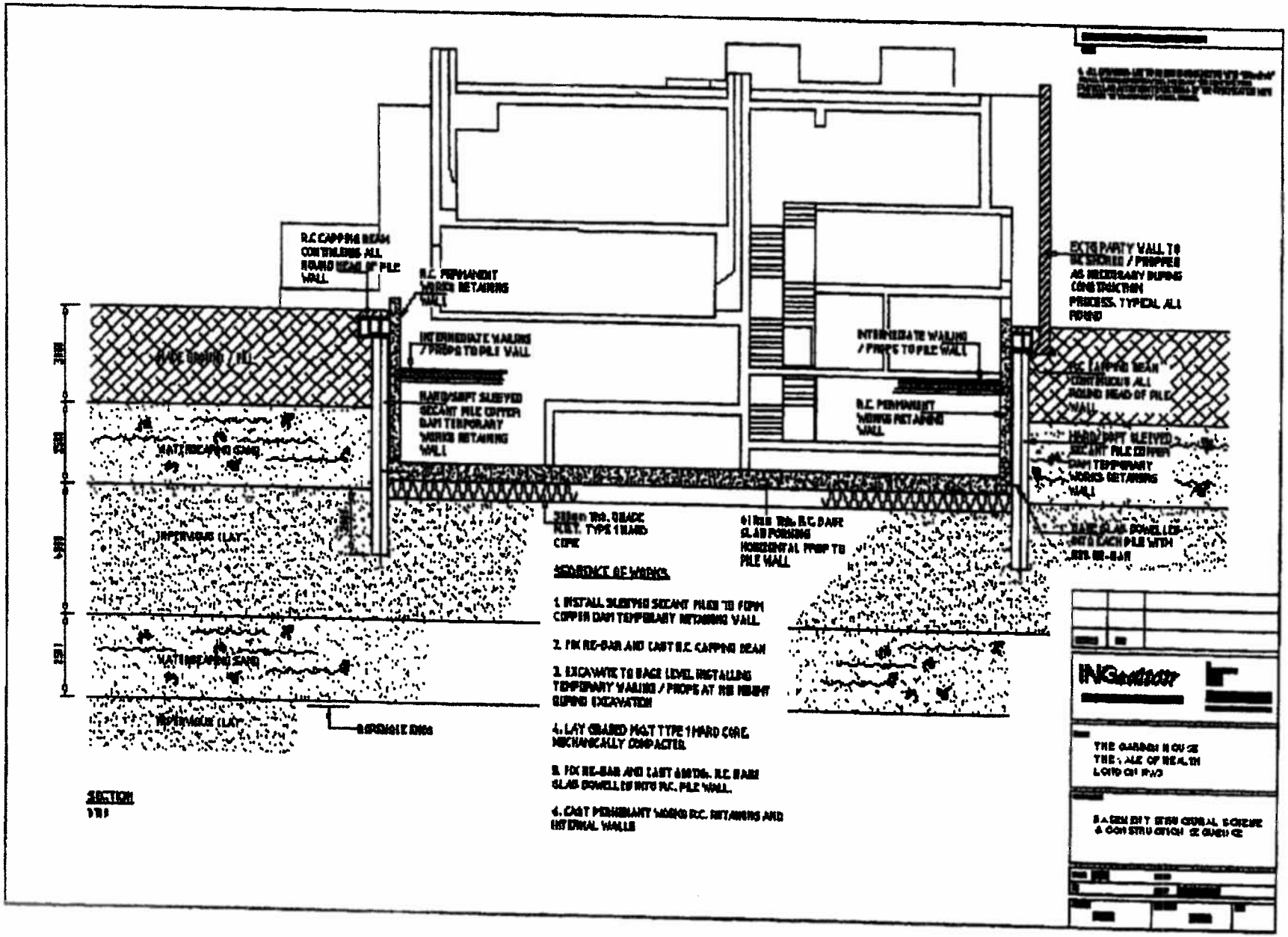
5.7 It is recommended that static monitoring points be set up around the excavation in order to monitor resulting ground movements.

David J Warren MIStructE CEng
INGealtoir

21ST October 2005.

APPENDIX 1:

Schematic Drawing Showing Basement Structural Scheme


R.C. CAPPING BEAM CONTINUOUS ALL ROUND HEAD OF PILE WALL
R.C. PERMANENT WORKS RETAINING WALL
INTERMEDIATE WALING / PROPS TO PILE WALL
HARD/SOFT SLEEVED SECANT PILE COFFER DAM TEMPORARY WORKS RETAINING WALL
EXTG PARTY WALL TO BE SECURED / PROPPED AS NECESSARY DURING CONSTRUCTION PROCESS. TYPICAL ALL ROUND
MADE GROUND (FILL)
WATER BEARING SAND
IMPERVIOUS CLAY
WATER BEARING SAND
IMPERVIOUS CLAY
BASEMENT FLOOR
SEQUENCE OF WORKS
1. INSTALL SLEEVED SECANT PILES TO FORM COFFER DAM TEMPORARY RETAINING WALL
2. FIX RE-BAR AND CAST R.C. CAPPING BEAM
3. EXCAVATE TO BASE LEVEL INSTALLING TEMPORARY WALING / PROPS AT 3m HIGH DURING EXCAVATION
4. LAY BLINDING MAT TYPE 1 HARD CORE, MECHANICALLY COMPACTED
5. FIX RE-BAR AND CAST 600Thk. R.C. RAFT SLAB DOWELLED INTO R.C. PILE WALL.
6. CAST PERMANENT WORKS R.C. RETAINING AND INTERNAL WALLS
SECTION

APPENDIX 2:

Outline report prepared by civil engineers Messers. RPS Design Ltd. concerning the effects of the proposed works on the long-term integrity of adjoining houses and the hydrology in the immediate vicinity.

RPS Design

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THE GARDEN HOUSE, VALE OF HEALTH, HEMPSTEAD HEATH, LONDON, NW3 1AN

1. Introduction

1.1 RPS Design was instructed to review the work carried out by Listers Geotechnical Consultants and the proposals set out by Ingealtóir to provide a report on the impact of the proposed new dwelling on the hydrogeology of the site itself and on the surrounding area.

2. Baseline Conditions

2.1 Reference to British Geological Survey Sheet 256 (North London) indicates that the underlying geology is the London Clay Formation. At this location the Claygate Member of the London Clay Formation - comprising silt and fine grained sand - lies on top of the London Clay itself.

2.2 The Claygate Member beneath the site extends to a depth greater than the 12m achieved by the drilling equipment accessible to the site. This comprises soft to firm and stiff sandy clays with intervening beds of clayey silt and fine sand. Two water bearing strata were identified at depths of approximately 2.5m and 10m depth. These strata are likely to extend horizontally for many metres around the site.

2.3 The Claygate Member is identified as a "minor aquifer" on the Environment Agency's Groundwater Vulnerability mapping. This is a general classification indicating an aquifer of possible local importance for agriculture or industry use. However, there are no current water abstraction licences within 1km of the site and it does not lie within an Environment Agency Source Protection Zone.

2.4 The monitoring of groundwater levels in the boreholes indicates that the flow is in an easterly direction towards the pond and that the groundwater is likely to be in continuity with this surface water feature.

3. Proposals

3.1 A basement some 19m in length and between 8m and 11m in width providing for a swimming pool, changing facilities and boiler room will be constructed to a maximum of approximately 5.5m below existing ground level.

3.2 The lowest level of excavation falls below the shallower water bearing stratum identified by the ground investigation and significantly above the lower identified stratum.

4. Impacts

4.1 The water bearing stratum at approximately 2.5m depth within the Claygate Member is taken into consideration in the design of the basement of the proposed new dwelling. Dewatering the excavation by traditional methods would raise the potential of a significant adverse impact on the surrounding properties during the construction phase - particularly Heath Villas immediately to the west of the Garden House.

4.2 It is therefore proposed to sink a secant piled coffer dam which will be founded in the impervious stratum of the Claygate Member beneath the water bearing stratum identified at a depth of approximately 2.5m. The walls of the coffer dam will prevent ingress of groundwater laterally and the impervious base will prevent the ingress of groundwater vertically. Construction phase impacts to the adjoining properties are therefore removed.

4.3 The installation of the concrete coffer dam through the groundwater will provide potential for a short term adverse impact on it from washed out cement and fine particles. However, control of the concreting process will balance the anticipated groundwater pressures to prevent this. Any washout that does occur will not impact groundwater to a distance greater than one or two metres. Overall the impact on the groundwater during the construction phase will be minor adverse and temporary.

4.4 The existing groundwater regime will be maintained by the installation of the coffer dam and groundwater flow towards the pond will not be interrupted. The impact on the groundwater, long term, is therefore negligible.

5. Conclusions

5.1 The construction of a deep basement as part of the redevelopment of the Garden House by way of providing a secant piled coffer dam will have negligible impact on the groundwater flows and quality both during the construction period and long term.

5.2 Maintenance of the existing groundwater regime provided by this proposal removes the risk of any adverse impact to adjoining properties that might have occurred had traditional dewatering techniques been proposed.

MW
21-Nov-05

APPENDIX 3:

Extract from geotechnical and contamination report prepared by Messers. Listers Geotechnical Consultants Ltd.

SEE APPENDIX

APPENDIX E

Limitations

Limitations

This report is based details of the scheme provided by the Client.

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