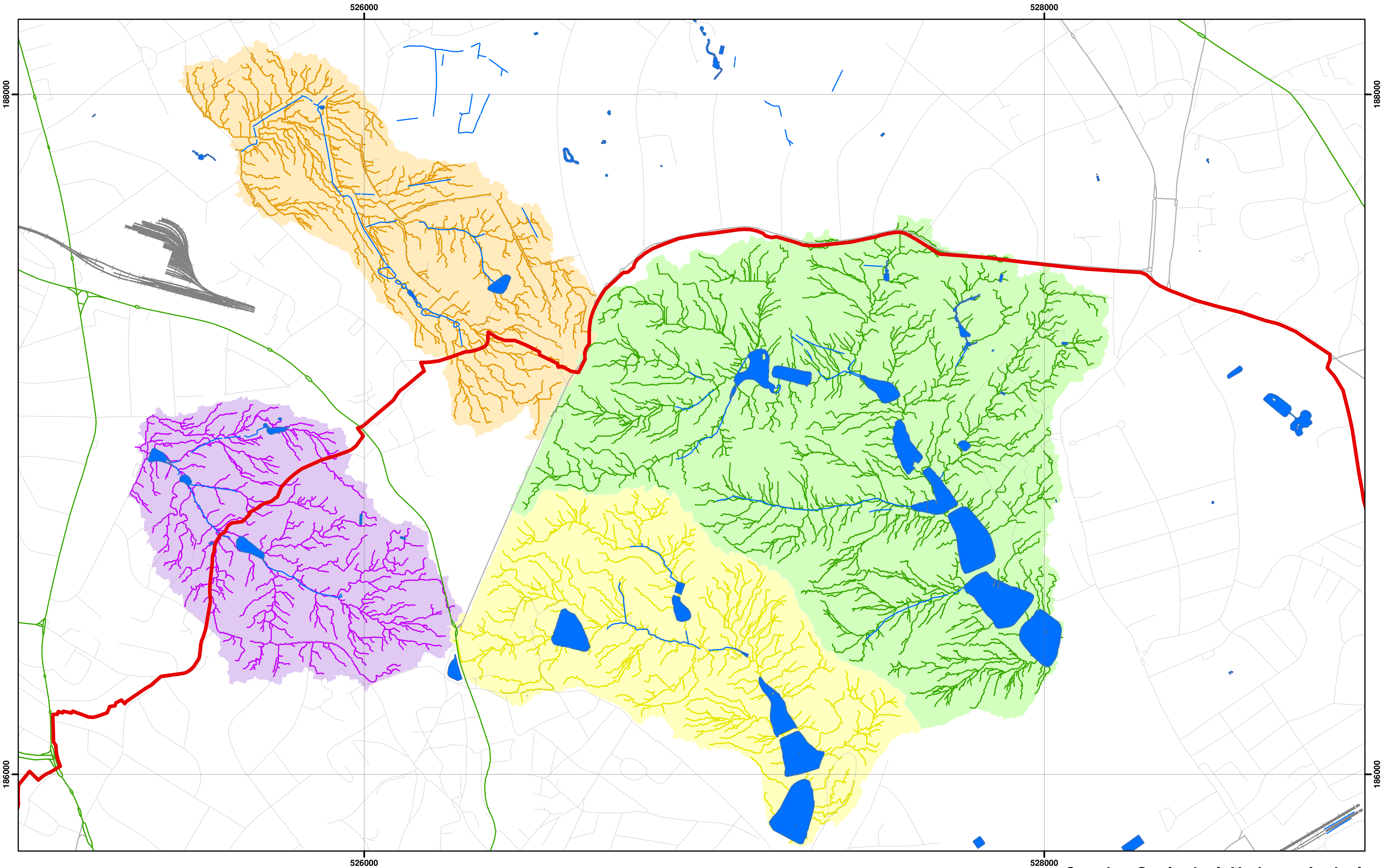


Catchments and Drainage after Haycock, 2010

N

Scale at A3: 1:10,000

0 0.125 0.25 0.5 0.75 1

Kilometers

Coordinate System:
British National Grid
GCS_OSGB_1936

Legend

- London Borough of Camden
- Railway Lines
- A Roads
- Surface Water
- Highgate Chain Catchment
- Golders Hill Chain Catchment
- Hampstead Chain Catchment
- Hampstead Heath Extension Chain Catchment

Camden Geological, Hydrogeological and Hydrological Study

Hampstead Heath Surface Water Catchments and Drainage

213923

FIGURE **14**

Consulting Structural Engineers
Consulting Civil Engineers

London • Cambridge • Norwich
1– 5 Offord St London N1 1DH
Telephone 020 7700 6666

design@conisbee.co.uk
www.conisbee.co.uk

23 DOWNSIDE CRESCENT

APPENDIX B – SITE INVESTIGATION REPORT

SEPTEMBER 2014

Desk Study and Ground Investigation Report

23 Downside Crescent
London NW6

Client Robert Callow

Engineer Heyne Tillett Steel

J13331

October 2014




Geotechnical & Environmental Associates

Document Control

Project title	23 Downside Crescent, London, NW3 2AN	**Project ref**	J13331
Report prepared by	Claire Siberry MSci FGS		
Report checked and approved for issue by	Steve Branch BSc MSc CGeol FGS FRGS MIEnvSc		

Issue No	**Status**	**Date**	**Approved for Issue**
1	Final	18 December 2013	
2	Final (Revised)	28 January 2014	
3	Final (Amended)	28 October 2014	SN

This report has been issued by the GEA office indicated below. Any enquiries regarding the report should be directed to the office indicated or to Steve Branch in our Herts office.

✓	Hertfordshire	tel 01727 824666	mail@gea-ltd.co.uk
	Nottinghamshire	tel 01509 674888	midlands@gea-ltd.co.uk

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 site investigation carried out by Geotechnical and Environmental Associates Limited (GEA) on the instructions of Heyne Tillett Steel, on behalf of Robert Callow, with respect to the proposed construction of a basement below the footprint of the main body of the house and the addition of a single-storey extension at the rear of the house. The purpose of the investigation has been to research the history of the site with respect to possible contaminative uses, 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.

DESK STUDY FINDINGS

The earliest Ordnance Survey (OS) map studied, dated 1871, shows the site to be open fields, with the beginnings of residential development of the surrounding area to the north and south, with Haverstock Hill 150 m southwest of the site. By 1896, development had spread around the site and a hospital had been built approximately 150 m to the north, although the site remained undeveloped. The 1896 map also shows several air shafts between 80 m and 290 m of the site to the north, west and northeast. By 1915, Belsize Underground Station had been built 90 m southwest of the site, and the site itself was occupied by the existing terraced house with undeveloped land immediately to the northwest. This was later developed into tennis courts by 1935, and the site and tennis courts have remained unchanged since that time, with the exception of terraced housing replacing the majority of the tennis courts 45 m north of the site by 1989. The 1954 map shows two railway tunnels, labelled as "Belsize Tunnel" and "Belsize New Tunnel" 25 m and 85 m north of the site respectively, with the tunnels associated with the air shafts shown on earlier maps. The map also shows tanks 135 m southwest of the site and associated with a nursery 80 m southwest of the site, and "deep shelters" 125 m northwest and 135 m southwest of the site. These features were still labelled on the most recent 1:2,500 OS map studied dated 1991, after which OS maps studied were of a scale too small to detail these features.

GROUND CONDITIONS

Beneath a 50 mm surface covering of gravel, made ground was encountered over London Clay, which was proved to the maximum depth investigated of 6.45 m. The made ground comprised dark brown mottled brown sandy silty clay with gravel of flint, brick, charcoal and ash clinker and occasional roots, and was found to extend to depths of between 0.20 m and 0.40 m in the boreholes, and to depths of between 0.56 m to 0.90 m in the trial pits. The London Clay comprised an initial horizon of soft brown and grey slightly gravelly to gravelly clay to depths of between 1.00 m and 2.00 m, over firm becoming stiff, locally fissured, brown mottled grey clay with occasional roots, occasional selenite crystals, and was proved to the maximum depth investigated of 6.45 m. The house construction comprises a suspended ground floor slab supported on moderate width strip foundations, bearing within the London Clay at a depth of 0.80 m.

Groundwater was not encountered during drilling of the boreholes, but subsequent monitoring of the standpipes installed to depths of 6.00 m recorded groundwater at depths of between 3.53 m and 4.95 m two and three weeks after installation in Borehole No 2, and at depths between 0.80 m and 0.88 m in Borehole No 1. Groundwater was encountered at depths of 0.60 m and 0.80 m in the two trial pits excavated in the rear garden. The contamination testing has indicated two elevated concentrations of PAH within three samples tested, and single elevated concentrations of lead and arsenic.

RECOMMENDATIONS

It should be possible to support the basement by means of spread foundations bearing within the London Clay below basement level. A net allowable bearing pressure of 180 kN/m² may be applied using moderate width spread foundations at a depth of 5.00 m. It should be possible to support the rear extension using moderate width foundations and a net allowable bearing pressure of 70 kN/m² may be applied at a depth of 1.50 m. Foundations will however need to be deepened in accordance with NHBC guidelines within the zone of influence of existing and proposed trees. It should be possible to form the basement by traditional underpinning of the existing foundations. The excavation of the basement will remove the entire thickness of made ground and hence no potential sources of contamination will remain following redevelopment. Consideration should however be given to the protection of site workers during construction.

Part 1: INVESTIGATION REPORT

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

1.0 INTRODUCTION

Geotechnical and Environmental Associates Limited (GEA) has been commissioned by Heyne Tillett Steel, on behalf of Robert Callow, to carry out a desk study and ground investigation at 23 Downside Crescent, London, NW3 2AN.

1.1 Proposed Development

Consideration is being given to the construction of a basement below the footprint of the main body of the house, which may extend up to 5.00 m below ground level, and the addition of a single level extension at the rear of the house.

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

1.2 Purpose of Work

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

- to check the history of the site with respect to previous contaminative uses;
- to determine the ground conditions and their engineering properties;
- to provide advice with respect to the design of spread foundations and retaining walls;
- to provide an indication of the degree of soil contamination present; and
- to assess the risk that any such contamination may pose to the proposed development, its users or the wider environment.

1.3 Scope of Work

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

- a review of readily available geological maps;
- a review of historical Ordnance Survey (OS) maps and environmental searches sourced from the Envirocheck database and on-line sources;
- a review of archive information held by GEA and a review of online borehole records held by the British Geological Survey (BGS); and
- a walkover survey of the site carried out in conjunction with the fieldwork.

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

- a single borehole advanced to a maximum depth of 6.45 m by means of an open-drive lined percussive sampler;
- standard penetration tests (SPTs), carried out at regular intervals in the borehole, to provide additional quantitative data on the strength of the soils;
- a single window sampler borehole advanced to a depth of 6.00 m;
- installation of two standpipe piezometers to depths of 6.0 m, and two subsequent monitoring visits, over a period of three weeks;
- six trial pits manually excavated to investigate the nature of the existing foundations of the house and neighbouring wall;
- laboratory testing of selected soil samples for contamination and 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.

The report includes a contaminated land assessment which has been undertaken in accordance with the methodology presented in Contaminated Land Report (CLR) 11[1] and involves identifying, making decisions on, and taking appropriate action to deal with, land contamination in a way that is consistent with government policies and legislation within the United Kingdom. The risk assessment is thus divided into three stages comprising Preliminary Risk Assessment, Generic Quantitative Risk Assessment, and Site-Specific Risk Assessment.

1.4 Limitations

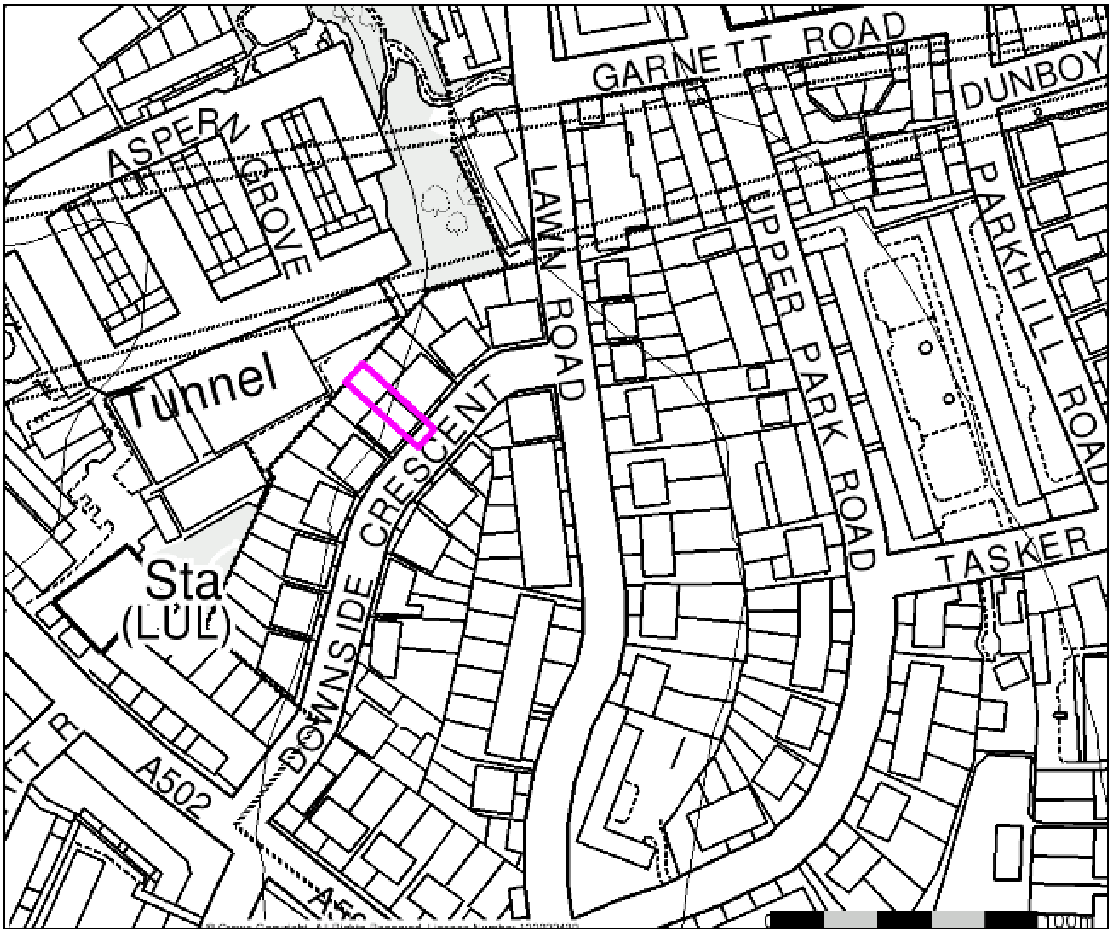
The conclusions and recommendations made in this report are limited to those that can be made on the basis of the investigation. The results of the work should be viewed in the context of the range of data sources consulted, the number of locations where the ground was sampled and the number of soil, 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.

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

2.0 THE SITE

2.1 Site Description

The site is located approximately 135 m northeast of Belsize Park Underground Station, 190 m to the south of Royal Free Hospital, and 530 m southeast of Hampstead Heath railway station. The site may be additionally located by National Grid Reference (NGR) 527492, 185174 and is shown on the map below.



The site is reasonably level and forms a roughly rectangular shape with dimensions of approximately 10 m northeast-southwest by 35 m northwest-southeast and is occupied by a mid-terrace three-storey house fronting onto Downside Crescent to the southeast, with a single storey extension and patio at the rear. The house is bordered by private gardens and houses fronting onto Downside Crescent to the southwest and northeast, and by tennis courts to the northwest.

The property is showing some indications of movement, with 5 mm to 20 mm wide cracks present between the extension and main house which suggest rotation towards the rear where the extension appears to be suffering from subsidence. The rear garden is laid to lawn with hedges, flower beds and 8 m to 10 m tall semi-mature deciduous trees, and a 22 m tall mature deciduous tree outside the rear of the property. The front garden has a surface covering of gravel with flower beds around the perimeter. The level of the ground floor level and rear garden level is approximately 1.00 m above street level and the local topography slopes gently down towards the northeast.

2.2 Existing building damage

During the site walkover, it was noted that it appears that the single storey extension is suffering from subsidence, and cracks of between 5 mm and 20 mm in width are present between the main house and the rear single storey extension, becoming widest at the top (see photos below). The pattern of cracking is indicative of rotation of the extension away from the house, and the presence of cracking in the wall of the main section of the house suggests that the extension is pulling the wall from the main house with it.

2.3 Site History

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

The earliest Ordnance Survey (OS) map studied, dated 1871, shows the site to be open fields, with the beginnings of residential development of the surrounding area to the north and south, with Haverstock Hill 150 m southwest of the site. By 1896, development had spread around the site and a hospital had been built approximately 150 m to the north, although the site remained undeveloped. The 1896 map also shows several air shafts between 80 m and 290 m of the site to the north, west and northeast.

By 1915, Belsize Underground Station had been built 90 m southwest of the site, and the site itself was occupied by the existing terraced house with undeveloped land immediately to the northwest. This was later developed into tennis courts by 1935, and the site and tennis courts have remained unchanged since that time, with the exception of terraced housing replacing the majority of the tennis courts 45 m north of the site by 1989.

The 1954 map shows two railway tunnels, labelled as “Belsize Tunnel” and “Belsize New Tunnel” 25 m and 85 m north of the site respectively, with the tunnels associated with the air shafts shown on earlier maps. The map also shows tanks 135 m southwest of the site and associated with a nursery 80 m southwest of the site, and “deep shelters” 125 m northwest and 135 m southwest of the site. These features were still labelled on the most recent 1:2,500 OS map studied dated 1991, after which OS maps studied were of a scale too small to detail these features.

2.4 Other Information

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

The desk study research has indicated that there are no registered landfills, historic landfills, registered waste transfer sites, waste management facilities or recorded pollution incidents within 500 m of the site. There have been no pollution incidents to controlled waters within 500 m of the site. There are two controlled process operating within 183 m belonging to dry cleaners.

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

The site is 26 m south of Belsize Wood, which is designated as a Local Nature Reserve. The site is not located within a nitrate vulnerable zone or any other sensitive land use.

The London Underground (LU) Northern Line passes through Belsize Underground Station 160 m southwest of the site. The Belsize and New Belsize Tunnels pass 25 m and 85 m north of the site respectively, and link West Hampstead Thameslink, ,located 2 km southwest of the site, with Kentish Town 1.5 km southeast of the site. A deep shelter is located 130 m southwest of the site on the corner between Downside Crescent and Haverstock Hill, and 130 m west of the site adjacent to the Belsize Tunnel.

2.5 Geology, Hydrology and Hydrogeology

The Geological Survey map of the area (Sheet 256) indicates that the site is underlain by London Clay.

A search of borehole records held by the British Geological Survey (BGS) has indicated that the London Clay was found beneath a moderate thickness of made ground, at a distance of 160 m to the southwest of the site. The London Clay Formation is classified by the EA as Unproductive Stratum, which refers to a soil or rock with low permeability and of negligible significance for water supply or river base flow.

Any groundwater flow within the London Clay will be at a very slow rate, due to its negligible permeability; the permeability will be predominantly secondary, through fissures in the clay. Published data for the permeability of the London Clay indicates the horizontal permeability to generally range between 1 x 10^{-11} m/s and 1 x 10^{-9} m/s, with a lower vertical permeability.

The nearest surface water feature is Hampstead No 1 Pond 665 m to the north, although the site lies outside the catchment of the Hampstead Heath chain of ponds. The River Thames is approximately 6.8 km to the southeast and flows in an easterly direction. The direction of groundwater flow within the London Clay beneath the site is likely to be controlled by the local topography and therefore is likely to be in a southerly and southeasterly direction.

Historically, the Fleet River[2] flowed approximately 290 m to the north of the site, along the line of Fleet Road, in a roughly southerly direction. The two sources of the Fleet River are separated by Parliament Hill; the source of the western branch of the river is on Hampstead Heath and forms the Hampstead Ponds, before going underground near Hampstead Heath Station and running down the line of Fleet Road towards Camden Town. Today the Fleet is entirely covered and culverted and forms part of the surface water sewerage system; a Thames Water tunnel roughly 3.0 m in diameter known as the 'Fleet Sewer.'

There are no Environment Agency designated Groundwater Source Protection Zones (SPZs) on the site and there are no listed water abstraction points within 1 km of the site.

The site is not located within an area at risk of flooding from rivers or sea, as defined by the Environment Agency.

2.6 Preliminary Risk Assessment

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

2.6.1 Source

The historical usage of the site that has been established by the desk study and the site walkover indicates that the site does not have a potentially contaminative history by virtue of it having been occupied by the existing mid-terrace house throughout its developed history. In addition, there have been no sources of contamination identified in the immediate surrounding area, including no potential sources of soil gas. Much of the shallow soil will be removed from below the site in the course of the basement excavation in any case.

2.6.2 Receptor

The site will continue to have a residential end use following the redevelopment of the site and no new receptors will result. However, the residential end use is considered a high sensitivity end-use. Buried services are likely to come into contact with any contaminants present within the soils through which they pass and site workers are likely to come into direct contact with any contaminants present in the soil and through inhalation of vapours during basement excavation and construction.

[2] Nicholas Barton (2000) London's Lost Rivers. Historical Publications Ltd

2.6.3 Pathway

As the proposed single storey basement is to be excavated beneath the existing building, there will be limited potential contaminant exposure pathways as the structures will effectively form a barrier between any contaminants within the near-surface soils and end-users or infiltration of surface water. However, in areas of soft landscaping potential contaminant exposure pathways exist with respect to end users.

Soluble contaminants within the made ground could also potentially migrate onto adjacent sites as a result of infiltration of surface run-off. The presence of the underlying negligibly permeable clay of the London Clay Formation will limit the potential for infiltration to a Principal Aquifer at depth.

Buried services will be exposed to any contaminants present within the soil through direct contact and site workers will come into contact with the soils during demolition and construction works.

There is thus considered to be low potential for a contaminant pathway to be present between any potential contaminant source and a target for the particular contaminant.

2.6.4 Preliminary Risk Appraisal

On the basis of the above it is considered that there is a low risk of there being a significant contaminant linkage at this site, which would result in a requirement for major remediation work.

3.0 EXPLORATORY WORK

Access to the site was limited by the presence of the existing building. Therefore, in order to meet the objectives described in Section 1.2, as far as possible within the access limitations, a single borehole was advanced to a depth of 6.45 m by means of an opendrive percussive sampler (Terrier rig), and a single window sampler borehole was advanced to a depth of 6.00 m. Standard Penetration Tests (SPTs) were carried out at regular intervals in the opendrive percussive borehole to provide quantitative data on the strength of soils encountered.

A 19 mm groundwater monitoring standpipe was installed in each of the boreholes to a depth of 6.00 m and the standpipes have been monitored on three occasions over a period of three weeks following installation.

In addition, six trial pits were hand excavated to expose the existing foundations of the house and boundary walls. One of the trial pits was excavated in the main section of the house, with the remainder excavated in the side passageway and front and rear gardens adjacent to the shared wall with No 21, the rear extension and the main section of the house.

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

A selection of the samples recovered from the boreholes and trial pits was submitted to a soil mechanics laboratory for a programme of geotechnical testing and an analytical laboratory for a programme of contamination testing.

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

3.1 Sampling Strategy

The trial pit and borehole locations were specified by the consulting engineers and were positioned on site in accessible locations whilst avoiding buried services by a geotechnical engineer from GEA.

Three samples were recovered from the made ground and have been subjected to analysis for a range of common industrial contaminants and contamination indicative parameters. For this investigation the analytical suite for the soil included a range of metals, speciation of total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), total cyanide and monohydric phenols. The soil samples were selected to provide a general view of the chemical conditions of the soils that are likely to be involved in a human exposure or groundwater pathway and to provide advice in respect of re-use or for waste disposal classification. The contamination analyses were carried out at an MCERTs accredited laboratory with the majority of the testing suite accredited to MCERTS standards. Details of the MCERTs accreditation and test methods can be provided if required.

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

4.0 GROUND CONDITIONS

The investigation has confirmed the expected ground conditions in that, beneath a moderate thickness of made ground, London Clay was encountered and proved to the full depth of the investigation.

4.1 Made Ground

Beneath a 50 mm surface covering of gravel, the made ground comprised dark brown mottled brown sandy silty clay with gravel of flint, brick, charcoal and ash clinker and occasional roots, to depths of between 0.20 m and 0.40 m within the boreholes, and to depths of between 0.56 m to 0.90 m in the trial pits.

In Trial Pit Nos 1, 2, 3 and 5 the made ground was encountered beneath a surface covering of concrete slabs, builders sand and/or concrete.

In Trial Pit No 4, the made ground comprised brown mottled grey and reddish rown sandy clay with gravel of flint, brick, clinker and ask clinker.

In Trial Pit No 6, a 100 mm surface cover of topsoil comprised of dark brown / black silty clay with frequent roots was underlain by made ground to a depth of 0.56 m.

No visual or olfactory evidence of contamination was observed within these soils; however three samples were selected for confirmatory analysis and the results are discussed in Section 4.4.

4.2 London Clay

The London Clay comprised an initial horizon of soft brown and grey slightly gravelly to gravelly clay to depths of between 1.00 m and 2.00 m.

Below the initial horizon firm becoming stiff, locally fissured, brown mottled grey clay with occasional roots and occasional selenite crystals, was proved to the maximum depth investigated of 6.45 m.

In Trial Pit No 1, rare subrounded flint cobbles less than 120 mm were found in the London Clay, and in Trial Pit No 2, black clay pockets and roots were encountered.

Laboratory plasticity index tests have indicated the clay to generally be high shrinkability with amended plasticity indices between 50% and 61%.

4.3 Groundwater

Groundwater was encountered in Trial Pit Nos 1 and 3 at depths of 0.60 m and 0.80 m respectively. Groundwater was not encountered within the boreholes during drilling, but has subsequently been recorded in the standpipes. A table summarising the groundwater monitoring is found below.

Borehole	Date installed	Date monitored		
		8.11.13	22.11.13	28.11.13
1	5.11.13	2.30 m	0.88 m	0.80
2	5.11.13	DRY	4.95 m	3.53

A search of borehole records held by the British Geological Survey (BGS) and of previous investigations carried out by GEA has not revealed any borehole data within a suitable distance of the site to provide comment on the general groundwater level within the area. It is possible that the groundwater measured within the standpipes represents perched water within the made ground that has flowed along the boundary with the London Clay and into the standpipes. It was noted during the period of the ground investigation that high rainfall was experienced, and if the water measured is perched, it may account for the variable results, particularly in Borehole No 2.

During the monitoring visit on the 22nd November, Borehole No 1 was purged of water to ascertain whether the standpipe would recharge to the level of groundwater encountered in Borehole No 2, which it had a week later. There may be benefit in also carrying out a rising head test to determine the rate at which water re-enters the standpipe.

It was discussed with the Engineer whilst on site on the 8th November 2013 that a drain was potentially running in a northeast-southwest orientation across the patio area close to Trial Pit Nos 1 and 2.

The shallow water level encountered in Trial Pit Nos 1 and 3, and within the standpipe in Borehole No 1 may be the result of a burst drain. It should be noted however, that it is not unusual to find groundwater collected around foundations in clay.

4.4 Soil Contamination

The table below sets out the values measured within three samples of made ground analysed; all concentrations are in mg/kg unless otherwise stated.

Determinant	BH1 0.10 m	BH2 0.15 m	TP3 0.40 m
pH	7.5	8.0	9.9
Arsenic	**46**	16	22
Cadmium	0.31	<0.10	0.20
Chromium	22	23	18
Copper	52	85	44
Mercury	0.84	0.85	0.32
Nickel	18	16	18
Lead	380	**1400**	410
Selenium	0.43	0.23	<0.20
Zinc	120	88	88
Total Cyanide	<0.50	<0.50	<0.50
Total Phenols	<0.3	<0.3	<0.3
Sulphide	3.1	1.4	1.9
TPH	59	19	16
Total PAH	**15**	**19**	2.2
Benzo(a)pyrene	**1.4**	**1.5**	0.19
Naphthalene	0.12	0.15	<0.1
Total organic carbon %	5.2	2.5	3.3
Note: Figures in bold indicates concentration in excess of risk-based soil guideline values, as discussed below			

4.4.1 Generic Quantitative Risk Assessment

The use of a risk-based approach has been adopted to provide an initial screening of the test result to assess the need for subsequent site-specific risk assessment. To this end, contaminants of concern are those that have values in excess of a generic human health risk based guideline values which are either that of the CLEA[3] Soil Guideline Value where available, or is a Generic Guideline Value calculated using the CLEA UK Version 1.06 software assuming a residential end use. The key generic assumptions for this end use are as follows:

- that groundwater will not be a critical risk receptor;
- that the critical receptor for human health will be young female children aged zero to six years old;

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

- that the exposure duration will be six years;

- that the critical exposure pathways will be direct soil and indoor dust ingestion, consumption of homegrown produce, consumption of soil adhering to homegrown produce, skin contact with soils and indoor dust, and inhalation of indoor and outdoor dust and vapours; and

- that the building type equates to a two-storey small terraced house.

It is considered that these assumptions are acceptable for this generic assessment of this site, with the exception of that made on groundwater, which is a sensitive receptor at this site. This assessment is based upon the potential for risk to human health, which at this site is considered to be the critical risk receptor. The tables of generic screening values derived by GEA and an explanation of how each value has been derived are included in the Appendix.

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

- additional testing to zone the extent of the contaminated material and thus reduce the uncertainty with regard to its potential risk;

- site specific risk assessment to refine the assessment criteria and allow an assessment to be made as to whether the concentration present would pose an unacceptable risk at this site; or

- soil remediation or risk management to mitigate the risk posed by the contaminant to a degree that it poses an acceptable risk.

The concentrations of the contaminants of concern highlighted by a comparison of the measured concentrations against the generic screening values are tabulated below. This assessment is based upon the potential for risk to human health, which at this site is considered to be the critical risk receptor.

Elevated concentrations of PAH, including benzo(a)pyrene, within two samples of made ground recovered from Borehole Nos 1 and 2, and single elevated concentrations of arsenic and lead have been measured in samples of made ground recovered from Borehole No 1 and 2, respectively. The significance of these results is considered further in Part 2 of the report.

4.5 Existing Foundations

Trial Pit No 1 was excavated adjacent to the shared wall with No 21 within the rear garden, and found the wall to be supported by a concrete footing bearing on London Clay at a depth of 1.20 m.

Trial Pit No 2 was excavated adjacent to the rear extension and encountered two brick corbels supported by a concrete footing bearing on the London Clay at a depth of 0.64 m.

Trial Pit No 3 was excavated in the corner between the main house and the extension and encountered three brick corbels supported by a concrete footing on the main house wall, and a single brick corbel supported by a concrete footing on the extension wall, each bearing on London Clay, at a depth of 0.90 m. A 35 mm wide gap was encountered between the bricks in the corbel on the extension wall and was found to extend at least 50 mm through the wall into soft ground.

Trial Pit No 5 was excavated adjacent to the northeastern wall of the main house in the side passageway and encountered three brick corbels supported by a concrete footing bearing on London Clay, at a depth of 0.70 m.

Trial Pit No 6 was excavated in the front garden adjacent to the house and encountered two brick corbel supported by a concrete footing bearing in the London Clay at a depth of 0.60 m.

Trial Pit No 4 was excavated within the house and it was found that the brick walls of the house comprise three brick corbels supported on a 150 mm thick concrete strip foundations at a depth of 0.80 m, bearing within the London Clay. The foundations extended out from the walls 280 mm. A suspended ground floor slab was encountered at a depth of 500 mm, and wooden joists supported by the suspended concrete slab supported 20 mm thick wooden flooring.

Part 2: DESIGN BASIS REPORT

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

5.0 INTRODUCTION

Consideration is being given to the construction of a basement below the footprint of the main body of the house, which may extend up to 5.00 m below ground level, and the addition of a single level extension at the rear of the house. The loads of the proposed development are not known at this stage, but are expected to be light to moderate.

6.0 GROUND MODEL

The desk study has revealed that the site has not had a potentially contaminative history, having apparently been occupied by the existing residential property for its entire developed history and on the basis of the fieldwork, the ground conditions at this site can be characterised as follows.

- Beneath a moderate thickness of made ground, London Clay is present and was proved to the maximum depth investigated of 6.45 m;
- Beneath a 50 mm surface covering of gravel, the made ground comprised dark brown mottled brown sandy silty clay with gravel of flint, brick, charcoal and ash clinker and occasional roots, to depths of between 0.20 m and 0.40 m within the boreholes, and to depths of between 0.56 m to 0.90 m in the trial pits;
- the London Clay comprises an initial horizon of soft brown and grey slightly gravelly to gravelly clay to depths of between 1.00 m and 2.00 m; over
- firm becoming stiff, locally fissured, brown mottled grey clay with occasional roots and occasional selenite crystals, and was proved to the maximum depth investigated of 6.45 m.
- groundwater has been measured at depths of between 0.80 m and 4.95 m in the standpipes; and
- the chemical analyses revealed elevated concentrations of PAH, including benzo(a)pyrene in two samples of made ground, and single elevated concentrations of lead and arsenic.

7.0 ADVICE AND RECOMMENDATIONS

Formation level for the proposed basement will be within the London Clay, which should provide a suitable bearing stratum for spread foundations excavated from basement level. Alternatively, piled foundations would also provide a suitable solution.

Excavations for the proposed basement structure will require temporary support to maintain stability and prevent any excessive ground movements. The existing foundations will need to be underpinned prior to construction of the proposed basement or will need to be supported by new retaining walls.

The results of the groundwater monitoring to date indicate that some form of groundwater control is likely to be required.

7.1 Basement Construction

7.1.1 Basement Excavation

The proposed basement will extend beneath the footprint of the existing main house, and is anticipated to extend to a depth of 5.00 m below ground level, such that formation level will be within the London Clay.

Groundwater has been found at depths of between 0.80 m and 0.88 m in the rear garden within Trial Pit Nos 1 and 3 and Borehole No 1. It is possible that the measured water reflects perched groundwater within the made ground rather than a general "water table" within the London Clay. However, on the basis of the monitoring to date, it is apparent that groundwater is likely to be encountered within the 5.0 m deep basement excavation, although this may be perched water, and it is not possible to assess the quantity and persistence of groundwater entering the excavation. In any case, the groundwater will need to be removed and it should be possible to control the water with sump pumping in the initial stages where water is entering the excavation. It would be prudent to excavate trial pits to the full depth of the basement excavation, or as deep as possible to assess the rate of groundwater inflow into an excavation; however if this is not achievable, it should be possible to pump the water out of the standpipes and monitoring the rate at which it recharges. It is also recommended that further monitoring of the standpipes is carried out to establish equilibrium levels and determine the extent of any seasonal fluctuations.

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, existing and neighbouring structures, and to protect against potential groundwater inflows.

There are a number of methods by which the sides of the basement excavation could be supported in the temporary and permanent conditions. The choice of wall may be governed to a large extent by the requirement to prevent groundwater inflows and whether it is to be incorporated into the permanent works and have a load bearing function. The final choice will depend to a large extent on the need to protect nearby structures from movements, and the required overall stiffness of the support system. Consideration will also need to be given to the access restrictions of working beneath the existing building.

It may be possible to adopt traditional mass concrete underpinning, however if the groundwater table is close to the formation level of the basement it will be difficult to form underpins within the London Clay which will soften and lose strength in the presence of groundwater inflows. Therefore some form of groundwater control is likely to be required and ideally trial excavations should be carried out to ascertain the rate of groundwater recharge. Consideration may need to be given to piled foundations.

Careful control of pumping will be required to ensure that it does not lead to undermining and settlement of the adjacent buildings. If the adopted method of temporary support during excavations is not watertight, it would be prudent for the chosen contractor to have a contingency plan in place to deal with more significant inflows as a precautionary measure.

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.

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 (Φ' – degrees)
Made ground	1800	Zero	25
London Clay	1950	Zero	25

On the basis of the groundwater observations made to date, groundwater is likely to be encountered within the basement excavation during construction, though further monitoring of the standpipe should be continued in order to establish a design water level. Consideration will need to be given to the possibility of groundwater collecting within any disturbed zone behind the retaining walls and it may be prudent to design for a groundwater level of two-thirds the retained height in this respect.

Reference should be made to BS8102:2009[4] with regard to requirements for waterproofing and design with respect to groundwater pressures.

7.1.3 Basement Heave

The 5.00 m deep excavation of the basement will result in an unloading of around 95 kN/m^2. The effects of the longer term swelling movement within the London Clay will be mitigated to some extent by the load applied by the new foundations. It would however be prudent to a detailed analysis of these movements once the basement design has been finalised.

Consideration will need to be given to the effects of differential movement between the existing house and rear extension.

It would be prudent to conduct a more detailed analysis of these movements once the basement design has been finalised.

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

7.2 Spread Foundations

Groundwater has been measured close to or at formation level for both the basement and the extension and it may not be possible to form spread foundations without groundwater control, although this will ideally be confirmed through continued monitoring and trial excavations.

Provided that a dry excavation can be maintained, moderate width spread foundations excavated from basement level may be designed with a net allowable bearing pressure of 180 kN/m^2 at a depth of 5.00 m. This value includes an adequate factor of safety to protect against bearing capacity failure and should ensure that settlement remains within normal tolerable limits.

If the proposed loads are high or the required founding depths become uneconomic or it is not possible to construct spread foundations within the water table, piled foundations would provide a suitable foundation option should access permit.

It should be possible to support the rear extension using moderate width strip foundations. Moderate width strip or pad foundations bearing in the firm London Clay should be placed at a minimum depth of 1.00 m, assuming that restrictions are applied on planting of shrubs in the vicinity of foundations, or at a depth of 1.50 m if there is unrestricted planting of shrubs in the new development, subject also to the further restrictions on new tree planting as detailed in the NHBC guidelines. The foundations may be designed to apply a net allowable bearing pressure of 70 kN/m^2 at a depth of 1.50 m; this value incorporates an adequate factor of safety against bearing capacity failure and should ensure that settlement remains within normal tolerable limits.

Perched water was encountered at depths of between 0.60 m and 0.80 m at the rear of the property. The source of the water in this area is unknown and further investigation is required in this respect. It would be prudent to check the rate of inflow, either by conducting trial excavations, or by pumping the water out of the standpipe and monitoring the rate at which it recharges. If the rate of inflow is relatively slow and of limited volume, it should be controllable with sump pumping. The chosen contractor should have a contingency plan to deal with more significant flows.

It was noted during the site walkover that it appears that the rear extension is suffering from movement, which could be as a result of desiccation due to tree roots, although more information is required to make a judgment in this respect. The rear extension will need to be underpinned to mitigate the effects of further subsidence, but further investigation of possible causes of the movement will be required to determine the depth of underpinning required.

Foundations will need to be deepened in the vicinity of existing and proposed trees and National House Building Council (NHBC) guidelines should be followed in this respect. High shrinkability clays should be used in calculations. Where trees are to be removed the required founding depth should be determined on the basis of the existing tree height if it is less than 50% of the mature height and on the basis of full mature height if the current height is more than 50% of the mature height. Where a tree is to be retained the final mature height should be adopted.

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

7.3 Shallow Excavations

On the basis of the borehole findings and trial pits, it is considered that shallow excavations for foundations and services that extend through the made ground or London Clay should remain generally stable in the short term, although some instability may occur.

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

Groundwater inflows may be encountered within made ground, particularly within the vicinity of existing foundations, and in the vicinity of the patio area where shallow water was encountered. Any inflows of groundwater into excavations should be suitably controlled by sump pumping, although this should be confirmed by trial excavations to the full depth of the proposed basement and foundations.

7.4 Piled Foundations

For the ground conditions at this site a driven or bored pile could be adopted, although the noise and vibrations typically associated with the installation of driven piles is likely to render their use unacceptable at this residential site. At this stage, and subject to further assessment of the groundwater conditions, it is considered likely that a contiguous bored pile wall in association with sump pumping or grouting may be sufficient to protect against ground water inflows, although this should be confirmed by trial excavations at basement level. A secant pile wall will be suitable should groundwater control be unfeasible or the level of risk be deemed unacceptable.

If piled foundations are to be considered, it is recommended that a deeper borehole is carried out at the site to provide suitable design parameters.

7.5 Basement Floor Slab

Following the excavation of the new basement level, it should be possible to adopt a ground bearing basement floor slab bearing on the natural soils. It would be prudent to proof roll the stratum with any soft spots being removed and replaced with suitably compacted granular fill.

It is recommended that the basement slab is suitably reinforced to withstand heave and potential fluctuating groundwater pressures or that a void is incorporated below the slab to allow the movement to take place or a suitable compressible layer is provided. The rate of movement will of course depend on a number of site-specific factors such as the availability of water at formation level and if piles are used which may restrict heave movements. Further analysis should be carried out once the proposals have been finalised.

7.6 Effect of Sulphates

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

7.7 Existing Building Damage and Shallow Groundwater

It appears from the site walkover that the single storey extension is suffering from subsidence, and cracks 5 mm to 20 mm wide are present between the main house and the rear single storey extension, with the pattern of cracking suggesting rotation away from the main house.

The monitoring of the standpipe in Borehole No 1 has recorded water at depths of 0.88 m and 0.80 m two and three weeks after installation; similar depths were encountered in nearby Trial Pit Nos 1 and 3. This would suggest that this water is not groundwater or perched water accumulating around existing foundations. The source of the water is unknown. It may be from a burst drain that may be present under the patio.

It would be prudent in the first instance to identify the presence of the drain, suggested to be adjacent to Trial Pit Nos 1 and 2, and to undertake a drain survey to check for any leaks.

The presence of water accumulating around the foundations of the rear extension may have resulted in loss of fine material and consequent foundation settlement, but this is not considered likely unless the water is moving under pressure, and this type of flow is in any case unlikely due to the low permeability nature of the London Clay.

However, there are alternative causes that may have caused the building to subside.

- *Desiccation*: the London Clay has a high volume change potential, which can result in significant ground movement in response to changes in moisture content. Soil moisture contents below surface vegetation will vary seasonally and are additionally influenced by a number of factors including the action of tree roots. It was noted that a 22 m tall mature tree was present in the rear garden. If the extension was built in accordance with the NHBC guidelines today, foundations would need to extend to a minimum depth of 2.15 m, assuming a high water demand tree, to be sure of extending below the depth of root action. It was noted that the foundations extended to depths of between 0.64 m and 0.90 m.

- *Poor construction of the extension:* made ground is not an adequate stratum to support foundations, as settlement typically has not completed and as such foundations should be constructed on natural soil to prevent subsidence. The foundations for the extension are bearing on natural ground and this is therefore unlikely to be a factor.

- *Loads exceeding the bearing capacity of the soil:* where the loads of the building exceed the bearing capacity of the soil, failure may occur, or if the applied loads are too high excessive settlement may arise. It is however anticipated that the load of the single storey extension is low and unlikely to exceed the bearing capacity of the London Clay.

There are additional factors such as the presence of tunnels and nearby construction work that could have resulted in movement of the property. At this stage it is considered that the effect of trees is likely to be a contributory cause.

7.8 Site Specific Risk Assessment

The desk study identified a low risk of there being a significant pollution linkage present at this site. However, the chemical analyses have revealed elevated concentrations of PAH, including benzo(a)pyrene, in excess of the generic risk-based screening values for a residential end-use with plant uptake in two samples, and single elevated concentrations of arsenic and lead, within samples recovered from Borehole Nos 1 and 2.

The source of this contamination has not been identified, though it is likely to be due to fragments of extraneous material within the made ground. However, the made ground will be entirely removed by the basement excavation and no potential sources of contamination will remain. Consideration should however be given to the protection of site workers handling the soil.

End users will be effectively isolated from direct contact with the identified contaminants by the extent of buildings and areas of external hardstanding. However, end users could conceivably come into direct contact with the contaminated soils in garden areas only and suitable precautions may need to be taken in these areas to protect end users and to allow successful plant growth. It is recommended that additional sampling and testing is carried out in areas to remain as soft landscaped areas to confirm the absence of other contamination.

7.8.1 Site Workers

Site workers should be made aware of the contamination and a programme of working should be identified to protect workers handling any soil. The method of site working should be in accordance with guidelines set out by HSE[5] and CIRIA[6] and the requirements of the Local Authority Environmental Health Officer.

7.8.2 Buried Services

Consideration may need to be given to the protection of buried plastic services laid within the made ground. Details of the proposed protection measures for buried plastic services will in any case need to be approved by the EHO and the relevant service authority prior to the adoption of any scheme. It is possible that barrier pipe will be required or additional testing will need to be carried out.

7.9 Waste Disposal

Any spoil arising from excavations or landscaping works, which is not to be re-used in accordance with the CL:AIRE guidance[7], will need to be disposed of to a licensed tip. Under the European Waste Directive, waste is classified as being either Hazardous or Non-Hazardous and landfills receiving waste are classified as accepting hazardous or non-hazardous wastes or the non-hazardous sub-category of inert waste in accordance with the Waste Directive. Waste going to landfill is subject to landfill tax at either the standard rate of £64 per tonne (about £120 per m^3) or at the lower rate of £2.50 per tonne (roughly £5 per m^3). However, the classifications for tax purposes and disposal purposes differ and currently all made ground and topsoil is taxable at the 'standard' rate and only naturally occurring rocks and soils, which are accurately described as such in terms of the 2011 Order[8], would qualify for the 'lower rate' of landfill tax.

5 HSE (1992) HS(G)66 *Protection of workers and the general public during the development of contaminated land* HMSO
6 CIRIA (1996) *A guide for safe working on contaminated sites* Report 132, Construction Industry Research and Information Association
7 CL:AIRE (2011) *The Definition of Waste: Development Industry Code of Practice* Version 2, March 2011
8 *Landfill Tax (Qualifying Material) Order 2011*

Based upon on the technical guidance provided by the Environment Agency[9] it is considered likely that the made ground from this site, as represented by the three chemical analyses carried out, would be classified as NON-HAZARDOUS waste under the waste code 17 05 03* (soils and stones containing dangerous substances) and would be taxable at the standard rate, due to the high concentration of lead. It is likely that the natural soils, if separated out, could be classified as an INERT waste also under the waste code 17 05 04 (soils and stones not containing dangerous substances). This material would be taxable at the lower rate, if accurately described as naturally occurring clay in terms of the 2011 Order on the waste transfer note. As the site has never been developed or used for the storage of potentially hazardous materials, it is likely that WAC leaching tests would not be required for such inert waste going to landfill. This would however need to be confirmed by the receiving landfill site.

Under the requirements of the European Waste Directive all waste needs to be pre-treated prior to disposal. The pre-treatment process must be physical, thermal, chemical or biological, including sorting. It must change the characteristics of the waste in order to reduce its volume, hazardous nature, facilitate handling or enhance recovery. The waste producer can carry out the treatment but they will need to provide documentation to prove that this has been carried out. Alternatively, the treatment can be carried out by an approved contractor. The Environment Agency has issued a position paper[10] which states that in certain circumstances, segregation at source may be considered as pre-treatment and thus excavated material may not have to be treated prior to landfilling if the soils can be "segregated" on site by sufficiently characterising the soils insitu prior to excavation.

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

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

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

9 Environment Agency (2008) *Hazardous Waste: Interpretation of the definition and classification of hazardous waste. Technical Guidance* WM2 Second Edition Version 2.2, May 2008

10 Regulatory Position Statement (2007) *Treating non-hazardous waste for landfill - Enforcing the new requirement* Environment Agency 23 Oct 2007

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.

This report makes recommendations to undertake a drainage survey to check the integrity of the drain that may exist underneath the patio in the rear garden.

The investigation has encountered elevated concentrations of PAH, including benzo(a)pyrene, and single elevated concentrations of arsenic and lead, within the samples of made ground. Whilst end users will be protected from the contamination by the extent of buildings and areas of external hardstanding, this report makes recommendations for additional sampling and testing carried out in areas to remain as soft landscaped areas to confirm the absence of other contamination. Site workers will need to be protected against contaminated soil during construction of the new basement and extension.

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

If during ground works any visual or olfactory evidence of contamination is identified it is recommended that further investigation be carried out and that the risk assessment is reviewed. 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

Trial Pit Records and Photographs

SPT Summary Sheet

Laboratory Geotechnical Test Results

Chemical Analyses

Generic Guideline Values

Envirocheck Summary and Extracts

Historical Maps

Site Plan

Geotechnical & Environmental Associates (GEA), Tyttenhanger House, Coursers Road, St Albans, AL4 0PG	**Site** 23 Downside Crescent, London, NW6 2AN	**Number** **BH1**

Excavation Method	**Dimensions**	**Ground Level (mOD)**	**Client**	**Job Number**
Drive-in Window Sampler	60mm to 1.00m 50mm to 2.00m 30mm to 6.00m		Robert Callow	J13331
	Location Rear garden	**Dates** 05/11/2013	**Engineer** Heyne Tillett Steel	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.10	D1				(0.40)	Made Ground: (Grass over brown sandy clay with gravel of flint, brick and charcoal. Rare roots).		
0.40	D2				0.40			
					(0.60)	Soft brown and grey mottled gravelly CLAY with rare roots. Gravel is angular to subrounded fine to coarse flint.		
1.00	D3				1.00	Stiff fissured brown locally mottled blue-grey CLAY with occasional black clay pockets and mica. Occasional orange silt pockets. Between 1.00m and 1.30m; rare decomposing roots. At 1.50m; occasional nodules of hard white silt.		
1.60	D4							
						Between 2.00m and 2.80m; firm.		
2.50	D5							
3.50	D6				(5.00)	Below 3.50m; rare pockets of green and yellow fine and medium sand.		
4.50	D7					Below 4.70m; rare selenite crystals.		
5.50	D8							
			05/11/2013:DRY		6.00			
						Complete at 6.00m		

Remarks	**Scale (approx)**	**Logged By**
Groundwater was not encountered. On completion, a groundwater monitoring standpipe was installed to 6.00m.	1:50	CS
	Figure No. J13331.BH1	

Geotechnical & Environmental Associates

Tyttenhanger House
Coursers Road
St Albans
AL4 0PG

Site	Borehole Number
23 Downside Crescent, London, NW6 2AN	BH1

Installation Type: Standpipe

Dimensions: Internal Diameter of Tube [A] = 19 mm; Diameter of Filter Zone = 30 mm

Client: Robert Callow

Job Number: J13331

Location: Rear garden

Ground Level (mOD):

Engineer: Heyne Tillett Steel

Sheet: 1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
				0.10	Concrete
					Bentonite Seal
				1.00	
					Slotted Standpipe
				6.00	

Groundwater Strikes During Drilling

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

Groundwater Observations During Drilling

Date	Start of Shift Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	End of Shift Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)
05/11/13							6.00		DRY	

Instrument Groundwater Observations

Inst. [A] Type : Slotted Standpipe

Date	Instrument [A] Time	Depth (m)	Level (mOD)	Remarks
08/11/13		2.30		Borehole purged of water
22/11/13		0.88		
28/11/13		0.80		

Remarks

GEA Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** 23 Downside Crescent, London, NW6 2AN	**Number** **BH2**

Excavation Method	**Dimensions**	**Ground Level (mOD)**	**Client**	**Job Number**
Opendrive Lined Percussive Sampler	101mm to 2.00m 75mm to 3.00m 65mm to 6.00m		Robert Callow	J13331
	Location Front garden	**Dates** 05/11/2013	**Engineer** Heyne Tillett Steel	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.15	D1				(0.20) 0.20	Made Ground: (50 mm gravel over dark brown mottled brown slightly sandy silty clay with gravel of flint, brick and ash clinker. Occasional roots).		
0.50	D2					Soft becoming firm brown mottled grey CLAY with rare roots To 2.00m; slightly gravelly. Gravel is subrounded medium and coarse flint. To 3.00m; occasional orange silty clay lenses and pockets. and pockets of black clay.		
1.00-1.45 1.00	SPT N=7 D3	DRY	1,2/2,1,2,2					
1.50	D4					Below 1.50m; fissured.		
2.00-2.45 2.00	SPT N=8 D5	DRY	1,1/2,2,2,2			Below 2.00m; silty.		
2.50	D6							
3.00-3.45 3.00	SPT N=13 D7	DRY	2,2/3,3,3,4		(6.25)	Below 3.00m; brown with blue-grey gleying around decomposing roots. Locally rare green and yellow fine and medium sand lenses.		
						Below 3.60m; occasional selenite crystals.		
4.00-4.45 4.00	SPT N=14 D8	DRY	2,3/3,3,4,4			Below 4.10m; brown.		
4.50	D9							
5.00-5.45 5.00	SPT N=18 D10	DRY	3,4/4,4,5,5			At 4.80m; single decomposed root 20mm stained dark red and orange. Below 5.00m; stiff.		
6.00-6.45 6.00	SPT N=21 D11	DRY	3,4/5,5,5,6			Below 5.70m; occasional orange silt dustings on fissure surfaces.		
			05/11/2013:DRY		6.45			
						Complete at 6.45m		

Remarks Groundwater was not encountered. On completion, a groundwater monitoring standpipe was installed to 6.00m.	**Scale (approx)** 1:50	**Logged By** CS
	Figure No. J13331.BH2	

Geotechnical & Environmental Associates

Tyttenhanger House
Coursers Road
St Albans
AL4 0PG

Site	Borehole Number
23 Downside Crescent, London, NW6 2AN	BH2

Installation Type	Dimensions	Client	Job Number
Standpipe	Internal Diameter of Tube [A] = 19 mm Diameter of Filter Zone = 65 mm	Robert Callow	J13331

Location	Ground Level (mOD)	Engineer	Sheet
Front garden		Heyne Tillett Steel	1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
				0.10	Concrete
				1.00	Bentonite Seal
				6.00	Slotted Standpipe

Groundwater Strikes During Drilling

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

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)
05/11/13							6.45		DRY	

Instrument Groundwater Observations

Inst. [A] Type : Slotted Standpipe

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	
08/11/13		DRY		
22/11/13		4.95		
28/11/13		3.53		

Remarks

Geotechnical & Environmental Associates

Tyttenhanger House
Coursers Road
St Albans
AL4 0PG

Standard Penetration Test Results

Site : 23 Downside Crescent, London, NW6 2AN

Client : Robert Callow

Engineer : Heyne Tillett Steel

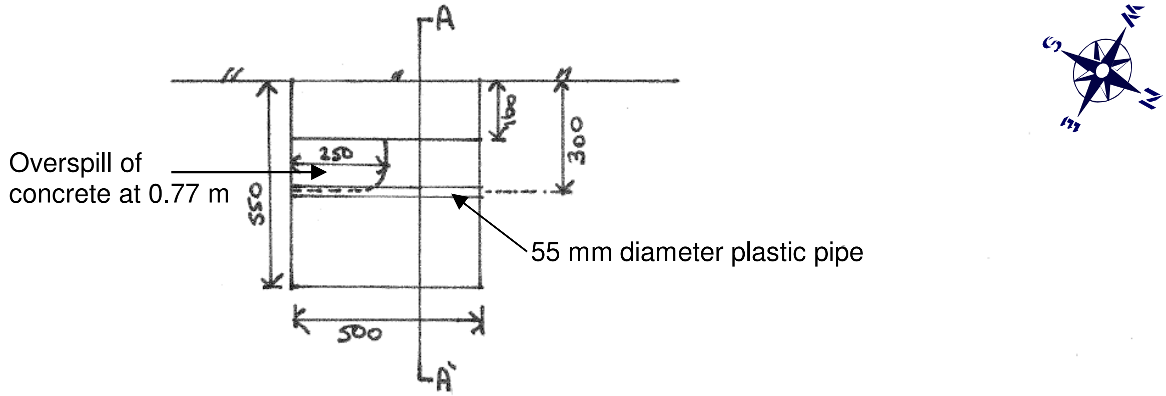
Job Number J13331

Sheet 1 / 1

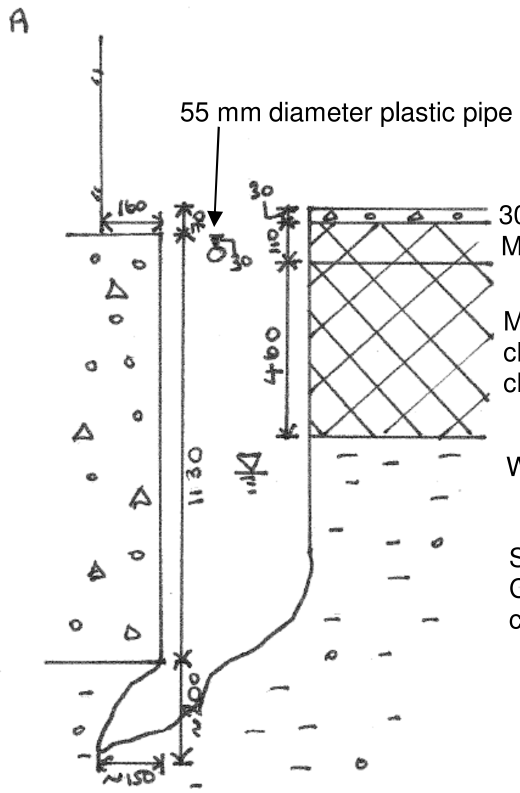
Borehole Number	Base of Borehole (m)	End of Seating Drive (m)	End of Test Drive (m)	Test Type	Seating Blows per 75mm		Blows for each 75mm penetration				Result	Comments
					1	2	1	2	3	4		
BH2	1.00	1.15	1.45	SPT	1	2	2	1	2	2	N=7	
BH2	2.00	2.15	2.45	SPT	1	1	2	2	2	2	N=8	
BH2	3.00	3.15	3.45	SPT	2	2	3	3	3	4	N=13	
BH2	4.00	4.15	4.45	SPT	2	3	3	3	4	4	N=14	
BH2	5.00	5.15	5.45	SPT	3	4	4	4	5	5	N=18	
BH2	6.00	6.15	6.45	SPT	3	4	5	5	5	6	N=21	

GEA Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans Herts AL4 0PG		Site 23 Downside Crescent, London, NW3 2AN	Trial Pit Number 1
Excavation Method Manual	**Dimensions** 500 x 550 x 1400	**Ground Level (m TBM)**	**Client** Robert Callow	**Job Number** J13331
	Location Rear garden	**Dates** 5.11.13	**Engineer** Heyne Tillett Steel	**Sheet** 1 / 7

Plan: -



Section A - A': -



30 mm concrete slab

Made Ground: (Concrete and sand rubble).

Made Ground: (Dark brown and brown slightly sandy clay with gravel of brick, flint, concrete, clinker and ash clinker. Occasional roots).

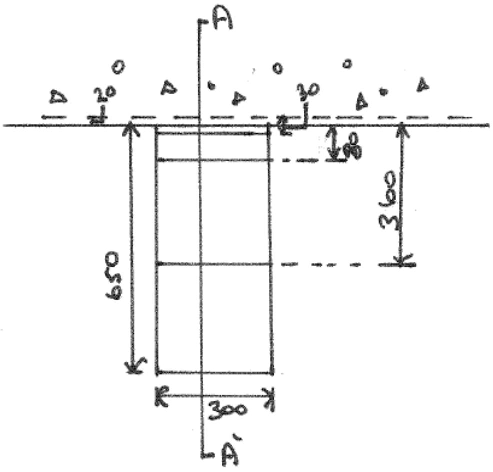
Water at 0.60 m.

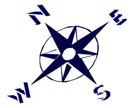
Soft orange-brown and grey mottled slightly gravelly CLAY. Gravel is subangular and subrounded fine to coarse flint. Rare subrounded flint cobbles <120 mm.

Remarks:	Scale:
All dimensions in millimetres	1:20
Sides of trial pit remained stable during excavation	Logged by:
Water encountered at 0.60 m.	CS

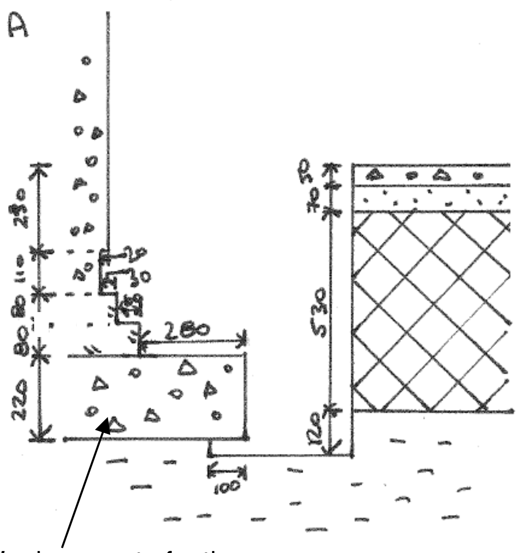
GEA Geotechnical & Environmental Associates — Tyttenhanger House, Coursers Road, St Albans, Herts AL4 0PG		Site: 23 Downside Crescent, London, NW3 2AN	Trial Pit Number: 2
Excavation Method Manual	**Dimensions** 300 x 650 x 770	**Ground Level (m TBM)**	**Client** Robert Callow	**Job Number** J13331
	Location Rear garden	**Dates** 5.11.13	**Engineer** Heyne Tillett Steel	**Sheet** 2 / 7

Plan: -





Section A - A': -



50 mm concrete slab over 70 mm builders sand.

Made Ground: (Dark brown and brown sandy clay with gravel of flint, brick, wood, clinker and ash clinker. Occasional roots).

Firm orange-brown mottled grey CLAY with occasional black clay pockets and roots.

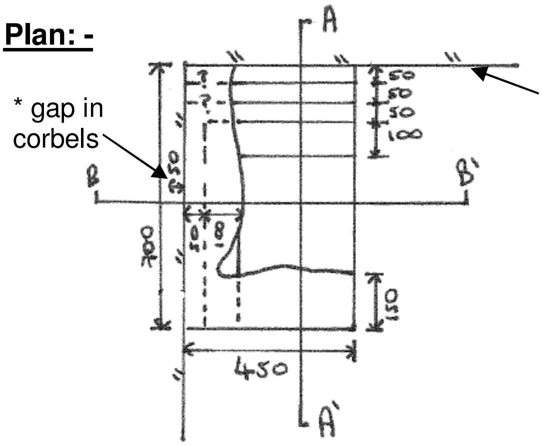
Weak concrete footing

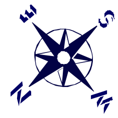
Remarks:	Scale:
All dimensions in millimetres	1:20
Sides of trial pit remained stable during excavation	Logged by:
Ground water not encountered	CS

GEA Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans Herts AL4 0PG	Site 23 Downside Crescent, London, NW3 2AN	Trial Pit Number 3

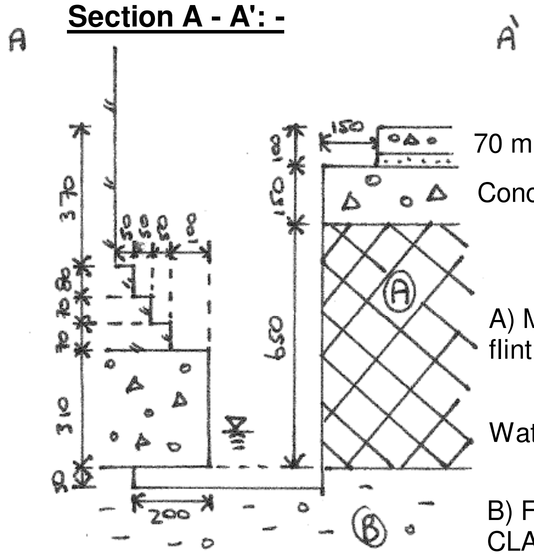
Excavation Method	Dimensions	Ground Level (m TBM)	Client	Job Number
Manual	450 x 700 x 950		Robert Callow	J13331
	Location	**Dates**	**Engineer**	**Sheet**
	Rear garden	5.11.13	Heyne Tillett Steel	3 / 7

Plan: -





Section A - A': -



70 mm concrete slab over 30 mm builders sand.

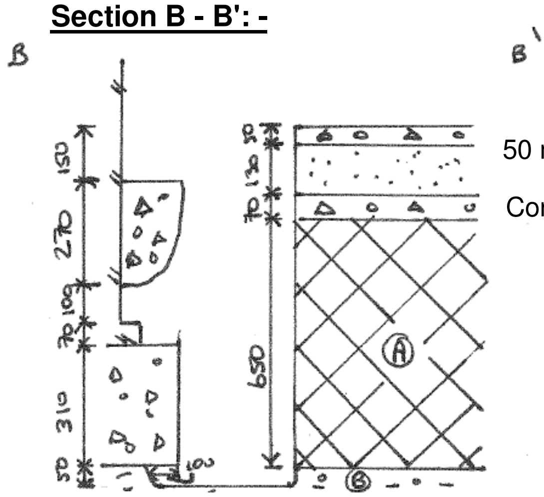
Concrete.

A) Made Ground: (Brown sandy clay with gravel of flint, brick, clinker, concrete and tile).

Water at 0.80 m.

B) Firm orange-brown mottled grey slightly gravelly CLAY. Gravel is subangular medium flint.

Section B - B': -



50 mm concrete slab over 130 mm builders sand.

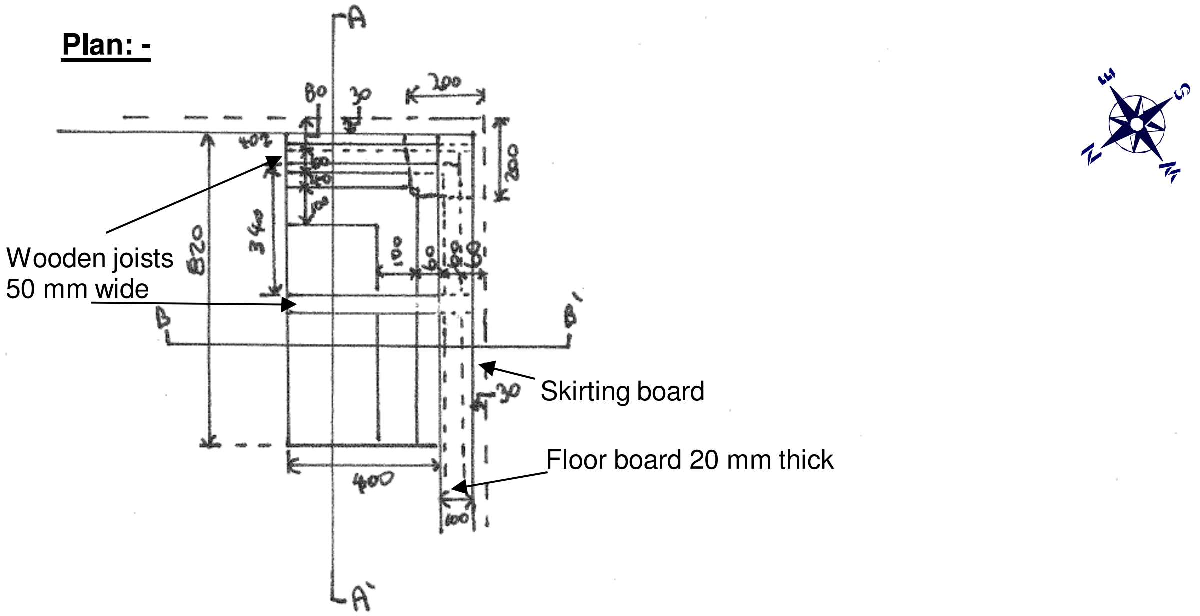
Concrete.

* 35 mm wide gap in brick corbels extends >50 mm back into wall into soft ground.

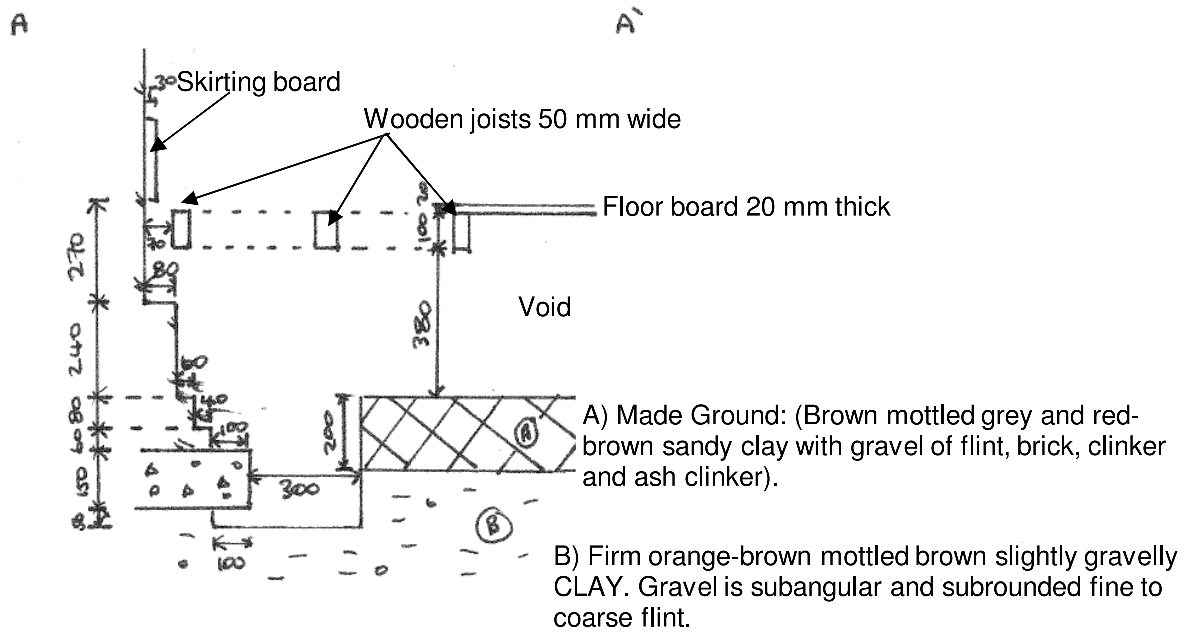
Remarks:	Scale:
All dimensions in millimetres	1:20
Sides of trial pit remained stable during excavation	Logged by:
Water encountered at 0.80 m.	CS

GEA Geotechnical & Environmental Associates		Tyttenhanger House Coursers Road St Albans Herts AL4 0PG	**Site** 23 Downside Crescent, London, NW3 2AN	**Trial Pit Number** 4
Excavation Method Manual	**Dimensions** 400 x 820 x 850	**Ground Level (m TBM)**	**Client** Robert Callow	**Job Number** J13331
	Location House	**Dates** 8.11.13	**Engineer** Heyne Tillett Steel	**Sheet** 4 / 7

Plan: -



Section A - A': -

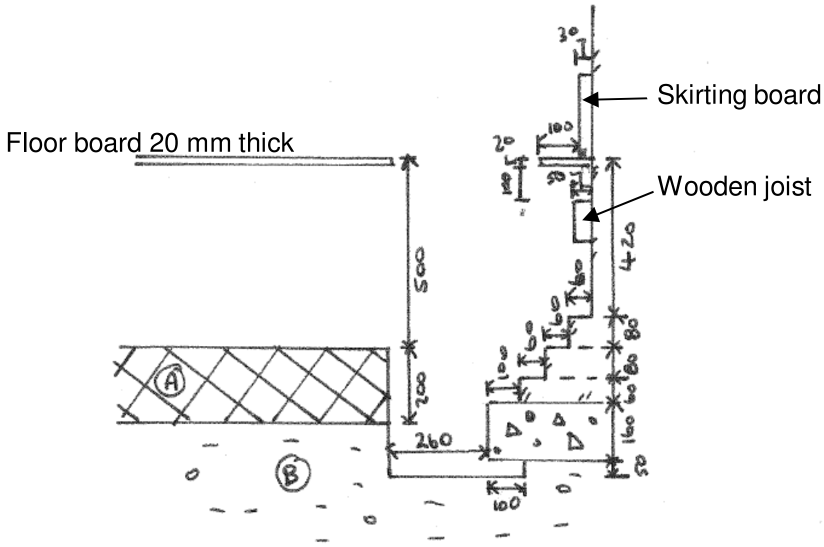


Remarks:	Scale:
All dimensions in millimetres	1:20
Sides of trial pit remained stable during excavation	Logged by:
Ground water not encountered	CS

GEA Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans Herts AL4 0PG	**Site** 23 Downside Crescent, London, NW3 2AN	**Trial Pit Number** **4**

Excavation Method	**Dimensions**	**Ground Level (m TBM)**	**Client**	**Job Number**
Manual	400 x 820 x 850		Robert Callow	J13331
	Location	**Dates**	**Engineer**	**Sheet**
	House	8.11.13	Heyne Tillett Steel	5 / 7

B **Section B - B': -** B'



Remarks:
All dimensions in millimetres
Sides of trial pit remained stable during excavation
Ground water not encountered

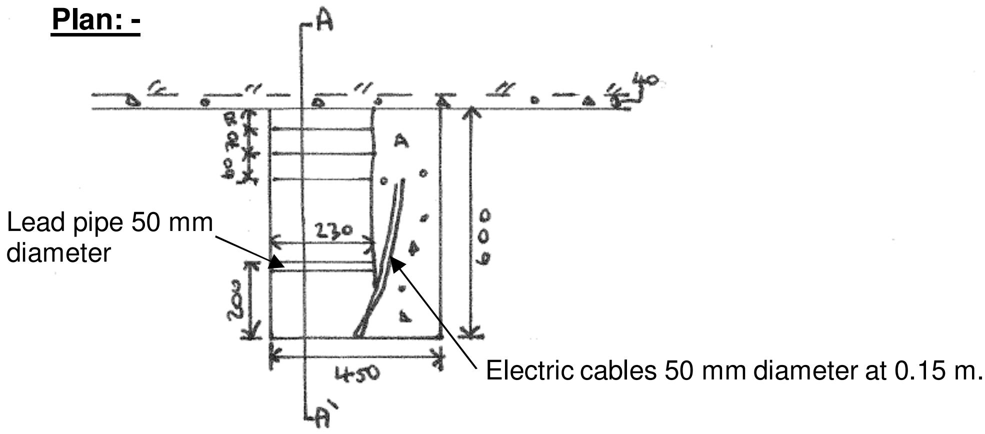
Scale: 1:20

Logged by: CS

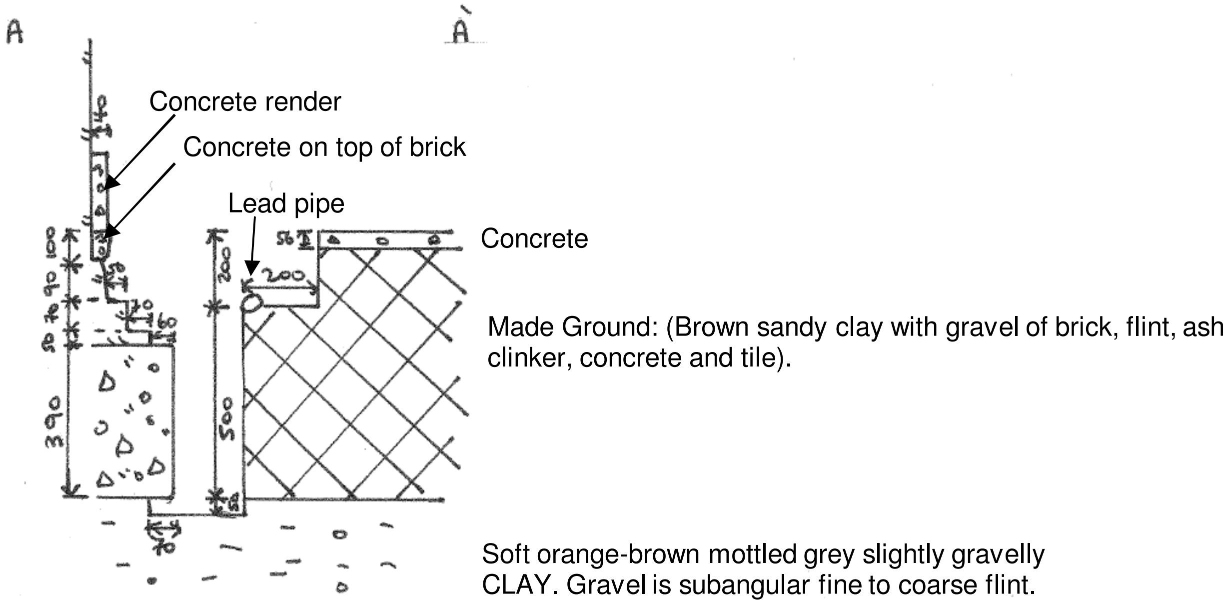
GEA Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans Herts AL4 0PG	**Site** 23 Downside Crescent, London, NW3 2AN	**Trial Pit Number** 5

Excavation Method	**Dimensions**	**Ground Level (m TBM)**	**Client**	**Job Number**
Manual	450 x 600 x 750		Robert Callow	J13331
	Location	**Dates**	**Engineer**	**Sheet**
	Side passage	8.11.13	Heyne Tillett Steel	6 / 7

Plan: -



Section A - A': -

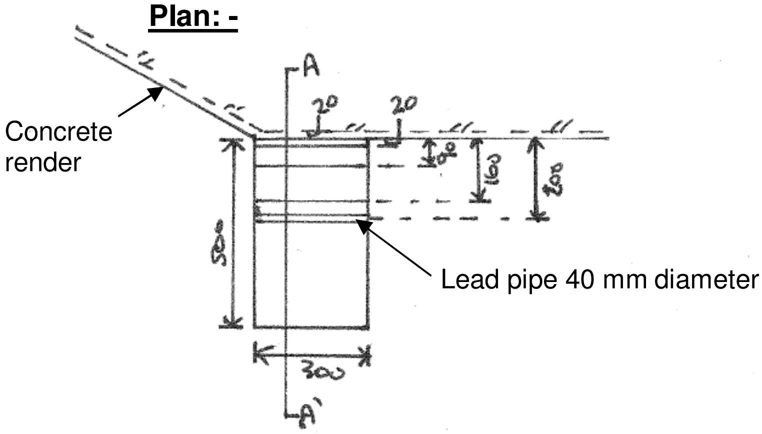


Remarks:	Scale:
All dimensions in millimetres	1:20
Sides of trial pit remained stable during excavation	Logged by:
Ground water not encountered	CS

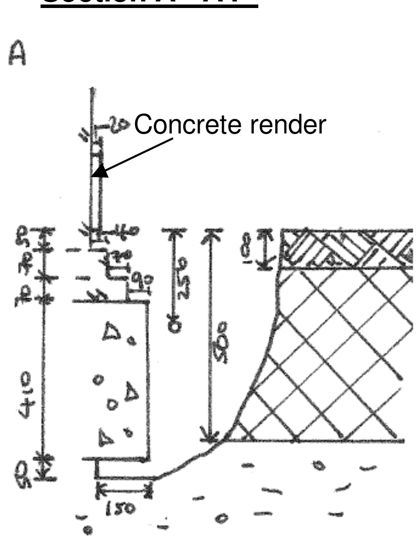
GEA Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans Herts AL4 0PG	**Site** 23 Downside Crescent, London, NW3 2AN	**Trial Pit Number** 6

Excavation Method	**Dimensions**	**Ground Level (m TBM)**	**Client**	**Job Number**
Manual	300 x 500 x 650		Robert Callow	J13331
	Location	**Dates**	**Engineer**	**Sheet**
	Front garden	8.11.13	Heyne Tillett Steel	7 / 7

Plan: -



Section A - A': -



Topsoil: (Dark brown / black silty clay with frequent roots).

Made Ground: (Brown sandy clay with gravel of flint, slate. ash clinker and concrete. Rare roots).

Firm orange-brown mottled grey slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse flint.

Remarks:	Scale:
All dimensions in millimetres	1:20
Sides of trial pit remained stable during excavation	Logged by:
Ground water not encountered	CS

Trial Pit Photographs

Site	23 Downside Crescent, London, NW3 2AN	**Job Number**	J13331
Client	Robert Callow	**Sheet**	1 / 4
Engineer	Heyne Tillett Steel		

Trial Pit No 1

Trial Pit No 2

Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans Herts AL4 0PG	**Trial Pit Photographs**

Site	23 Downside Crescent, London, NW3 2AN	**Job Number** J13331
Client	Robert Callow	**Sheet** 2 / 4
Engineer	Heyne Tillett Steel	

Trial Pit No 3