elliottwood

30 Ellerdale Road

London, NW3 6BB

Basement Impact Assessment and Subterranean Construction Method Statement

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Appendices

1.0 Introduction

1.1 Elliott Wood Partnership LLP is a firm of consulting structural engineers approximately 100 strong operating from their head office in South West London. Residential developments of all scales have been central to the workload of the practice with many in the Greater London area. In particular Elliott Wood Partnership LLP have been producing designs for basements to both existing and new buildings. To date this numbers approximately 500 sites many of which have been in the London Borough of Camden. Our general understanding of the development of London, its geology and unique features together with direct experience on many sites puts us in a strong position to advise clients on works to their buildings and in particular the design and construction of their basement.

1.2 Elliott Wood Partnership LLP were appointed by the building's owner to advise on the structural implications of the proposed refurbishment works and construction of a new basement under the building and part of the garden. This report follows the guidance given in the Camden Planning Guidance on Basements and lightwells CPG4, DP23 and DP27. The Basement Impact Assessment has been carried out by GEA and Elliott Wood Partnership LLP with persons holding the required qualifications relevant to each stage. The purpose of the statement is to demonstrate a suggested method, form and sequence of construction for the new basement so as not to adversely affect any neighbouring structures or infrastructure.

1.3 Access has generally been gained to all parts of the site and building. A site investigation has been completed at the property comprising of four trial pits and three augered boreholes.

1.4 A detailed set of drawings showing the existing site, building and proposed works has been provided by KSR Architects.

2.0 Description of Existing Building and Site Conditions

2.1 No. 30 Ellerdale Road is a detached three storey house built in late 1960s, situated in the London Borough of Camden. The house has previously undergone works to construct a new single storey rear extension and generally alter the layout of the building throughout. Elliott Wood Partnership LLP were the Structural Engineers for these works and therefore have a good understanding of the existing structure.

2.2 The existing building is constructed as a load bearing masonry structure supporting timber floor joists at the upper levels with a concrete ground bearing slab at ground floor level. There are a number of steel beams and picture frames that have been installed as part of the refurbishment works.

2.3 The site slopes from the front to the rear with the back of the rear garden being 3.2metres below the front. The rear garden is terraced over three levels with brick retaining walls at each level.

2.4 A site investigation has been carried out consisting of three boreholes and four trial pits which indicates that the underlying ground is Claygate member overlaid by between 1 to 3 metres of made ground. Ground water was monitored in the boreholes and found to be approximately 6.5metres below internal ground floor level.

2.5 There are a number of mature trees both in the garden of number 30 and in adjacent gardens. The proximity of the existing and new trees will need to be considered in the final design of the basement and its foundations.

2.6 The results of our desk study can be summarised as follows;

- The building does not appear to be in the vicinity of any historic rivers (reference Lost Rivers of London, Nicholas Barton).
- The site is located within Flood Zone 1 as shown on the latest Environment Agency Flood Maps, which indicates that the property is at low risk from flooding (reference; www.environment-agency.gov.uk).
- The site does not appear to be in the vicinity of any London Underground Ltd infrastructure (reference; www.google.co.uk/maps).
- The LCC London Bomb Damage Maps shows significant bomb damage to the previous property on the site. (reference, The LCC London Bomb Damage Maps 1939-1945, LTS)

3.0 Proposed Alterations

3.1 The proposal includes the construction of a new single storey basement under the footprint of the main house and part of the rear garden.

3.2 The new basement will be constructed by underpinning the perimeter walls of the main house and then installing a contiguous piled wall around the remainder of the proposed basement. This will allow for the safe excavation of the basement. A new reinforced concrete box will be installed inside the piled wall.

3.3 The underpins and piles will be designed to safely support all the earth and surcharge loads applied to it in the temporary and permanent condition.

3.4 The underpinning will need to be laterally propped at various levels during construction. The propping will provide lateral restraint to the underpins during excavation and therefore limit any potential movement of adjacent walls and floors to an acceptable amount.

3.5 Suitable monitoring arrangements should be agreed with the adjoining owners and specified to ensure that movements are maintained within acceptable limits and that early and immediate action can be taken to prevent any unexpected deflections or settlement.

4.0 Proposed Below Ground Drainage

4.1 Public sewer records have been obtained from Thames Water. The records have confirmed that there is a 1143mmx764mm combined sewer within Ellerdale Road. These can be found in the Appendix.

4.2 The Environment Agency flood zone maps indicate that the site is located in Flood Zone 1 (Low Risk) and as the site area is less than 1 Hectare, a Flood Risk Assessment in accordance with The National Planning Policy Framework (NPPF) is not normally required.

4.3 A CCTV drainage survey of the on-site drainage has been undertaken and has confirmed that the existing on-site drainage is combined (foul and surface water share the same pipe). It is proposed that the existing drainage connection to the public sewer is retained, subject to its condition and location.

4.4 As the proposed basement is below the level of the site drainage and sewer, a submersible packaged pumping station will be required to pump the basement sanitary appliances. To reduce the size of this pumping station (and to reduce the risk of flooding in the unlikely event of power failure/pump malfunction), it is proposed that the drainage for the ground floor and above is drained by gravity.

4.5 It is proposed that the new on-site drainage (foul and surface water) is kept separate where possible before connecting to the final manhole on site and then discharging to the combined public sewer within Ellerdale Road.

4.6 We understand that 1m of soil is proposed over the basement at the rear of the property. As the proposed hard standing area will be the same as the existing situation, the surface water runoff will not increase.

5.0 Party Wall Matters

5.1 The proposed works development falls within the scope of the Party Walls Act 1996. Procedures under the Act will be dealt with in full by the Employer's Party Wall Surveyor. The Party Wall Surveyor will prepare and serve necessary Notices under the provisions of the Act and agree Party Wall Awards in the event of disputes. The Contractor will be required to provide the Party Wall Surveyor with appropriate drawings, method statements and other relevant information covering the works that are notable under the Act. The resolution of matters under the Act and provisions of the Party Wall Awards will protect the interests of all owners.

5.2 The designs for 30 Ellerdale Road will be developed so as not to preclude or inhibit similar, or indeed any, works on the adjoining properties. This will be verified by the Surveyors as part of the process under the Act.

6.0 Hydrogeological Statement Summary

6.1 From the published data and site investigation completed, groundwater was monitored at approximately 6.5metres below internal ground floor level.

6.2 The formation level of the proposed basement is higher than the monitored ground water level. Localised pumping may still be required to deal with any seepage and surface water flow in the made ground however groundwater is unlikely to be encountered. Please refer to the basement impact assessment in the Appendix for more information.

6.3 Arup's Subterranean Development Scoping Study (para 5.1), June 2008, notes that the impact of subterranean development on groundwater flows is negligible as groundwater flows will find an alternative route if blocked by a subterranean structure.

7.0 Basement Waterproofing

7.1 The proposed basement will be designed to achieve a Grade 3 level of waterproofing protection as outlined in BS8102:2009.

7.2 The basement walls will be cast using water resistant concrete to form the primary barrier with an internal drained cavity system as a secondary barrier against possible water ingress. As part of the system any water that seeps through will be collected in a sump and be pumped up to high level where it will drain under gravity into the existing system.

8.0 Conclusion

8.1 It is assumed that the above measures and sequence of works are taken into account in the eventual design and construction of the proposed works.

8.2 Detailed method statements and calculations for the enabling and temporary works will need to be prepared by the Contractor for comment by all relevant parties including party wall surveyors and their engineers. Elliott Wood Partnership will need to ensure that adequate supervision and monitoring is provided throughout the works particularly during the excavation and demolition stages.

8.3 If the works noted above are properly undertaken by suitably qualified contractors, these works will pose no significant threat to the structural stability of the building or the adjoining properties.

8.4 To this end, Elliott Wood Partnership LLP will have an on-going role during the works on site to monitor that the works are being carried out generally in accordance with our design and specification. This role will typically involve weekly site visits at the beginning of the project and fortnightly thereafter. A written site report is provided to the design team, Contractor and Party Wall Surveyor.

Subterranean Construction Method Statement

9.0 Construction Method Statement

Construction Generally

Some of the issues that affect the sequence of works on this project are:
The stability of the existing building
The stability of neighbouring buildings
The stability of adjoining highways
Forming sensible access onto the site to minimise disruption to the neighbouring residents
Providing safe working environment

The proposed works involve the construction of a new basement under its footprint and part of the garden. The new basement will be constructed with a reinforced concrete box. The excavation of the new basement will require enabling works to safeguard both the adjoining buildings and highways. The preferred enabling works method is a bored reinforced concrete piled contiguous wall as this will provide a stiff retaining structure against lateral earth pressures that will limit movement of adjoining structures. It will also allow a safe means of excavation for the site operatives.

Once the works commence Elliott Wood Partnership LLP will have an ongoing role on site to monitor that the works are being carried out generally in accordance with our design and specification. This role will typically involve weekly site visits at the very beginning of the Contract and fortnightly thereafter. A written report of each site visit is provided for the Design Team, Contractor and Party Wall Surveyor.

Noise and Vibration

The Contractor shall undertake the works in such a way as to minimise noise, dust and vibration when working close to adjoining buildings in order to protect the amenities of the nearby occupiers.

All piling for the new basement will be constructed using contiguous flight augered bored piles. Due to the relatively small diameter (450mm) piles required, a mini piling rig can be used to install the piles. With the method of piling and small size of the piling rig, construction noise and vibration to adjacent properties will be minimised.

The arrangement of the site is generally beneficial for undertaking the proposed work as there is good access to the site from Ellerdale Road with front garden/drive area. As there are no works to be completed in front of the property this area can be set up for deliveries.

Below is an assumed sequence of works, this needs to be clarified by the contractor prior to commencement of works:

Stage 1: Site Set-Up

Erect a fully enclosed painted plywood site hoarding around the boundary of the site. The services within the site should be identified and isolated.

Tree Protection methods to be agreed and installed to all retained trees.

Stage 2: Enabling Works

The principles for the removal of spoil shall be agreed. Given the scope of works it is likely that conveyors will be used to move the spoil from within the building to a holding skip located outside the front of the building. Grab lorries will be used to remove the material from the skip.

Some suitable monitoring arrangements will be agreed with the adjoining owners and installed to ensure that movements are maintained within acceptable limits and that early and immediate action can be taken to prevent any unexpected deflections or settlement.

To allow for access of the piling rig the existing opening in the front façade will be enlarged with new temporary beams.

The existing ground floor slab can be broken out to allow for the piling and underpinning works to commence.

Stage 3: Installation of Bored Reinforced Concrete Piled Walls

Install the bored reinforced concrete piled retaining walls around the section of the basement outside the footprint of the building. Internal piles should also be installed to support the needles in the temporary case.

Stage 4: Installation of Temporary Needles

Install temporary needles and props to the existing walls, steel columns and beams that are being retained. The needles and props will be supported off the internal piles. Depending on location the needles will be installed at either ground or first floor level.

Stage 5: Underpinning to perimeter walls

Dig trial underpins for inspection by the structural engineer to check how well the existing soil is cemented and in particular its ability to “stand up”. Experience on nearby projects suggests that the ground is well cemented and suited to traditional underpin methods without the need for special measures.

Following completion of the above the reinforced concrete underpins to the building can proceed. The underpins should be installed in a maximum of 1 metre lengths.

The underpins should be propped at the top and base to prevent any lateral movement. The underpins will progress in a sequence to be agreed with the Contractor.

Stage 6: Bulk Excavation

Once the underpinning works are complete the bulk excavation to form the new basement can commence. Install temporary lateral propping to the underpinning across the width of the basement as required. The temporary propping will remain in place until the basement and ground floor structures are in place and have cured sufficiently.

Stage 7: Cast the Reinforced Concrete Box

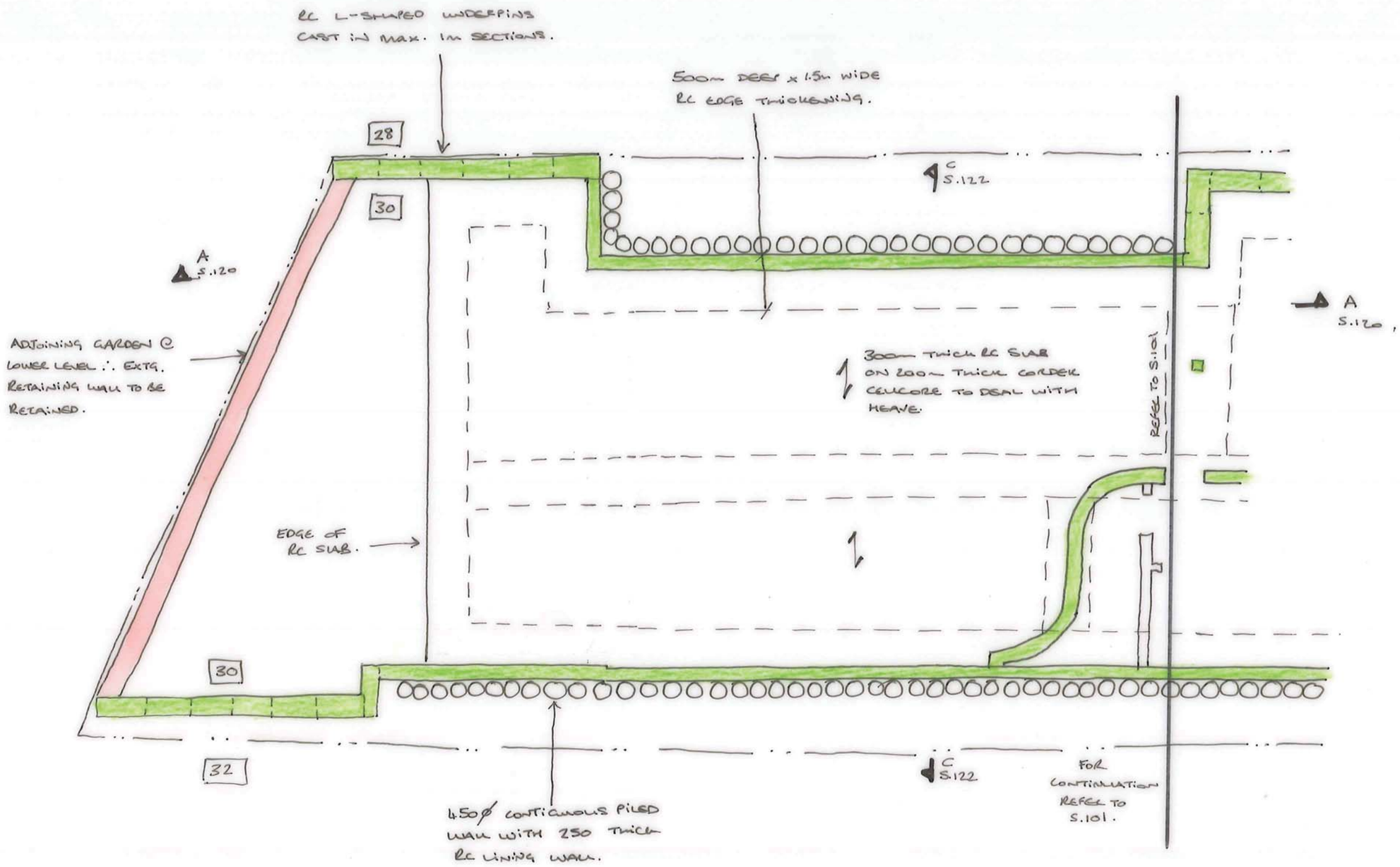
The basement slab can be cast. Once the basement slab has cured sufficiently the lateral propping directly above basement slab level can be removed. The high levels of lateral propping should be retained. The reinforced concrete lining walls can then be cast up to ground floor level.

Internal reinforced concrete walls can also be cast up to ground floor level.

Stage 8: Cast the Ground Floor Slab

Install the remaining steelwork at ground floor level. This allows for the temporary needles to be removed and the walls made good. Cast the ground floor slab. Once the slab has cured it will provide a permanent continuous prop to the top of the underpins. The upper level of lateral propping to the underpins can then be removed.

1.0 Proposed Drawings



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drawing title
PROPOSED BASEMENT PLAN (1 of 2)

scale(s)	date	drawn
1:100 @ A3	20.08.15	SWa

drawing status
PRELIMINARY

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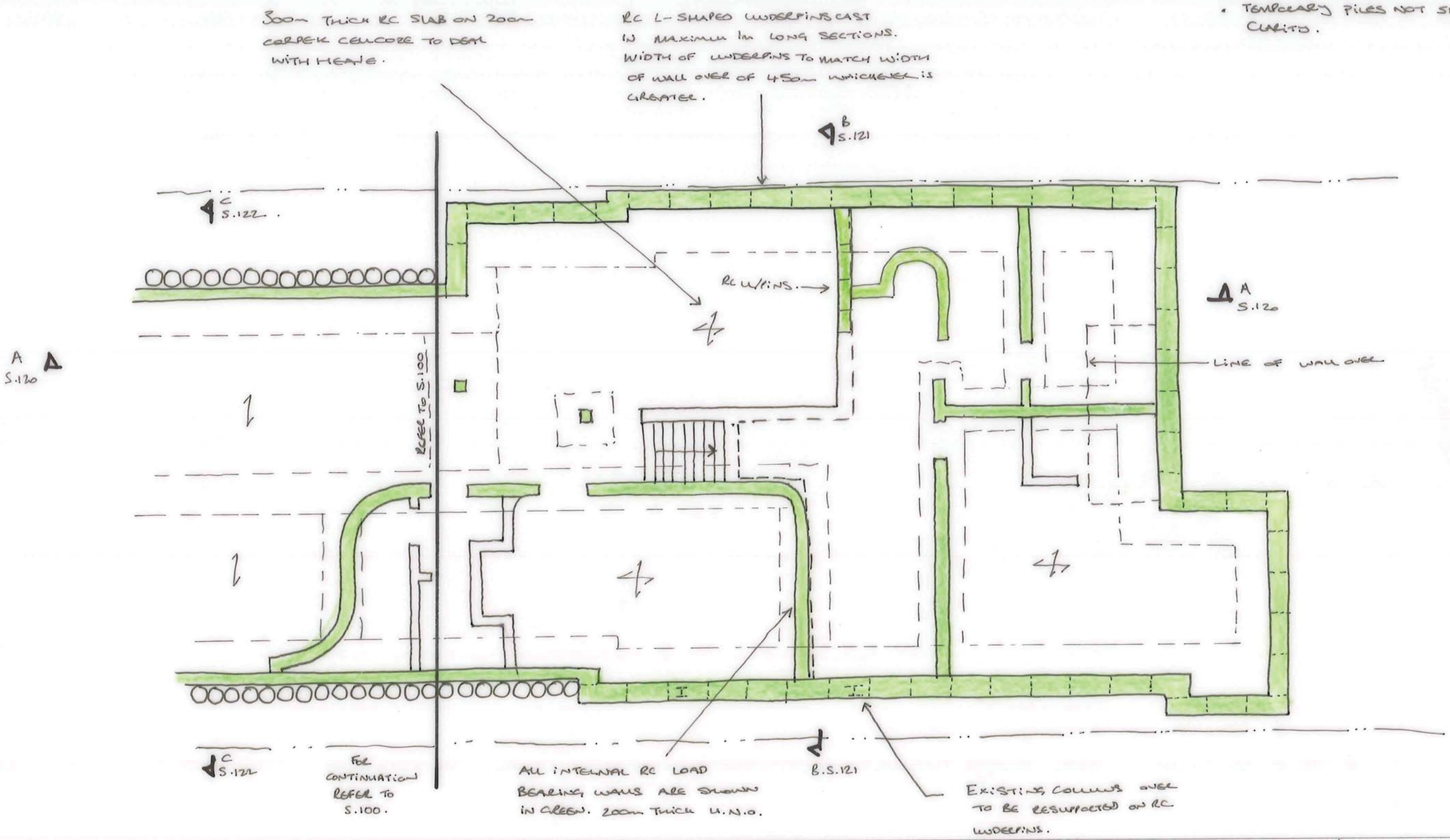
job no	drawing no	revision
211369	S.100	P1

NOTES:

- UNDERPIN SHAFTS TO BE FULLY PROPPED IN TEMP. CASE. ALL UNDERPINS TO REMAIN PROPPED UNTIL GROUND + BASEMENT SLABS HAVE BEEN CAST.
- TEMPORARY PILES NOT SHOWN FOR CLARITY.



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1:100@A3	20.08.15	SWC.

drawing status: PRELIMINARY

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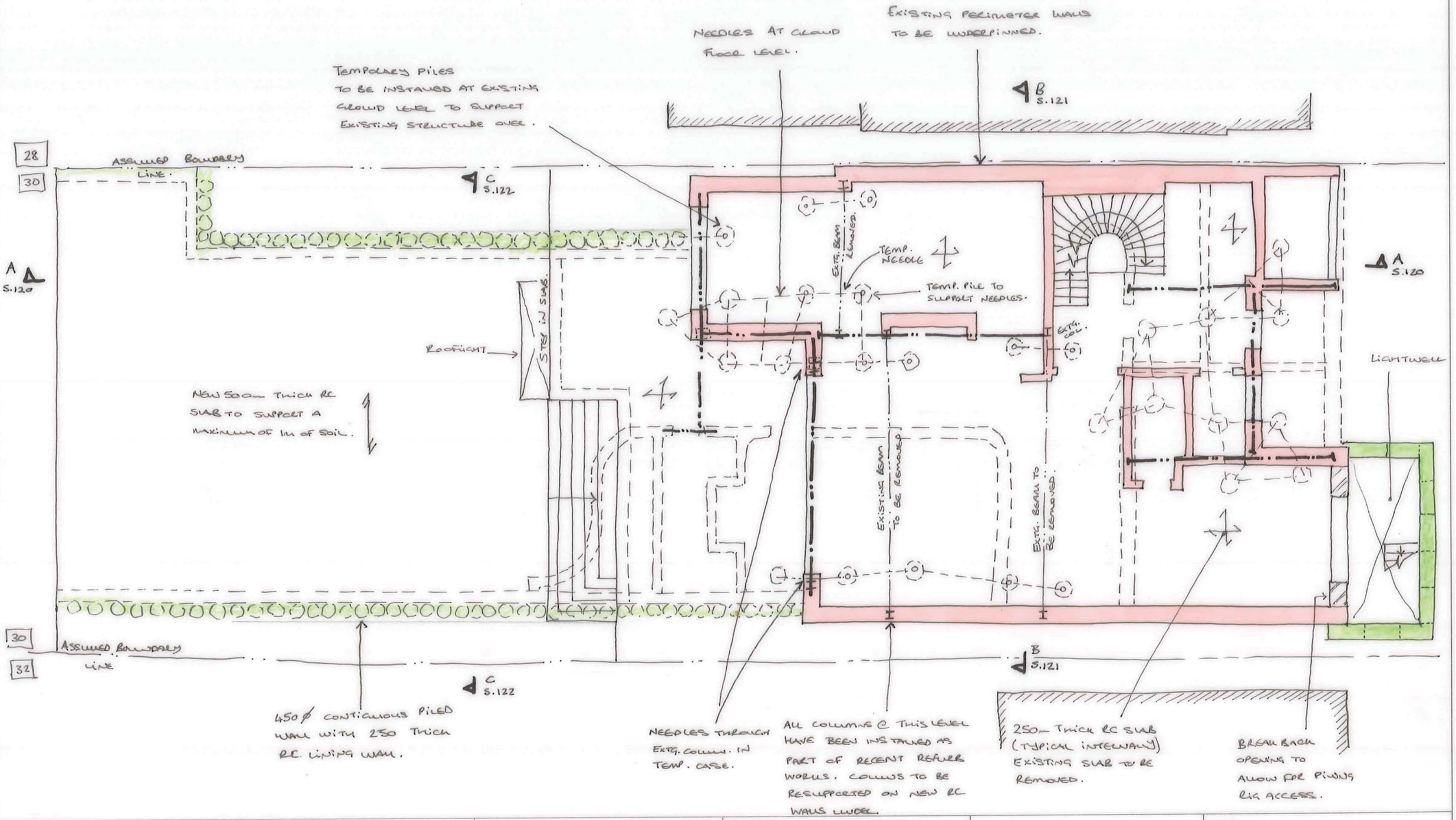
job no	drawing no	revision
211369	S.101	P5



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drawing title
PROPOSED GROUND FLOOR PLAN

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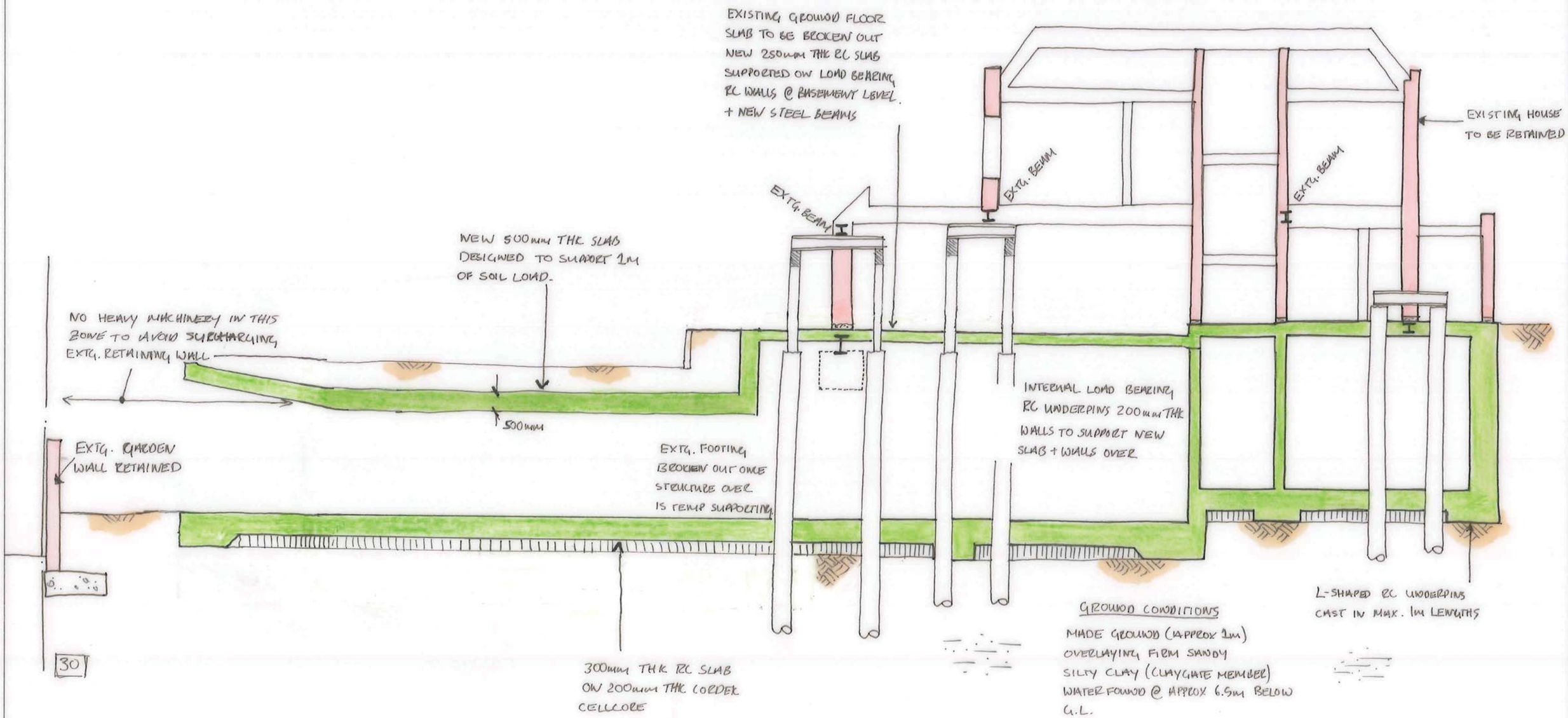

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SECTION A.A

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drawing status
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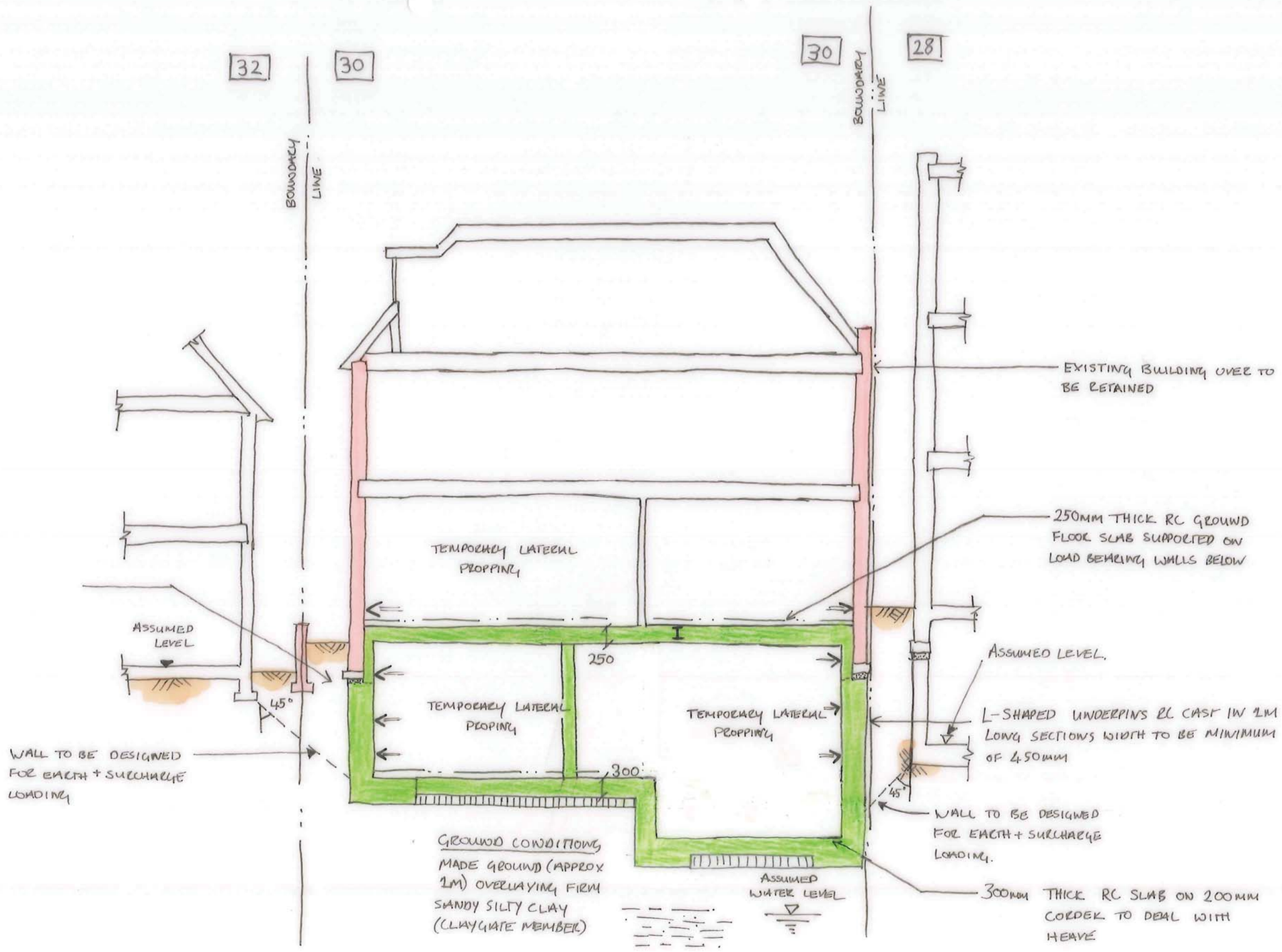
job no	drawing no	revision
211369	S.120	P5



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drawing status
PRELIMINARY

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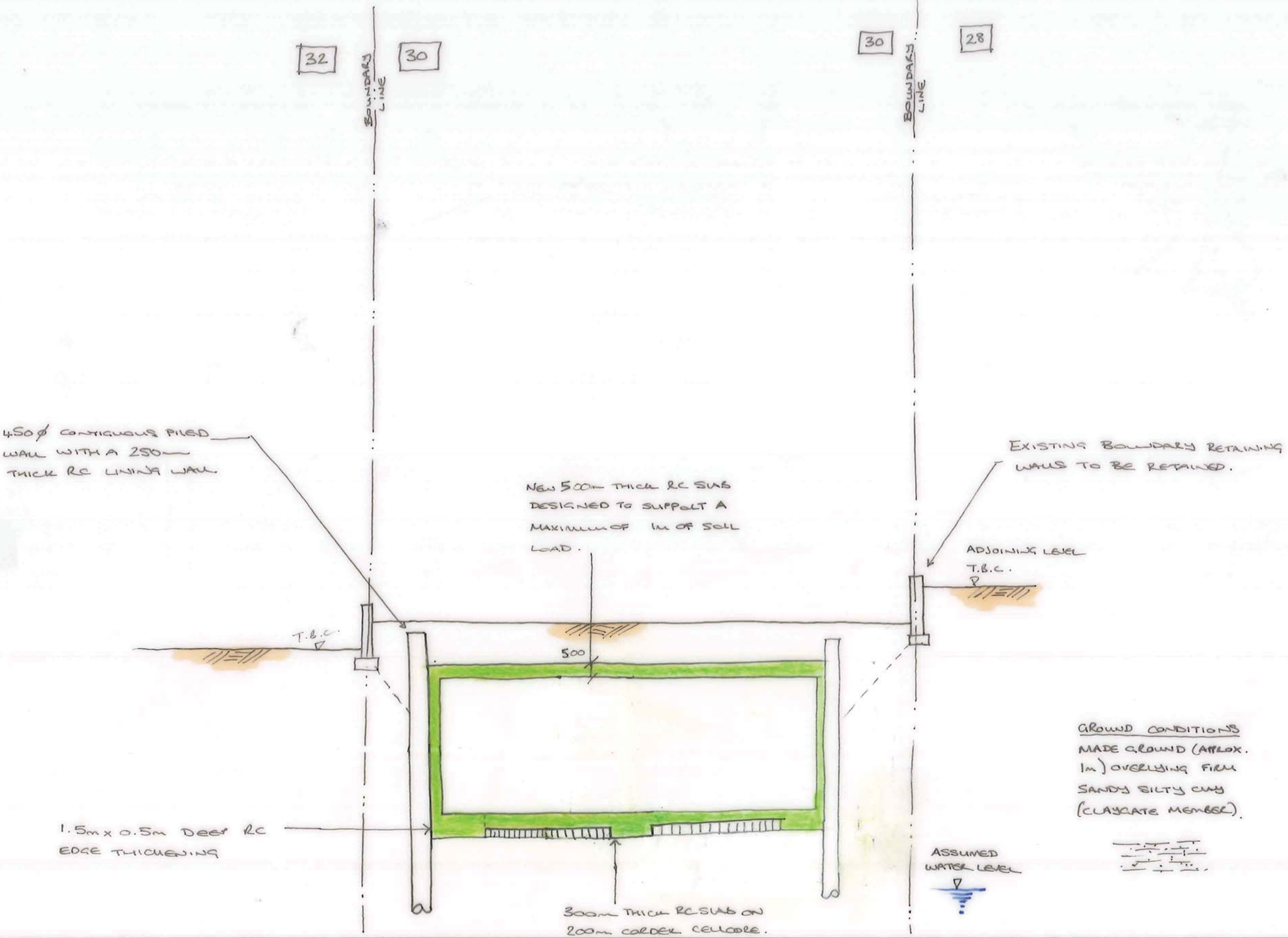
211369	S.121	P2



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drawing title

SECTION C-C

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drawing status

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job no	drawing no	revision
211369	S.122	P4

2.0 Desktop Study and Ground Investigation Report

Desk Study and Ground Investigation Report

30 Ellerdale Road
London
NW3 6BB

Client	Mr & Mrs Susskind
Engineer	Elliott Wood Partnership
	J11162
	September 2011

GEA Geotechnical & Environmental Associates

Document Control

Project title	30 Ellerdale Road, London, NW3 6BB	**Project ref**	J11162
Report prepared by	Caroline Anderson MEng AUS	Martin Cooper BEng CEng MICE	
Report checked by	Juliet Fuller BSc MSc DIC FGS		
Report approved for issue by	Steve Branch BSc MSc CGeol FGS FRGS MIEnvSc		

Issue No	Status	Date	Approved for Issue
1	Final	3 October 2011	

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.

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GEA Geotechnical & Environmental Associates

CONTENTS

30 Ellerdale Road, London, NW3 6BB
Mr & Mrs Susskind
Desk Study and Ground Investigation Report

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 desk study, including hydrogeological assessment, and ground investigation carried out by Geotechnical and Environmental Associates Limited (GEA), on the instructions of Elliott Wood Partnership, on behalf of Mr & Mrs Susskind, with respect to the construction of a single level basement beneath the existing house on this site. 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 and hydrogeology, to assess the extent of any contamination and to provide information to assist with the design of the basement and suitable foundations for the proposed development.

DESK STUDY FINDINGS

At the time of the earliest Ordnance Survey (OS) map, dated 1850, Ellerdale Road had not been constructed and the site was undeveloped. By 1871, the land was occupied by a series of footpaths in an area called Mount Farm. By 1895, Ellerdale Road had been constructed and the site formed part of the rear garden of a large detached house located to the south, with a greenhouse shown within the site boundary. At some time between 1936 and 1946 a building was constructed on the site and another building was constructed adjacent to the north of the site. Bomb damage maps and the OS map dated 1946 indicate these buildings to no longer exist at this time, following severe bomb damage during World War II. By 1946 the house to the south had been redeveloped as two semi-detached properties. The existing house on the site was constructed between 1968 and 1970.

GROUND CONDITIONS

The investigation has encountered a significant thickness of made ground or topsoil over the Claygate Member. The topsoil and made ground extended to depths of between 1.00 m (94.40 m OD) and 3.00 m (89.00 m OD). On the western side of the site the Claygate Member comprised light brown mottled orange brown fine silty sand to depths of between 3.0 m (89.0 m OD) and 3.4 m (88.60 m OD). This sand was underlain by soft becoming firm light brown mottled orange brown silty very sandy clay, in turn overlying stiff brown silty very sandy fissured clay interbedded with silty clayey sand which extended to depths of between 6.00 m (86.00 m OD) and 11.00 m (84.40 m OD). This was underlain by stiff dark brown very silty sandy clay with occasional shell fragments to the maximum depth investigated of 20.0 m (72.0 m OD).

Groundwater inflows were encountered at depths of 8.00 m (83.00 m OD) and 15.00 m (77.00 m OD), both rising to 6.50 m (85.50 m OD) after 20 minutes. Subsequent monitoring of groundwater in all boreholes recorded depths of between 6.46 m (88.79 m OD), and 6.55 m (85.45 m OD) after one week.

RECOMMENDATIONS

Excavations for the proposed basement structure will require temporary support to maintain stability and to prevent any excessive ground movements. Based on the groundwater observations to date, groundwater is not likely to be encountered within the basement excavation, although further monitoring should be carried out to confirm this. Traditional mass concrete underpinning is likely to provide the most appropriate method of extending the existing foundations and supporting the basement excavation, although trial excavations will be required in order to check the stability of the sandy clay. Spread foundations bearing within the firm very silty sandy clay of the Claygate Member below basement level should provide a net allowable bearing pressure of 100 kN/m^2.

Part 1: INVESTIGATION REPORT

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

1.0 INTRODUCTION

Geotechnical and Environmental Associates (GEA) has been commissioned by Elliott Wood Partnership, on behalf of Mr & Mrs Susskind, to carry out a desk study and ground investigation at 30 Ellerdale Road, London, NW3 6BB.

1.1 Proposed Development

It is proposed to construct a single level basement to a depth of 3.0 m below the existing two-storey property.

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

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 assess the possible impact of the proposed development on the local hydrogeology;
- to provide advice with respect to the design of suitable 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
- 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:

- three boreholes, advanced to a depth of 20.0m, by means of a dismantlable cable percussion drilling rig;

- standard penetration tests (SPTs), carried out at regular intervals in the boreholes, to provide additional quantitative data on the strength of the soils;
- four window sampler boreholess using a petrol-driven percussion hammer to a depth of 5.0m;
- three trial pits manually excavated to investigate the configuration of existing foundations;
- laboratory testing of selected soil samples for geotechnical purposes and for the presence of contamination; 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.

1.3.1 Basement Impact Assessment

The work carried out also includes a Hydrogeological Assessment and Land Stability Assessment (also referred to as Slope Stability Assessment), all of which form part of the Basement Impact Assessment (BIA) procedure specified in the London Borough of Camden (LBC) Planning Guidance CPG4[2] and their Guidance for Subterranean Development[3] prepared by Arup. The aim of this work is to provide information on the groundwater conditions specific to this site and land stability, in particular to assess whether the development will affect the stability of neighbouring properties and whether any identified impacts can be appropriately mitigated.

The BIA elements of the work have been carried out by Martin Cooper, a BEng in Civil Engineering, a chartered engineer (CEng) and member of the Institution of Civil Engineers (MICE), who has over 20 years' specialist experience in ground engineering, together with with Steve Branch, a BSc in Engineering Geology and Geotechnics, MSc in Geotechnical Engineering, a chartered geologist (CGeol) and Fellow of the Geological Society (FGS) with 25 years' experience in geotechnical engineering, engineering geology and hydrogeology. Both assessors meet the Geotechnical Specialist criteria of the Site Investigation Steering Group and satisfy the qualification requirements of the Council guidance.

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

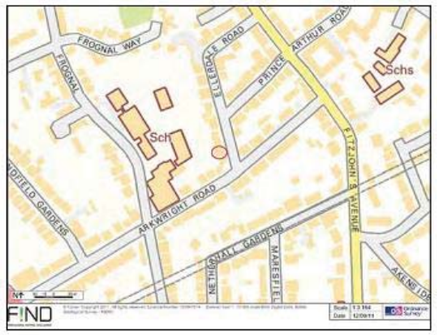
1 *Model Procedures for the Management of Land Contamination* issued jointly by the Environment Agency and the Department for Environment, Food and Rural Affairs (DEFRA) Sept 2004
2 London Borough of Camden Planning Guidance CPG4 *Basements and lightwells*
3 Ove Arup & Partners (2010) *Camden geological, hydrogeological and hydrological study. Guidance for Subterranean Development.* For London Borough of Camden November 2010

testing. Any comments made on the basis of information obtained from the client or other third parties are given in good faith on the assumption that the information is accurate; no independent validation of such information has been made by GEA.

2.0 THE SITE

2.1 Site Description

The site is located in Hampstead, northwest London, approximately 425 m to the southwest of Hampstead London Underground station, and 410m to the north east of Finchley Road and Frognal railway station. The site may be additionally located by National Grid Reference 526349, 185363 and is shown on the adjacent map.



The site forms a roughly rectangular area with maximum dimensions of approximately 55 m east-west by 15 m north-south and is occupied by No 30 Ellerdale Road, a two storey detached house with integral garage and associated front and rear gardens. The house fronts onto Ellerdale Road to the east and is bordered to the north and south by Nos 28 and 32 Ellerdale Road respectively and to the west by private gardens associated with houses fronting onto Arkwright Road and tennis courts in the grounds of the adjacent University College School (UCS).

The front garden comprises a concrete paved driveway in the north and a lawn in the south with planted borders which contain shrubs and bushes. A semi-mature London Plane tree is located outside the boundary on Ellerdale Road. The garden is laid to lawn in its entirety with planted borders which contain shrubs, bushes and deciduous trees.

The southern extent of Ellerdale Road is largely level with a gentle slope to the south where it connects to Arkwright Road. The site itself slopes south-westwards towards Frognal and the adjacent UCS. The rear garden is terraced over three levels which would have been formed by a cut and fill exercise. Each terrace level is retained by up to 1.0m of brick retaining wall. The westernmost boundary of the site is at a level approximately 3.2 m below the eastern boundary, and given the local topography the site remains elevated relative to the adjacent school to the southwest.

2.2 Site History

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

At the time of the earliest Ordnance Survey (OS) map, dated 1850, Ellerdale Road had not been constructed and the site was undeveloped. By 1871, the site was occupied by a series of footpaths in an area called Mount Farm. By 1895, Ellerdale Road had been constructed and

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the site formed part of the rear garden of a large detached house to the south. A greenhouse is also shown within the site boundary at this time.

At some time between 1936 and 1946 a building was constructed on the site and another building adjacent to the north of the site. Bomb damage maps and the OS map dated 1946 indicate these buildings to no longer exist at this time, following severe bomb damage during World War II. By 1946 the house to the south had been redeveloped as two semi-detached properties. The existing house on the site was constructed between 1968 and 1970.

2.3 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.

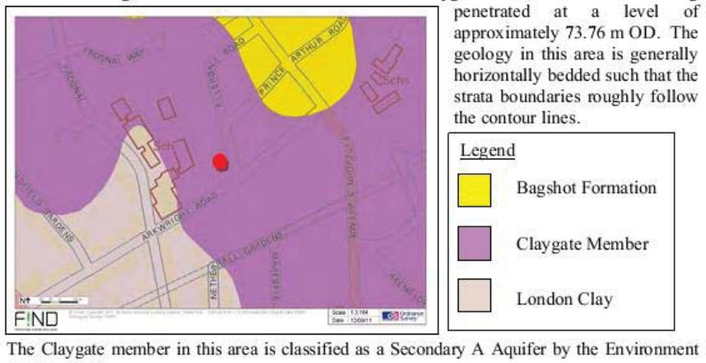
The search has revealed that there are no landfills, waste management, transfer, treatment or disposal sites within 500 m of the site.

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

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

2.4 Geology and Hydrogeology

The Geological Survey map of the area (sheet 256) indicates the site to be underlain by the Claygate Member of the London Clay. The Claygate Member forms the youngest part of the London Clay Formation, the basal boundary of which is shown on the OS map to lie at approximately 85.0 m OD in this area. However, previous investigations by GEA in this area have indicated that the base of Claygate Member extends some 10 m lower, to about 75 m OD. These records are corroborated by a BGS borehole drilled in Hampstead village, which extended through the full 33.4 m thickness of the Claygate Beds, with the base being penetrated at a level of approximately 73.76 m OD. The geology in this area is generally horizontally bedded such that the strata boundaries roughly follow the contour lines.



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

The boundary between the Bagshot Formation and the underlying Claygate Member is located to the north of the site. Existing and historical spring lines are present at the interface of the sandy Bagshot Formation and the underlying less permeable Claygate, and between the Claygate and the underlying essentially impermeable London Clay. These springs have been the source of a number of London's "lost" rivers, notably the Westbourne and Tyburn, which generally rose on Hampstead Heath. The OS map dated 1871 shows a tributary of the River Westbourne flowing approximately 120 m to the west of the site, adjacent to the existing line of Frognal, which had not yet been constructed. By the time of the map dated 1895, Frognal had been constructed along with several houses on the western side. The site itself remained undeveloped although the former river is not shown, suggesting that it had either been culverted or diverted.

Any water infiltrating the Bagshot Formation will generally tend to flow vertically downwards at a slow rate towards the Claygate Member and London Clay.

2.5 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.

2.5.1 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 gardens and the existing house for its entire developed history. However, the destruction of the building during World War II may have led to an increased thickness of made ground on the site comprising rubble and ash.

2.5.2 Receptor

The site will continue to have a residential end use following the excavation of the basement 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 contact with any contaminants present in the soils during demolition and construction works. Being underlain by a Secondary A Aquifer, groundwater is likely to be considered a moderately sensitive target.

2.5.3 Pathway

End users could conceivably come into contact with soils within private garden areas although this pathway is already in existence. Soluble contaminants within the made ground could also potentially migrate onto adjacent sites as a result of infiltration of surface run-off, this pathway is also already in existence. Except for the pathway of direct contact for site workers, no new pathways will be created by the basement excavation.

2.5.4 Preliminary Risk Appraisal

On the basis of the above it is considered that there is a very low risk of there being a significant contaminant linkage at this site which would result in a requirement for major remediation work. Furthermore, there is not considered to be a significant potential for hazardous soil gas to be present on or migrating towards the site: there should thus be no need to consider landfill gas exclusion systems.

3.0 EXPLORATORY WORK

In order to meet the objectives described in Section 1.2, three cable percussion boreholes were drilled to depths of 20.0m (72.00 m OD). In view of the limited access to the front and rear gardens the boreholes were drilled by means of a dismantlable rig. Standard penetration tests (SPTs) were carried out at regular intervals in the boreholes and disturbed and undisturbed samples were recovered for subsequent laboratory examination, geotechnical testing and contamination analysis. A standpipe was installed in each borehole to a depth of 7.0m.

Four window samples were also undertaken using a petrol-driven percussion hammer to a maximum depth of 5.0m and four trial pits were manually excavated in order to expose the existing foundations. All of the work was carried out under the supervision of a geotechnical engineer from GEA.

The borehole and trial pit records and results of the laboratory analyses are appended, together with a site plan indicating the exploratory positions. The Ordnance Datum (OD) levels on the borehole and trial pit records have been provided by Elliot Wood Partnership.

3.1 Sampling Strategy

The borehole and trial pit locations were specified by the consulting engineers and were confirmed on site by GEA to avoid the areas of known services.

Three samples of made ground were 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 are included in the Appendix together with the analytical results.

4.0 GROUND CONDITIONS

The investigation has broadly confirmed the expected ground conditions in that, beneath a significant thickness of topsoil or made ground, soil that has been identified as the Claygate Member which was proved to the full depth of the investigation.

4.1 Made Ground

The made ground extended to depths of between 1.3 m (93.95 m OD) and 3.0 m (89.0 m OD) and comprised dark brown silty sandy clay with pockets of orange brown sand, gravel, brick fragments, roots and occasional ash. The greater thickness of made ground was generally encountered in the west of the site reflecting the placing of fill to create terraces from the formerly sloping ground. Topsoil was only encountered in Borehole No 3, to a depth 1.0 m (94.40 m OD), and comprised dark grey silty clay over brown medium silty sand.

No visual or olfactory evidence of contamination was observed within these soils, although fragments of ash were noted within the made ground, which can commonly contain elevated concentrations of PAH, including benzo(a)pyrene and naphthalene. Samples of the made ground have been analysed for a range of contaminants and the results will be summarised in section 4.4 of the final report.

4.2 Claygate Member

This stratum initially comprised light brown mottled orange brown fine silty sand to depths of between 3.0 m (89.0 m OD) and 3.4 m (88.60 m OD) on the western side of the site. This upper sand was underlain by soft becoming firm light brown mottled orange brown silty very sandy clay, over stiff brown silty very sandy fissured clay interbedded with silty clayey sand extending to between 6.00 m (86.00 m OD) and 11.00 m (84.40 m OD).

The clay with layers of sand was underlain by firm becoming stiff dark brownish grey very silty sandy fissured clay with occasional shell fragments and partings of fine pale brown silty sand, which extended to the maximum depth investigated of 20.0 m (72.0 m OD). This material may possibly be the upper part (Unit D) of the London Clay and in any case, based on records from GEA archives and the BGS, it is apparent that the boreholes extended close to the base of the Claygate Member.

A pocket of water softened clay was encountered at 14.0 m (81.4 m OD) in Borehole No 3.

Plasticity index tests have indicated the clay to be of low to medium shrinkability.

4.3 Groundwater

Groundwater was initially encountered within the Claygate Member at depths of between 6.5 m (95.40 m OD) and 8.50 m (86.75 m OD), and subsequent inflows were encountered to a maximum depth of 15.0 m (77.0 m OD) in Borehole No 2. The groundwater inflows encountered in Borehole No 1 at depths of 8.00 m (83.00 m OD) and 15.00 m (77.00 m OD) both rose to 6.50 m (85.50 m OD) after 20 minute rest periods.

Standpipes were installed to a depth of 7.0 m in each of the boreholes and subsequent monitoring recorded groundwater at depths of 6.55 m (85.45 m OD), 6.46 m (88.79 m OD), and 6.49 m (88.91 m OD) in Borehole Nos 1, 2 and 3 respectively, approximately one week after installation.

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4.4 Soil Contamination

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

Determinant	Maximum concentration recorded (mg/kg)	Minimum concentration recorded (mg/kg)	Number of samples below detection limit	Normalised upper bound US_{95}
Arsenic	15	9.1	0	15
Cadmium	0.40	<0.1	2	0.4
Chromium	24	11	0	26.5
Copper	47	18	0	42.8
Mercury	2.6	0.17	0	2.6
Nickel	19	6.5	0	20.4
Lead	**1800**	230	0	**1590.2**
Selenium	0.69	<0.2	1	0.6
Zinc	310	62	0	277.0
Total Cyanide	-	<0.5	4	0.5
Total Phenols	-	<0.3	4	0.3
Sulphide	4.7	0.8	0	4.3
Total PAH	6.1	<2.0	1	6.7
Benzo(a)pyrene	0.59	<0.1	1	0.7
Naphthalene	0.14	<0.1	3	0.1
TPH	-	<10	4	0.1
Total Organic Carbon %	4.1	0.48	0	3.9

Note: The use of the normalised upper bound for 95th percentile confidence aims to remove some of the uncertainty associated with calculation of an arithmetic sample mean of a relatively small number of samples. The US95 value is the upper bound of the range within which it can be stated with 95% confidence that the true mean concentration of the data set will fall.
Figure in bold indicates concentration in excess of risk-based soil guideline values, as discussed in Part 2 of this report

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 results to assess the need for subsequent site-specific risk assessments. 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[4] 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;

4 *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. 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.

A comparison of the measured concentrations against the generic screening values has highlighted elevated concentrations of lead in the made ground. This assessment is based upon the potential for risk to human health, which at this site that is underlain by a Secondary A Aquifer is considered to be the critical risk receptor.

The significance of these results is considered further in Part 2 of the report.

4.5 Existing Foundations

The underside of the foundations of the existing house was only reached in one of the trial pits, at a depth of 1.3 m bearing on clayey sand of the Claygate Member. The base of the foundations was not encountered in Trial Pit Nos 1 and 4, whereas the foundation of the garden wall in Trial Pit No 3 was bearing on made ground.

Sketches and photographs of the trial pits are included in the Appendix.

Part 2: DESIGN BASIS REPORT

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

5.0 INTRODUCTION

Consideration is being given to the excavation of a single level basement to a depth of 3.0 m below the existing two-storey building. The anticipated load of the new structure has not been provided but is expected to be light.

6.0 GROUND MODEL

The desk study has revealed that the site has only ever been occupied by houses, and on the basis of the fieldwork, the ground conditions at this site can be characterised as follows.

- Beneath a significant thickness of made ground, the Claygate Member of the London Clay was encountered and was proved to the maximum depth investigated;
- the made ground extended to depths of between 1.3 m (93.95 m OD) and 3.0 m (89.0 m OD) and comprised dark brown silty sandy clay with pockets of orange brown sand, gravel, brick fragments, roots and occasional ash. The greater thickness of made ground was generally encountered in the west of the site, reflecting the placing of fill to create terraces from the formerly sloping ground. Topsoil was encountered in Borehole No 3 only, to a depth 1.0 m (94.40 m OD), and comprised dark grey silty clay over brown medium silty sand.
- the Claygate Member comprised an initial horizon of light brown mottled orange brown fine silty sand to depths of between 3.0 m (89.0 m OD) and 3.4 m (88.60 m OD) in the western extent of the site;
- underlying this was soft becoming firm light brown mottled orange brown silty very sandy clay, and was underlain by stiff brown silty very sandy fissured clay interbedded with silty clayey sand extending to between 6.00 m (86.00 m OD) and 11.00 m (84.40 m OD).
- firm to stiff dark brown very silty sandy and fissured clay with occasional shell fragments and partings of fine pale brown silty sand extended to the maximum depth investigated of 20.0 m (72.0 m OD);
- a zone of water softened clay was encountered in Borehole No 3 at 14.0 m (81.4 m OD) which occurs at the same depth as ground water inflow;
- groundwater was encountered during drilling at depths of between 6.50 m (95.40 m OD) and 15.0m (77.00 m OD);
- subsequent monitoring of standpipes has recorded groundwater at depths of between 6.46 m (88.79 m OD), and 6.55 m (85.45 m OD); and
- elevated concentrations of lead have been measured in the made ground.

7.0 ADVICE AND RECOMMENDATIONS

The excavation for the proposed basement structure will require temporary support to maintain stability of the existing and surrounding structures and to prevent any excessive ground movements. Based on the groundwater observations to date, groundwater is unlikely to be encountered within the basement excavation. 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.

Formation level for the proposed development will be within the Claygate Member, which should provide an eminently suitable bearing stratum for spread foundations excavated from basement level. Alternatively, piled foundations would also provide a suitable solution.

7.1 Basement Excavation

Groundwater has been measured in the standpipes at depths of 6.55 m (85.45 m OD), 6.46 m (88.79 m OD), and 6.49 m (88.91 m OD) in Borehole Nos 1, 2 and 3 respectively. Monitoring should be continued to establish equilibrium levels and the extent of any seasonal fluctuations, but at this stage it is assumed that groundwater will not be encountered in the basement excavation.

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, the existing house and surrounding structures and to protect against groundwater inflows. The choice of wall may be governed to a large extent by the access restrictions. The most cost-effective method of forming the proposed basement is likely to be traditional mass concrete underpinning constructed by means of a "hit and miss" approach. The viability of this option will however be governed by the ability of the clayey sand or firm becoming stiff sandy clay of the Claygate Member to stand unsupported and this should be checked by trial excavations extending to the proposed basement depth once access becomes available. There is also a possibility that pockets of perched water may be present within more permeable layers in the Claygate Member and excavation of trial pits will allow this possibility to be assessed.

Consideration could be given to the use of a bored pile retaining wall, which could have the advantage of being incorporated into the permanent works and will be able to provide support for structural loads. On the basis of the monitoring to date, it should be possible to adopt a contiguous bored pile wall, with the use of localised grouting if necessary in order to deal with groundwater inflows. A contiguous bored piled wall would have the disadvantage of reducing usable space in the basement, and in this respect a secant wall may be preferable as it would overcome the requirement for any secondary groundwater protection in the permanent works and maximise the basement area.

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.

7.1.1 Basement Retaining Walls

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

Stratum	Bulk Density (kg/m³)	Effective Cohesion (c' – kN/m²)	Effective Friction Angle (' – degrees)
Made ground	1700	Zero	27
Claygate Member (weathered)	1950	Zero	26
Claygate Member (unweathered)	2000	Zero	26

Groundwater is unlikely to be encountered within the excavation, although monitoring of the standpipes should be continued. At this stage, it is recommended that the basement is designed with a water level assumed to be two-thirds of the basement depth, unless a fully effective drainage system can be ensured. It may however be possible to review this requirement following additional investigation by means of trial excavations and further monitoring and the advice in BS8102:2009[5] should be followed in this respect.

7.1.2 Basement Heave

The excavation of a 3 m thickness of soil will result in an unloading of approximately 55 kN/m^2. This unloading will result in heave of the underlying clay, which will comprise short term elastic movement and longer term swelling that will continue over a number of years. These movements will be mitigated to some extent by the continued pressure applied by the existing house which will be retained although it is considered that a more detailed analysis of the possible heave should be carried out once the basement design has been finalised.

7.2 Spread Foundations

Moderate width pad or strip foundations excavated from basement level to bear in the medium dense clayey sand or firm sandy clay may be designed to apply a net allowable bearing pressure of 100 kN/m^2. This value incorporates an adequate factor of safety against bearing capacity failure and should ensure that settlement remains within normal tolerable limits.

7.3 Piled Foundations

For the ground conditions at this site some form of bored pile is likely to be the most appropriate type. A conventional rotary augered pile may be appropriate, with temporary casing installed into the top of the Claygate Member to maintain stability and prevent groundwater inflows, but casing may also be required to extend to 15.0 m where deeper inflows of groundwater were recorded. Alternatively, consideration could be given to the use of bored piles installed using continuous flight auger (cfa) techniques which would not require the provision of casing. The final choice of pile type will be largely governed by the access restrictions and working area.

The following table of ultimate coefficients may be used for the preliminary design of bored piles, which have been based on the SPT & Cohesion / OD level graph in the appendix.

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

Ultimate Skin Friction		**kN/m²**
Made Ground	GL to 93.0 m OD (basement excavation)	Ignore
Claygate Member ($\alpha = 0.5$)	93.0 m OD to 75.0 m OD	Increasing linearly from 25 to 67.5
Ultimate End Bearing		**kN/m²**
London Clay	79.0 m OD to 75.0 m OD	Increasing linearly from 1080 to 1215

In the absence of pile tests, guidance from the London District Surveyors Association[6] (LDSA) suggests that a factor of safety of 2.6 should be applied to the above coefficients in the computation of safe theoretical working loads. On the basis of the above coefficients and a factor of safety of 2.6, it has been estimated that a 450 mm diameter pile founding at a depth of, 15 m (78.0 m OD) below existing ground floor level should provide a safe working load of about 335 kN. Alternatively, a 450 mm diameter pile founding at a depth of 18 m (75.0 m OD) below ground floor level should provide an increased safe working load of 445 kN.

The above examples are not intended to constitute any form of recommendation with regard to pile size or type, but merely serve to illustrate the use of the above coefficients. Specialist piling contractors should be consulted with regard to the design of a suitable piling scheme for this site.

7.4 Shallow Excavations

On the basis of the trial pit findings, it is considered likely that it will be feasible to form relatively shallow excavations that extend through the made ground and terminate within the underlying sand without the requirement for lateral support, although localised instabilities may occur from within the made ground. Where personnel are required to enter excavations, a risk assessment should be carried out and temporary lateral support or battering of the excavation sides will be required in order to comply with normal safety requirements.

Inflows of groundwater into shallow excavations are not generally anticipated, although seepages may be encountered from perched water tables within the made ground, particularly within the vicinity of existing foundations, although such inflows should be suitably controlled by sump pumping.

7.5 Basement Floor Slabs

Following the excavation of the basement, it should be possible to adopt a ground bearing floor slab bearing on the natural clayey sand or sandy clay.

7.6 Hydrogeological Assessment

The current development proposal includes the construction of a single level basement beneath the existing house, which will extend to a depth of up to 3.0 m (92.4 m OD), into the Claygate Member.

6 LDSA (2009) *Foundations No 1 – Guidance notes for the design of straight shafted bored piles in London Clay.* LDSA Publication

Groundwater has been measured at a depth of approximately 6.5 m below ground level and the basement excavation is therefore unlikely to encounter groundwater inflows. A moderate thickness of clay will remain below formation level, however the frequent partings of sand would prevent the new basement from providing a cut-off to groundwater flows and will not cause any significant increase in the water level on the upstream side and thus have no influence on the local hydrogeology.

7.7 Site Specific Risk Assessment

Consideration is being given to the construction of a basement extension beneath the footprint of the existing house. No sources of contamination were identified during the desk study or fieldwork and there is considered to be a low risk of there being a significant contamination linkage at this site. Furthermore, there is not considered to be a significant potential for hazardous soil gas to be present. However, chemical analyses carried out on samples of the underlying soils have revealed elevated concentrations of lead in the made ground. The elevated concentrations of lead have been recorded in two samples of soil from Trial Pit Nos 2 & 4 and, whilst the high concentrations were not identified as statistical outliers, this is likely to be due to the limited number of samples tested, as the other results were all at background levels or below.

The high concentrations are most likely to be attributable to fragments of coal dust, metal or paint in the sample tested. Trial Pit Nos 2 and 4 were both located at the rear of the property in a flower bed and under concrete slab paving respectively. These contaminants have been subject to percolation of surface run-off for a number of years and yet still remain in the ground; consequently, it is considered that the measured concentrations do not represent soluble contamination. In addition, the flower bed forms a very limited area of soft landscaping within an area of hard cover. The made ground in this area is likely to be removed as part of the basement excavation and in view of the fact that end users are unlikely to come into contact with the soil by direct contact remedial measures are not deemed necessary. However, further assessment in the form of additional testing may be required to satisfy the Local Authority. It is also recommended that standard practices of health and safety are maintained by the site workers during construction.

7.7.1 Site Workers

As with all previously developed sites, should any suspicious soils be encountered during ground works, this assessment should be reviewed by a suitably qualified engineer. The measured contaminants could pose a potential risk to ground workers in the short term and 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[7] and CIRIA[8] and the requirements of the Local Authority Environmental Health Officer.

7.8 Waste Disposal

Any spoil arising from excavations or landscaping works will need to be disposed of to a licensed tip. Under the European Waste Directive landfills are classified as accepting inert, non-hazardous or hazardous wastes in accordance with the EU waste Directive.

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

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

Based upon on the results of the contamination tests and the technical guidance provided by the Environment Agency[9] the made ground in Trial Pit Nos 2 & 4 are likely to be classified as Hazardous waste based on the high lead concentrations. Elsewhere, the made ground from this site would be generally classified as a Non-Hazardous waste, whilst the natural soils may be classified as an Inert waste. However, it is recommended that a review should be carried out of the excess spoil that is likely to be generated and that should significant quantities of ash and clinker be encountered within this spoil that further testing be carried out to classify it as being a hazardous waste or a non-hazardous waste. WAC leaching tests should then be carried out on any material to be disposed of to landfill that is likely to be classified as being hazardous. Such WAC leaching tests may not be necessary upon samples of natural soils which are to be disposed of as an inert waste as the site may be considered as having had an uncontaminated history.

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 onsite prior to excavation by sufficiently characterising the soils insitu prior to excavation.

The above opinion with regard to the classification of the excavated soils 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.

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

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

APPENDIX

GEA Geotechnical & Environmental Associates

Tyttenhanger House, Coursers Road, St Albans, AL4 0PG

Site	Borehole Number
30 Ellerdale Road, London, NW3 6BB	BH1

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable percussion	150mm cased to 15.00m	92.00	Mr and Mrs Susskind	J11162

Location	Dates	Engineer	Sheet
Rear Garden	08/08/2011-10/08/2011	Elliott Wood Partnership	1/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
							Made Ground (paved surface over brown silty sandy clay with fragments of brick, gravel and roots))		
0.30	D1					(1.00)			
0.50	D2								
1.00	D3				91.00	1.00	Made Ground (brown very silty clay with ash, brick fragments, gravel and partings of sand)		
1.20	D4								
1.85	D5					(1.50)			
2.00-2.45	CPT N=5	2.00	DRY	1,0/1,1,1,2					
2.00	D6								
2.30	PT	2.00	DRY						
2.50	PT	2.00	DRY		89.50	2.50	Light brown mottled orange brown fine grained very silty SAND		
2.75	D7					(0.50)			
3.00-3.45	SPT N=11	2.80	DRY	1,2/3,2,3,3	89.00	3.00	Soft becoming firm light brown mottled orange brown silty very sandy CLAY with frequent partings of fine sand		
3.00	D8								
3.75	D9								
4.00-4.45	CPT N=12			1,2/3,3,3,3					
4.00	D10					(3.00)			
4.75	D11								
5.00-5.45	SPT N=14			2,3/4,3,3,4					
5.00	D12								
5.40	PT	5.00	DRY						
6.00	PT	5.50	DRY		86.00	6.00	Stiff dark brown very silty sandy CLAY with occasional shell fragments		
6.00	D13								
6.50-6.95	U1								
7.50	D14								
8.00	D15			Water strike(1) at 8.00m, rose to 6.50m in 20 mins, sealed at NOT SEALEDm.					
8.00-8.45	SPT N=16			1,2/3,4,4,5					
9.00	D16								
9.50-9.95	SPT N=14			1,1/3,3,3,5					
9.50	D17								

Remarks
Ground water monitored at 6.55m on 19/08/11
Standpipe installed at 7.0m
Services pit to 1.2m

Scale (approx)	Logged By
1:50	CA

Figure No. J11162.BH1

GEA Geotechnical & Environmental Associates

Tyttenhanger House, Coursers Road, St Albans, AL4 0PG

Site	Borehole Number
30 Ellerdale Road, London, NW3 6BB	BH1

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable percussion	150mm cased to 15.00m	92.00	Mr and Mrs Susskind	J11162

Location	Dates	Engineer	Sheet
Rear Garden	08/08/2011-10/08/2011	Elliott Wood Partnership	2/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.50	D18								
11.00	D19								
11.00-11.45	D2								
11.50-11.95	SPT N=16			2,3/3,4,4,5					
11.50	D20								
12.50	D21								
13.00-13.45	SPT N=20			2,3/4,4,6,6					
13.00	D22								
14.00	D23								
14.50-14.95	SPT N=22			2,4/4,5,6,7					
14.50	D24								
				Water strike(2) at 15.00m, rose to 6.50m in 20 mins. 09/08/2011:12.00m		(14.00)			
15.50	D25			10/08/2011:6.20m					
15.00	PT	9.00	12.00						
16.00-16.45	U3								
17.00	D26								
17.50-17.95	SPT N=23			3,3/4,5,6,8					
17.50	D27								
18.50	D28								
19.50	PT	15.00	DRY						
19.55	D29								
19.55-19.95	CPT 50*/100 N=0			50/ 10/08/2011:19.60m	72.00	20.00			

Remarks

Scale (approx)	Logged By
1:50	CA

Figure No. J11162.BH1

GEA Geotechnical & Environmental Associates

Tyttenhanger House, Coursers Road, St Albans, AL4 0PG

Boring Method	Casing Diameter	Ground Level (mOD)	Site	Borehole Number
Cable percussion	150mm cased to 15.00m	92.00	30 Ellerdale Road, London, NW3 6BB	BH1
	Location: Rear Garden	Dates: 08/08/2011-10/08/2011	Client: Mr and Mrs Susskind	Job Number: J11162
			Engineer: Elliott Wood Partnership	Sheet: 3/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
20.00	PT	15.00	19.60						

Remarks

Scale (approx): 1:50

Logged By: CA

Figure No.: J11162.BH1

GEA Geotechnical & Environmental Associates

Tyttenhanger House, Coursers Road, St Albans, AL4 0PG

Boring Method	Casing Diameter	Ground Level (mOD)	Site	Borehole Number
Cable percussion	150mm cased to 15.00m	95.25	30 Ellerdale Road, London, NW3 6BB	BH2
	Location: Rear Garden	Dates: 10/08/2011-11/08/2011	Client: Mr and Mrs Susskind	Job Number: J11162
			Engineer: Elliott Wood Partnership	Sheet: 1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(1.30)	Made Ground (dark brown silty sandy clay with pockets of orange brown sand, gravel and brick fragments		
0.30	D1								
0.50	D2								
1.00	D3								
1.20-1.65	CPT N=6			1,1/1,1,2,2	93.95	1.30			
1.20	D4								
1.30	PT	1.00	DRY				Soft becoming firm light orange-brown and pale-grey very silty sandy CLAY with very clayey sand		
1.89	D5								
2.00-2.45	CPT N=7			1,2/1,2,2,2					
2.00	D6								
						(2.70)			
2.75	D7								
3.00-3.45	CPT N=10			1,1/2,2,3,3					
3.00	D8								
3.75	D9								
4.00-4.45	SPT N=15			1,2/3,3,3,6	91.25	4.00			
4.00	D10								
4.75	D11								
5.00-5.45	SPT N=12			1,2/2,3,3,4					
5.00	D12								
						(4.30)	With pockets of pale orange-brown silty fine sand interbedded with layers of yellow-brown very silty clayey fine sand		
6.00	D13								
6.50-6.95	SPT N=14			1,2/2,3,3,6					
6.50	D14								
7.50	D15								
8.00	U1								
8.30	PT	8.00	DAMP	SLOW(1) at 8.50m, sealed at NOT SEALEDm.	86.95	8.30	Firm becoming stiff brown silty very sandy fissured CLAY		▽1
						(1.45)			
9.00	D16								
9.50-9.95	SPT N=14			2,2/3,3,4,4					
9.50	D17								
9.75	PT	9.00	9.00		85.50	9.75	Firm becoming stiff dark brown silty fissured CLAY with		

Remarks
Ground water monitored at 6.46m on 19/08/11
Standpipe installed at 7.0m
Services pit to 1.0m

Scale (approx): 1:50

Logged By: CA

Figure No.: J11162.BH2

GEA Geotechnical & Environmental Associates — Tyttenhanger House, Coursers Road, St Albans, AL4 0PG

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable percussion	150mm cased to 15.00m	95.25	Mr and Mrs Susskind	J11162
Location	**Dates**	**Engineer**		**Sheet**
Rear Garden	10/08/2011-11/08/2011	Elliott Wood Partnership		2/2

Site: 30 Ellerdale Road, London, NW3 6BB — **Borehole Number:** BH2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
							occasional partings of fine pale brown silty sand. Fissured		
10.50	D18								
11.00	U2								
12.00	D19								
12.50	D20			SLOW(2) at 12.50m.					▽2
12.50-12.95	SPT N=15			2,3/3,3,3,6					
13.50	D21								
14.00-14.45 14.00	SPT N=15 D22			2,4/3,3,4,5					▽3
				SLOW(3) at 14.50m.					
15.00	D23					(10.25)			
15.50-15.95 15.50	SPT N=17 D24			2,3/3,4,5,5					
16.50	D25								
17.00	U3								
18.00	D26								
18.50-18.95 18.50	SPT N=17 D27			2,3/4,3,4,6					
19.25	D28								
19.55-20.00 19.55	SPT N=19 D29			1,2/3,4,5,7					
20.00	PT	15.00	18.00		75.25	20.00			

Remarks

Scale (approx)	Logged By
1:50	CA

Figure No. J11162.BH2

GEA Geotechnical & Environmental Associates — Tyttenhanger House, Coursers Road, St Albans, AL4 0PG

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable percussion	150mm cased to 14.00m	95.40	Mr and Mrs Susskind	J11162
Location	**Dates**	**Engineer**		**Sheet**
Front Garden	12/08/2011-15/08/2011	Elliott Wood Partnership		1/2

Site: 30 Ellerdale Road, London, NW3 6BB — **Borehole Number:** BH3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.30	D1						Topsoil (dark grey silty clay over brown medium silty sand)		
0.50	D2					(1.00)			
1.00	D3				94.40	1.00	Firm becoming stiff greyish brown mottled orange-brown very silty sandy CLAY with frequent partings of orange-brown fine sand and occasional gravel interbedded with layers of pale yellow-brown silty sand and pockets of clay		
1.20-1.65 1.20	CPT N=8 D4			1,2/1,2,2,3					
1.85 2.00-2.45 2.00	D5 SPT N=10 D6			2,1/2,3,2,3					
2.75	D7								
3.00 3.00-3.45	PT U1	2.90	DRY						
3.75	D8								
4.00-4.45 4.00	SPT N=12 D9			1,2/3,2,3,4					
4.75	D10								
5.00-5.45 5.00	SPT N=16 D11			2,3/4,3,4,5		(10.00)			
6.00	D12								
6.50	D13			BEADING(1) at 6.50m.					▽1
6.50-6.95	SPT N=13	6.00	DAMP	2,2/3,3,3,4					
7.50	D14								
8.00-8.45 8.00	SPT N=14 D15			2,2/3,3,4,4					
9.00	D16								
9.50-9.95 9.50	SPT N=17 D17			2,3/3,4,4,6					

Remarks
Service pit to 1.0m
Standpipe installed at 7.0m
Ground water monitored at 6.49m on 19/08/11

Scale (approx)	Logged By
1:50	CA

Figure No. J11162.BH3

GEA Geotechnical & Environmental Associates — Tyttenhanger House, Coursers Road, St Albans, AL4 0PG

Site	Borehole Number
30 Ellerdale Road, London, NW3 6BB	BH3

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable percussion	150mm cased to 14.00m	95.40	Mr and Mrs Susskind	J11162
	Location	**Dates**	**Engineer**	**Sheet**
	Front Garden	12/08/2011-15/08/2011	Elliott Wood Partnership	2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(10.00)			▽2
10.50	PT	10.00	DAMP						
10.50	D18								
					84.40	11.00			
11.00	PT	10.00	DAMP				Stiff dark brown very silty sandy fissured CLAY with a layer of soft dark grey silty CLAY at 14.0m		
11.00-11.45	U2								
12.00	D19								
12.50-12.95	SPT N=16			1,2/3,3,4,6					
12.50	D20								
13.50	D21								
14.00-14.45	U3								
14.50	D22			MED FAST(2) at 14.50m, rose to 10.00m in 20 mins, sealed at NOT SEALEDm.					▽2
14.50-14.95	SPT N=16	10.00	10.00	2,3/3,4,4,5		(9.00)			
15.50	D23								
16.00-16.45	SPT N=17			2,3/3,4,5,5					
16.00	D24								
17.00	D25								
17.50-17.95	SPT N=18			1,2/3,4,5,6					
17.50	D26								
18.50	D27								
19.55-20.00	CPT N=19			1,2/3,4,5,7					
19.55	D28								
20.00	PT	14.00	9.00		75.40	20.00			

Remarks

Scale (approx)	Logged By
1:50	CA

Figure No. J11162.BH3

GEA Geotechnical & Environmental Associates — Tyttenhanger House, Coursers Road, St Albans, AL4 0PG

Site	Number
30 Ellerdale Road, London, NW3 6BB	WS1

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Ground level approximate		92.00	Mr and Mrs Susskind	J11162
	Location	**Dates**	**Engineer**	**Sheet**
	Rear garden	12/08/2011	Elliott Wood Partnership	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.65)	Made ground (dark brown silty sandy clay with gravel, charcoal and roots)		
0.30	D1			91.35	0.65			
					(1.25)	Made ground (light brown silty sand with fine to medium gravel, brick fragments and roots)		
1.20	D2							
1.90	D3			90.10	1.90			
				90.00	(0.10)	Brown mottled orange brown and light brown silty very sandy CLAY with occasional gravel		
					2.00			
					(1.40)	Light brown mottled orange brown fine grained very silty SAND		
2.80	D4							
				88.60	3.40			
					(1.60)	Soft becoming firm orange brown becoming brown silty sandy CLAY with partings of orange brown sand and grey silty with traces of selenite		
4.50	D5							
				87.00	5.00			
						Complete at 5.00m		

Remarks
No ground water encountered

Scale (approx)	Logged By
1:50	CA

Figure No. J11162.BH4

GEA Geotechnical & Environmental Associates

Tyttenhanger House, Coursers Road, St Albans, AL4 0PG

Site	Number
30 Ellerdale Road, London, NW3 6BB	WS2

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Ground level approximate		93.05	Mr and Mrs Susskind	J11162
	Location	**Dates**	**Engineer**	**Sheet**
	Rear garden	12/08/2011	Elliott Wood Partnership	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				92.70	(0.35) 0.35	Made ground (brown silty fine sand with gravel, cobbles, roots and rootlets)		
0.20	D1					Made ground (dark brown silty sandy clay with gravel fragments of brick and cobble sized coal)		
0.70	D2				(0.95)			
				91.75	1.30	Brown silty very clayey fine SAND with occasional fine gravel		
1.80	D3				(0.70)			
				91.05	2.00	Light brown becoming orange brown very silty clayey fine SAND with occasional partings of dark grey silt		
2.70	D4							
					(3.00)			
4.50	D5							
				88.05	5.00	Complete at 5.00m		

Remarks	Scale (approx)	Logged By
No ground water encountered	1:50	CA
	Figure No.	J11162.WS2

GEA Geotechnical & Environmental Associates

Tyttenhanger House, Coursers Road, St Albans, AL4 0PG

Site	Number
30 Ellerdale Road, London, NW3 6BB	WS3

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Ground level approximate		93.05	Mr and Mrs Susskind	J11162
	Location	**Dates**	**Engineer**	**Sheet**
	Rear garden	12/08/2011	Elliott Wood Partnership	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				92.80	(0.25) 0.25	Made ground (dark brown silty clayey sand with gravel, roots and rootlets)		
0.20	D1					Made ground (brown becoming light brown silty clayey sand with gravel, cobbles, frequent brick and brick fragments, roots, and a layer of charcoal at 1.9m)		
0.70	D2							
					(2.15)			
1.50	D3							
				90.65	2.40	Brown mottled orange brown very silty SAND with gravel		
2.80	D4				(1.00)			
				89.65	3.40	Light brown mottled orange brown very silty clayey fine SAND with frequent clay pockets		
3.60	D5							
4.00	D6				(1.60)			
4.90	D7							
				88.05	5.00	Complete at 5.00m		

Remarks	Scale (approx)	Logged By
No ground water encountered	1:50	CA
	Figure No.	J11162.WS3