# BASEMENT IMPACT ASSESSMENT REPORT

59 Maresfield Gardens
London NW3

Client: Stefanie Drews

Engineer: Elliott Wood

J11251D

March 2015




Geotechnical & Environmental Associates

## Document Control

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## 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

Geotechnical and Environmental Associates (GEA) was been commissioned as Geotechnical Designers by Elliott Wood Consulting Engineers on behalf of Stefanie Drews to provide Basement Impact Assessment (BIA) information in respect of this site at Maresfield Gardens, London NW3.

The original revised Basement Impact Assessment (BIA) referenced J11251 was submitted in conjunction with Planning Application Reference 2012/6795/P and related to a two-storey basement and swimming pool. Further information was requested by Arup who were acting as advisors to the London Borough of Camden (LBC). Following clarifications, GEA submitted a revised BIA referenced J11251A and dated December 2012. Arup confirmed that they were satisfied with the assessment in a letter dated 17 April 2013. It is understood that despite initial recommendation by the Planning Officers to approve the planning application, the application was subsequently refused by LBC at the Committee stage but was granted upon appeal. A smaller scheme was subsequently prepared following consultation with neighbours, residents and the Netherhall Neighbourhood Association as well as LBC, and permission was granted in Spring 2014. Further deliberation has yielded a further scheme, referenced as Scheme 4 which incorporates a two-storey basement but with the swimming pool located in the western end of the site to reduce the maximum excavation depth. This BIA report has been compiled in respect of the current development proposal. It has been carried out in accordance with guidelines from LBC in support of a planning application. The findings of the assessment have been presented in the same format as the previous submission in order to maintain a consistent approach to the analysis.

## SCOPE OF ASSESSMENT

The key elements of the design and methodology are presented in the assessment with fuller and supporting information provided within the appendix. In common with the previous assessments, detailed information in respect of the impact of basement construction is provided and the key issues are grouped into the construction sequence, retaining wall design, movement predictions and effect on groundwater.

## CONCLUSIONS

A summary of the retaining wall designs and predicted movements is within the report. In essence, the calculations indicate that the vertical ground movements around the excavation are likely to be in the range of 10 mm to 15 mm whilst horizontal movements may be in the order of 10 mm to 18 mm. The settlements, degree of rotation and strain range induced within the 57 Maresfield Gardens building are however predicted to be such that damage to the adjacent properties would be either 'Negligible' or 'Very Slight' for each of the separate phases of work but combined, the movements put the damage to the east wall of 57 Maresfield Gardens just into the slight category. When the values are compared with the Burland limiting strain of 0.075 % for the 'Very Slight' Damage Category it is evident that the 'slight' results are barely beyond the 'very slight' damage category. On this basis, the damage that would inevitably occur as a result of such an excavation would fall within the acceptable limits set out by LBC.

Changes in groundwater level due to a potential damming effect adjacent to the proposed basement development would not occur beyond a few metres because of the very low permeability Claygate Member and London Clay Formation strata present beneath the site. It is concluded that the proposed basement development is unlikely to result in significant changes to the groundwater regime beneath or adjacent to the site. No potential adverse impacts have been identified as a result of the groundwater impact assessment.

## 1.0 INTRODUCTION

Geotechnical and Environmental Associates (GEA) has been commissioned as Geotechnical Designers by Elliott Wood Consulting Engineers on behalf of Stefanie Drews to provide Basement Impact Assessment (BIA) information in respect of this site at Maresfield Gardens in Hampstead, Northwest London. This report should be read in conjunction with the following previous reports.

A Phase 1 desk study (report ref 51148 dated June 2008), Phase 2 site investigation (report ref 51148A July 2008) and supplementary site investigation and groundwater monitoring exercise (letter ref DAA/daa/51148B/6046 dated September 2008) were previously carried out by Ian Farmer Associates.

As part of the original BIA, a separate Surface Water Assessment (report ref WE11092, dated December 2011) and Groundwater Impact Assessment (report ref 1102/R1, dated December 2011) have been completed by Elliot Wood and Chord Environmental Ltd respectively. Additional site investigation and impact assessment work has been undertaken by GEA (ref J11251 Rep Issue 3, dated May 2012) which forms Appendix 1 of this assessment.

The original revised Basement Impact Assessment (BIA) referenced J11251 was submitted in conjunction with Planning Application Reference 2012/6795/P and related to a two-storey basement and swimming pool. Further information was requested by Arup who were acting as advisors to the London Borough of Camden (LBC). Following clarifications, GEA submitted a revised BIA referenced J11251A and dated December 2012. Arup confirmed that they were satisfied with the assessment in a letter dated 17 April 2013. It is understood that despite initial recommendation by the Planning Officers to approve the planning application, the application was subsequently refused by LBC at the Committee stage but was granted on appeal.

Following consultation with neighbours, residents and the Netherhall Neighbourhood Association as well as LBC, a further scheme was prepared. That scheme, denoted as Scheme No 3, incorporated a shallower single-storey basement and a reduced below-ground footprint. A BIA report was compiled in respect of the development proposal and referenced J11251C and dated November 2013. Once again Arup acted as independent advisors and further analysis led to a final submission dated April 2014 for which planning application was also granted.

With the two application schemes in hand, deliberation has taken place and a further scheme has been proposed. This scheme takes key elements from the two granted schemes to provide a scheme with a basement that, in scale and depth, lies between the two granted schemes.

This report is an assessment of the impacts of the latest basement proposal and has been carried out in accordance with guidelines from LBC in support of a planning application. The findings of the assessment have been presented in the same format as the previous submissions in order to maintain a consistent approach to the analysis.

### 1.1 Proposed Development

It is proposed to demolish the existing house and subsequently construct a new two-storey to three-storey building with double level basement and additional swimming pool level. The formation level for the basement is proposed to be 75.75 m OD, which corresponds to approximately 8.3 m below existing site level and 6.3 m below the ground floor level of the existing house. The formation of the proposed swimming pool level will extend from the basement to a lower level formation of approximately 74.45 m OD.

This report is specific to the proposed development and the advice herein should be reviewed prior to commencement of construction.

## 1.2 Purpose of Work

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

- to address the concerns of parties that may be affected by the proposed development by responding to specific technical questions in respect of ground movements;
- to address the concerns of parties that may be affected by the proposed development by responding to specific technical questions in respect of groundwater movement;
- to assess the scheme against the criteria set out in the London Borough of Camden Planning Guidance Document CPG 4.

## 1.3 Scope of Work

In order to meet the above objectives, a detailed review of the current proposals has been undertaken and developed through the following activities:

- confirmation of proposed basement levels;
- developing the previous hydrogeological data to formulate a groundwater model;
- derivation of a construction methodology;
- establishment of a practical construction sequence;
- design calculations for the basement retaining walls and prediction of ground movement;
- prediction of ground movements that might affect adjacent structures or property; and
- provision of a report presenting the above data.

## 1.4 Limitations

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

## 2.0 THE SITE

A detailed record of the historical, physical, hydrogeological and environmental setting of the site is presented in the GEA Site Investigation and Basement Impact Assessment Report reference J11251 dated May 2012 which forms Appendix 1.

## 3.0 BASEMENT IMPACT ASSESSMENT

As previously noted, this report should be read in conjunction with the previous GEA Site Investigation Report J11251 Rep Issue 3. Within Part 1 of that report, the first three stages of the CPG 4 Basement Impact Assessment process are set out. These are 1 - Screening, 2 – Scoping and 3 – Site Investigation and Study. Whilst some details of the proposed scheme have been revised since that report, the key elements remain unchanged and therefore the findings within these three stages are considered to remain valid; for the sake of clarity these are summarised below. The work carried out comprises a Land Stability Assessment (also referred to as Slope Stability Assessment) which forms part of the Basement Impact Assessment (BIA) procedure specified in the London Borough of Camden Planning Guidance CPG4[1] and their Guidance for Subterranean Development[2] prepared by Arup along with a hydrogeological impact assessment.

### 3.1 Screening

The initial assessment identified the following potential issues that needed to be assessed:

- The site includes man made slopes greater than 7°;
- The site is underlain by the Claygate Member, which is classified by the EA as a Secondary ‘A’ Aquifer;
- The proposed basement will extend into the local water table, such that dewatering may be required;
- The site is within 5 m of a public highway; and
- The development will increase the foundation depths relative to the neighbouring properties to a significant extent.

### 3.2 Scoping

The concerns previously raised in the Arup report essentially related to the fact that at the initial planning stage, much of the detailed design had not been undertaken. The BIA dated December 2012 provided sufficient detail to satisfy Arup who confirmed this in a letter to LBC dated 17 April 2013.

The key elements of the design and methodology are presented below with fuller and supporting information provided within the appendix.

1 London Borough of Camden (2013) Planning Guidance CPG4 *Basements and lightwells*
2 Ove Arup & Partners (2010) *Camden geological, hydrogeological and hydrological study. Guidance for Subterranean Development.* For London Borough of Camden November 2010

For a proper assessment of the impact of a basement upon its surroundings, a degree of project planning and preliminary design work needs to be undertaken so that key elements may be established. These elements are largely interrelated but can be largely grouped into four categories.

- Construction sequence
- Retaining wall design
- Movement predictions
- Effect on Groundwater

In addressing these items in detail, a detailed impact assessment may be deemed to have been carried out.

## 4.0 CONSTRUCTION SEQUENCE

The following sequence of operations has been derived to enable analysis of the ground movements around the basement both during and after construction. Detailed drawings of each stage are included within Appendix 2.

Essentially the sequence may be considered as three groups of activities, the first two comprising the short and medium term temporary works whilst and the third represents the construction of the permanent works.

The demolition of the existing building and support provided to the party wall with 57 Maresfield Gardens may also be of concern but is beyond the scope of this report.

### 4.1 Temporary Works in the East Garden

The perimeter of the proposed basement structure will extend beyond the footprint of the existing building by some 4.0 m but remains some 4.0 m from the eastern site boundary with Maresfield Gardens. The current ground floor level is 81.8 m OD and the footpath level in front of the property is 85.4 m. A 2.2 m high masonry retaining wall forms much of the difference in level with the remaining 1.4 m forming a slope of about 22°.

The retaining wall runs parallel with Maresfield Gardens, retaining soils for Nos 55 and 57 in a similar manner as shown in the photograph below.

The line of the proposed piled wall is behind the masonry retaining wall. Installing these piles from the road side of the wall would require the formation of a level platform which would either require cutting or filling the site and the piling rig would cause additional loading to the retaining wall. This is not desirable but in any case, this part of the site is probably too confined for even a small piling rig to operate.

Piling in this area will therefore be undertaken from a temporary piling platform, constructed from scaffolding or similar, on the western side of the masonry wall. Preparatory works will include the reprofiling of the current slope from the road down onto the piling platform.

These measures will allow the piling of the eastern wall but in addition, they will facilitate the installation of part of the basement wall along the northern boundary beyond which lies the garden and swimming pool of 40 Netherhall Gardens.

Following piling, a capping beam will be installed and temporary props placed across the corner to minimise ground movement and avoid any cantilevered sections of wall. This will allow the eastern part of the site to be excavated to a level of approximately 82.0 m OD which will be the installation level for the remaining piles on the site both for retaining walls and bearing piles.


## 4.2 Temporary Support to Piled Walls

Following the installation of the bored pile wall and capping beams, temporary props will be installed and the basement excavation will proceed. Although the finer detail of section sizes and spacings have to be finalised by the contractor, the anticipated general arrangements are shown on the sequence drawings. The general philosophy adopted is that diagonal braces will be used across the corners or returns of the basement walls whilst props will be positioned at roughly one-third spacings along the long walls of the basement. These props will strut the north wall from the south wall.

It is anticipated that steel temporary props will be used with strut forces spread along the wall by steel waling beams fixed to the piles.

Excavation will proceed in stages as set out in detail within the appended sequence drawings but in broad terms the order of operations will be install capping beam props, excavate to a suitable depth below the next propping level, install props and then repeat the operation until the final excavation level has been reached.

### 4.3 Permanent Works

When the final excavation depths have been reached the permanent works will be formed. The basement will comprise reinforced concrete walls with a drained cavity lining the inside of the bored pile wall. Reinforced concrete will be used for floor slabs and it is anticipated that heave protection will be installed beneath the lowest slabs.

In the eastern part of the site a light well will be formed. The lightwell will be a relatively small opening but necessarily free of floors between the final ground level and basement level. For this structure the permanent propping forces will be transmitted into the superstructure by thickened stiff reinforced concrete waling beams or stiff zones within the permanent internal retaining structure. It is acknowledged that the full extent of this element of the structure will only be determined at detailed design stage.

The floor slabs will be constructed lowest level first and when each floor has achieved adequate strength, the temporary props will be removed and the subsequent walls and floors cast until the structure is structurally complete.

## 5.0 RETAINING WALL DESIGN

It is recognised that the final retaining wall design is likely to be undertaken by the successful piling contractor and that it will be tied into elements of both temporary and permanent works undertaken by the principal contractor appointed for the construction. Plainly with planning permission not yet in place a contractor has not been appointed so a preliminary geotechnical design of the piled retaining walls has been undertaken by GEA. The design has been carried out to establish the most likely pile diameter and depths required for the basement and to estimate the movement of the retaining walls both in the short term during construction and also in the long term when different soil properties will govern wall behaviour.

### 5.1 Basis of Design

The design has been undertaken using the Wallap software (Version 6.05 Revision A42.B57.R48) produced and licensed by Geosolve and commonly used by piling contractors for their design of multi-propped pile retaining walls. This analysis has adopted the BS EN 1997 Eurocode 7 method of analysis although it is understood that some piling contractors may prefer to use the approach set out in CIRIA Report C580[3].

Observation of groundwater during the drilling of the boreholes and the subsequent monitoring and rising head permeability testing have indicated that the basement will need to be sealed against groundwater ingress. Layers of fine material are present within the Claygate Beds and these layers of silty sand are likely to be the path through which groundwater would seep into the basement. In order to prevent the possible ingress of such fine material or groundwater it is proposed that the piled retaining walls will be of secant construction and at this stage it is thought likely that a hard / firm wall will be adopted. In such a wall the 'female' piles are constructed from unreinforced weak concrete with the all of the bending moments and shear forces resisted by the fully reinforced 'male' piles. Given that a lining wall will be installed to face the secant wall, it may be that specialist piling contractors will consider that a hard / soft secant piled wall may be appropriate, where the female piles are constructed from a mix of cement, bentonite and sand.

3 Gaba, A, Simpson, B, Powrie, W and Beadman, D (2003) *Embedded retaining walls – guidance for economic design* CIRIA Report C580.

The female piles have been assumed to provide no contribution to the structural strength of the wall and are present only to prevent ingress of fines and water. These piles do not therefore need to extend to the full depth of the male piles and may be terminated within non-productive strata below the basement formation level. At this site the London Clay, assumed to be a non-productive stratum is present at 73.5 m OD. This level is beneath the deepest excavation level of 74.45 m OD and so the design is based upon female piles extending to a level of 72.5 m OD. At such a toe level, piles will be formed with a roughly 1.0 m penetration into the London Clay and hence prevent groundwater flow beneath the piles.

On the basis of the size of the site and the pile diameter proposed it is thought likely that the piling rig to install the piles will be in the weight range of 12 tonnes to 20 tonnes such as a Klemm 709. The details of this rig suggest that it should be suitable for working on such a site and capable of achieving the pile depth and diameter range envisaged.

The soil parameters adopted are those set out in Section 8 of the GEA Site Investigation and Impact Assessment Report reference J11251 dated May 2012. These parameters have been found to be acceptable in previous submissions and are considered to be appropriate for this proposal.

The topography and features at the eastern part of the site have been modelled as a series of surcharges, numbered 1 to 5 within the Wallap calculations. For complete clarity these are set out below.

Surcharge No 1 is a uniform 5 kN/m$^2$ surcharge that represents car loading on the drive and the road.

Surcharge No 2 is a uniform 5 kN/m$^2$ surcharge from the edge of the drive onto the road to represent a higher degree of traffic loading on the highway.

Surcharge No 3 is a 'triangular' surcharge of zero at 1.0 m behind the wall increasing to 17 kN/m$^2$ at the road edge and represents a 1.0 m thickness of made ground.

Surcharge No 4 is a uniform surcharge of 17 kN/m$^2$ at the road edge and onto the road to represent the higher ground level

In summary the combination of surcharges above represents distributed loading of 5 kN/m$^2$ immediately behind the piled wall, 5 kN/m$^2$ at 1.0 m away rising to 27 kN/m$^2$ at and beyond the edge of the road.

The loads imposed by the existing structure of 57 Maresfield Gardens have been derived from the foundation inspection pits within the Ian Farmer report and a load take-down supplied by Elliott Wood.

The retaining walls have been designed for three cases as required by EC7. Each of the wall cases has been assessed for Ultimate Limit State (ULS) Combination 1, ULS Combination 2 and Serviceability Limit State (SLS). The various load factors, soil parameter factors and output factors are indicated within the results of each case.

The detailed design within each case has been based on undrained soil parameters during temporary works and construction with long term drained soil parameters adopted for the long term permanent case with a reversion to at rest earth pressures. In order to present conservative calculations no drained cohesion, c', has been used in the calculations and an at-rest earth pressure $K_0$ of 1.0 has been adopted. The results of these runs form Appendix No 4 and comprise a set of three full analyses for the East Wall and South Wall. These are considered to represent the two most onerous cases and those that are critical in terms of the magnitude of wall deflection. The remaining load cases such as the West Wall or the western part of the North Wall will yield lower bending moments and shear forces and probably require a slightly lesser embedded depth. However that refinement of design will be for the piling contractor to establish at a later stage.

### 5.2 Summary Results and Secant Wall Proposal

The proposed secant piled wall comprises 450 mm diameter piles installed at 600 mm male to male and female to female centre to centre spacings. These spacings would allow each male pile to cut 150 mm into the adjacent female piles. The toe level of the female piles is proposed as 72.5 m OD and the male piles would extend to levels of 72.0 m OD or 70.0 m OD for wall stability.

The maximum unfactored bending moment is given as 106 kNm per pile in the eastern wall but generally between 75 kNm and 85 kNm per pile for the remainder of the site. Detailed reinforcement design will be undertaken by the piling contractor but at this stage these values are deemed sufficient to confirm that the 450 mm diameter scheme is appropriate.

A summary of the retaining wall designs and predicted movements is shown below but in essence, the calculations indicate that the section of piled wall surrounding the deepest part of the basement with the highest ground level may be expected to deflect into the excavation by around 12 mm. Elsewhere, where the ground level is lower and the basement is shallower the deflection of the wall is anticipated to be in the order of 10 mm with 10 mm movement predicted for the wall around the local deepening for the pool.

| Wall Section | Pile Toe Level (m OD) | Pile Length (m) | Maximum Bending Moment (kNm/pile) | Predicted Wall Deflection (mm) |
|---|---|---|---|---|
| North | 72.0 / 70.0 | 10 - 14 | 106 / 82 | 12 / 9 |
| South | 72.0 | 10 | 65 | 10 |
| East | 70.0 | 14 | 106 | 12 |
| West | 72.0 | 10 | 83 | 10 |

## 6.0 GROUND MOVEMENTS

An assessment of ground movements surrounding the excavation has been undertaken by GEA using the X-Disp computer program licensed from the OASYS suite of programmes from Arup.

The basement has been modelled as an open box formed of a secant piled wall and the soil movement relationships used are the default values for such an excavation that were derived from a number of historic case studies. The party wall of No 57 Maresfield Gardens has been set as a sensitive structure along with the east and west walls of that property. These three walls have been modelled as sensitive lines in the analysis and are the lines along which the damage assessment has been undertaken. It is noted that since the analysis is conservative, the ground surface movements predicted in Fig 2.8 of CIRIA 580 have been reduced by 50 %.

This is because the data upon which the graphs are based is extremely limited and in these ground conditions, if care is taken pile during installation and sequencing then a lower value, closer to that of a contiguous wall, is more appropriate.

In addition the swimming pool of No 40 Netherhall Gardens has been set as a sensitive structure and its four walls have been assessed conservatively as free standing masonry structures. A structural assessment will be required to confirm this assessment and would form part of the detailed structural design at a later stage.

Details of the analysis together with full tabular results and output movement contour plots are included within the appendix but the cumulative results of the combined piling and excavation phases are summarised in the table below.

| Property | Wall | Damage Category |
|---|---|---|
| 57 Maresfield Gardens | North Elevation | Cat 0 Negligible |
| | West Wall | Cat 2 Slight |
| | East Wall | Cat 2 Slight |
| Swimming Pool of 40 Netherhall Gardens | South | Cat 0 Negligible |
| | West | Cat 2 Slight |
| | East | Cat 0 Negligible |
| | North | Cat 2 Slight |

The analysis has concluded that the vertical ground movements around the excavation are likely to be in the range of 10 mm to 15 mm whilst horizontal movements may be in the order of 10 mm to 18 mm. The settlements, degree of rotation and strain range induced within the 57 Maresfield Gardens building are however given as being such that the predicted damage to the adjacent properties would be either ‘Negligible’ or ‘Very Slight’ for each of the separate phases of work but combined, the movements put the damage to the east wall of 57 Maresfield Gardens just into the slight category with the strains calculated to be up to 0.0844 % for 57 Maresfield Gardens and 0.0757 % for the 40 Netherhall Gardens Swimming Pool which also represents ‘slight’ damage. When these values are compared with the Burland limiting strain of 0.075 % for the ‘Very Slight’ Damage Category it is evident that the ‘slight’ results are barely beyond the ‘very slight’ damage category. In any case however, a robust regime of monitoring will be in place and as such, the movement results can be fed back into the design and if movements are greater than predicted then adjustment to the propping arrangements may be made to ensure that any damage to adjacent properties remains within acceptable limits.

On this basis, the damage that would inevitably occur as a result of such an excavation would fall within the acceptable limits set out by LBC.

## 6.1 Monitoring

The predictions of ground movement based on the ground movement analysis will be checked by monitoring of adjacent properties and structures. The structures to be monitored during the construction stages will include No 57 Maresfield Gardens, the boundary wall and existing swimming pool of No 40 Netherhall Gardens, the pavement along Maresfield Gardens Road and the new proposed secant piled wall. Condition surveys of the above will be carried out before and after the proposed works.

The precise monitoring strategy will be developed at a later stage and it will be subject to discussions and agreements with the owners of the adjacent properties and structures. Contingency measures will be implemented if movements of the adjacent structures exceed predefined trigger levels. Both contingency measures and trigger levels will need to be developed within a future monitoring specification for the works.

## 7.0 EFFECT ON GROUNDWATER

A groundwater impact assessment of the previous developments was undertaken by a Consulting Hydrogeologist, Chord Environmental, and the conclusions were presented in the previous BIA. The proposed pile lengths have not changed from the previous scheme in that all wall piles penetrate the London Clay by at least 1.0 m. In plan area the basement proposed for this scheme is essentially the same as the previous one so the previously identified effect of the basement upon the prevailing groundwater conditions has been confirmed by Chord Environmental to remain appropriate. This information is summarised below with the full assessment report forming Appendix 3.

The assessment has been based on information and guidance published by the London Borough of Camden and on site investigation information.

Detailed site investigation information has established the presence of low permeability clays beneath the Site. Rates of groundwater flow are therefore very low (estimated at c.3m/a) and the underlying strata are incapable of supporting flow to water features such as streams or spring lines down gradient of the site.

Changes in groundwater level due to potential damming effect adjacent to the proposed basement development would not occur beyond a few metres because of the very low permeability Claygate Member and London Clay Formation strata present beneath the site.
It is concluded that the proposed basement development is unlikely to result in significant changes to the groundwater regime beneath or adjacent to the site. No potential adverse impacts have been identified as a result of the groundwater impact assessment.

It is noted that the toe level of the male piles within the groundwater impact assessment is 67 m OD; however this was based on initial retaining wall design and has been subsequently refined to 70.0 m OD and 72 .0 m OD. Chord Environmental have confirmed that this does not affect the conclusions of the report.

## 8.0 CONCLUSIONS

The foregoing represents a detailed review of the potential impacts that the proposed redevelopment.

The effects of the proposal on adjacent and neighbouring structures and the regime of groundwater have been assessed in detail. The potential effects of this scheme, which is shallower in depth and of a smaller below-ground footprint, are less than those of the previous proposals and the impacts have been assessed to be acceptable for such a development.

Accordingly the findings of this assessment will form the basis of the design of both temporary and permanent works.

# APPENDICES

# APPENDIX 1

GEA Site Investigation and Impact Assessment Report

# Site Investigation & Impact Assessment Report

## 59 Maresfield Gardens London NW3

Client Stefanie Drews & Colin Rowat

Engineer Elliott Wood

J11251

May 2012




Geotechnical & Environmental Associates

## Document Control

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## BRIEF

This report describes the findings of a site investigation carried out by Geotechnical and Environmental Associates Limited (GEA), on the instructions of Elliott Wood, on behalf of Stefanie Drews & Colin Rowat, with respect to the construction of a new two-storey house with double basement and additional swimming pool level. The purpose of the investigation has been to research the history of the site with respect to possible contaminative uses, to determine the ground and hydrogeological conditions, 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. The report also includes a Land Stability Impact Assessment, which forms part of the Basement Impact Assessment procedure in accordance with guidelines from London Borough of Camden in support of a planning application. The site has previously been the subject of a desk study (report ref; 51148) and ground investigations (report ref; 51148A and letter ref; DAA/daa/51148B/6046) completed by Ian Farmer Associates in 2008.

## DESK STUDY FINDINGS

The previous desk study indicates that Maresfield Gardens and Netherhall Gardens were established some time between 1871 and 1894. At this time the site formed part of the rear garden of a large property fronting onto Netherhall Gardens immediately to the north of the site, prior to which it had formed part of an open field, with a small stream crossing the northwestern part of the site. The site remained undeveloped until some time between 1958 and 1965 when the existing row of terraced properties, comprising Nos 55, 57 and 59, was constructed. The site and surrounding area have remained essentially unaltered from this time.

## GROUND CONDITIONS

Beneath a variable thickness of made ground, to depths of between 0.2 m (81.60 m OD) and 3.0 m (81.8 m OD), firm, locally soft or “stiff” orange-brown and brownish grey mottled blue-grey to greenish grey silty sandy clay becoming firm bluish grey silty sandy clay of the Claygete Member was found to extend to depths of 8.3 m (73.4 m OD) and 12.0 m (72.5 m OD). Below the made ground on the western part of the site, Alluvium, comprising “stiff” pale yellowish brown mottled orange-brown silty sandy to very sandy clay over greenish brown mottled orange-brown silty slightly sandy clay, was encountered overlying the Claygate Member to depths of between 4.0 m (77.0 m OD) and 4.4 m (77.4 m OD). The London Clay comprised stiff becoming very stiff fissured dark grey slightly silty clay with occasional claystones and partings of sand, and extended to the full depth of the investigation of 20.0 m (61.7 m OD).

Groundwater was generally encountered as seepages within the Claygate Member at depths of between 2.0 m (80.0 m OD) and 6.0 m (79.3 m OD), whilst a slow inflow was recorded in Borehole No 1 at a depth of 4.5 m (77.2 m OD), rising to 4.3 m (77.4 m OD) after a period of 20 minutes. A deeper water strike, comprising a seepage from within the London Clay, was also recorded in one of the boreholes at a depth of 18.5 m (66.0 m OD). Subsequent monitoring measured groundwater at depths of 1.96 m (79.74 m OD), 3.56 m (80.94 m OD) and 4.40 m (80.90 m OD) in Borehole Nos 1, 2 and 3 respectively, indicating an approximate groundwater flow direction towards the west-southwest.

## 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 likely to be encountered within the double level basement excavation and a secant pile wall is understood to be the preferred option of supporting the basement excavation. The proposed development should not have a significant influence on the local hydrogeology or surface water regime and it is unlikely that the proposed development will affect the stability of the existing slopes, provided that excavations do not remain unsupported and that appropriate retaining walls are provided.

No visual or olfactory evidence of contamination was noted during the field work and testing of soils has not identified the presence of contamination. As such remedial action should not be required.

# 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, on behalf of Stefanie Drews & Colin Rowat, to carry out a site investigation at 59 Maresfield Gardens, London, NW3 5TE. This report also forms part of a Basement Impact Assessment (BIA), which has been carried out in accordance with guidelines from the London Borough of Camden (LBC) in support of a planning application.

A Phase 1 desk study (report ref; 51148), Phase 2 site investigation (report ref; 51148A) and supplementary site investigation and groundwater monitoring exercise (letter ref; DAA/daa/51148B/6046) have been previously carried out by Ian Farmer Associates in June, July and September of 2008 respectively.

As part of the BIA, a separate Surface Water Assessment (report ref; WE11092, dated December 2011) and Groundwater Impact Assessment (report ref; 1102/R1, dated December 2011) have been completed by Elliot Wood and Chord Environmental Ltd respectively. Copies of these reports have been supplied by the consulting engineers and are referred to within this report where appropriate.

### 1.1 Proposed Development

It is proposed to demolish the existing house and subsequently construct a new two-storey to three-storey building with double level basement and additional swimming pool level. Proposed formation level for the basement is understood to be about 76.0 m OD, which corresponds to approximately 9.5 m below existing road level and 5.5 m below the ground floor level of the existing house. The proposed swimming pool level will extend from the basement to a lower level of approximately 74.5 m OD.

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 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 and to provide advice on any effects of the proposed development on the stability of the existing slope;

- 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 and hydrogeological maps;
- a review of the previous desk study and ground investigation reports carried out by Ian Farmer Associates; 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:

- two cable percussion boreholes, advanced to depths of 20.0 m, by means of a dismantlable cable percussion drilling rig;
- standard penetration tests (SPTs), carried out at regular intervals in the cable percussion boreholes, to provide additional quantitative data on the strength of the soils;
- a single opendrive sampler borehole, advanced to a depth of 9.0 m on the eastern part of the site;
- six window sampler boreholes advanced to a depth of 6.0 m;
- the installation of groundwater monitoring standpipes into the two cable percussion boreholes and the single opendrive sampler borehole, to depths of between 8.0 m and 12.0 m, and a single monitoring visit after a period of approximately two weeks;
- five trial pits, manually excavated in order 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 *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

### 1.3.1 Basement Impact Assessment

The work carried out also includes a Land Stability Assessment (also referred to as Slope Stability Assessment), which forms part of the 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 the work is to provide information on land stability and in particular to assess whether the development will affect the stability of neighbouring properties and whether any identified impacts can be appropriately mitigated by the design of the development.

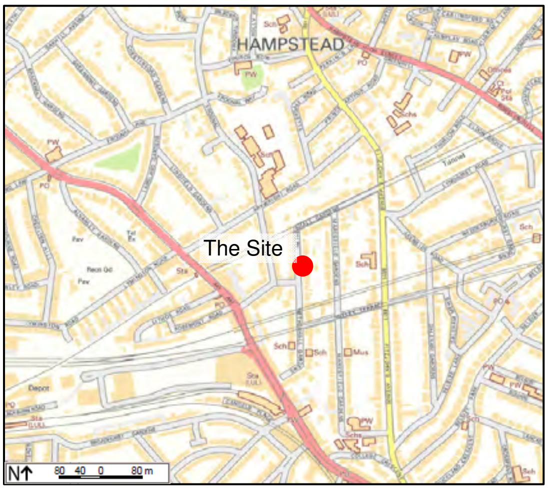
The BIA elements of the work have been carried out by Martin Cooper, a BEng in Civil Engineering, a chartered engineer (CEng) and member of the Institution of Civil Engineers (MICE), who has over 20 years specialist experience in ground engineering. The assessment has been made in conjunction with Steve 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 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

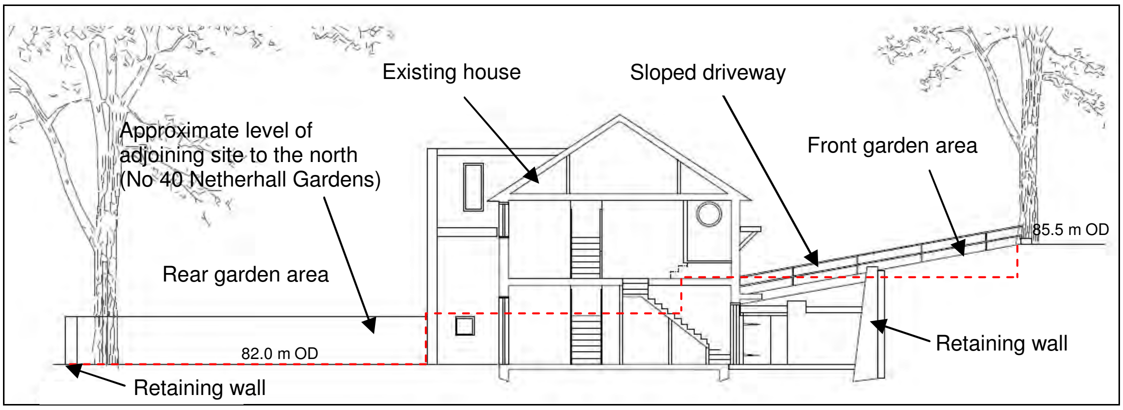
## 2.1 Site Description




The site covers a roughly rectangular area measuring approximately 30 m by 8 m and is occupied by No 59 Maresfield Gardens, a split level two-storey end of terrace property, with front driveway, garden and courtyard area to the front and a small rear garden to the rear. It fronts onto Maresfield Gardens to the east and is bounded by the adjoining terraced house, No 57, to the south, an access road to an area of private parking to the west and No 40 Netherhall Gardens to the north. The site may be additionally located by National Grid Reference 526418,185169, and is shown on the map opposite.

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

The topography of the surrounding area slopes down to the south and west, although the site itself slopes relatively steeply down to the west, such that the western boundary of the site is at a level of approximately 3.5 m below street level on the eastern part of the site giving an apparent slope angle of 6.7°. However, the house, rear garden and front courtyard area occupy a relatively level area, separated from street level by a 2.0 m to 2.5 m high retaining wall and steeply sloping front garden area, where the slope angle increases to a maximum of approximately 14°. The front driveway slopes down at an average angle of approximately 9.5°, to a car port situated at mid height level of the existing house. The basic layout of the site is shown on the section below. Due to the sloping nature of the area, the site is also situated at a lower level than No 40 Netherhall Gardens to the north, the level of which is shown relative to the site by the dashed red line on the drawing below.




*Existing site section*

The retaining wall on the eastern part of the site extends to the south beyond the footprint of the site and provides support to the slope in front of the adjoining properties of No 57 and 55 Maresfield Gardens. Retaining structures are also present supporting the higher ground of No 40 Netherhall Gardens to the north and on the southern part of the site, where there is a drop in level to the adjoining access road and private parking area. It understood that a swimming pool is situated within the rear garden of the property to the north, and at its closest point is approximately 2.0 m from the site boundary. The pool is understood to extend to a maximum depth of approximately 2.0 m, such that its base is likely to be situated at a similar level to the existing ground level of the site.

The site is well vegetated with a number of semi-mature and mature deciduous trees including lime, fig, yew, cherry, holly and London plane.

## 2.2 Site History

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

The previous desk study by Ian Farmer Associates indicates that Maresfield Gardens and Netherhall Gardens were established some time between 1871 and 1894. At this time the site formed part of the rear garden of a large property fronting onto Netherhall Gardens immediately to the north of the site, prior to which it had formed part of an open field, with a small stream crossing the northwestern part of the site.

The site remained undeveloped until some time between 1958 and 1965 when the existing row of terraced properties, comprising Nos 55, 57 and 59, were constructed. The site and surrounding area have remained essentially unaltered from this time.

Historically the site is understood to have been situated between the headwaters of the River Tyburn and River Westbourne, which both rise in the Hampstead area, before flowing in a roughly southerly direction towards the River Thames. The stream crossing the northwestern part of the site prior to 1896 is likely to be part of the tributary system of the River Westbourne. However, it is not shown on any subsequent maps and was presumably infilled and / or diverted as the area was developed.

## 2.3 Other Information

The previous desk study has revealed no active landfills, waste management, transfer, treatment or disposal sites within 500 m of the site. However, there are records of an historical waste transfer and disposal facility approximately 415 m to the southwest of the site, although it is unlikely to have any adverse effect on the site. There have also not been any recorded pollution incidents to controlled waters within 250 m of the site.

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.

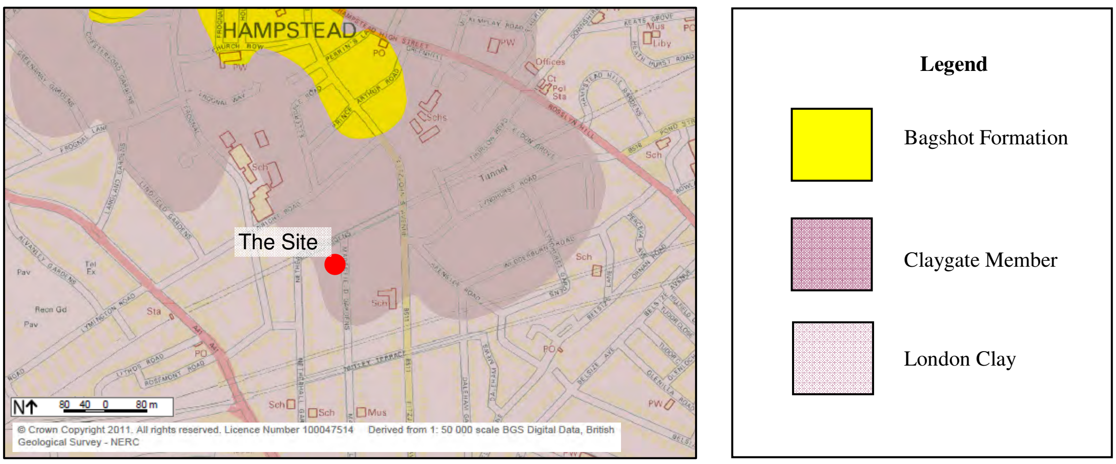
## 2.4 Railway Tunnel

A Network Rail tunnel runs along the line of Netherhall Gardens from Finchley Road & Frognal station to the west of the site to Hampstead Heath station to the east.

From a previous enquiry made to Network Rail, with regard to a nearby development on Netherhall Gardens, it is understood that the tunnel invert level is 60 m OD. As the site is in excess of 25 m to the south of the tunnel centre line, the proposed development will not therefore have any impact on the nearby tunnel.

## 2.5 Geology

The Geological Survey map of the area (sheet 256) indicates that the site should be underlain by the Claygate Member, which in turn is underlain by London Clay; the Claygate Member forms the youngest part of the London Clay Formation. The geology in this area is generally horizontally bedded such that the boundary between the geological formations roughly follows the ground surface contour lines. The boundary between the Claygate Member and the overlying Bagshot Formation is approximately 300 m to the north of the site, whilst the boundary with the underlying upper facies of the London Clay is less than 50 m to the west of the site, as shown by the geological extract below.



According to the BGS memoir, the Claygate Member in this area is principally a finely interbedded and thinly laminated sequence of clay, silt and fine-grained sand, whilst the underlying London Clay is a much more homogenous slightly calcareous silty clay to very silty clay, with some beds of clayey silt grading to silty fine grained sand.

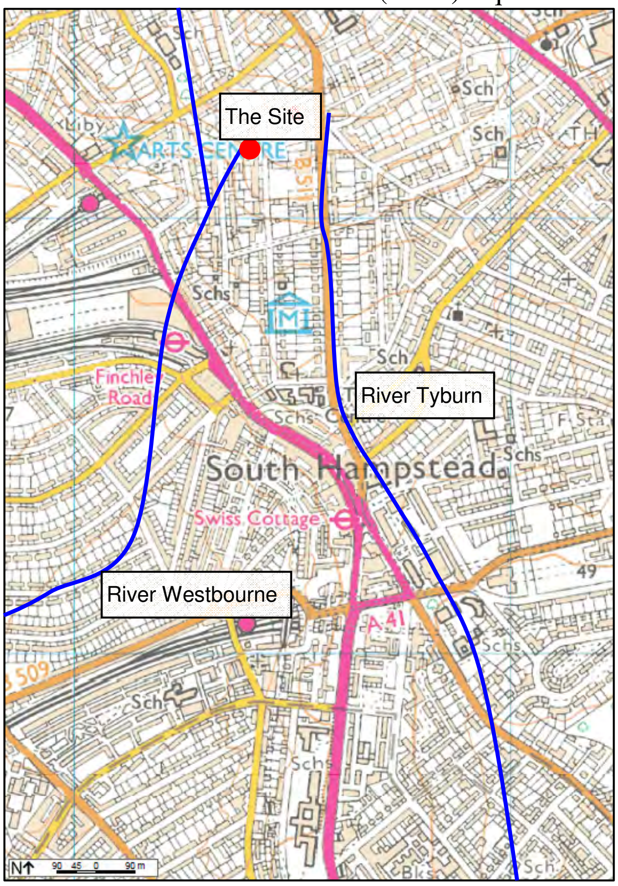
## 2.6 Hydrology and Hydrogeology

The Claygate Member is classified by the Environment Agency as a Secondary 'A' aquifer, which refers to layers of variable permeability capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers. The London Clay, under the same classification system, is designated as unproductive strata, rather than its former classification as a non-aquifer, and is of negligible significance for water supply.

The topographical maps show that the nearest surface water feature are the Hampstead Ponds, which are located approximately 1 km to the northeast of the site on the southern part of Hampstead Heath, on the opposite side of a watershed.

The site is not within an area at risk from flooding, nor is it located within a Groundwater Source Protection Zone as defined by the EA.

A figure provided in the BGS memoir showing groundwater contours in 1965 indicates groundwater beneath the site to be at a level of -70 m OD (i.e. approximately 155 m below ground level). This reflects the level of groundwater within the chalk aquifer at depth; the London Clay effectively acts as a barrier to flow between the lower (chalk) aquifer and superficial groundwater. However a more recent contour map of groundwater levels provided by the Environment Agency[4] indicates that by 2009, groundwater in the London area had risen by approximately 40 m and is more likely to be at around -30 m OD, currently 115 m below ground level




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

4 Environment Agency Status Report (2009) *Management of the London Basin Chalk Aquifer*

Historically a tributary of the River Tyburn[5] rose approximately 150 m to the east of the site, as shown on the adjacent map, at the corner of Lyndhurst Road and Fitzjohns Avenue. It is shown on the map dated 1871 rising from a small pond near to what is annotated as Shepherd's Well, although is no longer shown on subsequent maps following the construction of Fitzjohns Avenue.

The principal course of the Westbourne flowed in a southerly direction, approximately 100 m to the west of the site. However, the historical maps have shown that a small headwater tributary, which rose from a pond 20 m to the northeast, flowed across the northwestern corner of the site. However, as with the headwaters of the Tyburn, it is not shown on any subsequent maps and was presumably infilled and removed as the area was developed.

Groundwater in the area is most likely to have been flowing to the headwaters of the Westbourne, which crossed the northwestern part of the site. The direction of groundwater flow within the Claygate Member beneath the site will be controlled by the local topography and is therefore likely to be in a west-southwesterly direction, in the direction that the former river flowed. Water infiltrating the underlying London Clay will generally tend to flow vertically downwards at a very slow rate towards the lower chalk aquifer.

Due to the predominantly cohesive nature of the soils, the groundwater flow rate is unlikely to be particularly high. Information provided in the Envirocheck report indicates that the permeability of the Claygate Member may range from "very low" to "high". Published data for the permeability of the London Clay indicates the horizontal permeability to generally range between $1 \times 10^{-10}$ m/s and $1 \times 10^{-8}$ m/s, with an even lower vertical permeability. The Claygate Member, however, is more sandy in composition and permeability could be expected to be higher.

## 2.7 Previous Investigation

The previous investigation carried out by Ian Farmer Associates in July 2008, which followed on from their initial desk study, comprised the completion of a single borehole, drilled using a "Geotool" window sampling rig to a depth of 15.5 m on the front driveway ramp. This borehole was supplemented by two shallow window sample boreholes, completed on the rear part of the site and two hand dug trial pits.

The boreholes confirmed the expected ground conditions, in that, beneath a variable thickness of made ground, comprising brown sandy silty clay with brick fragments and rootlets, firm becoming stiff orange-brown and pale grey becoming dark grey sandy silty clay of the Claygate Member was encountered and found to be underlain at a depth of 12.0 m in the deep borehole by stiff to very stiff fissured dark grey silty London Clay, which was proved to the full depth of the investigation of 15.5 m.

The trial pits were positioned to expose the boundary wall conditions with No 40 Netherhall Gardens to the north and the adjoining property of No 57 to the south. In Trial Pit No 1, which is understood to have been positioned in the rear garden of the site, rather than within the existing building as indicated on the site plan, a simple concrete footing was exposed, which was found to bear within made ground at a depth of 0.4 m. In Trial Pit No 2, the party wall foundations with the adjoin property of No 57 were shown to comprise a concrete footing bearing within made ground at a depth of 0.85 m.

Groundwater was only encountered within the deeper borehole on the eastern part of the site within the Claygate Member at depths of 4.33 m and 10.00 m. Two standpipes, Nos 1 and 1A

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

were installed into this borehole to depths of 12.0 m and 6.0 m and during two subsequent monitoring visits groundwater was recorded at depths of 5.41 m and 4.71 m in Standpipe No 1, whilst groundwater was recorded at depths of 3.57 m and 3.56 m in Standpipe No 1A. During monitoring, Standpipe No 1 was found to be blocked or damaged at a depth of 6.5 m, such that the results from this position are likely to be questionable and of relatively limited value.

Ian Farmer Associates returned in September 2008 to complete a supplementary investigation and carry out further monitoring in order to investigate the permeability of the Claygate Member. The monitoring results were broadly similar to those of the earlier investigation and showed groundwater to be present within the Claygate Member at a level of between 79.9 m OD and 80.6 m OD. Rising head tests conducted within the standpipes and a single trial pit, excavated from ground floor level within the existing house, indicated that the permeability of the Claygate Member to be between 4.8 x $10^{-7}$ m/s and 2.9 x $10^{-7}$ m/s.

No contamination testing was undertaken in the previous investigations.

## 2.8 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.

### 2.8.1 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 a residential property for its entire developed history. There are thus no obvious likely sources of contamination on the site or in its immediate vicinity. No sources of soil gas have been identified.

### 2.8.2 Receptor

The use of the site for a residential end use may result in exposure to the soil and thus represents a relatively 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 aquifer, groundwater is unlikely to be considered as a particularly sensitive receptor.

### 2.8.3 Pathway

As the site is underlain by a secondary aquifer, there may be the potential for contaminant exposure pathways to exist for contaminants to move onto and off the site with the direction of groundwater flow. End users could conceivably come into contact with soils within private garden areas, although such pathways are already in existence. Not withstanding the risk to site workers and buried services, there is considered to be a low potential for a significant contaminant pathway to be present between any potential contaminant source and a target for the particular contaminant.

### 2.8.4 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. Furthermore as there is no evidence of filled ground within the vicinity and as it is anticipated to be underlain by cohesive soils at shallow depth, 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 soil gas exclusion systems.

# 3.0 SCREENING

The LBC guidance suggests that any development proposal that includes a subterranean basement should be screened to determine whether or not a full BIA is required.

## 3.1 Screening Assessment

A number of screening tools are included in the Arup document and for the purposes of this report reference has been made to Appendix E which includes 14 questions within a screening flowchart. Responses to the questions are tabulated below.

| Question | Response for 59 Maresfield Gardens |
|---|---|
| 1. Does the existing site include slopes, natural or manmade, greater than 7°? | *Yes. The front garden area slope at angles in excess of 7°. However, this area is already supported by a retaining structure.* |
| 2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7°? | *No* |
| 3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°? | *No* |
| 4. Is the site within a wider hillside setting in which the general slope is greater than 7°? | *No* |
| 5. Is the London Clay the shallowest strata at the site? | *No* |
| 6. Will any trees be felled as part of the proposed development and / or are any works proposed within any tree protection zones where trees are to be retained? | *No - no works are proposed within the root protection zones of the trees to be retained,* |
| 7. Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site? | *No. The Claygate Member is assessed as having a low to moderate potential for swelling clay subsidence.* |
| 8. Is the site within 100 m of a watercourse or potential spring line? | *No.* |
| 9. Is the site within an area of previously worked ground? | *No* |
| 10a. Is the site within an aquifer? | *Yes. The Claygate Member is classified as a Secondary 'A' aquifer, which refers to layers of variable permeability capable of supporting water supplies at a local rather than strategic scale.* |
| 10b. Will the proposed basement extend beneath the water table such that dewatering may be required during construction? | *Yes. The basement will extend below the depth at which groundwater has been encountered.* |
| 11. Is the site within 50 m of Hampstead Heath ponds? | *No* |
| 12. Is the site within 5 m of a highway or pedestrian right of way? | *Yes - the site fronts onto a public road* |
| 13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties? | *Yes - The development will increase the foundation depths relative to the neighbouring properties to a relatively significant extent.* |
| 14. Is the site over (or within the exclusion zone of) any tunnels, eg railway lines? | *No.* |

The above assessment has identified the following potential issues that need to be assessed:

- Q3 The site includes man made slopes greater than 7°.
- Q10A The site is underlain by the Claygate Member, which is classified by the EA as a Secondary 'A' Aquifer.
- Q10B The proposed basement will extend into the local water table, such that dewatering may be required.
- Q12 The site is within 5 m of a public highway.
- Q13 The development will increase the foundation depths relative to the neighbouring properties to a relatively significant extent.

The potential issues that need to be assessed, along with the possible effects of the basement construction on the local hydrology and hydrogeology are discussed further in Part 2 of this report.

### 3.1.1 Surface Flow and Flooding

The above assessment has been dealt with through the Surface Water Assessment conducted by Elliott Wood, which should be referred to with regard to the potential issues that have been identified and the proposals to address them.

In summary the assessment has shown that the site is situated within a Flood Zone 1 and that a full flood risk assessment is not required.

Whilst the proposed development will result in an increase in the amount of hard surfaced / paved areas, the amount relates to no more than 5 % of the total area of the site and the existing landscaped area to the front and rear of the property will be retained.

It is expected that surface water run off is likely to increase due to the proposed development. However, it is proposed that additional drainage and / or attenuation measures will be incorporated into the final design in order to prevent these changes having a detrimental impact on the site and surrounding area.

### 3.1.2 Subterranean Flow

A Groundwater Impact Assessment has been conducted by Chord Environmental Ltd and should be referred to with regard to the potential issues that have been identified.

The assessment has concluded that the proposed development is unlikely to have any adverse impact on the groundwater regime beneath or adjacent to the site due to the relatively low permeability of the Claygate Member beneath the site. Additionally, the development is unlikely to be affected by or impact upon the former headwater tributary of the Westbourne as the area has already been extensively developed with the former water course having been culverted or more likely backfilled, with the resultant drainage incorporated into the local surface water drainage system.

# 4.0 SCOPING AND SITE INVESTIGATION

The purpose of scoping is to assess in more detail the factors to be investigated in the impact assessment. Potential impacts are assessed for each of the identified potential impact factors.

The potential impacts of the proposed development on surface flow and flooding and subterranean flow have been dealt with in the separate assessments completed by Elliott Wood and Chord Environmental Ltd respectively, such that the following section focuses on the potential impacts that may have an impact on slope stability.

## 4.1 Potential Impacts

The following potential impacts have been identified.

| Potential Impact | Consequence |
|---|---|
| Site includes a man-made slope greater than 7°. | Local instability within the site and adjoining sites may occur |
| Site is within an aquifer. | Dewatering can cause ground settlement. The zone of settlement will extend for the dewatering zone, and thus could extend beyond a site boundary and affect neighbouring structures. Conversely, an increase in water levels can have a detrimental effect on stability. |
| The proposed basement will extend beneath the water table such that dewatering may be required during construction. | |
| Site within 5 m of a highway or pedestrian right of way. | Excavation of a basement may result in structural damage to the road or footway. |
| Founding depths relative to neighbours. | If not designed and constructed appropriately, the excavation of a basement may result in structural damage to neighbouring buildings and structures. |

These potential impacts have been investigated through the site investigation, as detailed below.

## 4.2 Exploratory Work

In order to meet the objectives described in Section 1.2, two cable percussion boreholes were drilled to a depth of 20.0 m, using a dismantlable cable percussion rig, a single opendrive sampler borehole was completed to a depth of 9.0 m on the eastern part of the site and six window sampler boreholes were advanced to depths of 6.0 m to further investigate the shallow ground conditions in areas that were only accessible to portable equipment. Standard penetration tests (SPTs) were carried out at regular intervals in the deep boreholes and disturbed and undisturbed samples were recovered for subsequent laboratory examination, geotechnical testing and contamination analysis.

The borehole records and results of the laboratory analyses are appended, together with a site plan indicating the exploratory positions. The Ordnance Datum (OD) levels shown on the borehole and trial pit records have been interpolated from spot heights shown on a site survey drawing (ref: 1067/102, dated July 2008), which was provided by the consulting engineers.

## 4.3 Sampling Strategy

The borehole and trial pit locations were positioned on site by GEA to provide optimum coverage of the site with due regard to the proposed development, whilst avoiding the areas of known services. The scope of investigation was determined by GEA in consultation with the consulting engineers and Chord Environmental to ensure that sufficient information was obtained to cover all elements of the BIA.

Groundwater monitoring standpipes were installed to depths of 8.0 m (73.7 m OD) and 12.0 m (72.5 m OD) in the two cable percussion boreholes, whilst a third standpipe was installed into the opendrive sampler borehole to a depth of 9.0 m (76.3 m OD), in order to facilitate future monitoring. Each has been monitored on two occasions over a one month period.

The two standpipes installed into the Geotool borehole completed as part of the previous investigation, have also been monitored as part of this investigation, although the condition of the standpipes means that the results from this position are likely to be questionable and of limited value.

Thee 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.

## 5.0 GROUND CONDITIONS

The investigation has confirmed the expected ground conditions in that, beneath a variable and locally significant thickness of made ground, the Claygate Member was encountered overlying the London Clay, which proved to the full depth of the investigation.

### 5.1 Made Ground

The made ground generally comprised brown to dark brown silty sandy clay with brick, grave, rootlets and occasional charcoal was encountered to depths of between 0.2 m (81.60 m OD) and 3.0 m (81.8 m OD).

The greater thickness of made ground was encountered on the eastern part of the site, either on the existing driveway ramp, or as in Borehole No 3, at the top of the sloped garden area behind the existing retaining wall.

No visual or olfactory evidence of contamination was observed within these soils, although fragments of charcoal 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 are summarised in section 5.6.

### 5.2 Alluvium

On the western part of the site only, Alluvium, comprising “stiff” pale yellowish brown mottled orange-brown silty sand to very sandy clay over greenish brown mottled orange-brown silty slightly sandy clay, was encountered beneath the made ground to depths of between 4.0 m (77.0 m OD) and 4.4 m (77.4 m OD).

The area in which these soils were encountered corresponds with where the historical records indicated a former stream crossed the site, understood to be a headwater tributary of the Westbourne.

The upper layers of Alluvium were found to be desiccated to a depth of 2.2 m (79.5 m OD) in Borehole No 5 and 2.0 m (79.8 m OD) in Borehole No 6. Both of these boreholes were located close to existing trees, including mature yew, lime, fig, cherry and fir trees.

## 5.3 Claygate Member

This stratum comprised firm, locally soft or “stiff” orange-brown and brownish grey mottled blue-grey to greenish grey silty sandy clay becoming firm bluish grey silty sandy clay and was encountered below the made ground, or Alluvium on the western part of the site.

The Claygate Member was encountered to the full depth of the window sample boreholes, which extended to depths of between 6.0 m (75.7 m OD) and 9.0 m (76.3 m OD) and was subsequently proved in the two cable percussion boreholes to depths of 8.3 m (73.4 m OD) and 12.0 m (72.5 m OD).

Desiccated soils were encountered within the Claygate Member in Borehole No 4, to a depth of 0.9 m (80.9 m OD). This borehole was situated within the courtyard area to the front of the existing house on the eastern part of the site, which was devoid of vegetation. However, a mature lime and London plane tree are present within 5.0 m of the position, albeit at the top of the retained slope.

Plasticity index tests have indicated the clay to be of moderate shrinkability with plasticity indices ranging from 23% to 32%. These soils were observed to be free of any evidence of soil contamination.

## 5.4 London Clay

The London Clay, comprising stiff becoming very stiff fissured dark grey slightly silty clay with occasional claystones and partings of sand, was encountered beneath the Claygate Member in both cable percussion boreholes to the full depth of the investigation of 20.0 m (61.7 m OD).

These soils were observed to be free of any evidence of soil contamination.

## 5.5 Groundwater

Groundwater was generally encountered as seepages within the Claygate Member at depths of between 2.0 m (80.0 m OD) and 6.0 m (79.3 m OD), whilst a slow inflow was recorded in Borehole No 1 at a depth of 4.5 m (77.2 m OD), rising to 4.3 m (77.4 m OD) after a period of 20 minutes.

A deeper water strike, comprising a seepage from within the London Clay, was also recorded in one of the boreholes at a depth of 18.5 m (66.0 m OD), rising to 18.3 m (66.2 m OD) after a period of 20 minutes. This occurrence was apparently associated with the presence of a claystone at that depth.

Subsequent monitoring of the standpipes installed into Borehole Nos 1, 2 and 3 has shown groundwater to be present at depths of 1.96 m (79.74 m OD), 3.56 m (80.94 m OD) and 4.40 m (80.90 m OD) respectively. The monitoring results generally indicate an approximate groundwater flow direction towards the west-southwest, as expected.

The standpipes installed into the Geotool borehole completed by Ian Farmer Associates, were also monitored during the investigation and recorded groundwater at depths of 3.73 m (80.47 m OD) and 3.43 m (80.77 m OD) in Standpipe Nos 1 and 1A respectively.

## 5.6 Soil Contamination

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

| Determinant | BH1 0.5 m | BH2 1.2 m | BH9 1.5 m |
|---|---|---|---|
| Arsenic | 9.6 | 14.0 | 11.0 |
| Cadmium | <0.1 | 0.2 | <0.1 |
| Chromium | 49.0 | 31.0 | 32.0 |
| Copper | 21.0 | 52.0 | 11.0 |
| Mercury | <0.1 | 0.4 | <0.1 |
| Nickel | 36.0 | 17.0 | 17.0 |
| Lead | 37.0 | 170.0 | 11.0 |
| Selenium | <0.2 | 0.4 | <0.2 |
| Zinc | 71.0 | 170.0 | 45.0 |
| Total Cyanide | <0.5 | <0.5 | <0.5 |
| Total Phenols | <0.3 | <0.3 | <0.3 |
| Sulphide | 2.8 | 2.2 | 1.1 |
| TPH | <10.0 | <10.0 | <10.0 |
| Total PAH | <2.0 | 2.7 | <2.0 |
| Benzo(a)pyrene | <0.1 | <0.1 | <0.1 |
| Naphthalene | <0.1 | 0.4 | <0.1 |
| Total organic carbon % | 0.9 | 2.9 | 0.2 |
| pH | 8.1 | 8.8 | 7.6 |
| *Note:* Figure in bold indicates concentration in excess of risk-based soil guideline values, as discussed below | | | |

### 5.6.1 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 the 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[6] 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:

6 *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 groundwater is not a critical risk receptor;
- that the critical receptor for human health will be young female child (aged zero to six years old);
- 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 dust, and inhalation of dust and vapours; and
- that the building type equates to a two-storey 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.

When comparing the results from the contamination testing to those in the Soil Guideline Values and Generic Guideline Values, the analyses have revealed no elevated concentrations in excess of the generic risk-based screening values.

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

# 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 other aspects of the development.

## 6.0 INTRODUCTION

Consideration is being given to the demolition of the existing building and the subsequent construction of a new two-storey to three-storey building with a double level basement and additional swimming pool level.

Formation level for the proposed basement is understood to be at approximately 76.0 m OD, which corresponds to 9.5 m below existing road level and 6.0 m below the ground floor level of the existing house and should therefore be within the Claygate Member.

The proposed swimming pool will be excavated from within the basement on the central eastern part of the site to a slightly lower level of approximately 74.5 m OD.

Unfactored internal loads for the proposed development are expected to be in the region of 150 kN, whilst higher loads of up to 220 kN are anticipated beneath the proposed swimming pool. Typical perimeter loads in the region of 50 kN/m are also anticipated.

## 7.0 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 the entirety of its developed history and on the basis of the fieldwork, the ground conditions at this site can be characterised as follows.

- Beneath a variable and locally significant thickness of made ground and locally Alluvium, the Claygate member was encountered overlying the London Clay Formation, which was proved to the maximum depth investigated;
- the made ground extends to depths of between 0.2 m (81.60 m OD) and 3.0 m (81.8 m OD);
- Alluvium was encountered below the made ground on the western part of the site, where a former stream is understood to have flowed;
- this Alluvium composed "stiff" pale yellowish brown mottled orange-brown silty sand to very sandy clay over greenish brown mottled orange-brown silty slightly sandy clay, was encountered to depths of between 4.0 m (77.0 m OD) and 4.4 m (77.4 m OD);
- the Claygate Member comprised firm, locally soft or "stiff" orange-brown and brownish grey mottled blue-grey to greenish grey silty sandy clay becoming firm bluish grey silty sandy clay and was encountered below the made ground, or Alluvium on the western part of the site;

- the Claygate Member was encountered to the full depth of the window sample boreholes, which extended to depths of between 6.0 m (75.7 m OD) and 9.0 m (76.3 m OD) and was subsequently proved in the two cable percussion boreholes to depths of 8.3 m (73.4 m OD) and 12.0 m (72.5 m OD);

- the underlying London Clay comprised stiff becoming very stiff fissured dark grey slightly silty clay with occasional claystones and partings of sand, was encountered beneath the Claygate Member in both cable percussion boreholes to the full depth of the investigation of 20.0 m (61.7 m OD);

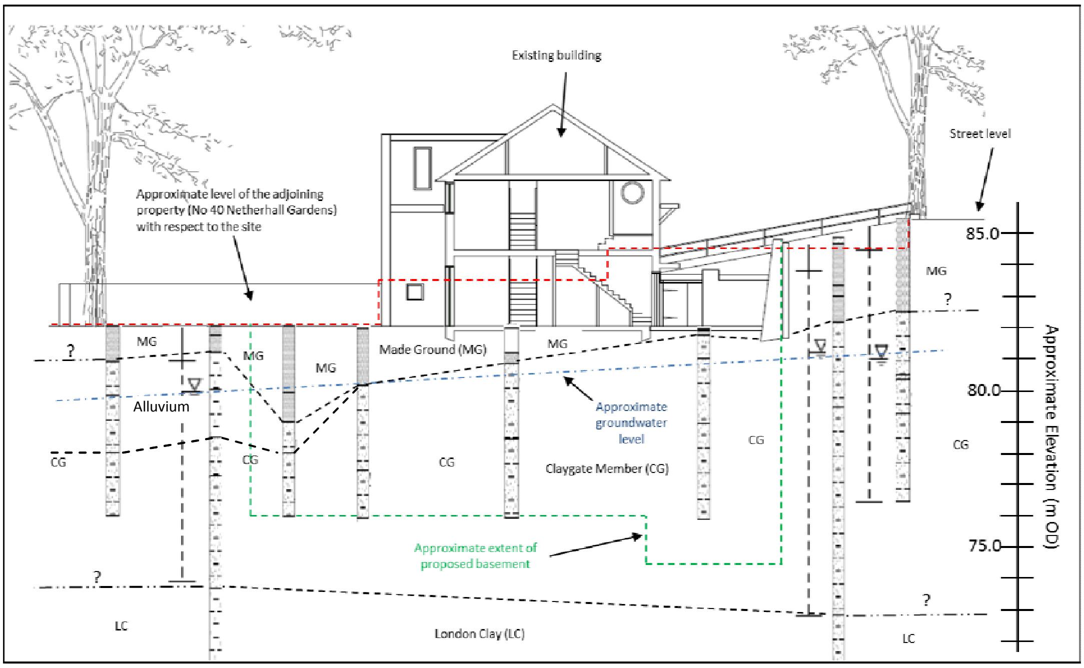
- groundwater was generally encountered as seepages within the Claygate Member at depths of between 2.0 m (80.0 m OD) and 6.0 m (79.3 m OD), whilst a slow inflow was recorded in Borehole No 1 at a depth of 4.5 m (77.2 m OD), rising to 4.3 m (77.4 m OD) after a period of 20 minutes;

- a deeper water strike, comprising a seepage from within the London Clay, was also recorded in one of the boreholes at a depth of 18.5 m (66.0 m OD), rising to 18.3 m (66.2 m OD) after a period of 20 minutes;

- groundwater monitoring has recorded groundwater at depths of 1.96 m (79.74 m OD), 3.56 m (80.94 m OD) and 4.40 m (80.90 m OD) in the standpipes installed into Borehole Nos 1, 2 and 3 respectively; and

- the contamination analyses have not indicated any elevated concentrations which could pose a risk to human health.

The cross-section below indicates the soil and groundwater conditions beneath the site and their relationship with the existing and proposed site layout. A copy of this idealised cross-section, along with a nominal section constructed using the borehole records are included in the appendix.



# 8.0 ADVICE AND RECOMMENDATIONS

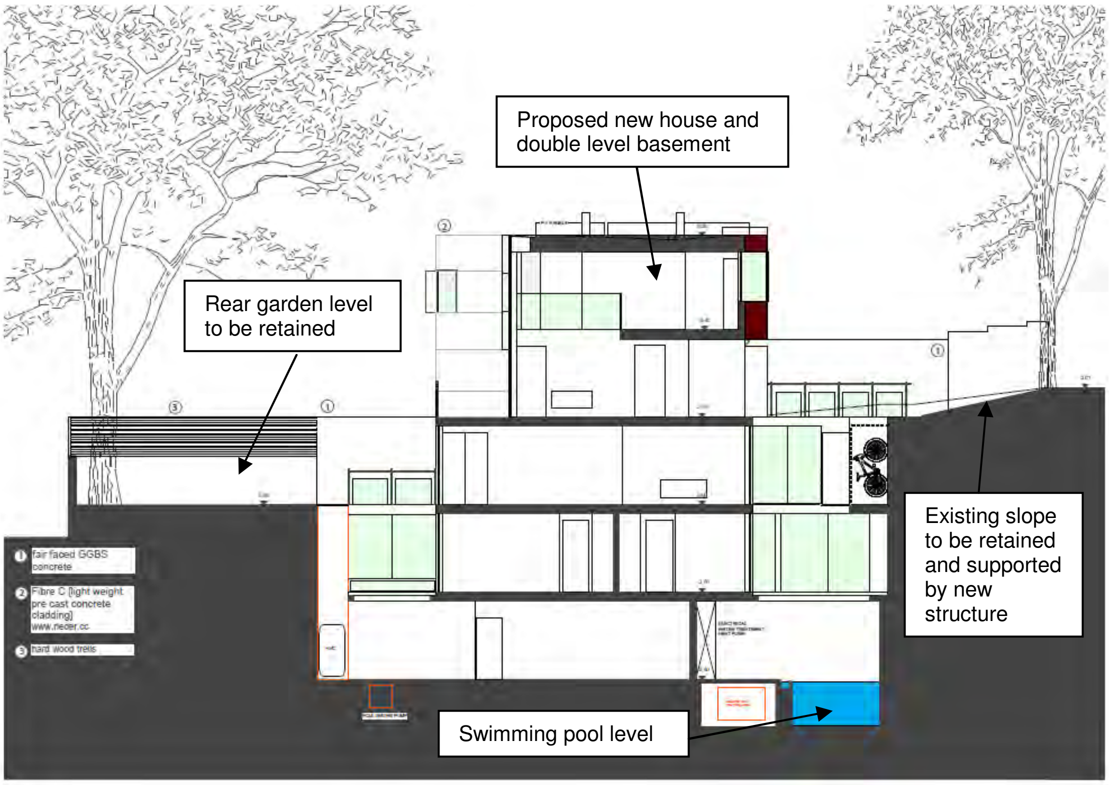
Excavations for the proposed basement structure will require temporary support to maintain stability of the existing and surrounding structures and to prevent any excessive ground movements, including the stability of the existing slope on the eastern part of the site, and the completed structure will need to take account of the stability of the adjoining sites to the north and south. Based on the groundwater observations to date, groundwater is likely to be encountered within the basement excavation.

It is understood that a piled foundation solution is the preferred option for the development. However, for completeness, alternative options such as spread or raft foundations have been considered, with attention drawn to any potential drawbacks of these options.

## 8.1 Basement Excavation

It is understood that the new basement will be excavated to a depth of approximately 6.0 m below existing ground floor level, to a level of 76.0 m OD, although deeper excavations to a level of 74.5 m OD will be required for the additional swimming pool level. Therefore formation level is likely to be within the firm to stiff clay of the Claygate Member. A section through the proposed development is shown below.

Groundwater monitoring has indicated that groundwater is likely to be encountered within the Claygate Member at levels of between 79.74 m OD and 80.94 m OD. On this basis, groundwater is likely to be encountered within the basement excavation, although it is recommended that further monitoring of the standpipes is carried out to establish equilibrium levels and determine the extent of any seasonal fluctuations.




*Proposed site section*

The permeability of the Claygate Member is likely to vary across the site although results from the previous investigation indicate that it is likely to be between 4.8 x $10^{-7}$ m/s and 2.9 x

$10^{-7}$ m/s. On this basis inflow rates into the excavation are therefore expected to be slow, although as the basement extends below the water table they are likely to be prolonged. Inflow rates will also be higher where more permeable layers within the Claygate Member are encountered and as the basement excavation will cover a much larger area than that covered by the investigation, it is possible that larger pockets or inter-connected layers of groundwater could be encountered. 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. It would also be prudent, once access is available, to carry out a number of trial excavations, to depths as close to the full basement depth as possible, to provide an indication of the likely ground water conditions.

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 slope, the surrounding structures, namely the neighbouring properties to the north and south, and to protect against groundwater inflows.

### 8.1.1 Slope Stability

The screening assessment has identified the presence of a man made slope with an angle in excess of 7° on the eastern part of the site.

At present this area is well vegetated and the existing slope generally shows no sign of any movement and is currently supported by an existing retaining structure. The proposed development will not introduce any new slopes or involve any steepening of this existing slope. Additionally the proposed development, which will include the construction of new retaining walls as part of the new basement structure will provide additional support to that already in place and further assessment is not deemed necessary at this stage.

It is recommended that there should not be any unsupported excavations and that the basement retaining walls are suitably designed to maintain the stability of the existing slope, as discussed below. Consideration could be given to the use of ground anchors in association with retaining walls, in order to add further stability to the slope and reduce the requirement for internal propping on this relatively small site.

The development will also need to maintain the stability of the adjoining properties to the north and south of the site and it is likely that some additional work, such as a more detailed topographic survey, may be required to fully understand the relationship of any potentially sensitive features to the site, such as the swimming pool in the rear garden area of No 40 Netherhall Gardens, so that the requirement for the provision of any necessary can be fully established and incorporated into the final design. It is, however, currently understood that the present design involves the construction of a piled retaining wall in front of the existing retaining wall on the eastern part of the site and the retaining wall of the adjoining property to the north, such that sufficient support is already likely to be in place, although this will need to be confirmed through analysis as part of the checking of the designs.

### 8.1.2 Basement Retaining Walls

On the basis of the above, the use of sheet piles are not considered a suitable option. The noise and vibrations associated with the installation of the sheet piles may be unacceptable to neighbouring properties.

A piled retaining wall is understood to be the preferred option and could have the advantage of being incorporated into the permanent works and may be able to provide support for structural loads. Whilst the monitoring carried out to date would suggest that the rate of groundwater inflow is likely to be very slow, such that it may be possible to adopt a contiguous bored pile wall with the use of sump pumping to deal with any groundwater inflows, a secant piled option would remove the requirement for any dewatering, which if carried out could conceivably have a negative impact on the site and surrounding area by causing ground settlement. Whilst it should be possible to adopt a secant bored pile without the requirement for any secondary groundwater protection in the permanent works, it is understood that the present design proposals include for the construction of a reinforced concrete wall with cavity drainage in order to reduce any potential impact on groundwater flowing around the basement.

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 in addition to the above, 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.

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 ($\phi'$ – degrees) |
|---|---|---|---|
| Made ground/ Alluvium | 1700 | Zero | 27 |
| Claygate Member | 1800 | Zero | 25 |
| London Clay | 1900 | Zero | 25 |

The design groundwater level should be determined on the basis of continued monitoring of the standpipes and the advice in BS8102:2009[7] should be followed with respect to waterproofing.

The retaining walls will need to be designed to take account of the overall stability of the site, as well as the adjoining properties to the north and south, and this will need to be considered in more detail once the layout has been finalised.

### 8.1.3 Basement Heave

The demolition of the existing house and subsequent excavation of an approximately 6.0 m to 7.5 m of soil will result in an unloading of approximately 120 $kN/m^2$. This unloading will result in heave of the underlying London Clay, which will comprise short term elastic movement and longer term swelling that will continue over a number of years.

An analysis of heave as a result of the excavation of the proposed basement has been carried out on the basis that the soils behave elastically, which provides a reasonable approximation to soil behaviour at small strains. Values of soil stiffness for the soils at this site are readily available from published data and we have used a well established method to provide our

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

estimates. Relationships of $E_u = 500\ C_u$ and $E' = 300\ C_u$ for the cohesive soils have been used to obtain values of Young's Modulus. Drained and undrained parameters have been used throughout, to provide an estimate of the total 'long term' and 'short term' movement.

As a result of the loads to be removed by the construction of the proposed basement level, potential elastic heave of the underlying London Clay in the region of 20 mm is estimated to occur in the short term as a result of the proposed excavations. A further 20 mm of long term movement will theoretically occur; although, on the basis of the formation of the new structure shortly after the completion of the excavation, these ground movements are unlikely to be fully realised, due to the reapplication of structural loads.

The predicted movements are reported to the nearest millimetre to aid in the understanding of relative movements; however, as with any heave estimate, an accuracy of no better than about 20 % should be expected.

These movements will be mitigated to some extent by the pressure applied by the proposed development, although it is considered that a more detailed analysis of the possible heave should be carried out as part of further design of the basement.

### 8.1.4 Ground Movement

In order to prevent damage to surrounding buildings and structures, it is recommended that the retaining walls are designed in accordance with best practice to limit potential ground movements and as part of further design of the basement, a detailed assessment of the potential ground movements around the site will need to be carried out, which should involve both a structural assessment of the behaviour of the retaining walls, as well as a geotechnical assessment of the behaviour of the ground supported behind these structures.

At this stage, however, it may be noted that for a well-supported excavation the likely vertical movements at the top of the wall as a result of the relief of both horizontal and vertical stresses in the surrounding soils is generally no more than 0.15% of the retained height, which in the context of this development equates to potential vertical movements of about 15 mm on the basis of a maximum retained height of 9.5 m. This figure is considered to be conservative and typical of a basement of this depth, although these movements should be re-evaluated on the basis of a more detailed analysis as part of further design of the proposed basement.

## 8.2 Spread Foundations

The excavation to form the basement level will result in a formation level in the Claygate Member at levels between 76.0 m OD and 74.5 m OD. It should therefore be possible to adopt moderate width pad or strip foundations in the firm clay at this level, designed to apply a net allowable bearing pressure of 150 $kN/m^2$ below the level of the proposed basement floor.

This value incorporates an adequate factor of safety against bearing capacity failure and should ensure that settlement remains within normal tolerable limits, although it is unlikely that it will be possible to attain the required depths without encountering groundwater inflows. The depth of excavation should be such that foundations are below the possible depth of desiccation, but should be checked.

## 8.3 Raft Foundation

Depending on the loads and whether they can be relatively uniformly distributed, it may be feasible to adopt a basement raft foundation for the proposed new building.

Whilst the overall load of the proposed new building is not known, it is likely that, due to the depth of excavation, the proposed development would be subject to a net unloading in excess of 60 kN/m$^2$.

On the basis of the heave analysis carried out in Section 8.1.3, overall movements in the region of 20 mm to 30 mm could potentially occur if this foundation option was adopted. However, further consideration may need to be given to possible movements if this foundation solution is to be considered and the loads of the proposed development have been finalised.

## 8.4 Piled Foundations

Whilst the above foundation options may be feasible, a piled foundation option is likely to be the most appropriate and is understood to be the preferred option. 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 London Clay to maintain stability and prevent groundwater inflows. 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 / level graph in the appendix. Groundwater has been assumed at a level of approximately 80.0 m OD.

| **Ultimate Skin Friction** | | **kN/m$^2$** |
|---|---|---|
| Made Ground and Claygate Member | All soil above 76.0 m OD | Ignore (basement) |
| Claygate Member ($\alpha = 0.6$) | 76.0 m OD to 73.5 m OD | Increasing linearly from 45 to 55 |
| London Clay ($\alpha = 0.6$) | 73.5 m OD to 62.0 m OD | Increasing linearly from 55 to 90 |
| **Ultimate End Bearing** | | **kN/m$^2$** |
| London Clay | 73.5 m OD to 62.0 m OD | Increasing linearly from 810 to 1350 |

In the absence of pile tests, guidance from the London District Surveyors Association[8] (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 300 mm diameter pile founding at a depth of 12 m below basement floor level, with a toe level of 64.5 m OD, should provide a safe working load of about 490 kN. Alternatively, a 450 mm diameter pile founding at the same depth should provide an increased safe working load of 760 kN. The above examples are not intended to constitute any form of recommendation with regard to pile size or type, but merely serve to

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

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.

## 8.5 Shallow Excavations

On the basis of the boreholes, 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 Claygate Member 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.

## 8.6 Basement Floor Slabs

Following the excavation of the basement, it is likely that the floor slab for the proposed basement will need to be suspended over a void to accommodate the anticipated heave and any potential uplift forces from groundwater pressures unless the slab can be suitably reinforced to cope with these movements. This should be reviewed once the levels and loads are known.

## 8.7 Effect of Sulphates

Chemical analyses of selected soil samples have revealed generally low concentrations of soluble sulphate, corresponding to Class DS-1 and AC-1S of Table C1 of BRE Special Digest 1:2005. The guidelines contained in the above digest should be followed in the design of any new foundation concrete.

## 8.8 Site Specific Risk Assessment

The site is not considered to have had a historical contaminative use and the results of the contamination analysis do not indicate any elevated concentrations in excess of the generic risk-based screening values. On this basis, it is not considered that any remedial measures to protect sensitive receptors are necessary.

## 8.9 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.

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 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

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

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.

## 9.0 LAND STABILITY IMPACT ASSESSMENT

The current development proposal includes the construction of a new two to three-storey house with a double level basement and additional swimming pool level, which will extend to a level of between 76.0 m OD and 74.5 m OD; formation level will therefore be within the Claygate Member.

The screening identified five potential impacts. The desk study and ground investigation information has been used below to review the potential impacts, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

The table below summarises the previously identified potential impacts and the additional information that is now available from the site investigation in consideration of each impact.

| Potential Impact | Site Investigation Conclusions |
|---|---|
| Site includes a man-made slope greater than 7°. | The existing slope shows no sign of any instability and is supported by an existing retaining wall. The proposed development will not introduce any new slopes or involve any steepening of this existing slope. Additionally the proposed development, which will include the construction of new retaining walls as part of the new basement structure will provide additional support to that already in place and further assessment is not deemed necessary at this stage. |
| Site is within an aquifer. | Although the Claygate Member is classified as a Secondary |

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

| | |
|---|---|
| The proposed basement will extend beneath the water table such that dewatering may be required during construction. | 'A' aquifer, the investigations carried out at the site have shown this stratum to predominantly comprise silty sandy clay of relatively low permeability. Whilst groundwater inflows may be prolonged, they are unlikely to be fast and there will be space for groundwater to flow around the proposed basement. |
| *Location of public highway* – excavation of basement could lead to damage | The investigation has not indicated any specific problems, such as weak or unstable ground, voids, high water table, that would make working within 5 m of public infrastructure particularly problematic at this site. |
| Founding depths relative to neighbours – excavation may lead to structural damage to neighbouring properties if there is a significant differential depth between adjacent properties. | The proposed basement will extend to a significant depth relative to the existing foundations of the neighbouring properties and will need to be designed to ensure the stability of the site and any potentially sensitive structures that adjoin the site. |

The results of the site investigation have therefore been used below to review the remaining potential impacts, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

*Site includes a man-made slope greater than 7°*

The existing slope is well vegetated and shows no sign of any movement and is currently supported by an existing retaining structure. The proposed development will not introduce any new slopes or involve any steepening of this existing slope. Additionally the proposed development, which will include the construction of new retaining walls as part of the new basement structure will provide additional support to that already in place and further assessment is not deemed necessary at this stage.

*Site is within an aquifer and will extend below the water table*

The Groundwater Impact Assessment carried out by Chord Environmental Ltd has concluded that the proposed development is unlikely to result in significant changes to the groundwater regime beneath or adjacent to the site and this report should be referred to for a full assessment of these issues.

The proposed basement construction will only act as a partial barrier to the groundwater flow, as there is space between this and neighbouring structures. It would, however, be prudent to incorporate appropriate drainage into the final design of the basement walls in order to ensure that any groundwater is able to freely drain around the basement structure.

*Location of public highway*

The basement excavation is at least 5 m from the highway, such that the basement excavation should not affect the highway. In addition, the proposed development will include retaining walls that will be designed to maintain the stability of the surrounding ground, thus protecting the adjacent road and associated infrastructure beyond. There is nothing unusual or exceptional in the proposed development or the findings of the investigation that give rise to any concerns with regard to stability over and above any development of this nature.

*Founding depths relative to neighbours*

The depths of adjacent foundations of No 57 are known from a previous investigation and will not immediately abut the new basement excavation, which will be set back from the party wall with the adjoining property. However, due to the depth of the proposed excavation, the retaining walls for the proposed basement will need to be designed to take account of the overall stability of the site and to ensure the stability of the adjoining properties to the north and south.

## 10.0 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 may 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.

An issue that requires careful consideration at this site is the extent to which groundwater will affect the basement excavation in the temporary condition and the level of the water table to be adopted in the permanent design. Recommendations have been made for continued monitoring of the standpipes to address these issues, but it is important that the contractor is able to deal with inflows of groundwater that may be locally more significant than anticipated.

Consideration will also need to be given to measures to guard against heave as a result of the double level excavation. As per the recommendations in the report, it is likely that the floor slab for the proposed basement will need to be suspended over a void to accommodate the anticipated heave unless the slab can be suitably reinforced to cope with these movements.

The design for the proposed development will need to ensure the stability of the adjoining sites to the north and south, as well as the existing retaining structure on the eastern part of the site. In this respect, whilst it is understood that the present design takes these requirements into account a full analysis of the design will be required to assess the potential impact of any ground movement as a result of the excavation.

# APPENDIX

Borehole Records

Monitoring Records

Geotechnical Test Results

SPT / Depth Graph

Cross-Sections

Chemical Analyses (Soil)

Generic Risk Based Screening Values

Site Plan

| GEA Geotechnical & Environmental Associates | Tyttenhanger House, Coursers Road, St Albans, AL4 0PG | Site | Borehole Number |
|---|---|---|---|
| | | 59 Maresfield Gardens, London, NW3 5TE | BH1 |

| Boring Method | Casing Diameter | Ground Level (mOD) | Client | Job Number |
|---|---|---|---|---|
| Cable Percussion | 150mm cased to 8.50m | 81.70 | Stefanie Drews & Colin Rowat | J11251 |
| | **Location** | **Dates** | **Engineer** | **Sheet** |
| | | 22/11/2011-23/11/2011 | Elliott Wood | 1/2 |

| Depth (m) | Sample / Tests | Casing Depth (m) | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | (0.30) | Made Ground (dark brown silty clay with brick and rootlets) | | |
| 0.30 | D1 | | | | 81.40 | 0.30 | Made Ground (brown silty sandy clay with brick, gravel and rootlets) | | |
| 0.50 | D2 | | | | | (0.50) | | | |
| | | | | | 80.90 | 0.80 | Soft becoming firm orange-brown silty CLAY with occasional gravel | | |
| 1.20-1.65 | SPT N=8 | | | 1,1/2,2,2,2 | | | | | |
| 1.20-1.65 | B1 | | | | | (1.20) | | | |
| 1.20-1.65 | D3 | | | | | | | | |
| 1.85 | D4 | | | | 79.70 | 2.00 | Firm dark brown, grey and greenish grey silty CLAY | | |
| 2.00-2.45 | U1 | | | | | | | | |
| 2.75 | D5 | | | | | (1.50) | | | |
| 3.00-3.45 | SPT N=7 | | | 1,1/1,2,2,2 | | | | | |
| 3.00-3.45 | D6 | | | | | | | | |
| | | | | | 78.20 | 3.50 | Firm brown silty sandy CLAY | | |
| 3.75 | D7 | | | | | | | | |
| 4.00-4.45 | U2 | | | | | (1.25) | | | ▼1 ▽1 |
| 4.75 | D8 | | | Slow Inflow(1) at 4.50m, rose to 4.30m in 20 mins, sealed at 8.00m. | 76.95 | 4.75 | Firm bluish grey silty sandy CLAY | | |
| 5.00-5.45 | D9 | | | | | | | | |
| 6.00-6.45 | SPT N=15 | | | 2,2/3,3,4,5 | | | | | |
| 6.00 | D10 | | | | | | | | |
| 6.50-6.95 | U3 | | | | | (3.55) | | | |
| 7.50 | D11 | | | | | | | | |
| 8.00-8.45 | SPT N=18 | | | 2,3/4,5,5,4 | | | | | |
| 8.00-8.45 | D12 | | | | 73.40 | 8.30 | Stiff becoming very stiff fissured dark grey slightly silty CLAY with partings of sand; occasional claystones to 17.2 m | | |
| 9.00 | D13 | | | | | | | | |
| 9.50-9.95 | U14 | | | | | | | | |

| Remarks | Scale (approx) | Logged By |
|---|---|---|
| Groundwater monitoring standpipe installed to 8.0 m | 1:50 | MP |
| | **Figure No.** J11251.BH1 | |

| GEA Geotechnical & Environmental Associates | Tyttenhanger House, Coursers Road, St Albans, AL4 0PG | Site: 59 Maresfield Gardens, London, NW3 5TE | Borehole Number: BH1 |
|---|---|---|---|

| Boring Method | Casing Diameter | Ground Level (mOD) | Client | Job Number |
|---|---|---|---|---|
| Cable Percussion | 150mm cased to 8.50m | 81.70 | Stefanie Drews & Colin Rowat | J11251 |
| | **Location** | **Dates** 22/11/2011-23/11/2011 | **Engineer** Elliott Wood | **Sheet** 2/2 |

| Depth (m) | Sample / Tests | Casing Depth (m) | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | ... as previous | | |
| 10.50 | D15 | | | | | | | | |
| 11.00-11.45 | SPT N=25 | | | 3,4/5,6,6,8 | | | | | |
| 11.00-11.45 | D16 | | | | | | | | |
| 12.00 | D17 | | | | | | | | |
| 12.50-12.95 | U4 | | | | | | | | |
| 13.50 | D18 | | | | | | | | |
| 14.00-14.45 | SPT N=27 | | | 4,5/6,6,7,8 | | | | | |
| 14.00-14.45 | D19 | | | | | | | | |
| 15.00 | D20 | | | | | (11.70) | | | |
| 15.50-15.95 | U5 | | | | | | | | |
| 16.50 | D21 | | | | | | | | |
| 17.00-17.45 | CPT N=34 | | | 12,5/8,9,9,8 | | | | | |
| 17.00-17.45 | D22 | | | | | | | | |
| 18.00 | D23 | | | | | | | | |
| 18.50-18.95 | U6 | | | | | | | | |
| 19.25 | D24 | | | | | | | | |
| 19.55-20.00 | SPT N=36 | | | 5,6/8,8,9,11 | | | | | |
| 19.55-20.00 | D25 | | | | 61.70 | 20.00 | | | |

| Remarks | Scale (approx) | Logged By |
|---|---|---|
| | 1:50 | MP |
| | **Figure No.** J11251.BH1 | |

Geotechnical & Environmental Associates

Tyttenhanger House
Coursers Road
St Albans
AL4 0PG

| Site | Borehole Number |
|---|---|
| 59 Maresfield Gardens, London, NW3 5TE | BH1 |

| Installation Type | Dimensions | Client | Job Number |
|---|---|---|---|
| Standpipe Piezometer | Internal Diameter of Tube [A] = 50 mm<br>Diameter of Filter Zone = 150 mm | Stefanie Drews & Colin Rowat | J11251 |

| Location | Ground Level (mOD) | Engineer | Sheet |
|---|---|---|---|
| | 81.70 | Elliott Wood | 1/1 |

| Legend | Water | Instr (A) | Level (mOD) | Depth (m) | Description |
|---|---|---|---|---|---|
| | | | 80.70 | 1.00 | Bentonite Seal |
| | ▼1 ▽1 | | 73.70 | 8.00 | Slotted Standpipe |
| | | | 73.20 | 8.50 | Bentonite Seal |
| | | | 61.70 | 20.00 | General Backfill |

**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) |
|---|---|---|---|---|---|---|---|---|---|
| 23/11/11 | | 4.50 | 4.00 | Slow Inflow | | | | 4.30 | 8.00 |

**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) |

**Instrument Groundwater Observations**

**Inst. [A] Type :** Slotted Standpipe

| Date | Instrument [A] Time | Depth (m) | Level (mOD) | Remarks |
|---|---|---|---|---|
| 09/12/11 | | 1.96 | 79.74 | |

**Remarks**

| GEA Geotechnical & Environmental Associates | Tyttenhanger House<br>Coursers Road<br>St Albans<br>AL4 0PG | Site<br>59 Maresfield Gardens, London, NW3 5TE | Borehole Number<br>**BH2** |
|---|---|---|---|

| Boring Method | Casing Diameter | Ground Level (mOD) | Client | Job Number |
|---|---|---|---|---|
| Cable Percussion | 150mm cased to 10.00m | 84.50 | Stefanie Drews & Colin Rowat | J11251 |
| | **Location** | **Dates** | **Engineer** | **Sheet** |
| | | 24/11/2011-25/11/2011 | Elliott Wood | 1/2 |

| Depth (m) | Sample / Tests | Casing Depth (m) | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Water |
|---|---|---|---|---|---|---|---|---|
| | | | | | 84.30 | (0.20) 0.20 | Concrete | |
| | | | | | | | Made Ground (brick rubble) | |
| 0.50 | B1 | | | | | | | |
| | | | | | | (1.30) | | |
| 1.20-1.65 | CPT N=12 | | | 5,1/5,3,2,2 | | | | |
| 1.20-1.65 | B2 | | | | | | | |
| | | | | | 83.00 | 1.50 | Made Ground (dark grey silty gravelly clay with brick and rootlets) | |
| | | | | | | (0.35) | | |
| | | | | | 82.65 | 1.85 | Made Ground (orange-brown silty sandy clay with brick fill) | |
| 1.85 | D1 | | | | | | | |
| 2.00-2.45 | CPT N=11 | | | 1,2/3,3,2,3 | | | | |
| 2.00-2.45 | B3 | | | | | | | |
| | | | | | | (0.85) | | |
| | | | | | 81.80 | 2.70 | Firm orange-brown silty sandy CLAY | |
| 2.75 | D2 | | | | | | | |
| 3.00-3.45 | U1 | | | | | | | |
| 3.75 | D3 | | | | | | | |
| 4.00-4.45 | SPT N=13 | | | 1,2/3,3,4,3 | | (2.70) | | |
| 4.00-4.45 | D4 | | | | | | | |
| 4.75 | D5 | | | | | | | |
| 5.00-5.45 | D6 | | | Seepage(1) at 5.00m, sealed at 5.40m. | | | | ∇1 |
| 5.00-5.45 | SPT N=16 | | | 1,2/3,4,5,4 | 79.10 | 5.40 | Firm bluish grey silty sandy CLAY | |
| 6.00 | D7 | | | | | | | |
| 6.50-6.95 | U2 | | | | | | | |
| 7.50 | D8 | | | | | | | |
| 8.00-8.45 | SPT N=20 | | | 2,3/4,5,5,6 | | | | |
| 8.00-8.45 | D9 | | | | | | | |
| | | | | | | (6.60) | | |
| 9.00 | D10 | | | | | | | |
| 9.50-9.95 | U3 | | | | | | | |

**Remarks**
Groundwater monitoring standpipe installed to 12.0 m

| Scale (approx) | Logged By |
|---|---|
| 1:50 | MP |

**Figure No.** J11251.BH2

Geotechnical & Environmental Associates

Tyttenhanger House
Coursers Road
St Albans
AL4 0PG

| Site | Borehole Number |
|---|---|
| 59 Maresfield Gardens, London, NW3 5TE | BH2 |

| Boring Method | Casing Diameter | Ground Level (mOD) | Client | Job Number |
|---|---|---|---|---|
| Cable Percussion | 150mm cased to 10.00m | 84.50 | Stefanie Drews & Colin Rowat | J11251 |
| | **Location** | **Dates** | **Engineer** | **Sheet** |
| | | 24/11/2011-25/11/2011 | Elliott Wood | 2/2 |

| Depth (m) | Sample / Tests | Casing Depth (m) | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description |
|---|---|---|---|---|---|---|---|
| 10.50 | D11 | | | | | | |
| | | | | | | (6.60) | |
| 11.00-11.45 | SPT N=21 | | | 3,4/4,5,6,6 | | | |
| 11.00-11.45 | D12 | | | | | | |
| | | | | | 72.50 | 12.00 | Stiff becoming very stiff fissured dark grey slightly silty slightly sandy CLAY; occasional claystones beween 18.5 m and 19.0 m |
| 12.00 | D13 | | | | | | |
| 12.50-12.95 | U4 | | | | | | |
| 13.50 | D14 | | | | | | |
| 14.00-14.45 | SPT N=29 | | | 4,5/6,7,7,9 | | | |
| 14.00-14.45 | D15 | | | | | | |
| 15.00 | D16 | | | | | | |
| 15.50-15.95 | U5 | | | | | | |
| | | | | | | (8.00) | |
| 16.50 | D17 | | | | | | |
| 17.00-17.45 | SPT N=31 | | | 5,6/7,8,8,8 | | | |
| 17.00-17.45 | D18 | | | | | | |
| 18.00 | D19 | | | | | | |
| 18.50-18.95 | U6 No Recovery | | | Slow Inflow(2) at 18.50m, rose to 18.30m in 20 mins. | | | |
| 19.00-19.45 | CPT N=33 | | | 6,7/8,8,8,9 | | | |
| 19.00-19.45 | D20 | | | | | | |
| 19.55-20.00 | SPT N=39 | | | 6,8/9,10,11,9 | | | |
| 19.55-20.00 | D21 | | | | | | |
| | | | | | 64.50 | 20.00 | |

| Remarks | Scale (approx) | Logged By |
|---|---|---|
| | 1:50 | MP |
| | **Figure No.** J11251.BH2 | |

| Geotechnical & Environmental Associates | Tyttenhanger House, Coursers Road, St Albans, AL4 0PG | Site | Borehole Number |
|---|---|---|---|
| | | 59 Maresfield Gardens, London, NW3 5TE | BH2 |

| Installation Type | Dimensions | Client | Job Number |
|---|---|---|---|
| Standpipe Piezometer | Internal Diameter of Tube [A] = 50 mm<br>Diameter of Filter Zone = 150 mm | Stefanie Drews & Colin Rowat | J11251 |

| Location | Ground Level (mOD) | Engineer | Sheet |
|---|---|---|---|
| | 84.50 | Elliott Wood | 1/1 |

| Legend | Water | Instr (A) | Level (mOD) | Depth (m) | Description |
|---|---|---|---|---|---|
| | | | 83.50 | 1.00 | Bentonite Seal |
| | ∇1 | | | | |
| | | | 72.50 | 12.00 | Slotted Standpipe |
| | | | 72.00 | 12.50 | Bentonite Seal |
| | ▼2 ∇2 | | 64.50 | 20.00 | General Backfill |

## 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) |
|---|---|---|---|---|---|---|---|---|---|
| 24/11/11 | | 5.00 | 5.00 | Seepage | | | | | 5.40 |
| 25/11/11 | | 18.50 | 10.00 | Slow Inflow | | | | 18.30 | |

## Groundwater Observations During Drilling

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

## Instrument Groundwater Observations

**Inst. [A] Type :** Slotted Standpipe

| Date | Instrument [A] Time | Depth (m) | Level (mOD) | Remarks |
|---|---|---|---|---|
| 09/12/11 | | 3.56 | 80.94 | |

**Remarks**

| GEA Geotechnical & Environmental Associates | Tyttenhanger House, Coursers Road, St Albans, AL4 0PG | Site: 59 Maresfield Gardens, London, NW3 5TE | Number: BH3 |
|---|---|---|---|

| Excavation Method | Dimensions | Ground Level (mOD) | Client | Job Number |
|---|---|---|---|---|
| Opendrive lined percussive sampler | 110mm to 1.00m | 85.30 | Stefanie Drews & Colin Rowat | J11251 |
| | **Location** | **Dates** 23/11/2011 | **Engineer** Elliott Wood | **Sheet** 1/1 |

| Depth (m) | Sample / Tests | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|---|---|---|---|---|---|---|---|---|
| 0.50 | D1 | | | | | Made Ground (dark brown sandy clay with gravel, rootlets, root fragments, brick, charcoal at 1.7 m and a layer of dark brownish grey motteled orange-brown sandy silt from 2.7 m to 2.9 m) - desiccated soil | | |
| 1.50 | D2 | | | | (3.00) | | | |
| 2.50 | D3 | | | | | | | |
| 2.80 | D4 | | | 82.30 | 3.00 | | | |
| 3.25 | D5 | | | | | Firm pale orange-brown mottled greenish grey silty slightly sandy becoming sandy CLAY with occasional partings of silty sand | | |
| 3.75 | D6 | | | | (2.00) | | | |
| 4.50 | D7 | | | 80.30 | 5.00 | | | |
| | | | | | (0.15) | Orange-brown sitly SAND | | |
| 5.10 | D8 | | | 80.15 | 5.15 | | | |
| 5.50 | D9 | | | | (1.10) | Firm brownish grey mottled greenish grey and orange-brown silty sandy CLAY with occasional partings of sand | | |
| | | | Seepage(1) at 6.00m. | 79.05 | 6.25 | | | ∇1 |
| 6.50 | D10 | | | | | Firm bluish grey sily sandy CLAY with occasional partings of grey sand | | |
| 7.50 | D11 | | | | (2.75) | | | |
| 9.00 | D12 | | | 76.30 | 9.00 | Complete at 9.00m | | |

**Remarks**
Groundwater monitoring standpipe installed to 9.0 m
Sample tube damp from 5.0 m, then wet at 6.0 m

| Scale (approx) | Logged By |
|---|---|
| 1:50 | MP |

**Figure No.** J11251.BH3

Tyttenhanger House
Coursers Road
St Albans
AL4 0PG

GEA Geotechnical & Environmental Associates

| Site | Borehole Number |
|---|---|
| 59 Maresfield Gardens, London, NW3 5TE | BH3 |

**Installation Type**: Standpipe Piezometer

**Dimensions**: Internal Diameter of Tube [A] = 50 mm; Diameter of Filter Zone = 110 mm

**Client**: Stefanie Drews & Colin Rowat

**Job Number**: J11251

**Location**:

**Ground Level (mOD)**: 85.30

**Engineer**: Elliott Wood

**Sheet**: 1/1

| Legend | Water | Instr (A) | Level (mOD) | Depth (m) | Description |
|---|---|---|---|---|---|
| | | | | | Bentonite Seal |
| | | | 84.30 | 1.00 | |
| | ∇1 | | | | Slotted Standpipe |
| | | | 76.30 | 9.00 | |

## 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) |
|---|---|---|---|---|---|---|---|---|---|
| 23/11/11 | | 6.00 | 1.00 | Seepage | | | | | |

## 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) | |

## Instrument Groundwater Observations

**Inst. [A] Type :** Slotted Standpipe

| Date | Instrument [A] Time | Depth (m) | Level (mOD) | Remarks |
|---|---|---|---|---|
| 09/12/11 | | 4.40 | 80.90 | |

**Remarks**

| GEA Geotechnical & Environmental Associates | Tyttenhanger House<br>Coursers Road<br>St Albans<br>AL4 0PG | Site<br>59 Maresfield Gardens, London, NW3 5TE | Number<br>**BH4** |
|---|---|---|---|

| **Excavation Method** | **Dimensions** | **Ground Level (mOD)** | **Client** | **Job Number** |
|---|---|---|---|---|
| Drive-in Window Sampler | | 81.80 | Stefanie Drews & Colin Rowat | J11251 |
| | **Location** | **Dates** | **Engineer** | **Sheet** |
| | | 28/11/2011 | Elliott Wood | 1/1 |

| Depth (m) | Sample / Tests | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|---|---|---|---|---|---|---|---|---|
| | | | | 81.75 | (0.05)<br>0.05 | Brick paving | | |
| | | | | 81.60 | (0.15)<br>0.20 | Made Ground (brown silty sandy clay with occasional gravel and rootlets) | | |
| 0.50 | D1 | | | | (0.70) | "Stiff" pale brownish grey mottled orange-brown and pale greenish grey sandy CLAY with rootlets and root fragments - desiccated soil | | |
| | | | | 80.90 | 0.90 | | | |
| 1.00 | D2 | | | | | Firm orange-brown and brownish grey mottled pale greenish grey sitly sandy CLAY with occasional rootlets; becoming dark grey at 2.5 m | | |
| 1.50 | D3 | | | | | | | |
| 2.00 | D4 | | Seepage(1) at 2.00m. | | (2.10) | | | ∇1 |
| 3.00 | D5 | | | 78.80 | 3.00 | Firm bluish grey silty sandy CLAY | | |
| | | | | | (3.00) | | | |
| 5.00 | D6 | | | | | | | |
| | | | | 75.80 | 6.00 | Complete at 6.00m | | |

| **Remarks** | **Scale (approx)** | **Logged By** |
|---|---|---|
| | 1:50 | MP |
| | **Figure No.**<br>J11251.BH4 | |

**GEA** Geotechnical & Environmental Associates

Tyttenhanger House
Coursers Road
St Albans
AL4 0PG

| Site | Number |
|---|---|
| 59 Maresfield Gardens, London, NW3 5TE | **BH5** |

| Excavation Method | Dimensions | Ground Level (mOD) | Client | Job Number |
|---|---|---|---|---|
| Drive-in Window Sampler | | 81.70 | Stefanie Drews & Colin Rowat | J11251 |
| | **Location** | **Dates** | **Engineer** | **Sheet** |
| | | 28/11/2011 | Elliott Wood | 1/1 |

| Depth (m) | Sample / Tests | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Made Ground (dark brown silty very sandy clay with rootlets, gravel and brick fragments) - desiccated soil | | |
| 0.50 | D1 | | | | (1.10) | | | |
| | | | | 80.60 | 1.10 | "Stiff" pale yellowish brown mottled orange-brown silty very sandy CLAY with rootlets and occasional flint; very hard and dry in sample tube - desiccated soil | | |
| 1.50 | D2 | | | | (1.10) | | | |
| | | | | 79.50 | 2.20 | Firm dark greenish brown becoming greenish grey mottled orange-brown silty slaightly sandy CLAY with occasional rootlets | | |
| 2.50 | D3 | | | | | | | |
| | | | | | (1.80) | | | |
| 3.50 | D4 | | | | | | | |
| | | | | 77.70 | 4.00 | Firm pale orange-brown mottled pale greenish grey becoming brownish grey sitly slightly sandy CLAY | | |
| 4.50 | D5 | | | | | | | |
| | | | | | (2.00) | | | |
| 5.50 | D6 | | | | | | | |
| | | | | 75.70 | 6.00 | | | |
| | | | | | | Complete at 6.00m | | |

| Remarks | Scale (approx) | Logged By |
|---|---|---|
| Groundwater not encountered | 1:50 | MP |
| | **Figure No.** J11251.BH5 | |

GEA Geotechnical & Environmental Associates

Tyttenhanger House
Coursers Road
St Albans
AL4 0PG

| Site | Number |
|---|---|
| 59 Maresfield Gardens, London, NW3 5TE | BH6 |

| Excavation Method | Dimensions | Ground Level (mOD) | Client | Job Number |
|---|---|---|---|---|
| Drive-in Window Sampler | | 81.80 | Stefanie Drews & Colin Rowat | J11251 |
| | **Location** | **Dates** | **Engineer** | **Sheet** |
| | | 28/11/2011 | Elliott Wood | 1/1 |

| Depth (m) | Sample / Tests | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Made Ground (brown silty sandy clay with gravel, brick and rootlets) - desiccated soil | | |
| 0.50 | D1 | | | | (1.00) | | | |
| | | | | 80.80 | 1.00 | "Stiff" yellowish brown silty sandy CLAY with occasional flint - desiccated soil | | |
| 1.50 | D2 | | | | (1.00) | | | |
| | | | | 79.80 | 2.00 | Firm dark grey, greenish grey and pale orange-brown silty slightly sandy CLAY; 0.15 m thick layer of reddish brown silty clay with charcoal fragments at 2.4 m | | |
| 2.50 | D3 | | | | | | | |
| | | | | | (2.40) | | | |
| 3.50 | D4 | | | | | | | |
| | | | Seepage(1) at 4.00m. | | | | | ∇1 |
| | | | | 77.40 | 4.40 | Firm brownish grey mottled orange-brown and pale greenish grey sitly slightly sandy CLAY | | |
| 4.50 | D5 | | | | | | | |
| | | | | | (1.60) | | | |
| 5.50 | D6 | | | | | | | |
| | | | | 75.80 | 6.00 | | | |
| | | | | | | Complete at 6.00m | | |

| Remarks | Scale (approx) | Logged By |
|---|---|---|
| | 1:50 | MP |
| | **Figure No.** | |
| | J11251.BH6 | |

Geotechnical & Environmental Associates

Tyttenhanger House
Coursers Road
St Albans
AL4 0PG

| Excavation Method | Dimensions | Ground Level (mOD) | Site | Number |
|---|---|---|---|---|
| Drive-in Window Sampler | | 81.70 | 59 Maresfield Gardens, London, NW3 5TE | BH7 |
| | **Location** | **Dates** | **Client** | **Job Number** |
| | | 28/11/2011 | Stefanie Drews & Colin Rowat | J11251 |
| | | | **Engineer** | **Sheet** |
| | | | Elliott Wood | 1/1 |

| Depth (m) | Sample / Tests | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Made Ground (brown silty sandy clay with gravel, brick and rootlets) - desiccated soil | | |
| 0.50 | D1 | | | | | | | |
| | | | | | (2.10) | | | |
| 1.50 | D2 | | | | | | | |
| | | | | 79.60 | 2.10 | Made Ground (pale brownish grey mottled orange-brown and bluish grey silty sandy clay with occasional brick) | | |
| 2.50 | D3 | | | | (0.90) | | | |
| | | | | 78.70 | 3.00 | Firm pale brownish grey mottled orange-brown and bluish grey silty sandy CLAY | | |
| 3.50 | D4 | | | | (1.00) | | | |
| | | | Seepage(1) at 4.00m. | 77.70 | 4.00 | Firm dark brownish grey becoming dark grey silty slightly sandy CLAY | | ∇1 |
| 4.50 | D5 | | | | | | | |
| | | | | | (2.00) | | | |
| 5.50 | D6 | | | | | | | |
| | | | | 75.70 | 6.00 | | | |
| | | | | | | Complete at 6.00m | | |

| Remarks | Scale (approx) | Logged By |
|---|---|---|
| | 1:50 | MP |
| | **Figure No.** | |
| | J11251.BH7 | |

| GEA Geotechnical & Environmental Associates | Tyttenhanger House, Coursers Road, St Albans, AL4 0PG | Site: 59 Maresfield Gardens, London, NW3 5TE | Number: BH8 |
|---|---|---|---|

| Excavation Method | Dimensions | Ground Level (mOD) | Client | Job Number |
|---|---|---|---|---|
| Drive-in Window Sampler | | 81.80 | Stefanie Drews & Colin Rowat | J11251 |
| | **Location** | **Dates** | **Engineer** | **Sheet** |
| | | 28/11/2011 | Elliott Wood | 1/1 |

| Depth (m) | Sample / Tests | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Made Ground (dark brown becoming brown silty sandy clay with gravel, brick and rootlets) | | |
| 0.50 | D1 | | | | | | | |
| | | | | | (1.80) | | | |
| 1.50 | D2 | | | | | | | |
| | | | | 80.00 | 1.80 | Firm brown motteld greenish brown, orange-brown and pale bluish grey becoming brownish grey silty sandy CLAY with occasional partings of silty sand | | |
| 2.50 | D3 | | | | | | | |
| | | | | | (2.70) | | | |
| | | | | 77.30 | 4.50 | Firm bluish grey silty slightly sandy CLAY with occasonal partings of silty sand | | |
| 5.00 | D4 | | Seepage(1) at 5.00m. | | | | | ∇1 |
| | | | | | (1.50) | | | |
| | | | | 75.80 | 6.00 | Complete at 6.00m | | |

| Remarks | Scale (approx) | Logged By |
|---|---|---|
| | 1:50 | MP |
| | **Figure No.** J11251.BH8 | |

| GEA Geotechnical & Environmental Associates | Tyttenhanger House, Coursers Road, St Albans, AL4 0PG | Site: 59 Maresfield Gardens, London, NW3 5TE | Number: **BH9** |
|---|---|---|---|

| Excavation Method | Dimensions | Ground Level (mOD) | Client | Job Number |
|---|---|---|---|---|
| Drive-in Window Sampler | | 82.00 | Stefanie Drews & Colin Rowat | J11251 |
| | **Location** | **Dates** | **Engineer** | **Sheet** |
| | | 28/11/2011 | Elliott Wood | 1/1 |

| Depth (m) | Sample / Tests | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|---|---|---|---|---|---|---|---|---|
| | | | | | (0.80) | Existing trial pit excavation | | |
| | | | | 81.20 | 0.80 (0.30) | Made Ground (brown slightly sandy clay with gravel, brick and concrete) | | |
| | | | | 80.90 | 1.10 | Firm orange-brown mottled pale greenish grey silty sandy CLAY with partings of silty sand and occasional gravel | | |
| 1.50 | D1 | | | | | | | |
| | | | Seepage(1) at 2.00m. | | | | | ∇1 |
| | | | | | (2.40) | | | |
| 3.00 | D2 | | | | | | | |
| | | | | 78.50 | 3.50 | Firm bluish grey silty sandy CLAY with partings of sitly sand | | |
| 4.00 | D3 | | | | | | | |
| | | | | | (2.50) | | | |
| 6.00 | D4 | | | 76.00 | 6.00 | | | |
| | | | | | | Complete at 6.00m | | |

**Remarks**
Borehole drilled through part of an exisiting trial pit within the house; bench level of trial pit at a depth of 0.8 m below floor level
Groundwater within trial pit measued at 1.48 m below floor level

| Scale (approx) | Logged By |
|---|---|
| 1:50 | MP |

**Figure No.** J11251.BH9

| | | | |
|---|---|---|---|
| PROJECT NAME | 59 MARESFIELD GARDENS, LONDON NW3 5TE<br>Job Number: J11251<br>GEO / 17634 | Date | 12/12/2011 |
| PROJECT NO: | | Approved | Simon Burke |
| | | Page | 1 of 2 |

| Sample details | | | | | Classification Tests | | | | | Density Tests | | Undrained Triaxial Compression Tests | | | Chemical Tests | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Borehole No. | Depth (m) | No. | Type | Description | MC (%) | LL (%) | PL (%) | PI | <425 mic (%) | Bulk (Mg/m³) | Dry (Mg/m³) | Cell Pressure (kPa) | Deviator Stress (kPa) | Shear Stress (kPa) | pH | 2:1 W/S SO4 (g/l) | Ground Water SO4 (g/l) | Other tests and comments |
| 1 | 2.00 | U1 | U | Soft light blue-grey and light brown silty CLAY | 35 | 42 | 19 | 23 | 100 | 1.95 | 1.44 | 40 | 70 | 35 | 6.8 | 0.24 | | |
| 1 | 4.00 | U2 | U | Firm to stiff brown and light blue-grey silty CLAY | 29 | 48 | 19 | 29 | 100 | 1.98 | 1.53 | 80 | 188 | 94 | | | | |
| 1 | 6.50 | U3 | U | Firm to stiff grey silty CLAY | 25 | 51 | 19 | 32 | 100 | 2.07 | 1.65 | 130 | 153 | 77 | | | | |
| 1 | 12.50 | U4 | U | Firm to stiff dark grey silty CLAY | 30 | | | | | 1.95 | 1.50 | 250 | 184 | 92 | | | | |
| 1 | 15.50 | U5 | U | Firm to stiff dark grey silty CLAY | 27 | | | | | 1.98 | 1.55 | 310 | 177 | 88 | | | | |
| 1 | 18.50 | U6 | U | Stiff dark grey silty CLAY | 30 | | | | | 1.97 | 1.52 | 370 | 223 | 111 | | | | |
| 2 | 3.00 | U1 | U | Firm orange brown clayey SILT | 30 | 49 | 18 | 31 | 100 | 1.88 | 1.45 | 60 | 99 | 50 | 7.8 | 0.39 | | |
| 2 | 6.50 | U2 | U | Firm dark grey silty CLAY | 28 | 51 | 22 | 29 | 100 | 1.96 | 1.54 | 130 | 102 | 51 | | | | |
| 2 | 9.50 | U3 | U | Soft to firm dark grey silty CLAY | 25 | | | | | 2.03 | 1.63 | 190 | 86 | 43 | | | | |
| 2 | 12.50 | U4 | U | Firm to stiff dark grey silty CLAY | 30 | | | | | 2.00 | 1.54 | 250 | 155 | 78 | | | | |
| 2 | 15.50 | U5 | U | Firm to stiff dark brown silty CLAY | 28 | | | | | 1.99 | 1.55 | 310 | 192 | 96 | | | | |
| 4 | 2.00 | D4 | D | Brown, grey and orange fine sandy silty CLAY with rare fine gravel | 35 | 48 | 20 | 28 | 98 | | | | | | | | | |

# SUMMARY OF GEOTECHNICAL TESTING

GEOLABS®

| PROJECT NAME | 59 MARESFIELD GARDENS, LONDON NW3 5TE | Date | 12/12/2011 |
|---|---|---|---|
| | Job Number: J11251 | Approved | Simon Burke |
| PROJECT NO: | GEO / 17634 | Page | 2 of 2 |

| Sample details | | | | | Classification Tests | | | | | Density Tests | | Undrained Triaxial Compression Tests | | | Chemical Tests | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Borehole No. | Depth (m) | No. | Type | Description | MC (%) | LL (%) | PL (%) | PI | <425 mic (%) | Bulk (Mg/m³) | Dry (Mg/m³) | Cell Pressure (kPa) | Deviator Stress (kPa) | Shear Stress (kPa) | pH | 2:1 W/S SO4 (g/l) | Ground Water SO4 (g/l) | Other tests and comments |
| 5 | 1.50 | D2 | D | Brown silty very sandy CLAY with rare fine to medium gravel | | | | | | | | | | | | | | Particle Size Distribution Test |
| 6 | 1.50 | D2 | D | Orange brown fine sandy silty CLAY | | | | | | | | | | | | | | Particle Size Distribution Test |

# SUMMARY OF GEOTECHNICAL TESTING

GEOLABS®



BS1377 : Part 2 : Clause 9 : 1990

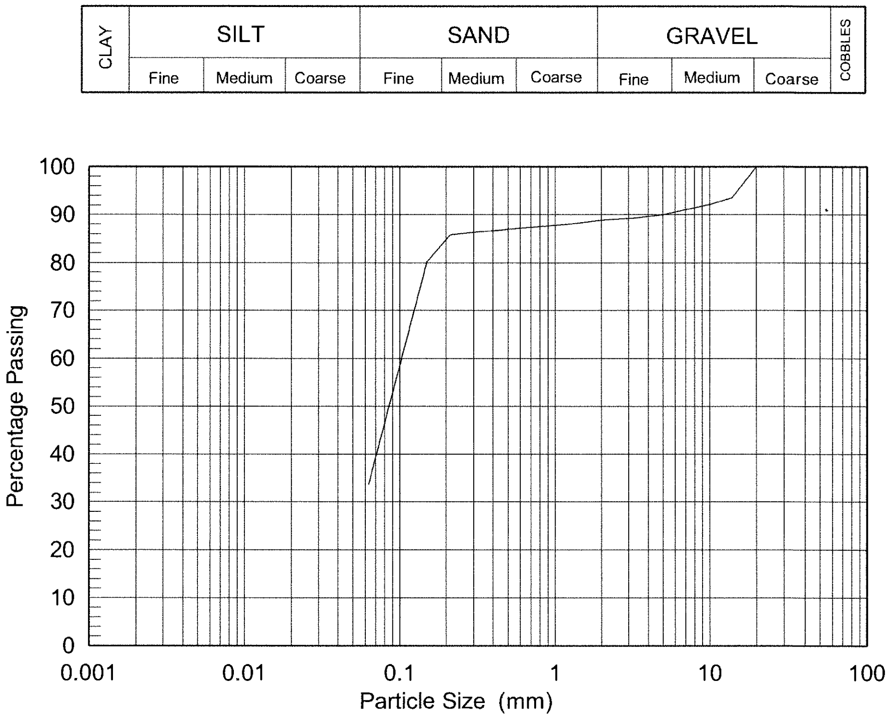
# Determination of Particle Size Distribution

| | |
|---|---|
| Borehole Number: | 5 |
| Sample Number: | D2 |
| Depth (m): | 1.50 |

Description:
Brown silty very sandy CLAY with rare fine to medium gravel
Insufficient material supplied to be representative in accordance with BS1377 requirements.

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method

| SIEVE | |
|---|---|
| Sieve | % pass |
| 200 mm | 100 |
| 125 mm | 100 |
| 90 mm | 100 |
| 75 mm | 100 |
| 63 mm | 100 |
| 50 mm | 100 |
| 37.5 mm | 100 |
| 28 mm | 100 |
| 20 mm | 100 |
| 14 mm | 94 |
| 10 mm | 92 |
| 6.3 mm | 91 |
| 5 mm | 90 |
| 3.35 mm | 89 |
| 2 mm | 89 |
| 1.18 mm | 88 |
| 600 µm | 87 |
| 425 µm | 87 |
| 300 µm | 86 |
| 212 µm | 86 |
| 150 µm | 80 |
| 63 µm | 34 |




| Particle Proportions | | |
|---|---|---|
| Cobbles | 0.0 | % |
| Gravel | 11.1 | % |
| Sand | 55.3 | % |
| Silt & Clay | 33.6 | % |

Checked and Approved
Initials: SB
Date: 12/12/2011

Project Number: **GEO / 17634**

Project Name: **59 MARESFIELD GARDENS, LONDON NW3 5TE**

**Job Number: J11251**

UKAS TESTING 1982

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BS1377 : Part 2 : Clause 9 : 1990

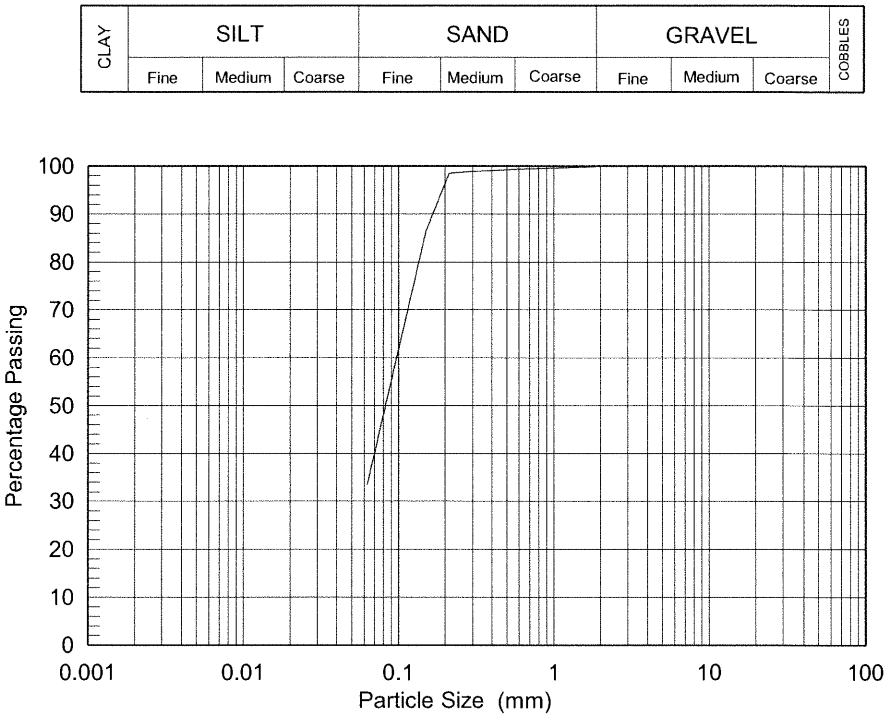
# Determination of Particle Size Distribution

Borehole Number: 6
Sample Number: D2
Depth (m): 1.50

Description:
Orange brown fine sandy silty CLAY

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method

| SIEVE | |
|---|---|
| Sieve | % pass |
| 200 mm | 100 |
| 125 mm | 100 |
| 90 mm | 100 |
| 75 mm | 100 |
| 63 mm | 100 |
| 50 mm | 100 |
| 37.5 mm | 100 |
| 28 mm | 100 |
| 20 mm | 100 |
| 14 mm | 100 |
| 10 mm | 100 |
| 6.3 mm | 100 |
| 5 mm | 100 |
| 3.35 mm | 100 |
| 2 mm | 100 |
| 1.18 mm | 100 |
| 600 μm | 99 |
| 425 μm | 99 |
| 300 μm | 99 |
| 212 μm | 98 |
| 150 μm | 86 |
| 63 μm | 34 |




| Particle Proportions | | |
|---|---|---|
| Cobbles | 0.0 | % |
| Gravel | 0.1 | % |
| Sand | 66.4 | % |
| Silt & Clay | 33.5 | % |

Checked and Approved
Initials: SB
Date: 12/12/2011

Project Number:
**GEO / 17634**
Project Name:
**59 MARESFIELD GARDENS, LONDON NW3 5TE**
**Job Number: J11251**

UKAS TESTING 1982

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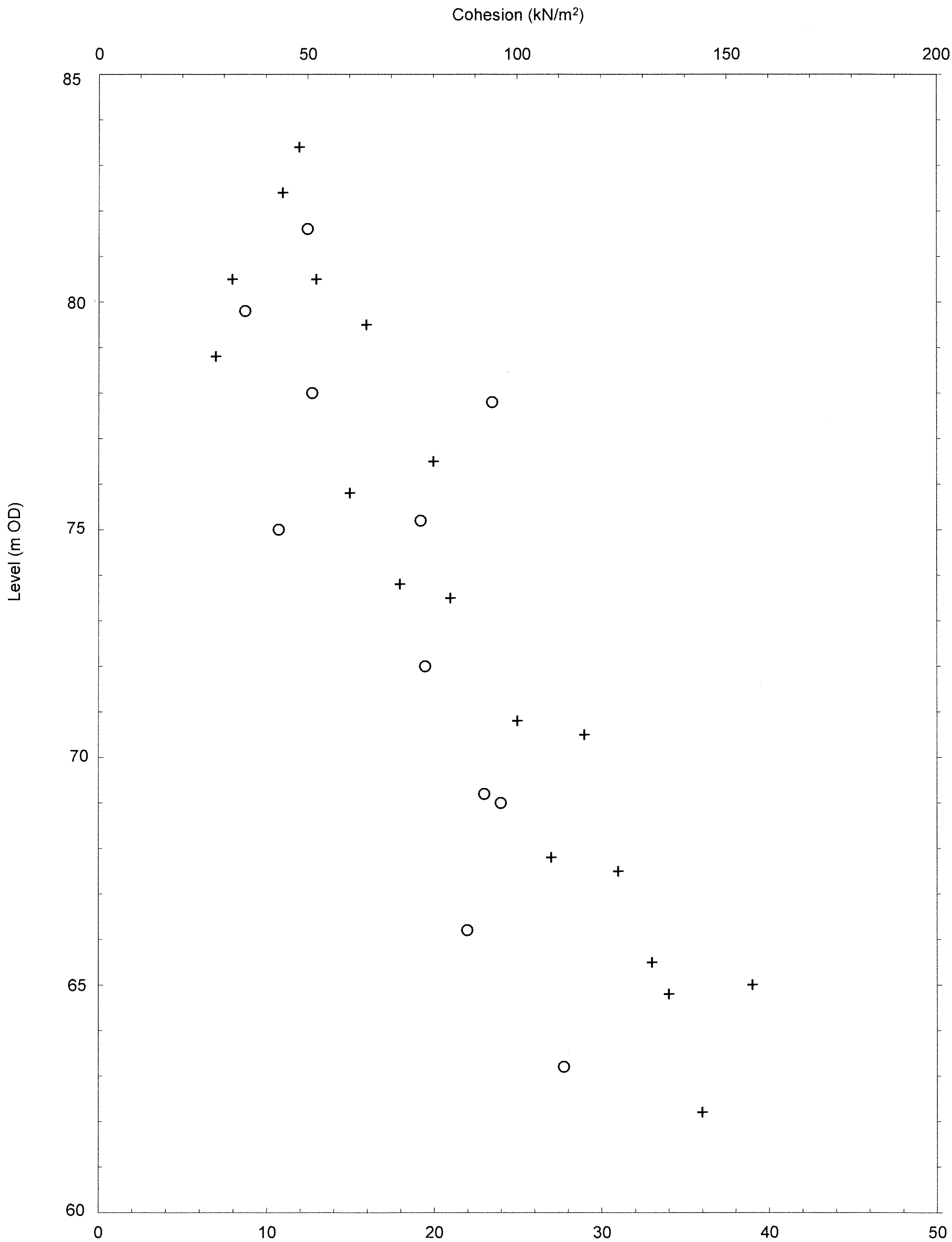
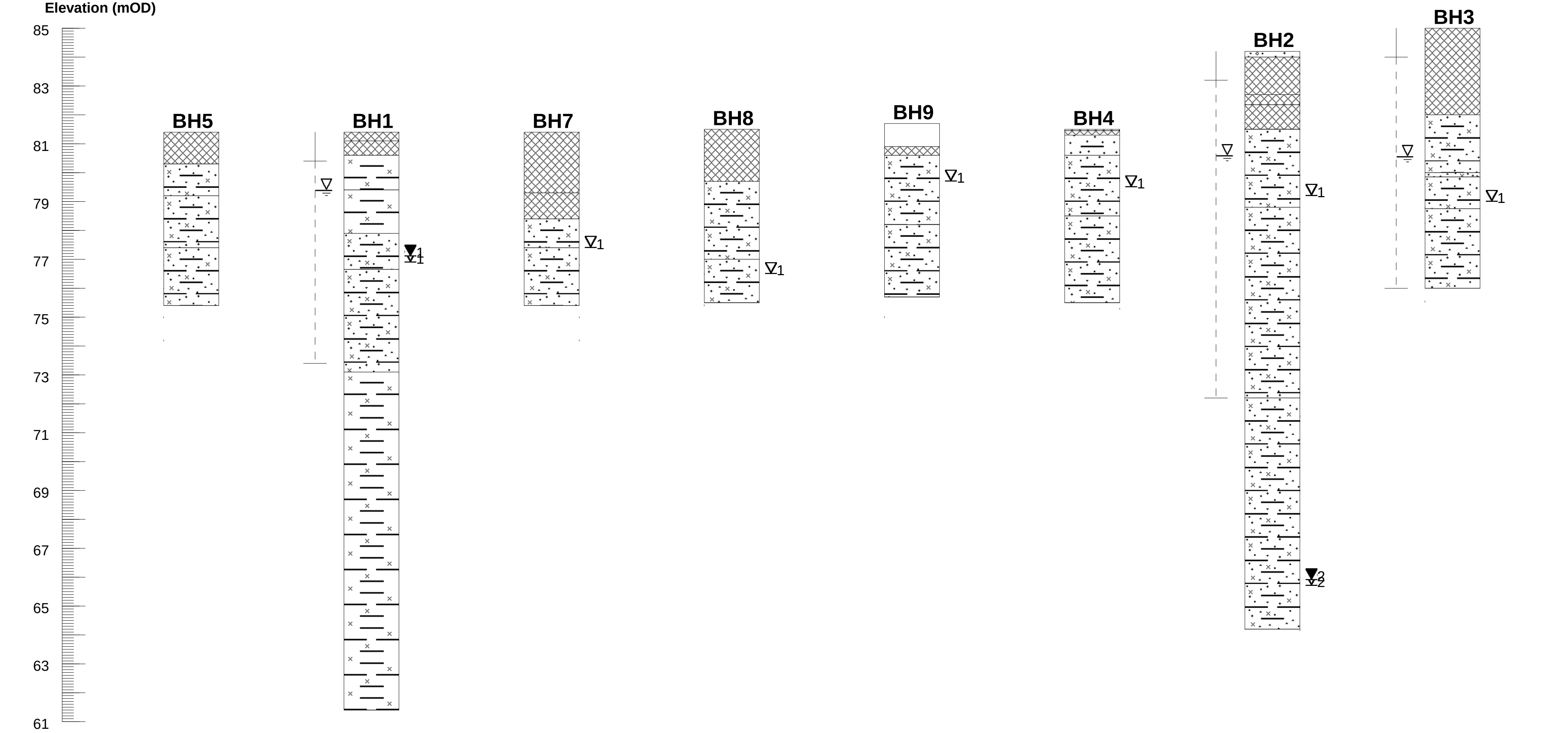
# SPT and Cohesion / Depth Graph

| | | | |
|---|---|---|---|
| **Site** | 59 Maresfield Gardens, London, NW3 5TE | **Job Number** | J11251 |
| **Client** | Stefanie Drews & Colin Rowat | **Sheet** | 1 / 1 |
| **Engineer** | Elliott Wood | | |




Cu = 4 N
+ SPT
o Cu




**Key**

| | |
|---|---|
| Groundwater Strike | Silty CLAY |
| Strike Rise Level | Sandy CLAY |
| Highest recorded piezo level | Silty sandy CLAY |
| Piezometer Tip | Silty SAND |
| Slotted Standpipe | |
| MADE GROUND | |
| CONCRETE | |

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| | | | |
|---|---|---|---|
| **Site** 59 Maresfield Gardens, London, NW3 5TE | | | |
| **Title** Nominal Section | | | |
| **Drawn** | **Checked** | **Sheet** 1/1 | **Job No.** J11251 |
| **Date** 10/05/2012 | **Date** | **Scale** 1:200[V] | **Figure No.** J11251.1 |

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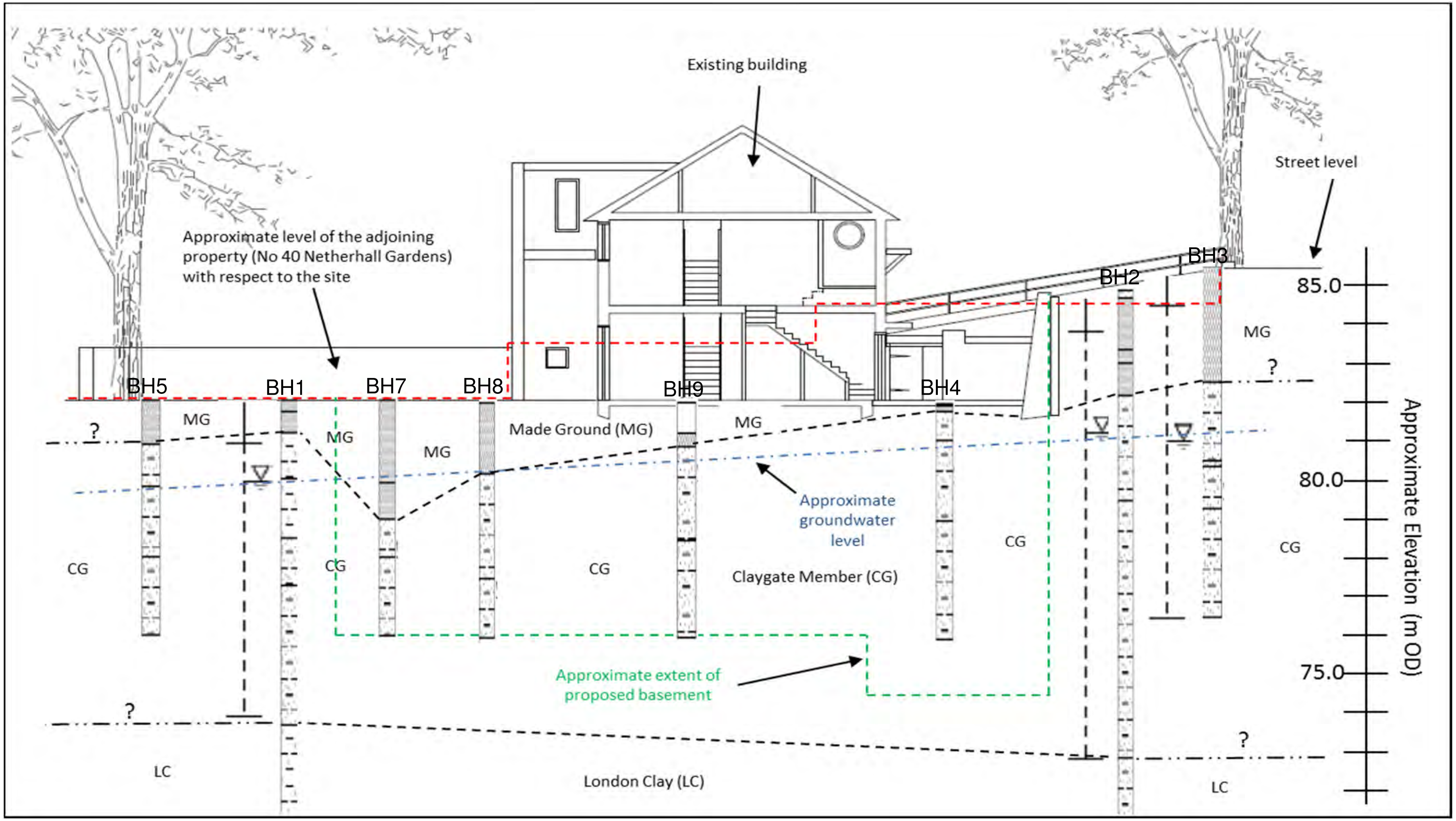
# Cross-Section

| | | | |
|---|---|---|---|
| **Site** | 59 Maresfield Gardens, London, NW3 5TE | **Job Number** | J11251 |
| **Client** | Stefanie Drews & Colin Rowat | **Sheet** | 1 / 1 |
| **Engineer** | Elliott Wood | | |



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# LABORATORY TEST REPORT

Chemtest
The right chemistry to deliver results

**Results of analysis of 3 samples**
**received 6 December 2011**

**Report Date**
**14 December 2011**

**J11251 - 59 Maresfield Gardens**

| SOP↓ | Determinand↓ | CAS No↓ | Units↓ | * | | | |
|---|---|---|---|---|---|---|---|
| | **Login Batch No** | | | | | **151083** | |
| | Chemtest LIMS ID | | | | AG78011 | AG78012 | AG78013 |
| | Sample ID | | | | BH1 | BH2 | BH9 |
| | Sample No | | | | | | |
| | Sampling Date | | | | 29/11/2011 | 29/11/2011 | 29/11/2011 |
| | Depth | | | | 0.5m | 1.2m | 1.5m |
| | *Matrix* | | | | *SOIL* | *SOIL* | *SOIL* |
| 2300 | Cyanide (total) | 57125 | mg kg-1 | M | <0.50 | <0.50 | <0.50 |
| 2325 | Sulfide | 18496258 | mg kg-1 | M | 2.8 | 2.2 | 1.1 |
| 2625 | Total Organic Carbon | | % | M | 0.94 | 2.9 | 0.20 |
| 2220 | Chloride (extractable) | 16887006 | g l-1 | M | <0.010 | 0.027 | 0.037 |
| 2430 | Sulfate (total) as SO4 | | mg kg-1 | | 400 | 2800 | 200 |
| 2450 | Arsenic | 7440382 | mg kg-1 | M | 9.6 | 14 | 11 |
| | Cadmium | 7440439 | mg kg-1 | M | <0.10 | 0.23 | <0.10 |
| | Chromium | 7440473 | mg kg-1 | M | 49 | 31 | 32 |
| | Copper | 7440508 | mg kg-1 | M | 21 | 52 | 11 |
| | Mercury | 7439976 | mg kg-1 | M | <0.10 | 0.36 | <0.10 |
| | Nickel | 7440020 | mg kg-1 | M | 36 | 17 | 17 |
| | Lead | 7439921 | mg kg-1 | M | 37 | 170 | 11 |
| | Selenium | 7782492 | mg kg-1 | M | <0.20 | 0.37 | <0.20 |
| | Zinc | 7440666 | mg kg-1 | M | 71 | 170 | 45 |
| 2670 | TPH >C5-C6 | | mg kg-1 | U | < 0.1 | < 0.1 | < 0.1 |
| | TPH >C6-C7 | | mg kg-1 | U | < 0.1 | < 0.1 | < 0.1 |
| | TPH >C7-C8 | | mg kg-1 | M | < 0.1 | < 0.1 | < 0.1 |
| | TPH >C8-C10 | | mg kg-1 | M | < 0.1 | < 0.1 | < 0.1 |
| | TPH >C10-C12 | | mg kg-1 | M | < 0.1 | < 0.1 | < 0.1 |
| | TPH >C12-C16 | | mg kg-1 | M | 1.8 | < 0.1 | < 0.1 |
| | TPH >C16-C21 | | mg kg-1 | M | 7.0 | < 0.1 | < 0.1 |
| | TPH >C21-C35 | | mg kg-1 | M | 0.96 | < 0.1 | < 0.1 |
| | Total Petroleum Hydrocarbons | | mg kg-1 | U | < 10 | < 10 | < 10 |
| 2700 | Naphthalene | 91203 | mg kg-1 | M | < 0.1 | 0.4 | < 0.1 |
| | Acenaphthylene | 208968 | mg kg-1 | M | < 0.1 | 0.18 | < 0.1 |
| | Acenaphthene | 83329 | mg kg-1 | M | < 0.1 | 0.24 | < 0.1 |
| | Fluorene | 86737 | mg kg-1 | M | < 0.1 | < 0.1 | < 0.1 |

All tests undertaken between 07/12/2011 and 13/12/2011

* Accreditation status

***This report should be interpreted in conjuction with the notes on the accompanying cover page.***

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FAO J Fuller / M Penfold

# LABORATORY TEST REPORT

**Results of analysis of 3 samples**
**received 6 December 2011**

**J11251 - 59 Maresfield Gardens**

Chemtest
The right chemistry to deliver results

**Report Date**
**14 December 2011**

| | | | | | | **151083** | |
|---|---|---|---|---|---|---|---|
| | | | | | AG78011 | AG78012 | AG78013 |
| | | | | | BH1 | BH2 | BH9 |
| | | | | | 29/11/2011 | 29/11/2011 | 29/11/2011 |
| | | | | | 0.5m | 1.2m | 1.5m |
| | | | | | *SOIL* | *SOIL* | *SOIL* |
| 2700 | Phenanthrene | 85018 | mg kg-1 | M | < 0.1 | 0.4 | < 0.1 |
| | Anthracene | 120127 | mg kg-1 | M | < 0.1 | < 0.1 | < 0.1 |
| | Fluoranthene | 206440 | mg kg-1 | M | < 0.1 | 0.88 | < 0.1 |
| | Pyrene | 129000 | mg kg-1 | M | < 0.1 | 0.62 | < 0.1 |
| | Benzo[a]anthracene | 56553 | mg kg-1 | M | < 0.1 | < 0.1 | < 0.1 |
| | Chrysene | 218019 | mg kg-1 | M | < 0.1 | < 0.1 | < 0.1 |
| | Benzo[b]fluoranthene | 205992 | mg kg-1 | M | < 0.1 | < 0.1 | < 0.1 |
| | Benzo[k]fluoranthene | 207089 | mg kg-1 | M | < 0.1 | < 0.1 | < 0.1 |
| | Benzo[a]pyrene | 50328 | mg kg-1 | M | < 0.1 | < 0.1 | < 0.1 |
| | Dibenzo[a,h]anthracene | 53703 | mg kg-1 | M | < 0.1 | < 0.1 | < 0.1 |
| | Indeno[1,2,3-cd]pyrene | 193395 | mg kg-1 | M | < 0.1 | < 0.1 | < 0.1 |
| | Benzo[g,h,i]perylene | 191242 | mg kg-1 | M | < 0.1 | < 0.1 | < 0.1 |
| | Total (of 16) PAHs | | mg kg-1 | M | < 2 | 2.7 | < 2 |
| 2920 | Phenols (total) | | mg kg-1 | N | <0.3 | <0.3 | <0.3 |
| 2010 | pH | | | M | 8.1 | 8.8 | 7.6 |
| 2030 | Moisture | | % | n/a | 16.6 | 14.6 | 25 |
| | Stones content (>50mm) | | % | n/a | <0.02 | <0.02 | <0.02 |
| 2040 | Soil colour | | | n/a | brown | brown | orange |
| | Soil texture | | | n/a | clay | sand | clay |
| | Other material | | | n/a | stones | stones, twigs | none |

All tests undertaken between 07/12/2011 and 13/12/2011
* Accreditation status
***This report should be interpreted in conjuction with the notes on the accompanying cover page.***


LIMS sample ID range AG78011 to AG78013

GEA Geotechnical & Environmental Associates

Tyttenhanger House
Coursers Road
St Albans
AL4 0PG

# Generic Risk-Based Soil Guideline Values

| | | |
|---|---|---|
| **Site** | 59 Maresfield Gardens, London, NW3 5TE | **Job Number** J11251 |
| **Client** | Stefanie Drews & Colin Rowat | **Sheet** 1 / 1 |
| **Engineer** | Elliott Wood | |

**Proposed End Use** Residential with plant uptake

**Soil pH** 8

**Soil Organic Matter content %** 2.5

| Contaminant | Guideline Value mg/kg | Data Source |
|---|---|---|
| ***Metals*** | | |
| Arsenic | 32 | SGV |
| Cadmium | 10 | SGV |
| Chromium (III) | 3000 | LQM/CIEH |
| Chromium (VI) | 4.3 | LQM/CIEH |
| Copper | 2,330 | LQM/CIEH |
| Lead | 450 | withdrawn SGV |
| Elemental Mercury | 1 | SGV |
| Inorganic Mercury | 170 | SGV |
| Nickel | 130 | LQM/CIEH |
| Selenium | 350 | SGV |
| Zinc | 3,750 | LQM/CIEH |
| ***Hydrocarbons*** | | |
| Benzene | 0.18 | SGV |
| Toluene | 320 | SGV |
| Ethyl Benzene | 180 | SGV |
| Xylene | 120 | SGV |
| Aliphatic C5-C6 | 55 | LQM/CIEH |
| Aliphatic C6-C8 | 160 | LQM/CIEH |
| Aliphatic C8-C10 | 46 | LQM/CIEH |
| Aliphatic C10-C12 | 230 | LQM/CIEH |
| Aliphatic C12-C16 | 1700 | LQM/CIEH |
| Aliphatic C16-C35 | 64,000 | LQM/CIEH |
| Aromatic C6-C7 | See Benzene | LQM/CIEH |
| Aromatic C7-C8 | See Toluene | LQM/CIEH |
| Aromatic C8-C10 | 65 | LQM/CIEH |
| Aromatic C10-C12 | 160 | LQM/CIEH |
| Aromatic C12-C16 | 310 | LQM/CIEH |
| Aromatic C16-C21 | 480 | LQM/CIEH |
| Aromatic C21-C35 | 1100 | LQM/CIEH |
| PRO ($C_5$ –$C_{10}$) | 646 | Calc |
| DRO ($C_{12}$ –$C_{28}$) | 66,490 | Calc |
| Lube Oil ($C_{28}$ –$C_{44}$) | 65,100 | Calc |
| **TPH** | **500** | Trigger for speciated testing |

| Contaminant | Guideline Value mg/kg | Data Source |
|---|---|---|
| ***Anions*** | | |
| Soluble Sulphate | 0.5 g/l | Structures |
| Sulphide | 50 | Structures |
| Chloride | 400 | Structures |
| ***Others*** | | |
| Organic Carbon | 6 | Methanogenic potential |
| Total Cyanide | 140 | WRAS |
| Total Mono Phenols | 290 | SGV |
| ***PAH*** | | |
| Naphthalene | 3.70 | LQM/CIEH |
| Acenaphthylene | 400 | LQM/CIEH |
| Acenaphthene | 480 | LQM/CIEH |
| Fluorene | 380 | LQM/CIEH |
| Phenanthrene | 200 | LQM/CIEH |
| Anthracene | 4,900 | LQM/CIEH |
| Fluoranthene | 460 | LQM/CIEH |
| Pyrene | 1,000 | LQM/CIEH |
| Benzo(a) Anthracene | 4.7 | LQM/CIEH |
| Chrysene | 8 | LQM/CIEH |
| Benzo(b) Fluoranthene | 6.5 | LQM/CIEH |
| Benzo(k) Fluoranthene | 9.6 | LQM/CIEH |
| Benzo(a) pyrene | 0.94 | LQM/CIEH |
| Indeno(1 2 3 cd) Pyrene | 3.9 | LQM/CIEH |
| Dibenzo(a h) Anthracene | 0.86 | LQM/CIEH |
| Benzo (g h i) Perylene | 46 | LQM/CIEH |
| **Total PAH** | **6.3** | B(a)P / 0.15 |
| ***Chlorinated Solvents*** | | |
| 1,1,1 trichloroethane (TCA) | 12.9 | LQM/CIEH |
| tetrachloroethane (PCA) | 2.1 | LQM/CIEH |
| tetrachloroethene (PCE) | 2.1 | LQM/CIEH |
| trichloroethene (TCE) | 0.22 | LQM/CIEH |
| 1,2-dichloroethane (DCA) | 0.008 | LQM/CIEH |
| vinyl chloride (Chloroethene) | 0.00064 | LQM/CIEH |
| tetrachloromethane (Carbon tetra | 0.039 | LQM/CIEH |
| trichloromethane (Chloroform) | 1.3 | LQM/CIEH |

*Notes*

Concentrations measured below the above values may be considered to represent 'uncontaminated conditions' which do not pose a risk to human health. Concentrations measured in excess of these valuesindicate a potential risk, and thus require further, site specific risk assessment.

SGV - Soil Guideline Value, derived from the CLEA model and published by Environment Agency 2009

withdrawn SGV - Former SGV, derived from the CLEA 2000 model and published by DEFRA pending confirmation of new approach to modeling lead

LQM/CIEH - Generic Assessment Criteria for Human Health Risk Assessment 2nd edition (2009)derived using CLEA 1.04 model 2009

Calc - sum of nearest available carbon range specified including BTEX for PRO fraction

B(a)P / 0.15 - GEA experince indicates that Benzo(a) pyrene (one of the most common and most carcenogenic of the PAHs) rarely exceeds 15% of the total PAH concentration, hence this Total PAH threshold is regarded as being conservative

Geotechnical & Environmental Associates

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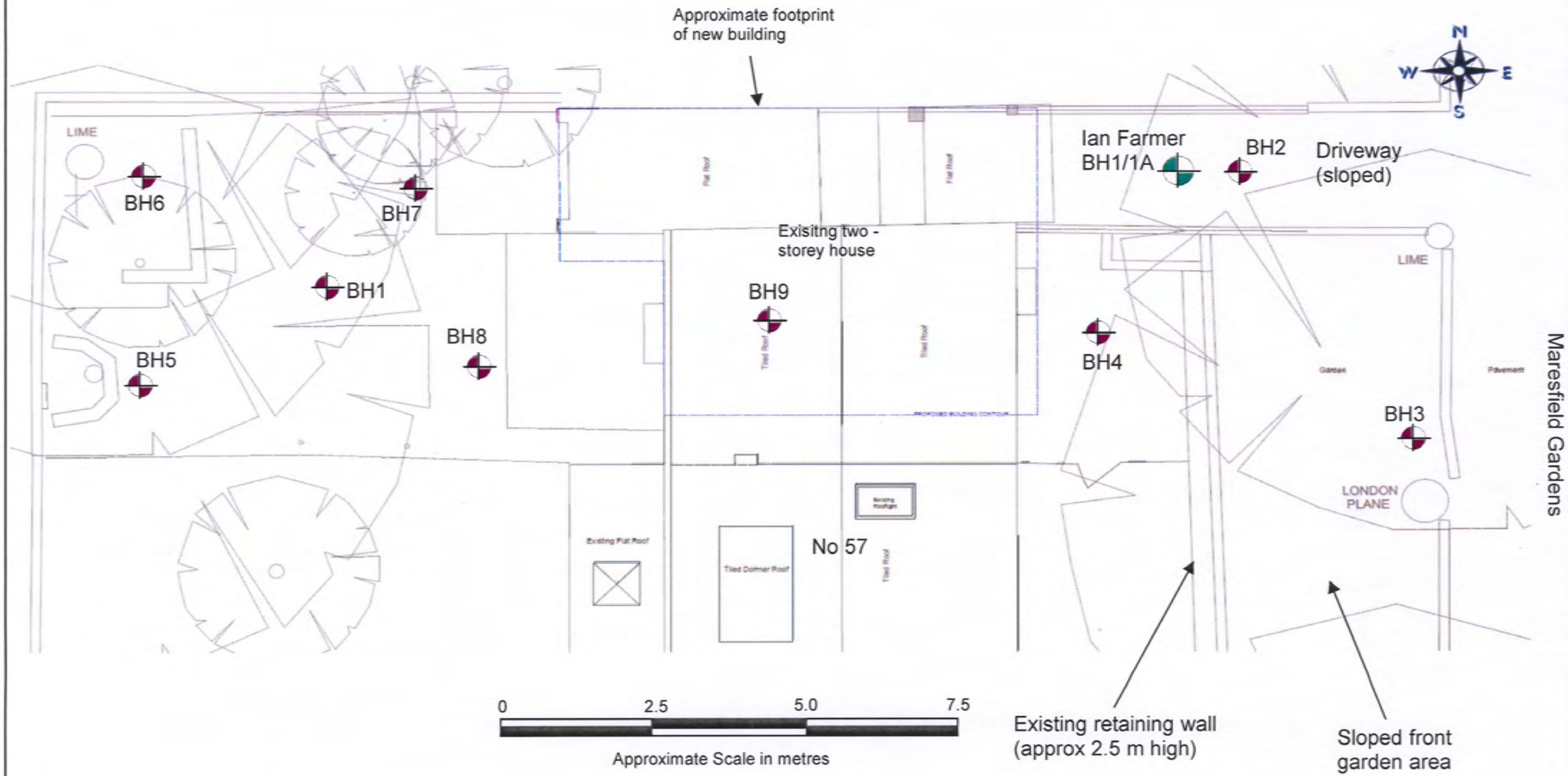
## Site Plan

| | | | |
|---|---|---|---|
| **Site** | 59 Maresfield Gardens, London, NW3 5TE | **Job Number** | J11251 |
| **Client** | Stefanie Drews & Colin Rowat | **Sheet** | 1 / 1 |
| **Engineer** | Elliott Wood | | |



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independent specialist providing a complete
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where information can be found
on all of the services that we offer.

# APPENDIX 2

Elliott Wood Partnership Structural and Drainage Supplementary Information for BIA elliottwood

59 Maresfield Gardens
Hampstead, London NW3 5TE

# Structural and Drainage Supplementary Information for Basement Impact Assessment

| | |
|---|---|
| Job number: | 2150020 |
| Revision: | P1 |
| Status: | Preliminary |
| Date: | February 2015 |

## Document Control

| issue no. | 01 | remarks: | Issued for planning | | | | |
|---|---|---|---|---|---|---|---|
| revision: | P1 | prepared by: | Adam Atkinson<br>MEng (Hons) | checked by: | Mark Renshaw<br>BEng (Hons) | approved by: | Miroslav Antelj<br>BEng (Hons) CEng MIStructE |
| date: | 02.03.15 | signature: | | signature: | | signature: | |

## Contents

## Non-Technical Summary

If the below measures and sequence of works are taken into account in the eventual design and construction of the proposed works and are properly undertaken by suitability qualified contractor, these works will pose no significant threat to the structural stability of the adjoining properties, the remaining house and surrounding grounds.

The attached reports state that the proposed basement will have no significant adverse effect on the local hydrogeology. They also state that both ground water and surface water will not be affected or cause significant adverse effects to the surrounding properties.

## 1.0 Introduction

1.1 Elliott Wood Partnership LLP (EW) 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 EW 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 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 EW were appointed by the building's owner to advise on the structural implications of the proposed construction of a new two-storey basement on the site of 59 Maresfield Gardens. The following report has been prepared to ensure that the property and neighbouring properties are safeguarded during the works. This report follows the guidance given in the Camden Planning Guidance on Basements and Lightwells CPG4. This assessment has been prepared in accordance with the guidance given in CPG4, DP23 and DP27. The Basement Impact Assessment has been carried out, by persons holding the required qualifications relevant to each stage.

1.3 We have been provided with site investigation results and information regarding the site, existing building and proposed developments by the Architects: 51% Studios, who were appointed on the previous preliminary stage.

.

1.4 This report focuses on the proposed subterranean works as opposed to the superstructure works and should be read in conjunction with all relevant Architects and Specialists supporting documents, some of which appear in the Appendices of this document.

1.5 The Contractor will provide a detailed method statement including all temporary works before the works can commence on site. The Contractor is to accept full responsibility for the stability and structural integrity of the works during the Contract and provide temporary support as necessary. He shall also prevent overloading of any completed or partially completed elements.

## 2.0 Description of Existing Building and Site Conditions

2.1 59 Maresfield Gardens is an existing two-story residential building situated on the Western side of Maresfield Gardens in Hampstead.

2.2 It is assumed that the existing building on the site is of traditional construction comprising timber floors and roof supported on load bearing masonry. The overall stability being provided by the cellular layout of the masonry walls and diaphragm action of the timber floors at each level.

2.3 The existing building is at the end of a terrace of three similar scale residential properties. It is bounded to the South by 57 Maresfield Gardens, to the North by the garden of a detached property (40 Netherhall Gardens), to the West by a small access road and to the East by the road Maresfield Gardens.

2.4 The existing main entrance to the property is at Lower Ground Floor level (approx. +81.8 AOD) with the adjacent road to the front of the property (Maresfiled Gardens) at a higher level (approx.. +85.3m AOD). There is an existing retaining wall to the front of the property to accommodate this step down in level. Behind this retaining wall the site is relatively flat from East-West.

2.5 There are does not appear to be any underground lines in the vicinity or tunnels beneath the site.

2.6 As part of a ground investigation by Ian Farmer Associates in 2008, a trial pit revealed that the existing foundations under the adjacent terrace are 700mm below ground level, 150mm deep and extend 250mm from the party wall. The concrete boundary wall to the North extends to 400mm below ground.

2.7 The adjacent site to the North (40 Netherhall Gardens) follows a similar profile to 59 Maresfield Gardens – sloping down from East to West – but is at a generally higher level. The differences in ground level between the two sites are accommodated by existing retaining walls along the site boundary, which are constructed separately from the main property 59 Maresfield Gardens.

2.8 There is an existing swimming pool within the garden of 40 Netherhall Gardens which lies approximately 2m from the site boundary. The pool was installed after the property at No. 59 Maresfield Gardens was constructed, meaning it is unlikely that any services for the pool will cross the site boundary.

## 3.0 Proposed Development

3.1 It is proposed that the existing structure will be completely demolished and replaced with a new build residential property. The proposed development will be a new five storey, single unit, residential building including lower and upper basement levels.

3.2 The double storey basement will extend approximately 9m below the existing upper ground level at the front of the site; and approximately 7.5m below the existing lower ground level at the rear of the site. The basement footprint is approx. 100m$^2$ and lies underneath the proposed superstructure for the majority, extending up to the position of the existing retaining wall to the front of the site.

3.3 It is proposed that the basement is constructed using a permanent secant piled retaining wall propped in the permanent condition by the reinforced concrete (RC) slabs at the proposed floor levels. An RC lining wall is to be cast up against the secant piled retaining wall to support the floor slabs. The perimeter RC wall is to be dowelled in to the secant piled wall with stainless steel reinforcement acting as a shear key such that the gravity loads are transferred to the piles and in to the ground. The perimeter reinforced concrete structure provides the primary means of defence against water ingress. The RC base slab at lower basement level will span between the perimeter secant piles and internal pile caps. The internal piles and pile caps support internal RC columns. There are a number of clear openings and glazed floor areas shown on the plans, in these locations the permanent pile walls will be designed to act un-supported by the slabs.

3.4 The proposed superstructure is to be constructed as an RC frame with suspended RC slabs. Lateral stability will be provided through RC shear walls. The superstructure is considered to be beyond the scope of the BIA.

3.5 Proposed structural drawings are contained within Appendix A.

## 4.0 Construction Generally

4.1 The enabling and temporary works and excavations will need to be undertaken in a carefully controlled sequence. In completing the preliminary structural design we have assumed the sequence below. The Contractor will, however, have to provide a detailed method statement including all temporary and permanent works design before the works can commence on site. These notes are to be read in conjunction with all EW drawings relating to the proposed work.

4.2 The key issues that affect the scope and sequence of works on this project are:
- The demolition of the existing building;
- The stability of adjoining structures;
- The stability of adjoining walls, paths and highways;
- The protection and waterproofing of the existing Party Walls in the temporary condition;
- Preventing water ingress in the permanent state.

4.3 The undertaking of such projects is specialist work and Elliott Wood Partnership will be involved in the selection of a competent Contractor who will need the relevant expertise and experience for this type of project.

4. 4 The Contractor will need to undertake the works in such a way as to minimise noise, dust and vibration when working close to adjoining buildings. A sequential propping sequence has been noted below allowing the staged reduced level excavations to be completed.

## 5.0 Assumed Sequence of Works

Refer to corresponding sequencing drawings in Appendix B.

5.1 Demolish roof, 1st floor, upper ground floor and part of lower ground floor of existing property leaving all retaining walls in place as well as the existing driveway. Providing propping to existing retaining walls where horizontal support is removed through demolition and to driveway where wall returns are removed. Provide waterproofing and temporary supports to party wall with number 57 Maresfield Gardens, if required.

5.2 Level existing lower ground level to approx. +81.80m AOD. Install temporary piling platform at +84.0m AOD and temporary access ramp. Redress drive level to +84.0m AOD.

5.3 From temporary piling platform and driveway install 1st stage secant piling from 450mm diameter piles cut off at +84.025m AOD.

5.4 Transfer piling rig to existing lower ground level via temporary access ramp. Remove temporary piling platform and temporary access ramp. Temporarily prop existing sloped brickwork retaining wall (at the front of the property) along the party wall line with No. 57 Maresfield Gardens. Cast capping beam on top of 1st stage piles to +84.45m AOD. Prop capping beam with flying shores.

5.5 Demolish existing driveway and sloped brickwork retaining wall in front of 1st stage piles.

5.6 Carry out 2nd stage 450mm diameter secant piles from lower ground level and internal 450mm diameter piles. Secant piles to be cut off at approx. +81.325m AOD but not to undermine existing adjacent structures. Internal piles to be cut off at formation level and filled with grout between formation level and existing lower ground level. Grout to be dug out in conjunction with ground during excavation.

5.7 Install temporary access ramp, remove piling rig and remove temporary access ramp.

5.8 Cast capping beam on top of 2nd stage piles to +81.75m AOD. Cast in 1m long sections in underpinning sequence as required to ensure adjacent structures are not undermined.

5.9 Reduce dig to +80.60m AOD and install temporary waling beams to secant pile walls and prop as temporary works (by others) at +81.10m AOD.

5.10 Excavate ground within secant piled retaining wall to reduced dig level to allow installation of perimeter waling beams and props as temporary works (by others) at +78.00m AOD.

5.12 Excavate to formation level: approx. +75.75 AOD generally; approx. +74.45m AOD in the pool area. Expose tops of internal piles.

5.13 Cast RC base slab at SSL +76.15m AOD generally; +74.85m AOD within pool area; including cranks between levels and RC chambers for drainage. The base slab will act as a permanent lateral prop for the piles.

5.14 Install temporary waling beams and props at +79.50m AOD.

5.15 Remove props at +78.00m AOD and cast RC lining walls and internal walls/columns up to underside of upper basement slab.

5.16 Cast upper basement level slab at SSL +78.95m AOD. The upper basement slab will act as a permanent lateral prop for the piles therefore, once slab has cured, remove props at +79.50m AOD.

5.17 Cast perimeter walls and internal columns up to underside of lower ground floor slab level.

5.18 Cast lower ground floor slab at SSL +81.75m AOD. The lower ground floor slab will act as a permanent lateral prop for the piles therefore, once the slab has cured, remove props at +81.10m AOD

5.19 Cast remainder of perimeter wall and internal columns up to underside of upper ground floor slab level.

5.20 Install temporary waling beams and props below upper ground floor slab level at approx. +83.85m AOD.

5.21 Remove flying shores at upper ground capping beam level and cast upper ground floor slab at SSL +84.45m AOD. Once the upper ground floor slab has cured, remove temporary waling beams and props at +83.85m AOD. The upper ground slab will act as a permanent lateral prop for the piles.

5.22 Cast RC walls and columns to form superstructure (beyond the scope of this document).

## 6.0 Temporary Works

6.1 Due to the nature of the proposals, temporary works will be required throughout the basement construction process.

6.2 Temporary horizontal propping will be required to resist the lateral forces until the permanent RC floors have been cast and cured to resist the forces in the permanent state. Assumed temporary propping levels are shown on our assumed sequencing drawings.

6.3 The existing party wall may need to be propped during works, and design checks for wind loading need to be performed to estimate whether any permanent propping is required.

6.4 Temporary works design is the responsibility of the Contractor. Detailed proposals, method statements and sequencing proposals will be required prior to commencing work on site. The temporary works scheme is to be checked and agreed with the project structural Engineer.

## 7.0 Piling in Relation to Existing Structures

7.1 The secant piled wall adjacent to the 57 Maresfield Gardens boundary should provide a minimum clear distance between the pile and foundation of 150mm. Based on the current trial pit information by Ian Farmer Associates the centre line of the secant piled wall is to be set out a minimum of 700mm from the vertical face of the party wall. Before the piling works are commenced further trial pits should be made to confirm the depth and profile of the party wall footings along the length of the wall.

7.2 The secant piles adjacent to the existing masonry retaining walls which form the site boundary with 40 Netherhall Gardens are to be set out a minimum of 500mm from the centre line of the piles to the vertical face of the wall (as advised by GEA). Before piling works commence trial pits should be undertaken to confirm that the footings of these retaining walls do not project within 150mm of the face of the proposed secant piled wall. It is considered highly unlikely that the foundations of these retaining walls project beyond the boundary line in to 59 Maresfield Gardens. This is due to the more recent construction of the swimming pool and associated retaining walls at 40 Netherhall Gardens. Furthermore, the flank wall of the existing structure at 59 Maresfield Gardens currently sits on independent foundations adjacent to the retaining wall. If the retaining wall foundation did project beyond the boundary line it would clash with the existing flank wall structure. As such a projection is highly unlikely.

7.3 The proposed secant piled wall at the front of the site will be bored behind the existing sloped brickwork retaining wall from a temporary piling platform at upper ground floor level. It is considered unlikely that the piles will clash with the existing footings of the wall. In the event that a clash does occur, the foundation should be cored before boring and casting the piles with appropriate temporary works designed to laterally restrain the top of the existing retaining wall.

## 8.0 Drainage Strategy

8.1 As indicated in the Surface Water Assessment prepared by Water Environment Ltd (refer to Appendix D) the intent is to restrict the surface water run-off discharge to 50% of the existing rate. However due to the sizes of contributing areas this flow rate is less than 5l/s which is accepted to be the lowest rate to which a flow control can be applied.

8.2 A CCTV drainage survey of the existing network was conducted by Waterflow PLC and a copy of the report is included in Appendix C of this report. It shows that the existing property discharges to a combined run in front of the property. This run continues downstream to serve other properties.

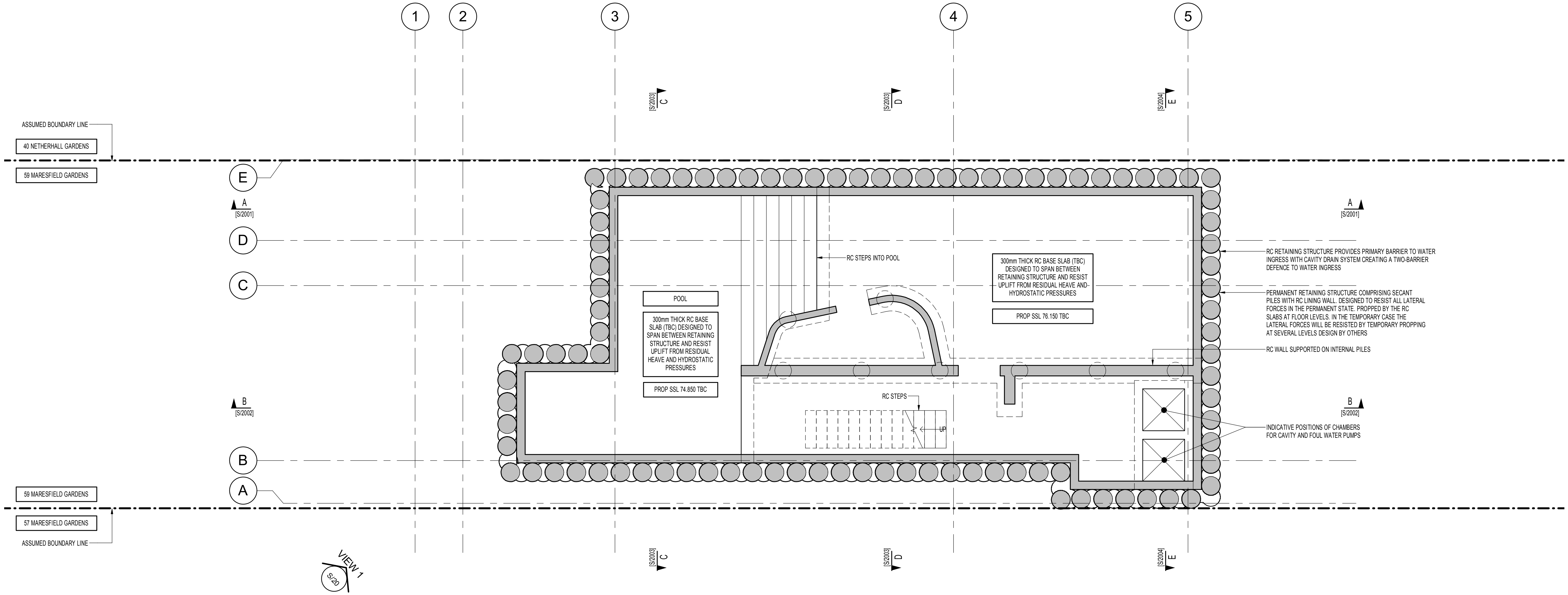
8.3 On the basis there discharge rates are not expected to exceed 5l/s there it is unlikely than an attenuation is required to be provided.

8.4 If possible some rainwater harvesting will be incorporated to help to reduce the overall volume of water leaving the site.

8.5 Foul water where possible should be routed above the lowest ground floor and connected into the existing combined water outfall manhole. A pump will be required to deal with any drainage below this manhole level i.e. the basement.

# APPENDICES

Appendix A: Structural Drawings and Surcharge Loading




This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.

Do not scale from this drawing.

NOT FOR CONSTRUCTION

| rev | date | by | chk | description |
|---|---|---|---|---|
| P1 | 27.02.15 | MJS | AA | Issued for Information & Comment |

drawing title
Proposed Lower Basement Plan

| scale (s) | date | drawn |
|---|---|---|
| 1:50@A1, 1:100@A3 | Jan 2015 | BMC |

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project
59 Maresfield Gardens
London

| project no. | | | drawing status. | | |
|---|---|---|---|---|---|
| 2150020 | | | Preliminary | | |
| originator. | zone. | level. | role. | drg no. | revision |
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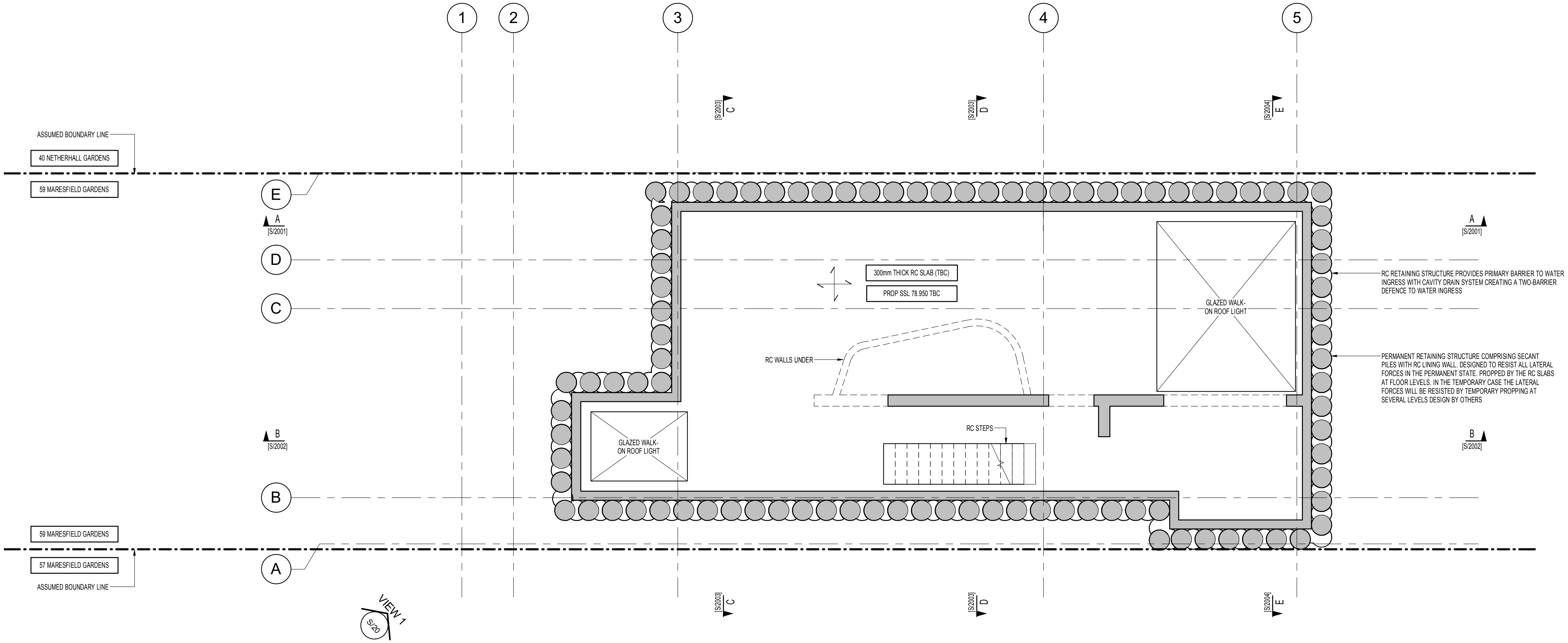


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drawing title
Proposed Upper Basement Plan

| scale (s) | date | drawn |
|---|---|---|
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project
59 Maresfield Gardens
London

| project no. | | | drawing status. | | |
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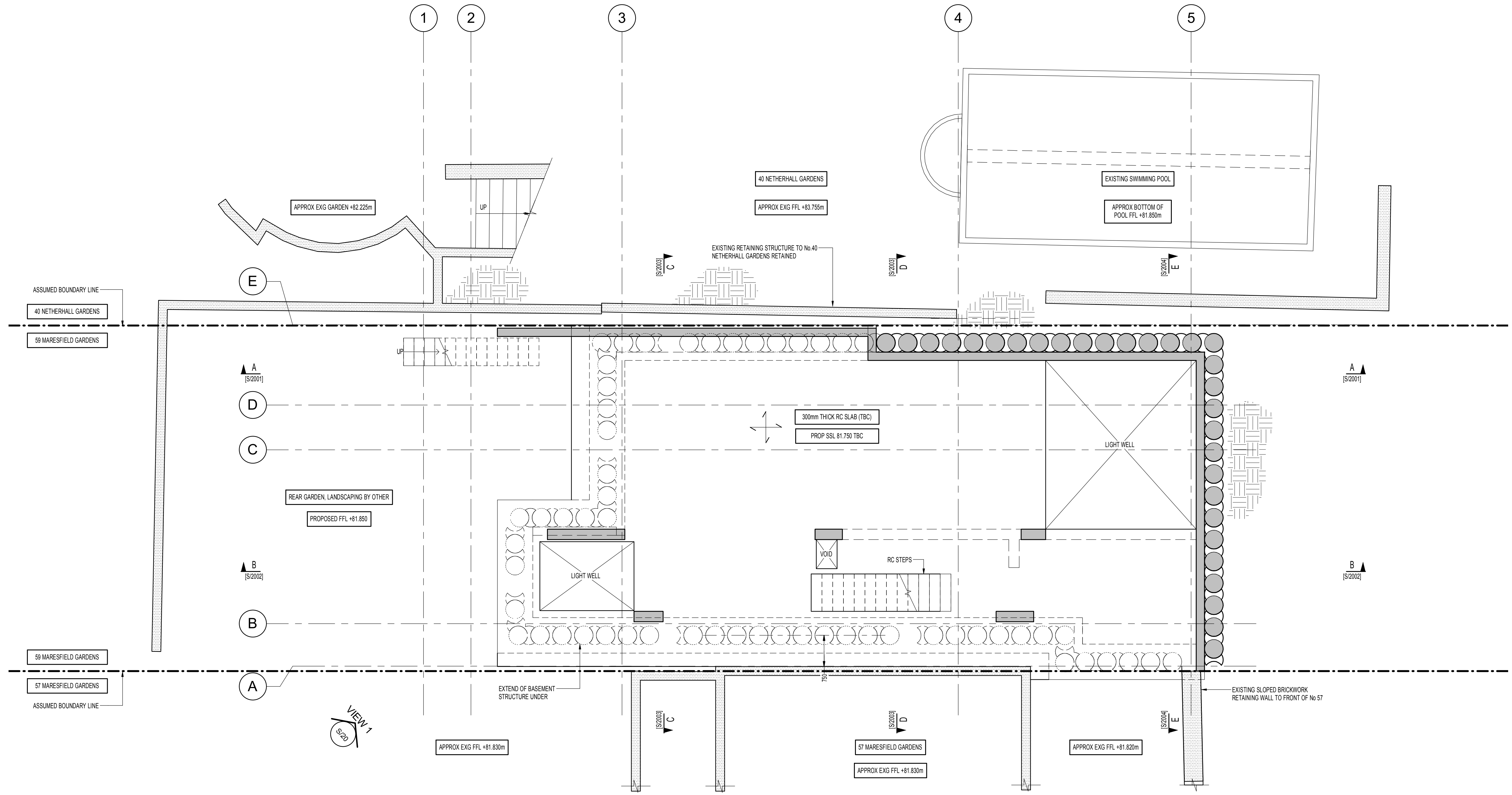


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| P1 | 27.02.15 | MJS | AA | Issued for Information & Comment |

drawing title
Proposed Lower Ground Floor Plan

| scale (s) | date | drawn |
|---|---|---|
| 1:50@A1, 1:100@A3 | Jan 2015 | BMC |

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project
59 Maresfield Gardens
London

| project no. | drawing status. |
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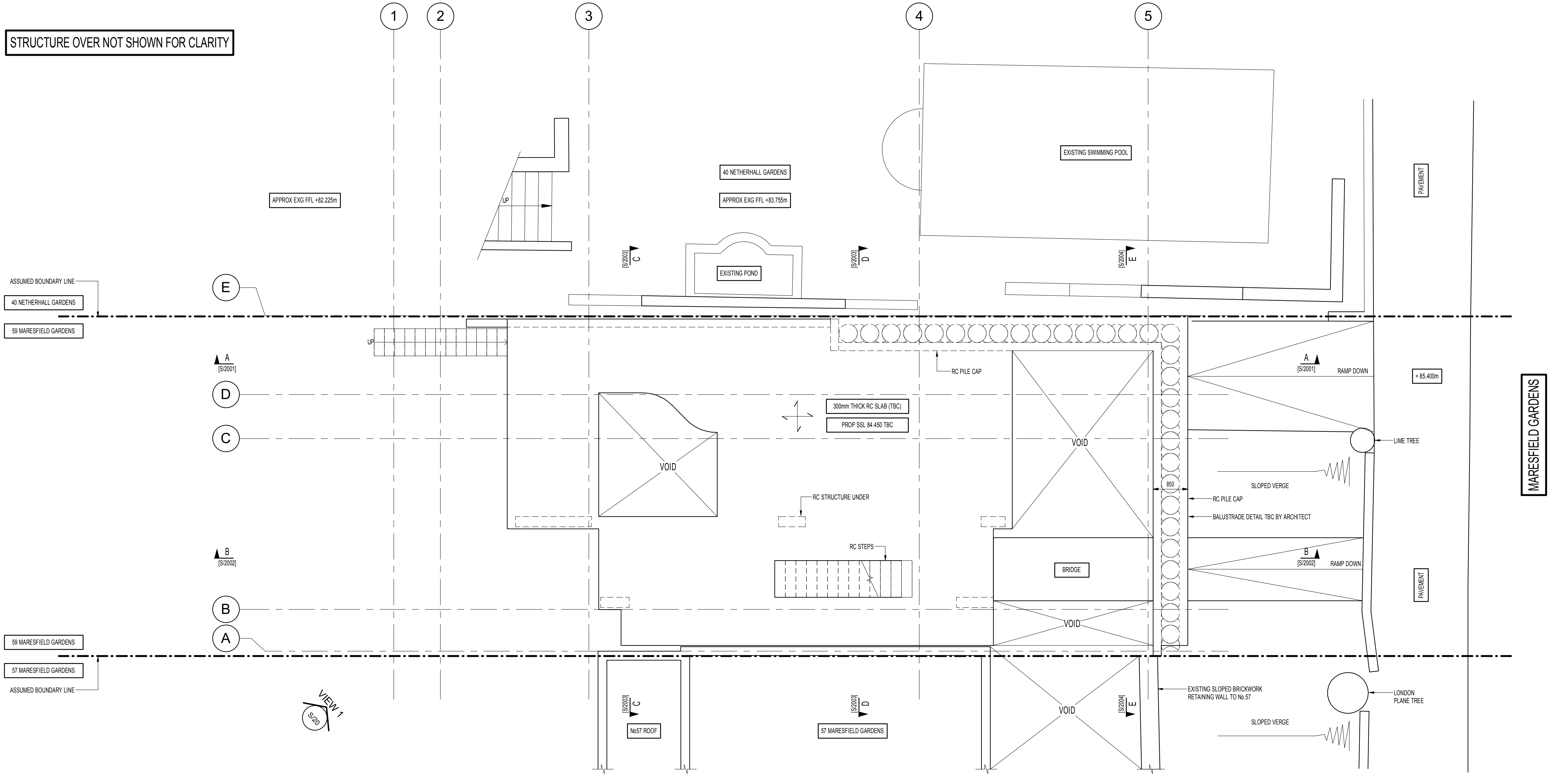


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Do not scale from this drawing.

NOT FOR CONSTRUCTION

| rev | date | by | chk | description |
|---|---|---|---|---|
| P1 | 27.02.15 | MJS | AA | Issued for Information & Comment |

drawing title
Proposed Upper Ground Floor Plan

| scale (s) | date | drawn |
|---|---|---|
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project
59 Maresfield Gardens
London

| project no. | | | drawing status. | | |
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| originator. | zone. | level. | role. | drg no. | revision |
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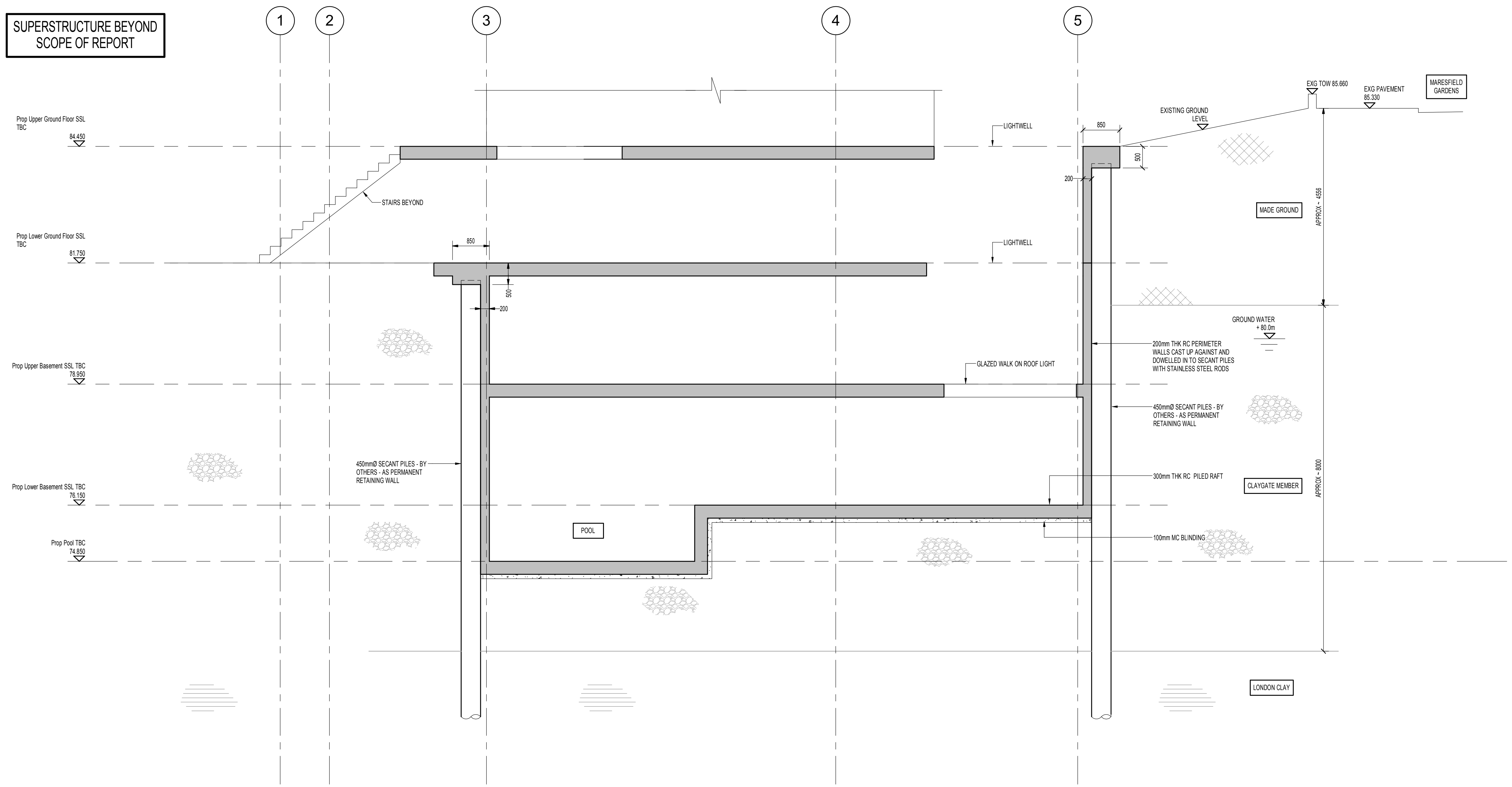


SECTION A-A

This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.

Do not scale from this drawing.

NOT FOR CONSTRUCTION

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|---|---|---|---|---|
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drawing title
Proposed Section A-A

| scale (s) | date | drawn |
|---|---|---|
| 1:50@A1, 1:100@A3 | Jan 2015 | BMC |

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project
59 Maresfield Gardens
London

| project no. | drawing status. |
|---|---|
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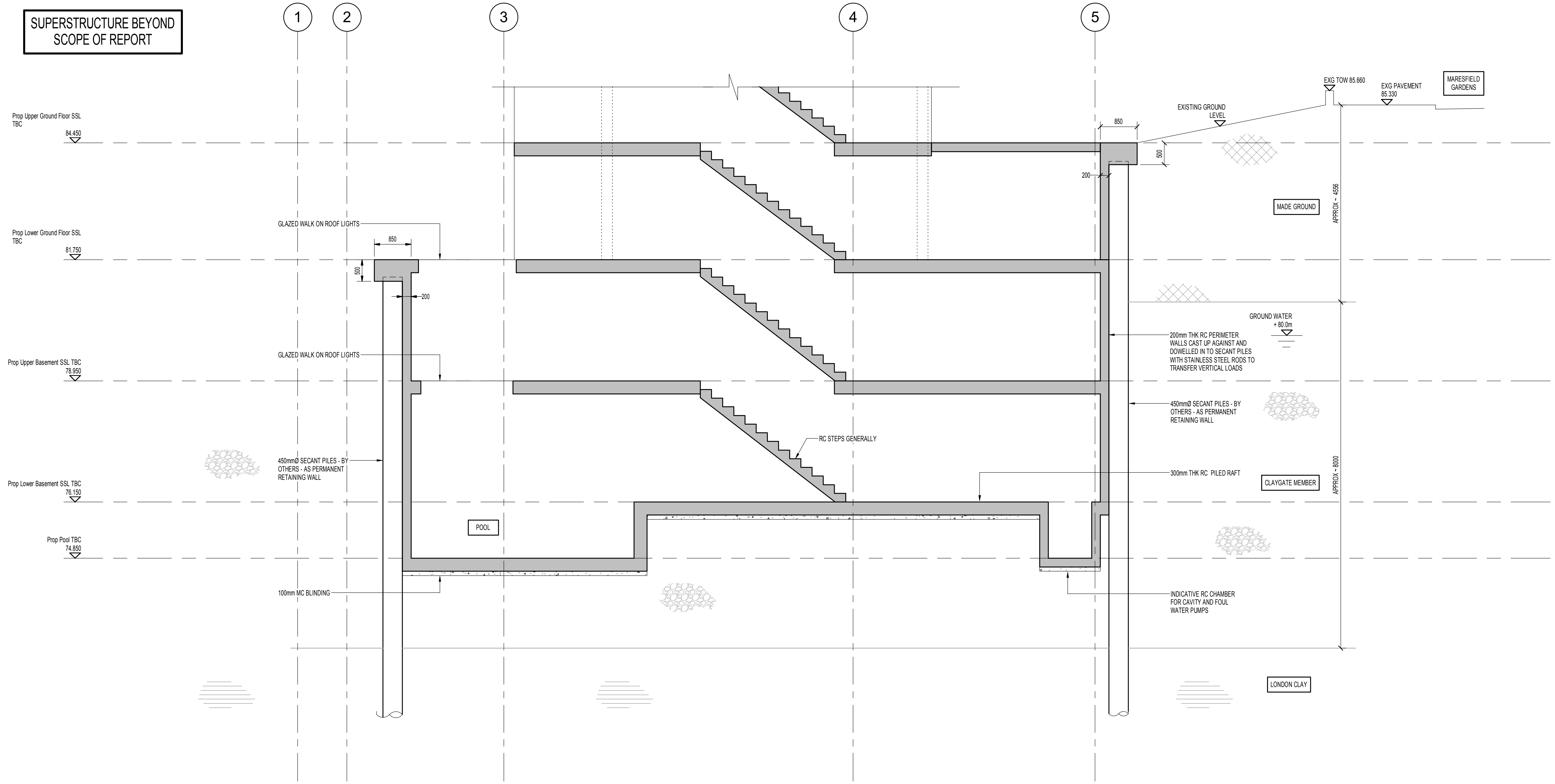


SECTION B-B

This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.

Do not scale from this drawing.

NOT FOR CONSTRUCTION

| rev | date | by | chk | description |
|---|---|---|---|---|
| P1 | 27.02.15 | MJS | AA | Issued for Information & Comment |

drawing title: Proposed Section B-B

| scale (s) | date | drawn |
|---|---|---|
| 1:50@A1, 1:100@A3 | Jan 2015 | BMC |

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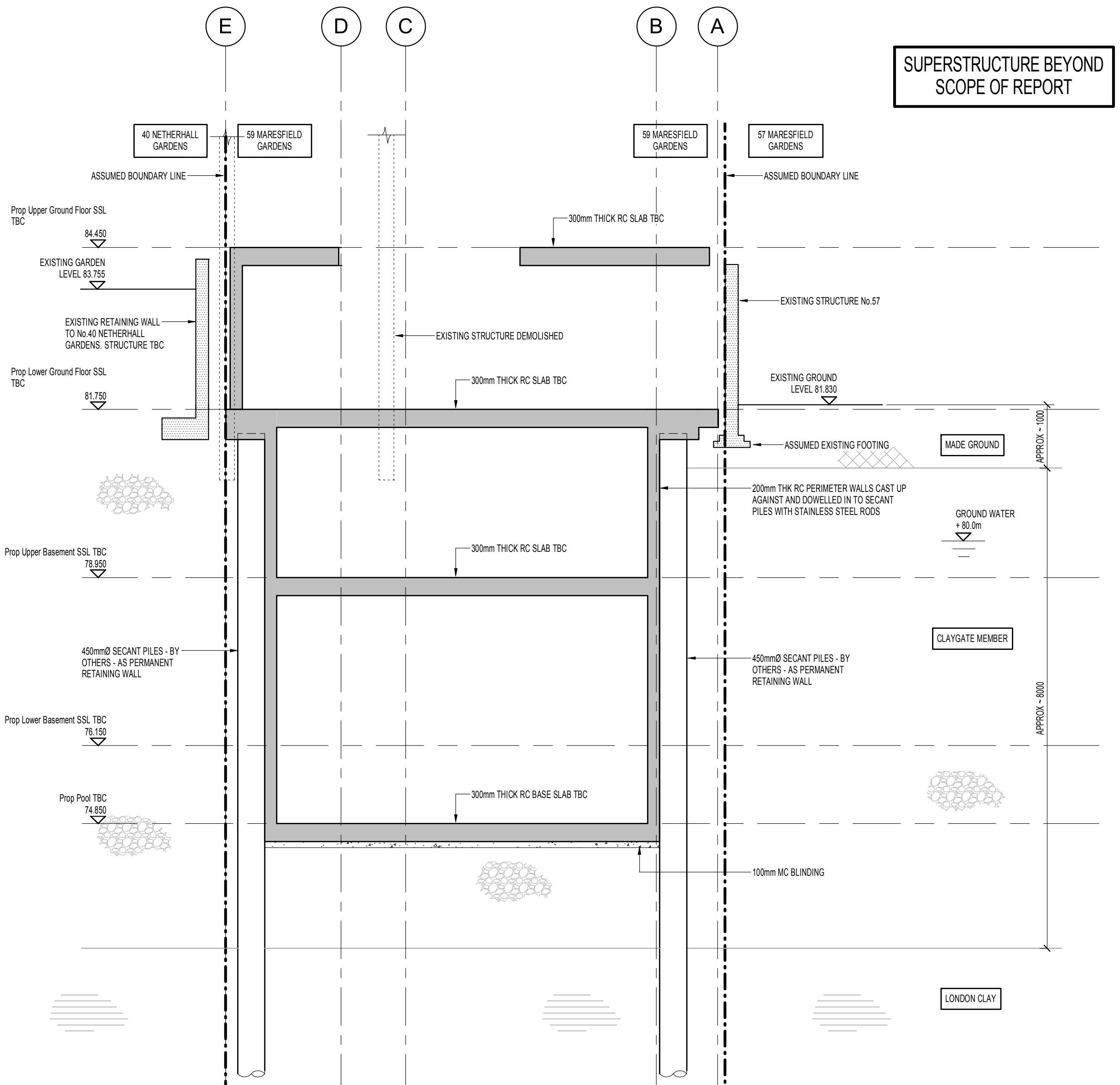
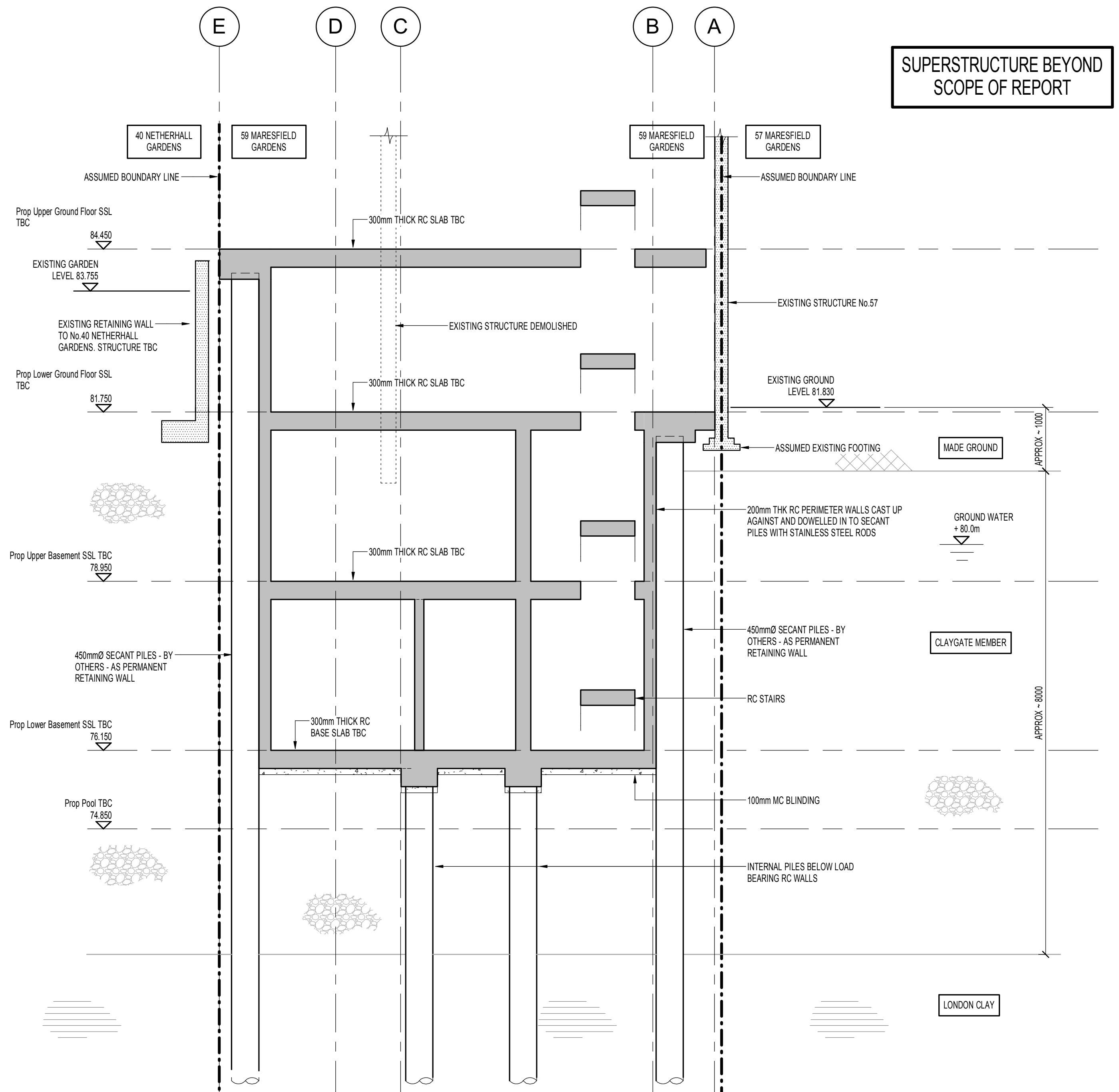
project: 59 Maresfield Gardens London

| project no. | | | drawing status. | | |
|---|---|---|---|---|---|
| 2150020 | | | Preliminary | | |
| originator. | zone. | level. | role. | drg no. | revision |
| EW | 00 | SEC | S | 2001 | P1 |




SECTION C-C




SECTION D-D

This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.

Do not scale from this drawing.

NOT FOR CONSTRUCTION

| rev | date | by | chk | description |
|---|---|---|---|---|
| P1 | 27.02.15 | MJS | AA | Issued for Information & Comment |

drawing title
Proposed Sections C-C & D-D

| scale (s) | date | drawn |
|---|---|---|
| 1:50@A1, 1:100@A3 | Jan 2015 | BMC |

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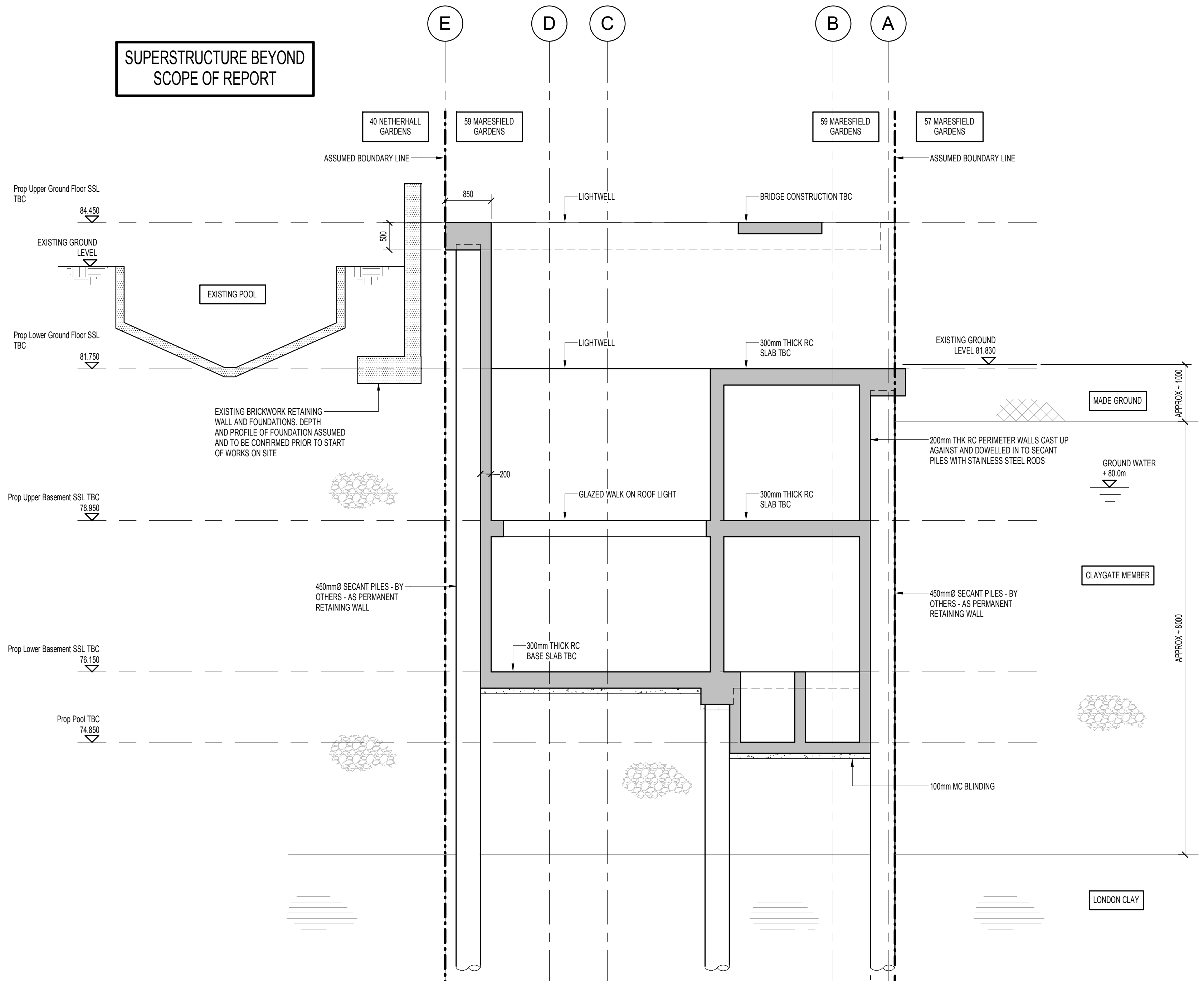
project
59 Maresfield Gardens
London

| project no. | | | drawing status. | |
|---|---|---|---|---|
| 2150020 | | | Preliminary | |

| originator. | zone. | level. | role. | drg no. | revision |
|---|---|---|---|---|---|
| EW | 00 | SEC | S | 2002 | P1 |




SECTION E-E

This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.

Do not scale from this drawing.

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| rev | date | by | chk | description |
|---|---|---|---|---|
| P1 | 27.02.15 | MJS | AA | Issued for Information & Comment |

drawing title
Proposed Section E-E

| scale (s) | date | drawn |
|---|---|---|
| 1:50@A1, 1:100@A3 | Jan 2015 | BMC |

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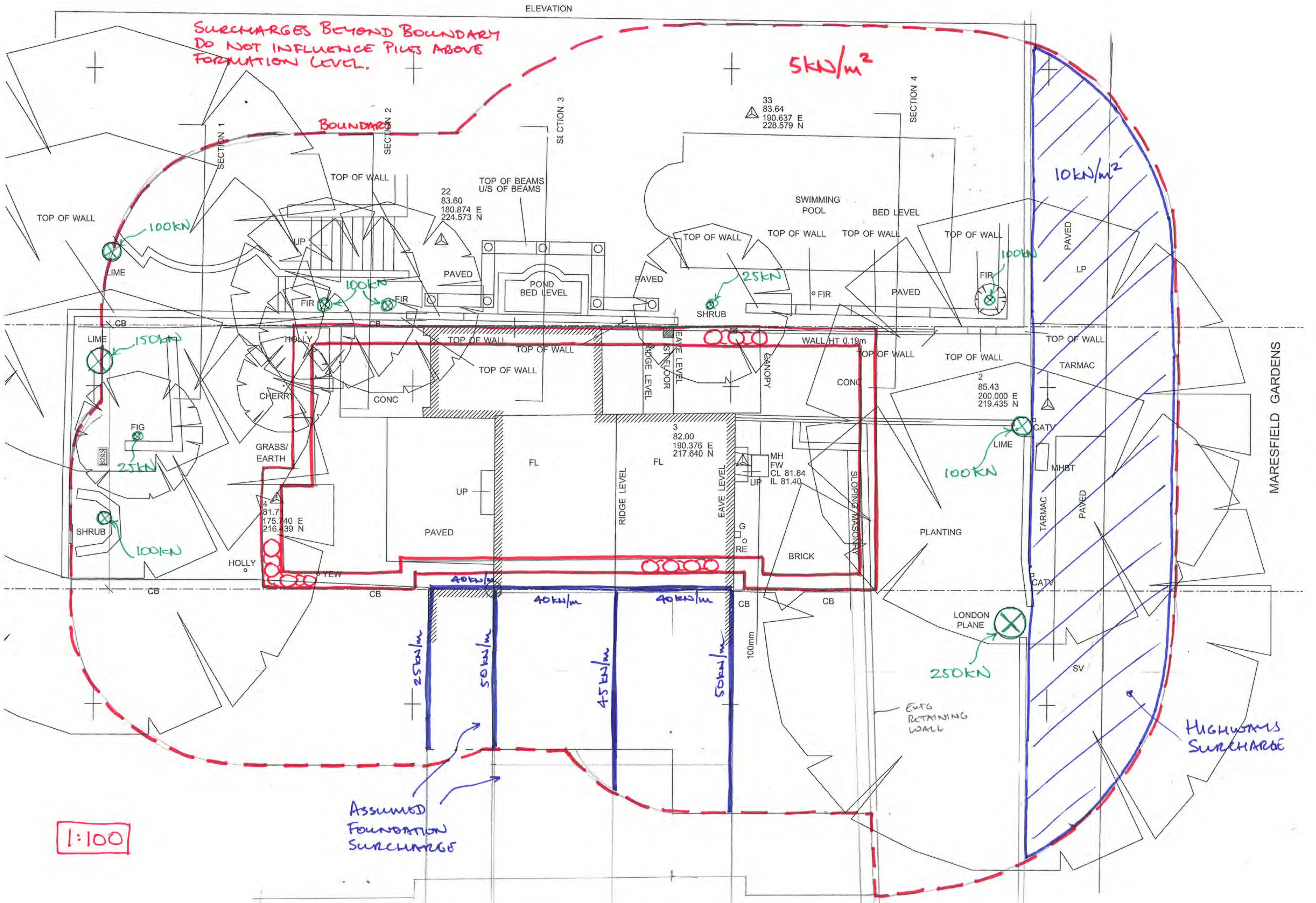
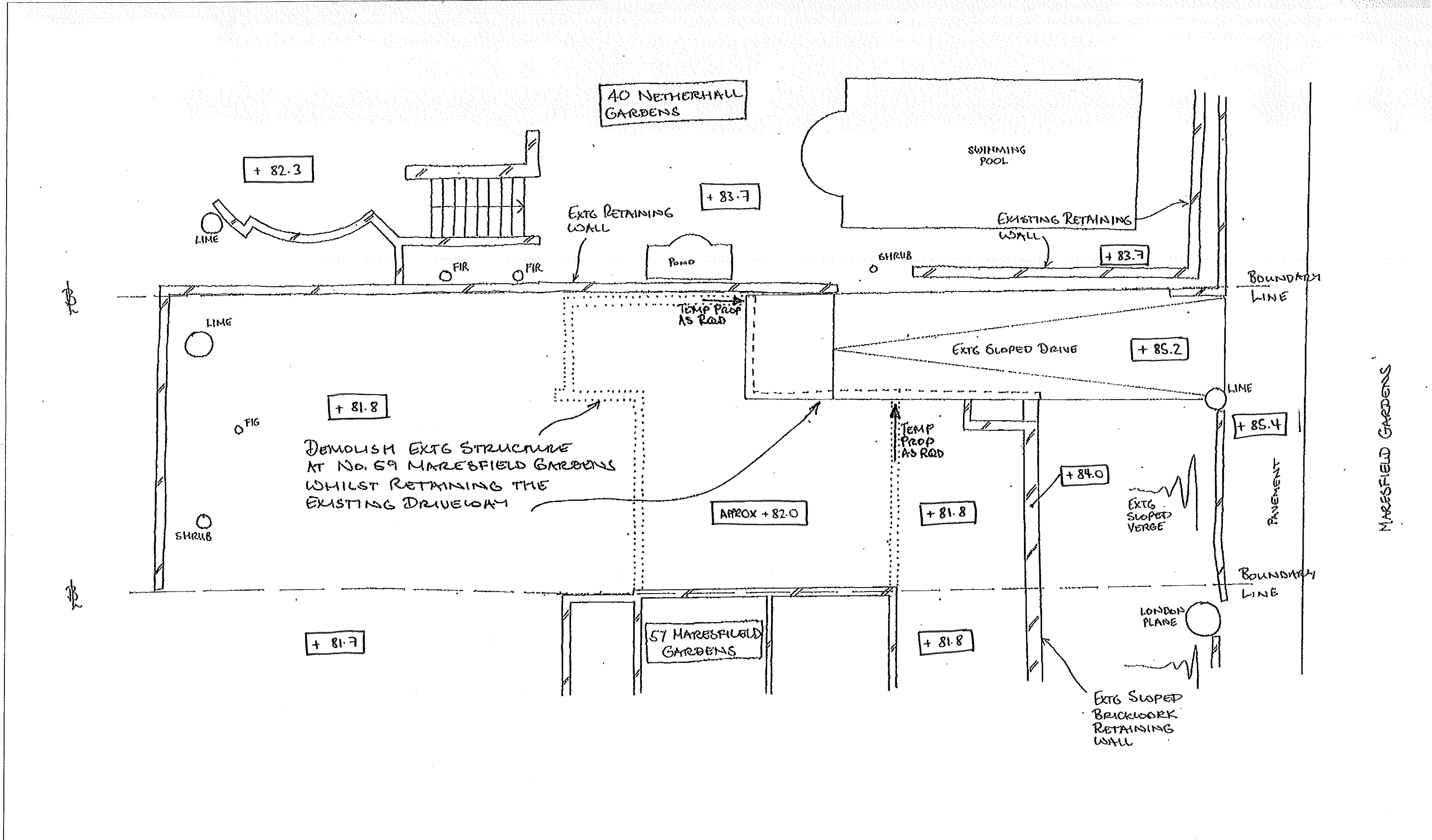
project
59 Maresfield Gardens
London

| project no. | | | drawing status. | | |
|---|---|---|---|---|---|
| 2150020 | | | Preliminary | | |
| originator. | zone. | level. | role. | drg no. | revision |
| EW | 00 | SEC | S | 2003 | P1 |



ELEVATION
SURCHARGES BEYOND BOUNDARY DO NOT INFLUENCE PILES ABOVE FORMATION LEVEL.
5kN/m²
10kN/m²
BOUNDARY
SECTION 1
SECTION 2
SECTION 3
SECTION 4
33
83.64
190.637 E
228.579 N
22
83.60
180.874 E
224.573 N
TOP OF BEAMS
U/S OF BEAMS
TOP OF WALL
SWIMMING POOL
BED LEVEL
POND BED LEVEL
PAVED
UP
LIME
FIR
SHRUB
CB
LP
100kN
150kN
25kN
250kN
40kN/m
25kN/m
50kN/m
45kN/m
WALL HT 0.19m
EAVE LEVEL
1ST FLOOR
RIDGE LEVEL
CANOPY
CONC
TARMAC
2
85.43
200.000 E
219.435 N
CATV
HOLLY
CHERRY
FIG
GRASS/ EARTH
3
82.00
190.376 E
217.640 N
FL
MH
FW
CL 81.84
IL 81.40
SLOPING MASONRY
MHST
4
81.71
175.740 E
216.439 N
PLANTING
BRICK
G
RE
YEW
MARESFIELD GARDENS
LONDON PLANE
100mm
SV
EXTG RETAINING WALL
HIGHWAYS SURCHARGE
ASSUMED FOUNDATION SURCHARGE
1:100

# Appendix B: Assumed Sequence of Construction Drawings




This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.

Do not scale from this drawing.

| rev | date | by | chk | description |
|---|---|---|---|---|

drawing title: PLAN SEQUENCING 1 OF 16

| scale(s) | date | drawn |
|---|---|---|
| ~1:100 | FEB'15 | AAT |

drawing status: PRELIMINARY

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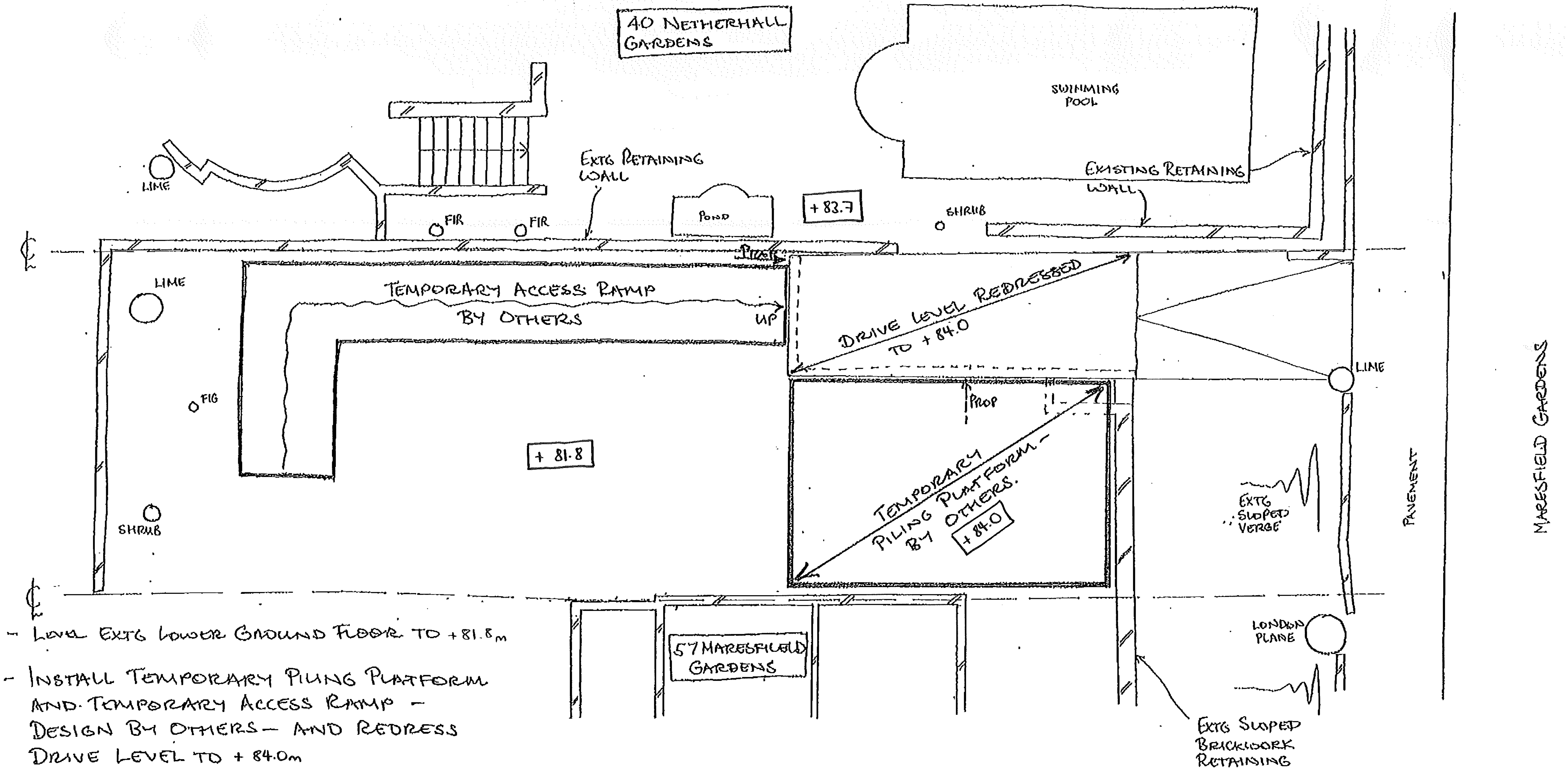
job title: 59 MARESFIELD GARDENS, LONDON

| job no | drawing no | revision |
|---|---|---|
| 2150020 | SK/100 | P1 |




- LEVEL EXTG LOWER GROUND FLOOR TO +81.8m
- INSTALL TEMPORARY PILING PLATFORM AND TEMPORARY ACCESS RAMP - DESIGN BY OTHERS - AND REDRESS DRIVE LEVEL TO + 84.0m

This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.

Do not scale from this drawing.

| rev | date | by | chk | description |
|---|---|---|---|---|

drawing title
PLAN SEQUENCING
2 OF 16

| scale(s) | date | drawn |
|---|---|---|
| ~1:100 | FEB'15 | AAT |

drawing status
PRELIMINARY

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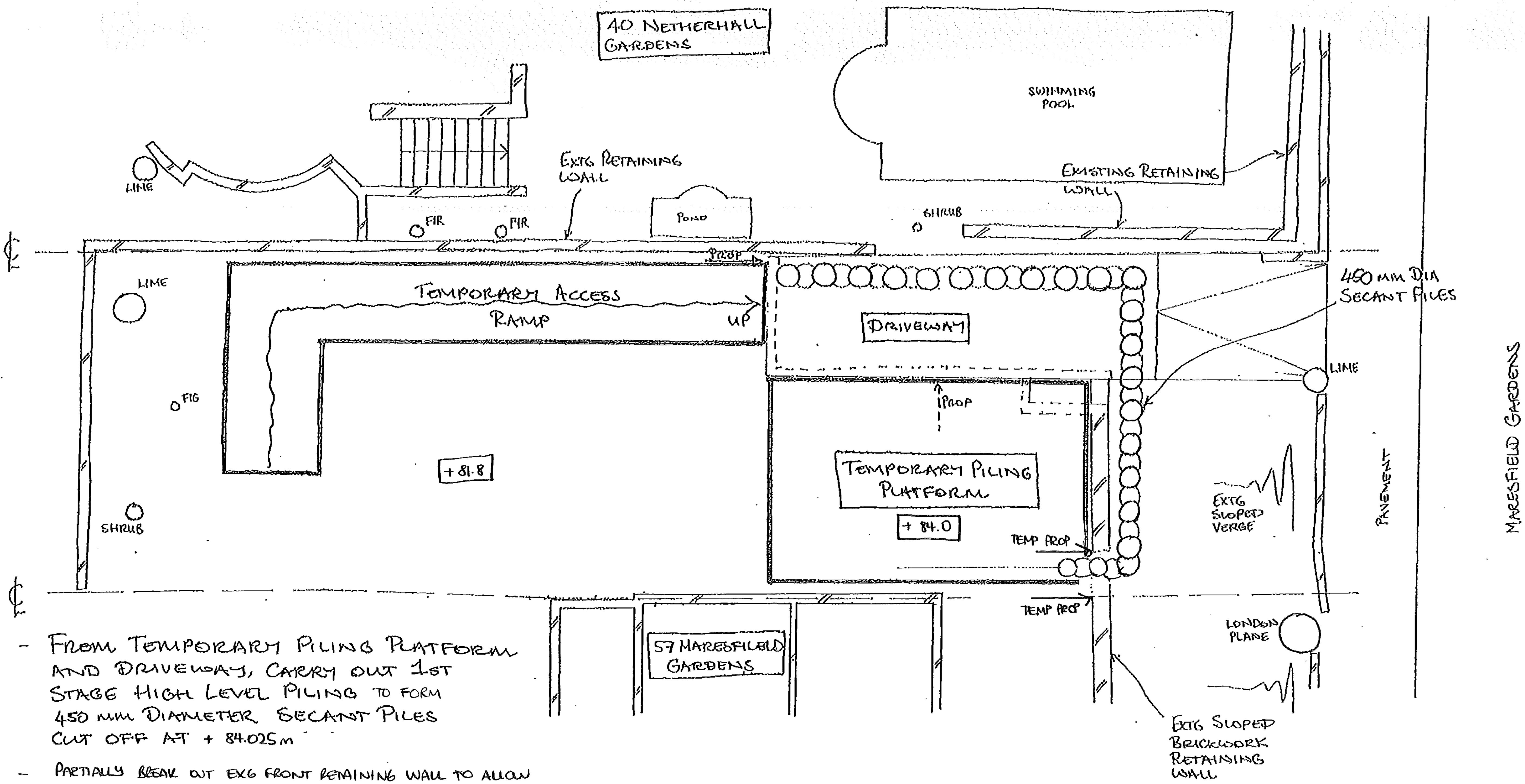
job title
59 MARESFIELD GARDENS, LONDON

| job no | drawing no | revision |
|---|---|---|
| 2150020 | SK/101 | P1 |




- FROM TEMPORARY PILING PLATFORM AND DRIVEWAY, CARRY OUT 1ST STAGE HIGH LEVEL PILING TO FORM 450 MM DIAMETER SECANT PILES CUT OFF AT + 84.025m
- PARTIALLY BREAK OUT EXG FRONT RETAINING WALL TO ALLOW SMALL SECTION OF RETURN PILED WALL TO BE CONSTRUCTED. ENSURE EXG WALL IS PROPPED AS REQ'D.



| rev | date | by | chk | description |
|---|---|---|---|---|

drawing title: PLAN SEQUENCING

3 OF 16

| scale(s) | date | drawn |
|---|---|---|
| ~1:100 | FEB'15 | AAT |

drawing status: PRELIMINARY

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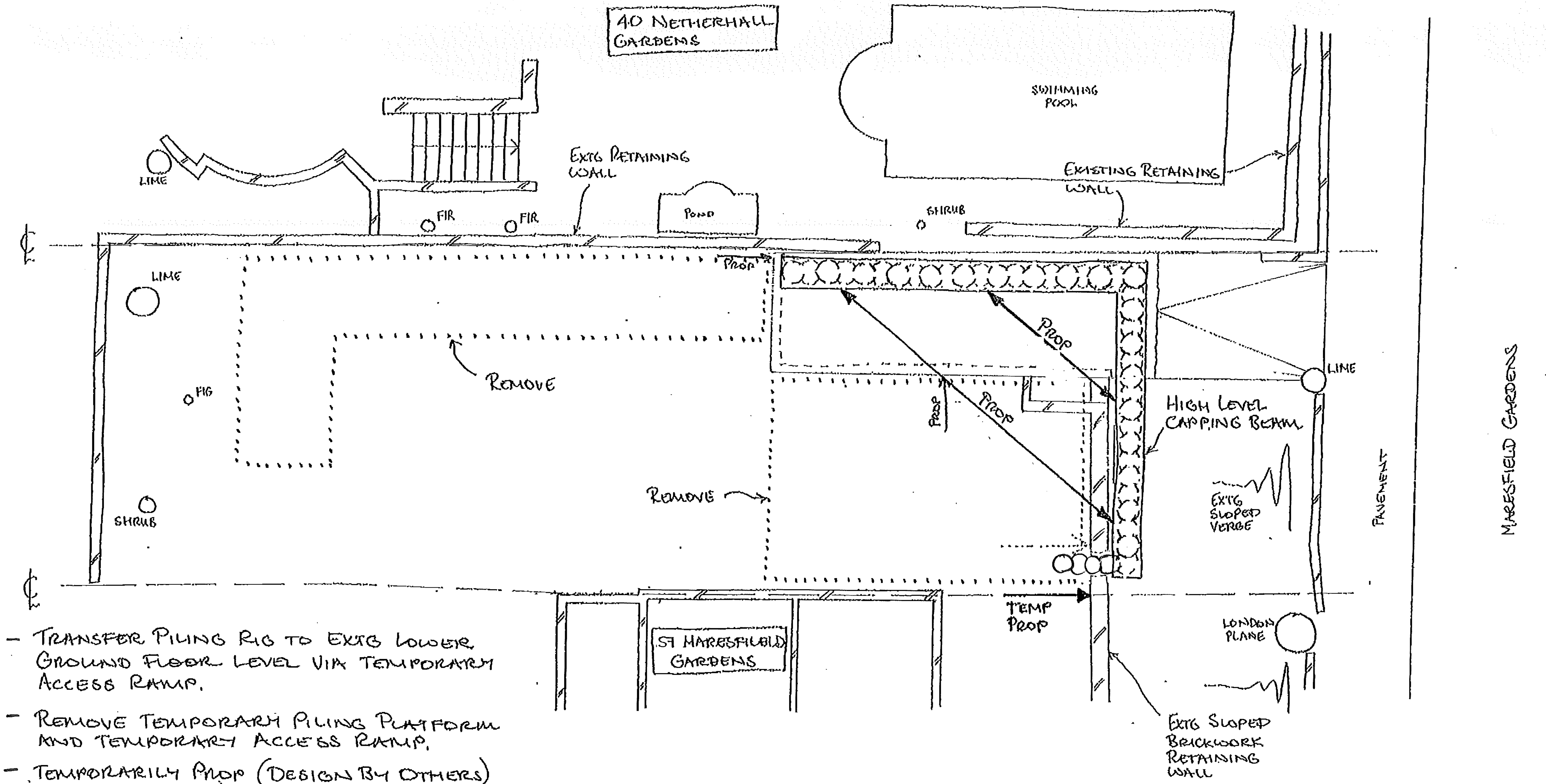
job title: 59 MARESFIELD GARDENS, LONDON

| job no | drawing no | revision |
|---|---|---|
| 2150020 | SK/102 | P1 |




- TRANSFER PILING RIG TO EXTG LOWER GROUND FLOOR LEVEL VIA TEMPORARY ACCESS RAMP.
- REMOVE TEMPORARY PILING PLATFORM AND TEMPORARY ACCESS RAMP.
- TEMPORARILY PROP (DESIGN BY OTHERS) EXTG SLOPED BRICKWORK RETAINING WALL

CAST CAPPING BEAM OVER HIGH LEVEL PILES TO + 84.45m AND PROP CAPPING BEAM WITH FLYING SHORES - BY OTHERS.



| rev | date | by | chk | description |
|---|---|---|---|---|

drawing title
PLAN SEQUENCING
4 OF 16

scale(s): ~1:100 | date: FEB'15 | drawn: AAT

drawing status: PRELIMINARY

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job title
59 MARESFIELD GARDENS, LONDON

| job no | drawing no | revision |
|---|---|---|
| 2150020 | SK/103 | P1 |