elliottwood

4 Frognal Rise
Hampstead
London, NW3 6RD

Structural Engineering Report and Subterranean Construction Method Statement

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Contents

Appendices

Non-Technical Summary

Elliott Wood Partnership LLP have worked on a number of projects in the area and is aware of both the underlying soil and groundwater; the basement has been designed with this in mind. From our experience, it is unlikely that the basement should have an adverse effect on the local hydrogeology. The supplemental site specific site investigation and BIA provides further evidence of this.

If the works noted below are properly undertaken by suitably qualified contractors, these works should pose no significant threat to the structural stability of the house or the adjoining properties.

A construction traffic management plan has been completed by Motion which gives advice on the likely programme, vehicular access and site set-up.

A Basement Impact Assessment has been prepared by GEA concluding that it is unlikely for the proposed works to result in any specific land, slope stability, groundwater or surface water issues.

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. It should be noted that EW were responsible for the design of a number of basements within the vicinity of No. 4 Frognal Rise.

1.2 EW were appointed by the building's owner to advise on the structural implications of the proposed construction of a new single storey basement on the site of 4 Frognal Rise. 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 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.

1.4 This statement 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 A detailed measured survey of the existing building has been organised and provided by the project Architect, Stephen Brandes Architects.

1.6 K F Geotechnical have carried out a site specific investigation to establish the general ground conditions. The investigation comprised of 3no. trial pits and 2no. boreholes.

1.7 A Basement Impact Assessment has been prepared by Geotechnical & Environmental Associates (GEA) which considers the effects of the proposed basement on the local slope stability, surface water and groundwater regime.

2.0 Description of Existing Building

2.1 No. 4 Frognal Rise is a two storey semi-detached house situated on the North side of Frognal Rise within proximity to the junction onto Frognal.

2.2 The existing building is a residential property assumed to be a load bearing masonry structure supporting timber joist floors and beams at each level. It is assumed that stability is provided by cellular action of the masonry walls and diaphragm action of the timber floors at each level. We have further assumed that the ground floor is a ground bearing reinforced concrete slab. Opening works will be undertaken on site at the first opportunity.

2.3 The existing building is not listed but is in the Hampstead conservation area within the Camden Borough.

2.4 Frognal Rise is not a street at risk of surface water flooding (as listed by Camden Planning Guidance CPG 4); therefore, a flood risk assessment has not been undertaken.

3.0 Ground Conditions

3.1 Geological maps indicate that the site is situated in an area with Bagshot Beds over Claygate Beds underlain by the London Clay Formation.

3.2 The ground conditions have been confirmed by a site specific investigation carried out by K F Geotechnical. The site investigation comprised of 3no. trial pits, one 15m deep borehole (BH1) in the existing driveway and a 12m deep borehole (BH2) in the rear garden. Groundwater monitoring standpipes have been installed in each borehole.

3.3 The ground conditions to the south of the site (BH1) generally consisted of approximately 2.0m of Made Ground on top of approximately 9.5m of Clayey Silty Sand. The Claygate Member started beneath this layer at approximately 11.5m below ground level (BGL).

3.4 The ground conditions to the north of the site (BH2) generally consisted of approximately 2.7m of Made Ground on top of approximately 1.0m of Clayey Silty Sand. Beneath this was a 2.7m thick layer of Sandy Silty Clay overlaying a 5.0m thick band of Silty Clayey Sand. Sandy Silty Clay started beneath this layer at approximately 11.4m BGL.

3.5 Groundwater inflows were noted at 9.0m BGL to the north of the site (BH2) and at 11.3m BGL to the south of the site (BH1).

3.6 Perched water was observed at a depth of 3.0m BGL to the north of the site.

3.7 Groundwater was measured at about 4.0m BGL in the north (BH2) and 6.0m BGL to the south of the site (BH1), however, GEA have suggested that the variation in measurements are unlikely to reflect the equilibrium level and could be a result of perched water trapped behind a retaining wall or other buried structures.

3.8 The BIA concludes that a safe bearing capacity of 150kN/m^2 can be safely used for the design of spread foundations below the proposed basement floor which is more than adequate for the proposed development and potential construction loads.

4.0 Desk study Summary and Observations

4.1 Generally the building appears to be in a reasonable condition for its age and type. It is generally robust and appears reasonably well constructed using good quality materials. The building generally appears to have been fairly well maintained.

4.2 There are a number of mature trees along the north-west boundary of the site with No. 22 Windmill Hill. There is also a large copper beech in rear of the site within proximity of the northern site boundary. The proximity of the existing and new trees will be considered in the final design of the basement and its foundations. A tree survey and report has been conducted by project Arboriculturalist, Martin Dobson to ensure that the works do not have an adverse impact on the retained trees. The proposed works do not fall within the root protection zones of any trees. For further information regarding existing and proposed trees refer to the Arboriculturalist's and Architect's report.

4.3 There are no obvious visible signs of significant movement or settlement to either this property or the directly adjoining buildings.

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

- The building appears to be in the vicinity of the historic river West Bourne (reference Lost Rivers of London, Nicholas Barton – refer to Appendix C).
- The site is not located within the flood plain or within a Groundwater Source Protection Zone as shown on the latest Environment Agency Flood Maps (reference; www.environment-agency.gov.uk).
- The site is not in the vicinity of any London Underground Ltd infrastructure (refer to confirmation letter in Appendix D).
- There is no record of historical bomb damage to the property (reference, The LCC London Bomb Damage Maps 1939-1945, LTS, map 27).

5.0 Proposed Alterations

5.1 The proposed works involve alterations the existing Garage structure and the rear section of the Main House. It is proposed to construct a new single storey basement under the foot print of the existing structure which extends into the existing drive way. It is intended for the footprint of the existing superstructure to increase slightly along the north section of site to match the foot print of the proposed basement.

5.2 In light of the sloping ground conditions across the site, the new basement will extend approximately 6.0m below ground level at its deepest section (north side) and approximately 3.0m at the shallowest section (south side).

5.3 The majority of the basement perimeter walls will be formed using L-shaped RC underpins whereas the north wall of the basement will be formed using contiguous piles with an RC liner wall. The contiguous piles and RC wall will resist lateral loads from any soil, hydrostatic and surcharge pressures. In locations where there is no contiguous piled wall, the RC walls alone will be designed to resist these lateral pressures. High and low level horizontal props will be installed to resist the lateral pressures in the temporary state. Where it is not possible to construct a piled wall (i.e. by the retained Garage structure) the RC retaining wall will be constructed in a two-level staged sequence to avoid undermining the retained structure.

5.4 The RC lining wall and the underpins will be cast with waterproof concrete to form the primary barrier to water ingress. A cavity drain system will be installed (to Architect's details) to provide a secondary barrier.

5.5 It is proposed to retain to the northwest boundary wall, therefore, an L-shaped RC retaining wall will be formed set within the boundary wall. The retaining wall will be constructed in maximum 1m sections to avoid undermining the retained boundary wall. High and low level horizontal props will be installed to resist the lateral pressures in the temporary state.

5.6 The proposed basement wall under the party wall shared with No. 2 Frognal Rise will be cast with L-shaped RC underpins which will be designed to resist any lateral pressures. High and low level horizontal props will be installed to resist the lateral pressures in the temporary state. Where required, transitional underpins will be installed to mitigate possible cracking to the existing walls which fall outside of the basement footprint.

5.7 The existing ground floor slab is to be removed and replaced with a suspended RC slab which will provide intermediate restraint to the piles and high level restraint to the underpins in the permanent case. The floor slab of the first floor extension will also be reinforced concrete which will provide restraint to the top of the piled wall and RC retaining wall to the front of the Garage.

5.8 Minor alterations are proposed throughout the building to the internal load bearing walls. Concrete lintels, steel beams, picture frames and new timber members will be installed where necessary.

6.0 Proposed Below Ground Drainage

6.1 It is proposed that the existing connection to the public sewer is retained and re-used. This will be subject to location and condition, which will be confirmed by a CCTV survey prior to works.

6.2 It is proposed that all drainage from the ground floor and above is drained via gravity. The proposed basement level will be lower than the level of the existing public sewer connection as such the foul effluent generated at basement level will need to be pumped to the main private drainage system. This will prevent any flooding from the public sewer in case of backup.

7.0 Basement Waterproofing

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

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

8.0 Party Wall Matters

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

8.2 The designs for 4 Frognal Rise will be developed so as not to preclude or inhibit similar, or indeed any, works on the adjoining properties. This will be verified by the Surveyors as part of the process under the Act.

9.0 Hydrogeological Statement Summary

9.1 Groundwater was measured at about 4.0m BGL in the north (BH2) and 6.0m BGL to the south of the site (BH1), however, GEA have suggested that the variation in measurements are unlikely to reflect the equilibrium level and could be a result of perched water trapped behind a retaining wall or other buried structures

9.2 Perched water was observed at a depth of 3.0m BGL to the north of the site.

9.3 A Basement Impact Assessment has been prepared by GEA concluding that it is unlikely for the proposed works to result in any specific land, slope stability, groundwater or surface water issues.

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

10.0 Conclusion

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

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

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

10.4 If the works noted above are properly undertaken by suitably qualified contractors, these works should pose no significant threat to the structural stability of the house or the adjoining properties. Based on our current knowledge of the building and if the works are carried out in this manner, then the likelihood of damage to the adjacent properties should be limited to Category 2 as set out in CIRIA report 580.

10.5 A Basement Impact Assessment has been prepared by GEA concluding that it is unlikely for the proposed works to result in any specific land, slope stability, groundwater or surface water issues.

11.0 Construction Method Statement

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Some of the issues that affect the sequence of works on this project are:

- The stability of the existing building;
- The stability of adjoining and adjacent buildings;
- Forming sensible access onto the site to minimise disruption to the neighbouring residents; and
- Providing a safe working environment.

The proposed works involve the construction of a new basement beneath the existing building, part of the existing driveway, and extends into the existing rear garden and garage. It is expected that the works will be completed as a top down type construction. The assumed sequence of construction is illustrated on EW Drawings SK.01 to SK.05 in Appendix A (These are to be read in conjunction with the suggested sequence below).

The undertaking of such projects to existing buildings is specialist work and EW will be involved in the selection of an appropriate Contractor with the relevant expertise and experience for this type of project.

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

The Contractor is entirely responsible for maintaining the stability of all existing buildings and structures, within and adjacent to the works, and of all the works from the date of possession of the site until practical completion of the works.

A full set of temporary works drawings and calculations will be provided by the Contractor and will be reviewed by EW prior to works starting on site.

Stage 1: Site set-up

- The services within the site should be identified and isolated as necessary. All below ground obstructions should also be removed to allow the works to progress.
- Tree Protection methods are to be agreed and installed to all retained trees.
- Monitoring points should be installed to all neighbouring structures and infrastructure and a base reading should be taken prior to any construction works starting on the site.

Stage 2: Internal soft strip & demolition

Complete soft strip of internal finishes within the building.

Props and needle beams are to be installed where required to enable installation of the new floor beams at First Floor. After the floor and walls over are adequately supported, the internal ground floor walls can be carefully broken out to enable removal of the ground flood slab. The rear walls of the main house (at first floor and ground floor) are to be retained during construction of the basement container. These walls provide overall stability to the retained structure and cannot be demolished until the proposed rear and side extensions have been built.

Carefully break down the existing rear section of the building along with the associated slab and foundations. Care should be taken as to avoid undermining the existing retaining wall to the rear of the house

Construct a temporary access ramp to allow access for the piling rig via the existing steps between the garage and the main house. The access ramp is to adhere to the maximum slope requirements.

Stage 3: Install piles

Install the piles across the rear of the proposed basement starting at the southwest boundary wall working back towards to the existing garage. The piles will be designed as propped cantilevers and will need to resist the lateral forces from soil and surcharge pressures in the temporary and permanent states. The contractor is to ensure that the piling operation does not impede on the tree/ground protection zone.

After piling works to the main house are completed, the access ramp can be removed after which the temporary piles to the front of the property can be installed in the driveway. During excavation for the basement, the driveway is to be partially retained to form an access platform during construction.

The front section of the existing garage structure can now be carefully broken down. Care should be taken to avoid undermining the existing foundations to be retained.

Stage 4: Install Underpins to Garage and Northwest Boundary wall

Dig trial underpins for inspection by EW to check how well the existing soil is cemented, ground water levels and flows and in particular the grounds ability to “stand up” whilst the individual underpin is completed. Given our experience on nearby projects we would expect that localised trench sheeting and props will need to be installed within the underpin shaft.

The underpinning works should be completed to the front of the existing garage and the northwest boundary wall. The underpinning will be constructed as reinforced concrete L-shaped pins. The reinforcement will be tied in the toe first followed by the stem. The underpins will be left to cure for 3 days and then dry-packed to the underside of the wall with 3:1 sharp sand to cement drypack well rammed in. The exact sequence of the underpinning will be advised by the Contractor as it will relate to their sequence of construction.

Suitable temporary sumps should be excavated at all stages within the excavation to allow groundwater to be collected and pumped out. Filters should be installed to ensure that the migration of fines is limited.

The temporary propping to the central bund will remain in place and removed as part of the bulk excavation. This method of construction will be used to limit any horizontal ground movement associated with the construction of the underpins and limits the risk of the underpinning works on the neighbouring buildings.

Stage 5: Bulk Excavation to Rear of House

Reduce level dig down to formation level for the proposed ground floor slab. Cross propping and waling beams are to be installed between the piles and the rear wall working down with the excavation. The levels at which propping is required is to be determined by the temporary works Engineer. The propping levels will take into account the permanent works design such that the RC slabs can be cast above/below the props whilst the props remain in place.

Stage 6: Break Out Internal Ground Floor Slab

Cross props are to be installed to the existing ground floor walls after which the existing ground floor slab can be carefully broken out. The levels and position at which propping is required is to be determined by the temporary works Engineer.

Locally break out the internal existing foundations following removal of the ground floor slab after which the areas to be backfilled with compacted fill.

Stage 7: Install Underpins to Main House and Cast Basement RC Wall

The temporary (mass concrete) and permanent (RC) underpin works should be completed to the Main House. The underpinning will be constructed as T-shaped or L-shaped pins as shown on the relevant drawings. The RC wall to the face of the piled wall shall be constructed as a series of U-Shaped underpins.

Where required, the reinforcement will be tied in the toe of the underpin first, followed by the stem. The underpins will be left to cure for 3 days and then dry-packed to the underside of the wall with 3:1 sharp sand to cement drypack well rammed in. The exact sequence of the underpinning will be advised by the Contractor as it will relate to their preferred sequence of construction.

The temporary propping to the central bund will remain in place and removed as part of the bulk excavation. This method of construction will be used to limit any horizontal ground movement associated with the construction of the underpins and limits the risk of the underpinning works on the neighbouring buildings.

The excavated shafts of the underpins and RC wall are to be backfilled to enable construction of the new ground floor slab.

Stage 8: Bulk Excavation to Driveway and Rear Section of Main House

In conjunction with the excavation required for the installation of the U-Shaped underpins, reduce level dig down to basement formation level in the driveway (the perimeter and internal underpins to the Main House should already be installed at this stage). Cross propping is to be installed between the piles, retaining walls and existing walls working down with the excavation. The levels at which propping is required is to be determined by the temporary works Engineer. The propping levels will take into account the permanent works design such that the RC slabs can be cast above/below the props whilst the props remain in place.

Stage 9: Cast RC Ground Floor Slab

Install a crash deck in the driveway and cast a temporary blinding layer at formation level (on the central bund under the Main House) for the ground floor slab. Install the tie reinforcement for the ground floor slab including starter bars for any new RC walls.

Cast RC Ground Floor slab using the Pynford Beam or Sacrificial Stool Method to install the RC beams under the retained ground floor walls. Once the slab has cured it will provide a permanent intermediate prop to the basement retaining walls/piles, hence, the intermediate level of horizontal temporary propping can be removed.

Stage 10: Bulk Excavation under Main House

Reduce level dig down to formation level for the proposed Basement slab across the site as required. Cross propping is to be installed between the piles, retaining walls and existing walls working down with the excavation. The levels at which propping is required is to be determined by the temporary works Engineer. The propping levels will take into account the permanent works design such that the RC slabs can be cast above/below the props whilst the props remain in place.

At this stage the piles to the front of the property will retain the front portion of the driveway to serve as an access platform throughout the duration of the basement and superstructure works.

Stage 11: Cast RC Base Slab

At formation level cast blinding layer and install the below ground drainage as required. Install and tie reinforcement as required then cast the proposed RC ground bearing slab.

Once the base slab has cured it will provide a permanent low level prop to the basement retaining walls/piles and hence, the lowest level of horizontal propping and waling beams can be removed.

Stage 12: Cast Ground Floor RC Liner Wall

Cast the RC liner wall along the face of the piled wall at Ground Floor then build the new ground floor perimeter walls tying them into the existing walls of the Main House. Install needle beams and temporary props where required then carefully break down the existing ground floor rear walls (stability has been maintained by the new perimeter ground floor walls).

Install the new First Floor steel beams after which the ground floor RC slab can be cast. Once the slab has cured it will provide a permanent high level prop to the piles and hence, the highest level of horizontal propping can be removed.

Stage 13: Construct Remaining Superstructure

Once the existing Ground Floor rear walls have been removed, the mass concrete underpins and the retained foundations can be carefully broken down.

The remaining superstructure works can commence after this.

12.0 Noise, Vibration and Dust Mitigation

12.0 Noise, Vibration and Dust

Any basement works should be completed in such a way as to ensure that construction impacts such as noise, vibration and dust are kept to acceptable levels for the duration of the works.

The proposed works involve alterations to the existing garage and Main House, and construction of a new single storey basement under the foot print of the existing structure and the existing drive way.

The construction works involves: piling along the north boundary of the basement and front of the site, underpinning to the front, rear, flank and internal walls, excavation and construction of the proposed basement shell.

A more detailed sequence of the works has been given in section 11.0. The basement works extend across the width of the property; therefore, the most likely to be affected by noise, dust and vibration will be the immediate neighbours at No. 2 Frognal Rise and No. 22 Windmill Hill. There may be some impact on other residents on Frognal Rise due to the related construction traffic but this should be minimal. Please refer to the Construction Traffic Management Plan for further details.

Below we have described the mitigation measures that are proposed to keep noise, dust and vibration to acceptable levels.

121 Mitigation Measures for Demolition Works

The breaking out of existing structures shall be carried out by diamond saw cutting and hydraulic bursting where possible to minimise noise and vibration to the adjacent properties. All demolition and excavation work will be undertaken in a carefully controlled sequence, taking into account the requirement to minimise vibration and noise. The contractor will need to utilise non-percussive breaking techniques where practicable.

The contractor should ensure that where any slab is adjacent to the boundary the concrete slab should be diamond saw cut first along the boundary to isolate the slab from any adjoining structures.

Dust suppression equipment should be used during the demolition process to ensure that any airborne dust is kept to a minimum.

12.2 Mitigation Measures for Underpinning works

The underpin shafts will be excavated using hand tools where possible. At the base of the underpin shaft it may be found that compressed air tools are required due to the compaction of the ground. Care should be taken in selecting a suitable air compressor that keeps noise to a minimum. The air compressor should be located within the site and behind a hoarding to minimise noise transfer to the adjoining properties.

The spoil will be removed from the excavation using an electrically powered conveyor. The contractor will need to ensure that this is regularly serviced and inspected to ensure any noise from this is kept to a minimum. The conveyor will be located as far from the neighbouring properties as practicable. In order to minimise dust, skips and conveyors should be covered or completely enclosed to ensure that dust cannot escape.

12.3 Mitigation Measures for Piling

The contiguous piled wall will be formed using a continuous flight auger rig – this is a non-percussive technique and therefore produces significantly less noise and vibration than the alternative driven piles. Some of the temporary piles will require breaking down to slab level once the basement works are complete. The contractor should ensure that they use non-percussive pile reduction techniques which are much quieter than traditional breakers.

12.4 Mitigation Measures for Bulk Excavation

Due to the size of the basement it is likely that some mechanical plant will be required to complete the bulk excavation. The contractor should ensure that any mechanical plant is switched off when not in use and is subject to regular maintenance checks and servicing. An electrically powered conveyor will be used as detailed above.

12.5 Mitigation Measures for the Construction of the concrete shell

The contractor should ensure that any concrete pours are completed within the permitted hours for noise generating works. The contractor should allow for a contingency period to ensure that concrete pours can be completed within these hours regardless of unforeseen circumstances such as batching plant delays and traffic congestion.

The fabrication and cutting of steelwork for the reinforced concrete walls and underpins shall take place off site. If any rebar needs to be trimmed on site this should be completed using hydraulic or pneumatic tools instead of angle grinders.

12.6 Dust Control

In order to reduce the amount of dust generated from the site, the contractor should ensure that any cutting, grinding and sawing should be completed off site where practicable. Any equipment used on site should be fitted with dust suppression or a dust collection facility.

The contractor will be responsible for ensuring good practice with regards to dust and should adopt regular sweeping, cleaning and washing down of the hoardings and scaffolding to ensure that the site is kept within good order. The contractor selected will be a member of the Considerate Contractors Scheme. Contact details of the contractor who will be responsible for containing dust and emissions within the site will be displayed on the site boundary so that the local residents can contact the contractor to raise any concerns regarding noise and dust.

The building will be enclosed within suitable scaffold sheeting and any stockpiles of sand or dust-generating materials will be covered. Cement, fine aggregates, sand and other fine powders should be sealed after use.

13.0 Structural Monitoring Proposals

13.0 Monitoring and limits on ground movements during excavation and construction

13.1 The Contractor shall provide monitoring on all the external retained elevation walls of No.4 Frognal Rise throughout their height as well as the immediately adjacent flank and return walls of No. 2 Frognal Rise during the basement construction.

13.2 Monitoring shall be completed as follows:

1) One month prior to any works being started to provide a base reading.
2) At the start and end of every shift during the excavation and until the basement slab and lining wall has been cast.
3) On a monthly basis thereafter for a 6 month period following completion of the notifiable works.

13.3 Cumulative movement of survey points must not exceed:

a. Settlement
Code amber trigger values: +/-6mm
Code red trigger values: +/-10mm

b. Lateral displacement
Code amber trigger values: +/-4mm
Code red trigger values: +/-8mm

13.4 Movement approaching critical values:

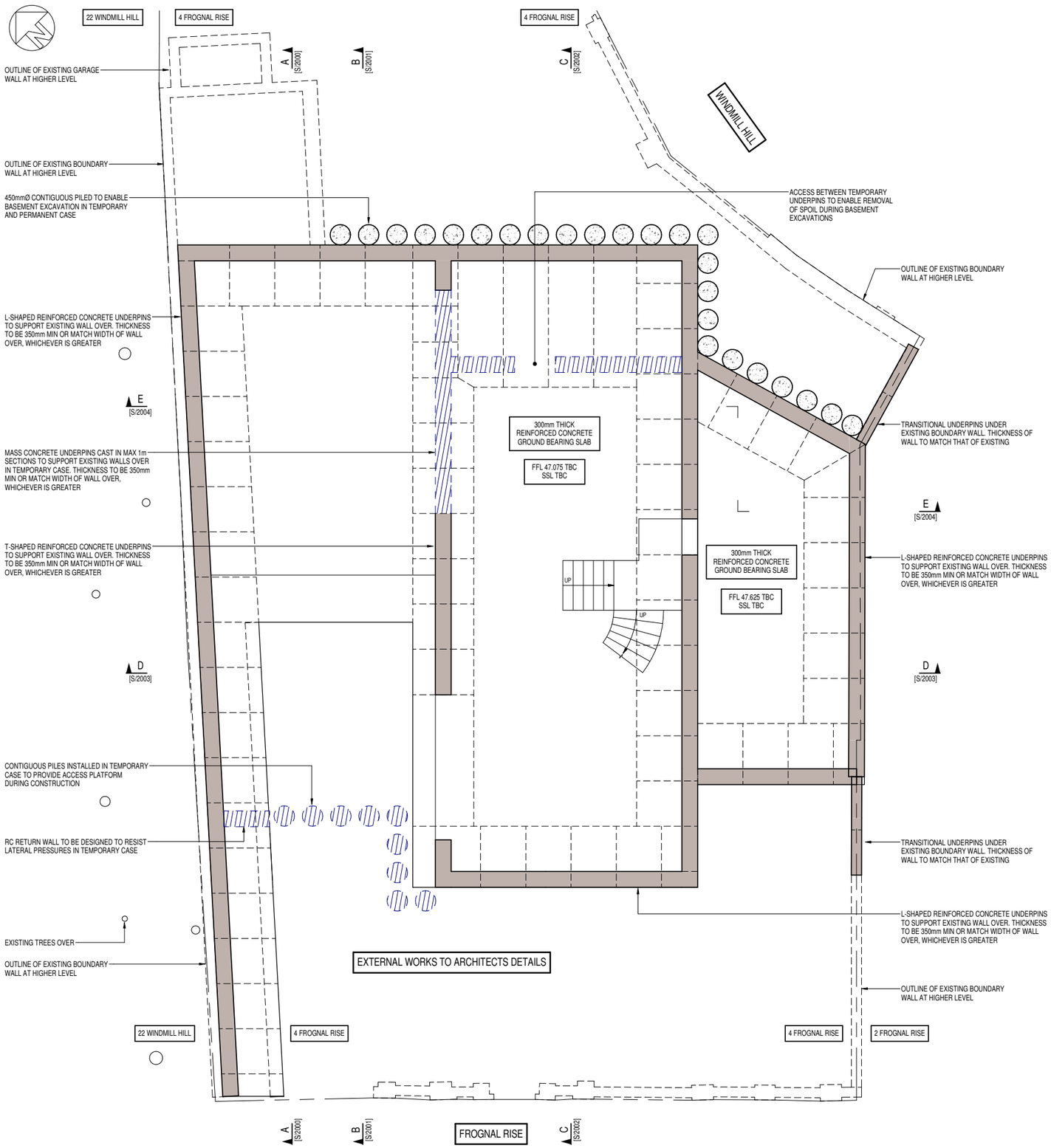
Code amber trigger value:

All interested parties, including the Adjoining Owner's Surveyor and his Engineer should be informed and further actions immediately agreed between two of the three Surveyors and implemented by the Building Owner. Notwithstanding the Party Wall requirements, the Contractor is to appoint, and to have permanently on site, a suitably qualified Structural Engineer who will be responsible for the reviewing of the movement monitoring results at the start and end of each day and provide immediate advice, remedial works and design as necessary in the event of movement being noted. The Contractor is to ensure that he has 24 hour/7 days a week access to emergency support provision including but not limited to additional temporary props, needles, waling beams and concrete supply at the start of the excavation and prior to any likelihood of this trigger value being reached. If this value is reached the Contractor, and his Engineer, must without delay provide all interested parties with his plan to implement any emergency remedial and supporting works deemed necessary. The Contractor must be ready to carry out these works without delay if the movement continues and approaches the trigger value below.

Code red trigger value:

All interested parties including Adjoining Owner's Surveyor and Engineer will be informed immediately. Works will stop and be made safe using methods and equipment agreed at the above stage. The Contractor is to ensure that the movement has stopped as a result of the implemented remedial works designed and installed at this stage. The requirements of the Party Wall Act will also ensure that two of the three Surveyors and their advising Engineers shall then enter into an addendum Award, setting out whether or not the Building Owner's works can re-commence and when, and if so agree additional precautions or modifications to the proposals prior to re-commencement.

A Proposed Structural Layouts and 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.

LEGEND

- EXISTING STRUCTURE
- NEW LOAD BEARING BLOCKWORK
- NEW LOAD BEARING BRICKWORK
- NEW REINFORCED CONCRETE
- NEW MASS CONCRETE
- PADSTONES
- LOAD BEARING STUDWORK
- NON LOAD BEARING WALLS
- LOAD BEARING STRUCTURE BELOW
- EXISTING STRUCTURE TO BE REMOVED
- NEW STEEL BEAMS
- NEW LINTELS OVER OPENINGS

FOR PLANNING

rev	date	by	chk	description
P3	29.05.15	BMC	GP	Issued for Planning
P2	05.05.15	BMC	GP	Issued for Information & Comment
P1	01.04.15	BMC	RWo	Issued for Information & Comment

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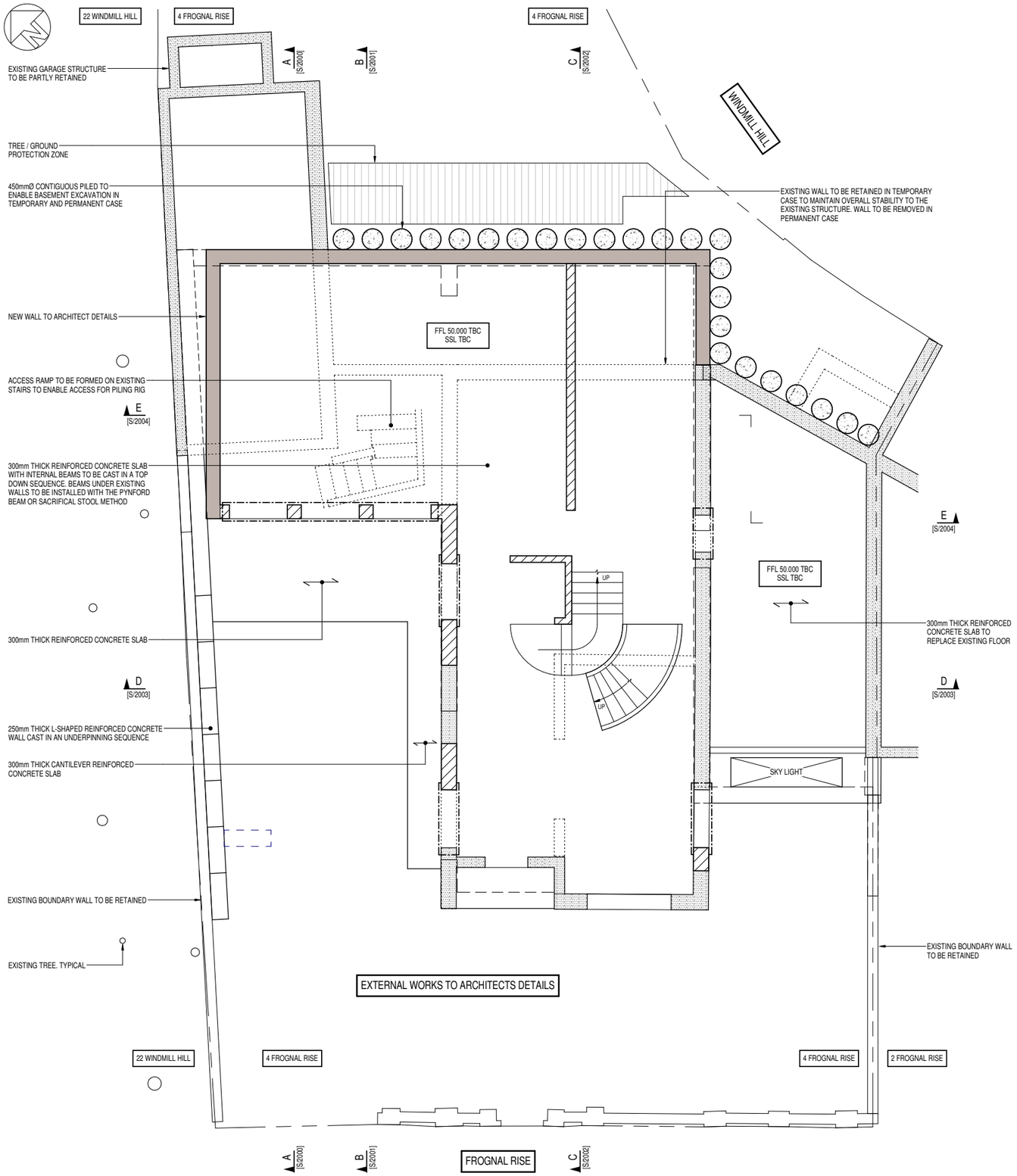
project
4 Frognal Rise

drawing title
Proposed Basement Plan

scale (s)	date	drawn
1:50@A1; 1:100@A3	March 2015	BMC

project no.			drawing status.		
213780			Preliminary		
originator.	zone.	level.	role.	drg no.	revision
EW	00	B01	S	0900	P3



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

Do not scale from this drawing.

LEGEND

- EXISTING STRUCTURE
- NEW LOAD BEARING BLOCKWORK
- NEW LOAD BEARING BRICKWORK
- NEW REINFORCED CONCRETE
- NEW MASS CONCRETE
- PADSTONES
- LOAD BEARING STUDWORK
- NON LOAD BEARING WALLS
- LOAD BEARING STRUCTURE BELOW
- EXISTING STRUCTURE TO BE REMOVED
- NEW STEEL BEAMS
- NEW LINTELS OVER OPENINGS

FOR PLANNING

rev	date	by	chk	description
P2	29.05.15	BMC	GP	Issued for Planning
P1	01.04.15	BMC	RWo	Issued for Information & Comment

elliottwood

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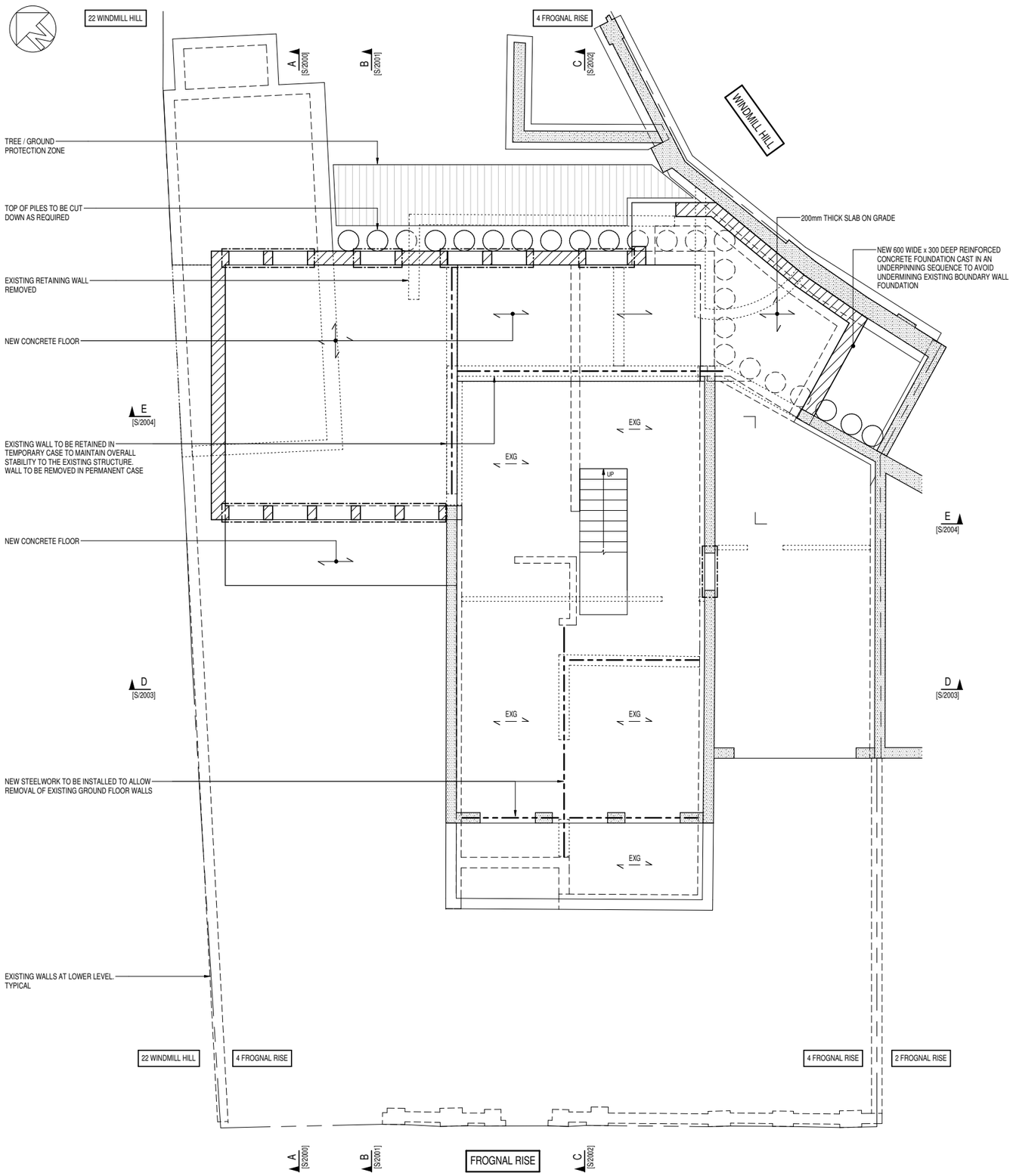
Consulting Structural and Civil Engineers. www.elliottwood.co.uk
tel: 020 8544 0033. fax: 020 8544 0066. info@elliottwood.co.uk

project
4 Frognal Rise

drawing title
Proposed Ground Floor Plan

scale (s)	date	drawn
1:50@A1; 1:100@A3	March 2015	BMC

project no.			drawing status.		
213780			Preliminary		
originator.	zone.	level.	role.	drg no.	revision
EW	00	L00	S	1000	P2



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Do not scale from this drawing.

LEGEND

- EXISTING STRUCTURE
- NEW LOAD BEARING BLOCKWORK
- NEW LOAD BEARING BRICKWORK
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- NEW MASS CONCRETE
- PADSTONES
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- LOAD BEARING STRUCTURE BELOW
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- NEW STEEL BEAMS
- NEW LINTELS OVER OPENINGS

FOR PLANNING

rev	date	by	chk	description
P2	29.05.15	BMC	GP	Issued for Planning
P1	01.04.15	BMC	RWo	Issued for Information & Comment

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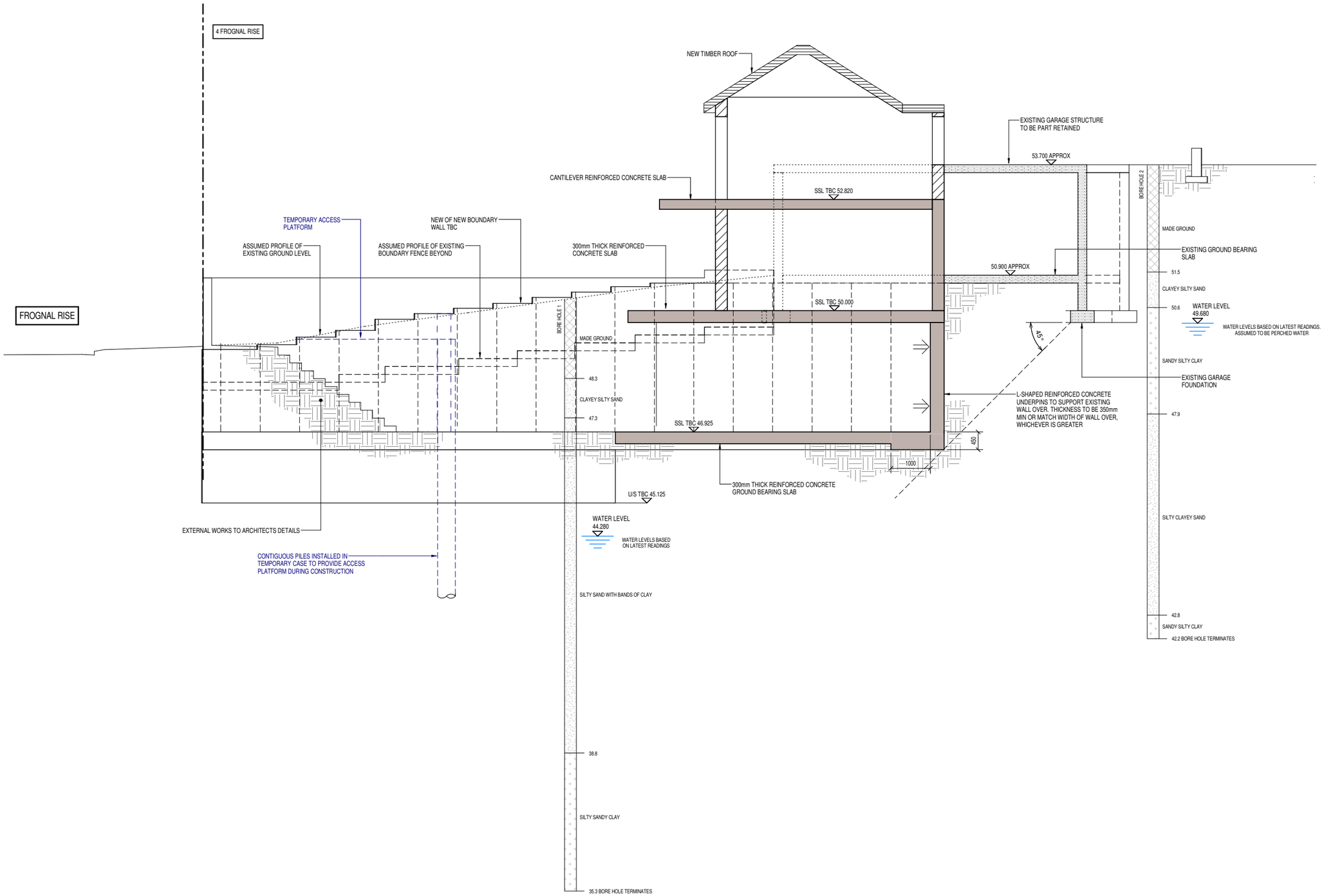
project
4 Frognal Rise

drawing title
Proposed First Floor Plan

scale (s)	date	drawn
1:50@A1; 1:100@A3	March 2015	BMC

project no.			drawing status.		
213780			Preliminary		
originator.	zone.	level.	role.	drg no.	revision
EW	00	L01	S	1010	P2



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Do not scale from this drawing.

LEGEND

- EXISTING STRUCTURE
- NEW LOAD BEARING BLOCKWORK
- NEW LOAD BEARING BRICKWORK
- NEW REINFORCED CONCRETE
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FOR PLANNING

rev	date	by	chk	description
P3	29.05.15	BMC	GP	Issued for Planning
P2	05.05.15	BMC	GP	Issued for Information & Comment
P1	01.04.15	BMC	RWo	Issued for Information & Comment

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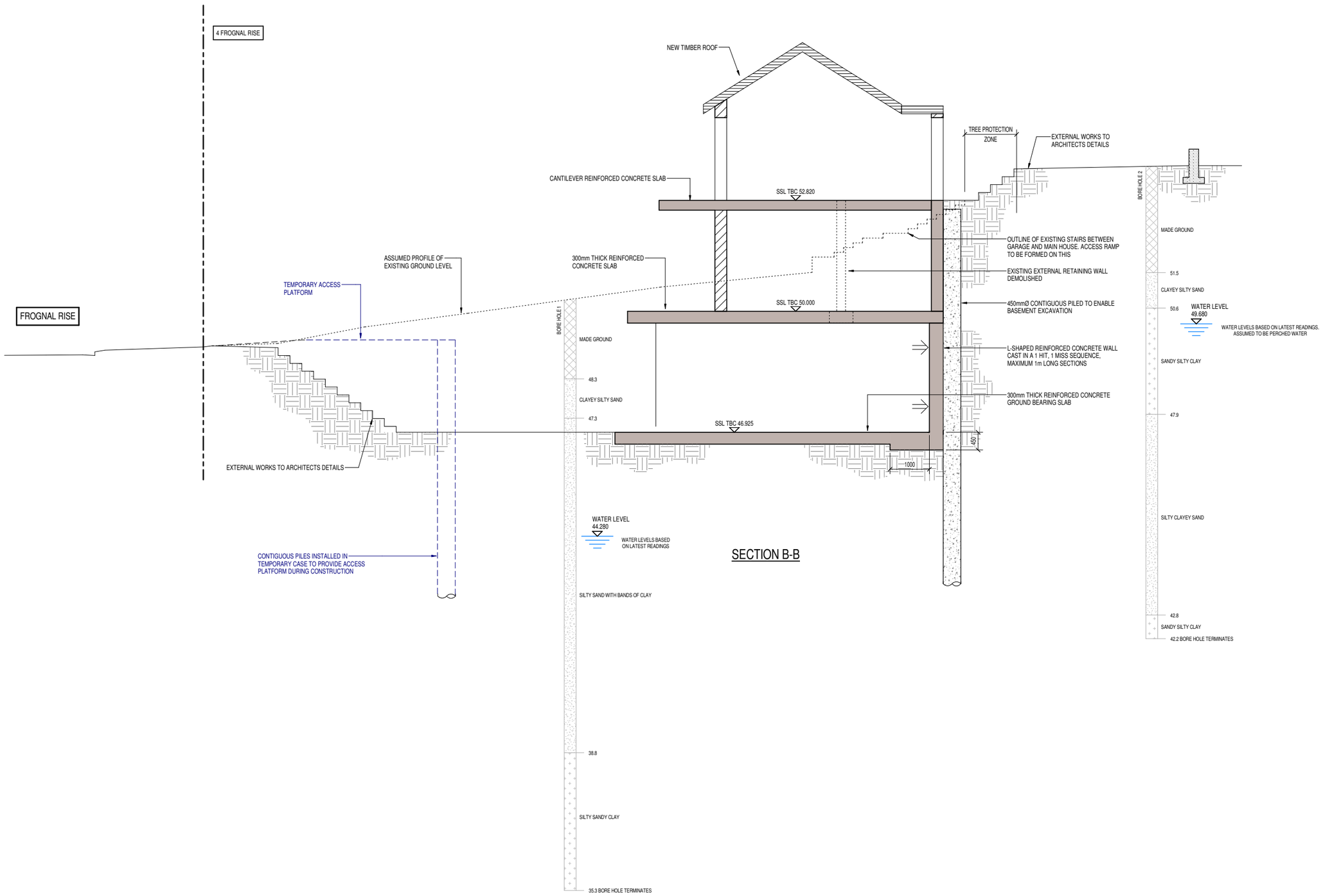
project
4 Frognal Rise

drawing title
Proposed Section A

scale (s)	date	drawn
1:50@A1; 1:100@A3	March 2015	BMC

project no.			drawing status.		
213780			Preliminary		
originator.	zone.	level.	role.	drg no.	revision
EW	00	SEC	S	2000	P3



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.

LEGEND

- EXISTING STRUCTURE
- NEW LOAD BEARING BLOCKWORK
- NEW LOAD BEARING BRICKWORK
- NEW REINFORCED CONCRETE
- NEW MASS CONCRETE
- PADSTONES
- LOAD BEARING STUDWORK
- NON LOAD BEARING WALLS
- LOAD BEARING STRUCTURE BELOW
- EXISTING STRUCTURE TO BE REMOVED
- NEW STEEL BEAMS
- NEW LINTELS OVER OPENINGS

FOR PLANNING

rev	date	by	chk	description
P3	29.05.15	BMC	GP	Issued for Planning
P2	05.05.15	BMC	GP	Issued for Information & Comment
P1	01.04.15	BMC	RWo	Issued for Information & Comment

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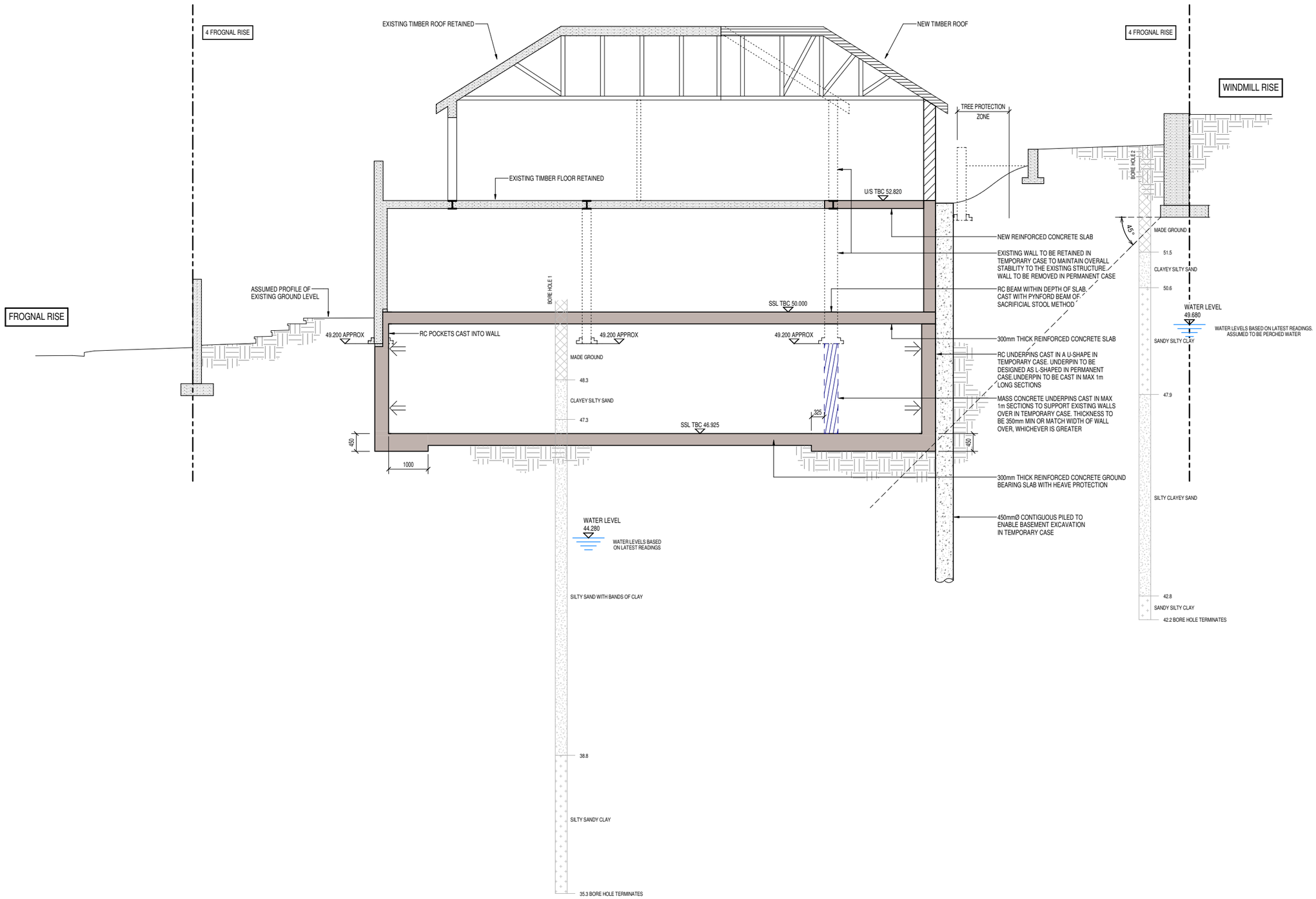
project
4 Frognal Rise

drawing title
Proposed Section B

scale (s)	date	drawn
1:50@A1; 1:100@A3	March 2015	BMC

project no.			drawing status.		
213780			Preliminary		
originator.	zone.	level.	role.	drg no.	revision
EW	00	SEC	S	2001	P3



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Do not scale from this drawing.

LEGEND

- EXISTING STRUCTURE
- NEW LOAD BEARING BLOCKWORK
- NEW LOAD BEARING BRICKWORK
- NEW REINFORCED CONCRETE
- NEW MASS CONCRETE
- PADSTONES
- LOAD BEARING STUDWORK
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- LOAD BEARING STRUCTURE BELOW
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- NEW STEEL BEAMS
- NEW LINTELS OVER OPENINGS

FOR PLANNING

rev	date	by	chk	description
P2	29.05.15	BMC	GP	Issued for Planning
P1	01.04.15	BMC	RWo	Issued for Information & Comment

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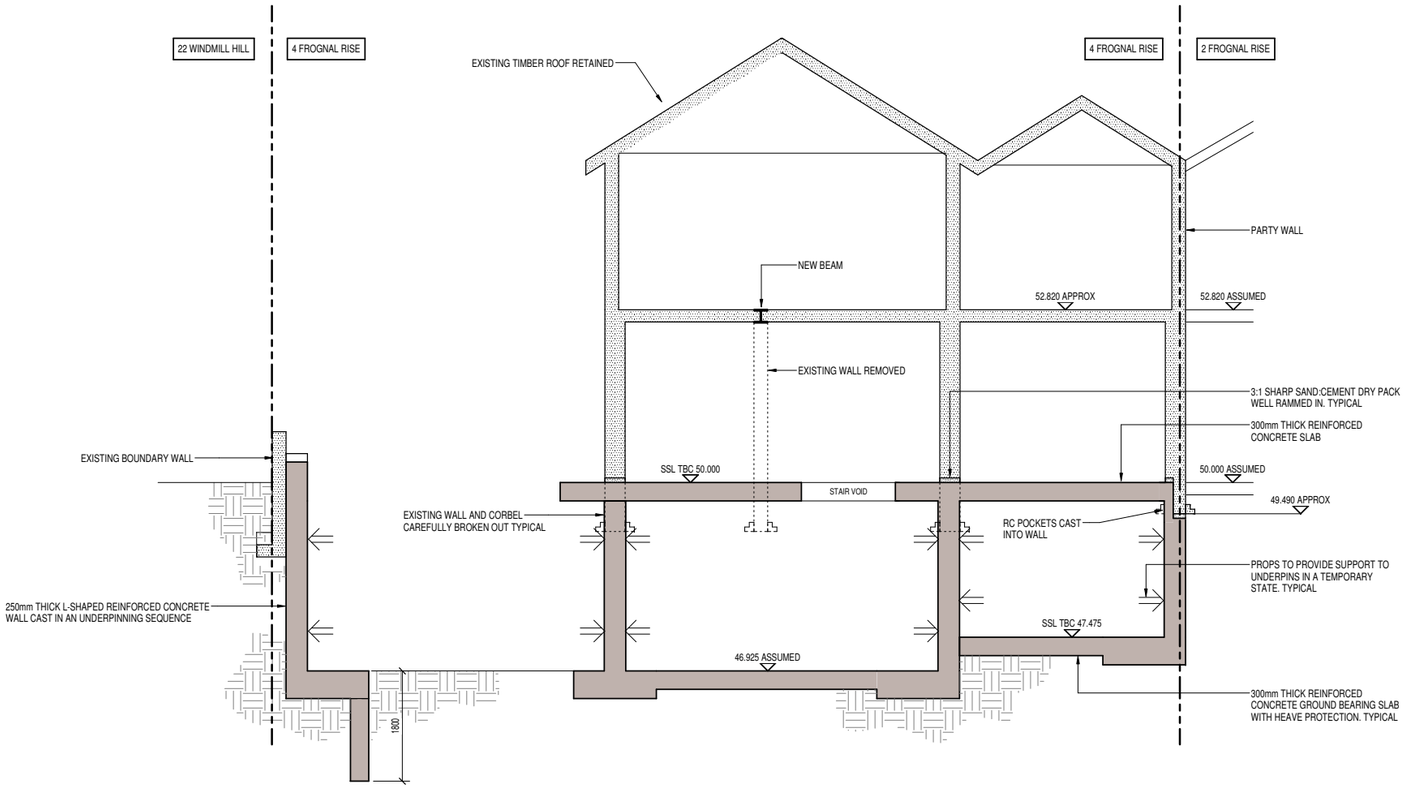
project
4 Frognal Rise

drawing title
Proposed Section C

scale (s)	date	drawn
1:50@A1; 1:100@A3	March 2015	BMC

project no.			drawing status.		
213780			Preliminary		
originator.	zone.	level.	role.	drg no.	revision
EW	00	SEC	S	2002	P2



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Do not scale from this drawing.

LEGEND

- EXISTING STRUCTURE
- NEW LOAD BEARING BLOCKWORK
- NEW LOAD BEARING BRICKWORK
- NEW REINFORCED CONCRETE
- NEW MASS CONCRETE
- PADSTONES
- LOAD BEARING STUDWORK
- NON LOAD BEARING WALLS
- LOAD BEARING STRUCTURE BELOW
- EXISTING STRUCTURE TO BE REMOVED
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FOR PLANNING

rev	date	by	chk	description
P3	29.05.15	BMC	GP	Issued for Planning
P2	05.05.15	BMC	GP	Issued for Information & Comment
P1	01.04.15	BMC	RWo	Issued for Information & Comment

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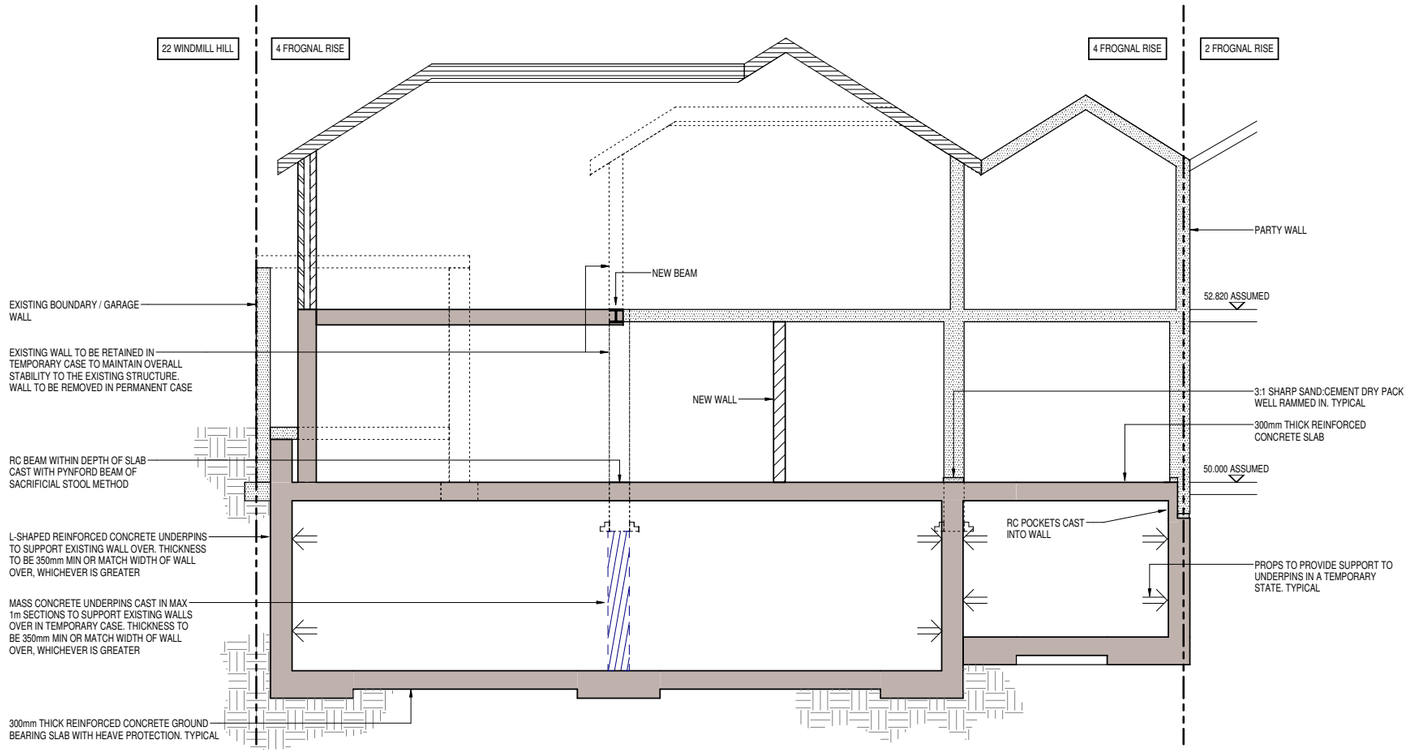
project
4 Frognal Rise

drawing title
Proposed Section D

scale (s)	date	drawn
1:50@A1; 1:100@A3	March 2015	BMC

project no.			drawing status.		
213780			Preliminary		
originator.	zone.	level.	role.	drg no.	revision
EW	00	SEC	S	2003	P3



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Do not scale from this drawing.

LEGEND

- EXISTING STRUCTURE
- NEW LOAD BEARING BLOCKWORK
- NEW LOAD BEARING BRICKWORK
- NEW REINFORCED CONCRETE
- NEW MASS CONCRETE
- PADSTONES
- LOAD BEARING STUDWORK
- NON LOAD BEARING WALLS
- LOAD BEARING STRUCTURE BELOW
- EXISTING STRUCTURE TO BE REMOVED
- NEW STEEL BEAMS
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FOR PLANNING

rev	date	by	chk	description
P2	29.05.15	BMC	GP	Issued for Planning
P1	01.04.15	BMC	RWo	Issued for Information & Comment

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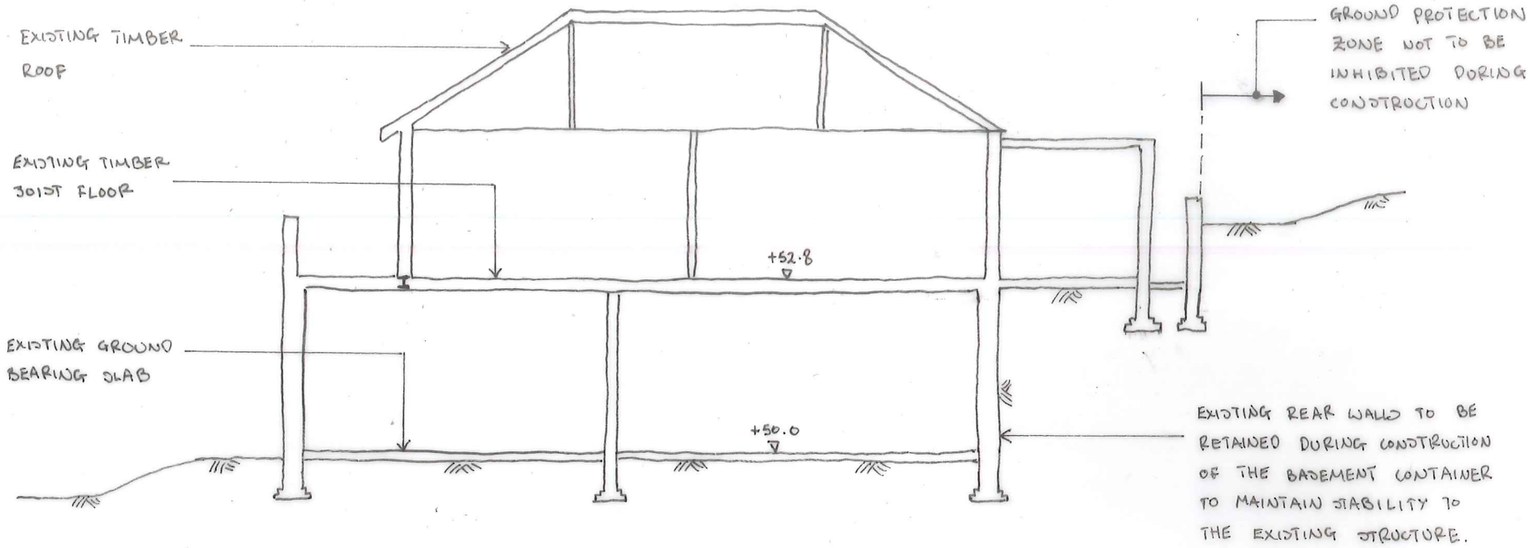
project
4 Frognal Rise

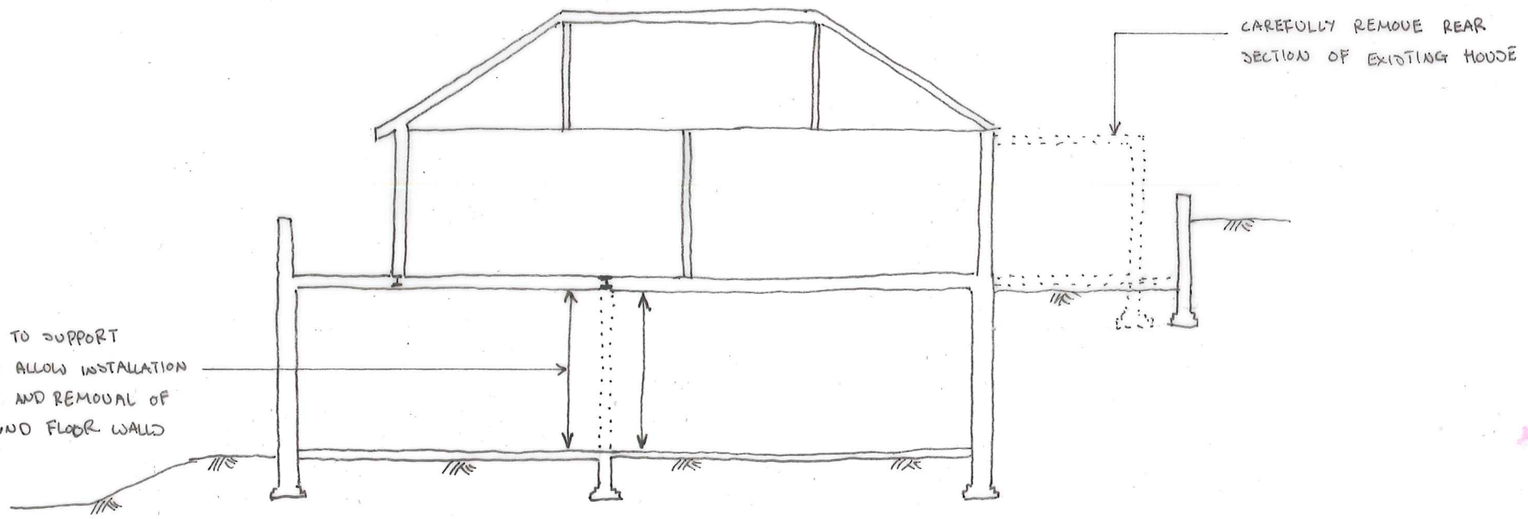
drawing title
Proposed Section E

scale (s)	date	drawn
1:50@A1; 1:100@A3	March 2015	BMC

project no.			drawing status.		
213780			Preliminary		
originator.	zone.	level.	role.	drg no.	revision
EW	00	SEC	S	2004	P2



EXISTING STRUCTURE



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rev	date	by	chk	description

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job title

4 FROGNAL RISE NW3 6RD

drawing title

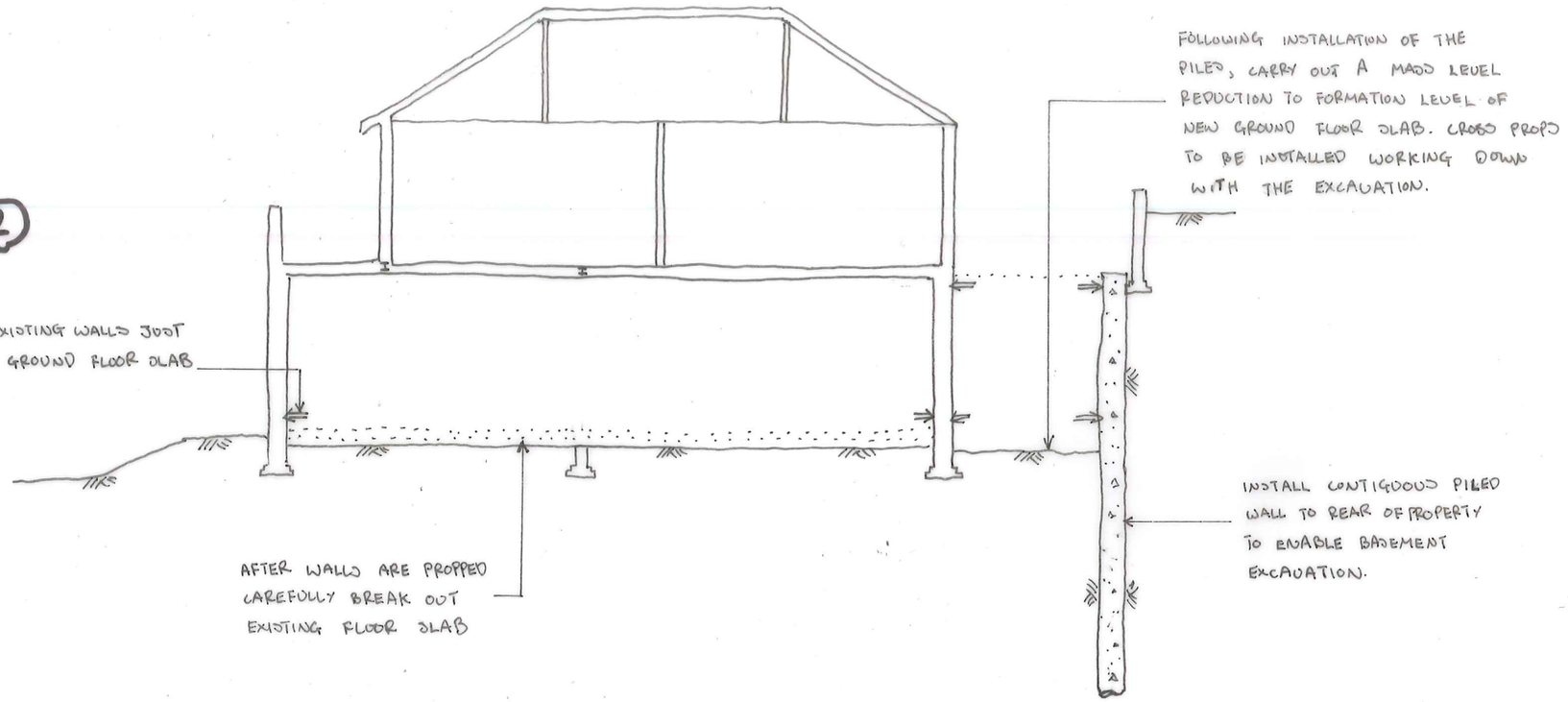
ASSUMED CONSTRUCTION SEQUENCE

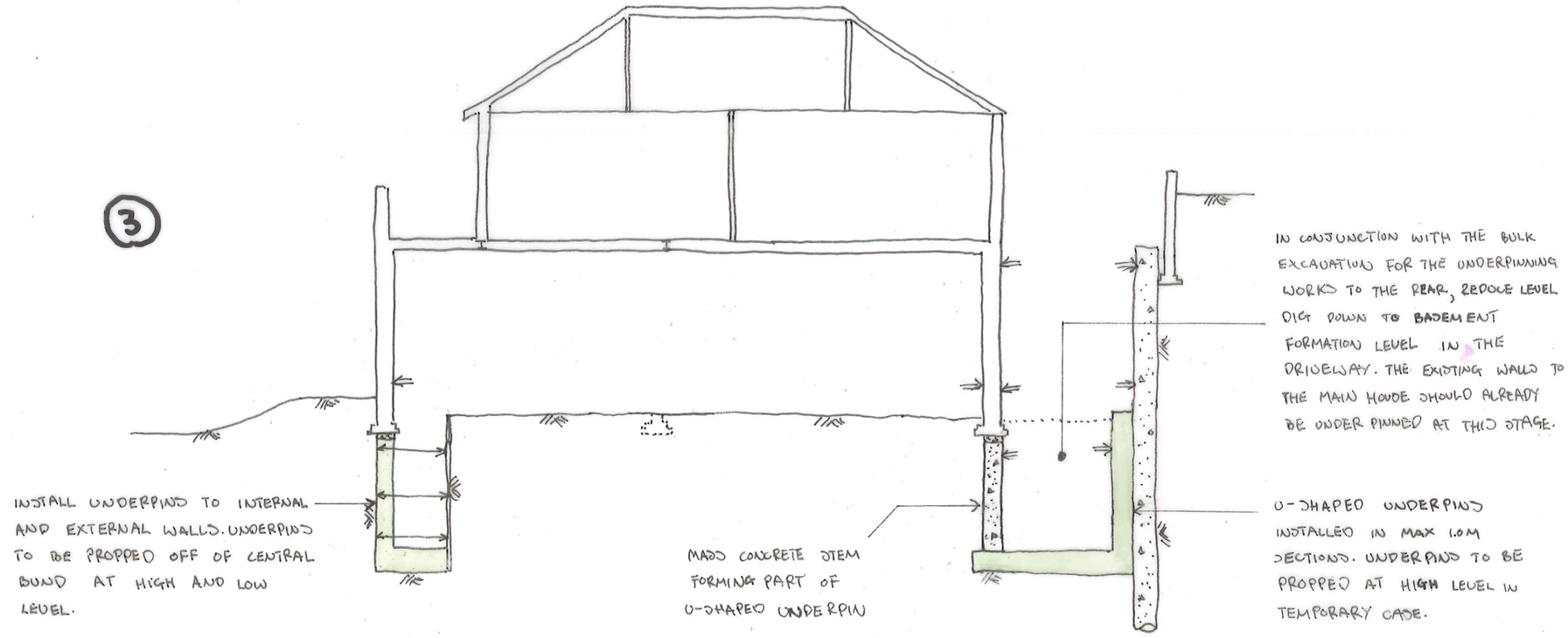
scale(s)	date	drawn
~1:100@A3	28.08.15	RWo

drawing status

PRELIMINARY

job no	drawing no	revision
213780	SK.01	P1





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rev	date	by	chk	description

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job title

4 FROGNAL RISE NW3 6RD

drawing title

ASSUMED CONSTRUCTION SEQUENCE

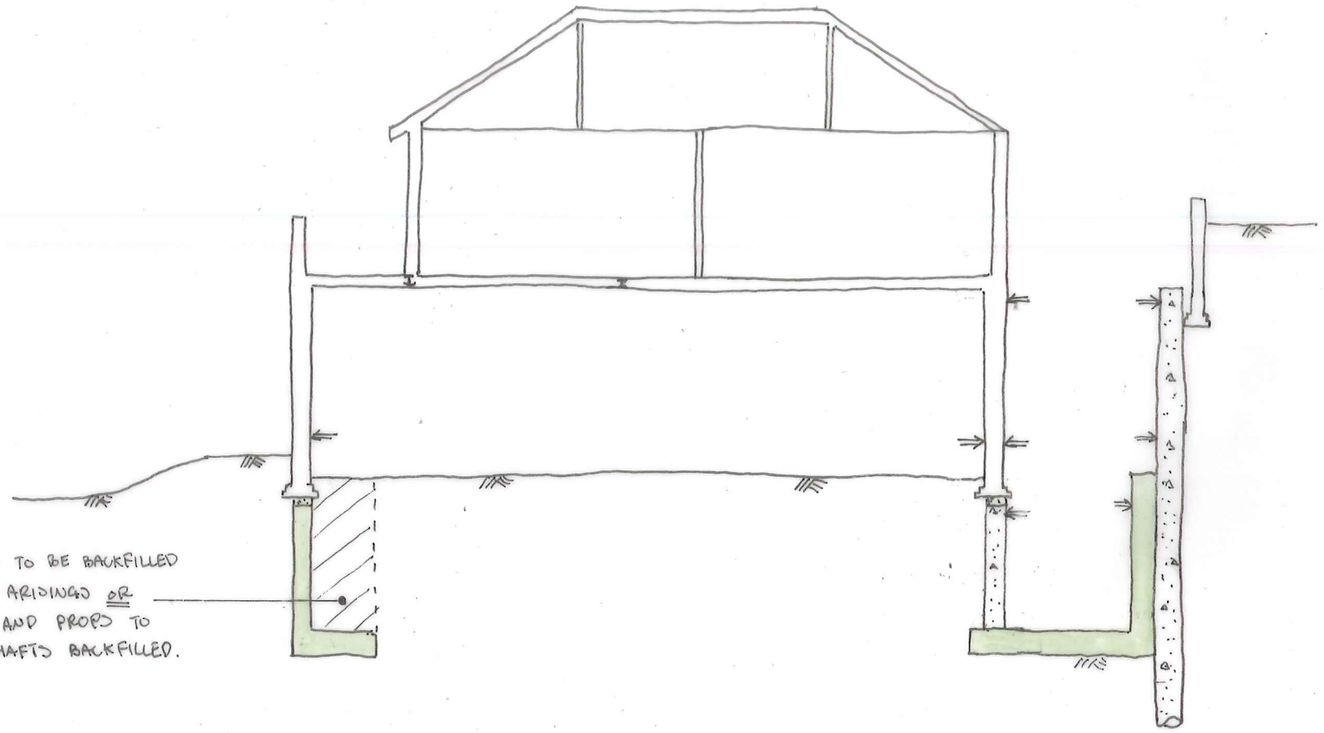
scale(s)	date	drawn
n1:100@A3	28.05.15	RWo

drawing status

PRELIMINARY

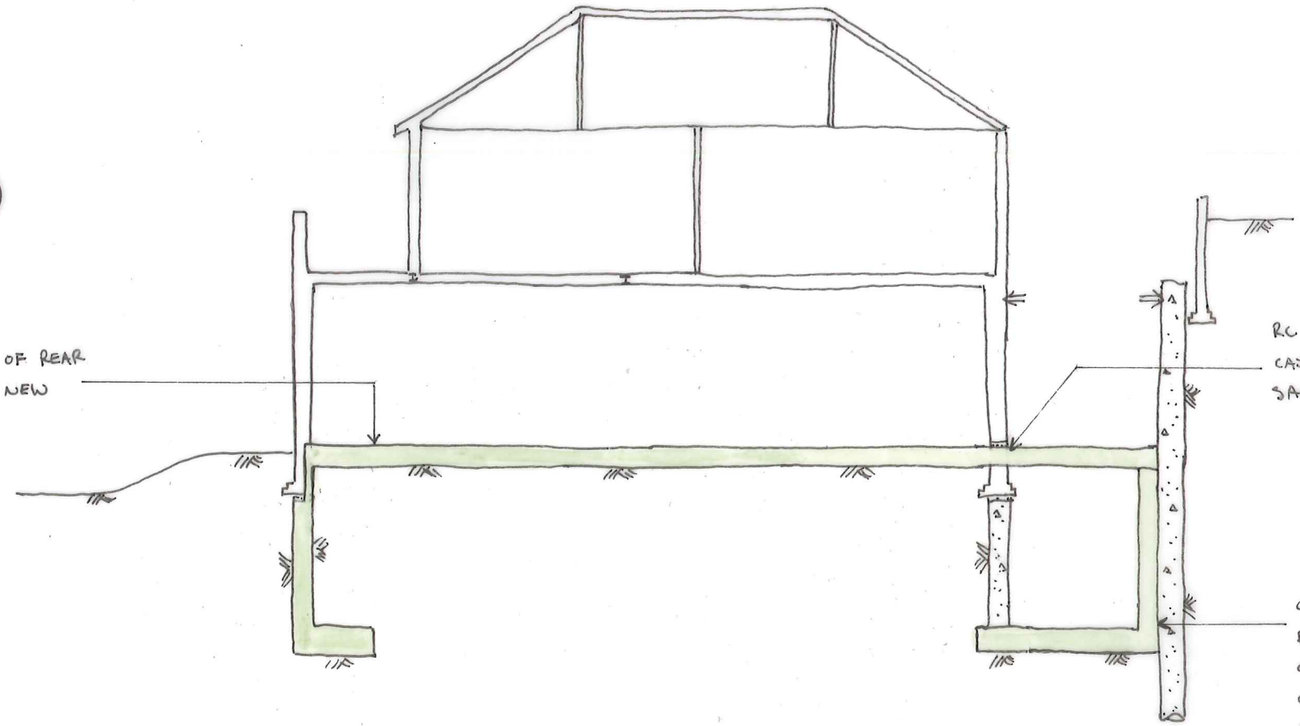
job no	drawing no	revision
213780	SK.02	P1

(4)



UNDERPIN SHAFTS TO BE BACKFILLED WITH COMPACTED ARISINGS OR TRENCH SHEETS AND PROPS TO REMAIN AND SHAFTS BACKFILLED.

(5)



FOLLOWING CONSTRUCTION OF REAR LINER WALL, CAST THE NEW GROUND FLOOR SLAB.

RC BEAM WITHIN SLAB DEPTH TO BE CAST WITH THE PYNFORD BEAM OR SACRIFICIAL STOOL METHOD.

CAST RC BASES FOLLOWED BY RC LINER WALL ALONG LENGTH OF PILED WALL. LOW LEVEL PROPS CAN BE REMOVED AFTER BASE SLAB IS IN PLACE AND CURED. WALLS CAST IN A 1 HIT, 1 MISS SEQUENCE.

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rev	date	by	chk	description

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job title

4 FROGNAL RISE NW3 6RD

drawing title

ASSUMED CONSTRUCTION SEQUENCE

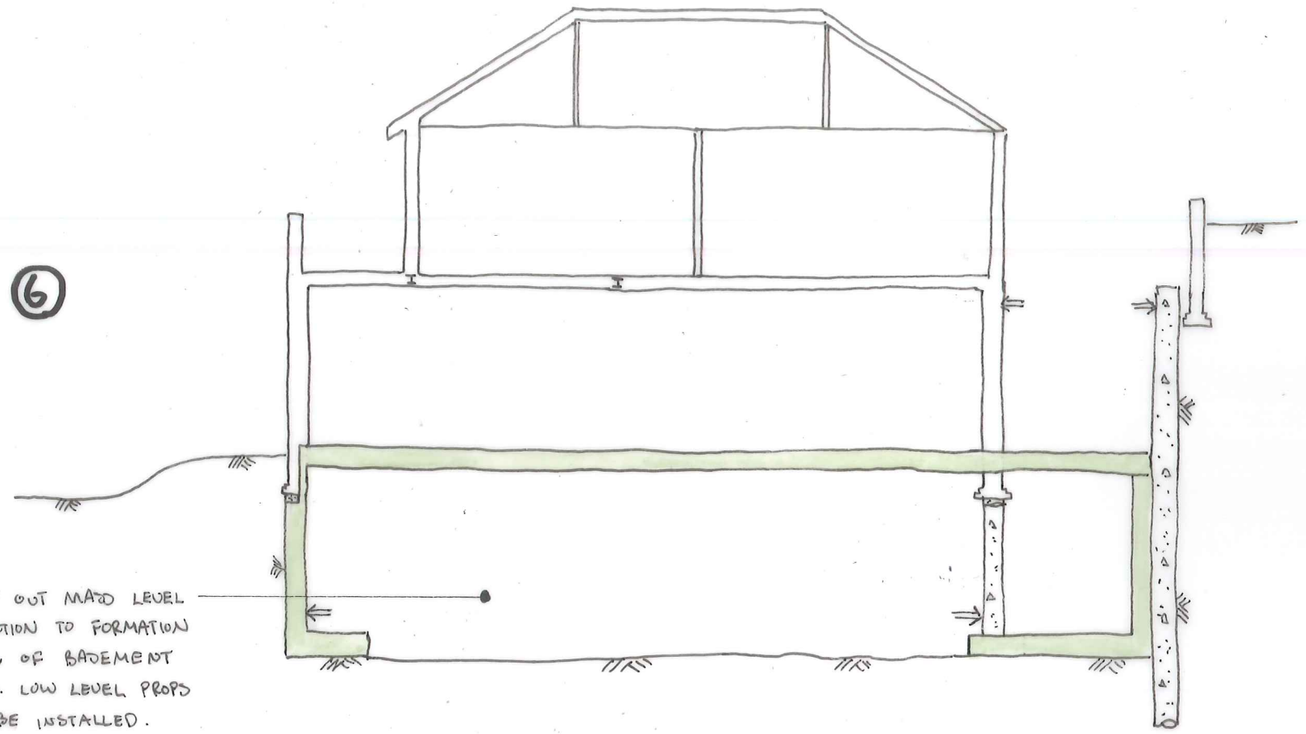
scale(s)	date	drawn
~1:100@A3	28.05.15	RWo

drawing status

PRELIMINARY

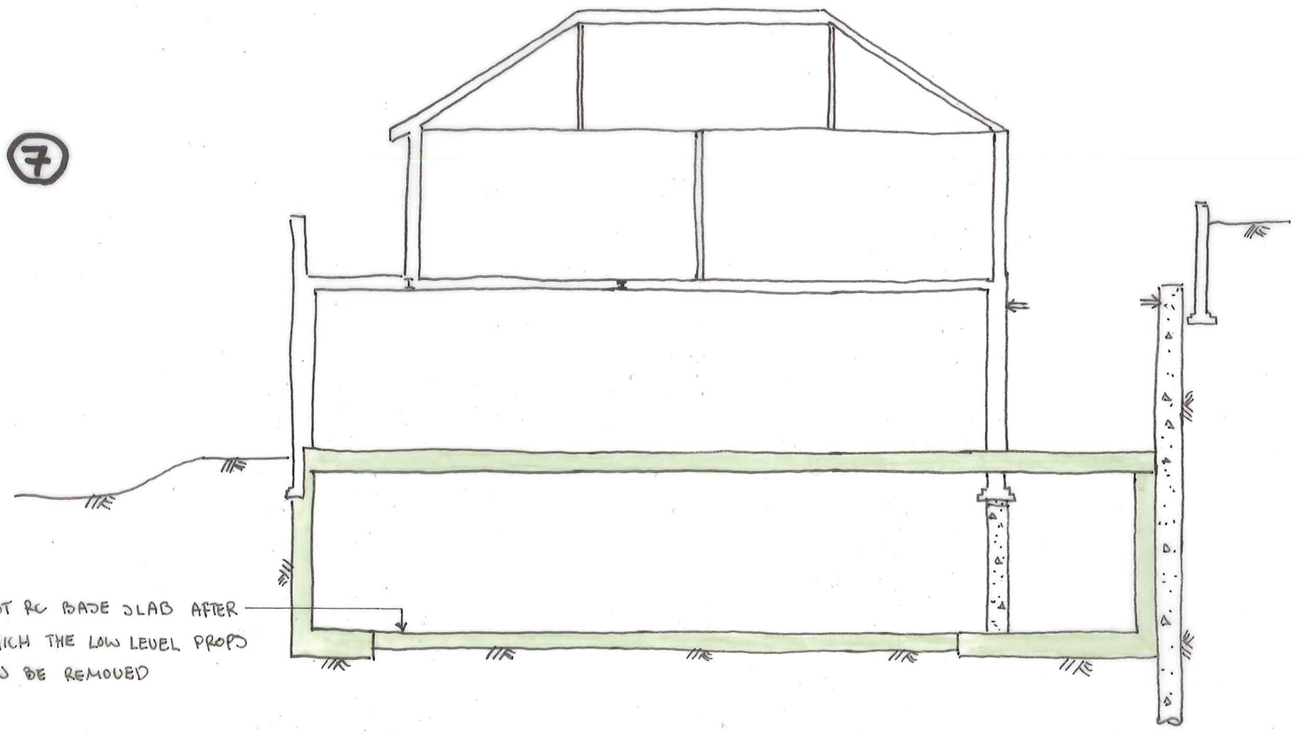
job no	drawing no	revision
213780	SK.03	P1

(6)



CARRY OUT MAJ LEVEL REDUCTION TO FORMATION LEVEL OF BASEMENT SLAB. LOW LEVEL PROPS TO BE INSTALLED.

(7)



CAST RC BASE SLAB AFTER WHICH THE LOW LEVEL PROPS CAN BE REMOVED

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job title

4 FROGNAL RISE NW3 6RD

drawing title

ASSUMED CONSTRUCTION SEQUENCE

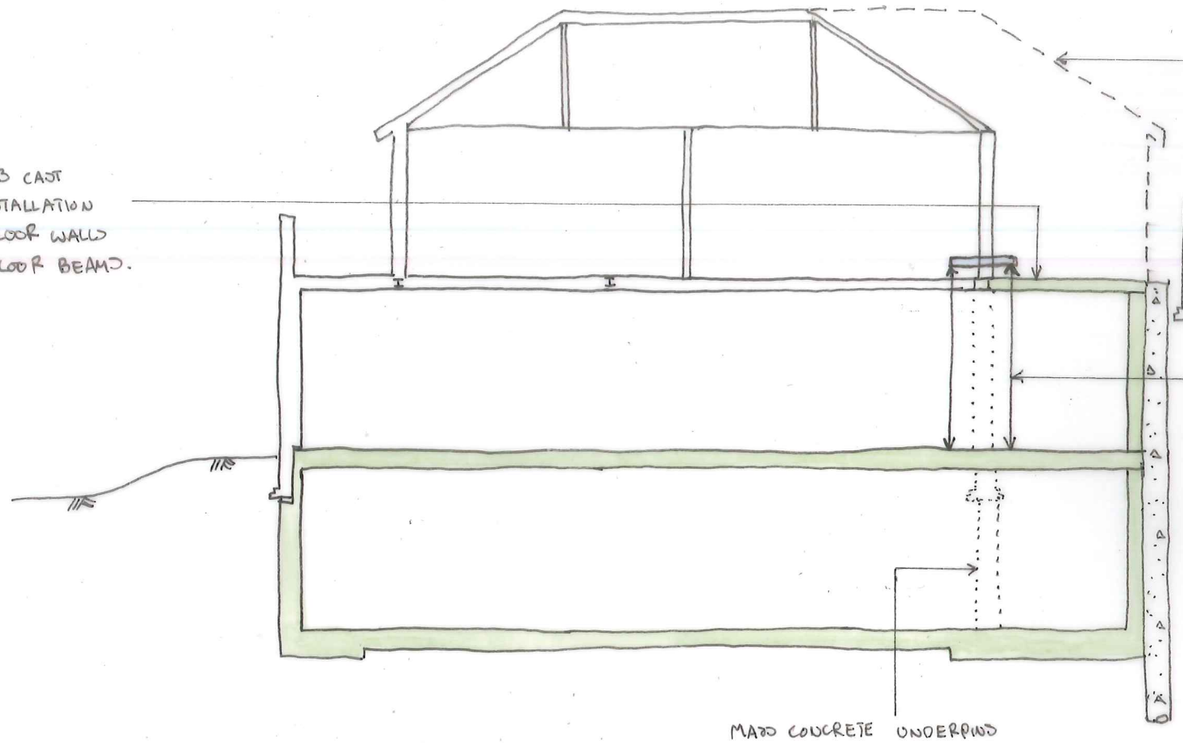
scale(s)	date	drawn
~1:100 @ A3	28.05.15	RWo

drawing status

PRELIMINARY

job no	drawing no	revision
213780	SK.04	P1

(2)



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rev	date	by	chk	description

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tel: (020) 8544 0033 **fax:** (020) 8544 0066 info@elliottwood.co.uk

job title

4 FROGNAL RISE NW3 6RD

drawing title

ASSUMED CONSTRUCTION SEQUENCE

scale(s)	date	drawn
~1:100 @ A3	28.05.15	RWb

drawing status

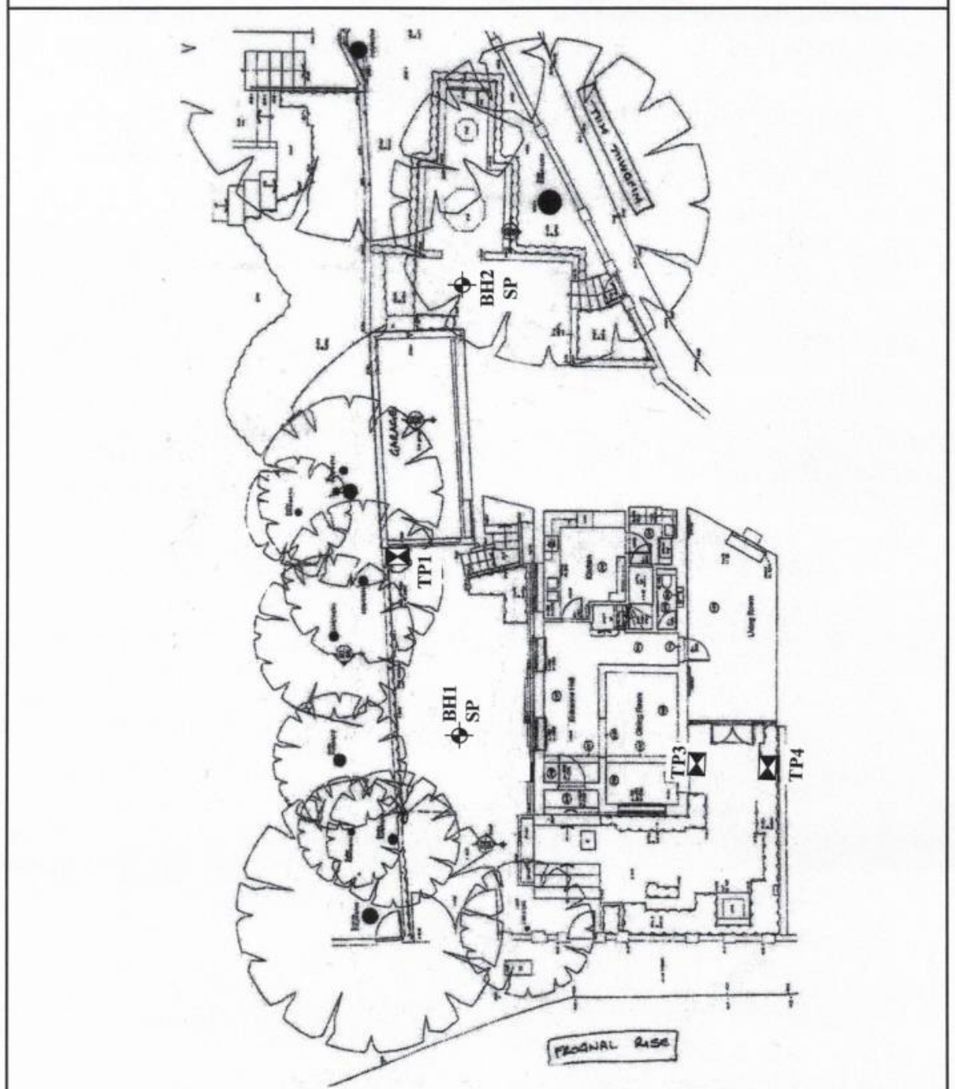
PRELIMINARY

job no	drawing no	revision
213780	SK.05	P1

B Site Investigation Logs

K F Geotechnical	SITE LOCATION PLAN		Ref: G/011506/101
85 Alexandra Road Farnborough Hants GU14 6BN Tel: 01252 518821	Sheet: 1 of 1	Scale: N/A	Date: 7 January 2015
	Client: Elliott Wood Partnership		

Location: **4 FROGNAL RISE, HAMPSTEAD, NW3 6RD**



Remarks:

Key:

Borehole (BH)	SP	Stand Pipe	MH	Manhole
Trial pit (TP)	RWP	Rainwater Pipe	G	Gully
Sample (S)		Soakaway (SW)		Tree/Bush (approx. ht in m)

K. F. Geotechnical	Borehole 1		Ref: G011506
85 Alexandra Road Farnborough Hants GU14 6BN Tel : (01252) 518821 Fax : (01252) 370394 Email : kfgroup@fbro.demon.co.uk	Sheet: 1	Scale: 1:50	Date: 19/12/14
	Client: ELLIOTT WOOD PARTNERSHIP		
Equipment & Method : Shell & Auger	Location: 4 FROGNAL RISE, HAMPSTEAD		

Description of Strata [thickness]	Reduced Level	Legend	Depth	Samples Type	Samples Depth	Tests Type	Tests Value	Field Notes
Slate slabs and concrete (0.10)	-0.10		0.10					
Concrete (0.10)	-0.20		0.20					
MADE GROUND: medium dense brown gravelly silty clayey sand with brick (1.80)				D	0.40			
				D	0.70			
				B	1.00	C	N=21	
Medium dense brown clayey silty SAND (1.00)	-2.00		2.00	D	2.00	S	N=15	
Medium dense brown silty SAND with bands of clay (8.50)	-3.00		3.00	D	3.00	S	N=19	
				D	4.00	S	N=21	
				D	5.00	S	N=23	
				D	6.40	S	N=25	
				D	8.00	S	N=24	
								Water strike at 9m. Rose to 7m after 5min. Sealed out at 11.5m
				D	9.50	S	N=24	
				W	10.00			

Where 0.3m penetration has not been achieved, the number of blows for the quoted penetration is given. (Not the N value)
All depths and reduced levels are in metres.
Water level observations during boring are given on the last sheet of the log.

U Undisturbed Sample
D Disturbed Sample
B Bulk Sample
W Water Sample
S Standard Penetration Test
V Vane Test
MP Mackintosh Probe

Remarks

Water standing at 7m on completion
Standpipe installed to 9m
Water added from 4m to 9m (300 litres)
Water added from 10m to 11.5m (25 litres)

K. F. Geotechnical

85 Alexandra Road
Farnborough
Hants
GU14 6BN
Tel : (01252) 518821
Fax : (01252) 370394
Email : kfgroup@fbro.demon.co.uk

Borehole 1 | Ref: G011506
Sheet: 2 | Scale: 1:50 | Date: 19/12/14
Client: ELLIOTT WOOD PARTNERSHIP
Equipment & Method : Shell & Auger
Location: 4 FROGNAL RISE, HAMPSTEAD

Description of Strata [thickness]	Reduced Level	Legend	Depth	Samples Type	Samples Depth	Tests Type	Tests Value	Field Notes
(Continued) Medium dense brown silty SAND with bands of clay (8.50)				D	11.00	S	N=23	
Stiff grey silty sandy CLAY (3.50)	-11.50		11.50	U	12.50		57 BLOWS	
				D	12.95			
				D	14.00	S	N=27	
Base of Borehole	-15.00		15.00					

Where 0.3m penetration has not been achieved, the number of blows for the quoted penetration is given. (Not the N value)
All depths and reduced levels are in metres.
Water level observations during boring are given on the last sheet of the log.

U Undisturbed Sample
D Disturbed Sample
B Bulk Sample
W Water Sample
S Standard Penetration Test
V Vane Test
MP Mackintosh Probe

Remarks

Water standing at 7m on completion
Standpipe installed to 9m
Water added from 4m to 9m (300 litres)
Water added from 10m to 11.5m (25 litres)

K. F. Geotechnical

85 Alexandra Road
Farnborough
Hants
GU14 6BN
Tel : (01252) 518821
Fax : (01252) 370394
Email : kfgroup@fbro.demon.co.uk

Borehole 2 | Ref: G011506
Sheet: 1 | Scale: 1:50 | Date: 7/1/15
Client: ELLIOTT WOOD PARTNERSHIP
Equipment & Method : Flight Auger
Location: 4 FROGNAL RISE, HAMPSTEAD

Description of Strata [thickness]	Reduced Level	Legend	Depth	Samples Type	Samples Depth	Tests Type	Tests Value	Field Notes
Yorkstone slabs over concrete (0.15)	-0.15		0.15					
MADE GROUND: loose dark brown gravelly clayey silty sand with brick and concrete rubble (1.05)				D	1.00	M	2,3,3,4	
MADE GROUND: firm light grey sandy silty clay with brick fragments (1.00)	-1.20		1.20	D	1.50			
				D	2.00	V	62	
MADE GROUND: medium compact brown gravelly silty sand with brick fragments (0.50)	-2.20		2.20	D	2.50			
Medium dense brown clayey silty SAND (0.90)	-2.70		2.70	D	3.00	M	17,33,40,47	
Stiff light brown/orange sandy silty CLAY (2.70)	-3.60		3.60	D	4.00	V	122	Roots of live appearance to 4.2m Water seepage at 3m
				D	5.00	V	132	
				D	6.00	V	138	
Medium dense brown/orange silty clayey SAND (5.10)	-6.30		6.30					
				D	8.00	M	40,43,50,50	
				D	10.00	M	39,50,50,50+	

Where 0.3m penetration has not been achieved, the number of blows for the quoted penetration is given. (Not the N value)
All depths and reduced levels are in metres.
Water level observations during boring are given on the last sheet of the log.

U Undisturbed Sample
D Disturbed Sample
B Bulk Sample
W Water Sample
S Standard Penetration Test
V Vane Test
MP Mackintosh Probe

Remarks

Borehole collapsing from 6.4m
Standpipe installed

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Borehole 2 | Ref: G011506
Sheet: 2 | Scale: 1:50 | Date: 7/1/15
Client: ELLIOTT WOOD PARTNERSHIP
Equipment & Method : Flight Auger
Location: 4 FROGNAL RISE, HAMPSTEAD

Description of Strata [thickness]	Reduced Level	Legend	Depth	Samples Type	Samples Depth	Tests Type	Tests Value	Field Notes
(Continued) Medium dense brown/orange silty clayey SAND (5.10)								
Very stiff brown/grey sandy silty CLAY (0.60)	-11.40		11.40					Water strike at 11.3m
Base of Borehole	-12.00		12.00	D	12.00	V	140+	

Where 0.3m penetration has not been achieved, the number of blows for the quoted penetration is given. (Not the N value)
All depths and reduced levels are in metres.
Water level observations during boring are given on the last sheet of the log.

U Undisturbed Sample
D Disturbed Sample
B Bulk Sample
W Water Sample
S Standard Penetration Test
V Vane Test
MP Mackintosh Probe

Remarks
Borehole collapsing from 6.4m
Standpipe installed

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Trial Pit 1 | Ref: G011506
Sheet: 1 | Scale: 1:10 | Date: 7/1/15
Client: ELLIOTT WOOD PARTNERSHIP
Equipment & Method : Trial Pit
Location: 4 FROGNAL RISE, HAMPSTEAD

Description of Strata [thickness]	Reduced Level	Legend	Depth	Samples Type	Samples Depth	Tests Type	Tests Value	Field Notes
SLAB 1' CONC.	-0.16		0.16					
GRAVELLY SAND WITH BRICK AND CONCRETE RUBBLE								Roots of live appearance to 1.1m
CONC. FOOTING	-1.10		1.10					

Where 0.3m penetration has not been achieved, the number of blows for the quoted penetration is given. (Not the N value)
All depths and reduced levels are in metres.
Water level observations during boring are given on the last sheet of the log.

U Undisturbed Sample
D Disturbed Sample
B Bulk Sample
W Water Sample
S Standard Penetration Test
V Vane Test
MP Mackintosh Probe

Remarks
Trial pit collapsing from 0.8m

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Trial Pit 3 | Ref: G011506
Sheet: 1 | Scale: 1:10 | Date: 7/1/15
Client: ELLIOTT WOOD PARTNERSHIP
Equipment & Method : Trial Pit
Location: 4 FROGNAL RISE, HAMPSTEAD

Description of Strata [thickness]	Reduced Level	Legend	Depth	Samples Type	Samples Depth	Tests Type	Tests Value	Field Notes
SLABS CONC	-0.12		0.12					
LOOSE GRAVELLY CLAYEY SILTY SAND WITH BRICK RUBBLE (170 (NTS) 210 180)	-0.37		0.37					
FIRM GRAVELLY SANDY SILTY CLAY + BRICK	-0.62							
CONC AS BELOW	-0.67		0.67					
Medium dense brown/orange clayey silty SAND (0.08)	-1.02		1.02	D	1.02	M	10,19,23,33	
Base of Trial Pit	-1.10		1.10					Roots of live appearance to 1.1m

Where 0.3m penetration has not been achieved, the number of blows for the quoted penetration is given. (Not the N value)
All depths and reduced levels are in metres.
Water level observations during boring are given on the last sheet of the log.

U Undisturbed Sample
D Disturbed Sample
B Bulk Sample
W Water Sample
S Standard Penetration Test
V Vane Test
MP Mackintosh Probe

Remarks
Trial pit dry and open on completon

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Trial Pit 4 | Ref: G011506
Sheet: 1 | Scale: 1:10 | Date: 7/1/15
Client: ELLIOTT WOOD PARTNERSHIP
Equipment & Method : Trial Pit
Location: 4 FROGNAL RISE, HAMPSTEAD

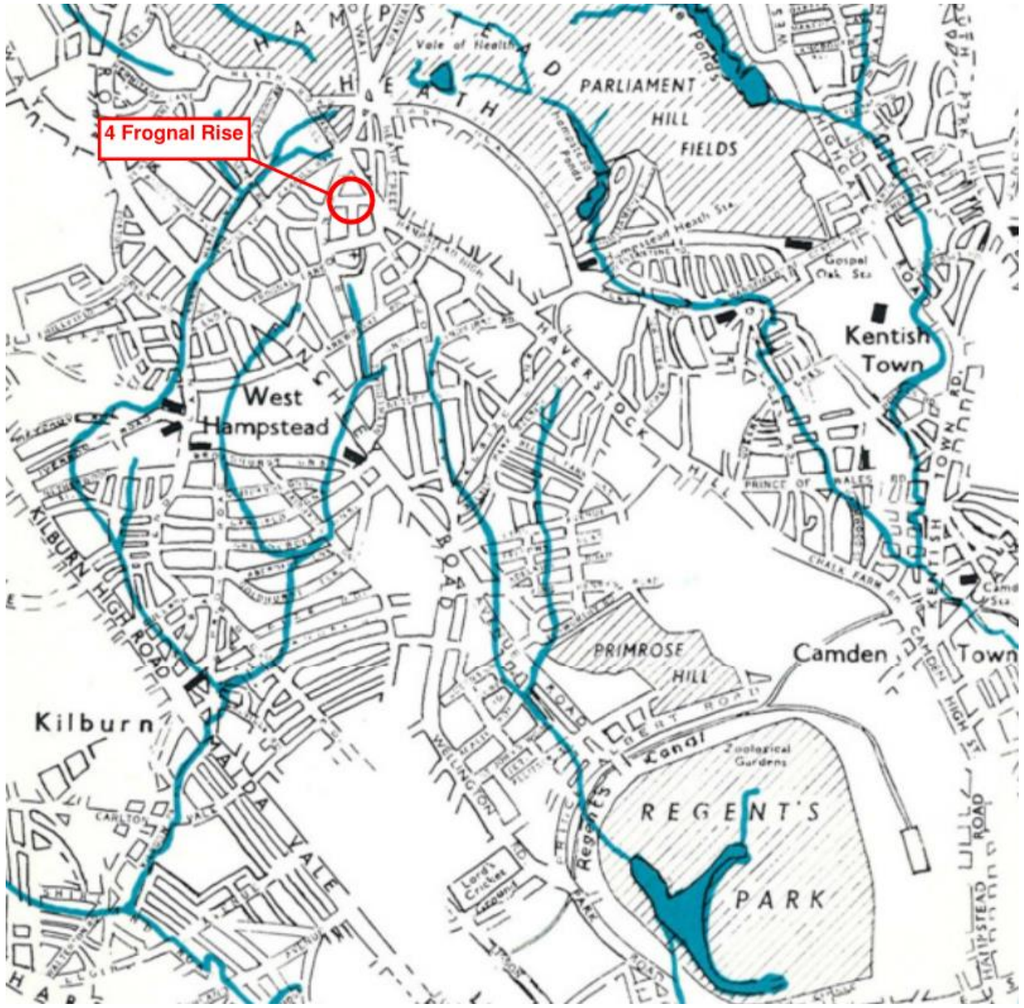
Description of Strata [thickness]	Reduced Level	Legend	Depth	Samples Type	Samples Depth	Tests Type	Tests Value	Field Notes
SLABS CONC	-0.11		0.11					
LOOSE GRAVELLY SILTY CLAY & SAND + BRICK (80)	-0.51		0.51					
-0.54 CONC AS BELOW	-0.74		0.74	D	0.74	M	16,19,22,24	
Medium dense brown/orange clayey silty SAND (0.06)	-0.80		0.80					Roots of live appearance to 0.8m
Base of Trial Pit								

Where 0.3m penetration has not been achieved, the number of blows for the quoted penetration is given. (Not the N value)
All depths and reduced levels are in metres.
Water level observations during boring are given on the last sheet of the log.

U Undisturbed Sample
D Disturbed Sample
B Bulk Sample
W Water Sample
S Standard Penetration Test
V Vane Test
MP Mackintosh Probe

Remarks
Trial pit dry and open on completon

C Lost Rivers of London Map



Frognal Rise appears to be in the vicinity of the historic river West Bourne.

Ref: A portion of the map showing the course of the Lost River Tyburn taken from Lost Rivers of London © 1962 and 1992 by Nicholas Barton, used by kind permission of Historical Publications Ltd

D London Underground Asset Location Confirmation

Date 04 December 2014
Our Ref 20878-SI-8-041214
Your Ref
To Sarah Wadley
Elliottwood
S.Wadley@elliottwood.co.uk

London Underground Limited

Hello Sarah,

4 Frognal Rise London NW3 6RD

Thank you for your communication of 4th December 2014.

I can confirm that London Underground has no assets within 50 metres of your site as shown on the plan you provided.

Should you have any further enquiries, please do not hesitate to contact me.

Shahina Inayathusein
Information Manager
LUL Infrastructure Protection
E-mail: Locationenquiries@tube.tfl.gov.uk
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London Underground Asset Location Confirmation

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