


The Grove, Highgate Structural Engineering Report for Planning (CMS)



constructure

Structural Designers

Constructure Ltd
15 Bell Yard Mews
London SE1 3TY

constructure.co.uk
office@constructure.co.uk
020 7403 7989

QUALITY MANAGEMENT

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PREPARED BY	Holly-Mo Vyse MEng	TITLE	Engineer
CHECKED BY	Tom Goodall BEng	TITLE	Engineer
AUTHORISED BY	Adam Harrison MEng CEng FICE	TITLE	Director

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TABLE OF CONTENTS.

1. INTRODUCTION	4
2. THE SITE	4
2.1. THE EXISTING STRUCTURE	
2.2. LOCAL GEOLOGY AND HYDROLOGY	
2.3. LONDON UNDERGROUND	
2.4. FLOOD RISK	
2.5. EXISTING UTILITIES AND UNDERGROUND SERVICES	
3. INVESTIGATION WORKS	7
3.1. SITE INVESTIGATION	
3.1.1. CONTAMINATION TESTING	
3.1.2. GROUNDWATER	
3.1.3. STABILITY OF EXCAVATIONS	
3.2. GROUND MOVEMENT ANALYSIS AND BUILDING DAMAGE ASSESSMENT	
4. DESCRIPTION OF WORKS	9
5. DETAILED PROPOSALS AND DESIGN CONSIDERATIONS	9
5.1. CONSTRUCTION SEQUENCE OF PROPOSED LOWER GROUND FLOOR EXTENSION	
5.1.1. BOUNDARY STRUCTURES	
5.1.2. HEAVE PROTECTION	
5.1.3. WATER PRESSURE AND CONTROL	
5.1.4. BASEMENT WATERPROOFING STRATEGY	
5.1.5. HIGHWAYS	
5.2. PARTY WALL MATTERS	
5.3. DESIGN CODES	
6. SEQUENCE OF LOWER GROUND EXTENSION CONSTRUCTION	11
7. TEMPORARY WORKS	12
8. POTENTIAL IMPACT UPON ADJOINING PROPERTIES AND LOCAL ENVIRONMENT	13
8.1. TREES	
8.2. DRAINAGE	
8.3. FLOOD RISK ASSESSMENT	
8.4. NOISE, DUST AND VIBRATION	
9. SUMMARY	15
APPENDICES.	16
APPENDIX A – STRUCTURAL DRAWINGS	
APPENDIX B – GROUND INVESTIGATION & HYDROGEOLOGICAL REPORTS	
APPENDIX C – FLOOD RISK ASSESSMENT	

1. INTRODUCTION

Constructure Ltd were appointed in March 2021 for structural advice on the proposed refurbishment and extension of the lower ground floor of No. 5, The Grove, Highgate. This report has been produced to accompany the Planning Application submission by 31/44 Architects, describing the scope and nature of the structural works. It details the outline approach that will be taken to safeguard the integrity of adjacent buildings, highways and services.

Local ground conditions have been assessed with targeted site investigations, scoped to ensure site conditions are well known. This assists to reliably inform the structural design and construction sequence.

Please refer to the appendix for structural engineering sketches which support this report and show the proposed sequence of the construction works.

2. THE SITE

The site is located in Highgate, with Hampstead Heath lying to the west/southwest. The property is accessed directly off The Grove with a gravel parking area to the front. To the southeast is Highgate Cemetery, and at the rear to the west are the expansive grounds of Witanhurst Mansion and ancillary buildings. To the northeast there is an underground service reservoir between The Grove and Highgate West Hill. To the rear of the building is a large 'L' shaped garden split in to two main areas. The upper terrace garden is approximately 15m x 30m and is separated from the lower garden (approximately 30m x 40m) with a high masonry retaining wall.

2.1. THE EXISTING STRUCTURE

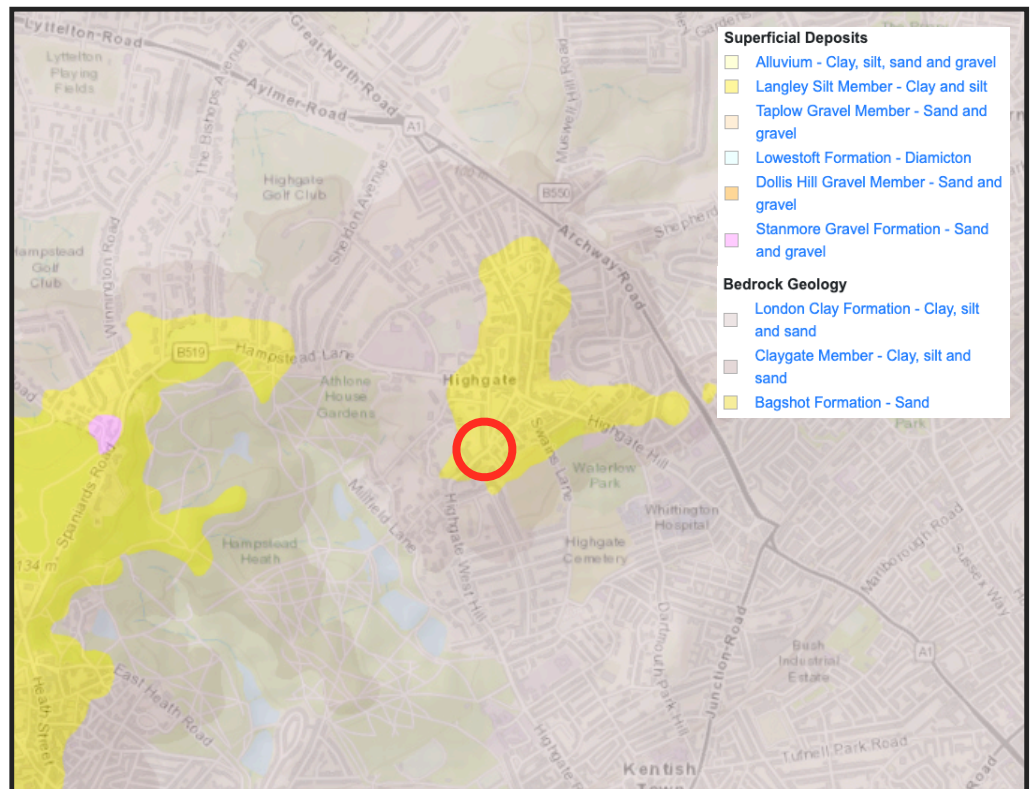
The property is a grade II listed building, constructed initially in 1688 and then rebuilt in 1933 by notable architect C. H. James. It has been reported that the property underwent a full refurbishment in the 1980's and then again in the early 2000's.

The structure consists of 3 storeys above ground and a lower ground floor level that opens onto the garden. The building is of traditional construction with masonry walls and timber floors. The roof soffit appears to be formed from a hollow clay pot slab, a technique commonly found around the 1930's when the building was rebuilt. There are two outcropping gable roof sections tiled in clay.

The building is seen to be in a good and sound condition, with no signs of structural distress or disrepair, and as such in its current condition and form is fully suitable for a lower ground floor extension beneath the front garden. Minor refurbishment works will be carried out to the main building as part of a previous planning application which has since been granted. All intended retained elements are considered adoptable with only light repair expected in the event of the exposure of hidden defects.

2.2. LOCAL GEOLOGY AND HYDROLOGY

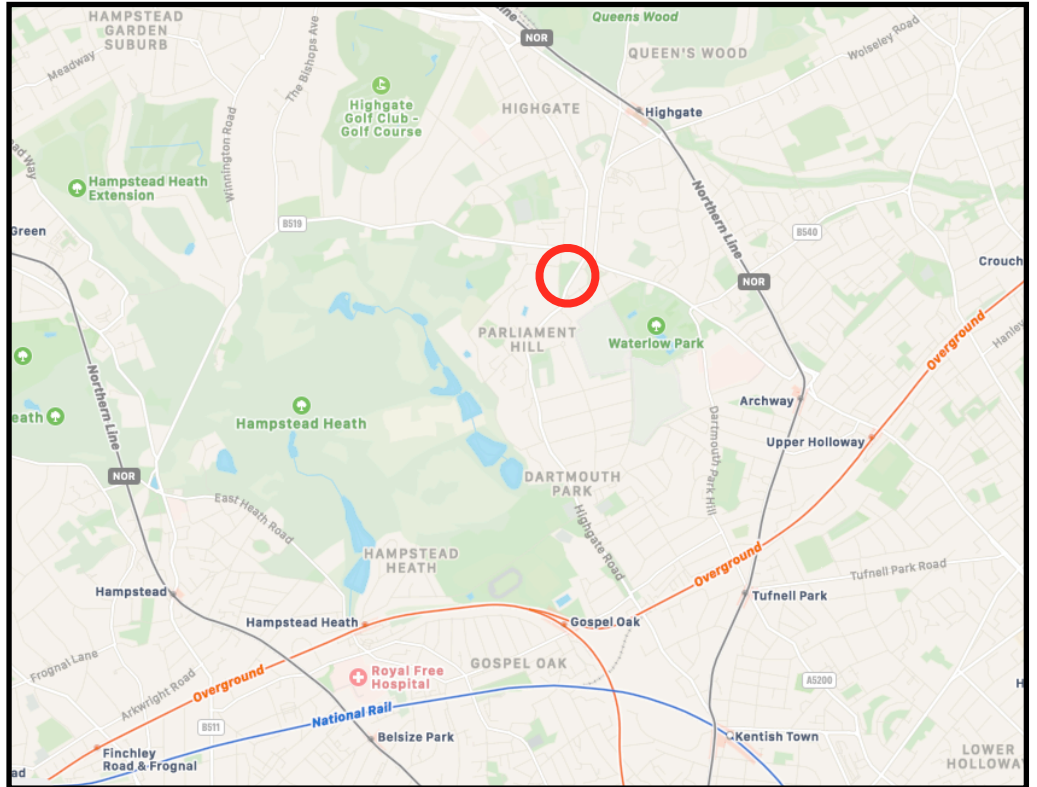
From geological maps for the area [Figure 1], the ground conditions (which have been confirmed through targeted site investigations) are known to comprise a layer of Made Ground overlaying the Bagshot Formation which extends to approximately 15m below street level. The targeted investigations encountered the Claygate Member below this depth.



[FIGURE 1] LOCAL GEOLOGICAL MAP

2.3. LONDON UNDERGROUND

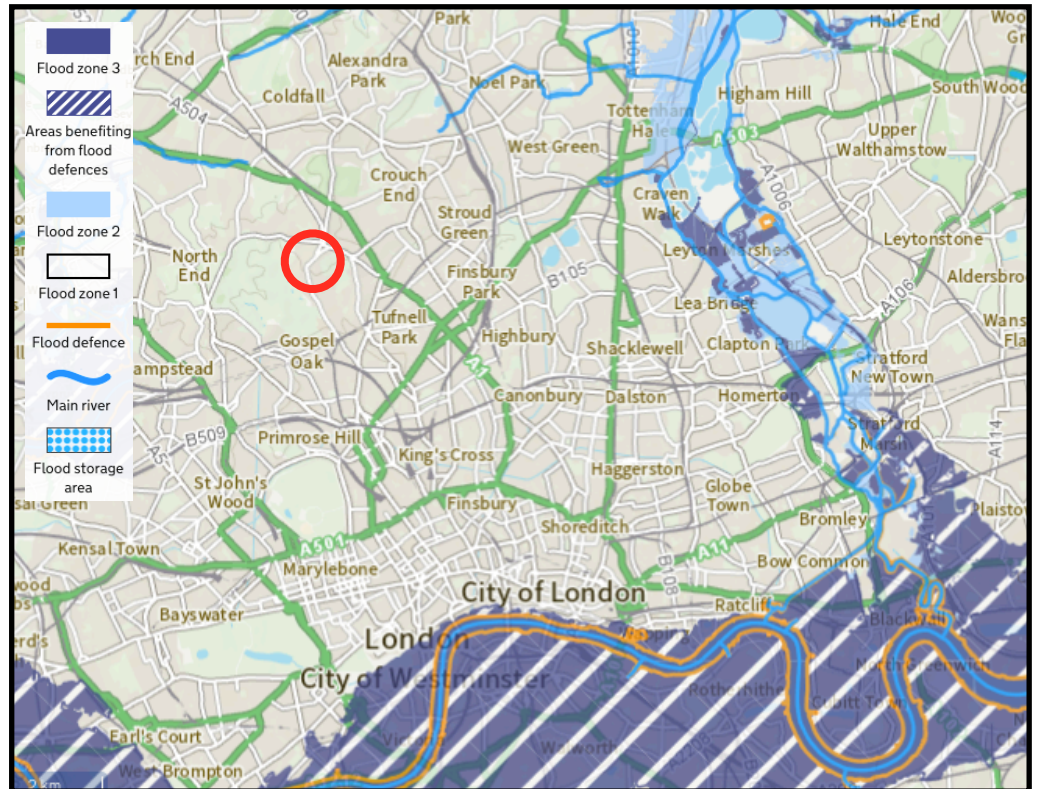
From the map with underground lines overlaid [Figure 2] it can be seen that the site is sufficiently far from London Underground infrastructure, with the closest line being the Northern Line, approximately 830m away from the front boundary to the north east. Therefore no consultation with the London Underground Asset Protection team is considered to be necessary.



[FIGURE 2] LOCAL TRANSPORT TUNNELS

2.4. FLOOD RISK

From the extract of the Environment Agency's Flood Risk map [Figure 3] it can be seen that the site lies within Flood Zone 1. As part of this planning application, a Flood Risk Assessment Report has been carried out by Hull Raiser Ltd (report ref: 230821).



[FIGURE 3] ENVIRONMENT AGENCY FLOOD RISK MAP SHOWING SITE

2.5. EXISTING UTILITIES AND UNDERGROUND SERVICES

Existing services including sewers and drainage runs will be identified prior to commencing the works. Due to the relatively minor increase in footprint to the lower ground floor, it is unlikely that the existing below ground drainage on the site will be greatly affected by the works. If required, drains will be moved to suit the new drainage design. From initial findings, the proposed basement works appear to be suitable with only minor alterations to existing drainage routes and invert levels.

3. INVESTIGATION WORKS

3.1. SITE INVESTIGATION

A site investigation was carried out in June 2021 by GEA Ltd (report ref: J21179, dated August 2021) to investigate the following:

- Existing house foundations; depth and configuration
- Soil conditions underlying the site; depth of made ground, plasticity of underlying strata, depth to Claygate Member etc.

- Water conditions sub-surface; potential for perched groundwater, high water table etc.
- Stability of excavations
- Composition of ground underlying site; possible contamination etc.

Prior to the site investigation works being carried out, a detailed desk study was undertaken, so as to assess the likely risks for the site, and to allow the scope to be targeted based on any particular risk items flagged.

The site works were carried out week commencing 28th June 2021 and included the following:

- 1 No. 20m deep borehole in the front garden
- 2 No. boreholes in the rear garden to approximately 7m below ground level
- Trial pits at a number of locations around the building and pool house (8 no. total)
- Installation of standpipes in each borehole to monitor groundwater

For detailed results and site plan showing investigation locations, refer to the GEA report.

3.1.1. CONTAMINATION TESTING

Contamination testing has been carried out during the site investigation works, and the results of these tests are recorded in the Site Investigation report. High levels of lead were found within the test samples however the conclusion is that there would be no adverse risks to end users, adjacent sites and groundwater however this must be considered by the Contractor to protect the health of site workers carrying out the excavation and construction works.

3.1.2. GROUNDWATER

Groundwater was encountered in each of the three boreholes undertaken at the site. The deep borehole at the front of the site encountered water at a depth of 12m below ground level. The 2 boreholes to the rear of the site found water at approximately 6mbgl. The difference in groundwater levels loosely correlates with the difference in ground level from the front to the rear of the property.

3.1.3. STABILITY OF EXCAVATIONS

Excavations in Made Ground are likely to be unstable and so will require temporary support. Excavations within the Sandy Gravels are expected to be relatively unstable in the short term so any excavation deeper than 1.2m and requiring entry by site personnel will require shoring for safety.

3.2. GROUND MOVEMENT ANALYSIS AND BUILDING DAMAGE ASSESSMENT

As part of the GEA report, a detailed GMA has been carried out. The results of the damage assessment predicted that the damage to the adjoining and adjacent structures would fall within Category 0 (Negligible), as defined in accordance with the Burland Scale.

4. DESCRIPTION OF WORKS

This planning application covers the construction of the lower ground floor extension beneath the front garden. Additionally, minor structural changes will be carried out to the main building as part of a separate planning application which has since been granted.

5. DETAILED PROPOSALS AND DESIGN CONSIDERATIONS

5.1. CONSTRUCTION SEQUENCE OF PROPOSED LOWER GROUND FLOOR EXTENSION

Prior to any works commencing on site, party wall awards will need to be agreed with the neighbouring properties. Refer to Section 5.2 for details.

The new lower ground floor extension will be constructed using a combination of the following:

- Bored contiguous piled walls around extension perimeter
- Internal bearing piles to support the basement slab
- Reinforced concrete slabs, liner walls and capping beam
- Mass concrete underpins (eg. to plant room in close proximity to the works)

Due to the depth of the proposed lower ground floor extension, temporary works will be required. Within our report (section 6) we have indicated a proposed sequence of works for the extension construction, with indicative temporary works as required to achieve the key construction stages. The final temporary works design and sequencing will be determined and detail designed by the Contractor, with review of principles by ourselves to ensure compliance with the permanent works design.

5.1.1. BOUNDARY STRUCTURES

The building has adjoining properties on either side (No. 4 & No.6). Party Wall Awards will be required with each property.

The sequence of works and the position of the extension means that the party wall lines do not require underpinning.

Movement monitoring targets will be applied to No. 6 to assure that any movement that occurs remains within the limits specified. As stated within the GMA, predicted damage is expected to fall within Category 0 (Negligible).

The proposed works are considered to be far enough away from No.4, as it is stepped back from the main frontage, to not require movement monitoring. This will need to be determined as part of the Party Wall Awards and agreed, and if necessary monitoring can be applied to this property also.

5.1.2. HEAVE PROTECTION

The results of the site investigation have shown that Claygate Member is present at a depth of around 15m below ground. It is possible that the ground at depth could heave as a result of removal of overburden, and a heave mat will therefore be incorporated within the sub-slab build up as a precaution, to prevent future uplift loading onto the lower

ground floor slab as result of long term heave. The piles and basement slab will also be designed to resist hydrostatic pressure plus long term heave (to the design fail load of the heave mat), with the piles designed to resist this.

5.1.3. WATER PRESSURE AND CONTROL

The site investigation report states that groundwater is present at approximately 12m below lower ground level within the front garden. Significant inflows of groundwater into shallow excavations are unlikely, however seepages may be encountered from localised perched water tables and the possibility of water sitting much higher as a result of either extremely wet periods of weather, or a localised event such as a burst water main, should be allowed for in the design. It is anticipated that localised de-watering pumps will be sufficient to deal with the possibility of percolating groundwater through any granular upper stratum as a result of inclement weather. The permanent structure is to be designed on the basis that the perched water can sit 1m below external ground level. Design crack widths are to be limited to <0.2mm to the outer face of all RC elements, so as to minimise the risk of water penetration through cracks.

5.1.4. BASEMENT WATERPROOFING STRATEGY

The basement will be designed (by others) to a minimum of Class 3 to BS8102 and so Type C construction, or drained cavity, will be used (see Table 1. for an extract of the standard from BS 8102). The basement reinforced walls will be levelled up as required with an approved concrete repair product, so as to receive the drained cavity membrane, if any of these are found to be out of tolerance.

Grade	Example of use of structure ^{A)}	Performance level
1	Car parking; plant rooms (excluding electrical equipment); workshops	Some seepage and damp areas tolerable, dependent on the intended use ^{B)} Local drainage might be necessary to deal with seepage
2	Plant rooms and workshops requiring a drier environment (than Grade 1); storage areas	No water penetration acceptable Damp areas tolerable; ventilation might be required
3	Ventilated residential and commercial areas, including offices, restaurants etc.; leisure centres	No water penetration acceptable Ventilation, dehumidification or air conditioning necessary, appropriate to the intended use
^{A)} The previous edition of this standard referred to Grade 4 environments. However, this grade has not been retained as its only difference from Grade 3 is the performance level related to ventilation, dehumidification or air conditioning (see BS 5454 for recommendations for the storage and exhibition of archival documents). The structural form for Grade 4 could be the same or similar to Grade 3.		
^{B)} Seepage and damp areas for some forms of construction can be quantified by reference to industry standards, such as the ICE's <i>Specification for piling and embedded retaining walls</i> [1].		

[TABLE 1] GRADES OF WATERPROOFING PROTECTION WITHIN A BASEMENT (EXTRACT TAKEN FROM BS8102)

5.1.5. HIGHWAYS

The front (eastern end) of the property is adjacent to the public highway of The Grove. The surcharge to be used in the design is based on the Highways Agency Design Manual for Roads and Bridges Volume 1, Section 3, Part 14. Values of HB loading of 12.0kN/m² or HA loading of 10.0kN/m² will be adopted. The proposed retaining structures in the vicinity of this highway will therefore be designed to accommodate these loads in addition to the loadings imposed by the ground.

Where applicable, the Highway Authority will require an Approval In Principle (AIP) submission. This submission will require details for for the permanent design, as well as the contractors temporary works proposals for the vaults.

5.2. PARTY WALL MATTERS

The proposed development falls within the scope of the Party Wall 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 notifiable under the Act. The resolution of matters under the Act and provision of the Party Wall Awards will protect the interests of all owners.

The scheme for No. 5, The Grove will be developed so as not to preclude or inhibit similar, or indeed any, works on the adjoining properties. The Surveyors will verify this as part of the process under the Act.

5.3. DESIGN CODES

The following design codes will be followed during the detailed design stage:

The Building Regulations 2010 - Approved Document A

- . BS 648 - Weights of building materials
- . BS 5950:1 - Structural use of steelwork in building
- . BS 5268 - Structural use of timber
- . BS 5628-1:2005 - Code of practise for the use of masonry
- . BS 6399:1 - Loadings for buildings (Dead and imposed loads)
- . BS 6399:2 - Loadings for buildings (Wind loads)
- . BS 8000:Section 2.2:1990 - Workmanship on building sites
- . BS 8002 - Earth retaining structures
- . BS 8004 - Foundations
- . BS 8102 - Protection of structures against water from the ground
- . BS 8110:1 - Structural use of Concrete

6. SEQUENCE OF LOWER GROUND EXTENSION CONSTRUCTION

Prior to any construction works commencing, any existing site services beneath the extension footprint are to be confirmed as redundant. Party wall awards will need to be agreed and where necessary relevant information covering the works that are notifiable under the Act is to be provided.

Once the site has been setup with hoardings and sheeting as necessary, the removal of vegetation and trees can be carried out as necessary.

A temporary piling mat (designed by contractor) is to be installed at ground level to provide sufficiently level and firm ground. Contiguous piles (or similar) are then to be

installed on 3 sides of the proposed extension. Internal bearing piles are also to be installed from existing ground level. It should be noted that the perimeter piling is to be designed to support vertical load in the permanent condition and the horizontal loads in the temporary condition. All piles are to be designed by a specialist to permanent loadings as defined by Constructure. The contiguous piles are expected to extend to a depth of approximately 11m below existing ground level.

Once the piling has been completed, the capping beam will be cast, which may also be used to fix temporary props, following which the excavation within the building footprint can begin. Spoil is to be removed in stages allowing the contiguous piles to be propped and braced as required to temporarily support the retained soil. Detailed arrangement of the propping is to be confirmed by the contractor's temporary works engineer. The internal bearing piles are to be broken down as the excavation progresses along with the existing lightwell retaining wall.

Local shoring and propping may be required at lower ground formation level to allow for services and sumps at a lower depth.

Once the excavation has reached formation level, the ground can then be prepared for the construction of the new lower ground level slab. A heave mat is to be installed beneath the slab. Installation is to be in line with the relevant heave mat specialists details, typically overlaying a concrete blinding. The new suspended RC basement slab is to be 300mm thick.

Once the slab has been cast and cured all permanent vertical elements can be constructed. The liner walls are designed to be propped at the top and base of the wall and will therefore require temporary props until the top slab is in place and the shell is completed.

Details of waterproofing are to be confirmed by the architect/specialist.

A detailed construction method statement is to be provided by the contractor. All temporary works are the responsibility of the contractor. Detailed drawings, method statements and risk assessments are to be issued to the permanent works engineer for review/comment.

7. TEMPORARY WORKS

Temporary works design and coordination must be carried out by a suitably qualified and experienced specialist and full design details, including drawings and calculations, must be submitted to the structural engineer for comment. This specialist will be appointed by the Contractor who will be responsible for the design, erection and maintenance of all temporary works to ensure the stability of the existing structure, excavations and adjacent structures at all times.

Once the RC lining structure and capping slab have been cast and cured to each area, props may be removed to these areas, in a sequence as agreed with the structural engineer prior to implementation of the works.

Monitoring points are to be installed to agreed areas, which will allow movement during the excavation to be assessed for compliance against maximum allowable, and trigger levels within the structural specification.

8. POTENTIAL IMPACT UPON ADJOINING PROPERTIES AND LOCAL ENVIRONMENT

The use of temporary propping and the proposed construction method reduces the amount of potential ground movement and so minimises the effects of settlement and movement of adjacent structures to ensure that it will not be problematic.

Along with this, the appointed Contractor shall undertake the works using good practice in accordance with the structural design, following all the agreed methods of construction and required temporary works, such as horizontal propping of any underpins. In practice some minor settlement is possible, but this will not be permitted to be worse than 'Category 1, aesthetic' according to BRE Digest 251 guidelines, limiting deflections to 5mm. The monitoring regime implemented will be used to check that this constraint is worked within.

The design of the works has taken consideration of the environmental forces as well as the response of the structural elements as their collective whole, and is being carefully designed to have the the required stiffnesses to remain within acceptable deflection constraints. The coordination of sequencing, and the checking of compliance of temporary works will minimise potential for movement. The minimal movement that may occur will be defined by accepted limits, which would be considered as being accommodated within the elasticity of the superstructures.

This overall approach considers all of the potential risks, and ensures that the excavation and construction of the proposed works will not affect the structural integrity of this property, neighbouring structures, roadways and public utilities.

8.1. TREES

It is considered that there are no trees of significance in close proximity to the proposed basement, and the basement does not encroach on any tree root protection zones of any significant trees along The Grove. An Arboricultural report has been carried out by Landmark Trees (report ref: TSS/5TGV/AIA/01b).

8.2. DRAINAGE

The development comprises the refurbishment and extension of an existing single family dwelling house. The lower ground floor is to extend beneath the existing front garden. The front garden currently has hard landscaping forming the finished surface where rainwater will run-off rather than draining naturally into the underlying soil strata. Therefore, there will be no significant increased discharge into the existing drainage and sewage systems. As part of the development, new soft landscaping will be installed to reduce surface water run-off. See item 8.3 below for further detail.

The proposed lower ground floor extension is to be founded within the Bagshot Formation, the conclusions of the hydrogeological assessment carried out by GEA conclude that the proposed works will not close a pathway, or create a cut-off, and should not therefore have any noticeable effect on ground water flow.

8.3. FLOOD RISK ASSESSMENT

A Flood Risk Assessment (FRA) was carried out by Hull Raiser Ltd in September 2021 (report ref: 230821). The report confirms that the proposed development will not exacerbate any existing flood risk. The proposed extension beneath the front garden

doesn't have the capacity to introduce SuDS techniques and therefore cannot provide any major benefits to the local area.

8.4. NOISE, DUST AND VIBRATION

All demolition and construction works will be carried out by a competent and qualified contractor, who will be required to accord with the Considerate Constructors Scheme, and take all necessary measures to minimise the short term disturbances in terms of noise, vibration and dust which might impact on the local environment and the neighbouring residents and businesses.

The following measures and actions will be implemented:

Noise – Neighbours will be notified in advance of noisy activity, in particular where these are on or near boundary structures. Where there is particular sensitivity, activity will be restricted to 08:00-18:00 Monday to Friday and 8:00-13:00 Saturday.

In all cases where possible, electrically operation tools will be used in preference to engine driven machinery.

The use of site radios will be considered carefully in terms of their locations and volume levels, and if any neighbour complaints are received, a firm prohibition of their use will be enforced.

Vibration – While the use of percussive, powered machinery upon hard construction materials in many situations will likely give rise to inevitable vibration, wherever possible and in accordance with CCS Code, unnecessary vibration will be avoided and mitigated. This will take the form of the careful planning and consideration of the hardness of the material being demolished, and the works planned and notified accordingly, and where considered particularly unavoidable, the 08:00-18:00 Monday to Friday and 8:00-13:00 Saturday working hours principle be observed.

Dust – External activity shall be contained as best as possible using suitable hoardings and sheeting.

Materials stored externally would be covered or contained to avoid wind and weather disturbance to granular and particulate materials. Structural concrete will be typically mixed off-site and delivered, but where small quantities or mortar are to be site mixed, this can be done in an enclosed area to limit cement dust from becoming airborne.

Deliveries of materials shall be covered where potential for dust is prevalent. Waste skips and excavated soils are to be covered whenever practicable.

For activities that generate dust, surface wetting-down, and water misting will be used to suppress dusting. Rotary cutters will use water as a dust suppressant.

Housekeeping – Shared driveways, external pavements on the site and in front of, will be regular swept, and should vehicles or windows become soiled, the contractor shall arrange cleaning as the neighbour so desires.

9. SUMMARY

During construction, lateral and vertical stability of the building will be maintained by temporarily propping, such that no significant adverse movement is expected.

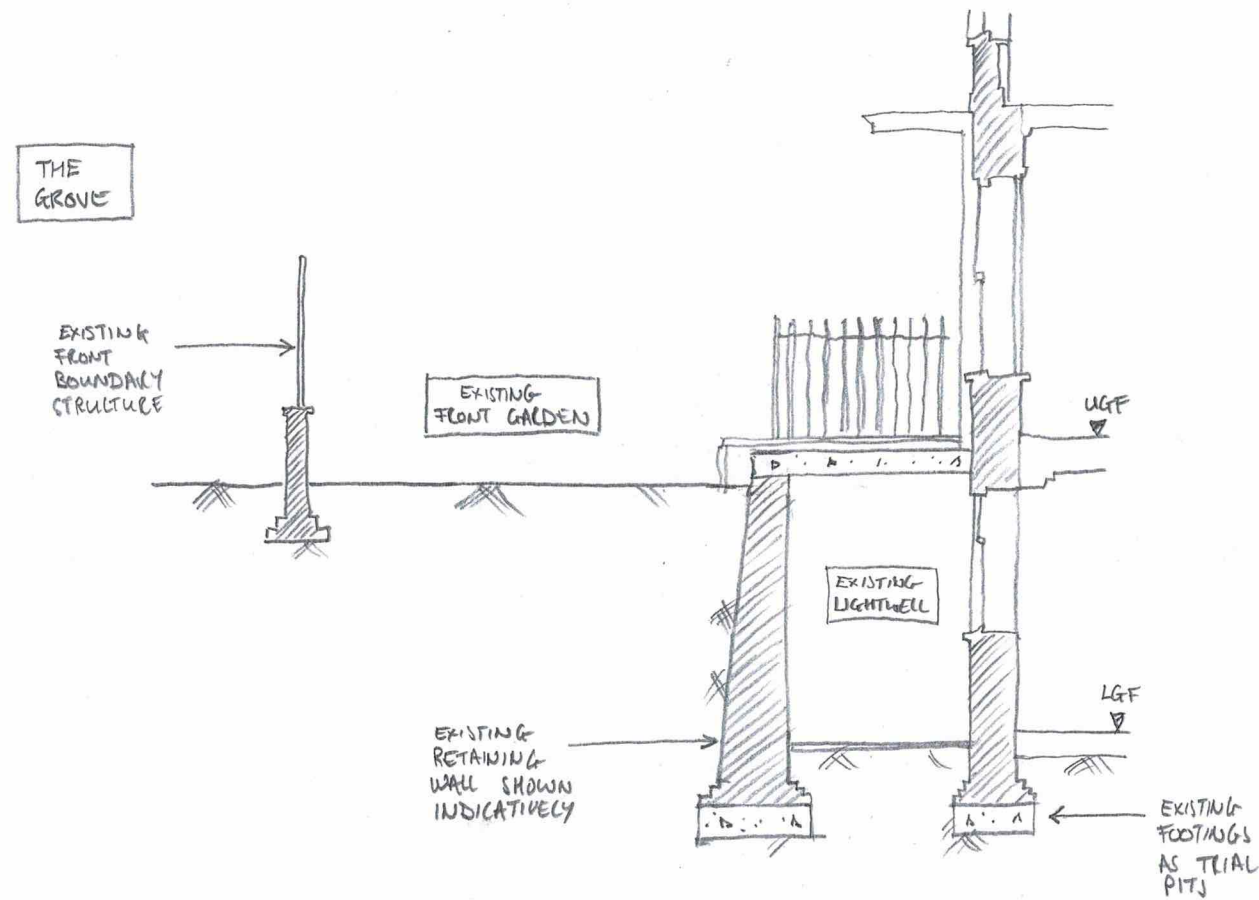
Environmental impacts have been assessed, and the response to geotechnical and hydrological aspects have been considered. The proposals are deemed to not have any adverse impact in this respect.

Once complete, the new structure will provide a robust and secure support without detriment to the overall stability of the highways or adjoining properties.

APPENDICES.

APPENDIX A – STRUCTURAL DRAWINGS

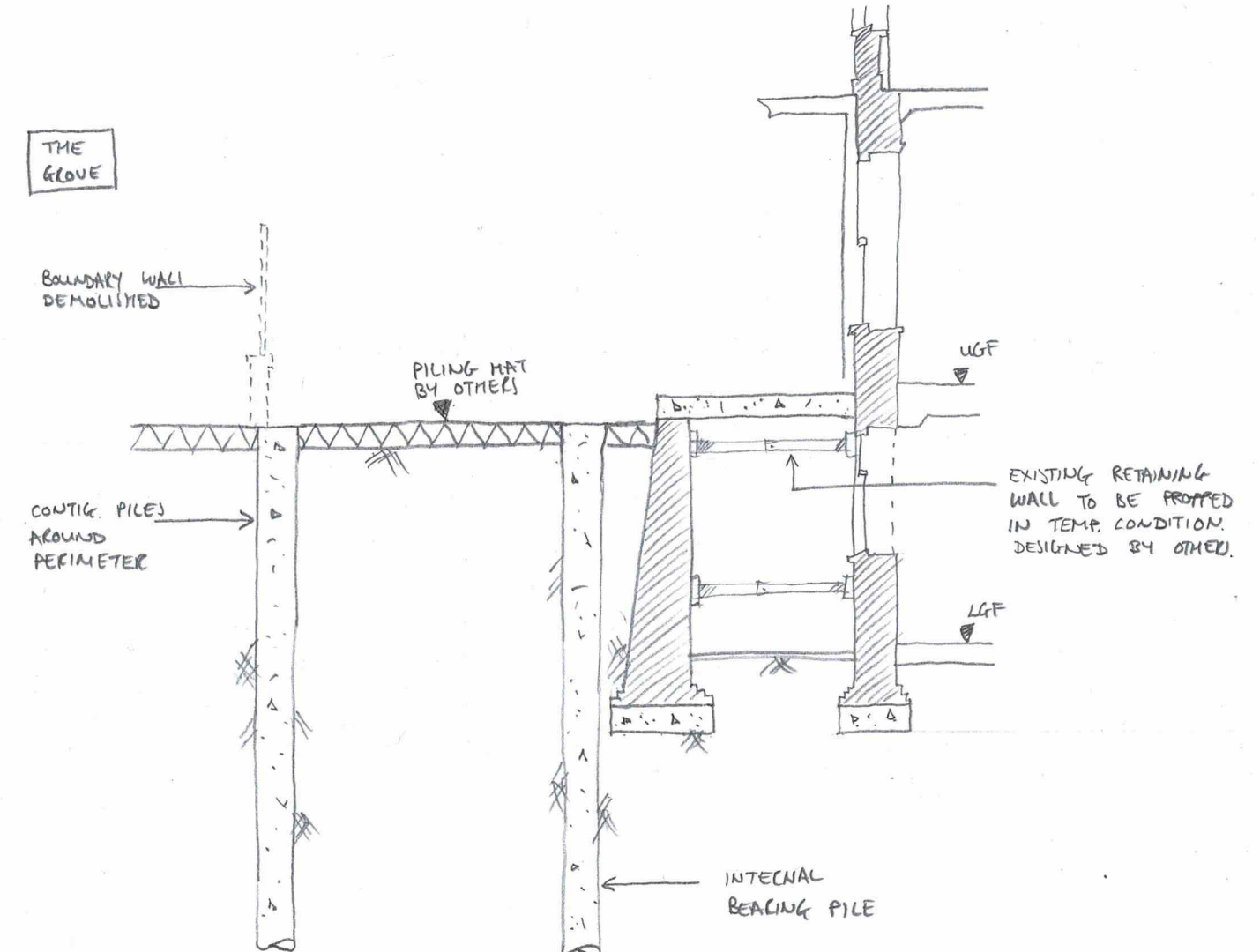
Sketch 2124-SK-110 & 2124-SK-111 showing the proposed structural sequence



EXISTING SITE CONDITIONS

- VEGETATION ETC. TO BE REMOVED FROM SITE
- BOUNDARY WALL ALONG FRONT TO BE DEMOLISHED
- FENCES TO BE REMOVED, WHERE POSSIBLE ITEMS TO BE RE-USED

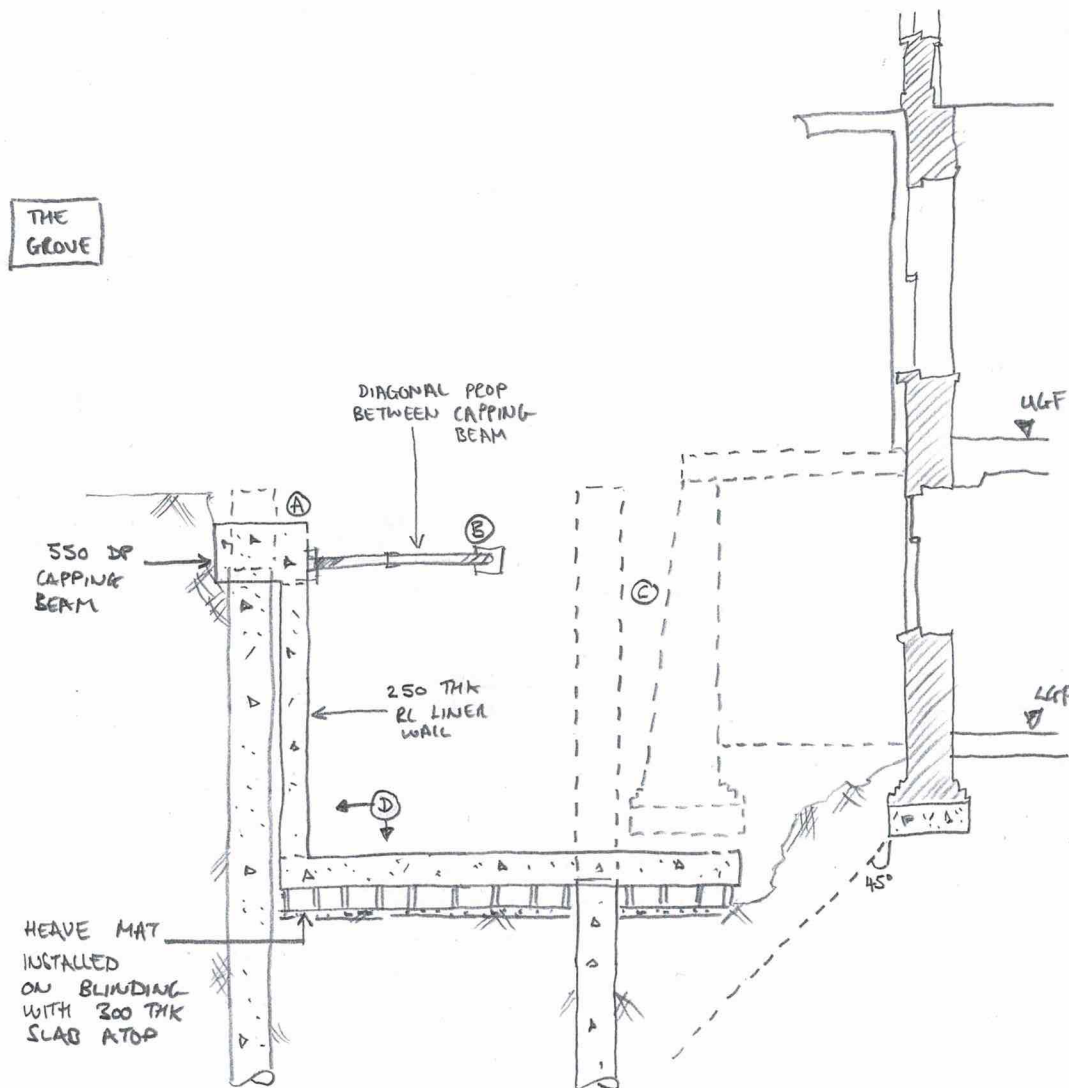
BASEMENT CONSTRUCTION SEQUENCE OF WORKS



STAGE 1 OF WORKS

- PILING MAT TO BE INSTALLED TO SPECIALIST DESIGN
- EXISTING RETAINING WALL PROPPED AGAINST BUILDING AS REQUIRED
- CONTIG. PILES & INTERNAL BEARING PILES TO BE INSTALLED FROM EXISTING GROUND LEVEL

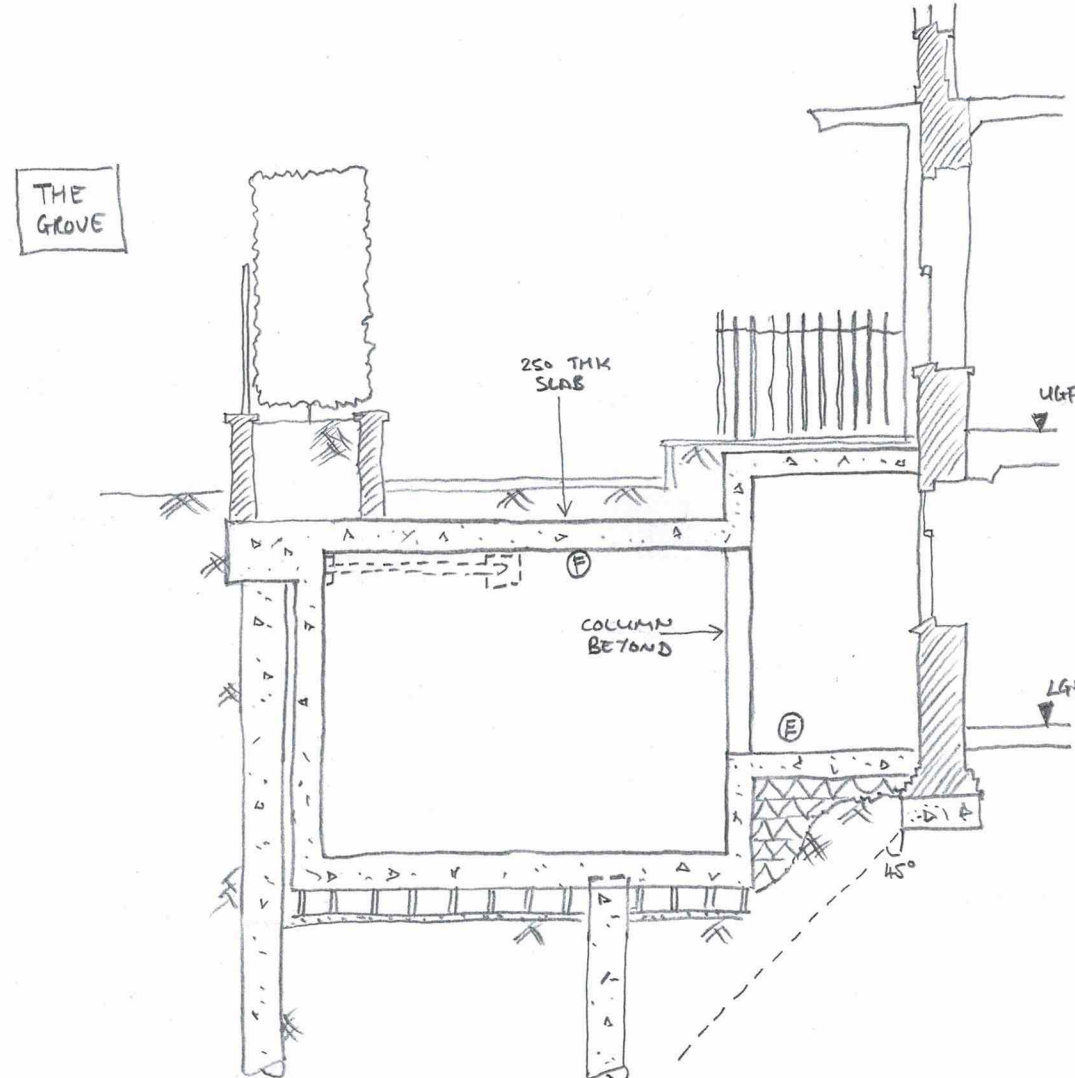
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STAGE 2 OF WORKS

- (A) CAPPING BEAM INSTALLED ALONG CONTIG. PILES
- (B) DIAGONAL PROPS INSTALLED
- (C) INTERNAL BEARING PILE BROKEN DOWN & EXISTING RETAINING WALL DEMOLISHED
- (D) INSTALL LINER WALLS & BASEMENT SLAB

BASEMENT CONSTRUCTION
SEQUENCE OF WORKS



STAGE 3 OF WORKS

- (E) INSTALL NEW SLAB WITHIN LIGHTWELL
- CONSTRUCT NEW COLUMNS
- (F) INSTALL TOP SLAB. ONCE COMPLETED & CURED, TEMPORARY PROPS TO BE REMOVED
- ALL FINISHES & WATERPROOFING TO ARCHITECT DETAILS

Project No. 2124	Sheet SK-111	Revision	Project THE GROVE
Date 26.8.21	Engineer T.G	Checked	

APPENDIX B – GROUND INVESTIGATION & HYDROGEOLOGICAL REPORTS

Refer to separate document for GEA report (ref: J21179 - Rev. 2)

APPENDIX C – FLOOD RISK ASSESSMENT

Refer to separate document for Hull Raiser Ltd report (ref: 230821)