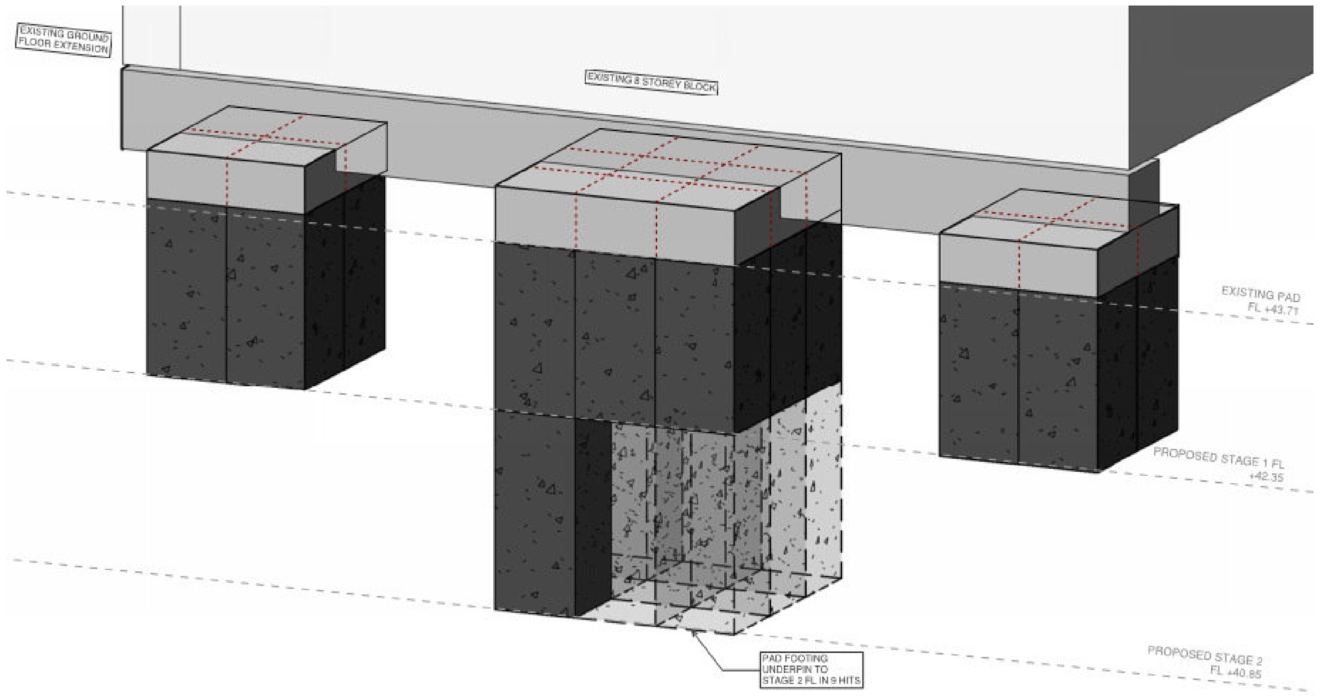
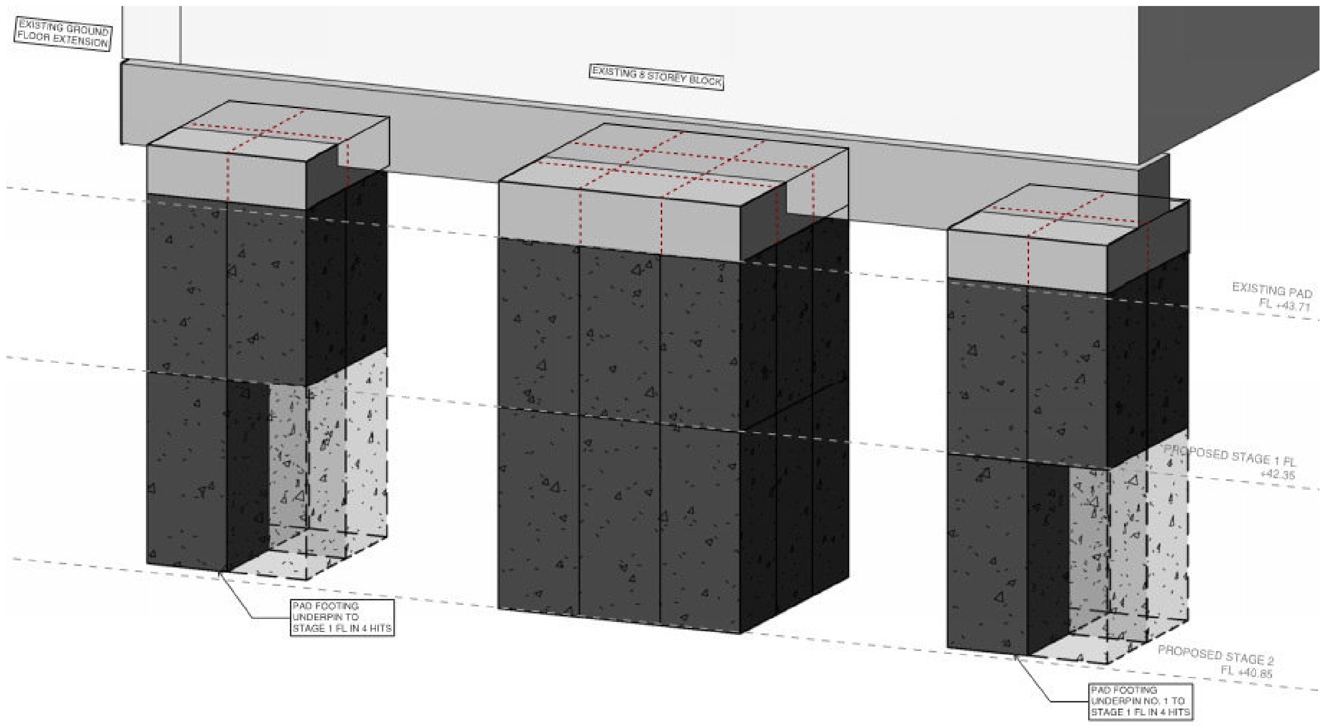
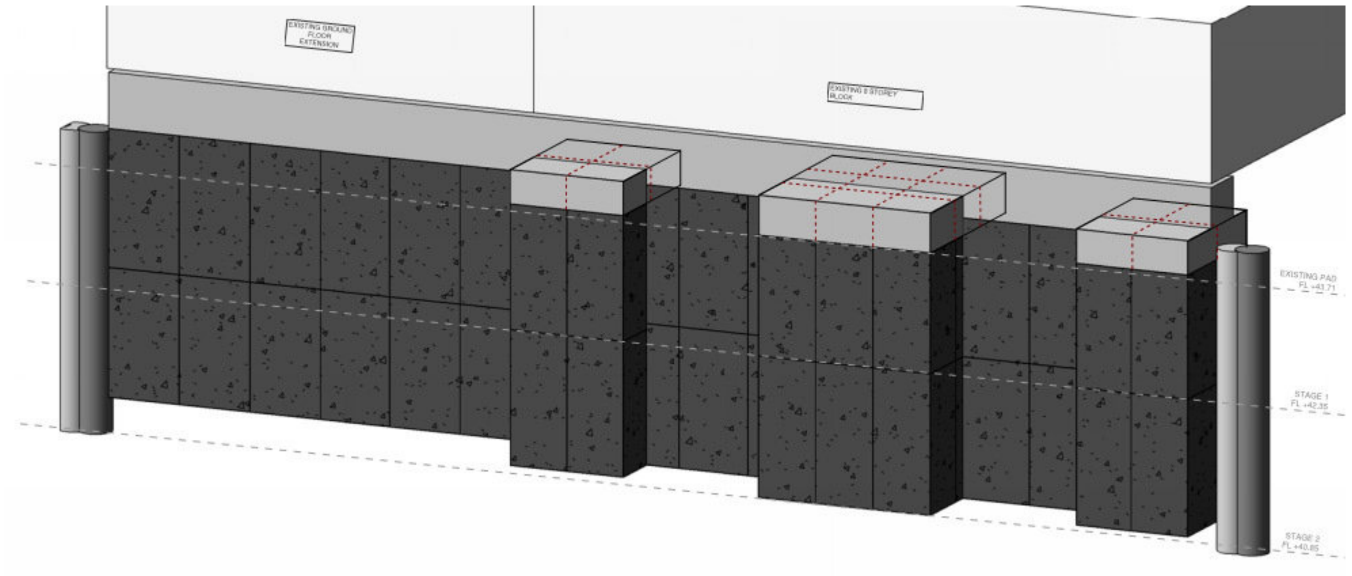




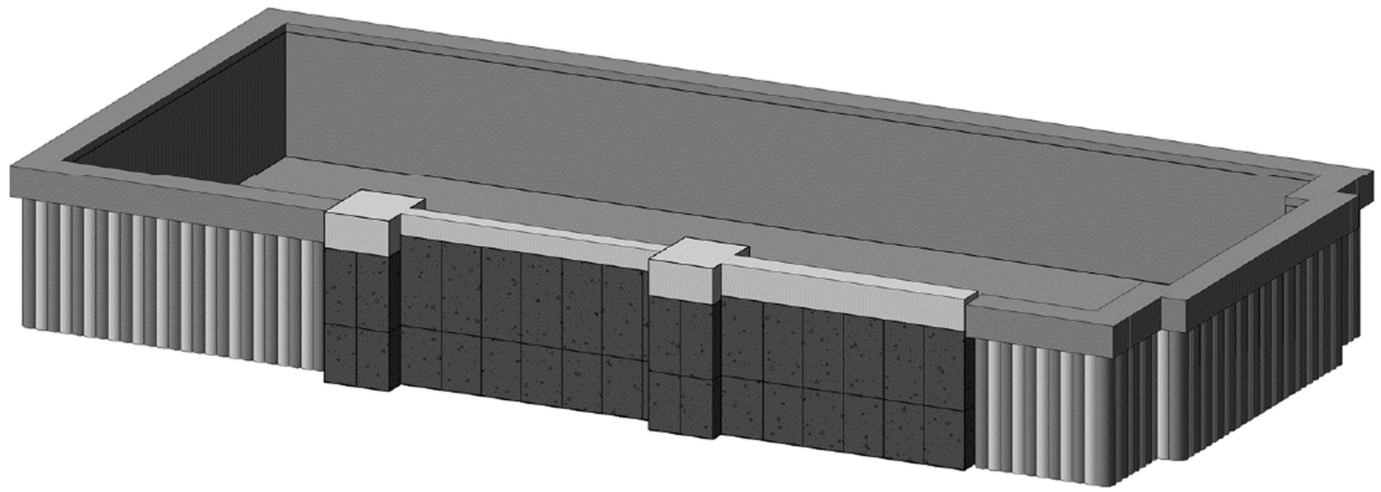
STAGE 6– COMPLETE UNDERPINS TO FINAL PROPOSED FORMATION LEVEL +40.85

- Underpin central pad footing to proposed formation level in 9 hits as previously.
- Underpin the corner pad footing to final formation level in 4 hits as previously.
- Extend underpins of strip footing to proposed formation level sequentially as per the first stage of underpinning.
- Provide continuous temporary restraints to underpins at min 3 levels.
- Excavated soil is removed throughout the process.



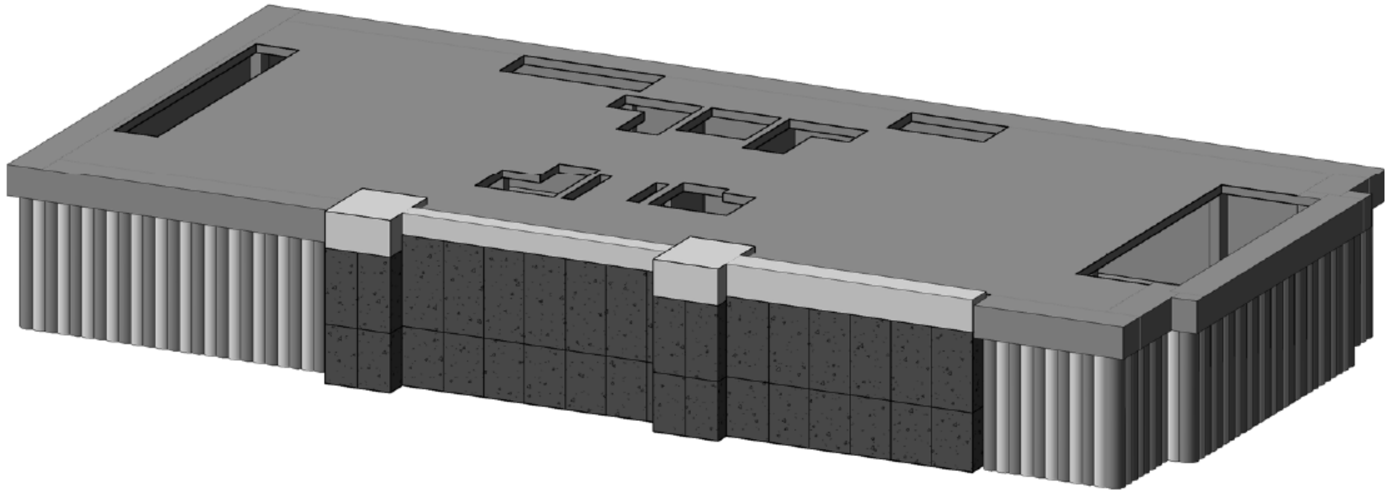
STAGE 8 – CAST BASEMENT SLAB AND WALLS

- Once the excavation reaches the formation level throughout prepare the basement raft slab reinforcement including starter bars for the RC walls and columns extending up, pour concrete and allow curing.
- Prepare shuttering and reinforcement for new perimeter and internal walls and columns from basement to lower ground floor level, pour concrete and allow curing.



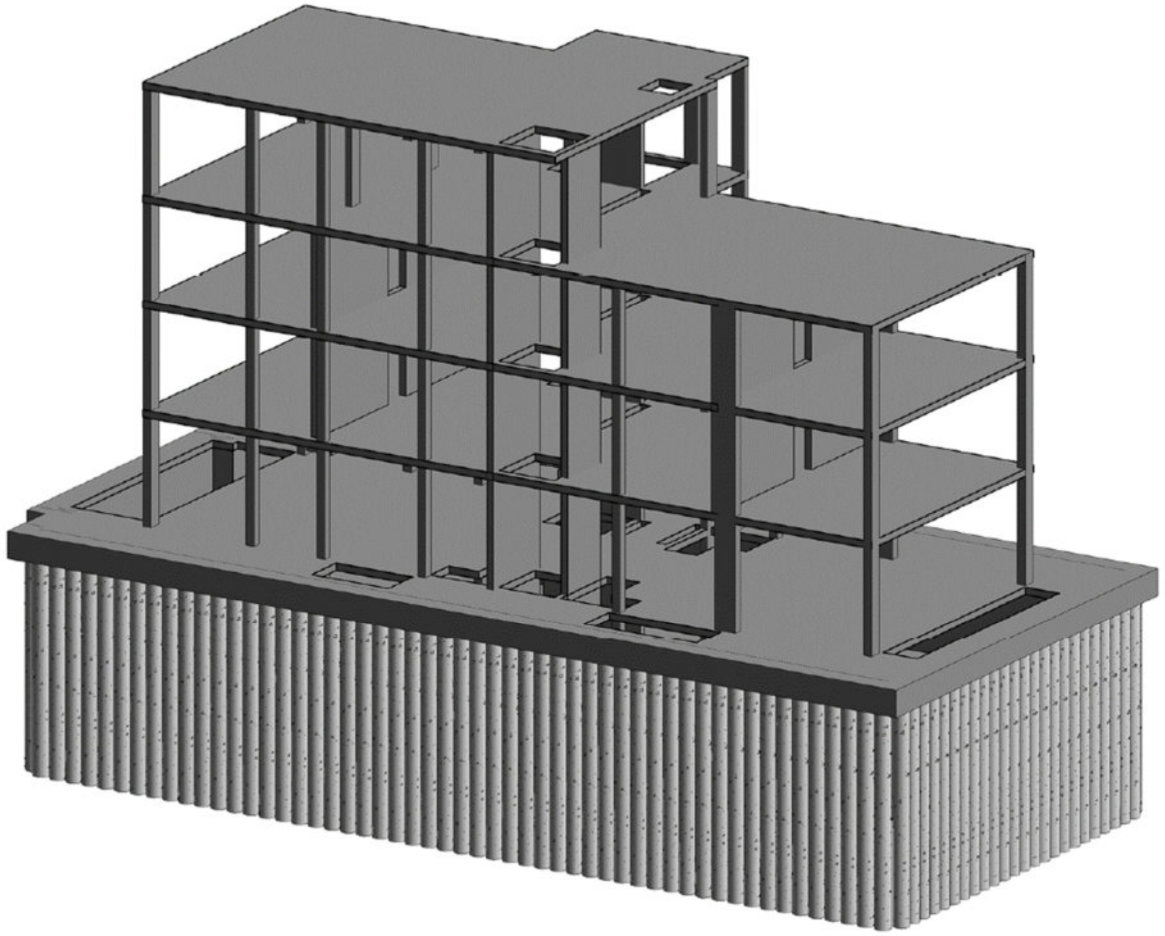
STAGE 8 – CAST GOUND FLOOR SLAB AND REMOVE PROPPING

- Prepare the suspended ground floor slab reinforcement, pour concrete and allow curing.
- At this stage the propping installed at basement level can be removed
- Prepare shuttering and reinforcement for new perimeter and internal walls and columns from ground floor level, pour concrete and allow curing.



STAGE 8 – BEGIN CONSTRUCTION OF SUPERSTRUCTURE

- Continue with the RC frame until the structure is completed.



9 Ground Movement Assessment

A ground movement assessment has been carried out by CGL Ltd as part of their Basement Impact Assessment. See Appendix 2 for the full report.

The key construction activities that will result in ground movement during the works are:

1. Secant pile wall installation and deflection during excavation
2. Possible settlement due to underpinning of existing Barrie House structure
3. Possible short and long-term heave due to unloading of London Clay Formation
4. Possible settlement due to building loads of the proposed development

The amount of ground movement caused by these activities relates to the ground conditions, together with the care and sequence with which the works are carried out. This analysis is based on the sequence of construction described previously. Should the Contractor propose to carry out the works in a different sequence to that assumed in our design then a further assessment of the predicted movement will be required, and the proposal only accepted if there is no significant change to the scale of predicted movement.

All projects which involve an appreciable level of excavation will cause a degree of movement and the CGL assessment has helped to quantify this for the project.

The ground movement assessment found the total vertical ground movement caused by the works as shown in Figure 18. As expected, the assessment has indicated that some minor ground movement is likely to occur under the adjacent properties:

- 72 Kingsland
- 16 Kingsland
- Existing Barrie House flats
- Existing single storey extension to Barrie House

72 and 16 Kingsland

The maximum movements predicted for both installation of the wall and excavation are approximately 3.12 mm vertical settlement and 4.36 mm horizontal ground movement when propping is employed as proposed. See Figure 20 for the movements predicted for each property, as per the CGL ground movement analysis. The ground movement assessment report states that "horizontal movements that will impact the neighbouring properties are anticipated to be from the pile wall installation, deflection and excavation movements only. The horizontal movements at the existing structures on site will be due to lateral movements from the underpinning. As discussed previously, as the underpins are stiff concrete walls and lateral movements are expected to be negligible. Assuming good construction practices and control, horizontal deflection in front of the underpinned wall are expected to be minimal and within the limits of strain for Damage Category 0/ Damage Category 1."

Barrie House

The maximum long term vertical movement due to unloading/reloading is predicted to be 3.3 mm of heave at the footing of the single storey extension. An additional 5mm of settlement has been allowed for to take into account potential settlement due to underpin construction. The horizontal movements are predicted to be negligible due to the foundations being in front of the reinforced concrete underpins.

Further results, damage category assessment and conclusions from the report are shown in the Sections 7.4, 7.5 and 7.6 of the CGL report in Appendix 2.

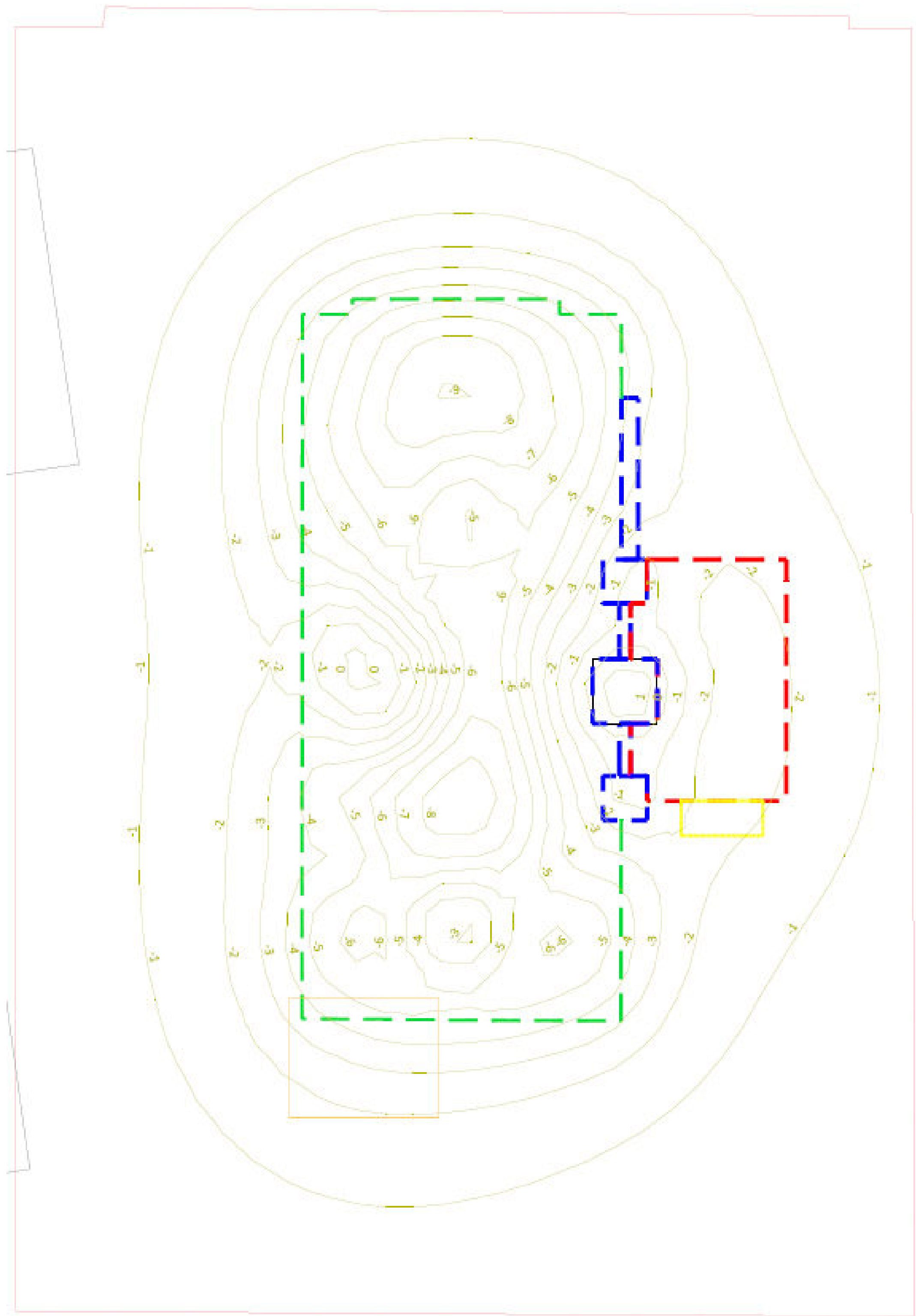


Figure 18 Total vertical ground movements from CGL's Ground Movement Assessment

10 Ground Movement and Potential Damage

The excavation and construction methodology proposed for the basement works are not envisaged to have a significant impact on the existing fabric of the adjoining properties, and will not exceed the accepted damage category limit of Damage Category 1 (very slight).

The Contractor will be aware of the care required in carrying out the works and how the likely movements depend on the sequence of works. Should the Contractor propose to carry out the works in a different sequence to that assumed in our design then a further assessment of the predicted movement will be required, and the proposal only accepted if there is no significant change to the scale of predicted movement.

10.1 Damage Assessment

CGL's analysis has shown that the likely maximum ground movement will be of the order of 1-3.5mm vertically downwards and 1-3.5mm horizontally toward the basement (with propping).The amount of movement will then reduce with distance away from the new basement. These ground movements will extend under the adjoining properties. The cracks which are predicted within the CGL's report (Appendix 2) show that most walls will fall within the 0 - Negligible with some in 1 - Very Slight categories as measured against the Burland Scale (Figure 19).

Whilst these movements are small, the differential movement across the width of the adjoin properties could lead to cracks appearing in the walls and in the finishes. As explained in this report the scale of movement predicted could lead to hairline cracks in the walls, though many of the adjoining buildings appear to have a lime based mortar in their brickwork walls and this may be able to take up this small movement without cracking. Finishes to floors, walls, and ceilings however can be more susceptible to cracking as a result of this movement, especially brittle finishes.

The Contractor will be required to carry out detailed monitoring of the adjoining properties to record ground movements, and take action should the movement not be as expected. Trigger levels will be set to identify limits on monitored results and to define actions if these limits are reached. The traffic light approach will be adopted with green, amber, and red trigger levels set.

The new structure is designed to be self-stabilising and independent of adjoining buildings while providing support and lateral restraint.

10.2 Mitigation Measures

Measures to mitigate potential damage as a result of ground movements include:

1. CFA bored piles to limit ground disturbance and vibration.
2. Large diameter piles to increase stiffness of the retaining wall and limit deflection
3. Propping of the retaining wall during construction to limit deflection
4. Temporary works to ensure stability of existing structures.
5. Movement monitoring and trigger levels

On this basis, the damage that will occur as a result of such an excavation should fall well within the acceptable limit to not exceed damage category 2.

Category of damage	Description of typical damage	Approximate crack width (mm)	Limiting tensile strain ε_{lim} (per cent)
0 Negligible	Hairline cracks of less than about 0.1 mm are classed as negligible	<0.1	0.0-0.05
1 Very slight	Fine cracks that can easily be treated during normal decoration. Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection	<1	0.05-0.075
2 Slight	Cracks easily filled. Redecoration probably required. Several slight fractures showing inside of building. Cracks are visible externally and some repointing may be required externally to ensure weathertightness. Doors and windows may stick slightly.	<5	0.075-0.15
3 Moderate	The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable lining. Repointing of external brickwork and possibly a small amount of brickwork to be replaced. Doors and windows sticking. Service pipes may fracture. Weathertightness often impaired.	5-15 or a number of cracks > 3	0.15-0.3
4 Severe	Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Windows and frames distorted, floor sloping noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Service pipes disrupted.	15-25 but also depends on number of cracks	>0.3
5 Very severe	This requires a major repair involving partial or complete rebuilding. Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion, Danger of instability.	Usually > 25 but depends on number of cracks	

Damage Category Chart (CIRIA C580)

Figure 19 Burland Crack Damage Scale

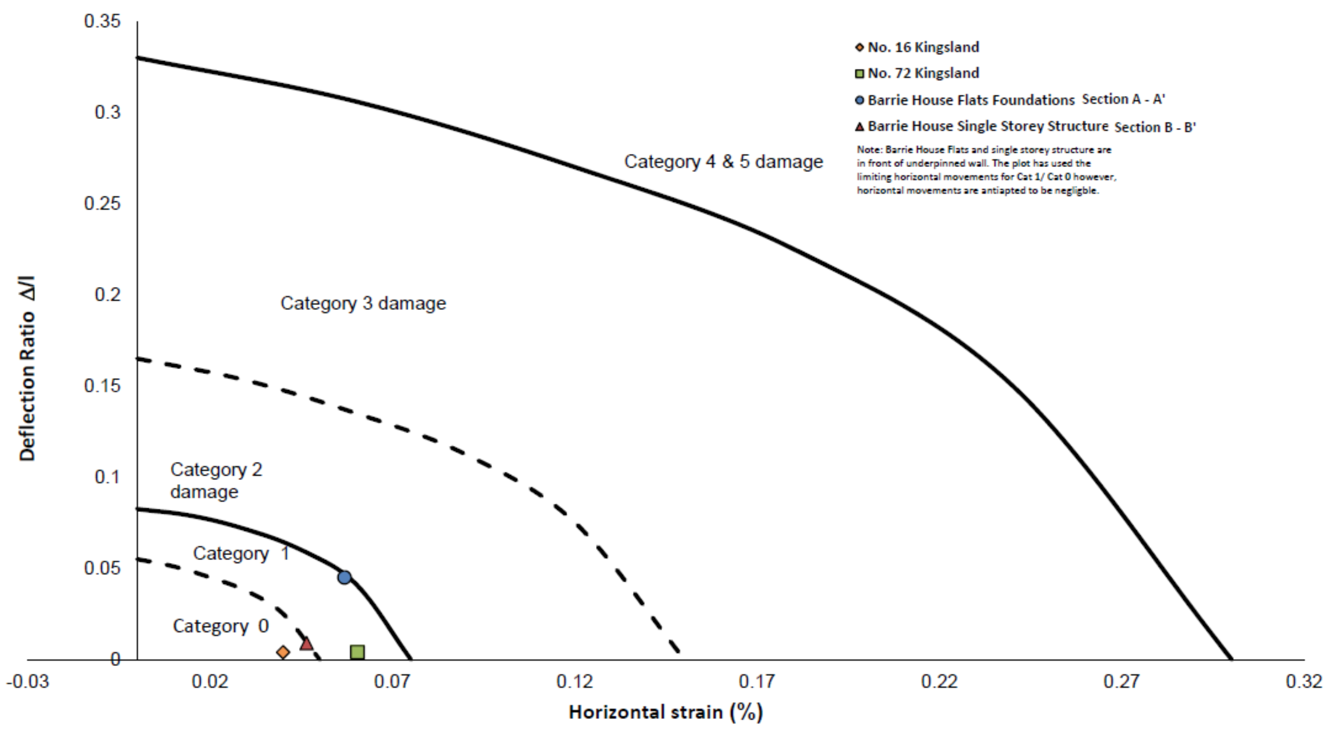


Figure 21 CGL Ground Movement Assessment Summary

Summary of Cumulative Horizontal Movements

Property	*Horizontal movements (mm)*	*Width (m)*	*Maximum horizontal strain (%) over property*
No.72 Kingsland	4.36	5	0.06
No. 16 Kingsland	2.79	5	0.04
Barrie House flats	0	4.4m from underpin	0.057
Barrie House single storey extension	0	11.2	0.046

Summary of Cumulative Vertical Movements

Property	*Vertical movements from piled wall installation and basement excavation (mm)*	*Construction of underpin settlement*	*Vertical movements from unloading / reloading of soil (mm)*	*Cumulative vertical movements (mm)*	*Maximum vertical deflection ratio over property*
No.72 Kingsland	-3.12	-	negligible	-3.12	0.004
No. 16 Kingsland	-2.02	-	negligible	-2.02	0.004
Barrie House flats	-	-5	+2.7	-3.76	0.045
Barrie House single storey extension	-	-5	+3.3	-1.95	0.009

Note. +ve = heave, -ve = settlement

Figure 20 CGL Damage Category Results

10.3 Monitoring

As part of the works it will also be required to monitor the existing building, both during underpinning of the existing building and also during excavation/ construction of the new structures.

A third-party monitoring company will be required to carry out this monitoring, which is to ensure actual ground movements during construction are in line with the predicted ground movements. Proposed monitoring points will be confirmed during the next phase of the works.

Monitoring works will need to be commenced 1 month before demolition works start on site, to help establish a baseline and record pre-construction movements. A minimum of 4 readings should be obtained during this period.

As works commence readings are to be taken on a weekly basis, this frequency of reading will be retained until the main excavation phase commences. During the main excavation phase readings should be increased to twice weekly. Providing ground movements are in line with predictions, the monitoring will then be reduced to a weekly frequency and maintained at this level until 1 month after completion of the basement box. Readings will then be reduced to a monthly basis until completion of the main structural works.

If the monitoring shows that actual movements look likely to exceed the anticipated figures, action will need to be taken by the contractor, in order to bring them under control – further details can be found in the next section.

The proposal could involve stopping the works on site, however this is unlikely providing the contractor is proceeding diligently on site. An action plan of what to do if movements appear to be excessive will need to be agreed with the contractor, details of which will need to be reflected in the method statement for the works.

The construction methodology will aim to limit damage to the existing building and neighbouring buildings to Category 0 (negligible).

10.4 Movement Trigger Levels

10.4.1 Trigger levels are used to identify limits on the monitored results and to confirm/ identify actions if these levels are reached. The traffic light system will be adopted, with green, amber and red trigger levels set.

10.4.2 The setting of appropriate trigger levels is to consider the following factors:

- The amount of predicted movement
- Accuracy of the monitoring equipment
- Normal/ preconstruction movements of the buildings
- Likely damage resulting from the predicted movement.

10.4.3 The underpinning specifications give performance specifications for the temporary works, which limit movements and damage criteria to appropriate levels for the type and age of buildings surrounding the site.

10.4.4 The accuracy of the monitoring equipment for reading horizontal and vertical movements is to be limited to +/- 1mm.

10.4.5 The impact of normal movements of a building, such as thermal movements will need to be judged during the monitoring. The extent of this will need to be assessed during the early stages of the monitoring. To this end trigger levels will be set at monitoring points close to the ground where the effects of thermal movements are reduced.

10.4.6 Proposed trigger levels will be specific to the walls permissible displacement to ensure the damage category remains with the 0 to 1 range (Negligible to Very Slight). The values will need to be discussed post planning with the appointed Party Wall surveyors and contractor to ensure a practical construction sequence can be adopted.

10.5 Actions to be taken by the design team and the contractor if these trigger levels are reached are summarised in the table below:

Actions		
Alert Level	Design Team	Contractor
Green	Continue to review monitoring as normal	Continue work as programmed and monitor as normal
Amber	a) Review monitoring results with contractor b) Review contractors amber action plan c) Make comments on contractor's proposals and discuss with CA	Contractor to implement amber level action plan. This should include the following: a) Recheck monitoring to confirm readings b) Review method of working and highlight any activity relating to measured movements c) Propose revised methodology in to reduce trend in increasing movements d) Agree revised proposals wit CA prior to implementing. e) Increase frequency of monitoring
Red	a) Review monitoring results with contractor b) Review contractors red level action plan c) Make comments on contractor's proposals and discuss with CA d) Carry out condition survey with PW surveyor on affected buildings.	Contractor to implement his red level action plan. This should include the following: a) Stop work b) Recheck monitoring to confirm readings c) Install additional temporary works where required. d) Submit new methodology/ proposals to stop further movements. e) Agree revised proposals with CA prior to implementing f) Increase frequency of monitoring

10.6 Monitoring Points

The monitoring locations shown below are suggested locations, to be confirmed at a later stage. Monitoring points will be set 250mm above existing ground floor level where possible.

● = Monitoring Point

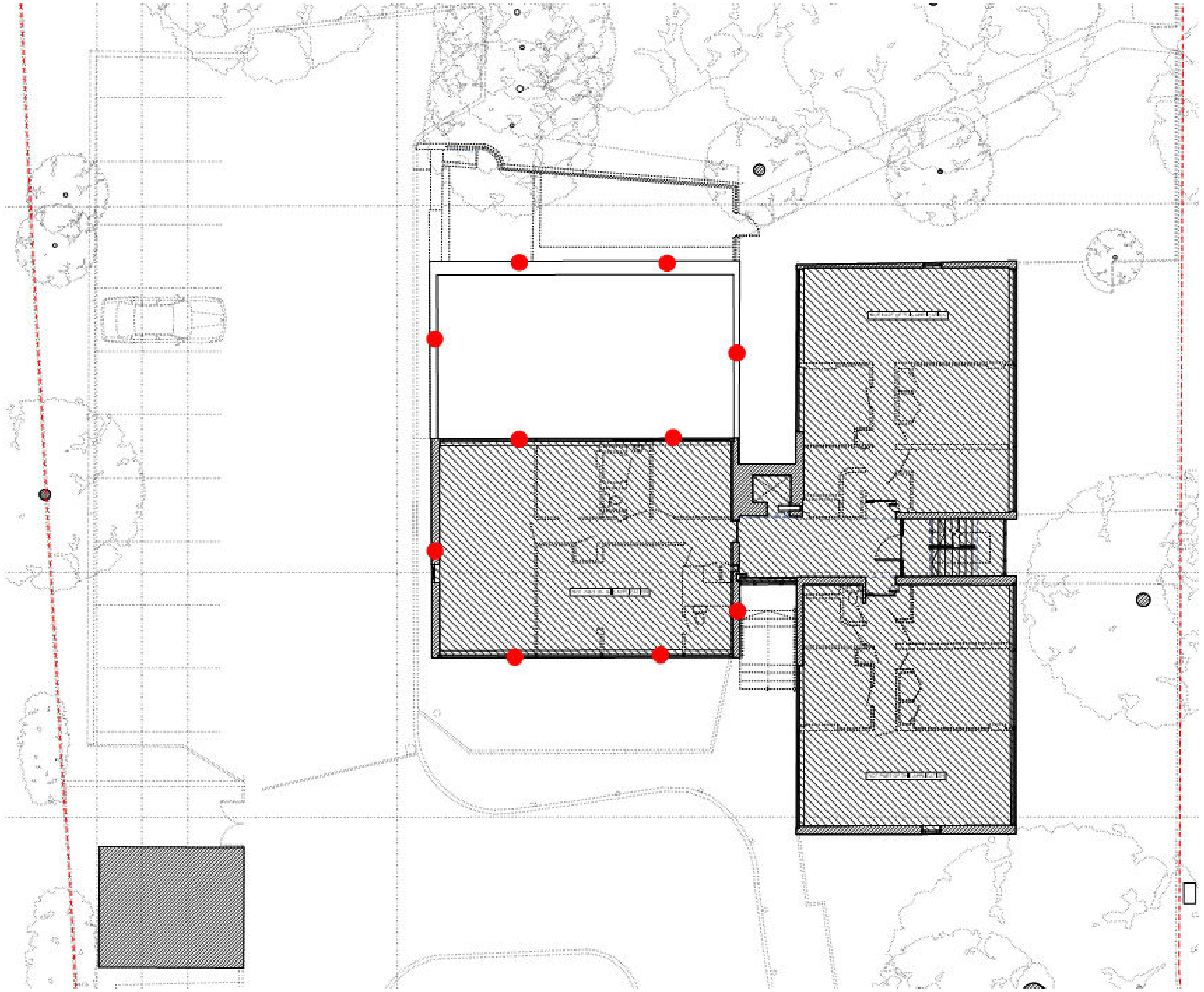


Figure 22 Existing First Floor with indicative monitoring locations

11 Construction Activities

11.1 Assumptions

The following assumptions have been made during the design of the substructure of the building:

- Final design of temporary works and construction phasing will need to be developed further by the appointed contractor and following further opening up works on site.
- Method Statements for the proposed demolition and sequencing of the temporary propping will need to be agreed prior to commencement of all works, to ensure proposals do not adversely impact the structure of the retained buildings.

11.2 Noise

Measures which will be employed to control noise include:

1. Deliveries to and from the site to be agreed and to form part of an approved Traffic Management Plan

2. Strict adherence to site working hours.

3. A noise barrier will be installed prior to work commencing.

4. Restrictions on the equipment that can be used will be in place to prevent noise pollution, and equipment which will not be permitted include:
   a. Vibration compactors
   b. Hammer or vibration piling rigs
   c. Diesel powered concrete mixers
   d. Diesel powered paving breakers, jack hammers, hoists, and conveyor belts.

5. Diesel powered compressors and generators will be restricted to equipment which is acoustically contained and meets the required noise levels.

6. Large plant such as concrete mixer trucks will not be permitted on the site.

7. All equipment must not generate noise at a level above 70 dB at the site perimeter of the wall with a first Action Level Trigger of 73 dB. It is proposed that in exceptional circumstances a noise level of 75dB may occur if this is done for very limited hours and only once all of the adjoining residents have been informed. This is on the basis of the guidelines set out in BS 5228 Part 1: 2009.

8. In the case where the removal of large concrete items is required, the concrete is to be broken up by means of coring a series of holes and then using hydraulic bursting equipment to split it apart prior to removal.

9. The breaking out of concrete is to be done with small handheld electrically powered units. This is subject to the restrictions aforementioned.

10. The site office and staff accommodation is to be located within the confines of the site.

11. Hiring of equipment shall be done for reputable companies who can provide well maintained equipment.

12. Cutting of steelwork will not be permitted on-site

13. Unnecessary revving of engines will not be permitted on-site.

14. All noise-generating machinery will be turned off when not being used

11.3 Vibration

In addition to the measure already mentioned, the following measures are to be imposed on site and addressed within the contract documentation.

1. Piling works will not be permitted on-site.

2. Sheet piling works will not be permitted on-site.

3. Vibration compactors will not be permitted.

4. All equipment onsite will not generate vibration above a PPV of 0.3mm/s when recorded at the line of the perimeter noise barrier. In exceptional circumstances there may be a requirement to exceed this to a level of 1.0mm/s. As above this will only be permitted for a very small number of hours and only once the local residents have been informed. This is in line with the guidance set out in BS 5998 Part 2: 2009.

11.4 Dust

As above, the measures listed here will be introduced at the site and be a requirement in the contract documentation:

1. The barrier required to mitigate noise will also function as a dust barrier

2. The site will be hosed down in dry periods to prevent dust from forming and drifting into adjacent properties.

3. Materials which could become airborne such as sand are to be covered with tarpaulins to prevent them being picked up by the wind.
   1.

4. All loading and unloading of soils and sandy materials will take place within the site barrier with all material dropped within the loading bay being swept clean.

5. Any vehicle wheels are to be hosed down and the road and pedestrian carriageway in front of the site is to be washed daily.

6. The building being clad in scaffolding will reduce any dust from the removal of plaster from leaving the site boundary.

12 Design Criteria

12.1 Design Life

The design life of the building can be defined as the period of use intended by the designer as agreed with the client. It should be noted that the design life of a buildings component parts might not be the same as the design life of the building. As such three categories arise for defining durability of building elements:

- *replaceable* shorter life than the building life with replacement envisaged
- *maintainable* with periodic treatment will last the life of the building
- *lifelong* will last the life of the building.

The design life for the building is assumed to be 60 years and as such can be categorised as 'Normal Life' to BS 7543.

The structural concrete frames and new foundations are designed to be lifelong; however obvious defects should be repaired during the building life and a defined maintenance plan should be adopted.

12.2 Loading

12.2.1 Dead Loading

The following loads have been assumed for the weight of the structure/finishes and facades, allowances do not included the self-weight of the supporting primary steelwork:

Building	Build-up description	Loading
RC Basement	600 mm RC slab Finishes	15.0 1.5
		16.5 kN/m²
RC Floors	200mm RC slab Finishes Ceiling & Services	5.0 0.5 0.15
		5.65 kN/m²
RC Roof	200mm RC slab Sedum Roof Ceiling & Services Waterproofing +Finishes	5.0 1.5 0.15 0.25
		6.9 kN/m²

12.2.2 Imposed Loading

Area	UDL (kN/m²)	Point Load (kN)	BS6399:1 1996 Table 1 ref.
Typical Floors (Domestic)	1.5	1.4	A
Floors (Garage)	2.5	9.0	F
Floors (Plant)	7.5	4.5	E
Roof	0.75	1.4	

12.2.3 Wind Loading/ Climate

The structure will be designed using the following wind load information in accordance with BS 6399: Part 2. Code of Practice for Wind Loads. Trade Contractor's design to include specific wind analysis for element under consideration. Values below are for global wind analysis only.

Wind design parameters	
Basic wind speed, V_b	21.0 m/s
Altitude factor, S_a	1.05
Seasonal factor, S_s	1.0
Directional factors, S_d	1.0
Dynamic wind pressure	0.835kN/m²

12.3 Materials

The following structural materials are to be used for the project:

Steel grade	S355
Concrete grade	C40
Reinforcement high yield	f_y=500N/mm2

12.4 Durability

Concrete elements will be designed to the recommendations in BS EN 19921-1 Design of Concrete Structures and BS 8500 Concrete – Complementary British Standard to BS EN 206-1, and concrete mixes specified to suit the "normal" structural performance level. Where concrete elements are in contact with the ground, special considerations may have to be adopted depending on the recommendations of the Geotechnical Site Investigation.

12.5 Robustness

The design of the building assumes a categorisation of building type as Consequence Class 2B Upper Risk Group.

The design of the structure will be to recommendations made in BS EN 1991-1-7 General Actions – Accidental Action. The building will be designed to satisfy stability requirements of the relevant codes, and will be provided with effective horizontal and vertical ties. Alternatively, it may be preferable to check that with the notional removal of a supporting column the building remains stable and area of collapse does not exceed the building regulation requirements.

12.6 Fire Rating (tbc)

For the purpose of the structural design the following is assumed:

Element	Rating (minutes)
Concrete ground and suspended floors	60
Steel frame	60
Roof	60

12.8 Protected Trees and Root Protection Areas

No protected trees have been identified.

12.9 Design Guides

The following Codes of Practice and design guides have been used in the assessment of the development to this stage.

Reference	Title
BS 648	Schedule of weights of building materials
BS 5950	Structural use of steelwork in building. Part 1: Code of practice for design in simple and continuous construction: hot rolled sections. Part 2. Specification for materials, fabrication and erection: hot rolled sections.
BS 6399	Loadings for buildings. Part 1: Code of practice for imposed floor loading Part 2. Code of practice for wind loads. Part 3. Code of practice for imposed roof loads
BS 7543	Durability of buildings and building elements, products and components
BS 8002	Earth retaining structures.
BS 8004	Foundations
BS 8110	Structural use of concrete. Part 1. Code of practice for design and construction. Part 2. Code of practice for special circumstances
BS 8500-1:2002	Concrete – Contemporary British Standard to BS EN 206-1
BS EN 206-1	Concrete: Specification, performance, production and conformity
CIRIA R149	Protecting Development from Methane 1995
NHBC Chapter 4.2	Building near trees
NHBC Chapter 4.4	Strip and trench fill foundations
Structural Engineer's Pocket Book	General Design Guidance
TRRL LL1132	The structural design of bituminous roads

Vehicle Impact Loads: Any vulnerable parts of the basement car park and building structure will be assessed in accordance with the requirements of BS EN 1991-1-7 Section 4.3 Accidental actions caused by road vehicles.

13 Below Ground Drainage

The proposed development will incorporate a new surface water and foul water drainage network to serve the development. This will outfall to the existing Public Sewers running in the adjacent Broxwood way, utilising the existing connection where possible.

Due to the proposed basement a foul water pump is required to serve this level and any foul water runs which cannot be served by gravity. This pump will incorporate 24hour storage as required by Building Regulations Part H. The outfall main from this pump will then connect to the gravity connection to the Public Sewer.

A CCTV survey will be carried out to ascertain the line and condition of the existing connection with any proposed mitigation measures carried out as part of the works.

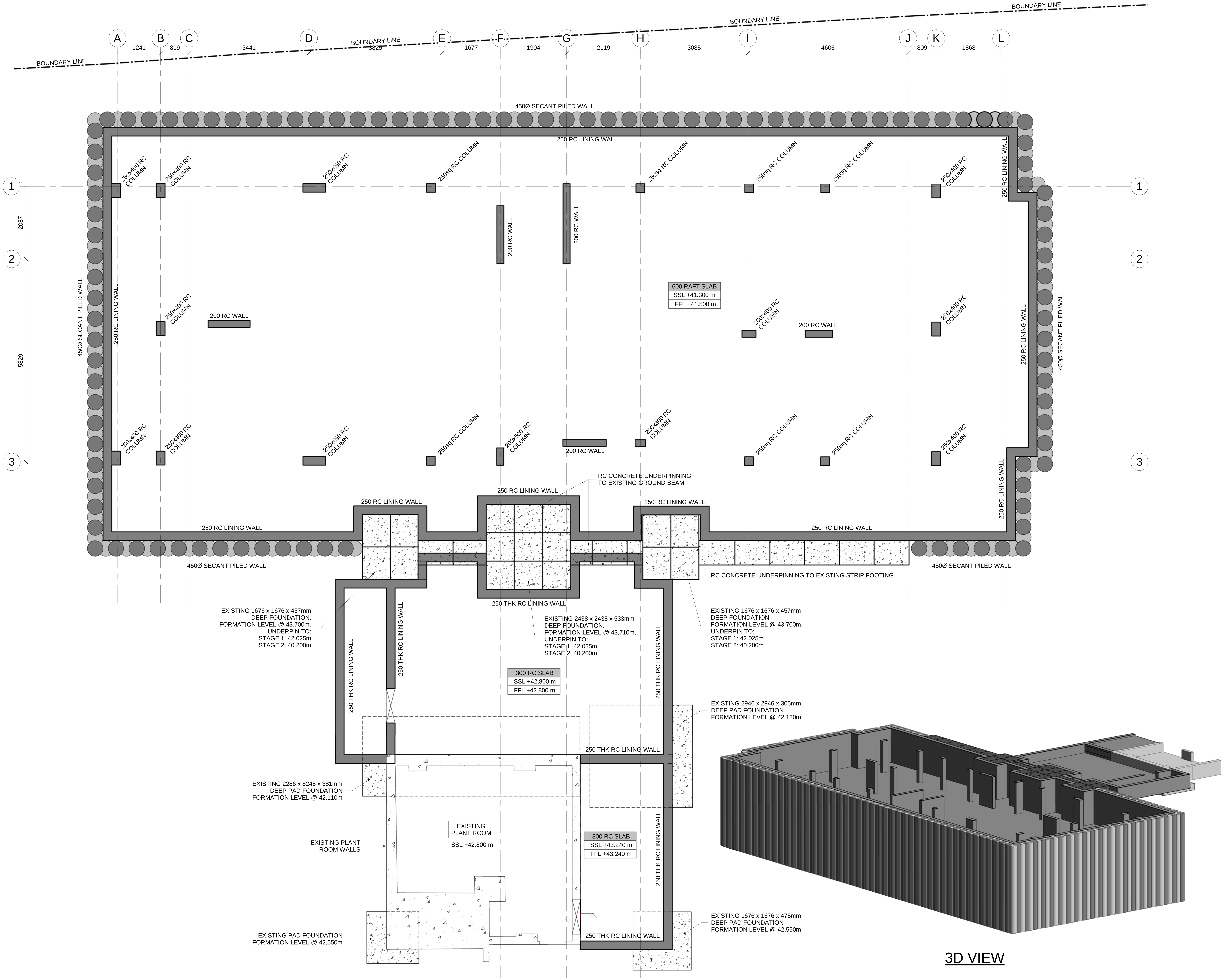
Surface water from the proposed development will be routed to this existing connection also. A sedum roof will be incorporated into the development to promote the use of SUDS within the site and reduce peak run-off rates during storm events. Due to space limitations and the existing soil properties, infiltration of surface water to the ground is not proposed. This will ensure that there is no impact on groundwater sources in the area.

The impermeable area of the site will not be increased as a result of the proposed development. In this regard, the peak run-off rates from the site will not increase. This is in line with London Plan and Thames Water policy and ensure that there is no adverse effect on the receiving infrastructure.

Agreement will be made with Thames Water to connect to their Public Sewers.

The drainage for this site is not connected to any adjacent property and as stated above will have its own induvial connection to the public sewers.

APPENDIX 1
Structural Scheme Drawings



3D VIEW

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2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE 'GENERAL NOTES DRAWING', 1805-PAR-ZZ-XX-DR-S-0001 & 0002.
3. THIS DRAWING IS TO BE READ WITH ALL RELEVANT ARCHITECT'S & SERVICES ENGINEERS DRAWINGS.
4. THE CONTRACTOR IS TO NOTIFY THE CONTRACT ADMINISTRATOR (C.A) OF ANY DISCREPANCIES BETWEEN THIS DRAWING & SITE CONDITIONS BEFORE IMPLEMENTING THE WORK. DETAILS ON THIS DRAWING ARE TO BE CHECKED ON SITE BY THE CONTRACTOR & ANY DISCREPANCIES REPORTED TO THE ENGINEER SO THAT ADJUSTMENT MAY BE MADE TO THE STRUCTURAL SCHEME IF NECESSARY.
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6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE STABILITY OF THE EXISTING STRUCTURES ON THE SITE AND MUST TAKE ALL NECESSARY PRECAUTIONS TO SAFEGUARD THE STABILITY.
7. ANY TEMPORARY WORKS INCLUDING, NEEDLING, SHORING, STRUTTING & PROPPING SHALL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR.
8. ALL DEMOLITION WORKS SHALL BE UNDERTAKEN STRICTLY IN ACCORDANCE WITH THE PARTY WALL AGREEMENTS.

REV	DATE	DESCRIPTION	BY
P02	17.05.18	PRELIMINARY ISSUE	AJE
P01	01.02.18	PRELIMINARY ISSUE	SE

Project:
BARRIE HOUSE

Title:
GENERAL ARRANGEMENT
LOWER GROUND FLOOR

Client:
KALEMINSTER Ltd.

Architect:
MWA

INFORMATION

Designed:	AM	Drawn:	AJE
Checked:	BP	Date:	JAN '18
Project No:	1805	Scale @ A1:	1 : 50

Drawing No:
1805-PAR-ZZ-LG-DR-S-0090-S2-P02

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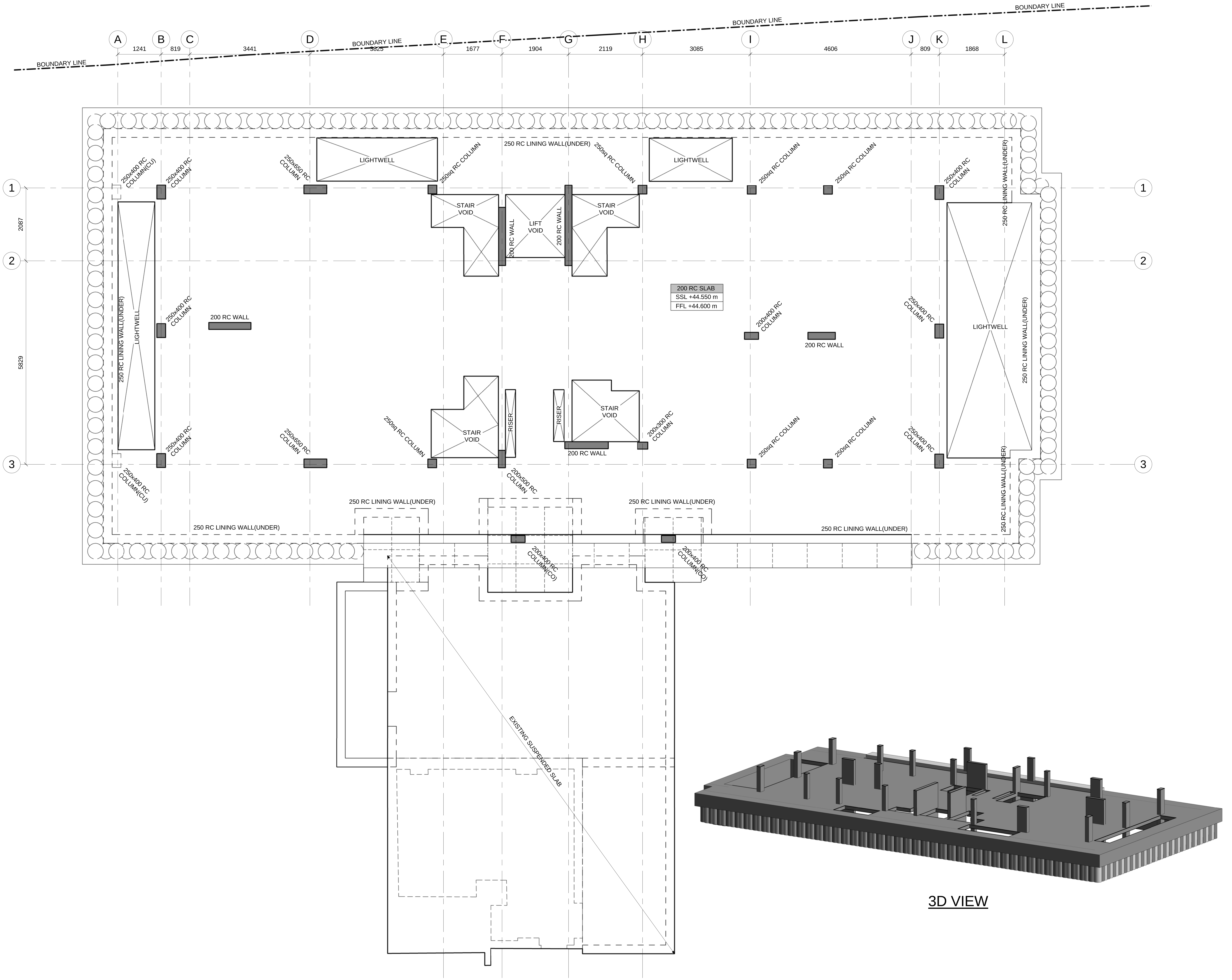

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P02	17.05.18	PRELIMINARY ISSUE	AJE
P01	01.02.18	PRELIMINARY ISSUE	SE
REV	DATE	DESCRIPTION	BY

Project:
BARRIE HOUSE

Title:
GENERAL ARRANGEMENT
GROUND FLOOR

Client:
KALEMINSTER Ltd.

Architect:
MWA

INFORMATION

Designed:	AM	Drawn:	AJE
Checked:	BP	Date:	JAN '18
Project No:	1805	Scale @ A1:	1 : 50

Drawing No:
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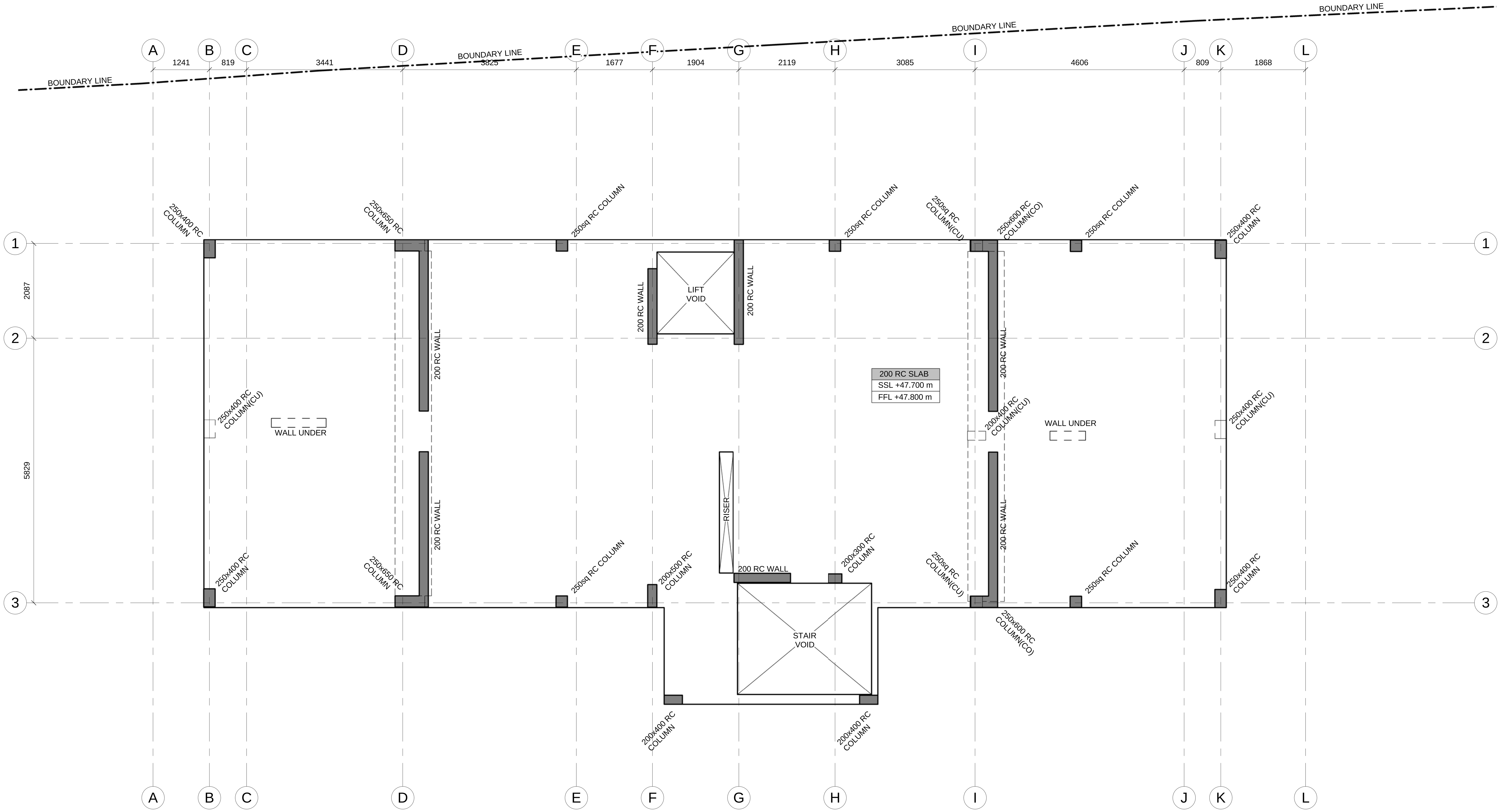

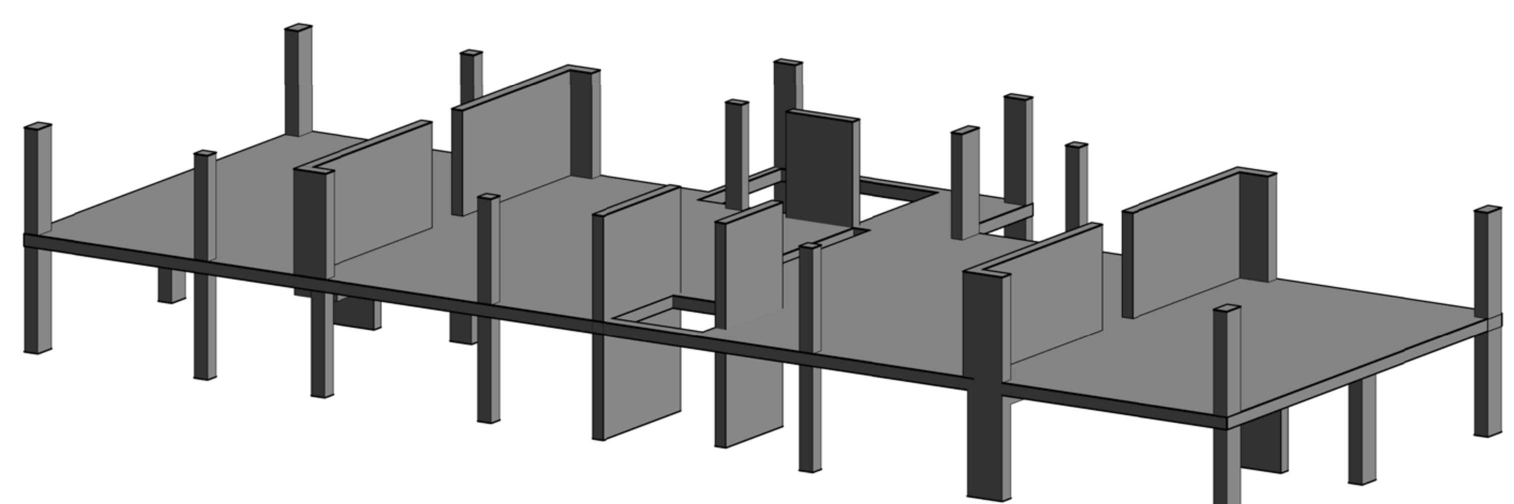

3D VIEW

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REV	DATE	DESCRIPTION	BY
P01	17.05.18	PRELIMINARY ISSUE	AJE

Project:
BARRIE HOUSE

Title:
GENERAL ARRANGEMENT
FIRST FLOOR

Client:
KALEMINSTER Ltd.

Architect:
MWA

INFORMATION

Designed: AM
Drawn: AJE
Checked: BP
Date: JAN '18
Project No: 1805
Scale @ A1: 1 : 50

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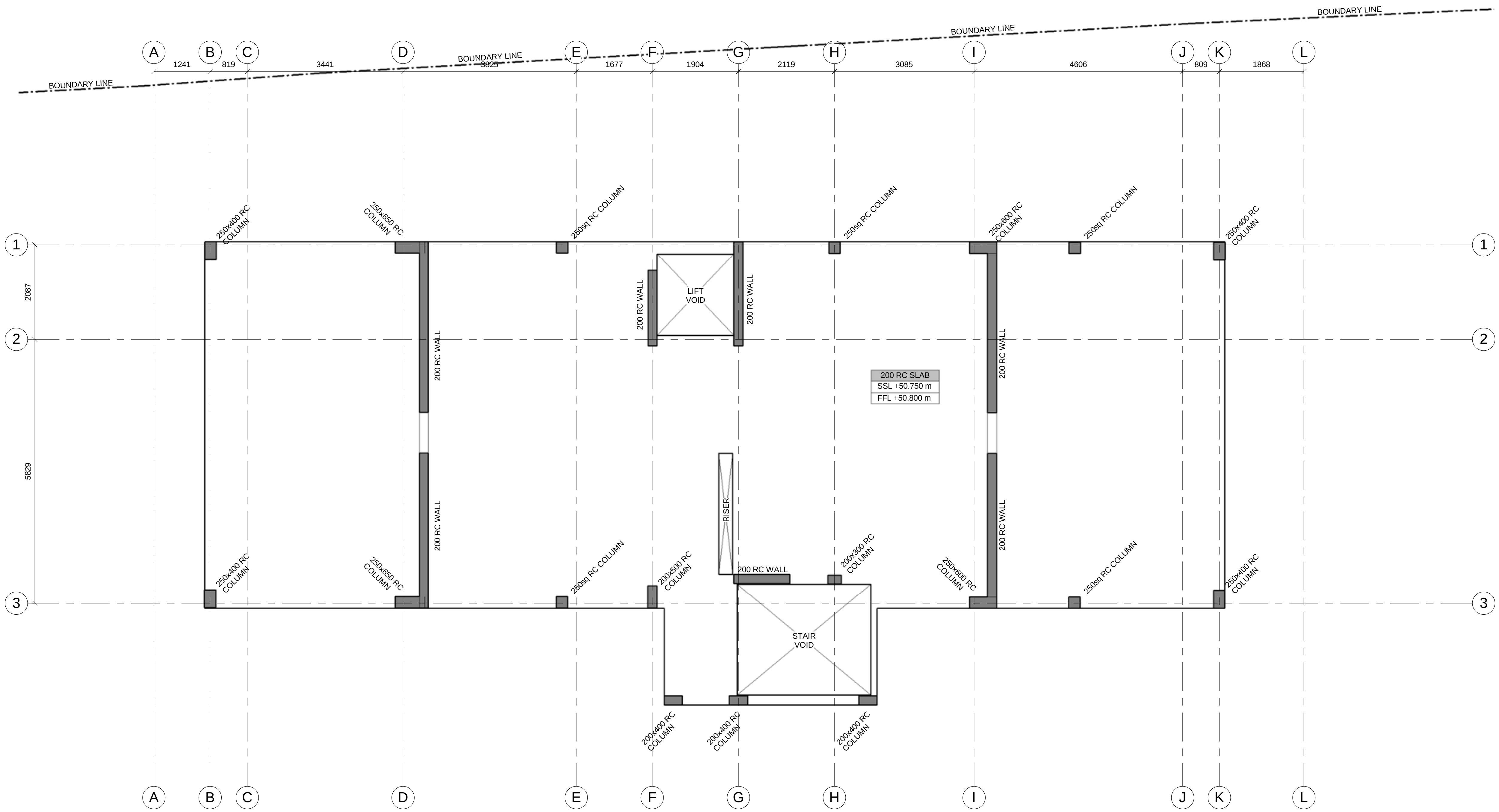

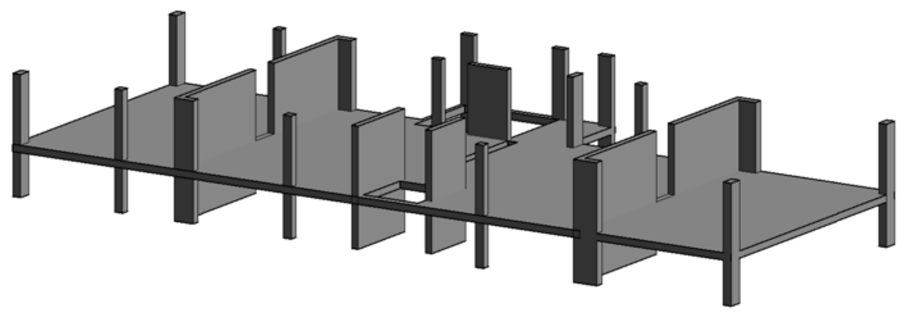

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REV	DATE	DESCRIPTION	BY

Project: BARRIE HOUSE

Title: GENERAL ARRANGEMENT SECOND FLOOR

Client: KALEMINSTER Ltd.

Architect: MWA

INFORMATION

Designed:	AM	Drawn:	AJE
Checked:	BP	Date:	JAN '18
Project No:	1805	Scale @ A1:	1 : 50

Drawing No: 1805-PAR-ZZ-02-DR-S-0120-

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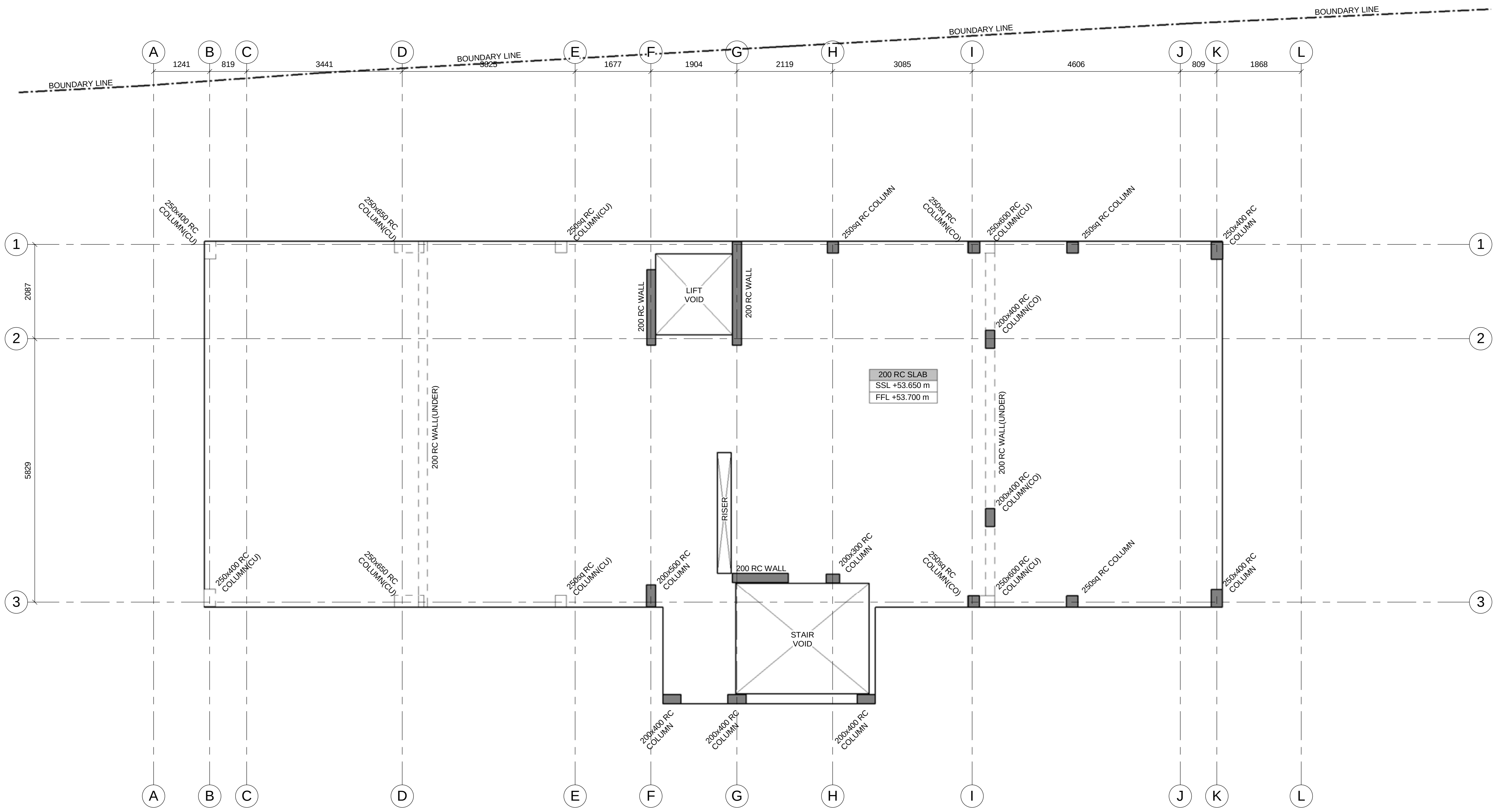

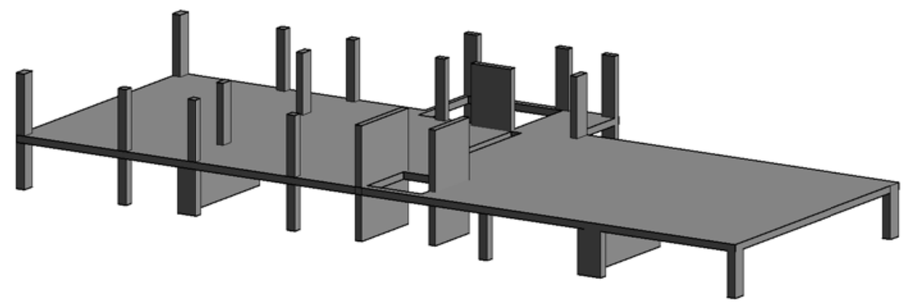

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REV	DATE	DESCRIPTION	BY

Project:
BARRIE HOUSE

Title:
GENERAL ARRANGEMENT
THIRD FLOOR

Client:
KALEMINSTER Ltd.

Architect:
MWA

INFORMATION

Designed:	AM	Drawn:	AJE
Checked:	BP	Date:	JAN '18
Project No:	1805	Scale @ A1:	1 : 50

Drawing No:
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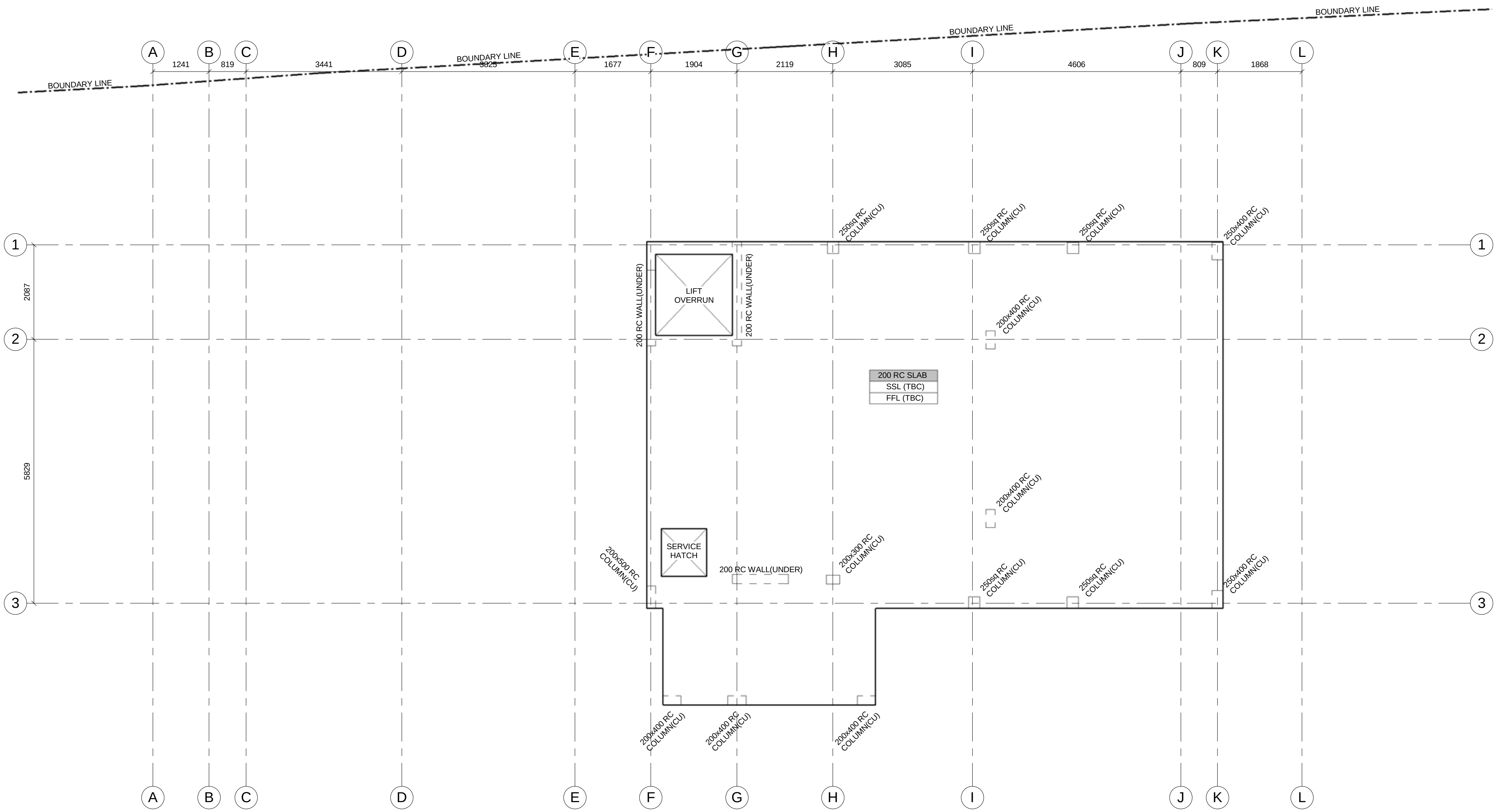

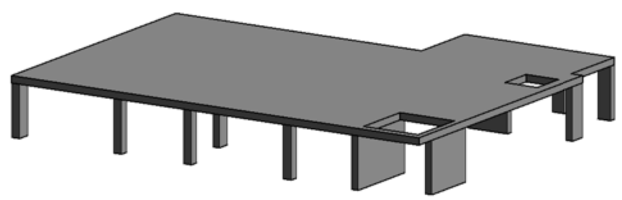

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REV	DATE	DESCRIPTION	BY

Project:
BARRIE HOUSE

Title:
GENERAL ARRANGEMENT
ROOF PLAN

Client:
KALEMINSTER Ltd.

Architect:
MWA

INFORMATION

Designed:	AM	Drawn:	AJE
Checked:	BP	Date:	JAN '18
Project No:	1805	Scale @ A1:	1 : 50

Drawing No:
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APPENDIX 2
CGL Ltd Ground Investigation Report

Parmarbrook

Barrie House

Basement Impact Assessment

Revision 2

May, 2018

Card Geotechnics Limited
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Reference	CG/28408	Revision	0	Issue Date	Jan 2018
			1		Jan 2018
			2		May 2018

Contents

FIGURES

Appendices

1. INTRODUCTION

It is proposed to develop the site "Barrie House" at 29 St Edmund's Terrace in the London Borough of Camden (LBC). The proposed development involves the construction of a four storey extension including a single storey basement level to the existing Barrie House structure. Card Geotechnics Limited (CGL) have been instructed by Parmarbrook ('the client') to undertake a *Basement Impact Assessment (BIA),* including a detailed ground movement analysis for the proposed development to determine its potential effect on nearby structures, surface water runoff and groundwater flow.

The LBC's guidance document *"CPG4, Basements and Lightwells"*[1]*,* requires a Basement Impact Assessment (BIA) to be undertaken for new basements in the Borough and sets out five stages for a BIA to "*enable the Borough to assess whether any predicted damage to neighbouring properties and the water environment is acceptable or can be satisfactorily ameliorated by the developer*". The five stages are set out below:

1. Screening
2. Scoping
3. Site investigation
4. Impact assessment
5. Review and decision making

A site investigation has previously been undertaken at the site by Soil Consultants[2] in 2012. The results of this have been used to inform the Screening, Scoping, Impact Assessment and Decision Making Stages.

This report identifies the key issues relating to land stability, hydrogeology and hydrology as part of the screening process (Stage 1) and includes a review and interpretation of existing site investigation data to establish a conceptual site model (Stages 2 and 3). The report provides an impact assessment (Stage 4) of potential ground movements on adjacent structures and the hydrogeology of the surrounding area for the purposes of planning.

[1] Camden Planning Guidance. (2014). *CPG4, Basements and Lightwells, July 2015.*
[2] Soil Consultants. (2012). *Ground Investigation Report - Barrie House* Ref. 9241/OT

2. SITE CONTEXT

2.1 Site Location

The Site is located at Barrie House, 29 St Edmund's Terrace, London NW8 7QH. The site is located within the London Borough of Camden. The approximate National Grid Reference for the site is 527495E, 183575N. A site location plan is presented as Figure 1.

2.2 Site Description

A site walkover was undertaken by a CGL Engineer on 6th December 2017. The site was found to comprise a roughly square plot approximately 0.18 hectares in area and is currently occupied by Barrie House, an eight storey detached residential block constructed in the 1950's. The existing structure includes a partial basement beneath the centre of the Barrie House structure. The basement currently houses the plant room and several small rooms. Historical structural drawings and site visits indicate a backfilled void exists adjacent to the existing partial basement. The void is surrounded by a masonry wall, below the ground floor slab. The space is understood to have been backfilled to a level of approximately 44.8mOD based on historical structural drawings provided in Appendix A.

The existing building of Barrie House is located centrally within the site. A small (approximately 7m^2) two storey porter's lodge is present on the north west side of the site, where the ground level is approximately 45 meters above ordnance datum (mOD). Landscaped gardens are presented around the on-site structures with a large number of deciduous trees. The trees are mainly clustered in an area to the east of the building. Several large stumps are also present along the south and west of the site. The trees were observed to be around 2m to 3m tall and appeared to be mature. Vehicular access to the site is off Broxwood Way and leads to a tarmacked car parking area in the west of the site.

It is understood that the existing ground floor of the building is founded on pad foundations on the London Clay Formation. A single storey ground floor extension constructed in 1959 at the rear of the building is founded on strip floorings. Where the basement is present it is understood to be founded on strip footings on the London Clay Formation[2].

The site is bound to the south east by St Edmund's Terrace and to the west by Broxwood Way. Two rows of terraced houses / apartment blocks are present to the north of the site, referred to as Nos. 32 to 72 Kingsland and Nos. 1 to 16 Kingsland. The closest properties of each of these rows are No. 16 and No.72 Kingsland. The closest point of the neighbouring properties is the southern corner of No. 72, which is approximately 7.5m from the proposed development. At its closest point No. 16 is approximately 9.5m from the proposed piled wall and approximately 9m from the porters lodge (to be demolished). The porters lodge is approximately 10.0m from the road of Broxwood Way. The proposed piled wall is approximately 12.8m from Broxwood Way. To the east of the site, a building is present named Regent Heights and Nos. 30 to 36 St Edmund's Terrace. These structures are approximately 20m from the closest part of the Barrie House building. There are no existing party wall structures. CGL's in-house information indicates the presence of the King's Scholar Pond Sewer approximately 145m west of the site and the Middle Level Sewer No. 8, and enlargement of Northern Outfall Sewer approximately 110m south of the site. The site layout is presented in Figure 2.

2.3 Proposed Development

The proposed development is understood to comprise the demolition of the porter's lodge and the construction of a four storey extension adjacent to the northern wall of existing Barrie House including a new basement. It is proposed to remove the backfilled soil in the space adjacent to the existing plant room. The proposed development will accommodate nine new residential flats with the excavated backfilled void proposed to be used as a bike storage area.

The new basement will be retained by a secant piled wall around the perimeter of the basement with the exception of the section of the basement perimeter beneath the existing Barrie House structure, which will not have a piled wall. The existing structure at this section of the wall is to be underpinned.

The proposed new basement will be founded on pad foundations below a 600mm thick concrete slab with formation level of 40.70mOD. The formation level of the pads and underpins will be at 40.20mOD, 0.5m below the formation level of the basement slab. This will involve an excavation of up to approximately 5.30m of soil from the existing ground level of approximately 46mOD.

The excavation of the backfilled void area will be from a level of approximately 44.8mOD to a formation level of approximately 42.5mOD, some 2.3m of excavation. The excavated backfilled void area will have a 300mm basement slab, with floor level at 42.8mOD.

Indicative proposed development plans provided by the structural engineer are provided as Appendix B.

2.4 Topography

The site generally slopes from down from north to south with the highest point located in the north east corner of the site at approximately 48.6mOD. The lowest point is in the south west corner of the site with a level of approximately 42mOD. The distance on site between these points is approximately 55m, results in a slope of about 1 in 8. With reference to the topographical map of Camden within

Camden's Strategic Flood Risk Assessment[3] (SFRA) the local area around the site appears to slope down from Primose Hill (approximately 200m north east of the site) towards the south west. There is also a small slope down to the south towards *Regents Park* (approximately 200m south of the site).

The steepest slope on site is within the west of the building where there is a vehicular ramp down from the car park/building entrance, where the level is approximately 45.4mOD to the level of Broxwood Way, some 43.0mOD. This change in level occurred over approximately 13.5m, indicating a slope of around 1 in 5.5.

[3] URS (2014) *London Borough of Camden – Strategic Flood Risk Assessment*

3. GROUND AND GROUNDWATER CONDITIONS

3.1 Published Geology

The British Geological Survey (BGS) map of the area[4] indicates that the site is underlain by the London Clay Formation. The London Clay Formation is indicated to be approximately 50m thick, with the base of the stratum anticipated at around -10mOD. The London Clay Formation is in turn documented to be underlain by approximately 15m of the Lambeth Group, which is in turn underlain by approximately 15m of the Thanet Sand Formation. The Thanet Sand Formation is underlain by the Chalk at a level of around -50mOD.

The London Clay Formation is described as stiff to very stiff, over-consolidated, dark grey clay with selenite crystals and occasional sand lenses. The clay weathers to a firm orange brown.

The map additionally shows superficial head deposits overlaying the London Clay Formation at the site. No thickness of these deposits is indicated, and it is noted that the locations of the head deposits are interpreted by digital slope analysis and are not mapped deposits that have been verified by fieldwork.

3.2 Unpublished Geology

Nearby borehole records from the BGS[5] have been reviewed to provide insight into the local ground conditions. The records indicate that the area is directly underlain by London Clay, which is weathered at shallow depths. Three records from approximately 50m of the site have been summarised in Table 1. The borehole records are provided in Appendix C.

Table 1. Summary of Unpublished Ground Conditions

Strata	*Description*	*Top Level (mOD) [mbgl]*	*Thickness (m)*
Made Ground	Tarmac / Soft grey-brown / dark brown and black silty clay with chalk and brick fragments *Not present in TQ28SE409*	38.0 to 38.2 [0]	0 to 2.5
Weathered London Clay Formation	Firm to stiff fissured brown clay becoming stiffer with depth. Silty with yellow brown silt parting in borehole TQ28SE1231. Silt partings and blue grey mottling in TQ28SE1230.	35.7 to 50.1 [0 to 2.5]	8.7 to 10.4
London Clay Formation	Stiff to very stiff grey – blue / dark grey fissured clay. Mudstone boulders and sand fissures noted in TQ28SE409, also with traces of shell fragments and lignite at 66.5mOD. Silt clay and carbonaceous impurities noted in TQ28SE1231.	27.0 to 39.8 [10.4 to 11.2]	Proven to 67mbgl (-17mOD)

Note. mbgl = meters below ground level

[4] British Geological Survey (*1998*). *South London Sheet 270*. England and Wales. Solid and Drift Geology. 1:50,000
[5] http://mapapps.bgs.ac.uk/geologyofbritain/home.html? (Accessed Dec 2017)

Groundwater was noted within the Made Ground at borehole TQ28SE1231 at approximately 36.08mOD (2.1meters below ground level (mbgl)). Groundwater was not reported in the two other records.

3.3 Hydrogeology and Hydrology

The site is approximately 170m north of *Regents Canal* and approximately 750m north of the *Boating Lake* in *Regents Park.* Reference to CGL archive information and Barton's *Lost Rivers of London*[6] indicates the historical (culverted) *River Tyburn* is located approximately 230m south west of the site (at its closets point) and flows broadly north to south towards *Regents Park* and into the *Boating Lake.* Based on the local topography sloping towards the south west it is considered that groundwater onsite will run towards the historical *River Tyburn* to the south west.

The Environment Agency (EA) mapping indicates the site is within a Flood Zone 1. This indicates the site has a less than 1 in 1000 annual probability, a 'low' probability, of flooding from river or sea flooding. As the site is less than one hectare in size a flood risk assessment is not required for the site by the Environment Agency. The flood maps included within CPG4[1] and Camden's SFRAA[3]indicate the site location has a 'very low' risk of surface water flooding (less than 1 in 1000 years). Around the border of Primrose Hill (approximately 200m north of the site) the risk from surface water flooding is shown as 'low' to 'medium'. The site is not shown to have experienced extreme flooding in 1975 or 2002 flooding events. According to the Camden SFRA SuDS Drainage Potential Map the site on the border of an area that is highly compatible for infiltration SUDS and an area with very significant constraints. Environment Agency groundwater flood incidents have been recorded approximately 300m west of the site. The site is located within a critical drainage area but is not located within a local flood risk zone[3].

The EA[7] has produced an aquifer designation system consistent with the requirements of the Water Framework Directive. The designations have been set for superficial and bedrock geology and are based on the importance of aquifers for potable water supply, and their role in supporting surface water bodies and wetland ecosystems. The site does not overlie a designated superficial or bedrock aquifer and is noted as being underlain by the London Clay Formation, designated a 'non-productive stratum' by the Environment Agency.

The site does not fall within a Groundwater Vulnerability Zone as indicated by EA mapping. The site is located within a Source Protection Zone 1, related to the Barrow Hill reservoir approximately 20m

[6] Barton, N. (1992) *The Lost Rivers of London*. Hertfordshire Historical Publications.
[7] http://www.environment-agency.gov.uk (accessed November 2016)

north east of the site. This reservoir is of new construction (2014) and is a tanked, concrete lined reservoir.

3.4 Previous Site Investigation

A site investigation has previously been undertaken by Soil Consultants[2] in 2012 comprising three foundation inspection pits (TP1 to TP3) to expose foundation positions of the Barrie House building. A 75mm diameter hole was drilled through each pad to measure the thickness of the foundations. Three window sample boreholes (WS1 to WS3) were then progressed from these trial pit locations, with the concrete pad being cored out to enable window sampling at WS1 and WS3, and the borehole WS2 being progressed from the edge of the pad. The window sample boreholes were undertaken to a maximum depth of 5mbgl (39.6mOD). A cable percussion borehole (BH1) was completed in the carpark area to a depth of 7.5mbgl (38.5mOD).

In-situ testing was undertaken comprising Standard Penetration Tests (SPTs) at regular intervals in borehole BH1 and regular Hand Shear Vane and Pocket Penetrometer tests undertaken within the window sample boreholes. Groundwater monitoring standpipes were installed in window sample boreholes WS1 and WS2, both with plain pipe from 0mbgl to 1mbgl and with slotted pipe from 1mbgl to 4mbgl.

3.4.1 Ground Conditions

The ground conditions encountered by the previous investigation were found to be consistent with the published geology and are summarised in Table 2 below.

Table 2. Summary of Ground Conditions

Strata	*Description*	*Top Level (mOD) [mbgl]*	*Thickness (m)*
[MADE GROUND – PAD LOCATIONS]	Brown topsoil and clay with occasional building rubble. Soft to firm brown clay with occasional flint gravel and dark brown sand/ silt lenses in WS2 only.	44.6 to 45.6 [0.0]	0.5 to 2.1
[CONCRETE FOUNDATION – PAD LOCATIONS]	*Only observed in WS1 and WS3. One reinforcement bar circa. 10mm diameter observed in WS3 concrete core.*	44.4 to 44.7 [0.9]	0.7 to 0.9
[MADE GROUND – CAR PARK AREA]	Asphalt over grey/black mixture of ashy sand with asphalt, clinker and flint gravel becoming clayey at 45.65mOD (0.35mbgl).	46.0 [0]	0.5
[LONDON CLAY FORMATION]	Stiff brown CLAY with some orange patches, occasional grey gleying, selenite crystals and rare orange sand partings. Noted as soft to firm in BH1 and becoming stiff at 6mbgl in WS1.	42.5 to 45.5 [0.5 to 2.1]	*Base not proven at 38.5mOD (7.5mbgl)*

The details of the strata encountered are discussed in the following report sections. A plot of the undrained shear strength (c_u) data versus level (mOD) from the Soil Consultants report[2] is presented in Figure 3.

3.4.2 Made Ground

Made Ground was identified above each foundation pad and generally comprised a topsoil layer followed by brown clay with some occasional building rubble (primarily concrete and brick). Borehole WS2 was undertaken adjacent to a pad. A similar topsoil and brown clay was identified above the pad level at this location. From the top level of the pad the Made Ground at borehole WS2 was reported at depths between 43.47mOD (1.13mbgl) and 42.50mOD (2.1mbgl) and was found to comprise a soft to firm brown clay with occasional flint gravel and dark brown sand/ silt lenses.

The concrete pads at the window sample locations were found to be between 0.72m and 0.8m in thickness. At boreholes WS1 and WS2 where cores of the concrete pad were extracted, only borehole WS3 was noted to have reinforcement. This consisted of one reinforcement bar approximately 10mm in diameter located 0.5m from the top of the pad (43.9mOD, 1.3mbgl).

At the borehole BH1 in the car park the Made Ground was reported as an asphalt layer approximately 100mm thick over a grey/black mixture of ashy sand with asphalt, clinker and flint gravel becoming clayey at 45.65mOD (0.35mbgl).

3.4.3 London Clay Formation

The London Clay Formation was identified directly beneath the Made Ground in boreholes BH1 and WS2 and directly beneath the concrete pads at boreholes WS1 and WS3. The base of the London Clay Formation was not proven in any location, with the maximum depth reached being 38.5mOD (7.5mbgl).

The stratum was found to be soft in the first 1.6mbgl (to a level of 44.4mOD) within borehole BH1 and firm between 1.6mbgl and 6.0mbgl (44.4mOD to 40.0mOD). At the window sample locations the London Clay Formation was reported as being a stiff brown clay with occasional grey gleying, selenite crystal and rare orange partings. At borehole WS2 the top of the London Clay Formation was reported to be stiff, locally firm with orange patches at depths between 42.5mOD to 42.4mOD (2.1mbgl to 2.3mbgl) . The top of the London Clay Formation was interpreted to be weathered to a depth of approximately 42.4mOD, with the clay becoming more uniformly brown with depth. Claystone was recorded as “incipient claystone” at in WS1 and WS3 at 2.1mbgl (43.6mOD and 43.3mOD, respectively).

SPTs undertaken at borehole BH1 recorded SPT 'N' values between N=6 (at 2.3mbgl (43.7mOD)) and N=16 (at 6.3mbgl (39.7mOD)), correlating to undrained shear strengths of 27kN/m^2 to 72kN/m^2 (based on f1 = 4.5[8]).

Hand shear vane tests were undertaken in the soils retrieved from the window samples boreholes. The undrained shear strengths measured by the hand shear vanes were found to range between 43kN/m^2 and 120kN/m^2. Each of the hand shear vane undrained shear strength results, excluding the 40kN/m^2 at WS1 (-1.9mbgl (43.7mOD)), were found to be over 60kN/m^2. Pocket penetrometer testing was additionally undertaken and found a strength profile similar to that obtain from the hand shear vane. One Quick Undrained Triaxial test (QUT) was undertaken in the London Clay from borehole BH1 at 44.9mOD (1.1mbgl) and the undrained shear strength of the sample was found to be 26kN/m^2 indicating a soft clay of low strength[9].

Laboratory testing for Atterberg Limits was undertaken on ten samples of the London Clay Formation, with 33 samples tested for moisture content. The results of this testing indicated the following percentages:

- Moisture content: 20% to 34%;
- Liquid limit: 70% to 91%;
- Plastic Limit: 25% to 30%;
- Plastic limit: 42% to 61%

The ten samples tested for Atterberg Limits were additionally tested for the percentage passing 425 µm. It was found that >95% of the particles were smaller than 425µm. Based on this the modified plasticity index is between approximately >40% and >58%. The laboratory testing results indicate the London Clay Formation at the site has a 'very high' to 'extremely high' plasticity[9], and has a 'high' volume change potential[10]. Based on this and the large number of trees it is recommended that the various trees on site should be identified by an arboriculturalist to determine potential future grown and potential root penetration. Trees should not be planted or removed without expert advice about the potential effects and management.

[8] Stroud, M.A. (1975). *The standard penetration test in insensitive clays and soft rocks. Proceedings of the European Symposium on Penetration Testing,* 2, 367-375.
[9] British Standards Institution (2015) *Code of practice for site investigations.* BS 5930:2015
[10] NHBC (2013) *NHBC Standards. Chapter 4.2 Building near trees.*

3.5 Groundwater

The Soil Consultants[2] investigation did not identify groundwater in the boreholes on site during the drilling of the boreholes, with the exception of standing water being observed in borehole WS1 at 44.2mOD (1.4mbgl). Monitoring standpipes were installed in boreholes WS1 and WS2. A single monitoring visit was undertaken on 15th October 2012. Groundwater was recorded in borehole WS1 44.95mOD (0.95mbgl) and in borehole WS2 at 41.1mOD (3.5mbgl). The groundwater level in borehole WS1 was recorded 1.1m above a claystone band.

The response zone of WS1 is within the Weathered London Clay Formation/London Clay Formation/ concrete. The response zone of WS2 is the same, with the very top of the response zone also within the Made Ground. It is possible that isolated pockets of groundwater are present in the Made Ground, Weathered London Clay Formation and London Clay Formation. Based on these variable groundwater levels further monitoring visits were undertaken by CGL at the Soil Consultants[2] boreholes WS1 and WS2, the findings of these visits are presented in Section 6 of this report.

3.6 Geotechnical Design Parameters

Geotechnical design parameters have been determined based on the description of the soils, field testing and laboratory test results from the site. The design levels have been based primarily on borehole BH1, the most representative location for the new basement development. The geotechnical design parameters are summarised in Table 3. For the purposes of the analysis the Weathered London Clay and the London Clay Formation are considered as a single unit.

Table 3. Geotechnical Design Parameters

Strata	Design level (mOD) [mbsl]	Bulk unit weight γ_b (kN/m3)	Undrained cohesion c_u (kPa) [c']	Friction Angle φ' (°)	Young's modulus E_u (MPa) [E']
Made Ground	46	18	[0]	28	[15]
London Clay Formation	45.5	20	$30 + 12z^a$ [5]	22^b	$18 + 7.2z^c$ $[13.5 + 5.4z]^d$

a z = depth below top of strata

b British Standards institution. (1994). Code of practice for Earth retaining structures. BS 8002:1994.]

c Based on $600c_u$

d Based on 0.75E'

4. SCREENING

4.1 Introduction

CGL has adopted a screening process based on the Camden Borough Council basement development guidance '*Basements and Lightwells CPG4*'[1]. Relevant questions for the site in and proposed development are presented below.

4.2 Subterranean (Groundwater) Flow

This section answers the questions relating to groundwater flow. Table 4 presents a summary of these answers.

Table 4. Responses to Figure 3, CPG4

Question	*Response*	*Action required*
1a. Is the site located directly above an aquifer?	No. The nearest designated aquifers are 1.5km to the south of the site and 1km to the north of the site. Both are designated Secondary A Aquifers.	None
1b. Will the proposed basement extend beneath the water table surface?	Potentially. Variable water levels identified in the previous site investigation. The Made Ground onsite is directly underlain by the London Clay Formation and as such groundwater is not anticipated.	Further monitoring visits
2. Is the site within 100m of a watercourse, well, or potential spring line?	No. The nearest water course is the *Regent Canal* approximately 170m south of the site. The nearest natural water course is the culverted *River Tyburn* approximately 230m west of the site.	None
3. Is the site within the catchment of the pond chains on Hampstead Heath?	No.	None
4. Will the proposed basement development result in a change in the proportion of hard surfaced/paved areas?	No. The proposed basement will be constructed in the existing carpark area which is currently covered by hardstanding.	None
5. As part of site drainage, will more surface water than at present be discharged to ground (e.g. via soakaways and/or SUDS)?	No. It is anticipated surface water will be discharged to the existing infrastructure. Soakaway type drainage is unlikely to be feasible given the geology at the site.	None
6. Is the lowest point of the proposed excavation close to, or lower than, the mean water level in any local pond or spring lines?	No. There are no evident ponds or spring lines in the vicinity of the site.	None

4.2.1 Non-Technical Summary: Subterranean (Groundwater) Flow

The proposed development is underlain by the London Clay Formation, designated an 'unproductive stratum' by the EA. The proposed basement extension will be in the car park area currently covered by hardstanding. As such the proportion of hardstanding will not be increased and the development is not anticipated to have a significant impact on groundwater infiltration rates.

The previous site investigation did not encounter laterally pervasive groundwater on site during drilling. One monitoring visit was undertaken by Soil Consultants and found variable groundwater levels across the site during monitoring. The site is underlain by a limited thickness of Made Ground and then by the London Clay Formation. The London Clay Formation is a relatively impermeable stratum and is classed as an unproductive aquifer and as such significant groundwater is not anticipated and groundwater is not anticipated to impact the development. As the groundwater levels across site have been found to be variable, further monitoring visits will be undertaken to confirm the groundwater level at the existing monitoring wells. The groundwater monitoring visits undertaken by CGL are discussed later in Section 6.

It is noted that the site is within a Source Protection Zone (SPZ) Inner Zone 1, relating to Barrow Hill reservoir. However as the proposed development is within the relatively impermeable London Clay Formation, the reservoir is a tanked, concrete lined reservoir, and is upstream from the site, the proposed development is not anticipated to have an impact on the SPZ Inner Zone 1.

4.3 Slope/Land Stability

This section answers the questions relating to site topography, trees, neighbouring infrastructure and potential ground movements associated with basement development. Table 5 presents a summary of these answers.

Table 5. Responses to Figure 4, CPG4

Question	***Response***	***Action required***
1. Does the site include slopes, natural or manmade, greater than about 1 in 8?	Yes. The maximum slope on site is marginally over 1 in 5 to the west / south west of the existing apartment block. The slope stability was assessed in the Soil Consultants report2 and a factor of safety of 1.45 was found for the slope stability indicating the overall stability should be acceptable. No signs of deep-seated failure were observed.	None
2. Will the proposed re-profiling of the landscaping at site change slopes at the property boundary to greater than about 1 in 8?	No. The proposed development will not significantly alter the profile of the landscaping at the site boundaries.	None
3. Does the development neighbour land including railway cuttings and the like with a slope greater than about 1 in 8?	No.	None

Question	Response	Action required
4. Is the site within a wider hillside setting in which the general slope is greater than about 1 in 8?	No. Whilst there is a steep slope on site where the car park / building entrance area slopes down to Broxwood Way, the hill slopes around the site have a gentler gradient.	None
5. Is the London Clay the shallowest stratum on site?	No. Made Ground has been found over the London Clay on the site. However, the effect of heave of the London Clay due to excavation to form the new area of the basement will still need to be considered though due to the limited thickness of the Made Ground in the car park area.	Impact assessment
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?	None. From the proposed development drawings, it is understood no trees will be felled as part of the development.	None
7. Is there a history of shrink/swell subsidence in the local area and/or evidence of such at the site?	Seasonal swelling is likely to occur due to the large number of trees present. As no trees are to be felled the development will not significantly change ground/structure interaction. Additionally, the proposed foundations for development will be at a level of approximately 40.20mOD, considered to be beyond the depth of influence of the tree roots.	None
8. Is the site within 100m of a watercourse or a potential spring line?	No.	None
9. Is the site within an area of previously worked ground?	There is a limited thickness of Made Ground on site likely to be associated with the construction of the existing building. The Made Ground was found to be thicker at the locations of the pad foundations of the existing building as would be expected. In the car park area, the Made Ground was found to be of a minimal thickness of 0.35m.	None
10. Is the site within an aquifer?	No.	None
11. Is the site within 50m of Hampstead Heath Ponds	No.	None
12. Is the site within 5m of a highway or pedestrian right of way?	Yes. The site is within 5m of Broxwood Way, however the basement development on site will be over 15m from Broxwood Way.	None
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Potentially but neighbours are not directly adjacent to development. The closest neighbour is approximately 7.5m from the proposed basement development on site. It will be necessary to determine the potential ground movements from the proposed development at the neighbouring properties.	Impact assessment
14. Is the site over (or within the exclusion zone of) any tunnels?	No. The site is not understood to be over or within the exclusion zone of tunnels.	None

4.3.1 Non-Technical summary: Slope/Land Stability

The Soils Consultants report[2] found the maximum slope on site to be marginally over 1 in 5, from the west / south west of the existing apartment block. The slop stability was assessed in the Soil

Consultants report2 and a factor of safety of 1.45 was found for the slope stability indicating the overall stability should be acceptable. No signs of deep-seated failure were observed. The slopes around the site do not exceed a gradient of 1 in 8. As such the site is not considered to be at risk from slope stability issues.

An impact assessment will be required as the basement excavation will result in unloading of the London Clay Formation, which could result in heave movement. The ground movements generated by the proposed development at the location of the neighbouring properties are anticipated to be low based on the distance to the properties, this will be confirmed by the impact assessment. Measures to mitigate potentially damaging movements will be provided if found to be necessary.

The London Clay Formation on site has the potential to create a shrink/swell hazard. Due to the high plasticity of the London Clay Formation the removal of any trees could have an effect on the shrink/swell potential of the clay. If any trees are planted or removed further advice may be required. However, it is noted that there are no changes to number of trees planned and that the foundations of the proposed development will be around 40.20mOD, considered to be beyond the likely depth of influence of tree roots.

4.4 Surface Flow and Flooding

This section answers questions relating to the impact of the proposed development on existing drainage, permeable surfacing and flood risk. Table 6 presents a summary of these answers.

Table 6. Responses to Figure 5, CPG4

Question	***Response***	***Action required***
1. Is the site within the catchment of the pond chains on Hampstead Heath?	No.	None
2. As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off), be materially changed from the existing route?	No. There may be a marginal change in route on site as surface water will flow around the proposed above ground extension where currently it can flow over the carpark area. This is a minor change in route though as the surface water would already flow around the existing building from the highest point in the north east of the site to the lowest point in the south west of the site.	None
3. Will the proposed development result in a change in the proportion of hard surfaced/paved external areas?	No. The proposed basement will be constructed in the existing carpark area which is currently covered in hardstanding.	None
4. Will the proposed basement result in a change to the profile of the inflows of surface water being received by adjacent properties or downstream watercourses?	No. The nearest surface water features are over 300m from the site. Impacts of the proposed development on surface water flow are anticipated to be minimal and over the distance of over 300m from the site to surface water features the effects of the proposed development will dissipate.	None

5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No.	None
6. Is the site in an area identified to have surface water flood risk according to either the Local Flood Risk Management Strategic or the Strategic Flood Risk Assessment or is at risk from flooding, for example because the proposed basement is below the static water level of nearby surface water features?	EA mappings indicates the site is at a 'low' risk of surface water flooding and it is noted that the site did not experience flooding in the significant flooding events in 1975 and 2002.	None

4.4.1 Non-Technical Summary: Surface Flow and Flooding

The proposed basement extension will be constructed in the area of the site currently used as a car park. As such the proposed development will not involve the removal of soft landscaped areas and therefore the proportion of hardstanding on site will not change due to the development.

There could potentially be a marginal change in route on site as surface water will flow around the proposed above ground extension where currently it can flow across the carpark area. This would be a very minor change in route, however as the surface water would already flow around the existing building in the general north east to south west direction. The nearest surface water feature (excluding historical features) is over 300m from the site and any changes in surface water flow on site would be expected to dissipate over this distance, being negligible at the surface water feature.

4.5 Summary

Based on this screening exercise, further stages of basement impact assessment are required for this site. These should address the items presented in Table 7.

Table 7. Summary of Screening Exercise

Item	*Description*
1.	***Subterranean (groundwater) flow*** Investigation – Groundwater levels across site have been found to be variable. Further monitoring visits will be undertaken to confirm the groundwater level at the existing monitoring wells. The proposed development will not increase the proportion of hardstanding on site and is therefore not anticipated to impact the amount of surface water able to drain into soils.
2.	***Slope/land stability*** Assessment – The proposed development is potentially at risk from shrink/swell of the London Clay Formation, however the proposed development is not anticipated to affect the shrink/swell capacity of the clay. The impact on the existing structure and nearby properties of unloading of the soils/re-loading with the proposed above ground extension will be considered in a ground movement assessment.
3.	***Surface flow and flooding*** None – the proposed development will not increase the proportion of hardstanding on site and is anticipated to have a negligible impact on surface water run-off or surface water attenuation characteristics.
4.	***Cumulative impacts*** As groundwater flow would not be expected within the London Clay, it is expected that cumulative impacts from the construction of the basement will be negligible. As the proportion of hardstanding on the site will not change the proposed

Item	*Description*
	development is not anticipated to impact to surface water flow onsite. Based on the distance to neighbouring properties the ground movements are anticipated to have a negligible impact on the neighbouring structures.

5. SCOPING

On the basis of the screening report, further groundwater monitoring visits are required and a Basement Impact Assessment should be undertaken.

The groundwater monitoring visits will aim to determine groundwater levels on the site, if groundwater is present. The findings of these groundwater monitoring visits are presented within Section 6.

The Basement Impact Assessment will be used to find the impact of the proposed development on the existing apartment block and to predict the ground movements at the neighbouring properties as a result of the proposed development. A building damage assessment for the existing apartment block and the neighbouring buildings will be included within the basement impact assessment.

6. ADDITIONAL GROUNDWATER MONITORING

6.1 Groundwater Monitoring

Groundwater monitoring visits were undertaken at the site by CGL on 6th, 14th and 20th December 2017. The groundwater level at the two Soil Consultants monitoring wells (boreholes WS1 and WS2) were recorded on each visit. The wells were found to be 20mm standpipes with no covers. It was not possible to purge the wells to measure recharge rates due to the diameter of the standpipe and boreholes being located under foliage. The results are presented in Table 8 below. The records of the groundwater monitoring visits are included as Appendix D.

Table 8. Summary of Groundwater Monitoring Visits

Borehole	Response Zone	Date	Groundwater level (mOD) [mbgl]
WS1	Weathered London Clay Formation and London Clay Formation	06.12.17	44.4 [1.2]
WS1		14.12.17	44.8 [0.8]
WS1		20.12.17	44.7 [1.0]
WS2	Made Ground, Weathered London Clay Formation and London Clay Formation	06.12.17	42.7 [1.9]
WS2		14.12.17	42.8 [1.8]
WS2		20.12.17	42.8 [1.8]

The groundwater was found at levels between 42.7mOD (1.9mbgl) and 44.78mOD (0.82mbgl). The groundwater levels were generally consistent at each of the window sample locations, however the groundwater level at borehole WS2 was approximately 1m lower than the groundwater level at borehole WS1. It is noted that as pipes had no cover and that some of the water could be standing water that has entered during rainfall.

The groundwater level at borehole WS1 was broadly consistent with the level reported in the Soil Consultants report[2], which was found to be at a level of 44.95mOD (0.95mbgl). The groundwater level measured by CGL at borehole WS2 was found to be higher than the level of 41.1mOD (3.5mbgl) reported by Soil Consultants[2].

The observed groundwater levels indicate that groundwater is likely to be encountered during the excavation of the proposed basement and as such ground water control measures will be required. Additionally, as the groundwater is within the Weather London Clay / London Clay Formation the ingress rate is anticipated to be slow and groundwater control is likely to be achieved by sump pumping as the excavation progresses. The water could potentially be perched within the Made Ground, in which case it would be expected to be of limited volume.

7. BASEMENT IMPACT ASSESSMENT

7.1 Conceptual Site Model

A conceptual site model (CSM) relating to potential ground movement, has been developed based on the available data. The CSM is presented in Figure 4.

7.2 Damage Categories

Ground movements have been calculated and used to assess potential 'damage categories' that may apply to the existing building on site and neighbouring structures due to the proposed basement construction method and assumed construction sequence. The methodology proposed by Burland and Wroth[11] and later supplemented by the work of Boscardin and Cording[12] has been used, as described in *CIRIA Special Publication 200*[13].

General damage categories are summarised in Table 9 below.

Table 9. Classification of damage visible to walls (reproduction of Table 2.5, CIRIA C580[14])

Category	*Description*
0 (Negligible)	Negligible – hairline cracks
1 (Very slight)	Fine cracks that can easily be treated during normal decoration (crack width <1mm)
2 (Slight)	Cracks easily filled, redecoration probably required. Some repointing may be required externally (crack width <5mm).
3 (Moderate)	The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable linings. Repointing of external brickwork and possibly a small amount of brickwork to be replaced (crack width 5 to 15mm or a number of cracks > 3mm).
4 (Severe)	Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows (crack width 15mm to 25mm but also depends on number of cracks).
5 (Very Severe)	This requires a major repair involving partial or complete re-building (crack width usually >25mm but depends on number of cracks).

The above assessment criteria are primarily relevant for assessing masonry structures founded on strip footings. Therefore, this methodology is appropriate for the assessment of the impact of the development at the single storey structure and the house No.16 and No.72 Kingsland. The assessment

[11] Burland, J.B., and Wroth, C.P. (1974). *Settlement of buildings and associated damage*, State of the art review. Conference on Settlement of Structures, Cambridge, Pentech Press, London, pp611-654

[12] Boscardin, M.D., and Cording, E.G., (1989). *Building response to excavation induced settlement*. J Geotech Eng, ASCE, 115 (1); pp 1-21.

[13] Burland, Standing J.R., and Jardine F.M. (eds) (2001), *Building response to tunnelling, case studies from construction of the Jubilee Line Extension London*, CIRIA Special Publication 200.

[14] CIRIA (2003). *Embedded retaining walls – guidance or economic design*. CIRIA C580.

has also been used for the existing flats at Barrie House however it is noted the flats are founded on pad foundations. The angular distortion of the flats occurring due to differential settlement between the pads has been included.

7.3 Land / Slope Stability

The following sections assess the ground movements that may results from the construction of the basement and how these could affect the nearby structures. It is understood the excavation will be retained by a secant piled wall with underpins proposed where the proposed basement eastern wall is beneath the existing ground floor western wall of Barrie House.

Ground movements are derived from:

- Pile wall installation: Vertical and horizontal ground movements will be generated during the installation of the secant pile wall proportional to the length of the piles.
- Pile wall deflection: Deflections occur as the excavation proceeds and the piled wall is loaded with retained earth and water pressures, this can give rise to lateral and vertical ground movements.
- Heave movements: The London Clay Formation is susceptible to short term heave and time dependant swelling on unloading, which will occur as a result of basement excavation, generating upward ground movements.
- Long term ground movement: The net loading on formation soils will generate ground movement, which could affect adjacent foundations. This takes into account existing stress conditions, additional loads from the basement structure and the weight of soil removed.
- Settlement of underpins: Some settlement of underpins following construction is anticipated, however this can be limited by following good construction practice.

It is noted that one wall of the existing Barrie House structure will be underpinned as part of the development. The north west wall of Barrie House will be underpinned with the formation level of the underpins proposed to be 40.20mOD, 0.5m below the formation level of the basement slab. The underpins are stiff concrete walls and lateral movements are expected to be negligible. Assuming good construction practices and control, horizontal deflections in front of the underpinned wall are expected to be minimal.

7.4 Ground Movements: Pile Wall Installation and Deflection

7.4.1 Pile Wall Installation and Deflection Assessment

A secant piled wall is proposed as part of the development around the perimeter of the new basement. The installation of these piles and the excavation of material for the basement will generate vertical and horizontal ground movements. An impact assessment has been undertaken to assess the magnitude of movement at the closest neighbouring properties of No. 16 and No.72 Kingsland, located 9.5m and 7.5m from the site, respectively. The existing foundations for the flats at Barrie House and the single storey structure are in front of the underpinned wall and so the movements due to installation of the piles has not been included for the assessment of these structures.

The assessment of the ground movements has been undertaken by CGL using CIRIA C760[15] to calculate the horizontal and vertical movements resulting from the excavation and the installation of the piled wall. The analysis has been undertaken assuming high support during excavation. The depth of embedment of the secant piles has been modelled as 3m below the formation assuming that the wall will be propped during construction. The excavation required to reach formation level is 5.3m, with the 3m of embedment this gives a total pile length of 8.3m.

The assessment of movements caused by excavation in front of the walls has been undertaken assuming "high support stiffness" during excavation with surface movements being 0.15% of the excavation depth. It has been assumed that the distance behind the wall to negligible movement due to excavation in front of the piled wall will be 4 times the excavation depth (21.2m) for horizontal movements and 3.5m times the excavation depth (18.55m) for vertical movements. The horizontal and vertical movements due to secant pile installation have been taken as 0.08% and 0.05% based on CIRIA 760[15]. It has been assumed the distance to negligible movements due to installation of the piles will be 1.5 times pile length for horizontal movements and 2 times pile length for vertical movements. These are conservative assumptions as per CIRIA C760[15].

7.4.2 Pile Wall Installation and Deflection Results

7.4.2.1 Ground movements

The results indicate that the ground movements at the piled wall at ground level (46mOD) due to installation and deflection of the piled wall, and excavation behind the wall, will be approximately 14.59mm of horizontal movement and 9.54mm of vertical movement directly adjacent to the wall. At a distance of 14m away from the proposed piled wall the horizontal and vertical movement are

[15] CIRIA C760. (2017). *Guidance on embedded retaining wall design.* CIRIA C760.

predicted to be less than 1mm. It is assumed that the movements dissipate in a non-linear, parabolic curve with distance from the wall.

The maximum movements at a neighbouring properties of No. 72 (7.5m from the proposed development) and No.16 (9.5m from the proposed development) are summarised in Table 10. The distances for movement to become less than 1mm are presented in Figure 5.

Table 10. Summary of Ground Movements due to piled wall installation and deflection

Stage	*Approximate distance from secant pile wall (m)*	*Level at which movements are assessed (mOD)*	*Max horizontal movements (mm)*	*Max vertical movements (mm)*
No. 72	7.5	46	4.36	3.12
No. 16	9.5	46	2.79	2.02

The movements at Broxwood Way, at around are predicted to be approximately 12.5m from the site, are predicted to be a maximum of 1.72mm of horizontal movements and 1.45mm of vertical movement. These are not anticipated to impact the roadway.

7.5 Ground Movements: Unloading / Reloading

An assessment of the vertical ground movements resulting from the proposed development has been undertaken using *PDISP (Pressure Displacement)* analysis software. *PDISP* assumes that the ground behaves as an elastic material under loading, with movements calculated based on the applied loads and the soil stiffness (E_u and E') for each stratum input by the user.

7.5.1 Excavation / demolition unloading

The proposed development will involve the unloading of around 5.3m of soil. Based on the ground conditions presented in Table 2 this would be expected to result in an unloading of some 105kN/m^2.

The excavation of the backfilled void area is understood to involve the removal of soil from approximately 44.8mOD to 42.5mOD, some 2.3m of excavation. The backfilled material is assumed to be Made Ground type material and to not be well compacted. A soil unit weight of 18kN/m^3 is assumed. Therefore the excavation of the backfilled void will result in an unloading of 48.6kN/m^2. An small area adjacent to the backfilled void will be excavated to form a stairway, it is understood this will be from ground level (and excavation of 3.5m), resulting in an unloading of 69kN/m^2.

An unloading of 30kN/m^2 has been applied to the PDISP model at 45mOD for the demolition of the two storey porters lodge.

7.5.2 Structural loading

7.5.2.1 Building loads

Loads for the building have been supplied by the structural engineer. These are provided in Appendix B. The building is proposed to be supported by a series of internal columns and liner walls around the perimeter of the basement. Loads supplied by the structural engineer are summarised in Table 11. The London Clay Formation at this level is predicted to have an allowable bearing capacity of some 200kN/m^2 based on the c_u of the London Clay Formation at the formation level (40.2mOD) being approximately 100kN/m^2. The pad foundations are to be approximately 2m^2. Pads at some columns were required to be extended slightly greater than 2m^2 to remain within the allowable bearing capacity. Where pads were found to overlap, the pads were merged and loads totalled and spread over the combined pad area. Where loads are indicated as wall loads, these have been modelled as having pad foundations with bearing area adjusted to limit pressure to 200kN/m^2 or less. These are indicative pad dimensions only.

The foundation dimensions and the foundation pressures calculated based on the allowable bearing capacity of around 200kN/m^2 that are input into the PDISP analysis are presented in Table 11. The loads have been referenced on Figure 6.

Table 11. Summary of Proposed Column Loads and Indicative Required Foundation Areas

Load reference	*Proposed load (combined)[kN]*	*Required pad area (m^2)*	*Foundation pressure (kN/m^2)*
A	280	4	70.0
B	210	4	52.5
C	310	4	77.5
D	225	4	56.3
E	1800	9.108	197.6
F	1060	6.077	174.4
G	200	4	50.0
H	640	4	160.0
I	210	4	52.5
J	380	4	95
K	800	5.0625	158.0
L	1085	5.76	188.4
M	280	4	70.0
N	210	4	52.5
O	310	4	77.5
P	300	16	111.3
Q	920		
R	280		
S	280		
T	665	4.41	150.8
U	210	4	52.5

It is understood that the perimeter liner wall loads will be carried by the secant pile wall and as such have not been included in the PDISP analysis.

7.5.2.2 Underpin loading

The existing foundations of the existing Barrie House structure, for the north west ground floor wall, are understood to be founded at 43.7mOD within the London Clay Formation. The underpins are proposed to be founded at 40.2mOD, within the London Clay Formation, 0.5m below the proposed slab formation level of 40.7mOD. The underpin arrangement and loads have been supplied by the structural engineer. The underpin loads have been input to PDISP as gross loads. The underpin column and wall loads have been spread over the areas indicated by the drawing Proposed Lower Ground Floor Plan P_20 provided in Appendix B. The underpinned pad foundations sizes will match the dimension of the existing pad foundations.

7.5.3 PDISP analysis results

The predicted short term and long term total ground movements for the proposed development are presented in Figure 7. The movements are summarised in Table 12. The PDISP analysis output summary is provided in Appendix E.

Table 12. Predicted Vertical Movement Summary

Stage	*Max heave within basement footprint (mm)*	*Max settlement within basement footprint (mm)*	*Max vertical movement at No. 72 Kingsland (closest neighbouring property) (mm)*
Short term	8.5	0.0	0.0
Total movements	9.5	2.0	Less than 0.5

The total vertical movements at the closest neighbouring properties of No. 16 and No.72 Kingsland at the proposed new basement formation level (40.2mOD) are predicted to be less than 0.5mm.

The vertical movements from the demolition of the porters lodge at ground level (46mOD) are predicted to be a maximum of 8.5mm of heave in the long term. This is predicted to dissipate to less than 1mm at approximately 7m from the porters lodge. The movements due to the demolition are predicted to be negligible at the neighbouring properties, No. 16 and No. 72 Kingsland.

7.6 Impact Assessment

The cumulative total movements at the closest neighbouring properties of No. 16 and No. 72 Kingsland, as well at the structures on site due to the proposed basement development are assessed in the following sections. At the structures on site the cumulative vertical movements have been calculated from the combined underpin construction and the unloading / reloading movements. At No.

16 and No. 72 Kingsland the cumulative vertical movements are based on the pile installation and deflection movements only as the vertical movements due to unloading / reloading was found to be negligible at the properties. Horizontal movements that will impact the neighbouring properties are anticipated to be from the pile wall installation, deflection and excavation movements only. The horizontal movements at the existing structures on site will be due to lateral movements from the underpinning. As discussed previously, as the underpins are stiff concrete walls and lateral movements are expected to be negligible. Assuming good construction practices and control, horizontal deflection in front of the underpinned wall are expected to be minimal and within the limits of strain for Damage Category 0/ Damage Category 1.

7.6.1 No. 16 and No. 72 Kingsland

The deflections and horizontal strain have been calculated for No. 72 and No. 16 assuming 5m widths of buildings. The profiles of horizontal and vertical movements at each property are presented in Figure 8. The maximum horizontal strain is predicted to be 0.04% at No. 16 and 0.60% at No. 72. The maximum vertical deflection is predicted to be <0.5mm at No. 16 and at No. 72, indicating deflection ratios of 0.004. The vertical movements at the properties due to the unloading / reloading of soil were found to be negligible at the properties and as such the damage assessment has been based on the installation and deflection movements only.

7.6.2 Existing Barrie House Flats

The existing flats at Barrie House are founded on pad foundations with formation levels between 43.71mOD and 42.11mOD. The impact assessment has been undertaken for the flats has been undertaken for section line A-A’ on Figure 2, at a level of 42.33mOD, the average level of the foundations not proposed to be underpinned. The section takes into account the settlement at the formation level of the foundation that will be underpinned.

The vertical displacement at the formation level of the underpin due to unloading / reloading of soils is predicted to be a maximum of approximately 4.0mm of heave beneath the underpins (reducing to 2.0mm of heave in the long term). The maximum long term vertical movement due to unloading / reloading is predicted to be 2.7mm of heave at the foundation closest to the underpin. An additional 5mm of settlement has been allowed for to take into account potential settlement due to underpin construction. It is assumed this dissipates from 5mm to 0mm parabolic ally over the 4.4m between the proposed underpin and the closest existing foundation. The total long term cumulative movements are predicted to be 3.76mm of settlement at the underpin and 2.7mm of heave at the closest foundation of the Barrie House flats. The vertical movement profile for the existing flats foundations is presented in Figure 9.

The predicted maximum differential settlement between the foundations is approximately 6.76mm between the underpin and the closest existing foundation (4.4m away). This indicates a maximum angular distortion of 1/650 which is less than the recommended angular distortion limit of 1/500 for structural integrity. The maximum vertical deflection between the underpin and the closest existing foundation (distance of 4.4m) is predicted to be 2mm, resulting in a deflection ratio of 0.045.

The horizontal movements are predicted to be negligible due to the foundations being in front of the reinforced concrete underpins.

7.6.3 Existing Single Storey Structure

The single storey ground floor extension at Barrie House is founded on strip footings 0.85m deep, extending approximately 11.2m from the proposed new basement. The assessment has been undertaken for section line B-B' on Figure 2 at a level of 45.15mOD.

The results of the assessment indicate that the unloading / reloading of the soils will cause around 3.3mm of vertical heave at the footing. An additional 5mm of settlement has been allowed for to take into account potential settlement due to underpin construction. It is assumed this dissipates from 5mm to 0mm parabolic ally over the 11.2m of the building. The maximum total long term cumulative vertical movements are predicted to be 1.95mm of settlement. The deflection over the 11.2m of strip footing is predicted to be less than 1mm, indicating a deflection ratio of 0.009. The vertical movement profile for the single storey structure strip foundation is presented in Figure 9.

Due to the strip footing being underpinned with reinforced concrete, the horizontal movements are anticipated to be negligible.

7.7 Damage Assessment – Summary

The cumulative long term total movements at the closest neighbouring properties of No. 16 and No. 72 Kingsland, as well at the structures on site due to the proposed basement development are summarised in Table 13 and Table 14.

Table 13. Summary of Cumulative Horizontal Movements

Property	*Horizontal movements (mm)*	*Width (m)*	*Maximum horizontal strain (%) over property*
No.72 Kingsland	4.36	5	0.06
No. 16 Kingsland	2.79	5	0.04
Barrie House flats	0 (2.5[a])	4.4m from underpin	0.057 [a]
Barrie House single storey structure	0 (5.2[b])	11.2	0.046 [b]

a. Limiting horizontal movement for Damage Category 1.
b. Limiting horizontal movement for Damage Category 0.

Table 14. Summary of Cumulative Long Term Vertical Movements

Property	*Maximum vertical movements from piled wall installation and basement excavation (mm)*	*Construction of underpin settlement (mm)*	*Maximum long term vertical movements from unloading / reloading of soil (mm)*	*Maximum cumulative long term vertical movements (mm)*	*Maximum vertical deflection ratio over property*
No.72 Kingsland	-3.12	-	Negligible	-3.12	0.004
No. 16 Kingsland	-2.02	-	Negligible	-2.02	0.004
Barrie House flats foundations (at underpin / existing foundation)	-	-5	+2.7	-3.76	0.045
Barrie House single storey structure	-	-5	+3.3	-1.95	0.009

Note. +ve = heave, -ve = settlement

The results of the assessment for each section are plotted on Figure 10.

The assessment indicates that Damage Category 1 "very slight damage" is applicable for No. 72 and Damage Category 0 "negligible damage" is applicable for No. 16 Kingsland. The predicted movements at the neighbouring properties are small and are unlikely to result in damage in excess of Category 1 ('very slight'). This is within the allowable limits specified within London Borough of Camden's basement planning guidance.

The predicted movements at the structures at Barrie House indicate the Damage Categories of Category 0 "negligible damage" for the single storey structure and Category 1 for the existing flats foundations "very slight damage". The movements are predicted to be negligible at the flats in the south of the site.

A construction monitoring scheme will be required to demonstrate that movements are within those predicted by the CGL analysis. Monitoring will be carried out by the contractors or their representatives using targets and methods agreed with party wall surveyors prior to the beginning of construction.

It is recommended that a condition survey is undertaken on all adjacent walls and property facades prior to the works commencing and ideally when monitoring baseline values are established. Existing cracks or structural defects should be carefully recorded, documented and regularly inspected as construction progresses.

8. SUBTERRANEAN (GROUNDWATER) FLOW

8.1 Introduction

This section provides a qualitative assessment of the effect the basement will have on the local hydrogeological regime and whether this will affect adjacent properties.

8.2 Groundwater Conditions

Groundwater has been found by CGL monitoring to be present on site at levels between 42.7mOD (1.9mbgl) and 44.8 (0.8mbgl) within the Weathered London Clay / London Clay Formation. The groundwater level was found to be deeper in the south of the site – indicating that if the groundwater encountered in WS1 and WS2 is laterally consistent – it is likely to flow down gradient to the south of the site. The flow rates through the London Clay would be expected to be very slow and a regional 'water table' would not be mobile and affected by the proposed development.

Whilst groundwater was encountered in both window sample boreholes WS1 and WS2 it was not encountered in borehole BH1 or window sample WS3. It is therefore considered likely that the groundwater is not laterally persistent. Based on this and the low permeability of the strata the groundwater is in, the proposed excavation is not anticipated to act as an obstruction to groundwater flow or to have a significant impact on local groundwater.

8.3 Impact on Adjacent Properties/Infrastructure

No significant change in groundwater pressures around the site perimeter is anticipated and therefore ground movements / settlement due to changing groundwater levels are not expected to occur.

8.4 Recommendations for Groundwater Control

The basement will be constructed using a combination of underpinning and secant piling. These structures will help to restrict ingress of water into the excavation. As the groundwater has been encountered within the London Clay Formation, a relatively impermeable soil, ingress would be expected to be slow and manageable through groundwater control measures such as sump pumping.

9. SURFACE FLOW AND FLOODING

9.1 Flood Risk

With reference to EA mapping, the site is at a 'low' risk from surface water flooding. The proposed excavation for the basement will be on an area currently covered by hardstanding. As such the excavation will not change the potential for surface water flooding. It is noted the site did not experience flooding in the significant flooding events in 1975 and 2002.

There could potentially be a marginal change in route on site as surface water will flow around the proposed above ground extension where currently it can flow over the carpark area. This would be a very minor change in route however as the surface water would already flow around the existing building in the general north east to south west direction. The nearest surface water feature (excluding historical features) is over 300m from the site and any changes in surface water flow on site would be expected to dissipate over this distance, being negligible at the surface water feature.

10. NON-TECHNICAL SUMMARY

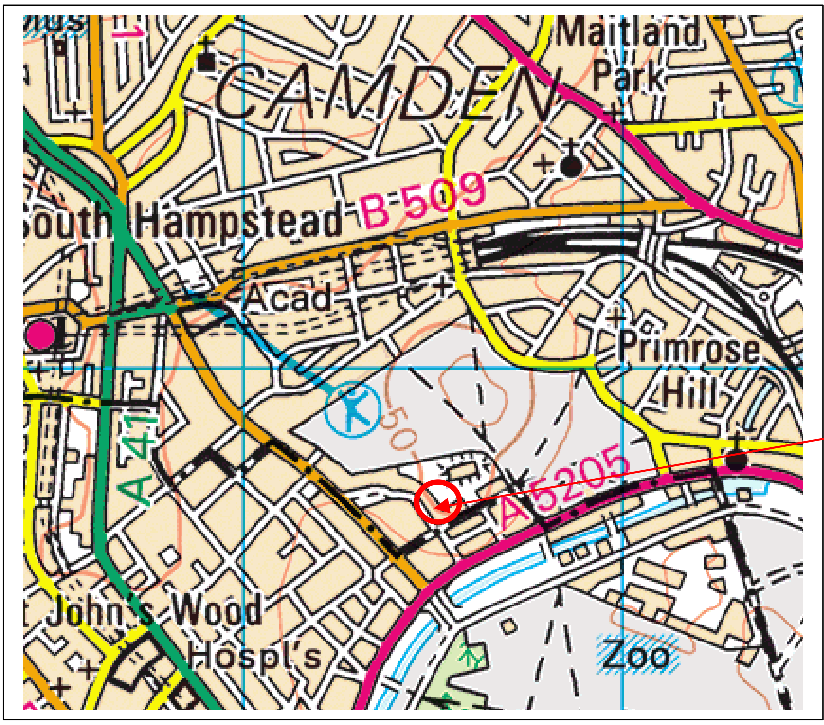
10.1 Conclusions

The results of this Basement Impact Assessment are informed by the previous site investigation[2], CGL groundwater monitoring visits and published and unpublished records. The analysis is also informed by drawings and loadings provided by the structural engineer, and is undertaken on the assumption of high quality workmanship during the construction of the basement.

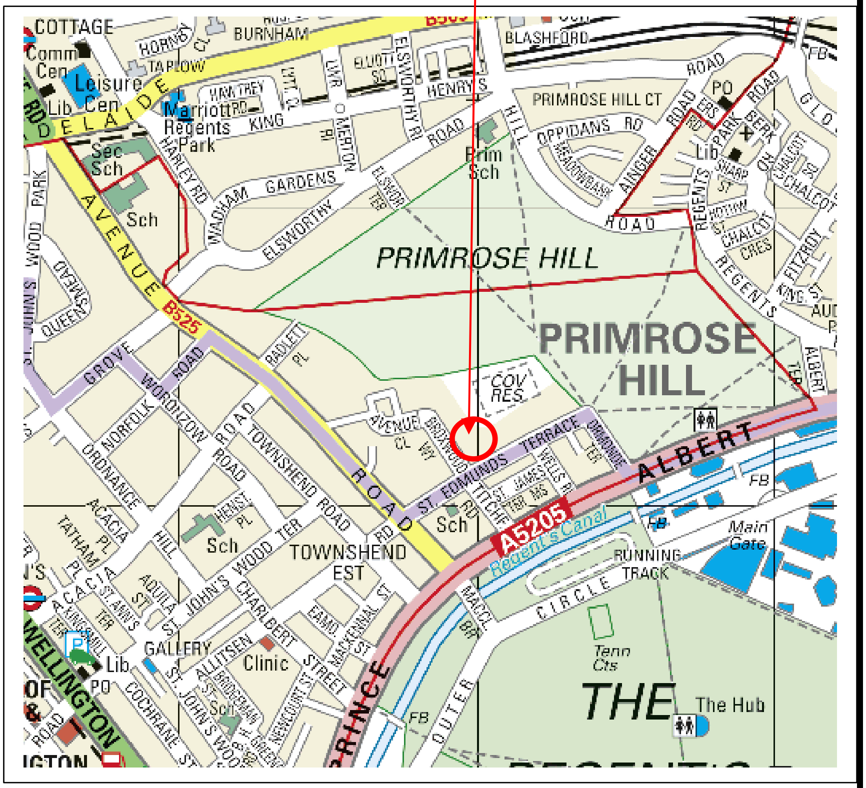
- The ground conditions on site comprise a thin layer of Made Ground over cohesive Weathered London Clay and subsequently the London Clay Formation.
- The construction of the basement will generate ground movements due to a variety of causes including heave, settlement, and installation of a secant pile wall and underpin deflection. However, there are no party wall structures and the nearest neighbouring structure is approximately 7.5m from the proposed development.
- Based on a typical 45° load spread from the proposed development the neighbouring structures will be out of the zone of influence of the proposed development.
- The movements due to excavation of the basement and installation of the secant pile wall are anticipated to dissipate to less than 1mm at a distance of 14.0m from the pile wall and as such will not significantly impact the neighbouring structures.
- The largest movements at the neighbouring structures due to the excavation and installation of the secant piled wall and excavation behind the wall are anticipated to be 4.36mm of horizontal movement at the southern corner of No.72 Kingsland and 2.79mm of horizontal movement at No. 16 Kingsland.
- The vertical movements due to installation of the piled wall and excavation behind the wall are predicted to be 3.12mm and 2.02mm of settlement at No.72 and No.16, respectively.
- The maximum vertical ground movement from unloading/ reloading of soils, at the neighbouring properties is predicted to be less than 1mm.
- The assessment indicates that Damage Category 1 “very slight” will be applicable to No. 72 Kingsland, whilst Damage Category 0 “negligible” will be applicable t No. 16 Kingsland.
- It is currently proposed to underpin foundations along one wall of the existing Barrie House structure. It is noted that settlement of the underpins would not affect neighbouring properties.

- The basement development and underpinning will cause ground movements at the existing foundations of the Barrie House flats and at the single storey structure with strip footings on site.
- The maximum long term cumulative vertical movements at the single storey structures and the flats are predicted to be 1.95mm and 3.76mm of heave, respectively.
- The angular distortion between the foundation of the existing flats which will be underpinned, and the closest existing foundation (not to be underpinned) is 1/650, and is not considered to pose a threat to the structural integrity of the building.
- Horizontal movements in front of the underpinned wall are anticipated to be negligible.
- Groundwater has been encountered within the Weathered London Clay / London Clay Formation on site. Due to the low permeability of the London Clay Formation, water ingress is anticipated to be low. Groundwater control is likely to be achieved by sump pumping as the excavation proceeds.
- It is recommended that prior to construction commencing, a condition survey be conducted for the neighbouring properties. Once construction begins the movement of the walls and the facades of the adjoining properties should be regularly monitored.
- It is predicted that the proposed development will have a negligible impact on the neighbouring properties and at the nearby roads of Broxwood Way and St Edmunds Terrace.
- The proposed footprint of the basement is currently covered by hardstanding. Therefore surface water flow and water ingress into the ground will not change. Groundwater has been identified in some areas on site and is likely to be encountered during excavation, however ingress rates are anticipated to be slow. Groundwater ingress is likely to be controlled through normal sump and pump dewatering.

FIGURES



Site location: Barrie House, NW8 7QH



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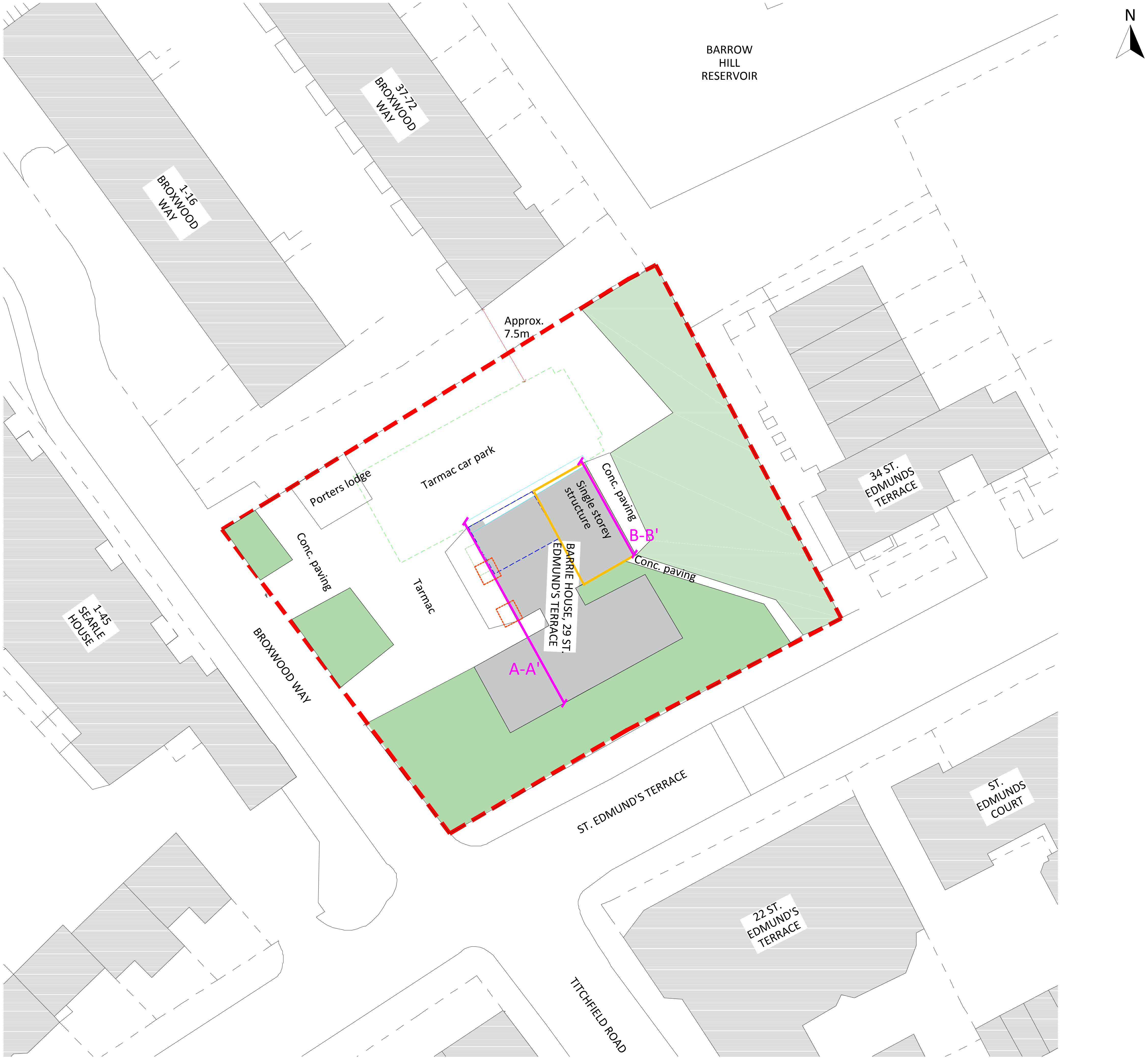
Client	Project	Job No
Parmarbrook	**Barrie House**	**CG/28408**
CGL	Title **Site Location Plan**	**Figure 1**



KEY

- Site Boundary
- Proposed new basement outline (approx.)
- Section of wall to be underpinned
- Existing Barrie House structure
- Existing areas of soft landscaping
- Backfilled void area
- Stairway area for excavation
- Existing single storey structure
- Approximate location of existing pad foundations for Barrie House flats

Rev	Date	Comments
1	16/05/18	Section lines added MRG
0	02/01/18	

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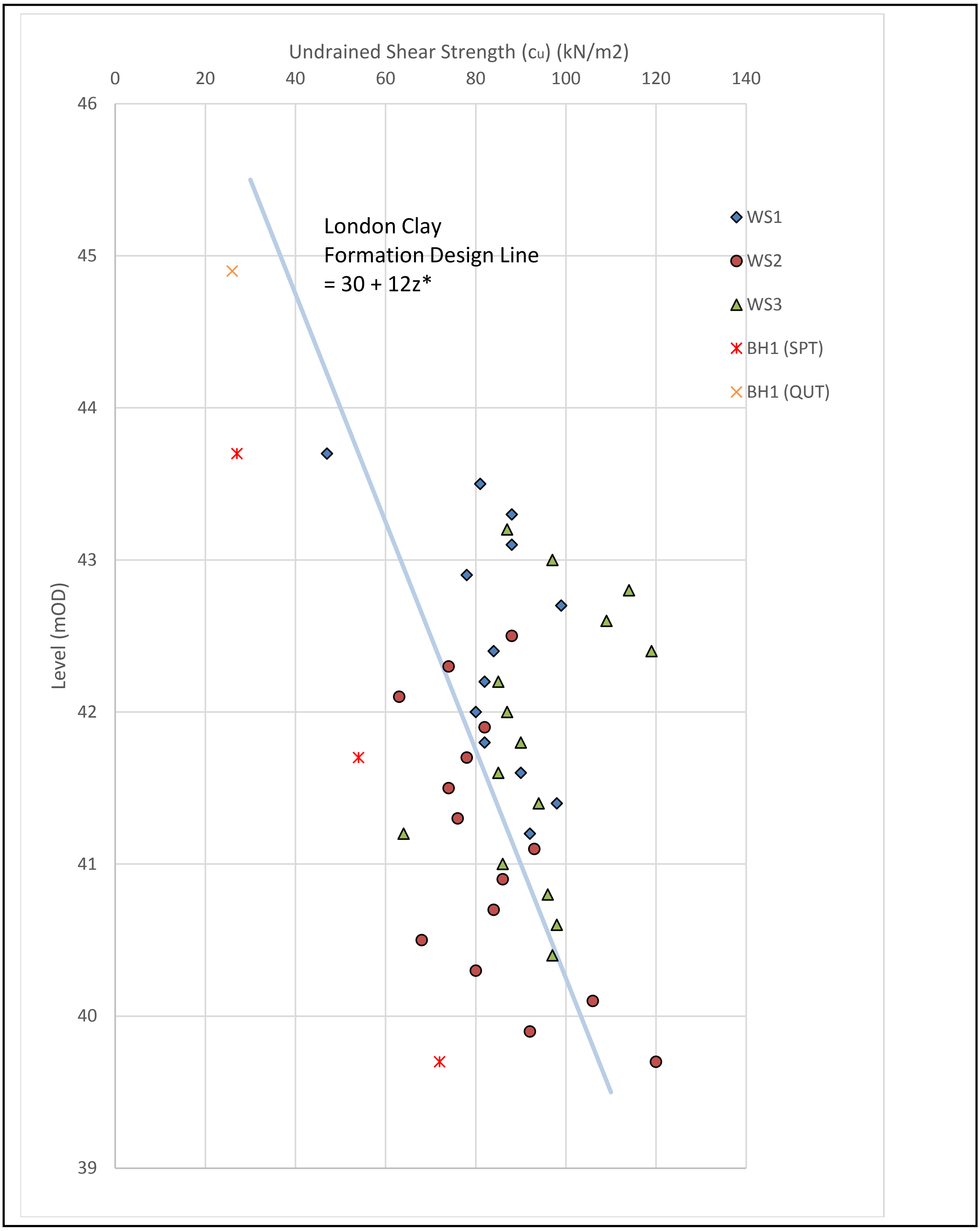
Project: **Barrie House, London**

Client: **Parmabrook**

Drawing title: **Figure 2 - Site Layout Plan**

Scale(s)	Job No.
NTS	CG/28408

			Dwg No.	Rev.
Drawn	TSB	02/01/18	CG/28408-001	0
Checked	JMS	02/01/18		
Approved	RJB	03/01/18		



z = depth below top of strata

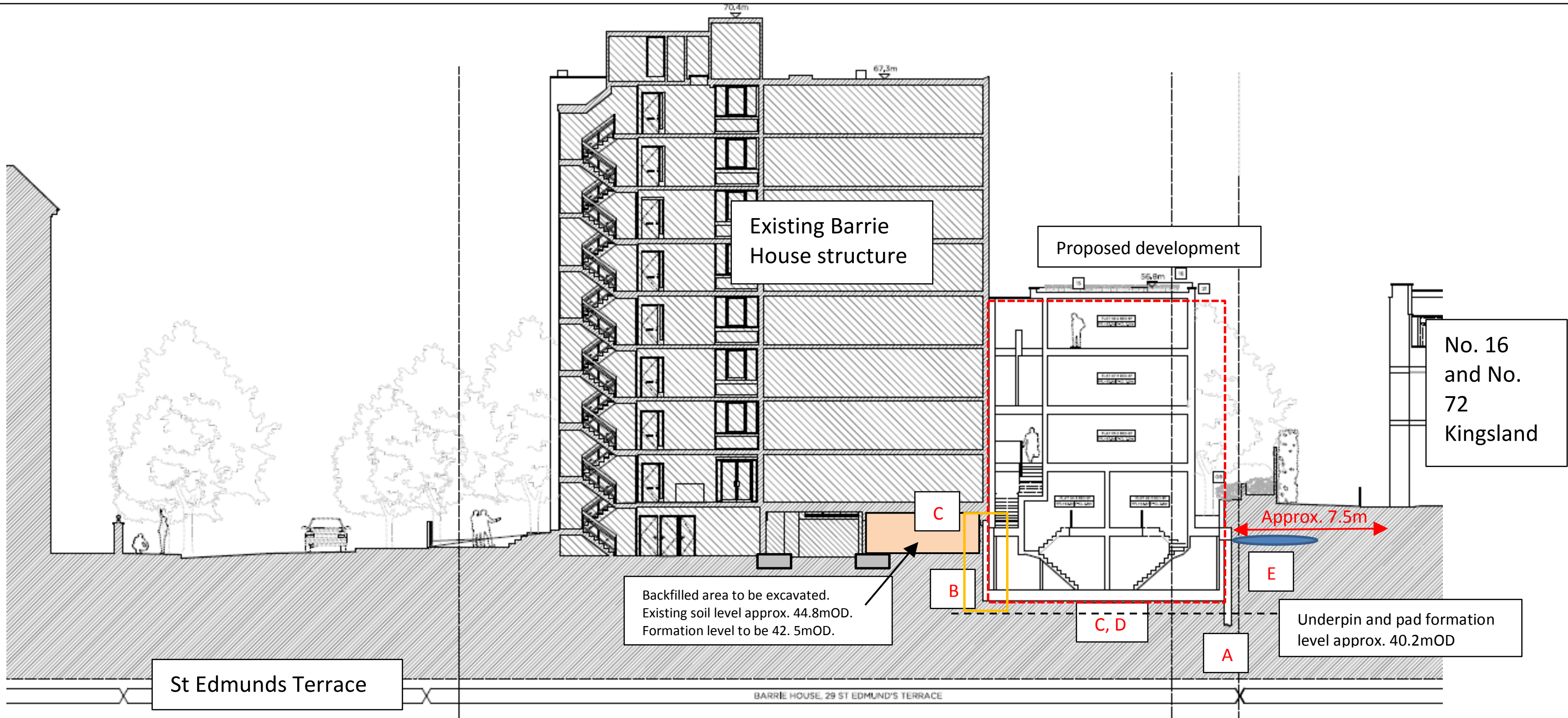
Client	Project	Job No
Parmarbrook	**Barrie House**	**CG/28408**
CGL	Title **Undrained Shear Strength (c_u) vs Level**	**Figure 3**

Potential source of ground movement:

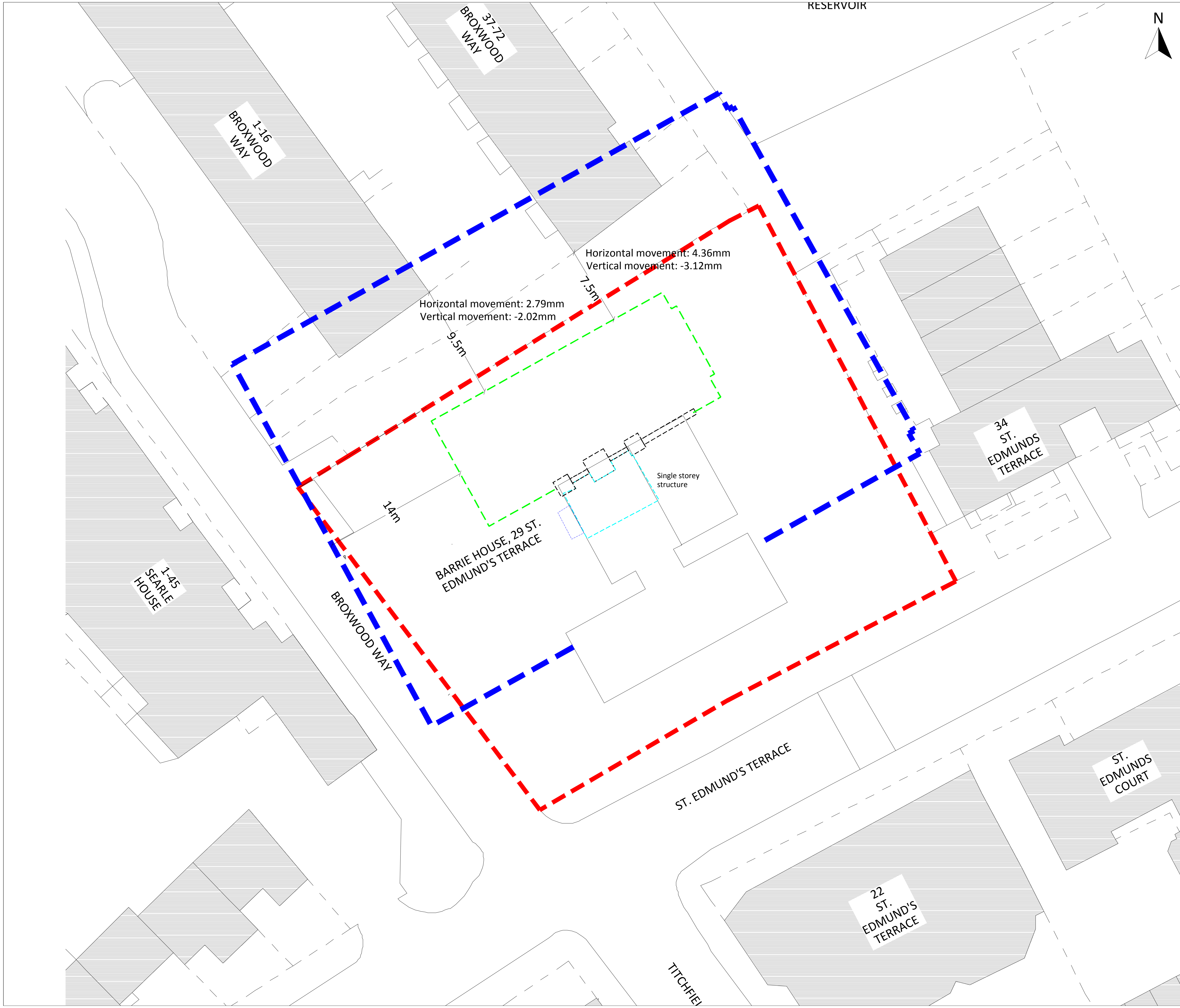
A. Secant pile wall installation and deflection during excavation
B. Possible settlement due to underpinning of existing Barrie House structure
C. Possible short and long term heave due to unloading of London Clay Formation
D. Possible settlement due to building loads of the proposed development

Groundwater:

E. Groundwater present on site within the London Clay Formation - the groundwater is located within a relatively impermeable soil and if groundwater is encountered during the excavation of the lower ground floor ingress is expected to be slow and manageable.



Client	Project	Job No
Parmarbrook	**Barrie House**	**CG/28408**
CGL	Title **Conceptual Site Model**	**Figure 4**



KEY

- Site Boundary
- Distance to negligible movements (<1mm)
- Proposed secant pile wall (approx.)
- Backfilled void area
- Underpinning locations
- Stairway excavation

Notes.

1. -ve vertical movement = settlement

Rev	Date	Comments
1	16/05/18	Comments
1	25/01/18	

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Project: **Barrie House, London**

Client: **Parmabrook**

Drawing title: **Figure 5 - Excavation and Pile Wall Installation Movements - Distance to Negligible Movements Plan**

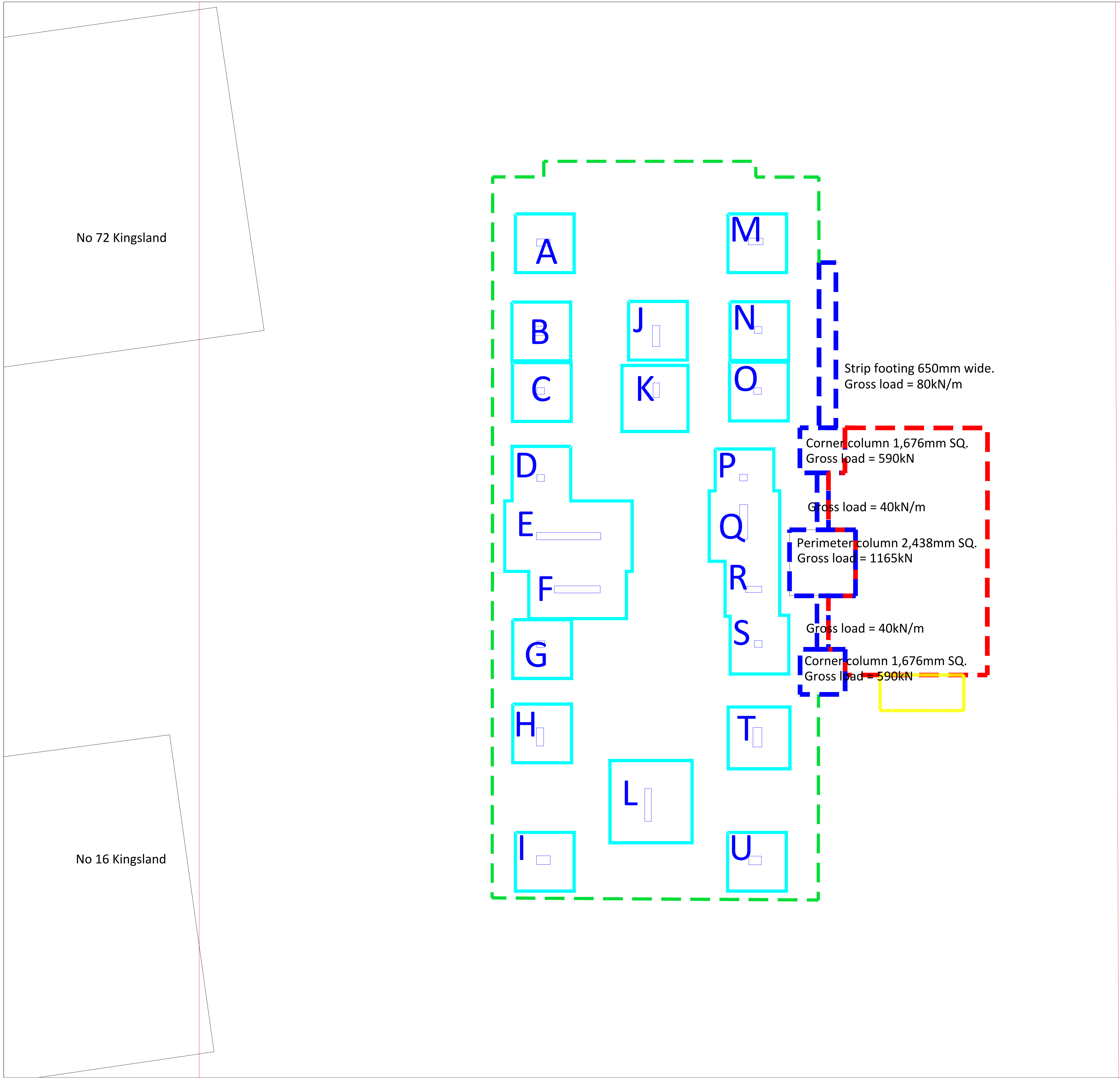
Scale(s): **NTS**

Job No.: **CG/28408**

Drawn	TSB	02/01/18
Checked	JMS	02/01/18
Approved	RJB	03/01/18

Dwg No.: **CG/28408-002**

Rev.: **0**



KEY

- Proposed secant pile wall
- Indicative pads for PDISP model
- Proposed column / wall load locations
- Underpinning locations
- Backfilled void area to be excavated
- Stairway excavation area

Rev	Date	Comments
2	16/05/18	MRG-Update pad details
1	25/01/18	MRG-Update underpin details and backfilled void area

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Project: **Barrie House, London**

Client: **Parmabrook**

Drawing title: **Figure 6 - Column Load Reference Plan and Indicative Pads**

Scale(s): **NTS**

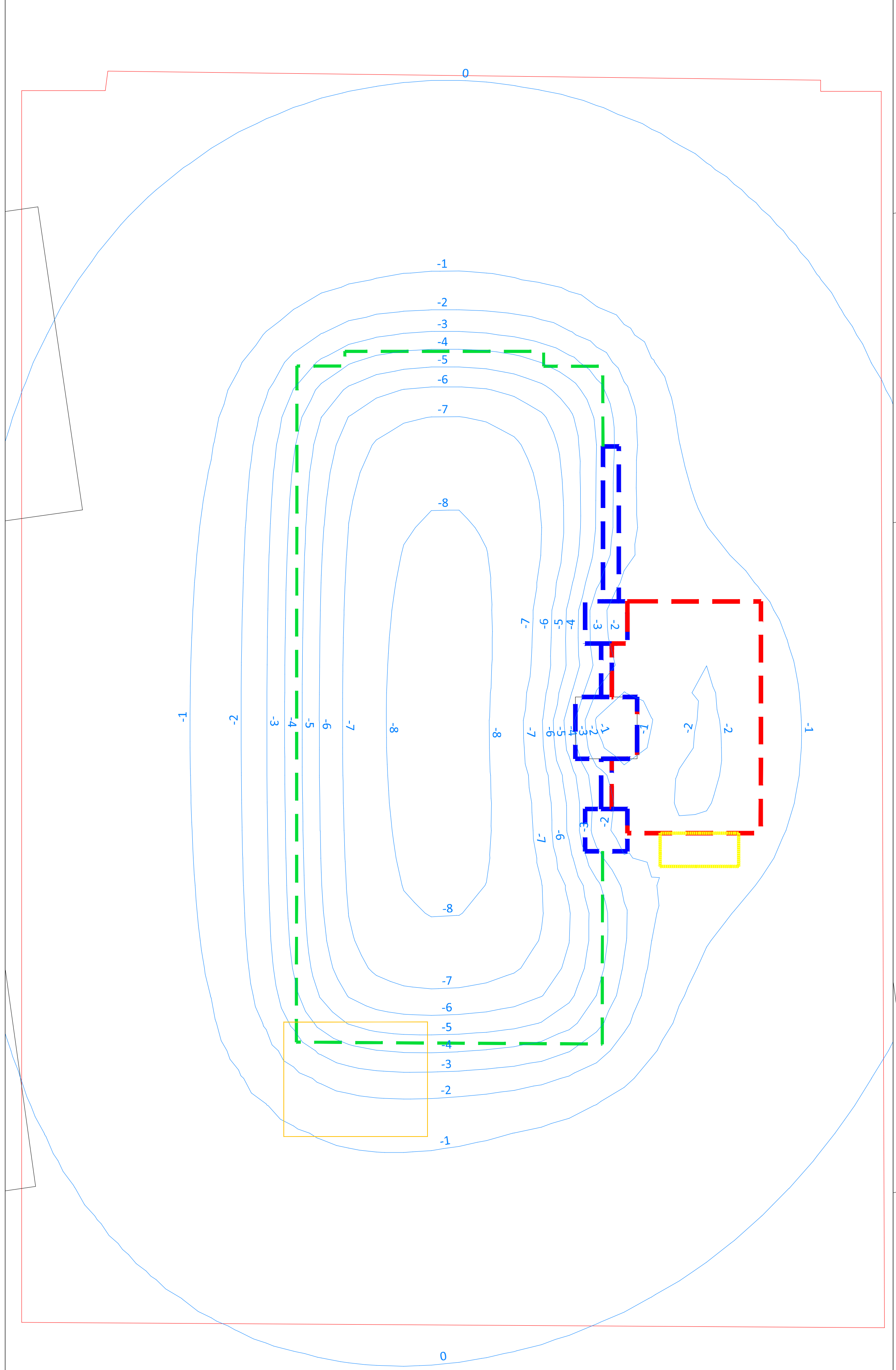
Job No.: **CG/28408**

Drawn	TSB	02/01/18
Checked	JMS	02/01/18
Approved	RJB	03/01/18

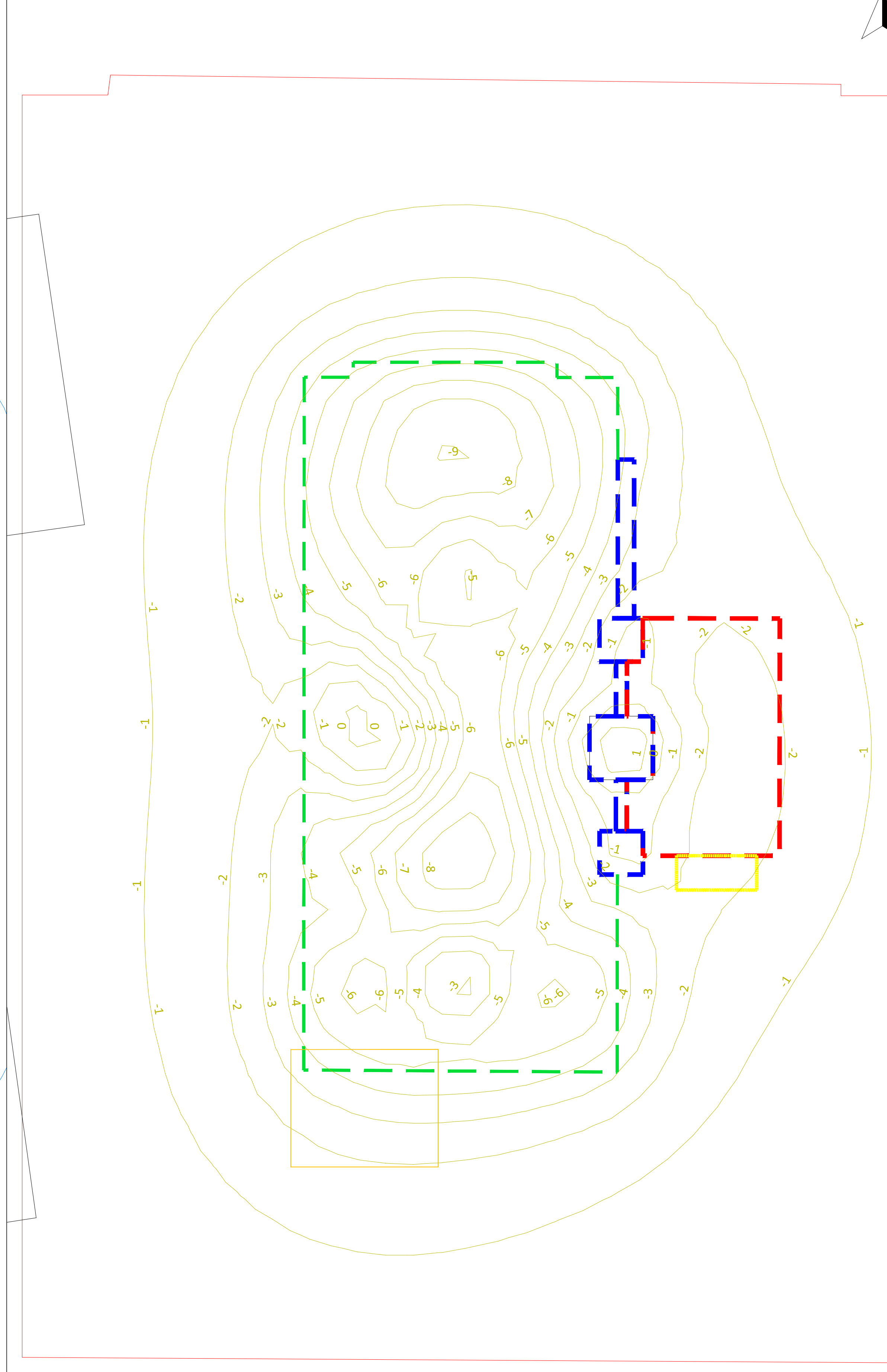
Dwg No.: **CG/28408-003**

Rev.: **1**

SHORT TERM



TOTAL MOVEMENTS



N

KEY

- Proposed secant pile wall
- Underpinned section
- 10m from secant pile wall (closest neighboring property at approx. 10.8m from secant pile wall)
- Stairway excavation area
- Backfilled void excavation area
- Porters lodge to be demolished

Notes

1. Contours are in mm.
2. Postive values indicate settlement and negative values indicate heave.

Rev	Date	Comments
1	16/05/18	MRG Revised for updated formation levels and pad loading
0	02/01/18	

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Project: **Barrie House, London**

Client: **Parmabrook**

Drawing title: **Figure 7 - Vertical Ground Movements at Formation Level (40.2mOD)**

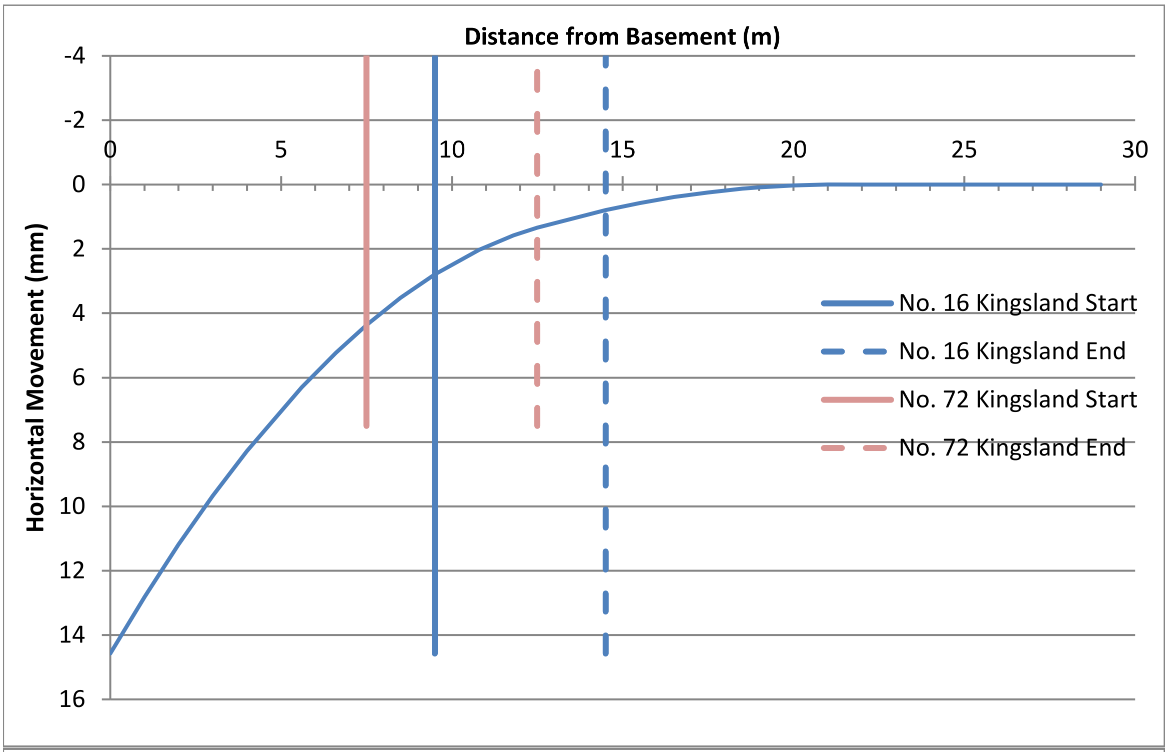
Scale(s): **NTS**

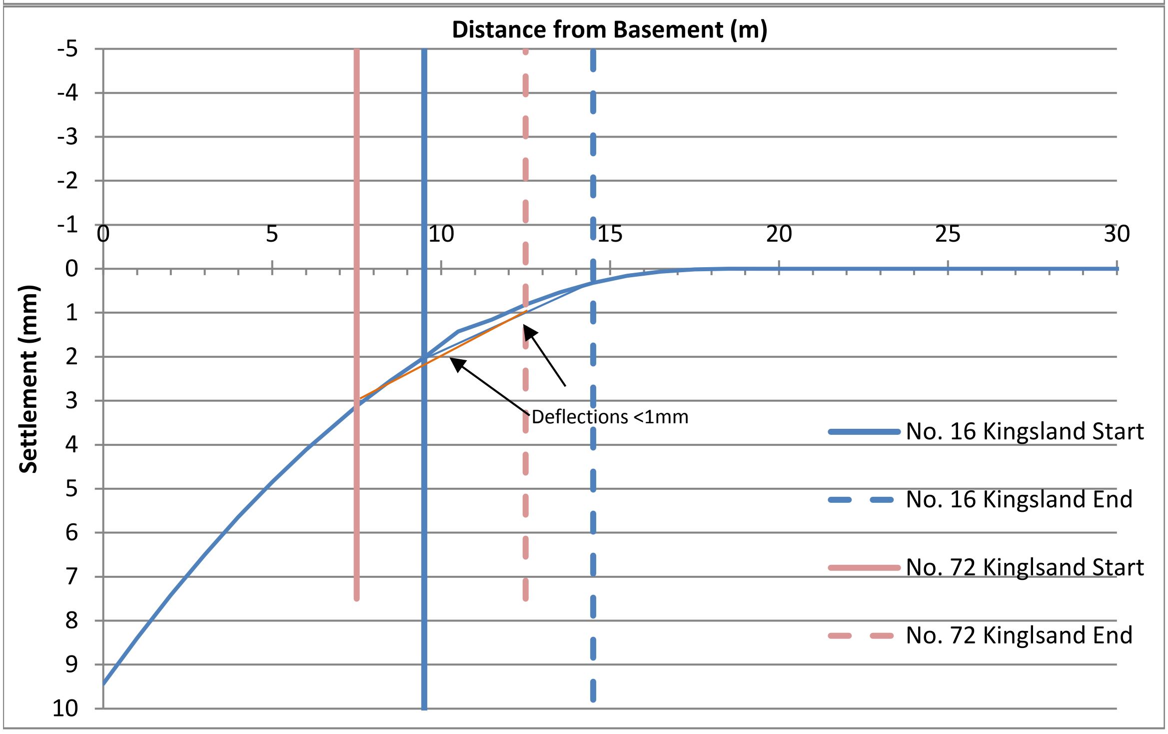
Job No.: **CG/28408**

Drawn	TSB	02/01/18
Checked	JMS	02/01/18
Approved	RJB	03/01/18

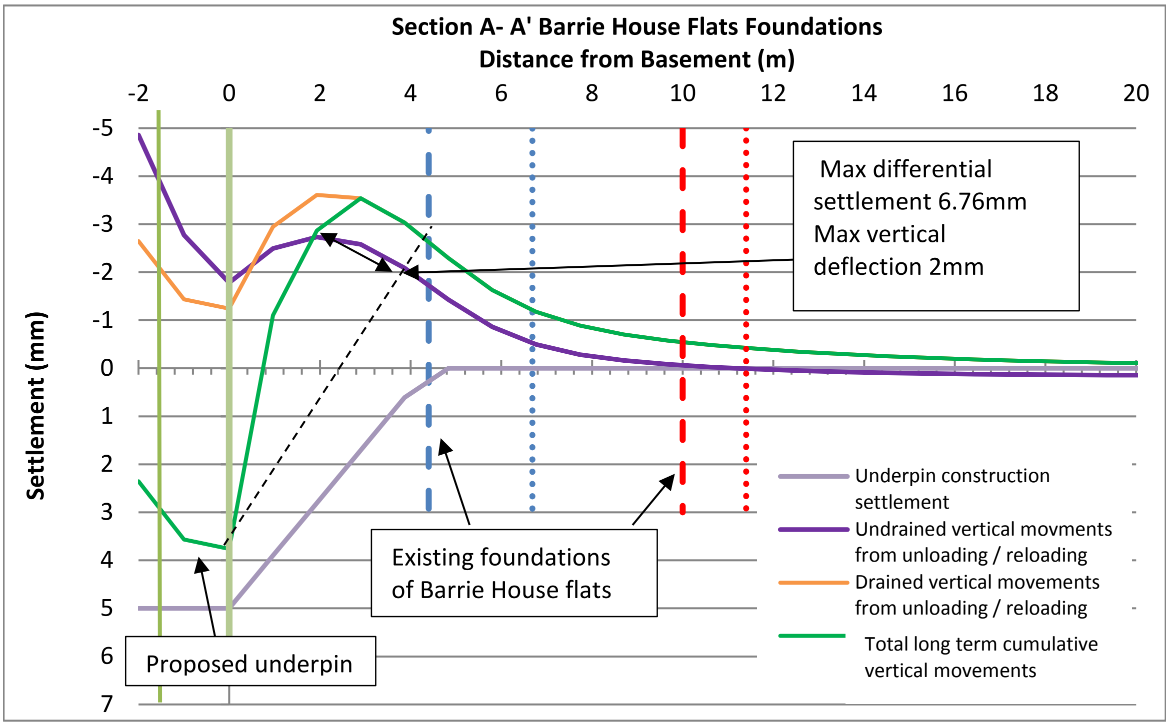
Dwg No.: **CG/28408-004**

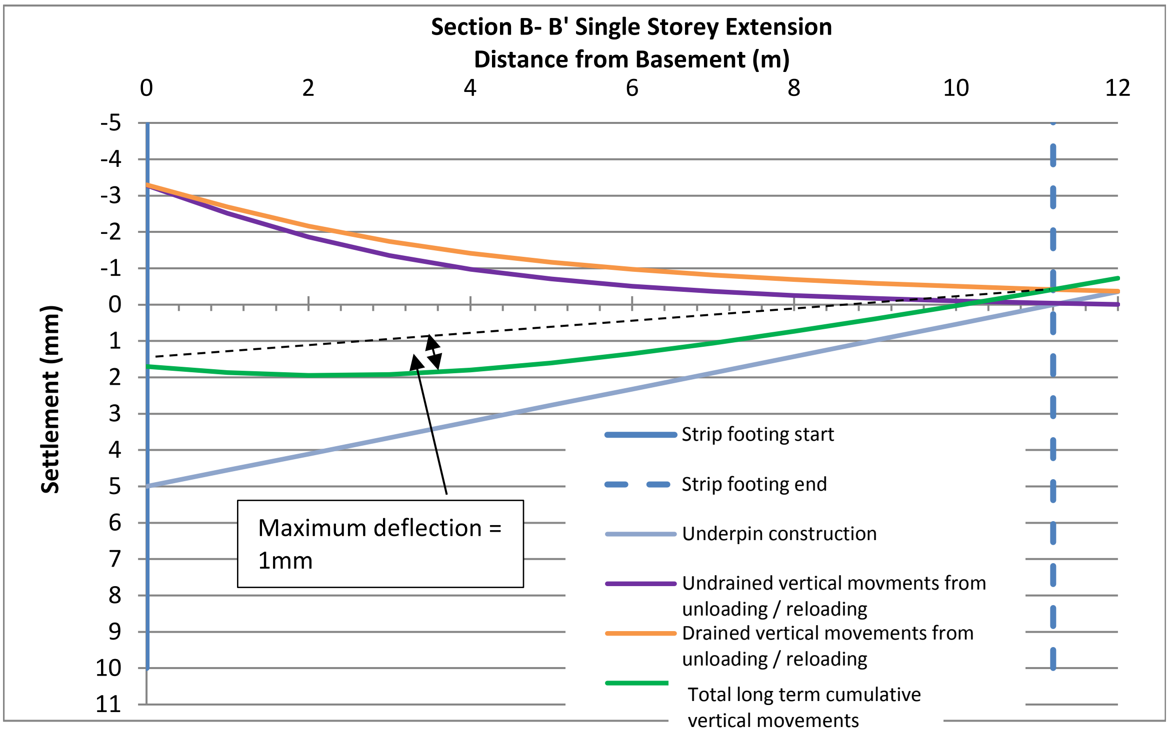
Rev.: **0**



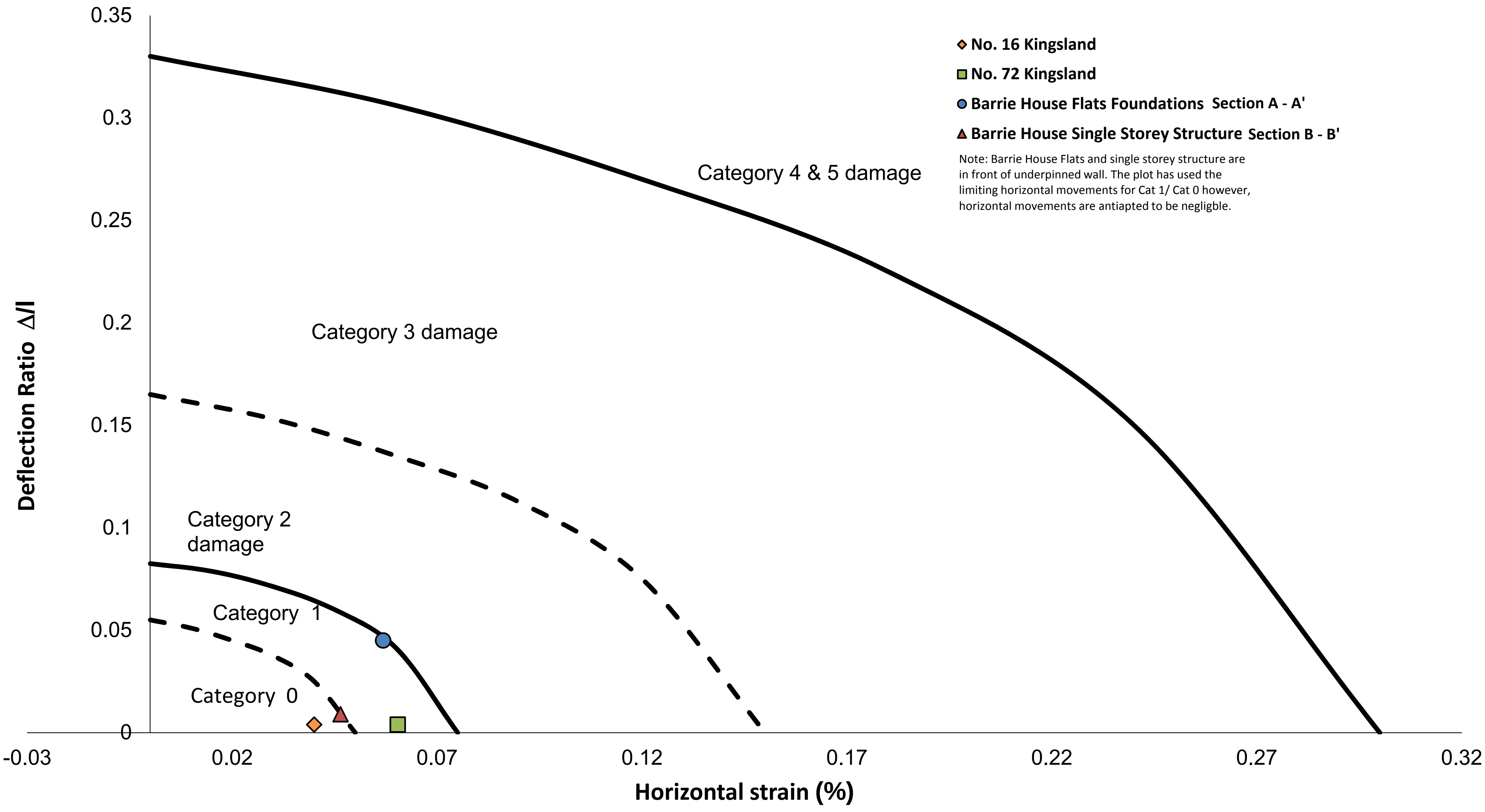


Client	Project	Job No
Parmarbrook	**Barrie House**	**CG/28408**
CGL	Title **Horizontal and Vertical Movements at No. 16 and 72 Kingsland**	**Figure 8**





Client	Project	Job No
Parmarbrook	**Barrie House**	**CG/28408**
CGL	Title **Vertical Movements at Barrie House Structures**	**Figure 9**



Client	Project	Job No
Parmarbrook	**Barrie House**	**CG/28408**
CGL	Title **Building Damage Assessment**	**Figure 10**

APPENDIX A

Historical Structural Drawings

NOTES:-

CONCRETE MIXES:-

GRADE "A" CONCRETE TO BE USED IN ALL COLUMNS, AND ALL CROSS BEAMS. | *Grade above 4th flr.*

6" COLUMNS TO HAVE LIMESTONE AS AGGREGATE.

GRADE "B" CONCRETE TO BE USED IN ALL LONGITUDINAL EDGE BEAMS.

GRADE "C" CONCRETE TO BE USED IN ALL SLABS AND STAIRCASES; IN BASEMENT WALL AND FLOOR "C.W." TO BE USED

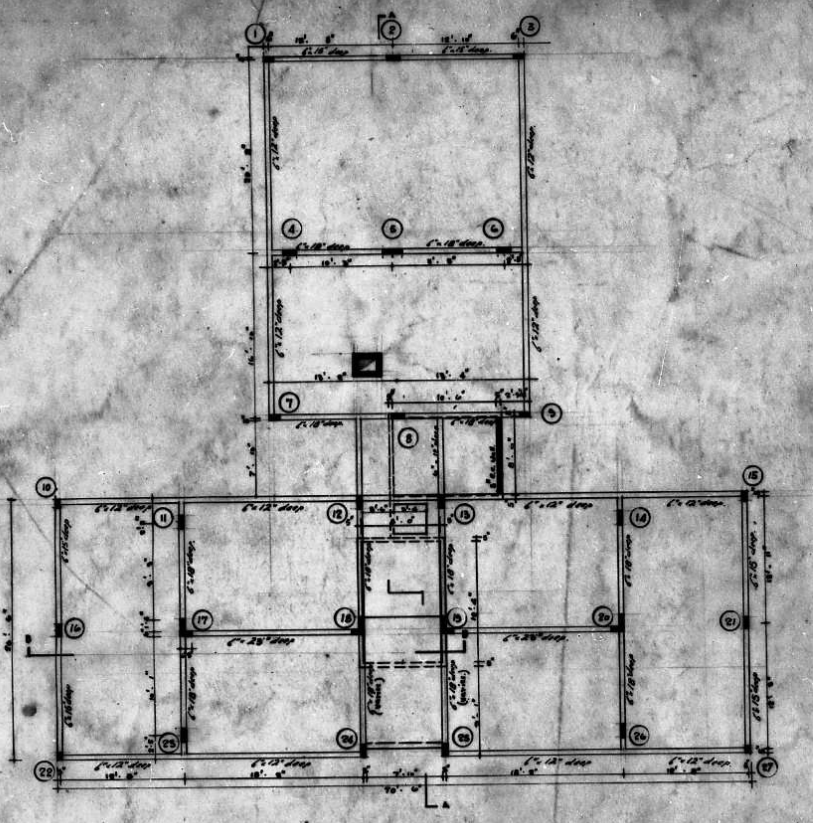
GRADE "E" CONCRETE TO BE USED IN ALL COLUMN FOOTINGS.

GRADE "F" CONCRETE TO BE USED FOR BLINDING CONCRETE UNDER BASEMENT.

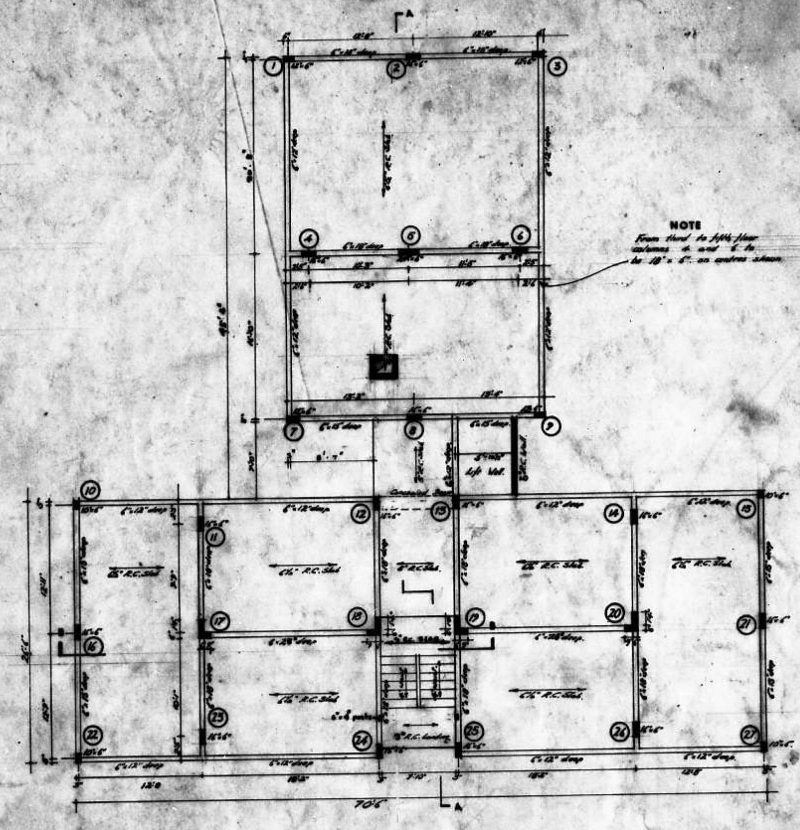
GRADE "G" CONCRETE TO BE USED FOR BLINDING CONCRETE TO FOOTINGS.

SULPHATE RESISTING CEMENT TO BE USED IN ALL CONCRETE AND MORTAR IN CONTACT WITH THE SOIL, EXCEPT SKIRT BEAMS.

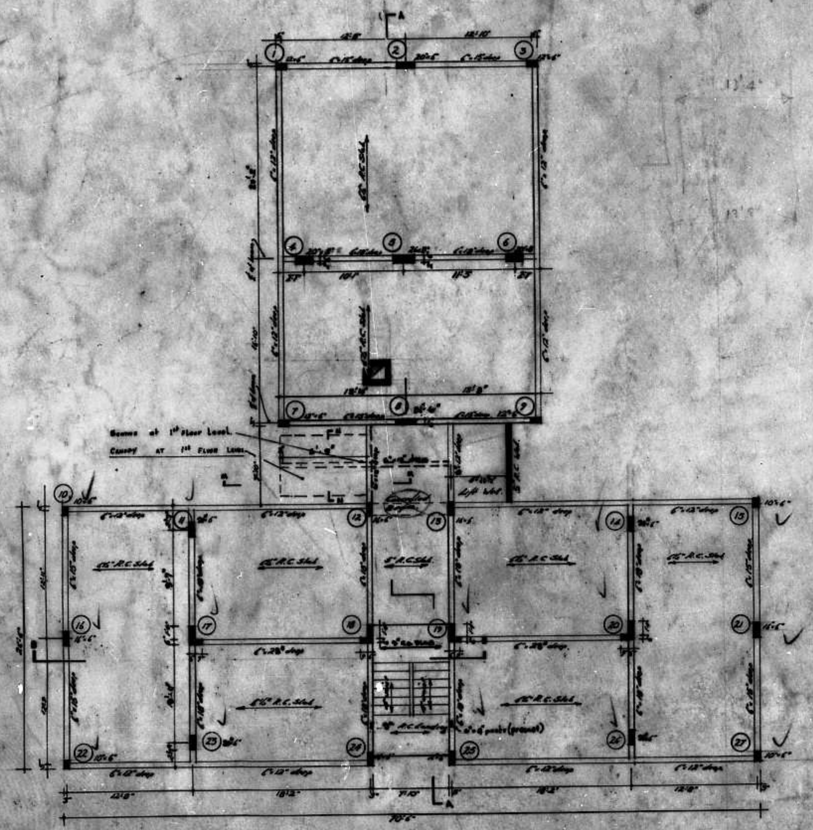
IN ALL 6" WIDE COLUMNS EITHER LIMESTONE AGGREGATE OR 6" MESH TO BE USED AS SPECIFIED.



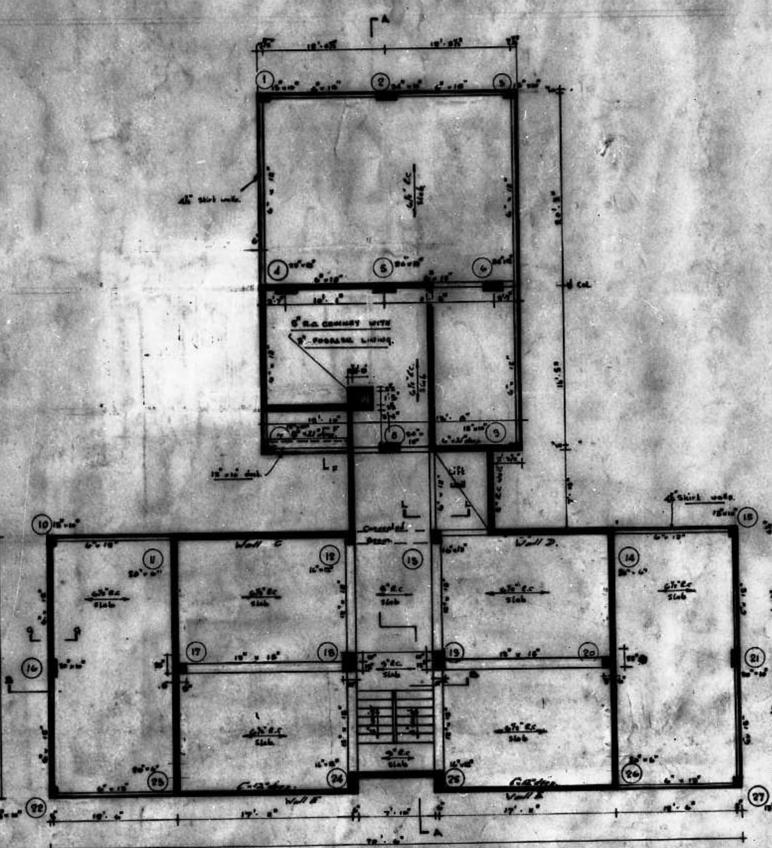
ROOF PLAN



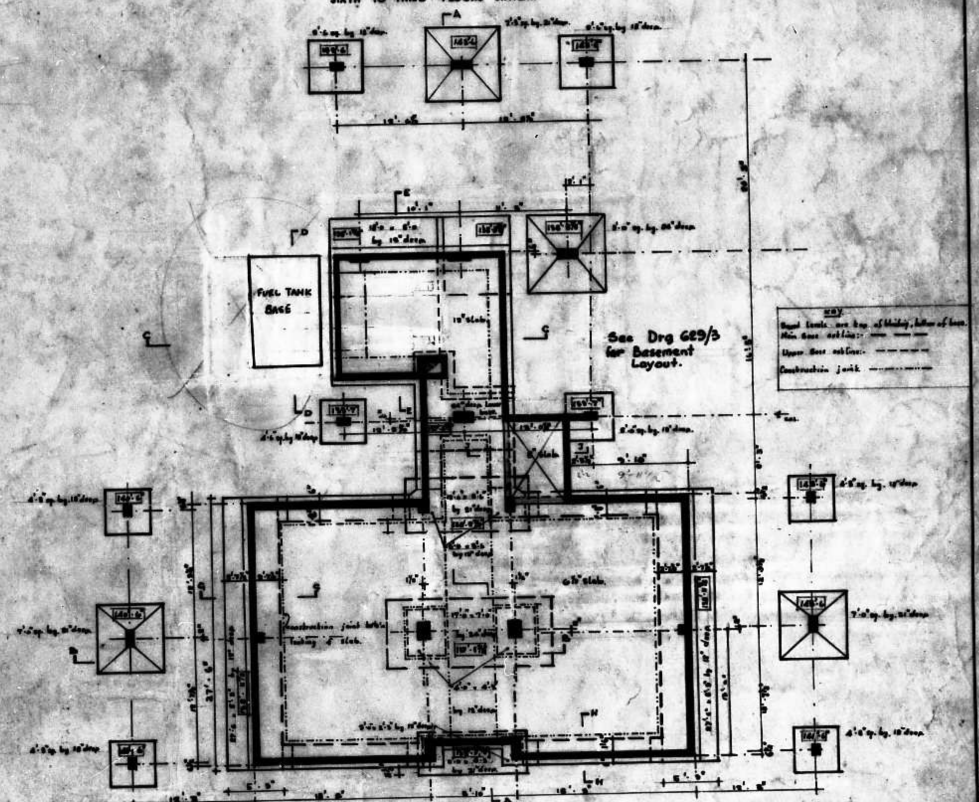
SEVENTH FLOOR PLAN
SIXTH TO THIRD FLOORS SIMILAR



SECOND FLOOR PLAN
FIRST SIMILAR



GROUND FLOOR PLAN



FOUNDATION PLAN

ISSUE	DATE	AMENDMENTS
A	21 Aug 57.	*Floor plan revised.*
B	OCT. 1957.	VARIOUS AMENDMENTS.
C	OCT. 1957	VARIOUS MINOR AMENDMENTS, BASEMENT & FOUNDATION ADDED
D	NOV. 1957.	MINOR ALTERATIONS AND ADDITIONS.
E	NOV. 1957.	SETTING OUT ; & DIM. AND COL. SIZES ALTERED.
F	Mar. 58	*Beam 7-8-9 at ground floor level amended.*
G	APR. 58	FUEL HOPPER REMOVED.

TITLE

29 ST EDMUNDS TERRACE N.W.8.

FLOOR PLANS FOUNDATION PLAN

SCALE 1/8" TO 1' 0"

ARCHITECT
PLANNING & DEVELOPMENT LTD
20 KNIGHTSBRIDGE S.W.1.

DRG. No 629/1ᵍ

DRAWN	R.S.L.R. & T.T.L.
DATE	AUGUST 57.
CHECKED	P

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CONSULTING ENGINEER.
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