Project No. 2163 | Revision [A]: July 2021

89A Gloucester Avenue

Basement Impact Assessment

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QUALITY MANAGEMENT

PROJECT NO.	2163		
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CLIENT	Max Deeley		
PROJECT ADDRESS	Gloucester Avenue, 89B, London NW1 8LB		
DOCUMENT TITLE	Basement Impact Assessment		
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REVISION HISTORY

Rev.	Date	Issue Purpose	Prepared	Checked	Authorised
-	14.07.21	DRAFT	AH	-	-
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1. INTRODUCTION

Constructure Ltd were appointed in June 2021 for initial structural advice on the proposed construction of a front lightwell extension to the property occupying upper and lower ground floor levels at 89A Gloucester Avenue

This Basement Impact Assessment report has been produced to accompany the Planning Application submission by Max Deeley, describing the scope and nature of the structural works. It details the outline approach that will be taken to safeguard the integrity of the existing building, neighbouring structures, highways and services, in particular with the construction of the proposed basement, and also the possible implications of the build on the local environment and how these are to be mitigated.

Due to various factors it has not been possible to assess local ground conditions physically on site, but a review of the publicly available information has been investigated and taken account of within the design approach. The results of the desktop investigations are included within this report.

Please refer to the appendix for a list of structural engineering drawings which support this report and show the shell and core works in detail.

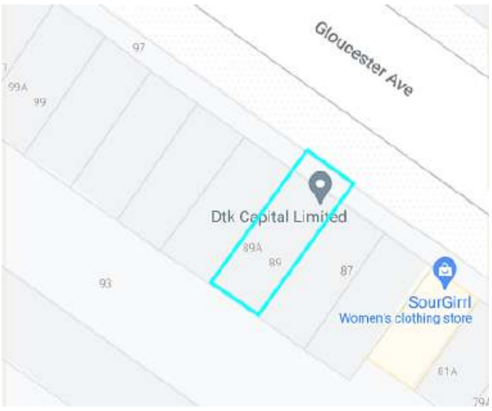
1.1. THE EXISTING SITE AND STRUCTURE

The existing building is a five storey townhouse, thought to have been constructed during the mid to late 19th century. It is understood to be of a traditional construction of timber joisted floors supported off load bearing masonry, with a tiled mansard roof over.

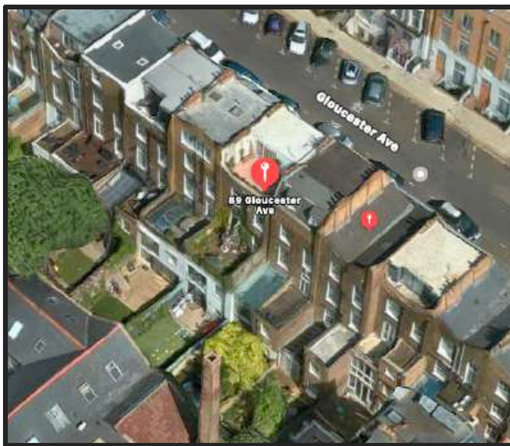
It is located to the north west of the Grand Union Canal, to the north side of Regent's Park and is accessed directly off Gloucester Avenue. Directly to the west lies Primrose Hill, with the ground general sloping in a north west to south east direction. The property lies around 150m from the bottom of the hill, where the Grand Union Canal passes under the road to continue into the north side of Regent's Park.

The site is roughly level across its footprint, with the garden to the rear being lower that the road level to the front.

Aerial Photo



Site Boundary



View from the South

View from the West

View from the North

View from the East

1.2. THE PROPOSED WORKS

As part of a general refurbishment, it is proposed to increase the size of the front LGF area, through incorporating the existing vault into the internal space, and pushing the front wall c. 600mm towards the pavement line, thereby increasing the usable internal area.

It is proposed that new walk on roof lights are incorporated as part of the works, so as to improve the natural light to the new bedroom and en-suite below, plus provide bin and bike storage space over, with new plantings to conceal these from the pavement and roadway.

2. DESK STUDY

A desk study has been carried out. Reference has been made to the following sources:

- Online Geological Maps
- Online Hydrogeological Maps
- Aerial Photographs

- Historic Ordnance Survey Maps ([1]Conservation area statement for Primrose Hill, Camden)
- MAGIC website mapping
- Environment Agency website for Flood Risk
- Bomb Maps

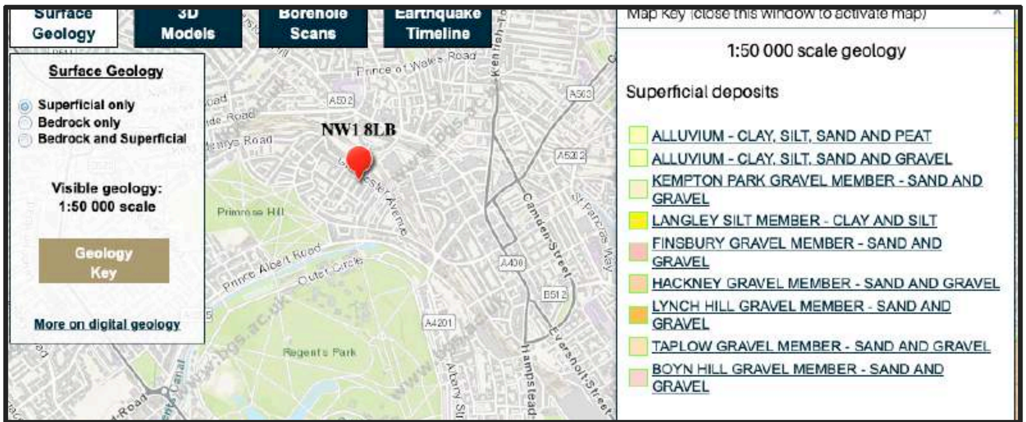
2.1. SITE HISTORY

The site sits within the Primrose Hill conservation area, and was developed from the early - mid 1800's onwards. It is thought the terraced properties along Gloucester Avenue were developed some time prior to 1870, by which time the housing construction in what is now the conservation area was largely complete[1].

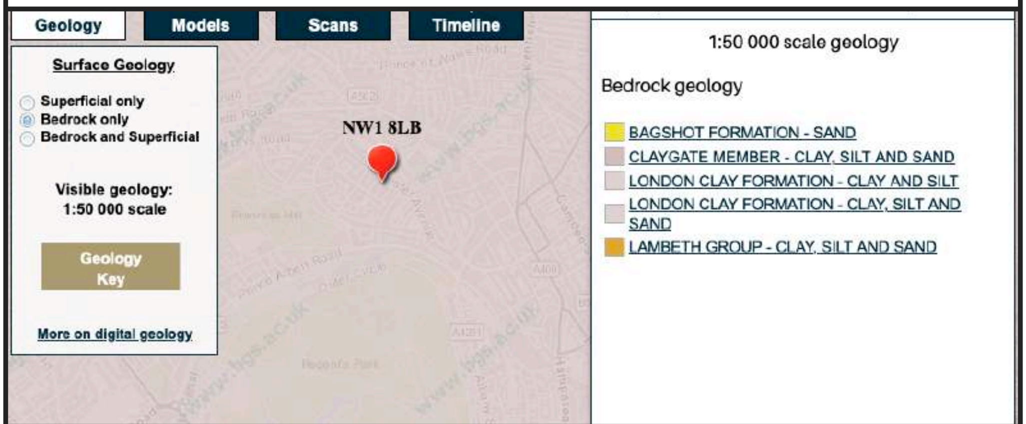
2.2. LOCAL GEOLOGY AND HYDROLOGY

From a review of the publicly available geology information, the site appears to be in an area underlain by the London Clay, with no superficial deposits recorded.

Based on data from several nearby sites we expect the risk of other ground conditions being encountered, other than made ground of variable thickness, is low.



Surface Geology [BGS Extract]



Bedrock Geology [BGS Extract]

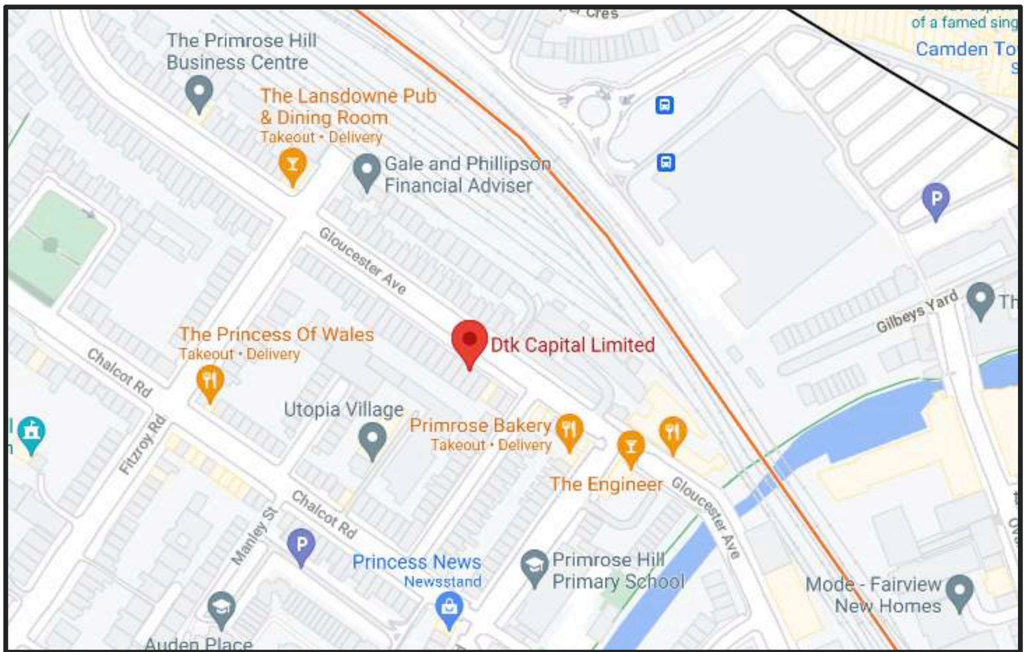
2.3. UNDERGROUND FEATURES

2.3.1. CROSSRAIL / CROSSRAIL 2

Crossrail runs roughly 2km to the south and Crossrail 2 several km's to the west, so neither are considered to be of concern for the project.

2.3.2. LUL / TFL / NATIONAL RAIL

The closest TfL rail asset is found to the east side of Gloucester Avenue, albeit sufficient far away as to not be of concern. The nearest LUL line is approximately 1km to the east, this being the northern line [1].



1. TfL Assets (none present)

2.3.1. LOST RIVERS

No “lost rivers” are believed to be near our site, with the closest being the Tyburn River around 1km to the west of Primrose Hill, and the Fleet, which passes north/south to the east of Camden Town.

2.3.2. POST OFFICE TUNNELS

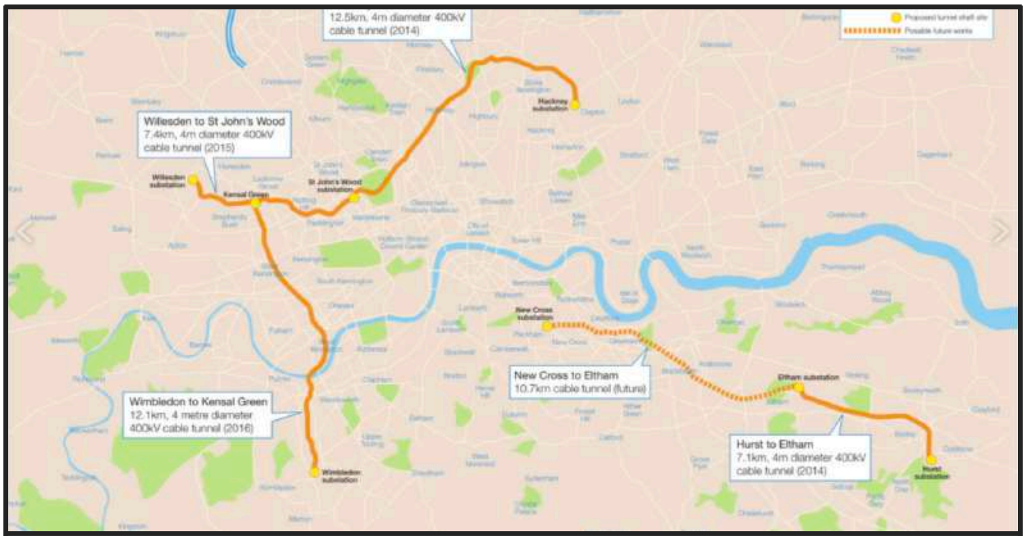
The Post Office tunnel from Paddington to Whitechapel runs several km's to the south of the site, and is therefore not of concern.

2.3.3. UKPN TUNNELS

The publicly available map of UKPN tunnels indicates the 400kv Willesden to St John's Wood tunnel passes through Regent's Park to the south of the site. It is therefore sufficiently far away to not be of concern [2].

2.3.4. BT TUNNELS

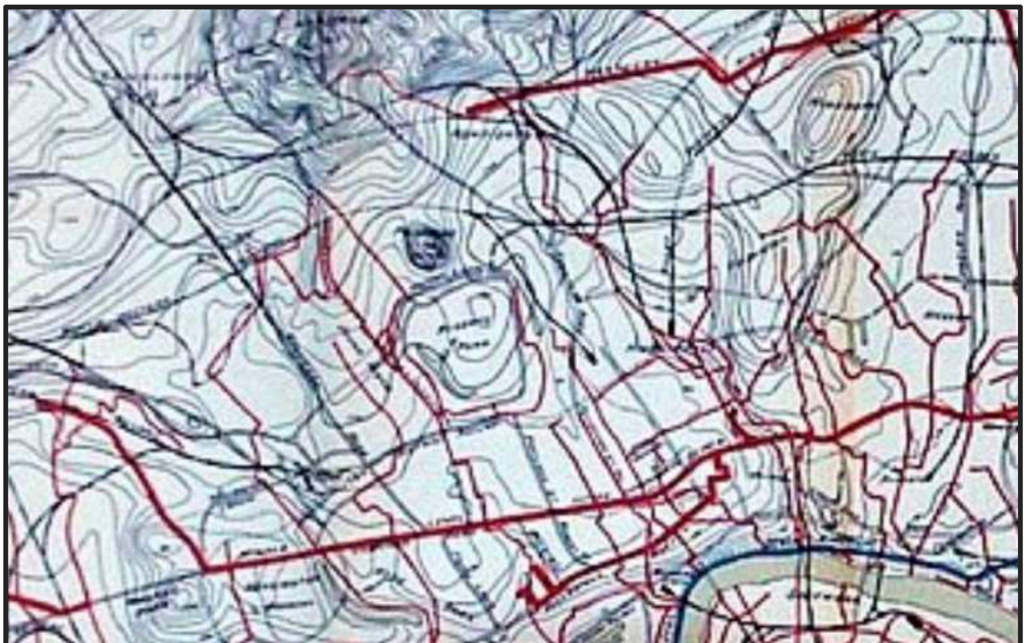
No known BT tunnels are in the area.



2. UKPN Tunnel Map

2.3.5. HISTORIC STORM SEWERS

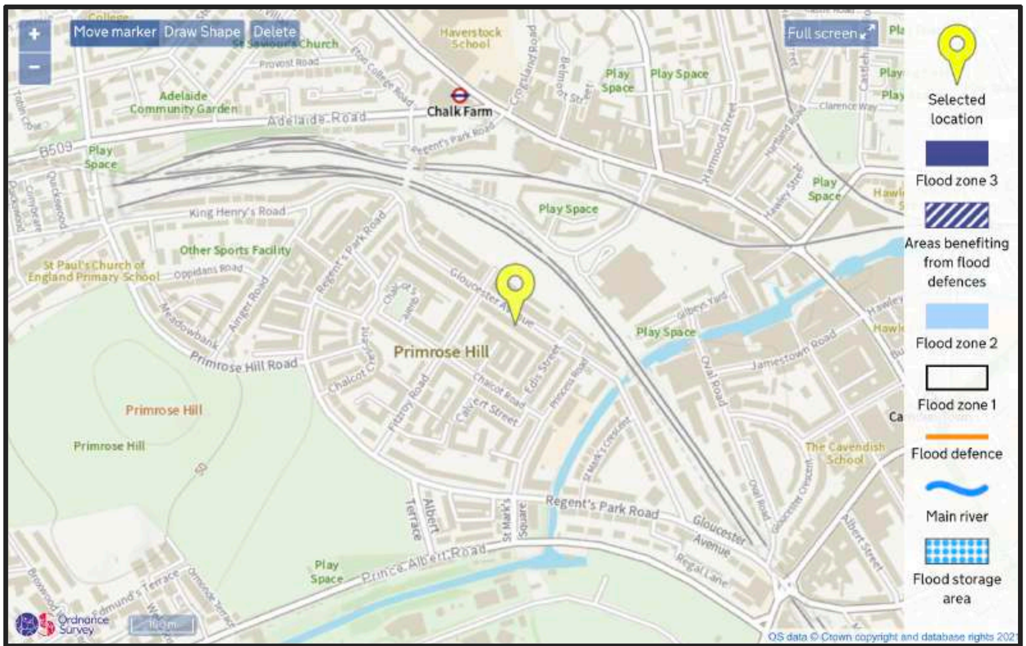
The site appears to be lying to the west of the nearest main sewer line, which passes through Chalk Farm, and down to Camden Town. Any such sewers should appear on the Thames Water asset search and be fully identified prior to commencing the detailed design work [3].



3. Historic Sewers

2.4. FLOOD RISK

With reference to the Environment Agency's Flood Risk map it can be seen that the site lies outside the flood risk zones. The site is on higher ground than the areas that historically experienced flooding. As such, a Flood Risk Assessment is not deemed required for this purpose [4 & 5].

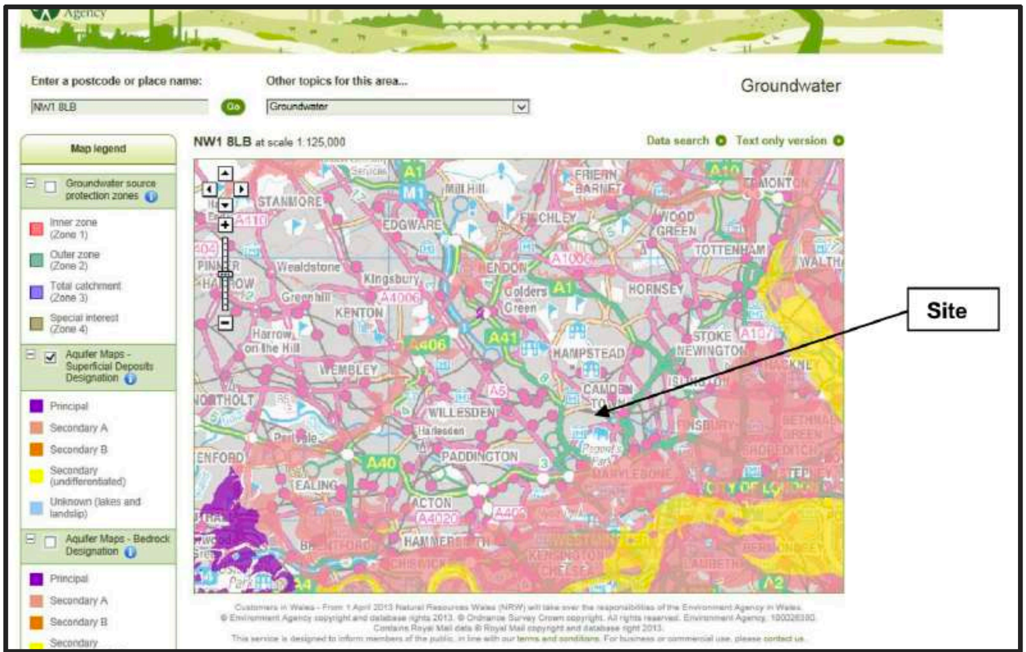


4. Ground Water Flood Zones [Extract from Environment Agency website]

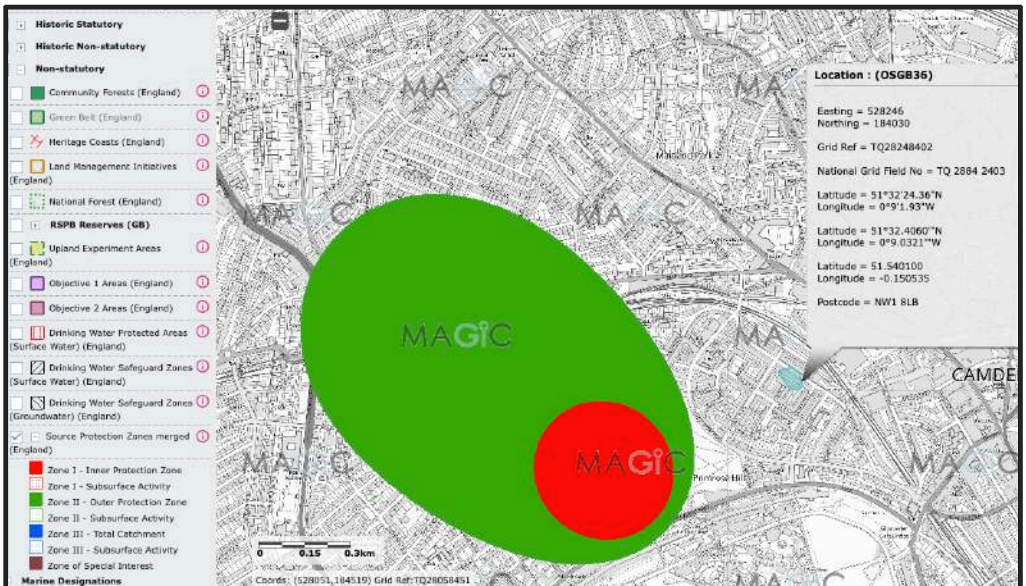
5. Surface Water Flood Risk Map [Extract from Environment Agency website]

2.5. AQUIFERS

From a review the EA's maps for the site, it is underlain by London Clay, which is classed as an unproductive aquifer [6 & 7].



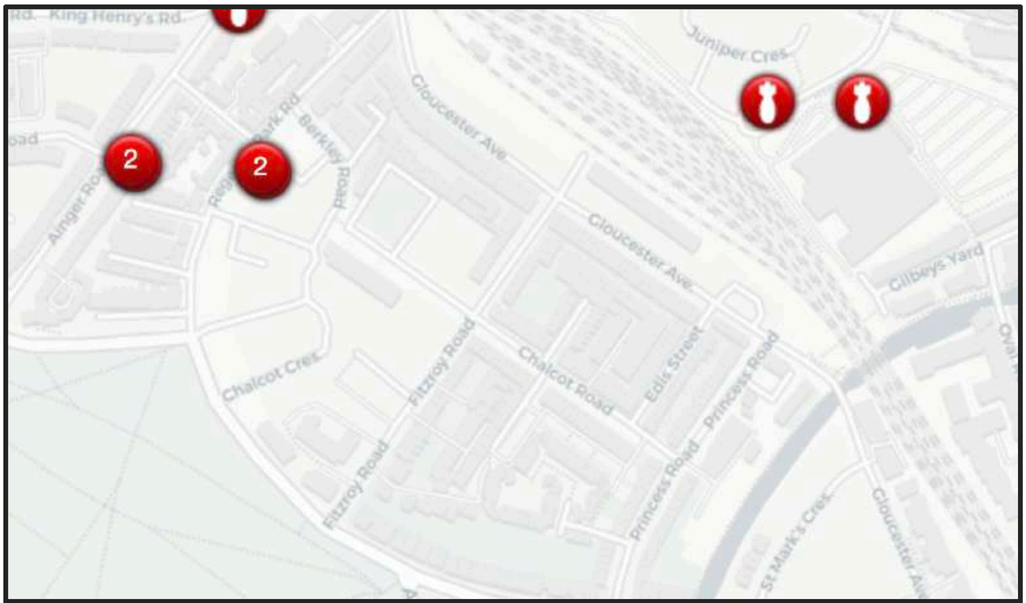
6. EA map for aquifers (none present)



7. Aquifers - Source Protection Zones [Extract from DEFRA Maps]

2.6. UNEXPLODED ORDNANCE

From a review of the bombsight.org website a relatively small number of bombs landed in the area, with the closest appearing to be circa 150m to the north-east, next to the overground railway line. Whilst this is considered a reasonable distance, we would recommend that a comprehensive 3rd party UXO check is commissioned, and any recommendations followed, prior to any basement excavations taking place [8].



8. Bomb Census [Extract from www.bombsight.org Maps]

2.7. NEIGHBOURING PROPERTIES

The building sits within a terrace of similar age properties, with party walls adjoining to the north west and south east, the street to the north east, and a small garden area to the south west.

3. STAGES 1 & 2: SCREENING AND SCOPING ASSESSMENTS

Camden Planning Guidance CPG4 assessment requirements have been used for the initial stages for screening and scoping assessment, the checklists for which are addressed below. These inform the further investigations in subsequent sections.

3.1. STAGE 1: SCREENING

SCREENING CHECKLIST: SUBTERRANEAN GROUNDWATER FLOW			
CONSIDERATION		RESPONSE	JUSTIFICATION
1A	Is the site located directly above an aquifer?	NO	The site is mapped as being underlain by London Clay, which is classed as an unproductive Aquifer [6 & 7].
1B	Will the proposed basement extend beneath the water table surface?	NO	The water table sits deep under the site within the chalk. Perched water is present in the clay, albeit this is extremely slow moving due to the impermeable nature of the London Clay.
2	Is the site within 100m of a watercourse, well (disused/ used), or potential spring line?	NO	The nearest surface water feature is the Grand Union Canal, around 200m to the south east.
3	Is the site within the catchment of the pond chains on Hampstead Heath?	NO	The property is located topographically down-stream of the pond chain
4	Will the proposed basement development result in a change in the proportion of hard surfaced/paved areas?	NO	The proposed basement extension is contained within existing hard standing areas.
5	As part of the site drainage, will more surface water (eg rainwater and run-off) than at present be discharged to the ground (eg via soakaways and/or SUDS)?	NO	We are not increasing the area of hard standing, nor proposing to alter the ground level below ground drainage layouts
6	Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to or lower than the mean water level in any local pond or spring line?	NO	The site level at lower ground floor level is above the level of the canal.

SCREENING CHECKLIST: SLOPE STABILITY			
CONSIDERATION		RESPONSE	JUSTIFICATION
1	Does the existing site include slopes, natural or man-made, greater than 7°, or 1 in 8?	NO	
2	Will the proposed re-profiling of the landscaping at site change slopes at the boundary to more than 7°, or 1 in 8?	NO	
3	Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°, or 1 in 8?	NO	
4	Is the site within a wider hillside setting in which the slope is greater than 7°, or 1 in 8?	NO	
5	Is the london clay the shallowest stratum at the site?	YES	The geological maps for the area show the site well within a consistent area of London Clay, of significant thickness.
6	Will any trees be felled as part of the proposed development, and/or any works proposed within tree protection zones where trees are to be retained?	NO	
7	Is there a history of seasonal shrink/swell subsidence in the local area, and/or evidence of such effects at the site?	NO	No evidence of seasonal shrink/swell subsidence has been noted, with the existing lower ground floor foundations likely being beyond the zone of influence of most trees.
8	Is the site within 100m of a watercourse?	NO	The nearest surface water feature is the Grand Union Canal, around 200m to the south east.
9	Is the site within an area of previously worked ground?	NO	No historic maps, nor historical records indicate any previous workings on the site.

10	Is the site within an aquifer? If so will the proposed basement extend beneath the water table such that dewatering may be required during the construction?	NO	No. See extracts in previous section showing EA maps.
11	Is the site within 50m of the Hampstead Heath Ponds?	NO	
12	Is the site within 5m of a highway or pedestrian right of way?	YES	The proposed development extends to the back of the public pavement. The new front wall is therefore to be designed as a retaining structure, supporting loads imposed by the pavement and roadway.
13	Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	NO	
14	Is the site over (or within exclusion zone of) any tunnels e.g. railway lines?	NO	

SCREENING CHECKLIST: SURFACE FLOW AND FLOODING IMPACT IDENTIFICATION			
CONSIDERATION		RESPONSE	JUSTIFICATION
1	Is the site in the catchment of the pond chains in Hampstead Heath	NO	The property is located topographically down-stream of the pond chain
2	As part of the proposed site drainage, will surface water flows (eg volume of rainfall and peak run-off) be materially changed from the existing route?	NO	Existing hard-standing areas remain in the proposed works.
3	Will the proposed basement development result in a change in the proportion of hard surfaced/paved external areas?	NO	The proposed basement extension is contained within existing hard standing areas.

4	Will the proposed basement result in changes to the profile of the inflows (instantaneous and long term) of the surface water being received by adjacent properties or downstream watercourses?	NO	See above
5	Will the proposed basement development result in changes to the quality of of surface water being received by adjacent properties or downstream watercourses?	NO	No changes are being proposed to any areas of soft or hard landscape

3.2. STAGE 2: SCOPING

The screening assessment identifies the following matters, which are required to be studied and justified or discussed further.

- The sequence and characteristics of the soil underlying the specific site have not been confirmed in-situ.
- The site and proposed works occur within 5m of the public highway or pedestrian right of way.
- A Ground Movement Assessment (GMA) may be required to assess the potential damage to neighbouring buildings.

These aspects are considered further in Stage 4 (see Section 5) and elaborated upon in Section 6 (detailed design considerations).

4. STAGE 3: SITE INVESTIGATION

4.1. SOIL UNDERLYING THE SITE

An on-site investigation should be completed before detailed design commences, which should confirm the site specific strata / soil build up, as well as the presence of any water (water table or perched water), hydro-geological flows, etc. The findings of the desktop investigations indicate we are likely to be excavating within the Clay strata, so perched water may be present, albeit with limited inflow. The investigation should also include a basic suite of contamination testing, even though based on the history of the site we are not expecting any contamination to be present. These investigations should allow a suitable and robust scheme to be developed without negatively impacting on the local environment.

4.2. DEPTH OF OUR FOUNDATIONS AND THOSE OF THE NEIGHBOURING BUILDING

Prior to detailed design trial pitting should be completed to check the levels of the existing footings to the vault areas.

4.3. GROUND MOVEMENT ASSESSMENT (GMA)

Once more is known about the ground conditions and neighbouring foundations a ground movement assessment may be opted for to help confirm the predicted movements of the neighbouring structures and highway are within agreed limits. The construction methodology will take these limits into account, along with possible actions should a trigger level be reached.

5. STAGE 4: IMPACT ASSESSMENT

5.1. PUBLIC HIGHWAY BOUNDARY PROXIMITY IMPACT

The implications of this matter are related to the design and construction of suitable retaining structures. This is therefore discussed and addressed in section 6, which details the considerations of how the structures will be built against the existing boundaries, and section 7, which addresses the works sequence.

5.2. GROUND MOVEMENT ANALYSIS

The proposed excavation will necessitate the removal of an additional c. 1m x 5m x 3m depth of soil, plus the existing retaining wall structure adjacent the pavement.

A Ground Movement Analysis may need to be conducted as part of the next phase, in line with CIRIA C580 to determine the movement response of the subsoils as a result of the proposed excavations. The methodology will help ensure a damage category of 1 or less on the Burland Scale, both to our property and the neighbouring properties.

Please refer to the appendices for the calculations, design output, construction sequence illustrations and structural drawings.

Constructure has significant experience of underpinning and the creation of lower ground floors and basement structures, and we do not expect significant movement (if any) to occur in the existing properties as a result of the proposed works.

5.3. STABILITY OF EXCAVATIONS

Excavations in the London Clay are expected to be relatively stable, albeit requiring shoring for safe access. Where underpinning is to be carried out, this should be possible in 1m bay widths, sequenced in a 5 bay hit/miss arrangement.

6. DETAILED PROPOSALS AND DESIGN CONSIDERATIONS

6.1. SITE CONSTRAINTS & SEQUENCING

The excavation of the additional lower ground floor volume is currently assumed to be completed by underpinning the existing load bearing walls forming the existing vaults, using mass concrete underpins, which will also serve to act as the primary retaining structure. An underpin-style sequenced approach to constructing the eastern wall (not below a load bearing wall over) will serve to complete the full retaining perimeter. A new ground floor RC slab over can then be reinstated.

The protection of the neighbouring properties and boundary structures has been carefully considered, such to ensure that during the works, the boundary and neighbouring structures are protected from ground movement. The techniques proposed therefore are designed to conform with this.

6.2. LOWER GROUND FLOOR SLAB

It is expected that the new lower ground floor slab will be formed as ground bearing, to match the existing.

6.3. HEAVE PROTECTION

Heavy is typically expected to occur approximately 50% during excavation, and 50% longer term. Due to the small area being extended, and the restraint provided by the new front retaining wall, it is not expected that a heave mat will be required.

6.4. WATER PRESSURE AND CONTROL

A degree of dewatering may be required during construction, however as we expected to be excavating into the clay strata inflows other than from surface water should be relatively minor and controllable using standard dewatering pumps. This dewatering is not expected to pose a problem for the construction or surrounding buildings/highway.

For the permanent design we have assumed a high ground water level to account for a general rise in water table level or a “burst water main” scenario. This has been accounted for for the hydrostatic pressure on the new section of lower ground floor slab, and also in terms of buoyancy.

6.5. HIGHWAYS

The front of the property is adjacent to a public highway of Gloucester Avenue.

As our excavation depth is circa 3m, the Highway surcharge (typically based on the Highways Agency Design Manual for Roads and Bridges Volume 1, Section 3, Part 14, with values of HB loading of 12.0kN/m2 or HA loading of 10.0kN/m2 being considered) will apply.

The proposed new retaining wall to the pavement edge will therefore be designed to resist these forces, with the return walls acting as stabilising buttresses. An initial calculation for this wall is appended to this report.

6.6. PARTY WALLS

The proposed development may fall within the scope of the Party Wall Act 1996 due to excavating near land belonging to another demise.

Procedures under the Act will be dealt with in full by the Employer’s Party Wall Surveyor. The Party Wall Surveyor will prepare and serve necessary notices under the provisions of the Act and agree Party Wall Awards in the event of disputes. The Contractor will be required to provide the Party Wall Surveyor with appropriate drawings, Method Statements and other relevant information covering the works that are notifiable under the Act. The resolution of matter under the Act and provision of the Party Wall Awards will protect the interests of all owners.

The scheme for this site will be developed so as not to preclude or inhibit similar, or indeed any, works on the adjoining properties in the street. The Surveyors will verify this as part of the process under the Act.

6.7. DESIGN CODES

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

The Building Regulations 2010 - Approved Document A

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

7. CONSTRUCTION METHODOLOGY

7.1. SEQUENCE OF WORKS

The outline construction sequence and temporary works assumed in the design and described in this report will be superseded by the Contractor's construction proposals. The Contractor will be required to provide full proposals, method statements and calculations to the engineer prior to the commencement of any works on site and these will be considered in conjunction with the permanent structures and verified as suitable before the works are implemented.

The appointed contractor will be required to provide a detailed works sequence with their tender submission. An outline sequence of the substructures works is likely to be as follows:

- Cordon off a portion of the pavement to provide access/site security (subject to relevant permissions)
- Secure site, erect hoardings, establish welfare facilities, and divert any on-site services required.
- Note: likely suspend some parking bays to the front for welfare location, across the public footpath (pedestrian site movement only).
- Carry out shallow underpinning to side section of existing vaults, from within the vault areas
- Install temporary propping as required within the vaults to facilitate demolition of the existing slab over
- Form new retaining structure to pavement side, using trench sheeting (as per contractors design), with new wall installed sequentially using an underpin sequence
- Form new lower ground floor slab, tied into new retaining wall, bearing onto the mass concrete underpins to each side (with dowels to tie down)

- Form new capping slab over (250thk. RC), and once cured remove temporary propping
- Install cavity drain system to details by others, and finishes

7.2. TEMPORARY WORKS

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

7.3. MOVEMENT CONTROL

The techniques proposed are proven to produce minimal or negligible movement effects to the party walls, and the deflection of the retaining walls can be practically limited so as to avoid disturbance to the retained ground.

It has been demonstrated that the excavations made and the works being conducted using normal techniques it is practical to achieve a level of 1 [very slight damage] on the Burland Scale, such to limit any damage to ‘slight’.

A heave response, due to the relatively minor overburden relief, is not considered to represent a practical risk.

7.4. MONITORING OF ADJACENT STRUCTURES

Due to the relatively minor excavation works being undertaken, it is not thought necessary for monitoring works to be carried out during the construction. If this is required as part of the party wall agreements, then target levels and monitor target positions will need to be agreed prior to works commencement on site.

7.5. NOISE, DUST AND VIBRATION

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

The following measures and actions will be implemented:

Noise – Neighbours will be notified in advance of noisy activity, in particular where these are on or near boundary structures. Where there is particular sensitivity, activity will be restricted to 09:00-17:00 Monday to Friday.

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

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

Vibration – While the use or percussive, powered machinery upon hard construction materials in many situations will likely give rise to inevitable vibration, wherever possible and in accordance with CCS Code, unnecessary vibration will be avoided and mitigated. This will take the form of the careful planning and consideration of the hardness of the material being demolished, and the works planned and notified accordingly, and where considered particularly unavoidable, the 09:00-17:00 working hours principle be observed.

Dust – Most of the works will be internal and so can be relatively easily isolated from becoming airborne and dispersing to neighbours and the local environment. External activity shall be contained as best as possible using suitable hoardings and sheeting.

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

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

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

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

8. SUMMARY

During construction, lateral and vertical stability of the existing and adjoining buildings will be maintained by directly underpinning the required existing load bearing party walls, such that no significant adverse movement is expected. The construction sequence used, including limiting excavations to 1m bays, should also serve to maintain stability to the soil and foundations of the property, adjoining properties, and immediately surrounding roadways.

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

Once complete, the new structure will provide a robust and secure support for both new and existing structures without detriment to the overall stability of the building, adjoining properties or Highway.

APPENDICES.

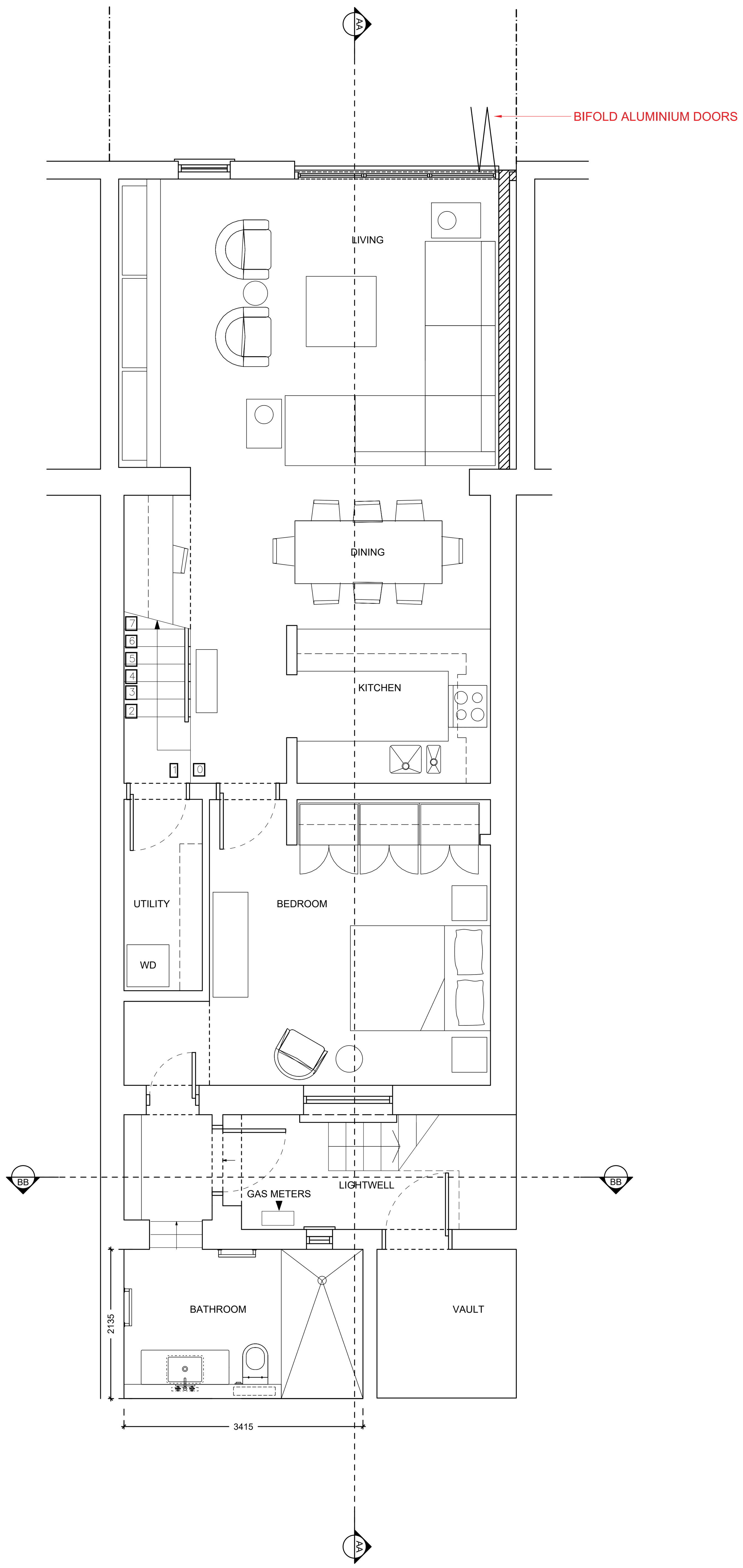
APPENDIX A: EXISTING AND PROPOSED DRAWINGS

Existing Survey Drawings + Proposed with structural over-mark

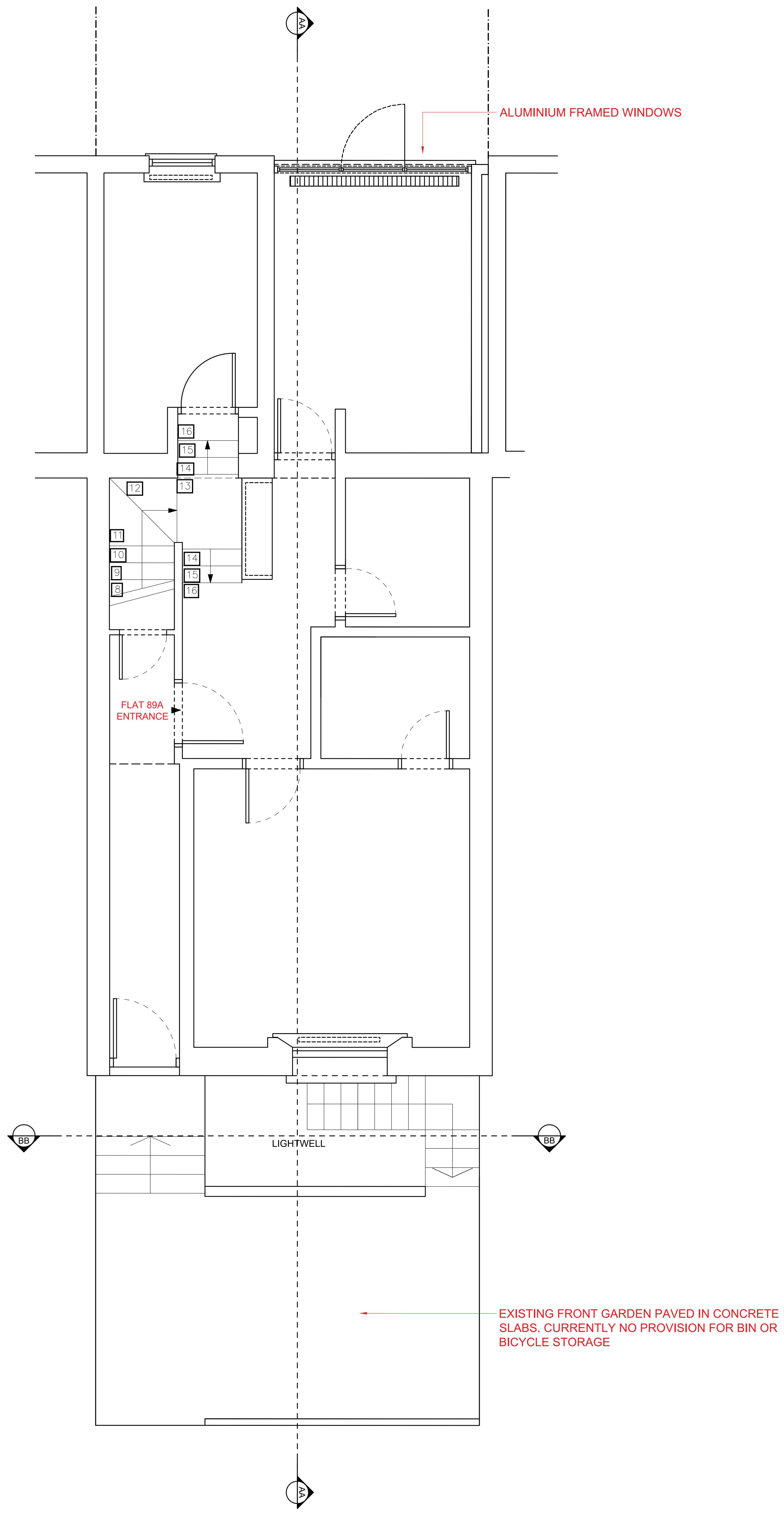
APPENDIX B: STRUCTURAL CALCULATIONS

Typical Retaining Wall

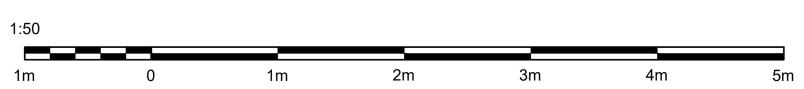
APPENDIX A: EXISTING AND PROPOSED DRAWINGS



01 LOWER GROUND FLOOR - EXISTING
SCALE: 1:50



01 UPPER GROUND FLOOR - EXISTING
SCALE: 1:50



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1013
GLOUCESTER AVENUE

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LG & UG FLOOR PLAN

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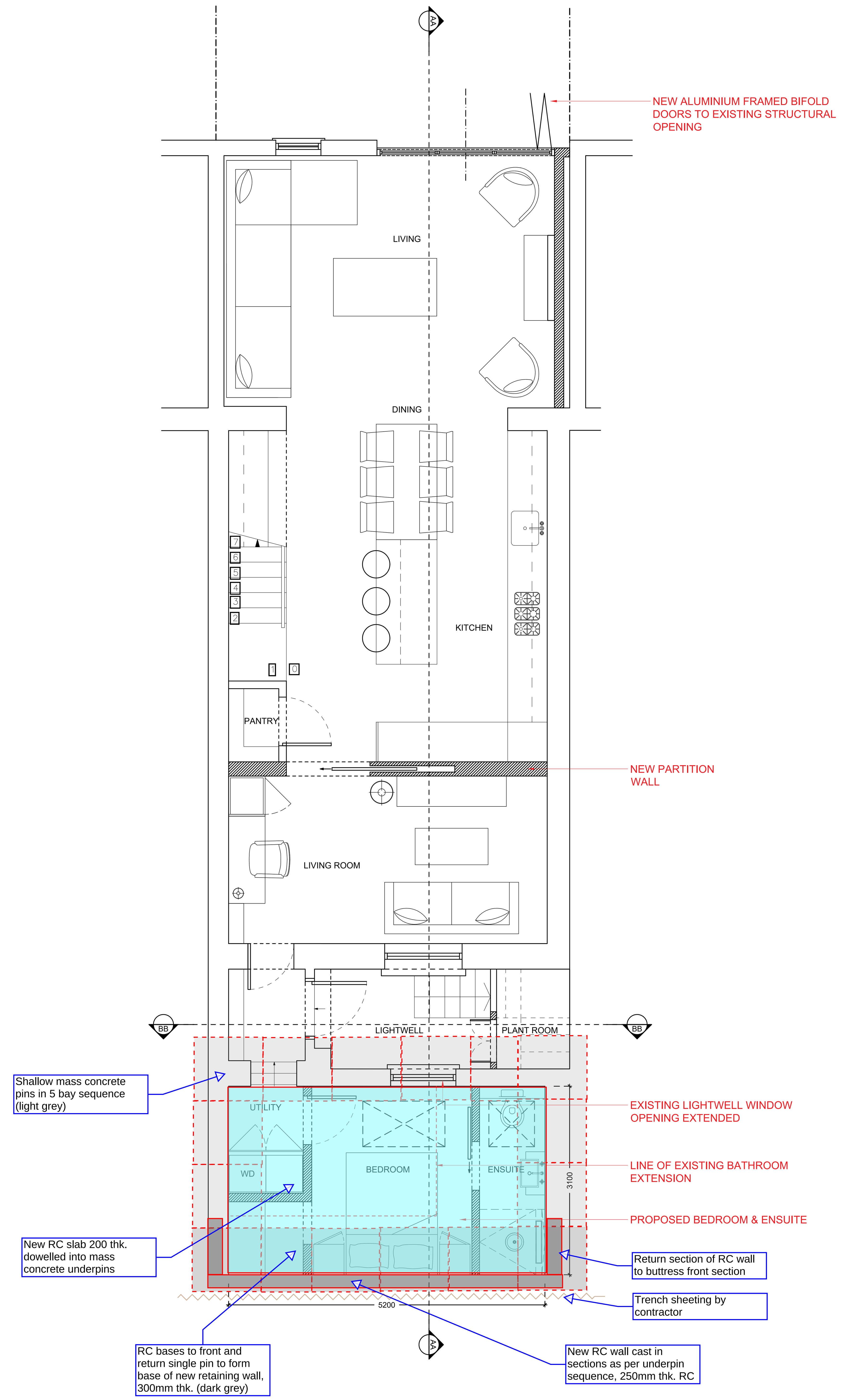

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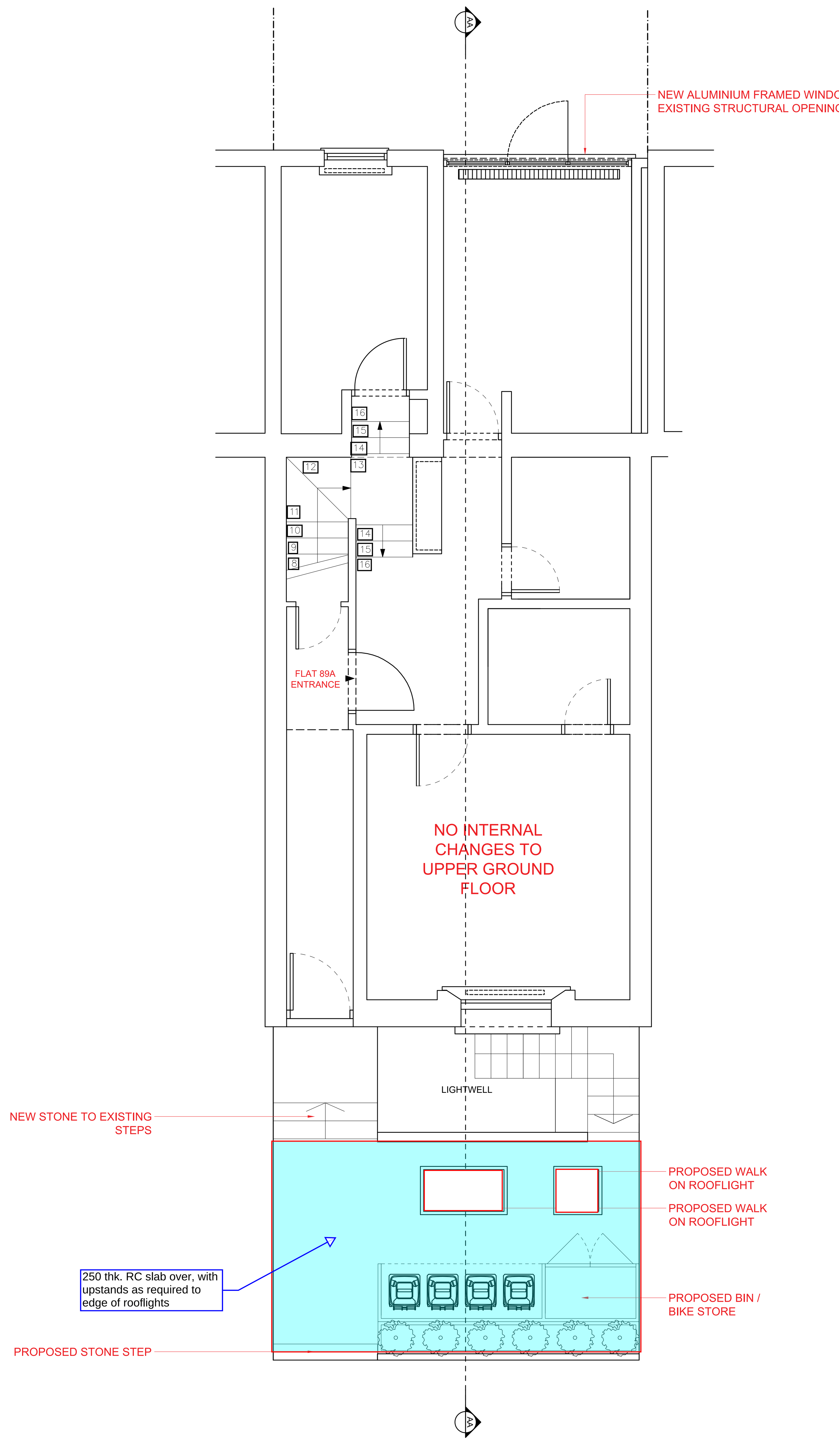

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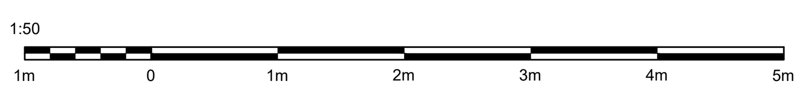
PRECEDENT WALK ON ROOFLIGHT



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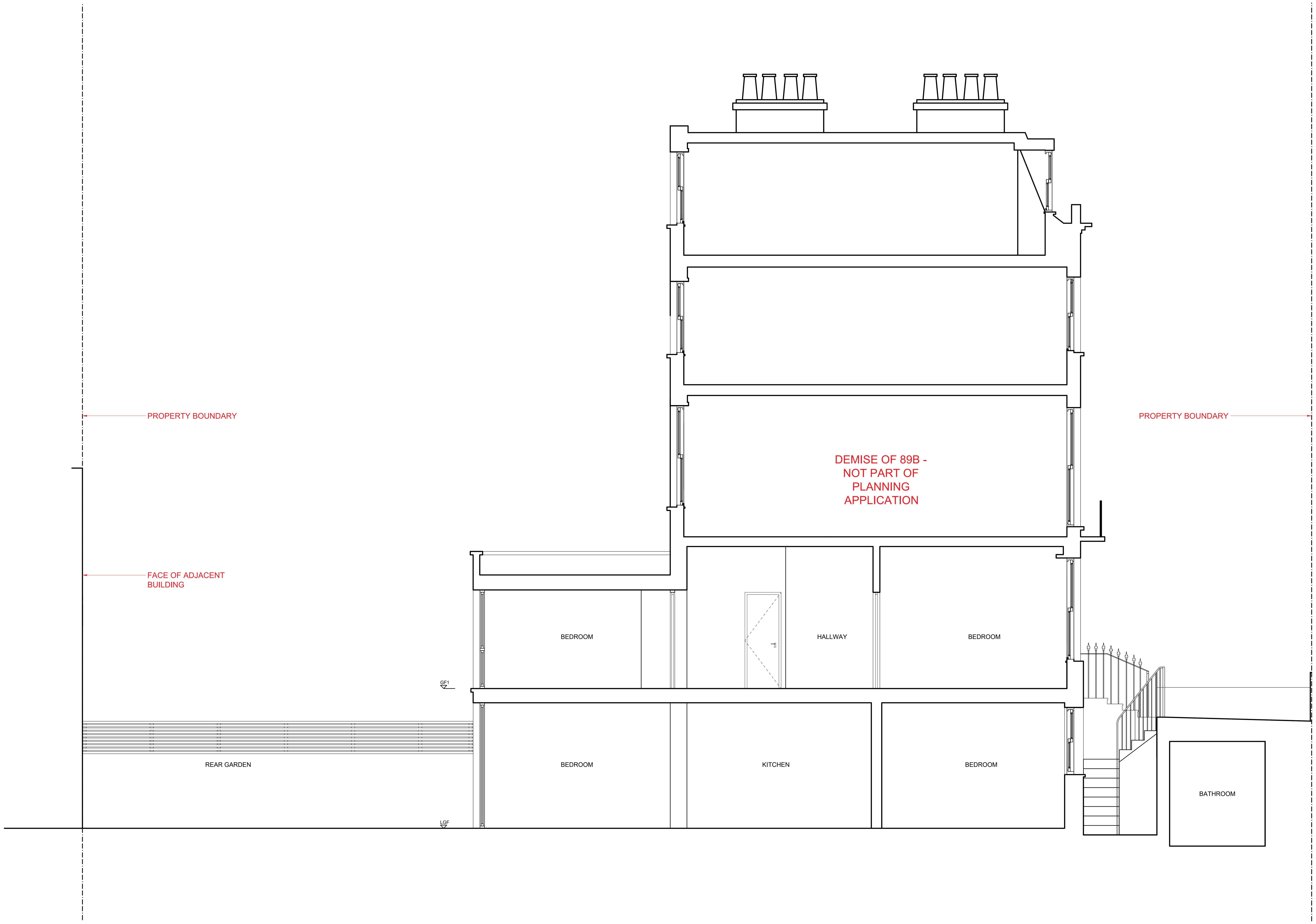
Project		
Project No. 2163	Sheet SK-01	Rev.
Date 13.07.21	Eng. AH	Chk.



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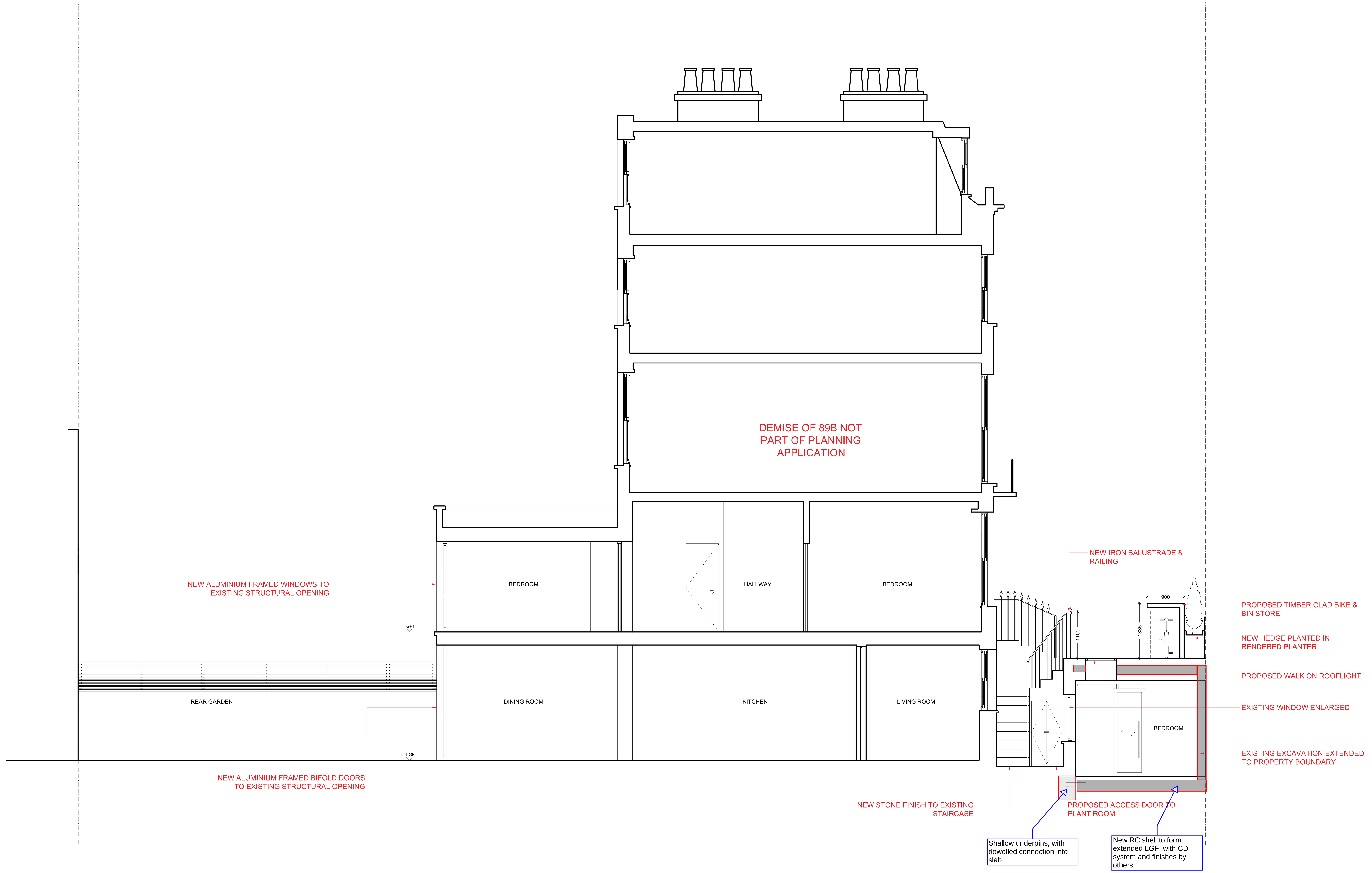

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1013
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PROPOSED
SECTION AA

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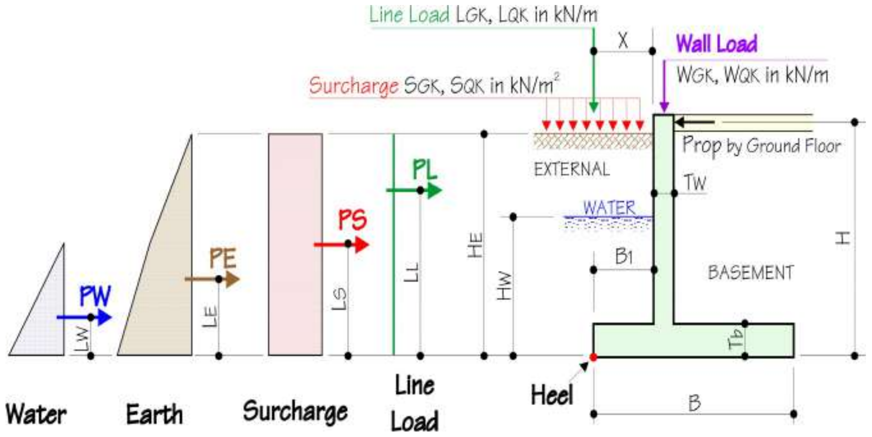
Project		
Project No. 2163	Sheet SK-10	Rev.
Date 13.07.21	Eng. AH	Chk.

APPENDIX B: STRUCTURAL CALCULATIONS

Project	89A Gloucester Avenue	The Concrete Centre		
Client		Made by	Date	Page
Location	TYPICAL RETAINING WALL	AH	13-Jul-2021	
	Basement wall design to BS8110:2005	Checked	Revision	Job No
	Originated from 'RCC61 Basement Wall.xls' v3.1 © 2006 TCC		-	2163

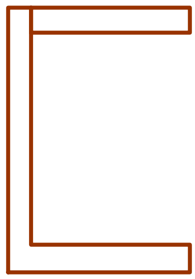
IDEALISED STRUCTURE and FORCE DIAGRAMS

DESIGN STATUS : VALID



DIMENSIONS (mm)

H =	3000	B =	2000	Tw =	250
Hw =	2000	BI =	0	Tb =	325
He =	3000				



Wall Geometry

MATERIAL PROPERTIES

steel class A

fcu =	35	N/mm²	γm =	1.50	concrete
fy =	500	N/mm²	γm =	1.15	steel

Cover to tension reinforcement (co) = 40 mm

Max. allowable design surface crack width (W) = 0.2 mm (0.2 or 0.3 mm only)

Concrete density = 24.0 kN/m3

SOIL PROPERTIES

Design angle of int'l friction of retained mat'l (Ø) =	19	degree	
Design cohesion of retained mat'l (C) =	0	kN/m2	(Only granular backfill considered, ie "C" = 0)
Density of retained mat'l (q) =	19	kN/m3	
Submerged Density of retained mat'l (qs) =	13.33	kN/m3	(default=2/3 of q), only apply when Hw >0 = 12.67
Design angle of int'l friction of base mat'l (Øb) =	20	degree	
Design cohesion of base mat'l (Cb) =	0	kN/m2	
Density of base mat'l (qb) =	10	kN/m3	
Allowable gross ground bearing pressure (GBP) =	150	kN/m2	

ASSUMPTIONS

a) Wall friction is zero

b) Minimum active earth pressure = 0.25qH

c) Granular backfill

h) Design not intended for walls over 3.5 m high

i)Does **not** include check for temp or shrinkage eff

LOADINGS (unfactored)

Surcharge load -- live (SQK) =	12	kN/m2
Surcharge load -- dead (SGK) =	10	kN/m2
Line load -- live (LQK) =	0	kN/m
Line load -- dead (LGK) =	0	kN/m
Distance of line load from wall (X) =	0	mm
Wall load -- live (WQK) =	10	kN/m
Wall load -- Dead (WGK) =	25	kN/m

LATERAL FORCES

Ko = 0.67 default Ko = (1-SIN Ø) = 0.67

Kac = 1.64 = $2Ko^{0.5}$

Force (kN)		Lever arm (m)		γ_f	Ultimate Force (kN)
PE =	50.02	LE =	1.051	1.40	70.02
PS(GK) =	20.23	LS =	1.50	1.40	28.33
PS(QK) =	24.28	LS =	1.50	1.60	38.85
PL(GK) =	0.00	LL =	3.00	1.40	0.00
PL(QK) =	0.00	LL =	3.00	1.60	0.00
PW =	20.00	LW =	0.67	1.40	28.00
Total	**114.53**				**165.20**

Project	**89A Gloucester Avenue**	**The Concrete Centre**	
Client	**0**	Made by **AH**	Date **13-Jul-2021**	Page
Location	**TYPICAL RETAINING WALL**	Checked **0**	Revision **-**	Job No **2163**
	Basement wall design to BS8110:2005		
	Originated from 'RCC61 Basement Wall.xls' v3.1 © 2006 TCC		

EXTERNAL STABILITY

STABILITY CHECK : OK

ANALYSIS - Assumptions & Notes

1) Wall idealised as a propped cantilever (i.e. pinned at top and fixed at base)
2) Wall is braced.
3) Maximum slenderness of wall is limited to 15, i.e [0.9*(He-Tb/2)/Tw < 15]
4) Maximum Ultimate axial load on wall is limited to 0.1fcu times the wall cross-sectional area
5) Design Span (Effective wall height) = He - (Tb/2)
6) -ve moment is hogging (i.e. tension at external face of wall)
   +ve moment is sagging (i.e. tension at internal face of wall)
7) " Wall MT. " is maximum +ve moment on the wall.
8) Estimated lateral deflections are used for checking th**PΔ** effect .

UNFACTORED LOADS AND FORCES

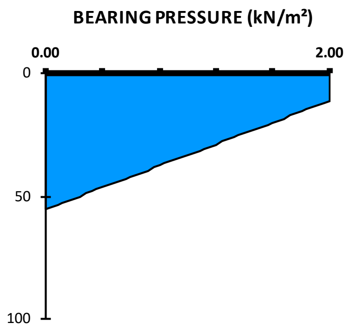
Lateral Force	Force (kN)	Lever arm to base (m)	Base MT. (kNm)	Wall MT. (kNm)	Reaction at Base (kN)	Reaction at Top (kN)	Estimated Elastic Deflection Δ (mm)
PE =	45.13	0.99	-17.23	8.53	35.40	9.73	0.3
PS(GK) =	19.14	1.42	-6.79	3.82	11.96	7.18	0.2
PS(QK) =	22.96	1.42	-8.15	4.58	14.35	8.61	0.1
PL(GK) =	0.00	2.84	0.00	0.00	0.00	0.00	0.0
PL(QK) =	0.00	2.84	0.00	0.00	0.00	0.00	0.0
PW =	16.88	0.61	-5.97	2.11	15.34	1.54	0.0
Total	**104.11**		**-38.14**	**19.04**	**77.06**	**27.06**	**0.7**

GROUND BEARING FAILURE

LOAD CASE: Wall Load **MAX**
Surcharge **MIN**

Taking moments about centre of base (anticlockwise "+")

Vertical FORCES (kN)		Lever arm (m)	Moment (kNm)
Wall load =	35	0.87	30.62499965
Wall (sw) =	16.05	0.87	14.04
Base =	15.60	0.00	0.00
Earth =	0.00	1.00	0.00
Water =	0.00	1.00	0.00
Surcharge =	0.00	1.00	0.00
Line load =	0.00	1.00	0.00
Σ V =	**66.65**		**Σ Mv = 44.67**



MOMENT due to LATERAL FORCES, **Mo** = -29.99 kNm

RESULTANT MOMENT, **M = Mv + Mo** = 14.68 kNm

ECCENTRICITY FROM BASE CENTRE, **M / V** = 0.22 m
MAXIMUM GROSS BEARING PRESSURE = **55.34** kN/m^2 **< 150** **OK**

SLIDING AT BASE

(using overall factor of safety instead of partial safety factor) F.O.S = 1.50

SUM of LATERAL FORCES, **P** = 77.06 kN
BASE FRICTION, F_b = - (**V** TANØb + B.Cb) = -24.26 kN

Factor of Safety, F_b / P = 0.31 < 1.50 FAIL .. but

therefore, LATERAL RESISTANCE to be provided by BASEMENT SLAB = 91.33 kN

Project	89A Gloucester Avenue	The Concrete Centre		
Client	0	Made by: AH	Date: 13-Jul-2021	Page
Location	TYPICAL RETAINING WALL	Checked: 0	Revision: -	Job No: 2163
	Basement wall design to BS8110:2005			
	Originated from 'RCC61 Basement Wall.xls' v3.1 © 2006 TCC			

BS8110 reference

OUTER BASE (per metre length)

γ_f = 1.50 (ASSUMED)

Ult. Shear = 28.49 kN (AT d from FACE of WALL)

Ult. MT. = 0.00 kNm TENSION - TOP FACE

BOTTOM REINFORCEMENT :

Min. As =	423	mm^2			Table 3.25
ϕ =	12	mm			
centres =	225	mm	< 762	OK	
As =	503	mm^2	> 423	OK	

MOMENT of RESISTANCE :

d =	279	mm			
Z =	265	mm			3.4.4.4
As' =	0	mm^2			
Mres =	57.93	kNm	> 0.00	OK	

SHEAR RESISTANCE:

100As/bd =	0.25%				
vc =	0.44	N/mm^2			Table 3.8
Vres =	121.91	kN	> 28.49	OK	3.5.5.2

CHECK CRACK WIDTH IN ACCORDANCE WITH BS8100/8007 : Temp & shrinkage effects not included

X = 57.86 mm ε_m = -0.001605 BS8007

Acr = 115.54 mm W = -0.36 mm < 0.20 OK App. B.2

NO CRACKING

INNER BASE (per metre length)

Ult. Shear = -40.45 kN (AT d from FACE of WALL)

Ult. MT. = 57.20 kNm TENSION - BOTTOM FACE

BOTTOM REINFORCEMENT :

Min. As =	423	mm^2			Table 3.25
ϕ =	12	mm			
centres =	225	mm	< 762	OK	
As =	503	mm^2	> 423	OK	

MOMENT of RESISTANCE :

d =	279	mm			
Z =	265	mm			
As' =	0	mm^2			
Mres =	57.93	kNm	> 57.20	OK	3.4.4.4

SHEAR RESISTANCE:

100As/bd =	0.18%				
vc =	0.44	N/mm^2			Table 3.8
Vres =	121.91	kN	> 40.45	OK	3.5.5.2

CHECK CRACK WIDTH IN ACCORDANCE WITH BS8100/8007 : Temp & shrinkage effects not included

X = 57.86 mm ε_m = 0.000159 BS8007

Acr = 115.54 mm W = 0.04 mm < 0.20 OK App. B.2

REINFORCEMENT SUMMARY for BASE

	Type	ϕ mm	centres mm	As mm^2	Min. As mm^2	
TOP	H	12	225	503	423	OK
BOTTOM	T	12	225	503	423	OK
TRANSVERSE	T	12	225	503	423	OK

Project	**89A Gloucester Avenue**		**The Concrete Centre**		
Client	**0**		Made by **AH**	Date **13-Jul-2021**	Page
Location	**TYPICAL RETAINING WALL**		Checked **0**	Revision **-**	Job No **2163**
	Basement wall design to BS8110:2005				
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APPROXIMATE WEIGHT OF REINFORCEMENT per metre length of wall

		No.	Type	Dia	Length	Unit Wt	Weight
WALL	VERTICAL - Internal face	6	H	12	2771	0.888	14.76
	VERTICAL - External face	6	H	16	2803	1.578	26.54
	TRANSVERSE (Ext.+ Int.)	24	H	10	1000	0.617	14.80
BASE	TOP (MAIN)	5	H	12	2096	0.888	9.30
	BOTTOM (MAIN)	5	H	12	2096	0.888	9.30
	TRANSVERSE (T & B)	18	H	12	1000	0.888	15.98
	WALL STARTERS (Int.)	6	H	12	976	0.888	5.20
	WALL STARTERS (Ext.)	6	H	16	1168	1.578	11.06

SUMMARY **Total reinforcement per metre length of wall (kg)** **107**