Providing Ground Solutions

St Paul's Mews (Islington) Ltd.

St Pauls Mews, London

Basement Impact Assessment

November, 2014

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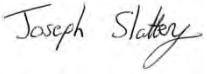
Author	Joseph Slattery, Engineer *BEng MEng FGS*			
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Reference	CG/18183	Revision	0	Issue Date December 2014

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1. INTRODUCTION

St Paul's Mews (Islington) Ltd. is proposing to construct a single storey development with single basement level below on a site at St Paul's Mews, London. Card Geotechnics Limited (CGL) has been instructed to undertake a Basement Impact Assessment (BIA) for the proposed development to assess the potential impact on surrounding neighbouring structures and hydrological features. The structural design and construction management of the basement will be undertaken by Form Structural Design Limited.

Camden Guidance CPG4[1] requires Basement Impact Assessments to be undertaken for new basements in the borough and sets out 5 stages:

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

This report is intended to address the screening process to assess the potential impacts of the basement as set out in CPG4 and the Camden geological, hydrogeological, and hydrological study (CGHHS)[2]. This assessment identifies key issues relating to land stability, hydrogeology and hydrology as part of the screening process.

This report also provides a qualitative impact assessment of geotechnical impacts on nearby structures and the surrounding area based on site information and construction methodology.

[1] Camden Planning Guidance, CPG4, Basements and Lightwells, September 2013.
[2] Ove Arup and Partners, Camden geological, hydrogeological, and hydrological study. Guidance for subterranean development, November 2010.

2. SITE CONTEXT

2.1 Site location

The site is located at St Paul's Mews, London NW1 9TZ in the London Borough of Camden. The National Grid Reference for the approximate site location is 529930, 184316.

The site location is shown in Figure 1.

2.2 Site layout

The site, and proposed development, at St Paul's Mews is typically square in shape measuring approximately 13.5m by 13m. The site and proposed development is orientated on an approximately a north-south axis.

The site is bounded on all four sides by a brick boundary wall. Beyond the boundary wall to the north, east and west of the site are the gardens of 128/130 Agar Grove, 132 Agar Grove and 126 Agar Grove respectively. The nearest existing properties are 128 & 130 Agar Grove, located approximately 10m from the northern site boundary. The access road to St Paul's Mews is located approximately 3m from the southern site boundary with the residential properties of 16 St Paul's Mews and 17 St Paul's Mews beyond (>10m from basement development). Current architectural drawings showing the existing and proposed site layout and sections are presented in Appendix A.

The site is currently being used as a car park. The site and surrounding region are relatively flat with no significant inclines, but it is understood that the adjacent garden areas are approximately 1.0m higher than current site level. The boundary walls are therefore all acting as retaining walls and as their construction includes brick piers it is suspected that the site had its levels decreased slightly when the car park was originally constructed.

2.3 Proposed development

The proposed development comprises the construction of a single storey residential property including a single storey basement level. The development will cover the entire site footprint. Current sections suggest the proposed basement will extend to approximately 4m below ground level (mbgl), with soil retained during excavation by a contiguous piled wall. The basement walls and slabs will be constructed within the contiguous piled wall footprint.

Development plans and sections are presented within Appendix A.

2.4 Site history

Inspection of Historical Ordnance Survey maps of the area (dating to early 1900s) indicates that the site has had no previous notable development and was likely to be formed during the construction of St Paul's Mews road and associated properties post 1913. This is the likely explanation as to why the current car park onsite is at a slightly lower level than the surrounding gardens but is at a similar level to St Paul's Mews access road.

2.5 Underground Infrastructure

With reference to CGL's in-house archive and mapping, there are no known tunnels or sewers in the immediate vicinity of the site.

2.6 Bomb damage maps

The London County Council Bomb Damage Maps[3] indicate that neither the site, nor the buildings in the immediate vicinity, suffered bomb damage.

2.7 Published Geology

The British Geological Survey (BGS) sheet[4] of the area indicates the site to be underlain by the London Clay Formation. This is in turn underlain by the Lambeth Group, Thanet Sand and Chalk at depth.

The London Clay Formation is an over consolidated firm to very stiff, becoming hard with depth, fissured, blue to grey silty clay of low to very high plasticity. The upper and lower parts may contain silty or fine grained sand partings. It also contains within it, laminated structured, nodular claystone and rare sand partings.

2.8 Unpublished Geology

Historical boreholes records freely available on the BGS website[5] indicate that the site is underlain by the London Clay Formation with a limited thickness of Made Ground expected. The thickness of the London Clay in the region has been proven to be approximately 35m from borehole records within 200m of the site.

A selection of the nearby BGS historical borehole records are provided in Appendix B and include a BGS borehole location plan.

[3] Saunders, A (Ed.) (2005) *The London County Council Bomb Damage Maps 1939-1945.* London Topographical Society
[4] British Geological Survey. (1994) North London. Sheet 256. Solid and Drift Geology 1:50,000.
[5] www.bgs.ac.uk/lexicon (accessed 28th November 2014)

Additionally, with reference to Camden Planning Portal[6] and CGL's in house job archive, a number of basement developments have been completed or are currently submitted for planning application in the region. Site investigation data available for a number of these developments indicate that London Clay is present directly below a limited thickness of Made Ground (typically <1m) and extends to depth. The clay was noted to be firm becoming stiff and very stiff with depth and a design undrained shear strength profile of typically 60 + 5z (where z is the depth below the surface of the London Clay) was derived from the in-situ and laboratory test data, which is in line with published data for the London Clay[7].

2.9 Hydrogeology

The Environment Agency[8] (EA) has produced an aquifer designation system consistent with the requirements of the Water Framework Directive. The London Clay Formation is not a productive stratum for groundwater. The site is not within a Groundwater Source Protection Zone.

With reference to historical boreholes on the BGS, site investigation information on the Camden planning portal for nearby properties and CGL's site investigation archive, groundwater was not encountered in the London Clay but slight groundwater seepage was occasionally present within the Made Ground and often at the interface between the Made Ground and relatively impermeable London Clay. The groundwater encountered in the Made Ground was generally low volume and present within isolated perched pockets.

2.10 Hydrology

Figure 11 of the Hampstead Heath Surface Water Catchments and Drainage of the Camden Geological, Hydrogeological and Hydrological Report[2] presents a copy of the 'Lost Rivers of London' map produced by Barton. A number of springs outcrop at the base of the Bagshot Formation to the north, flowing through various drainage channels and in various directions into the watercourses of the district (most of which are now diverted underground) including the River *Westbourne*, *Tyburn* and *Fleet*.

The map indicates that two branches/tributaries to the River *Fleet* are located approximately 800m to the east and west of the site, and flows parallel to the site in a north south direction towards the River Thames.

[6] http://www.camden.gov.uk/ccm/navigation/environment/planning-and-built-environment/planning-applications/ (accessed 28th November 2014)
[7] 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.
[8] http://www.environment-agency.gov.uk/wiyby (accessed 28th November 2014)

The Grand Union Canal is located approximately 500m south west of the site.

With reference to the Figure 14 of the same Arup[2] report, the site is located approximately 2km south east of the catchment for the pond chains on Hampstead Heath.

2.11 Flood risk

With reference to the EA website, the site is not within a Flood Risk Zone. Further, reference to Figure 15 Flood Map of the Arup[2] report indicates the site does not appear to be have been subjected to flooding during the flooding events of 1975 or 2002 and is not within an area identified as being at risk of potential flooding.

3. SCREENING (STAGE 1)

3.1 Introduction

A screening process has been adopted in accordance with CPG4, based on the flowcharts presented in that document. These are included in Appendix C for ease of reference. Responses to the questions posed by the flowcharts are presented below, and where 'yes' or 'unknown' may be simply answered with no analysis required, these answers have been provided.

3.2 Subterranean (Groundwater) flow

This section answers questions posed by Figure 1 in CPG4:

Table 1. Responses to Figure 1, CPG4

Question	Response	Action required
1a. Is the site located directly above an aquifer?	No. The site is located on an unproductive stratum (London Clay).	None
1b. Will the proposed basement extend beneath the water table surface?	No. However, some minor horizontal flow/seepage should be expected between the interface of the Made Ground and London. This water is likely to be encountered within isolated perched pockets and have limited flow rate.	None
2. Is the site within 100m of a watercourse, well or potential spring line?	No. With reference to Barton's 'Lost Rivers of London'[9], the River Fleet is located approximately 800m west of the site. The Grand Union Canal is located approximately 500m	None
3. Is the site within the catchment of the pond chains on Hampstead Heath?	No. The site is more than 2km from the Hampstead Chain Catchment.	None
4. Will the proposed basement development result in a change in the proportion of hard surfaced/paved areas?	No. With reference to current drawings the site is currently covered by hardstanding so the proportion will not change due to the proposed basement extension.	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. Given that the site is underlain by impermeable London Clay all surface water will be discharged to the sewer network through existing connections. The volume of water will not be greater than in the existing	None

[9] Barton N. (1962) *The Lost Rivers of London*

Question	Response	Action required
	condition.	
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, The nearest watercourse is 500m away from the site and the site and surrounding area is underlain by relatively impermeable London Clay.	None

In summary, the site is underlain by some 35m of London Clay. Regional groundwater flow is likely to be to the south towards the River Thames, evidenced by the spring lines shown on Barton's 'Lost Rivers of London', however flow rates within the London Clay are effectively negligible due to the very low mass permeability of this material.

There is the potential for localised and small quantities of perched water within the Made Ground and seepage is likely to be encountered between the Made Ground and London Clay interface during basement excavation. This is considered to be superficial groundwater and its local removal would not affect regional groundwater levels or local ground conditions.

The proposed development will not increase the proportion of impermeable surfaces and as such there will be no additional recharge to the ground above that of the existing hydrogeological regime.

3.3 Slope/land stability

This section answers questions posed by Figure 2 in CPG4.

Table 2. Responses to Figure 2, CPG4

Question	Response	Action required
1. Does the site include slopes, natural or manmade, greater than about 1 in 8?	No. The topography of the site is relatively level.	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.	None
3. Does the development neighbour land including railway cuttings and the like with a slope greater than about 1 in 8?	No The closest rail infrastructure is some 180m south and west of the site	None
4. Is the site within a wider hillside setting in which the general slope is greater than about 1 in 8?	No The topography of the site and surrounding area is relatively level.	None

Question	Response	Action required
5. Is the London Clay the shallowest stratum on site?	Yes. London clay is present below the site with a limitied thickness of Made Ground (Hardstanding) present. The London Clay is expected to be approximately 35m thick below the site.	None
6. Will any trees be felled as part of the proposed development and/or are any works proposed within any tree protection zones where trees are to be retained?	No. Preliminary plans do not indicate the felling of any trees and there are no trees present within the development footprint	None
7. Is there a history of shrink/swell subsidence in the local area and/or evidence of such at the site.	Unknown. The London Clay is susceptible to seasonal shrink/swell movements and it is likely that these will occur, particularly in close proximity to high water demand trees. The proposed basement will not remove any trees and its effect on such movements will therefore be negligible. Furthermore the basement property is detached and will not affect movements of nearby properties.	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?	No. No known area of worked ground is recorded. Limited Made Ground is expected onsite, most likely associated with the construction of the existing hardstanding.	None
10. Is the site within an aquifer?	No. The London Clay Formation is not a productive stratum for ground water.	None
11. Is the site within 50m of the Hampstead heath ponds?	No	None
12. Is the site within 5m of a highway or pedestrian right of way?	Yes. The proposed development fronts onto St Paul's Mews, and the basement is located some 3m from the road. Given that the basement will be constructed within a contiguous piled wall it is considered that the impact on the highway/right of way will be negligible. .	None
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties.	No. The proposed development does not have any neighbouring properties in the immediate vicinity around the boundary of the site. The nearest property is located approximately 10m from the northern site boundary and considered to be outside the zone of influence for any ground movements associated with the proposed basement development.	None
14. Is the site over (or within the exclusion zone of) any tunnels?	No. With reference to CGLs in-house archive there are no	None

Question	Response	Action required
	know tunnels, sewers or other notable buried infrastructure within a 150m radius of the site.	

In summary, the site is located over the London Clay Formation and it is anticipated based on the size of the development that relatively low magnitude heave movements/long term settlement may occur during construction and over the long-term.

However, based on the depth of the basement proposed and the distance to the neighbouring developments, any ground movement associated with the basement construction will not have an impact on these properties as they are outside the zone of influence.

The site is not within the influence zone of known railway or London Underground tunnels, however a service search should be undertaken to determine whether there may be deep sewers, cable tunnels, or other such infrastructure beneath the site. This will be undertaken by the client prior to construction.

3.4 Surface flow and flooding

This section covers the main surface flow and flooding issues as set out in CPG4, however detailed design of the site drainage will be completed by other parties.

Table 1. Responses to Figure 3, CPG4

Question	Response	Action required
1. Is the site within the catchment of the pond chains on Hampstead Heath?	No. The site is greater than 2km south east from the Hampstead Chain Catchment.	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 It is understood all surface water will be discharged to the sewer network through existing connections.	None
3. Will the proposed development result in a change in the proportion of hard surfaced/paved external areas?	No. With reference to current drawings the site is currently covered by hardstanding so the proportion will not change due to the proposed basement extension.	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. Basement formation will be above groundwater level and lies within near impermeable clay.	None

5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No. As Questions 3 and 4	None
6. Is the site in an area known to be at risk from surface flooding or is it at risk from flooding because the proposed basement is below the static water level of a nearby surface water feature?	No. The site is not in a flood risk zone subjected to flooding during the flooding events of 1975 or 2002 and is not within an area identified as being at risk of potential flooding.	None

In summary, the development of the site is not likely to cause significant variation in surface water flow and is not located within a Flood Risk Zone.

4. CONCLUSIONS

On the basis of this screening exercise the proposed basement development will have a negligible impact on land stability, hydrogeology and hydrology onsite or the surrounding region. Groundwater flow within the London Clay is effectively negligible, and the basement is entirely beneath an existing area of hard-standing, indicating that run-off/attenuation characteristics will not be affected.

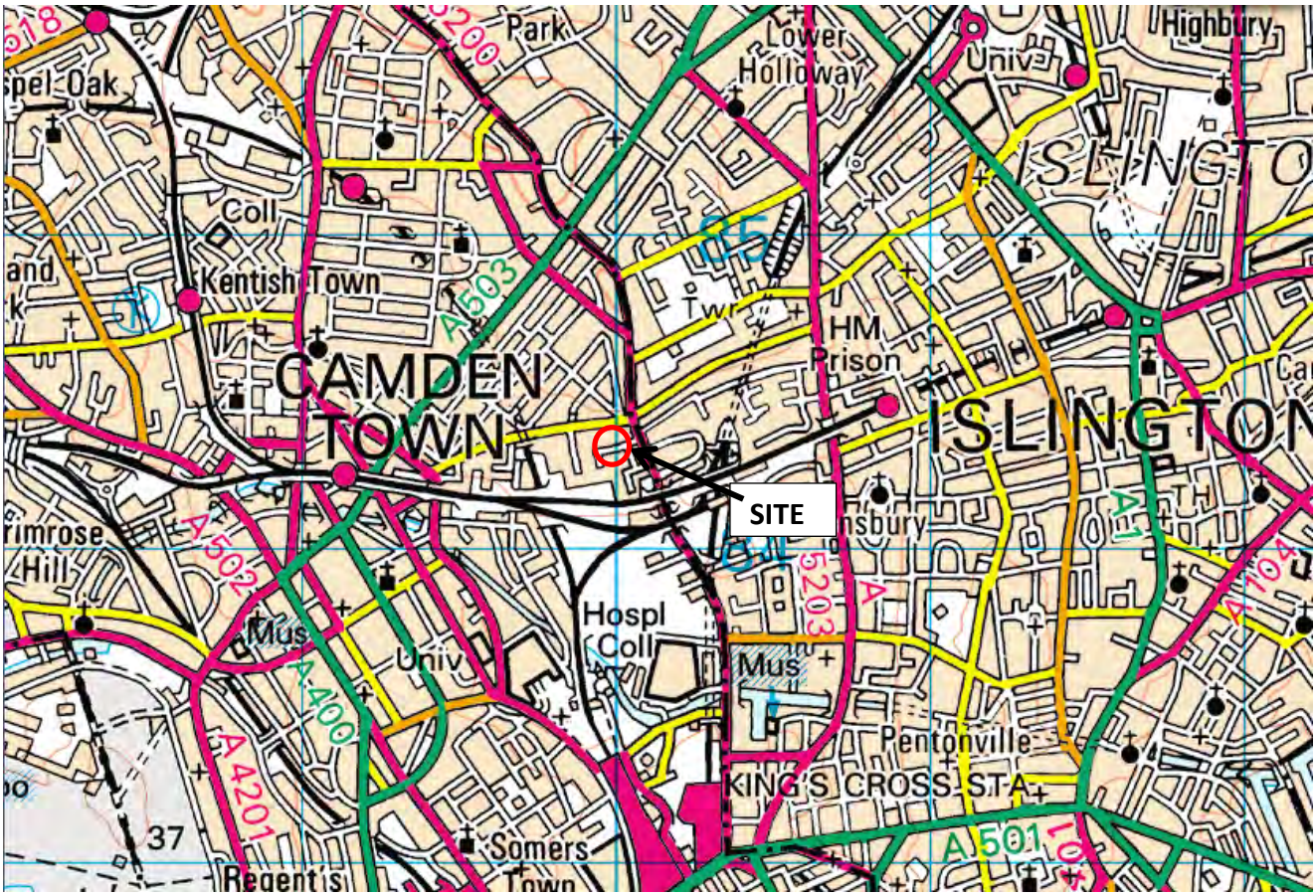
Additionally, based on the distance from the proposed basement to the neighbouring properties and roads, a detailed ground movement assessment is not required for this particular development as the neighbouring properties are all located a considerable distance (> 10m) from the basement excavation and outside the zone of influence from ground movements associated which such a small basement footprint and excavation depth.

Ground movements associated with the deflection of the retaining wall will be controlled by installing high level temporary steel propping during construction and controlled over the long term by the basement and ground floor reinforced concrete slabs. The construction methodology for the basement including the temporary works scheme can be found in greater detail within the Construction Method Statement for the proposed development prepared by FORM Structural Design[10].

The basement will extend foundations for the new development to a depth typically greater than the influence of potentially desiccated soils that may be present on site given the presence of trees around the site boundary. Furthermore, there will be no trees removed as part of the proposed development with no consequent effect on seasonal shrink/swell movements.

[10] Form Structural Design. St Paul's Mews, London. Construction Method Statement. Ref. 142176. November 2014.

FIGURES



Site Details
Post Code: NW1 9TZ

Grid Reference: 529930, 184316

N

Client	Project	Job No
St Paul's Mews (Islington) Ltd.	**St Pauls Mews, London**	**CG/18183**
CGL	Title: **Site location plan**	**Figure 1**

APPENDIX A

Site layout and proposed development drawings

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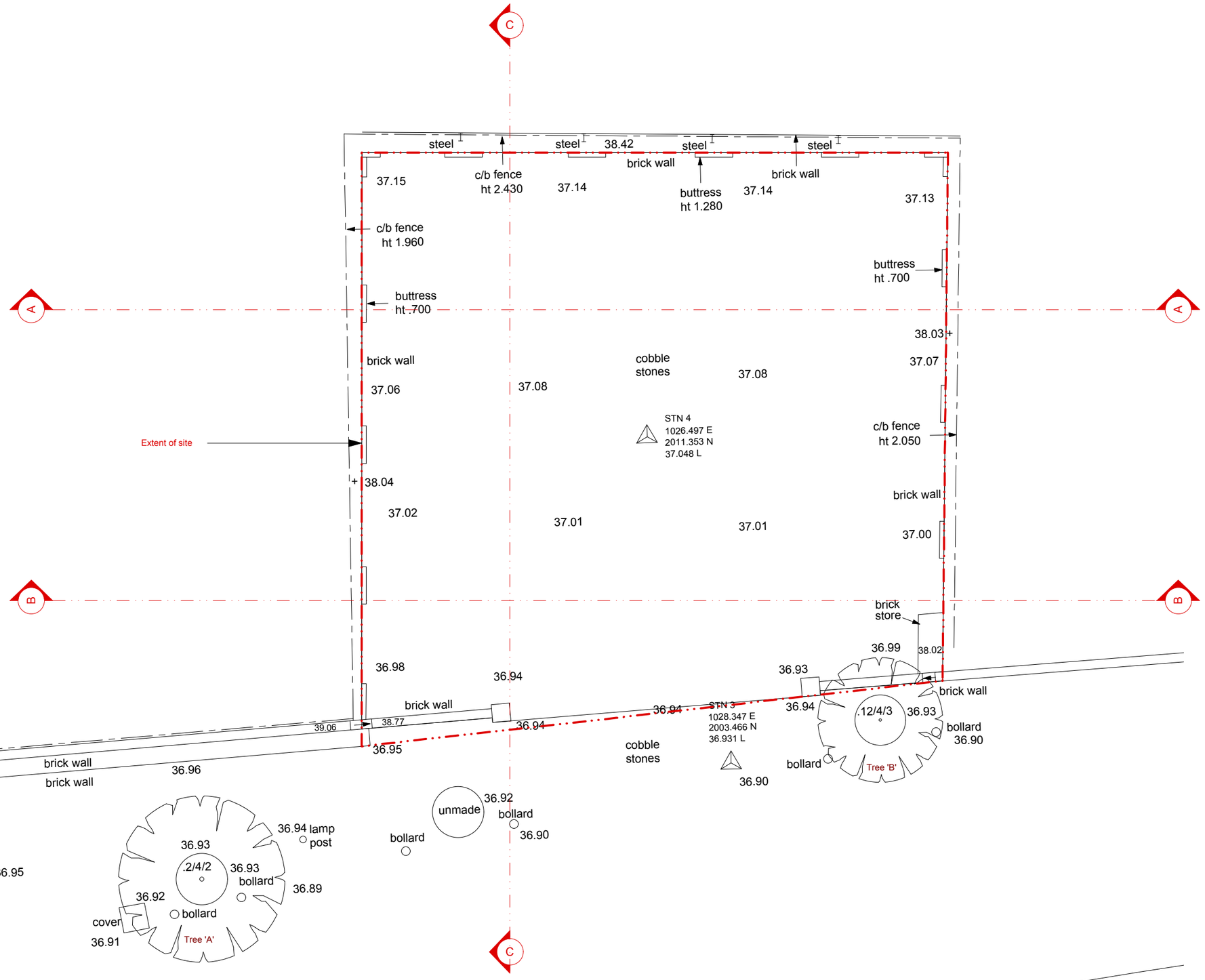

St Pauls Mews

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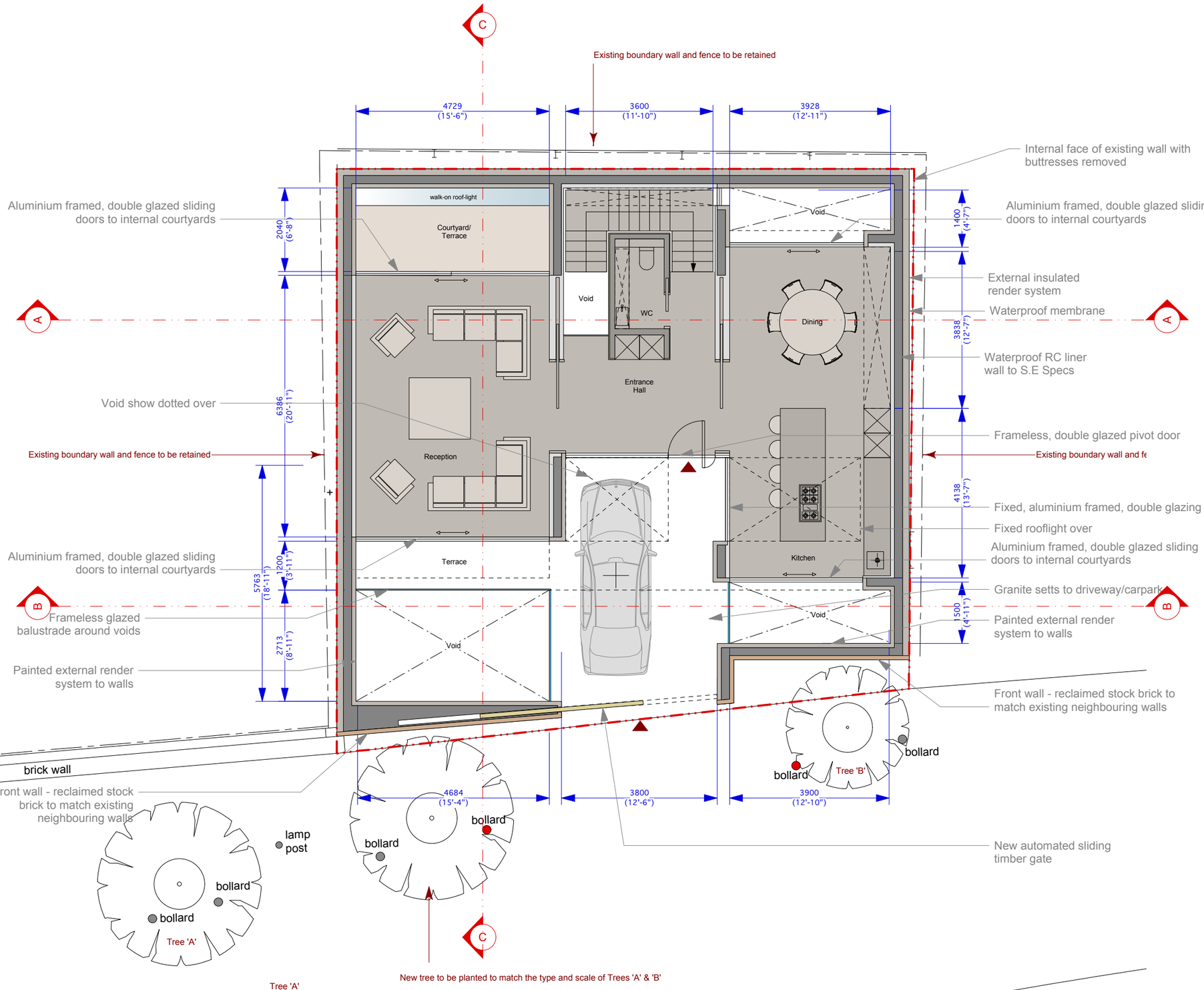

= 2150 sqft

St Pauls Mews

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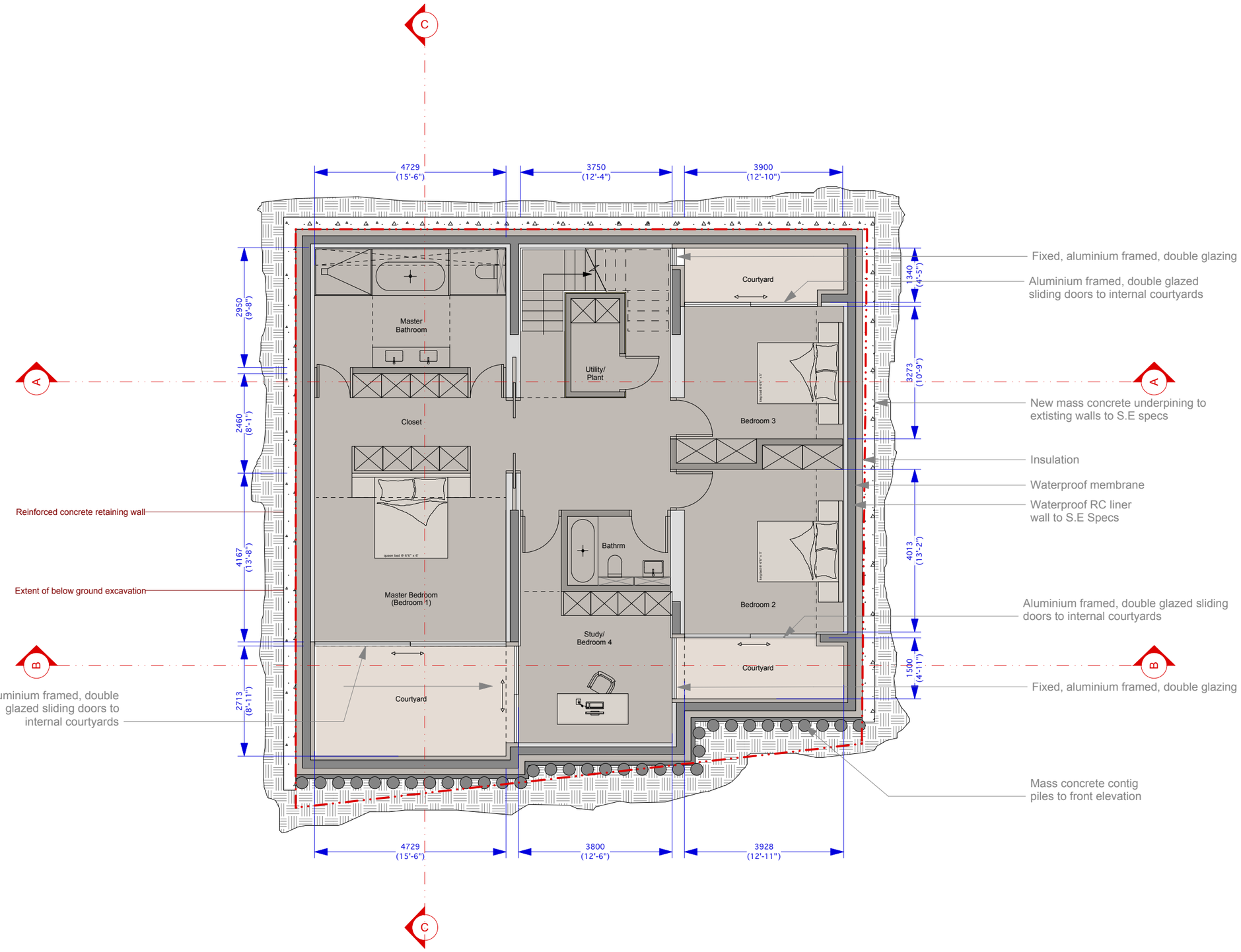

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= **2150 sqft**
= 900 sqft
= 1250 sqft

APPROX NORTH POINT

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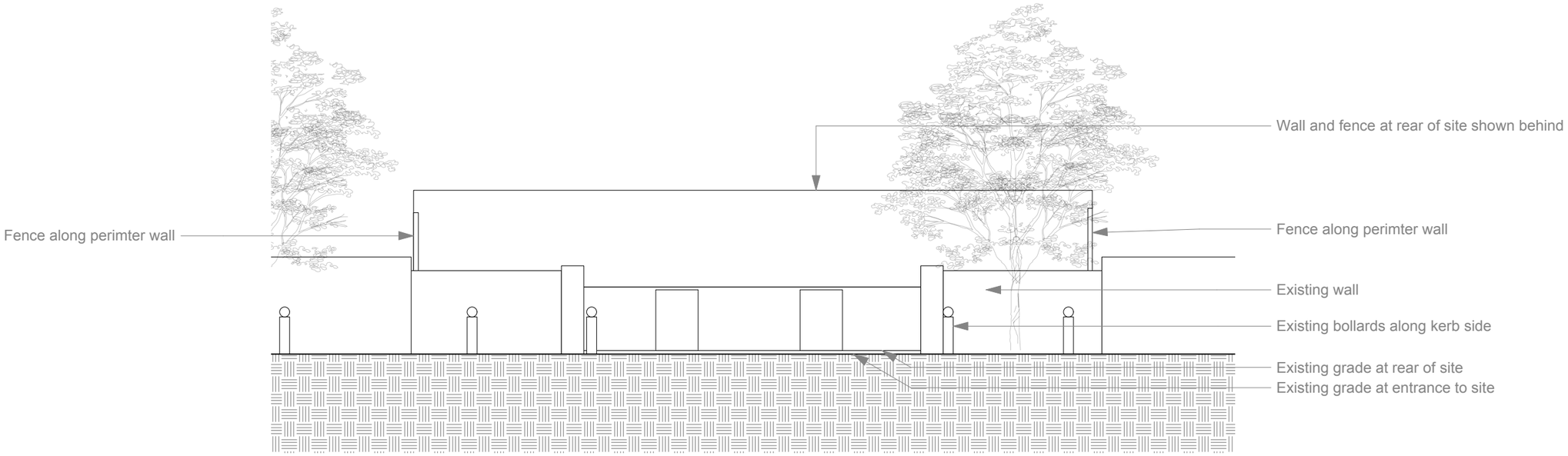

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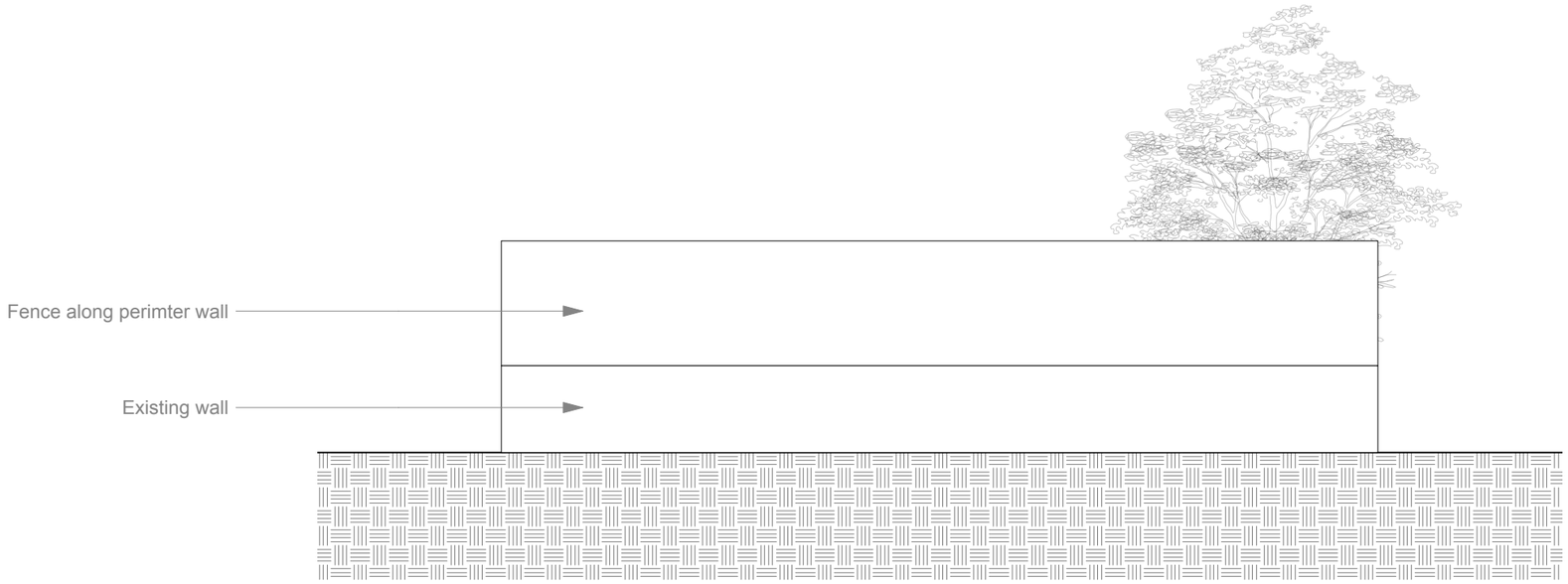

02 - REAR ELEVATION

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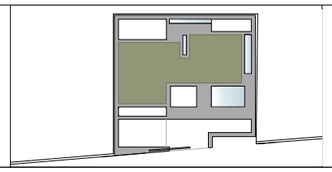

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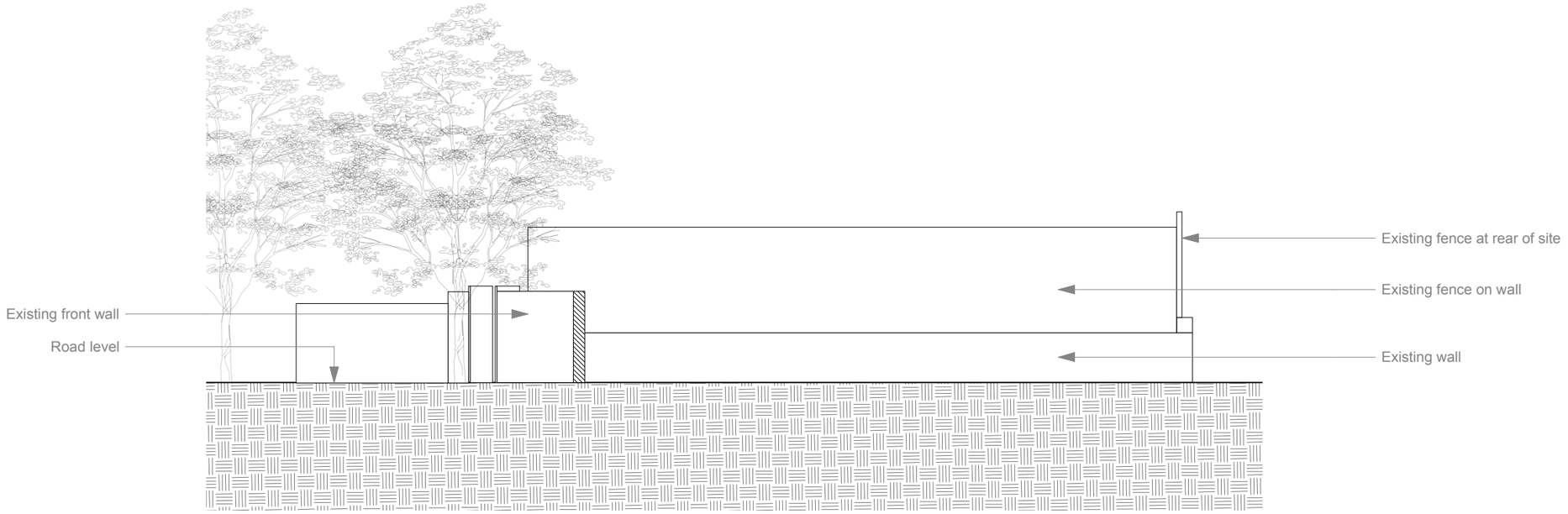

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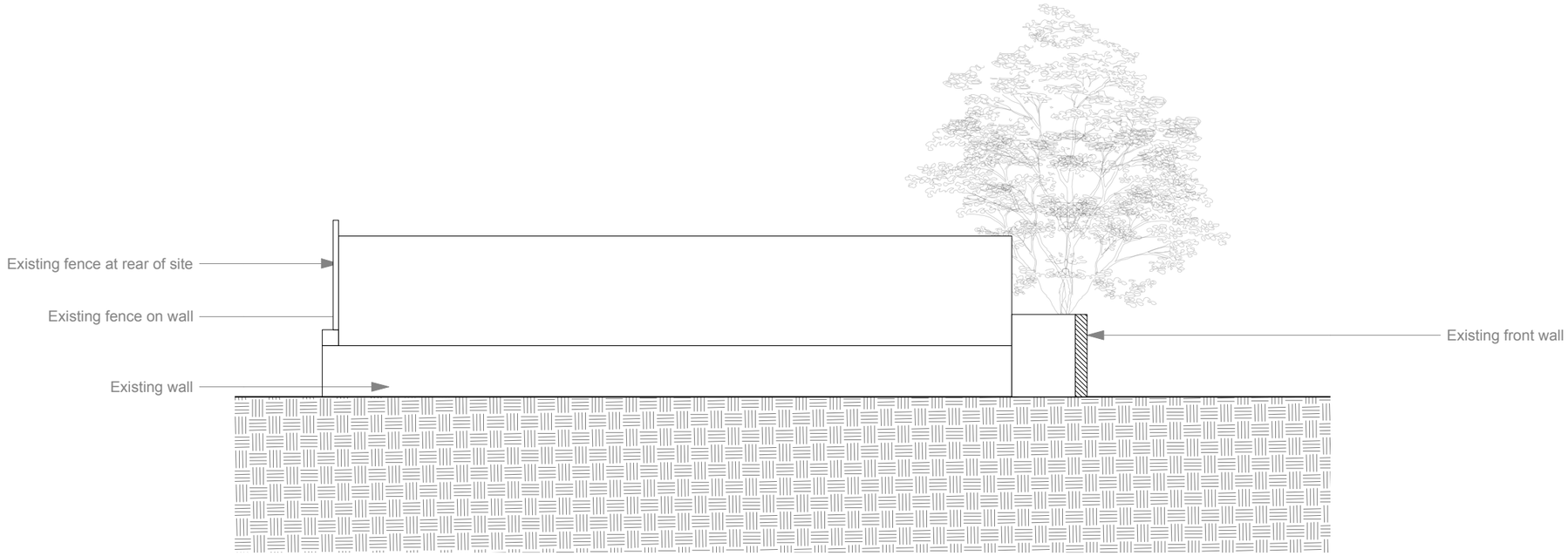

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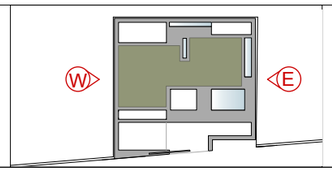

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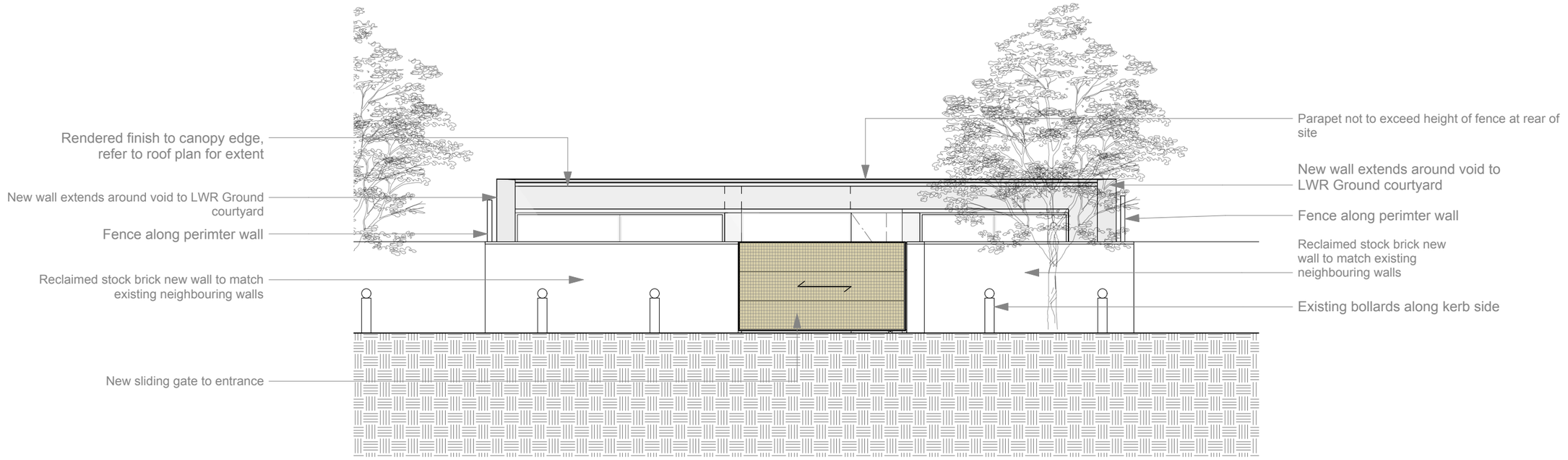

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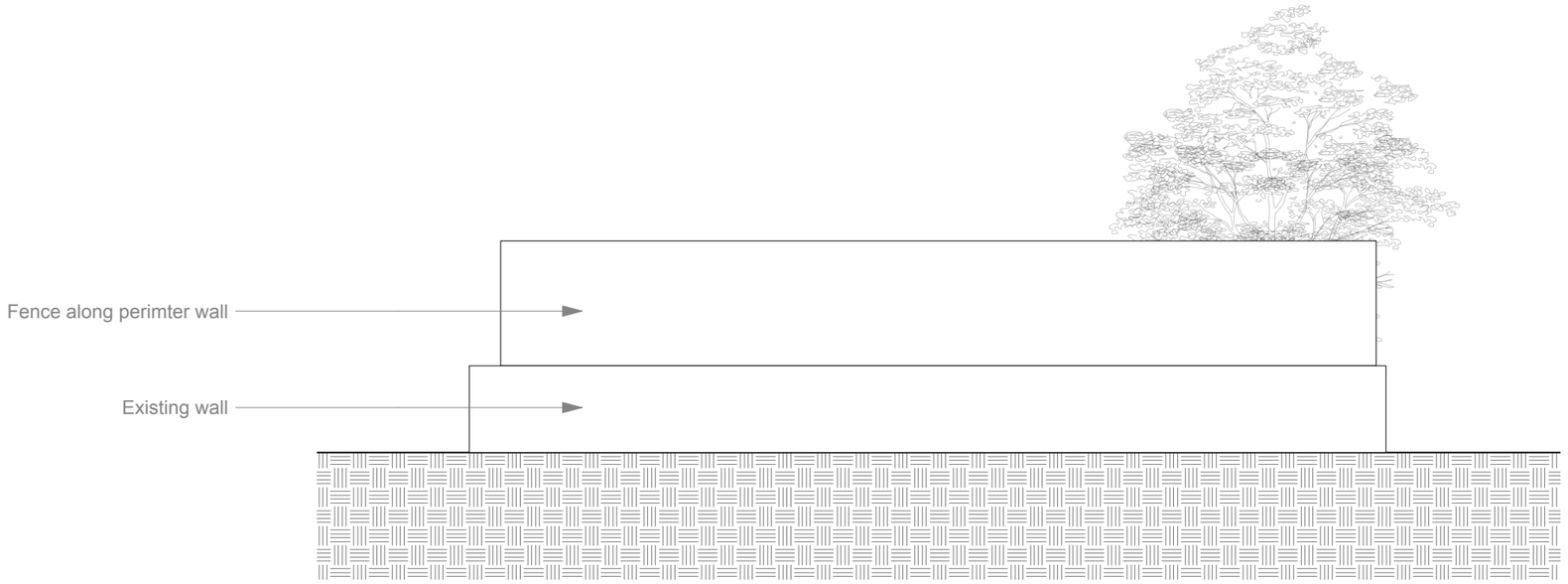

02 - REAR ELEVATION

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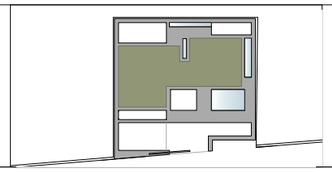

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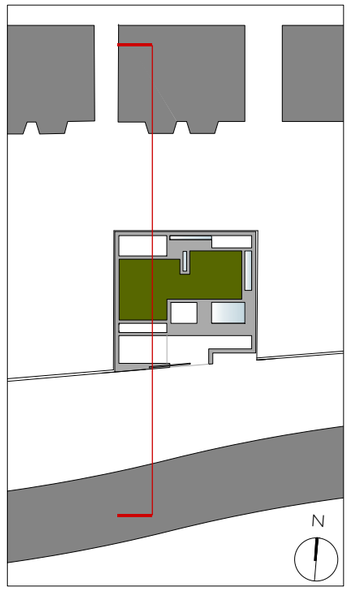
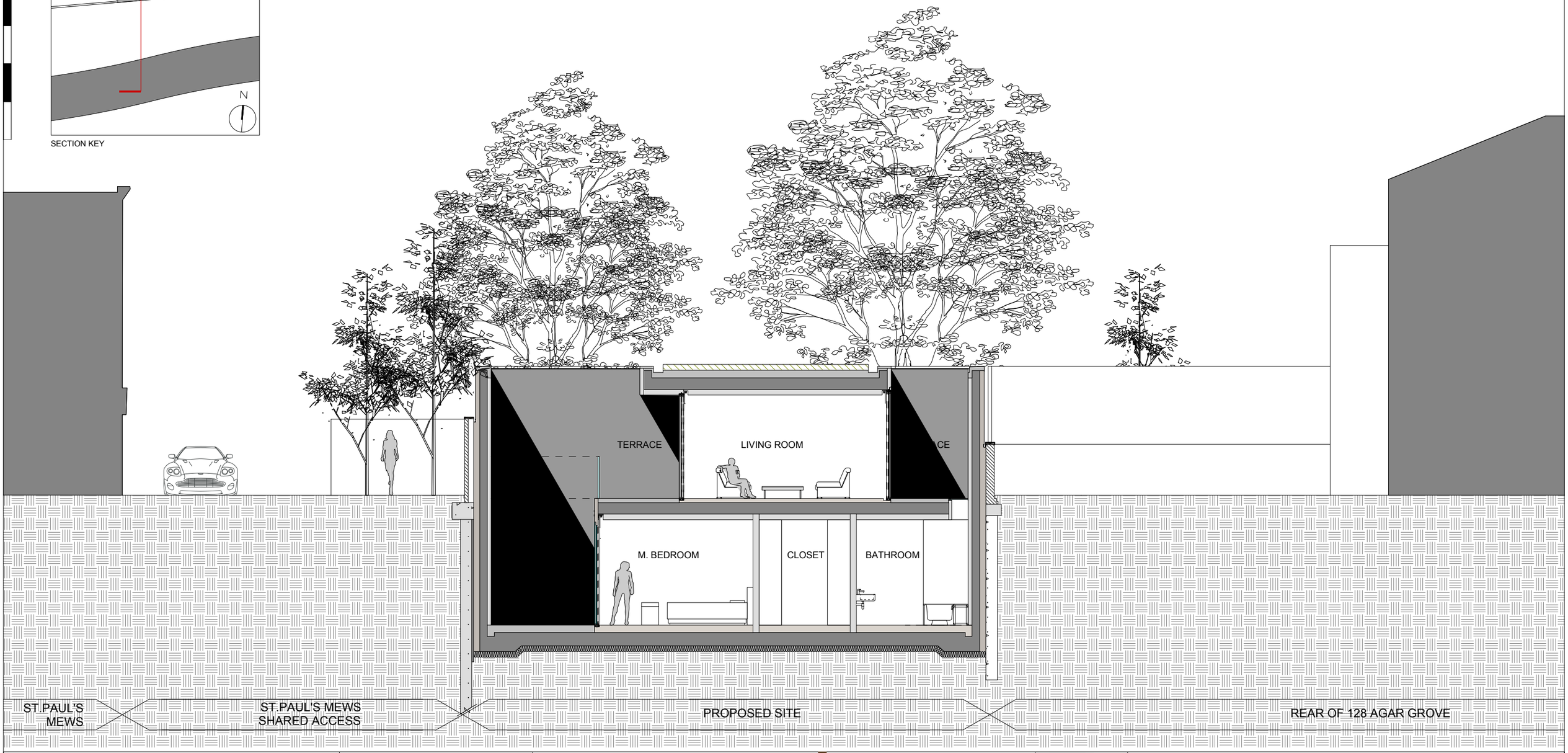
STATUS	**DRAFT PLANNING**						
PROJECT	ST PAULS MEWS, LONDON, NW1 9TZ						
DRAWING TITLE	**07.08.2014**	PROPOSED FRONT AND REAR ELEVATION					
DATE 03.2014	**SCALE** 1:50@A3	**JOB NO.** 448	**DRWG NO.** (00)_211	**REV.** -			



SECTION KEY



NOTES:

- DO NOT SCALE FROM THIS DRAWING.
- ALL DIMENSIONS TO BE CHECKED ON SITE.
- ALL OMISSIONS AND DISCREPANCIES TO BE REPORTED TO THE ARCHITECT IMMEDIATELY

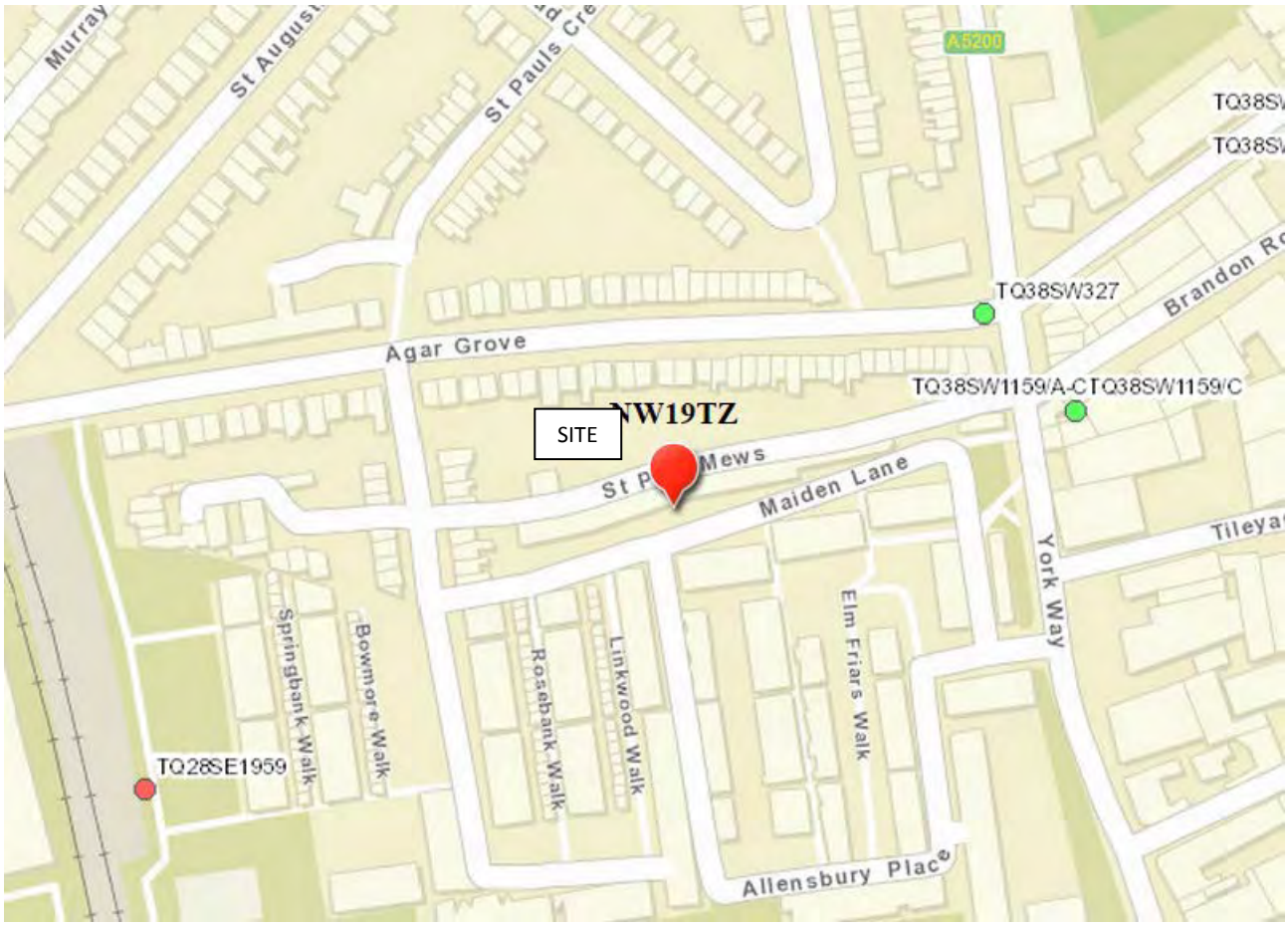
TF ARCHITECTURE
2-3 WOODSTOCK STREET
LONDON W1C 2AB

T. 020 7052 0756
F. 020 7052 0757
E. info@tfarchitecture.com

STATUS	**DRAFT PLANNING**				
PROJECT	ST PAULS MEWS, LONDON, NW1 9TZ				
DRAWING TITLE	**07.08.2014**	PROPOSED SECTION CC			
DATE 03.2014	**SCALE** 1:100@A3	**JOB NO.** 448	**DRWG NO.** (00)_303	**REV.** -	

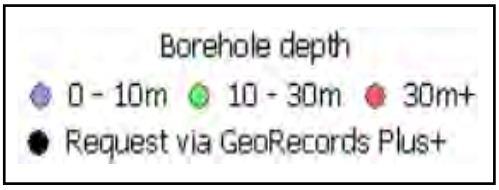
APPENDIX B

BGS borehole records



NOT TO SCALE

Source: www.bgs.ac.uk



N

Client	Project	Job No
St Paul's Mews (Islington) Ltd.	**St Pauls Mews, London**	**CG/18183**
CGL	Title **BGS borehole location plan**	**Appendix B**

Corner of St. James Rd &

C 38

WELL BORING at York Rd. N.W. County

Geol. map 1 in. map New Series 256 6 in. map 7 N.W.

Made by TQ 38 SW 327 Date 1907 — 10.

Sunk feet. Bored feet.

Communicated by L.C.C.

Height above Ordnance Datum 123.43, Rest level of water

Yield -37.02

Quality (with copy of analysis on separate sheet) 30045 84385

GEOLOGICAL FORMATION	NATURE OF STRATA	THICKNESS Feet	THICKNESS Inches	DEPTH Feet	DEPTH Inches
	Macadam.	±	6		
	Made Ground.	2	—	2	6
	Yellow clay.	33	—	35	6
	Blue clay. Unbottomed				
	Base of Bore at +120.93'.				

0.36

10.82 (10.46)

(50478X) Wt. W39733/0131 2,500 4/31 H. J. R. & L., Ltd. Gp. 616

RECORD OF BOREHOLE No: 1

Location : LILLEY H, YORK WAY
Contract No. : CP669/985
Type of Boring : Shell and Auger
Date (started) : 19.7.1972

Borehole Dia : 6"
Casing : 6"/15'0"
Ground Level :

Depth of Casing	Water Level	SAMPLES Depth	Type	No.	STRATA Legend	Depth	Thickness	DESCRIPTION OF STRATA
						0'0"		
		2'6"	D	1				
							9'0"	MADE GROUND - (brick rubble and clay)
		5'0" (N = 17)	D	2				
		7'6" (N = 8)	D	3				
		10'0"	D	4		9'0"		
							4'0"	MADE GROUND (Soft grey silty CLAY and brick rubble)
		12'6"	D	5		13'0"		
15'0"	Dry	15'0" - 16'5"	U	6				
		20'0"	D	7			14'0"	Firm brown grey mottled fissured silty CLAY with gypsum crystals.
		25'0" - 26'3"	U	8				
		27'6"	D	9		27'0"		
		30'0" - 31'5"	U	10				
							13'0"	Stiff grey brown fissured silty CLAY with gypsum crystals
		35'0"	D	11				
		38'6" - 39'11"	U	12				
						40'0"		End of borehole

REMARKS:

Borehole remained dry.

Foundation Engineering Ltd.

TQ 38 SW | 1152.6
c. 300 E 8435

RECORD OF BOREHOLE No: 2

Location : ISLINGTON, YORK WAY
Contract No. : CP669/985
Type of Boring : Shell and Auger
Date (started) : 19.7.1972 *

Borehole Dia : 6"
Casing : 6"/10'0"
Ground Level :

Depth of Casing	Water Level	SAMPLES Depth	Type	No.	STRATA Legend	Depth	Thickness	DESCRIPTION OF STRATA
						0'0"		
		2'6"	D	1			6'9"	MADE GROUND (Brick rubble and clay)
		5'0" (N = 23)	D	2		6'9"		
		7'6"	D	3				
		10'0" - 11'5"	U	4				
10'0"	Dry	15'0"	D	5				
		20'0" - 21'5"	U	6			33'3"	Stiff brown/grey fissured silty CLAY
		25'0"	D	7				
		30'0" - 31'5"	U	8				
		35'0"	D	9				
		38'6" - 39'8"	U	10		40'0"		End of borehole

MARKS:

Foundation Engineering Ltd.

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Site: CTRL GI DATA - Entire NDATA19 data set

Borehole Number: SA3766

Boring Method	Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion		31.42	UR/LCE	Issue 1
Location		**Dates**	**Engineer**	**Sheet**
530248 E 184188 N		07/11/1995	RILE	1/5

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					31.32	0.10	Reinforced CONCRETE (10mm diameter; 100mm spacing).;(MADE GROUND)		
0.20	V2					(0.45)			
0.20	K1				30.87	0.55	Dense; light grey and brown fine to coarse SAND and subangular; fine to coarse FLINT; BRICK and CONCRETE GRAVEL. Occasional cobble and boulder sized brick fragments.;(MADE GROUND)		
0.50	K3					(0.65)			
0.50	V4								
1.00	K5						Soft to firm; dark grey; brown and black sandy CLAY with some subangular; fine to coarse brick and flint gravel.;(MADE GROUND)		
1.00	V6				30.22	1.20			
1.20-1.65	U7			15 blows					
							Soft to firm; brown slightly sandy (fine to coarse) CLAY with a little angular; fine to coarse brick and flint gravel and occasional cobble sized pockets of black sandy very silty clay.;(MADE GROUND);Below 2.70m; becoming mottled dark grey and black.		
1.70-2.15	SPT N=4	1.20		1,1/1,,1,2					
1.70-2.15	D9								
2.00	K10								
2.00	V11								
2.20-2.65	U12			16 blows					
						(2.80)			
2.70-3.15	SPT N=3	2.20		1,1/1,1,1					
2.70-3.15	D14								
3.00	V18								
3.00	K15								
3.00	V16								
3.00	K17								
3.20-3.65	U19			22 blows					
3.70-4.15	SPT N=6	3.20		1,1/1,2,1,2					
3.70-4.15	V21								
4.00	K22				27.42	4.00	Firm; brown rarely mottled light grey CLAY with rare fine calcareous siltstone gravel and closely spaced partings of orange brown silt.;(LONDON CLAY - GRADE IV)		
4.00	V23								
4.20-4.65	U24			22 blows		(0.70)			
4.70-5.15	SPT N=7	4.20		1,1/2,1,2,2	26.72	4.70	Firm; brown mottled light grey extremely closely lensoidally fissured CLAY with closely spaced partings of orange brown silt and occasional coarse sand size selenite crystals.;(LONDON CLAY - GRADE IIIc)		
4.70-5.15	D26								
5.00	V28								
5.00	K27								
5.20-5.65	U29			38 blows		(1.00)			
5.70-6.15	SPT N=14	5.20		2,2/3,3,4,4	25.72	5.70	Stiff; brown occasionally mottled light grey extremely closely fissured CLAY. Fissures gleyed light grey. Occasional medium to coarse sand size selenite crystals and closely spaced partings of brown silt.;(LONDON CLAY - GRADE IIIb)		
5.70-6.15	D31								
6.00	K32								
6.00	V33								
6.20-6.65	U34			50 blows		(1.00)			
6.70-7.15	SPT N=16	6.00		2,3/3,4,4,5	24.72	6.70	Stiff; brown extremely closely to very closely fissured CLAY. Fissures randomly orientated; planar to undulose; smooth locally stained orange brown. Occasional fine gravel size selenite crystalsand closely spaced partings of brown silty sand.;(LONDON CLAY - GRADE IIIa)		
6.70-7.15	D36								
7.00	V38								
7.00	K37								
7.20-7.65	U39			48 blows					
7.70-8.15	SPT N=18	6.00		2,3/4,4,5,5					
7.70-8.15	D41								
8.00	K42								
8.00	V43								
8.20-8.65	U44			52 blows					
8.70-9.15	SPT N=23	6.00		2,3/5,5,6,7					
8.70-9.15	D46								
9.00	V48								
9.00	K47								
9.20-9.65	U49			54 blows					
9.70-10.15	SPT N=21	6.00		3,4/4,5,6,6					
9.70-10.15	D51								

Remarks

1) Prior to boring an inspection pit was excavated by hand to 1.20m depth. ;2) Arrangements for Aquifer Protection were implemented.;3) Groundwater was encountered at 37.50m during the subsequent monitoring period the water level in the borehole roseto 29.58m in 15 minutes and 27.50m after 20 minutes.;4) The borehole was advanced by chiselling from 37.10m to 37.40m for 75 minutes. ;5) On completion of boring; two standpipe piezometer were installed with the Casagrande tips at 39.00m and 6.80m depth and the followingdetail: From 41.30m to 40.30m; bentonite seal; from 40.30m to 37.50m; sand filter response zone; from 37.50m to 36.50m; bentonite seal; from 36.50m to 8.00m; cement/bentonite grout; from 8.00m to 7.00m; bentonite seal: from 7.00m to 5.00m; sand filter response zone; from 5.00mto 4.00m; bentonite seal; from 4.00m to 0.50m; cement/bentonite grout; and from 0.50m to ground level concrete and a double flush stopcock cover.

Scale (approx)	Logged By
1:50	SM

Figure No.

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Site: CTRL GI DATA - Entire NDATA19 data set

Borehole Number: SA3766

Boring Method	Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion		31.42	UR/LCE	Issue 1
	Location	**Dates**	**Engineer**	**Sheet**
	530248 E 184188 N	07/11/1995	RLE	2/5

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.00	K52					(5.00)			
10.00	V53								
10.20-10.65	U54			60 blows					
10.70-11.15	SPT N=22	6.00		3,4/4,5,6,7					
10.70-11.15	D56								
11.00	V58								
11.00	K57								
11.20-11.65	U59			55 blows					
					19.72	11.70			
11.70-12.15	SPT N=26	6.00		3,4/5,6,7,8			Stiff; grey very closely fissured CLAY. Fissures randomly orientated; smooth; rarely slightly polished with closely spaced partings of grey silt.;(LONDON CLAY - GRADE II)		
11.70-12.15	D61								
12.20-12.65	U62			70 blows					
12.70-13.15	SPT N=28	6.00		3,4/6,6,8,8					
12.70-13.15	D64					(2.50)			
13.20-13.65	U65			72 blows					
13.70-14.15	SPT N=27	6.00		4,4/6,6,7,8					
13.70-14.15	D67								
14.20-14.65	U68			64 blows	17.22	14.20	Very stiff; grey very closely to closely fissured CLAY. Fissures randomly orientated; planar; smooth; rarely slightly polished with closely spaced partings of grey silty fine sand.;(LONDON CLAY- GRADE Ib);From 15.70m to 16.70m; very closely spaced partings of grey silt.;Below 16.20m; with occasional thin laminae of brown silty fine sand and occasional coarse sand to fine gravel sized shell fragments.;At 18.70m; with very closely spaced partings of grey silt.;At 20.20m; stiff.;At 25.70m; becoming very silty.;From 30.70m to 33.70m; with very closely spaced partings of grey silt.;From 35.70m to37.10m; with occasional thin laminae of grey silty fine sand.		
14.70-15.15	SPT N=27	6.00		3,4/5,7,7,8					
14.70-15.15	D70								
15.20-15.65	U71			68 blows					
15.70-16.15	SPT N=30	6.00		3,4/6,7,8,9					
15.70-16.15	D73								
16.00	K74								
16.00	V75								
16.10-16.55	SPT N=31	6.00		3,5/6,8,8,9					
16.20-16.65	U76			70 blows					
16.70-17.15	D78								
17.20-17.65	U79			76 blows					
17.70-18.15	SPT N=31	6.00		4,4/5,8,9,9					
17.70-18.15	D81								
18.20-18.65	U82			78 blows					
18.70-19.15	SPT N=35	6.00		4,5/8,8,9,10					
18.70-19.15	D84								
19.20-19.65	U85			80 blows					
19.70-20.15	SPT N=36	6.00		4,6/7,9,10,10					
19.70-20.15	D87								

Remarks

Scale (approx)	Logged By
1:50	SM

Figure No.

Site	Borehole Number
CTRL GI DATA - Entire NDATA19 data set	SA3766

Boring Method	Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion		31.42	UR/LCE	Issue 1
Location		**Dates**	**Engineer**	**Sheet**
530248 E 184188 N		07/11/1995	RLE	3/5

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
20.20-20.65	U88			84 blows					
20.70-21.15	SPT N=38	6.00		4,5/8,9,10,11					
20.70-21.15	D90								
21.00	V92								
21.00	K91								
21.20-21.65	U93			90 blows					
21.70-22.15	SPT N=39	6.00		4,5/8,9,10,12					
21.70-22.15	D95								
22.20-22.65	U96			95 blows					
22.70-23.15	SPT N=40	6.00		5,7/8,10,10,12					
22.70-23.15	D98								
23.20-23.65	U99			90 blows					
23.70-24.15	SPT N=44	6.00		5,7/9,10,12,13					
23.70-24.15	D101								
24.20-24.60	U102			100 blows					
24.65-25.10	SPT N=42	6.00		4,6/8,10,12,12					
24.65-25.15	D104								
25.20-25.65	U105			100 blows					
25.70-26.15	SPT N=45	6.00		4,7/9,11,12,13					
25.70-26.15	D107								
26.00	K108								
26.00	V109								
26.00	K110								
26.00	V111								
26.20-26.65	U112			100 blows					
26.70-27.15	SPT 50/295	6.00		6,9/10,12,14,14					
26.70-27.15	D114								
27.20-27.65	U115			100 blows					
27.50	W152								▼1
27.70-28.15	SPT N=48	6.00		5,8/10,11,13,14					
27.70-28.15	D117								
28.20-28.65	U118			95 blows					
28.70-29.15	SPT 50/295	6.00		6,9/11,13,13,13					
28.70-29.15	D120								
29.20-29.65	U121			95 blows					
29.70-30.15	SPT N=47	6.00		5,8/10,11,12,14					
29.70-30.15	D123								

Remarks

Scale (approx)	Logged By
1:50	SM

Figure No.

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Site: CTRL GI DATA - Entire NDATA19 data set

Borehole Number: SA3766

Boring Method	Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion		31.42	UR/LCE	Issue 1
	Location	**Dates**	**Engineer**	**Sheet**
	530248 E 184188 N	07/11/1995	RLE	4/5

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(22.90)			
30.20-30.65	U124			90 blows					
30.70-31.15	SPT 50/295	6.00		6,9/11,12,14,13					
30.70-31.15	D126								
31.00	K127								
31.00	V128								
31.20-31.65	U129			85 blows					
31.70-32.14	SPT 50/285	6.00		5,10/12,12,13,13					
31.70-32.14	D131								
32.20-32.65	U132			90 blows					
32.70-33.14	SPT 50/285	6.00		4,9/11,13,14,12					
32.70-33.14	D134								
33.20-33.65	U135			95 blows					
33.70-34.13	SPT 50/275	6.00		5,8/10,14,14,12					
33.70-34.13	D137								
34.20-34.65	U138			95 blows					
34.70-35.13	SPT 50/280	6.00		4,9/11,12,14,13					
34.70-35.13	D140								
35.20-35.60	U141			100 blows					
35.65-36.07	SPT 50/270	6.00		6,10/12,14,14,10					
35.65-36.07	D143								
36.00	K144								
36.00	V145								
36.20-36.60	U146			100 blows					
36.65-37.05	SPT 50/245	6.00		7,11/12,14,16,8					
36.65-37.05	D148								
37.10-37.55	U149				-5.68	37.10	Grey; CLAYSTONE; moderately strong to strong. Recovered as; medium and coarse gravel sized fragments of thinly laminated claystone with much pyrite.;(HARWICH FORMATION)		
						(0.40)			
				Water strike(1) at	-6.08	37.50			V1
37.60	W152			37.50m, rose to	-6.18	37.60			
37.60	W153			27.50m in 20 mins,		(0.10)	Very dense; purple grey silty fine and medium SAND with occasional medium gravel sized pockets of black clayey silt.;(WOOLWICH AND READING - UPPER SAND?)		
37.60-37.93	D150			sealed at 6.00m.					
37.60-37.93	SPT 50/180	6.00		10,13/19,26,5					
37.60-38.10	B151								
							Very dense; light grey very clayey fine and medium SAND with occasional fine and medium gravel sized shell fragments.;(WOOLWICH AND READING - UNDIFFERENTIATED);At 38.60m; becoming very dense.		
38.60-38.77	SPT 50/23	6.00		16,9/33,17		(1.90)			
38.60-38.77	D154								
38.60-39.10	B155								
39.50	D156				-8.08	39.50			
39.60-39.70	V157			100 blows		(0.30)	Firm to stiff; grey very sandy CLAY.;(WOOLWICH AND READING - UNDIFFERENTIATED)		
39.85-40.03	SPT 50/25	6.00		14,11/38,12	-8.38	39.80			

Remarks

Scale (approx)	Logged By
1:50	SM

Figure No.

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Site	Borehole Number
CTRL GI DATA - Entire NDATA19 data set	SA3766

Boring Method	Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion		31.42	UR/LCE	Issue 1
	Location	**Dates**	**Engineer**	**Sheet**
	530248 E 184188 N	07/11/1995	RLE	5/5

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
39.85-40.13	D159					(0.50)	Very dense; light grey slightly clayey fine SAND.;(WOOLWICH AND READING - UNDIFFERENTIATED)		
39.85-40.30	B160								
40.30	D161				-8.88	40.30			
40.40-40.70	U162			100 blows		(0.60)	Stiff; light blue grey indistinctly laminated CLAY.;(WOOLWICH AND READING - UNDIFFERENTIATED)		
40.75-41.07	SPT 50/170	6.00		9,14/17,20,13					
40.75-41.07	D164				-9.48	40.90			
41.00	V166					(0.41)	Stiff to very stiff; green brown mottled light grey friable CLAY.;(WOOLWICH AND READING - LOWER MOTTLED CLAY)		
41.00	K165				-9.89	41.31			
							Complete at 41.31m		

Remarks

Scale (approx)	Logged By
1:50	SM

Figure No.

APPENDIX C

CPG4 screening extracts

Figure 1. Subterranean (ground water) flow screening chart

The Developer should consider each of the following questions in turn, answering either "yes", "unknown" or "no" in each instance.

Consideration should be given to both the temporary and permanent works, along with the proposed surrounding landscaping and drainage associated with a proposed basement development.

Question 1a: Is the site located directly above an aquifer?

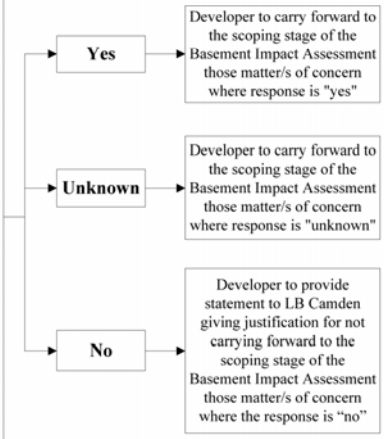
Question 1b: Will the proposed basement extend beneath the water table surface?

Question 2: Is the site within 100m of a watercourse, well (used/disused) or potential spring line?
Question 3: Is the site within the catchment of the pond chains on Hampstead Heath?

Question 4: Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?

Question 5: As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)?

Question 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 (not just the pond chains on Hampstead Heath) or spring line.



Notes / sources of information

Question 1: In LB Camden, all areas where the London Clay does not outcrop at the surface are considered to be an aquifer. This includes the River Terrace Deposits, the Claygate Member and the Bagshot Formation. The location of the geological strata can be established from British Geological Survey maps (e.g. 1:50,000 and 1:10,000 scale). Note that the boundaries are indicative and should be considered to be accurate to ±50m at best.
Additionally, the Environment Agency (EA) "Aquifer Designation Maps" can be used to identify aquifers. These can be found on the "Groundwater maps" available on the EA website (www.environment-agency.gov.uk) follow "At home & leisure" > "What's in Your Backyard" > "Interactive Maps" > "Groundwater". Knowledge of the thickness of the geological strata present and the level of the groundwater table is required. This may be known from existing information (for example nearby site investigations), however, it may not be known in the early stages of a project. Determination of the water table level may form part of the site investigation phase of a BIA.
Question 2: Watercourses, wells or spring lines may be identified from the following sources:

- Local knowledge and/or site walkovers
- Ordnance Survey maps (e.g. 1:25,000 or 1:10,000 scale). If features are marked (they are not always) the following symbols may be present: W; Spr; water is indicated by blue colouration. (check the key on the map being used)
- British Geological Survey maps (e.g. 1:10,000 scale, current and earlier editions). Current maps will show indicative geological strata boundaries which are where springs may form at the ground surface; of relevance are the boundary between the Bagshot Formation with the Claygate Member and the Claygate Member with the London Clay. Note that the boundaries are indicative should be considered to be accurate to ±50m. Earlier geological maps (e.g. the 1920's 1:10560 scale) maps show the location of some wells.
- Aerial photographs
- "Lost Rivers of London" by Nicolas Barton, 1962. Shows the alignment of rivers in London and their tributaries.
- The British Geological Survey (BGS) GeoIndex includes "Water Well" records. See www.bgs.ac.uk and follow "Online data" > "GeoIndex" > "Onshore GeoIndex".
- The location of older wells can be found in well inventory/catalogue publications such as "Records of London Wells" by G. Barrow and L. J. Wills (1913) and "The Water Supply of the County of London from Underground Sources" by S Buchan (1938).
- The Environment Agency (EA) "Source Protection Zone Maps" can be used to identify aquifers. These can be found on the "Groundwater maps" available on the EA website (www.environment-agency.gov.uk) follow "At home & leisure" > "What's in Your Backyard" > "Interactive Maps" > "Groundwater".
- The EA hold records of licensed groundwater abstraction boreholes. LB Camden is within the North East Area of the Thames Region. Details can be found on the EA website.
- LB Camden Environmental Health department may hold records of groundwater wells in the Borough.

Where a groundwater well or borehole is identified, it will be necessary to determine if it is extending into the Lower Aquifer (Chalk) or the Upper Aquifer (River Terrace Deposits, Bagshot Formation, Claygate Member etc). It is water wells extending into the Upper Aquifer which are of concern with regard to basement development.
Question 3: Figure 14 in the attached study, (prepared using data supplied by the City of London Corporation's hydrology consultant, Haycocks Associates) shows the catchment areas of the pond chains on Hampstead Heath.
Question 4: This will be specific to the proposed development and will be a result of the proposed landscaping of areas above and surrounding a proposed basement.
Question 5: This will be specific to the proposed development and will be a result of the chosen drainage scheme adopted for the property.
Question 6: The lowest point will be specific to the proposed development. Knowledge of local ponds may be taken from

- Local knowledge and/or site walkovers
- Ordnance Survey maps (e.g. 1:25,000 or 1:10,000 scale). If features are marked (they are not always) the following symbols may be present: W; Spr; water is indicated by blue colouration. (check the key on the map being used)
- Aerial photographs

Figure 2. Slope stability screening flowchart

The Developer should consider each of the following questions in turn, answering either "yes", "unknown" or "no" in each instance.

Consideration should be given to both the temporary and permanent works, along with the proposed surrounding landscaping and drainage associated with a proposed basement development.

Question 1: Does the existing site include slopes, natural or manmade, greater than 7°? (approximately 1 in 8)

Question 2: Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 7°? (approximately 1 in 8)

Question 3: Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°? (approximately 1 in 8)

Question 4: Is the site within a wider hillside setting in which the general slope is greater than 7°? (approximately 1 in 8)

Question 5: Is the London Clay the shallowest strata at the site?

Question 6: Will any tree/s 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? (Note that consent is required from LB Camden to undertake work to any tree/s protected by a Tree Protection Order or to tree/s in a Conservation Area if the tree is over certain dimensions).

Question 7: Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site?

Question 8: Is the site within 100m of a watercourse or a potential spring line?

Question 9: Is the site within an area of previously worked ground?

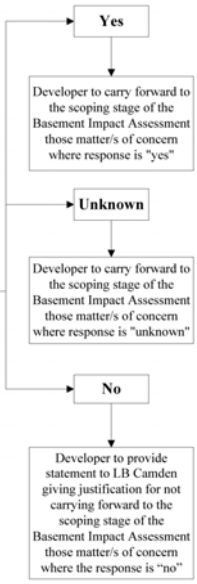
Question 10: Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?

Question 11: Is the site within 50m of the Hampstead Heath ponds?

Question 12: Is the site within 5m of a highway or pedestrian right of way?

Question 13: Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?

Question 14: Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?



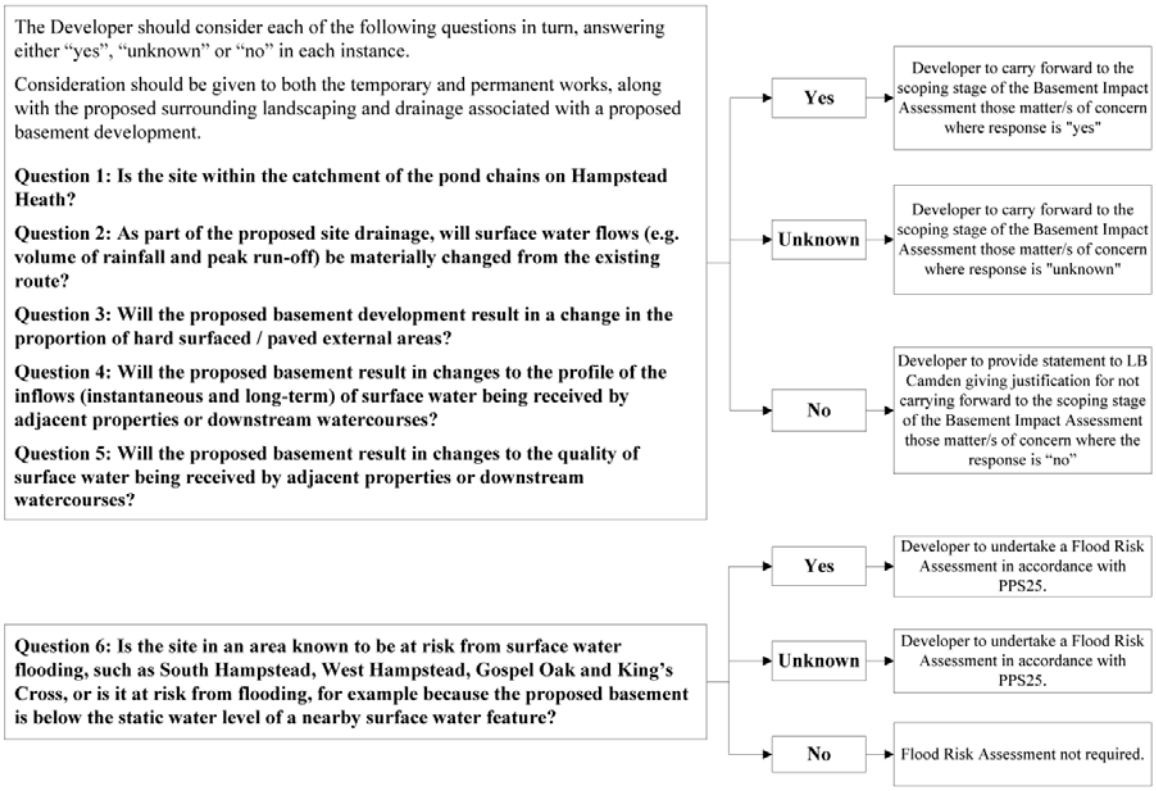
Notes / sources of information

Question 1, 3 & 4: The current surface slope can be determined by a site topographical survey. Slopes may be estimated from 1:25,000 OS maps, however in many urban areas such maps will not show sufficient detail to determine surface slopes on a property-by-property scale, just overall trends. With regard to slopes associated with infrastructure, e.g. cuttings, it should be ensured that any works do not impact on critical infrastructure.
Question 2: This will be specific to the proposed development and will be a result of the proposed landscaping of areas above and surrounding a proposed basement.
Question 5: The plan footprint of the outcropping geological strata can be established from British Geological Survey maps (e.g. 1:50,000 and 1:10,000 scale). Note that the boundaries are indicative and should be considered to be accurate to ±50m at best.
Question 6: this is a project specific determination, subject to relevant Tree Preservation Orders etc.
Question 7: this can be assessed from local knowledge and on-site observations of indicative features, such as cracking. Insurance firms may also give guidance, based on post code. Soil maps can be used to identify high-risk soil types. Relevant guidance is presented in BRE Digest 298 "Low-rise building foundations: the influence of trees in clay soils" (1999); BRE Digest 240 "Low-rise buildings on shrinkable clay soils: part 1" (1993); and BRE Digest 251 "Assessment of damage in low-rise buildings" (1995).
Question 8: Watercourses or spring lines may be identified from the following sources:

- Local knowledge and/or site walkovers
- Ordnance Survey maps (e.g. 1:25,000 or 1:10,000 scale). If features are marked (they are not always) the following symbol may be present "Spr"; water is indicated by blue colouration. (check the key on the map being used)
- Geological maps will show indicative geological strata boundaries which are where springs may form at the ground surface; of relevance are the boundary between the Bagshot Formation with the Claygate Member and the Claygate Member with the London Clay. Note that the boundaries are indicative should be considered to be accurate to ±50m at best. British Geological Survey maps (e.g. 1:10,000 scale, current and earlier editions).
- Aerial photographs
- "Lost Rivers of London" by Nicolas Barton, 1962. Shows the alignment of rivers in London and their tributaries.

Question 9: Worked ground includes, for example, old pits, brickyards, cuttings etc. Information can be gained from local knowledge and/or site walkovers, and from historical Ordnance Survey maps (at 1:25,000 or 1:10,000 scale, or better) and British Geological Survey maps (at 1:10,000 scale, current and earlier editions). Earlier geological maps (e.g. the 1:10560 scale series from the 1920s) include annotated descriptions such as "old pits", "formerly dug", "brickyard" etc.
Question 10: In LB Camden, all areas where the London Clay does not outcrop at the surface are considered to be an aquifer. This includes the River Terrace Deposits, the Claygate Member and the Bagshot Formation. The general footprint of the geological strata can be assessed from British Geological Survey maps (e.g. 1:50,000 and 1:10,000 scale). Note that the boundaries are indicative and should be considered to be accurate to ±50m at best.
The Environment Agency (EA) Aquifer Designation Maps can be used to identify aquifers. These are available from the EA website (www.environment-agency.gov.uk), by clicking on 'At home & leisure' > 'What's in Your Backyard' > 'Interactive Maps' > 'Groundwater'.
Details are required of the thickness of the geological strata present and the level or depth of the groundwater table. This may be known from existing information (for example nearby site investigations); however, it may not be known in the early stages of a project. Determination of the water table level may form part of the site investigation phase of a BIA and may require specialist advice to answer. Depth of proposed development is project specific.
Question 11: From local knowledge and/or site walkovers, and from Ordnance Survey maps (e.g. 1:25,000 or 1:10,000 scale). In relation to the stability and integrity of the pond structures and dams, the guidance of a Panel Engineer should be sought. (Details of Panel Engineers can be found on the Environment Agency website: http://www.environment-agency.gov.uk/business/sectors/64253.aspx). Duty of care needs to be undertaken during any site works in the vicinity of the ponds.
Question 12: From local knowledge and/or site walkovers, and from Ordnance Survey maps (e.g. 1:25,000 or 1:10,000 scale). Any works should not impact on critical infrastructure.
Question 13: From local knowledge and/or site walkovers. May find some details on neighbouring properties from searches of LB Council databases, e.g. planning applications and/or building control records.
Question 14: From local knowledge and/or site walkovers, from Ordnance Survey maps (e.g. 1:25,000 or 1:10,000 scale) and directly from those responsible for tunnels (e.g. TfL or Network Rail). Any works should not impact on critical infrastructure.

Figure 3. Surface flow and flooding screening flowchart



Notes / sources of information

Question 1: Figure 14 in the attached study (prepared using data supplied by the City of London Corporation's hydrology consultant, Haycocks Associates) shows the catchment areas of the pond chains on Hampstead Heath

Question 2: This will be specific to the proposed development and will be a result of the proposed landscaping of areas above and surrounding a proposed basement. The developer should provide documentation of discussion with Thames Water to confirm that the sewers have capacity to receive any increased wastewater flows.

Question 3: This will be specific to the proposed development and will be a result of the chosen drainage scheme adopted for the property

Question 4: This will be specific to the proposed development and will be a result of the proposed landscaping and chosen drainage scheme adopted for the property. SUDS will be required to compensate any increases in peak flow.

Question 5: This will be specific to the proposed development and will be a result of the proposed landscaping and chosen drainage scheme adopted for the property. SUDS will be required to compensate any increases in peak flow.

Question 6: The principles outlined in PPS25 should be followed to ensure that flood risk is not increased.