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42 ELSWORTHY ROAD, LONDON

Basement Impact Assessment – Revision E – Volume 4 of 4

APPENDIX L

GROUND MOVEMENT CALCULATIONS

CALCULATION SHEET

Project: **42 Elsworthy Road**	Job No: P17-1308	Sheet No: 1	Rev.
Subject: **Ground Movement Assessment**	AW	Checked by: RHG	
	Date: 24.10.22	Date: 10/11/22	

Ground movement calculations for proposed basement
At 42 Elsworthy Road, London NW6 7BH

A basement to accommodate living space is proposed at No.42 Elsworth Road

Ground movement estimates have been made using the guide CIRIA C760: Guidance on Embedded Retaining Wall Design, Gaba et al., CIRIA, 2017. Some tables and graphs are reproduced in the calculations.

Figure 1.1 Site Plan

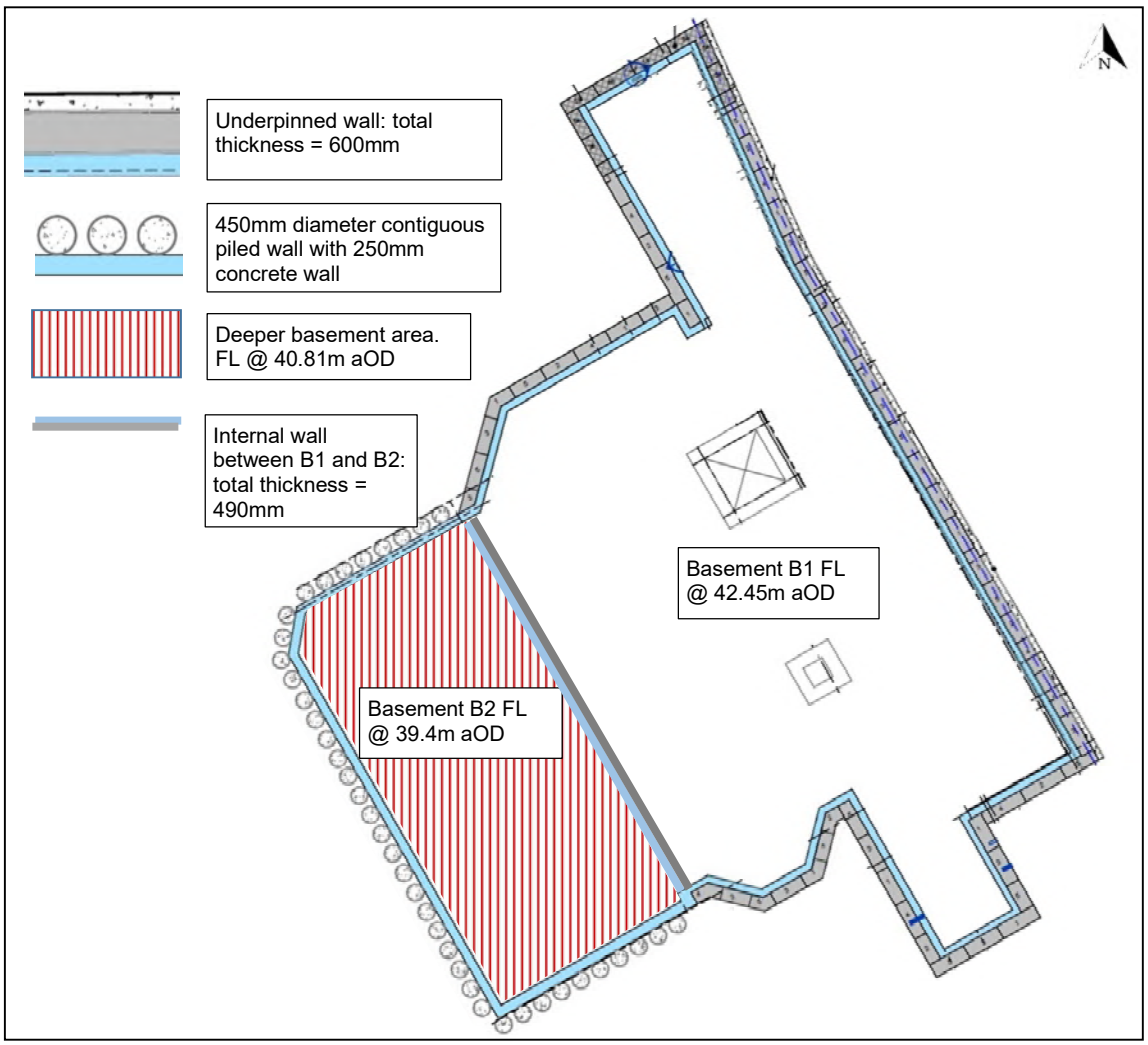

Figure 1.2 Proposed Basement Layout

Proposed elevations are detailed in Figure 1.3, below.

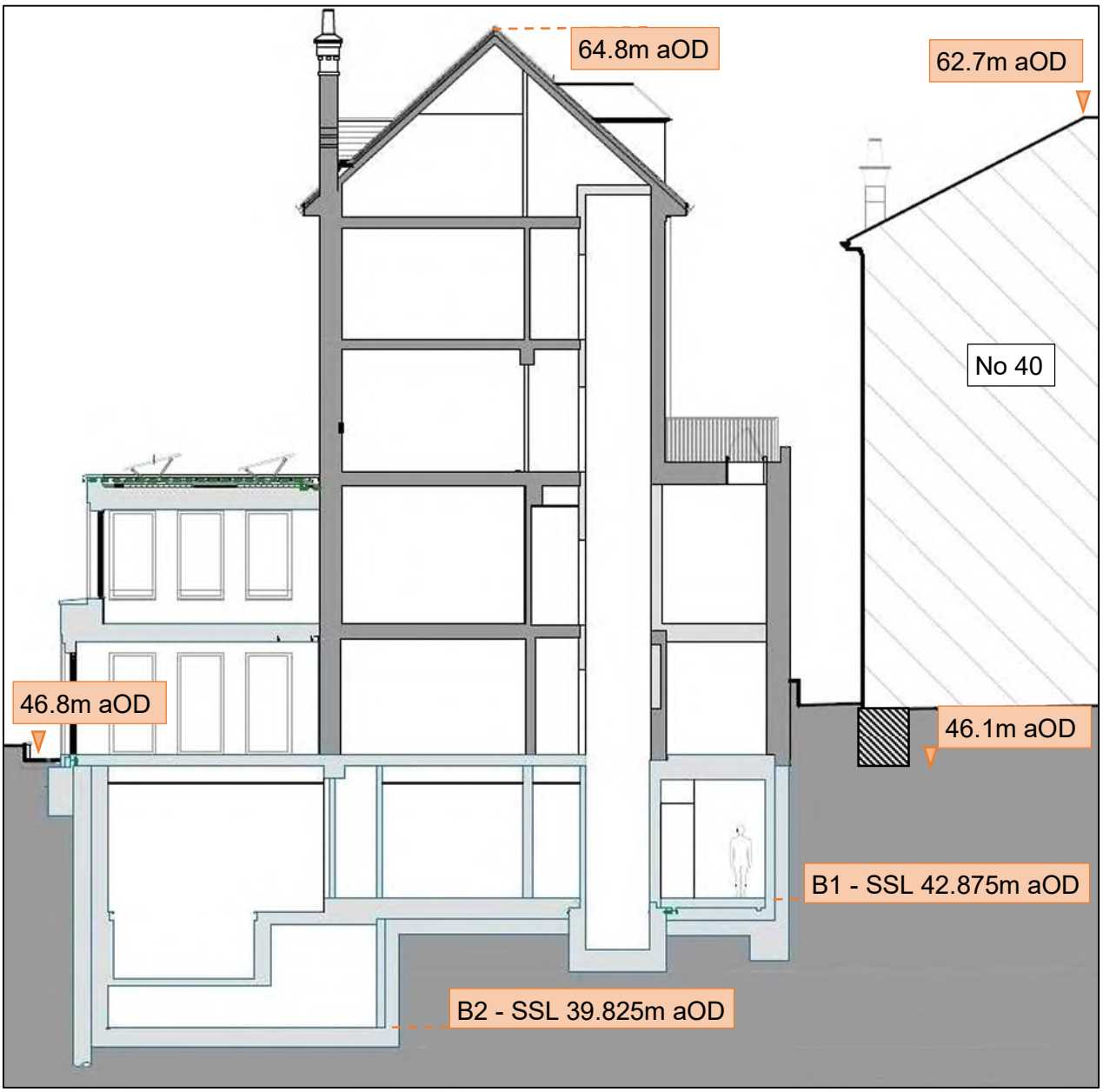

Figure 1.3 Proposed Elevations

Foundation formation level at No.40 Elsworthy Road is taken as equal those exposed at 42 Elsworthy Road (46.1m aOD).

SSL at basement level 1 (B1) is indicated to be 42.875m aOD. With an allowance of 425mm for basement slab, blinding and heave protection, formation level is taken as 42.45m aOD. Formation level for the underpinned wall is taken as 450mm below SSL at 42.425m aOD.

SSL at basement level 2 (B2) is indicated to be 39.825m aOD. With an allowance of 425mm for basement slab, blinding and heave protection, formation level is taken as 39.4m aOD. Formation level for the underpinned wall between B2 and B1 is taken as level with basement formation level (39.4m aOD).

The contiguous pile wall has an effective upstand of 6.0m. Therefore, taking a 1/3rd, 2/3rd insertion ratio, formation level would be 28.8m aOD (18m bgl).

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CALCULATION SHEET

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Table 6.1 Ground surface movements due to bored pile and diaphragm wall installation in stiff clay

Wall type	Horizontal movements		Vertical movements	
	Surface movement at wall (per cent of wall depth)	*Distance behind wall to negligible movement (multiple of wall depth)*	*Surface movement at wall (per cent of wall depth)*	*Distance behind wall to negligible movement (multiple of wall depth)*
Bored piles				
Contiguous	0.04	1.5	0.04	2
Secant	0.08	1.5	0.05	2
Diaphragm walls				
Planar	0.05	1.5	0.05	1.5
Counterfort	0.1	1.5	0.05	1.5

x

Notes

1 Maximum surface movement occurs close to the wall and is calculated as a percentage of the pile depth/diaphragm wall trench depth, as appropriate.

2 Extent of movement is calculated non-dimensionally by dividing by the pile depth/diaphragm wall trench depth, as appropriate.

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Table 6.2 Support stiffness categories (after Carder, 1995)

Support stiffness	Description/examples
High	Top-down construction, temporary props installed before permanent props at high level.
Moderate	Temporary props of high stiffness installed before permanent props at low level.
Low	Cantilever walls, temporary props of low stiffness or temporary props installed at low level.

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CALCULATION SHEET

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Table 6.3 Ground surface movements due to excavation in front of bored pile, diaphragm wall and sheet pile walls wholly embedded in competent ground (stiff clays)

Movement type	High support stiffness (high propped wall, top-down construction)		Low support stiffness (cantilever or low-stiffness temporary props or temporary props installed at low level)	
	Surface movement at wall (per cent of max excavation depth)	*Distance behind wall to negligible movement (multiple of max excavation depth)*	*Surface movement at wall (per cent of max excavation depth)*	*Distance behind wall to negligible movement (multiple of max excavation depth)*
Horizontal	0.15	4	0.4	4
Vertical	0.1	3.5	0.35	3.5

Notes

1 Maximum surface movement occurs close to the wall and is expressed as a percentage of maximum excavation depth in front of the wall.
2 Extent of movement is calculated non-dimensionally by dividing by maximum excavation depth.
3 Movements exclude those arising from wall installation effects.
4 Movements are for good workmanship and walls wholly embedded in stiff clays, retaining stiff clays or other competent soils.
5 Movements will be greater where soft soils are encountered at formation level (see Figure 6.14 and Appendix A6).

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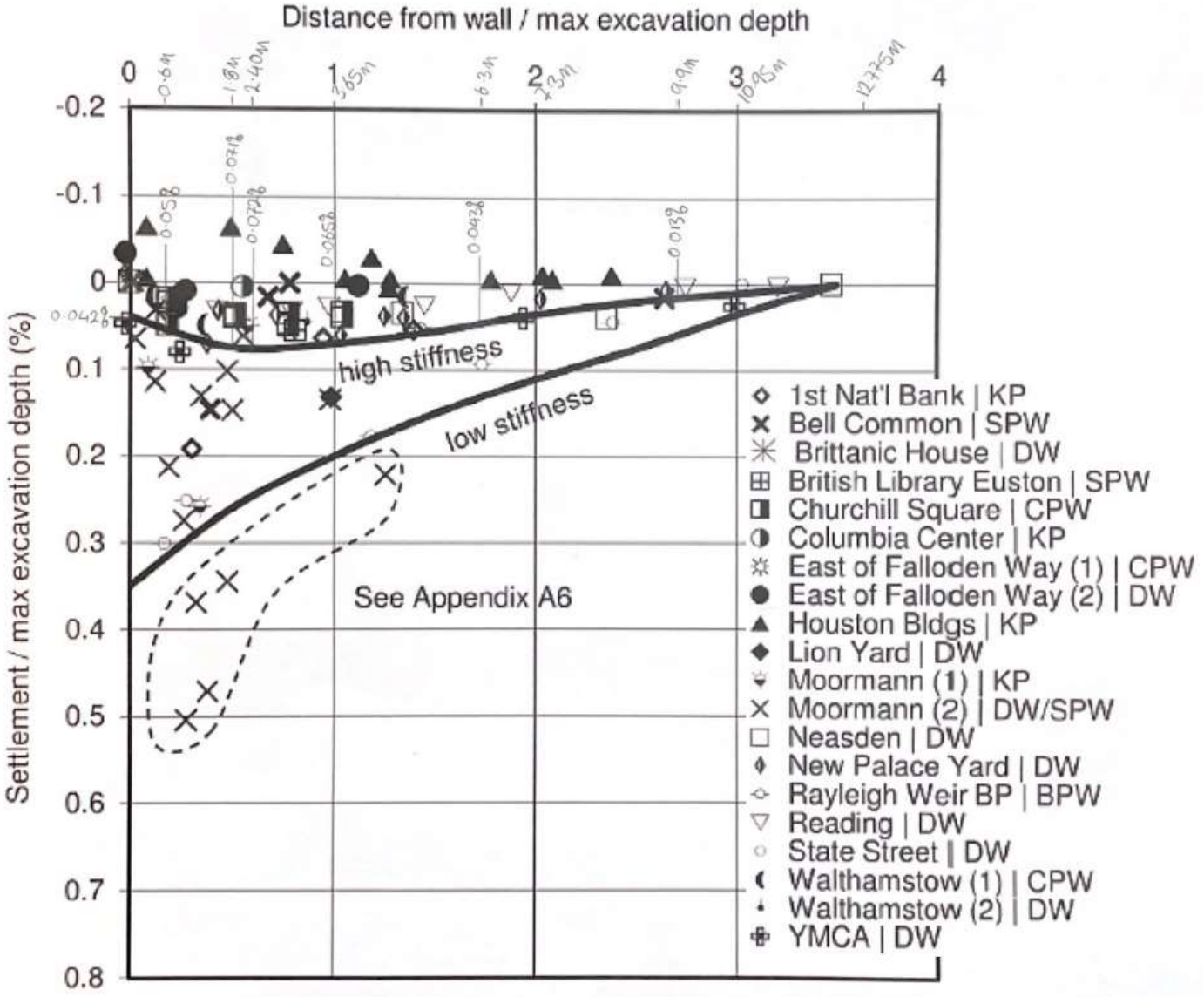

Figure 6.15b Vertial surface movements due to excavation

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CALCULATION SHEET

Project: **42 Elsworthy Road**	Job No: P17-1308	Sheet No: 7	Rev.
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Ground Surface Movement Due To Wall Construction – CIRIA C580

Depth of planar wall relative to No.40 = 3.675m.

Planar diaphragm wall

Table 6.1

Horizontal surface movement = 0.05%

$$\delta_h = \frac{0.05}{100} \times 3{,}675 = \boxed{1.84mm}$$ x

Distance to negligible horizontal movement = 1.5 x 3.675m = 5.51m x

Table 6.1

Vertical surface movement = 0.05%

$$\delta_v = \frac{0.05}{100} \times 3{,}675 = \boxed{1.84\text{mm}}$$ x

Distance to negligible vertical movement = 1.5 x 3.675m = 5.51m x

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CALCULATION SHEET

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Project: **42 Elsworthy Road**	Job No: P17-1308	Sheet No: 8	Rev.
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Ground Surface Movement Due To Excavation – CIRIA C580

Max depth of excavation = 3.65m

Table 6.2

A high support stiffness category has been adopted, based on top-down basement construction and permanent props at high level.

Table 6.3

Horizontal surface movement = 0.15%

$$\delta_h = \frac{0.15}{100} \times 3{,}650 = \boxed{5.48\text{mm}}$$

Distance to negligible horizontal movement: 4 x 3.65m = 14.6m

Fig. 6.15b

Vertical surface movement @ 2.4m = 0.072%

$$\delta_v = \frac{0.072}{100} \times 3{,}650 = \boxed{2.63mm}$$

Table 6.3

Distance to negligible vertical movement = 3.5 x 3.65m = 12.775m

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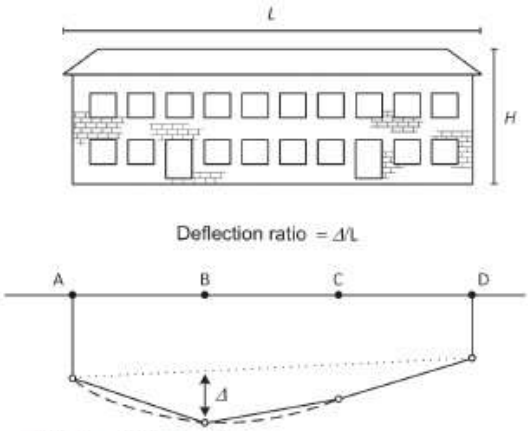
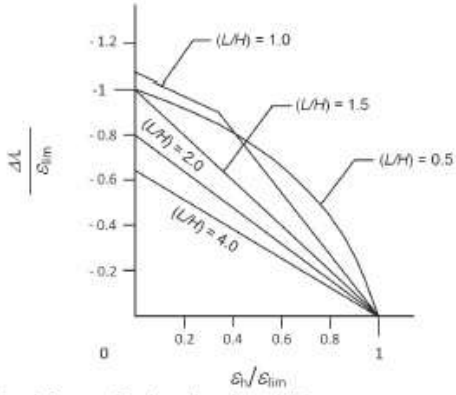
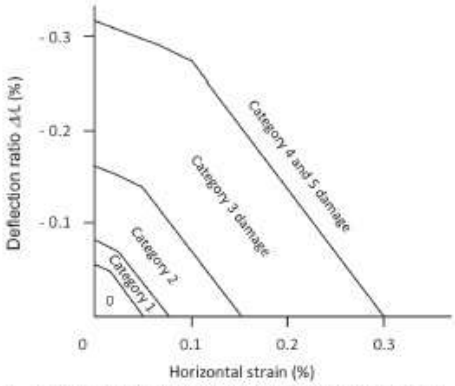


a Definition of deflection ratio



b Influence of horizontal strain on $\Delta/L/\varepsilon_{lim}$



c Relationship between damage category and deflection ratio and horizontal tensile strain for hogging for (L/H) = 1.0

Note

By adopting values of ε_{lim} associated with various damage categories given in Table 6.4, figure (b) can be developed into an interaction diagram showing the relationship between Δ/L and ε_h for a particular value of L/H figure (c) shows such a diagram for $(L/H) = 1.0$.

Figure 6.27 Relationship between damage category, deflection ratio and horizontal tensile strain (after Burland, 2001)

Box 6.3 Procedure for Stage 2 damage category assessment

The following steps should be undertaken in making a Stage 2 assessment of the damage to a structure:

1 Establish L and H for the structure (see Figure 6.27a for definitions of L and H).

2 Determine (L/H).

3 Determine relationship between (Δ/L) and ε_h for the required (L/H) from Figure 6.27b for ε_{lim} values from Table 6.4.

4 Estimate vertical and horizontal ground surface movements in the vicinity of the structure.

5 Determine (Δ/L) and ε_h $(= \delta_h/L)$ where δ_h is the horizontal movement.

6 Estimate damage category from the relationship between (Δ/L) and ε_h established from Step 3.

If the estimated damage category is higher than that specified, a Stage 3 assessment should be carried out.

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Table 6.4 Classification of visible damage to walls (after Burland et al, 1977, Boscardin and Cording, 1989, and Burland, 2001)

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

Notes

1 In assessing the degree of damage, account must be taken of its location in the building or structure.

2 Crack width is only one aspect of damage and should not be used on its own as a direct measure of it.

Planar Wall **No.40 Elsworthy Road**

Ground Surface Movement due to Wall Construction - B1 basement area

					At 1.8 m		At 9.9 m	
					Horizontal	Vertical	Horizontal	Vertical
	Depth of adjacent foundations		46.1	m aOD				
	Excavation formation level		42.45	m aOD				
	Wall formation level		42.425	m aOD				
	Relative depth of wall		3.675	m				
Table 6.1	Horizontal surface movement	0.050%	1.84	mm				
	Distance to neg. movement	1.5	5.5125	m				
			0.33	mm/m	1.24 mm		0.00 mm	
Table 6.1	Vertical surface movement	0.050%	1.84	mm				
	Distance to neg. movement	1.5	5.5125	m				
			0.33	mm/m		1.24 mm		0.00 mm

Ground Surface Movement due to Excavation in front of Wall - B1 basement area

	Relative depth of Excavation		3.65	m				
Fig 6.15a	Horizontal surface movement	0.150%	5.48	mm				
	Distance to neg. movement	4	14.6	m				
			0.375	mm/m	4.58 mm		1.7625 mm	
Fig. 6.15b	Vertical surface movement @ 1.80m	0.072%	2.628	mm				
	Distance to neg. movement	3.5	12.775	m				
			0.21	mm/m		2.13 mm		0.59 mm
					5.81 mm	3.37 mm	1.76 mm	0.59 mm

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CALCULATION SHEET

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Fig. 6.27

Sheet No.11

Sheet No.10

Max Δ_v/l

Horizontal Movements @ 40 Elsworthy Rd

$$\frac{L}{H} = \frac{8.1}{15.5} = \boxed{0.5}$$

Horizontal Strains

$$\varepsilon_h = \frac{\Delta}{l} = \frac{5.81-1.76}{8100} = 0.0005 = \boxed{0.05}$$

very slight category $\quad \frac{\varepsilon_h}{\varepsilon_{lim}} = \frac{0.05}{0.075} = \boxed{0.67}$

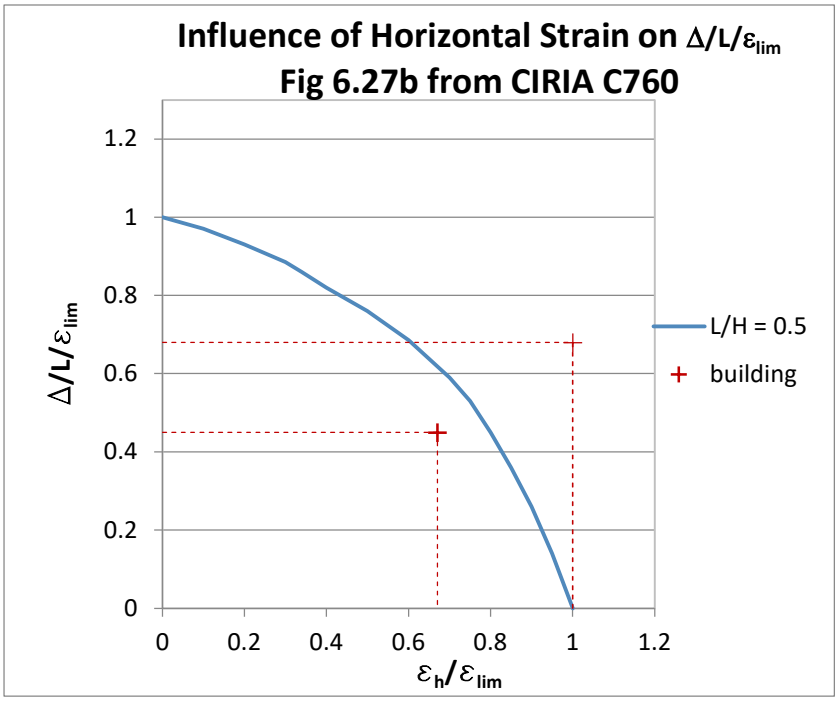
very slight category $\quad \frac{\varepsilon_h}{\varepsilon_{lim}} = \frac{0.05}{0.05} = \boxed{1.0}$

Vertical Strains

$$\frac{\Delta}{l} = \frac{3.37-0.59}{8100} = 0.00034 = \boxed{0.034\%}$$

very slight category $\quad \frac{\Delta/l}{\varepsilon_{lim}} = \frac{0.034}{0.075} = \boxed{0.45}$

very slight category $\quad \frac{\Delta/l}{\varepsilon_{lim}} = \frac{0.034}{0.05} = \boxed{0.68}$



The influence of horizontal strain places the damage category at No.40 Elsworthy Road from basement construction within the range of Category 1 to Category 2 (very slight to slight).

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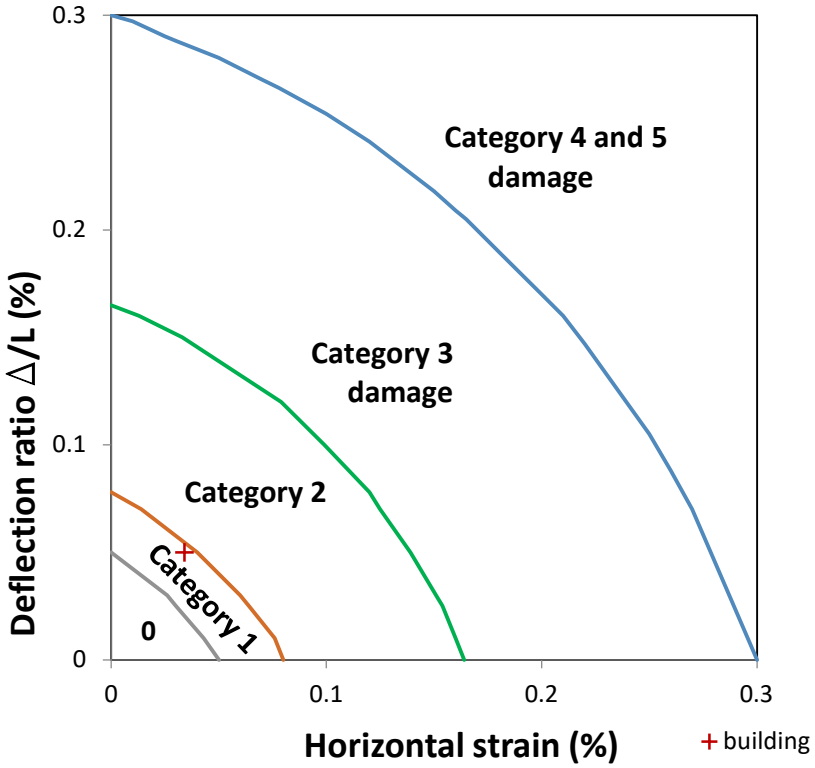
Fig 6.27c Relationship between damage category and deflection ratio and horizontal tensile strain (L/H) = 0.5



Plotting the influence of horizontal strain against the deflection ratio indicates No.40 Elsworthy Road will be subject to **Category 1**, 'very slight' damage. Anticipated damage of: '*Fine cracks that can easily be treated during normal decoration . Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection*'.

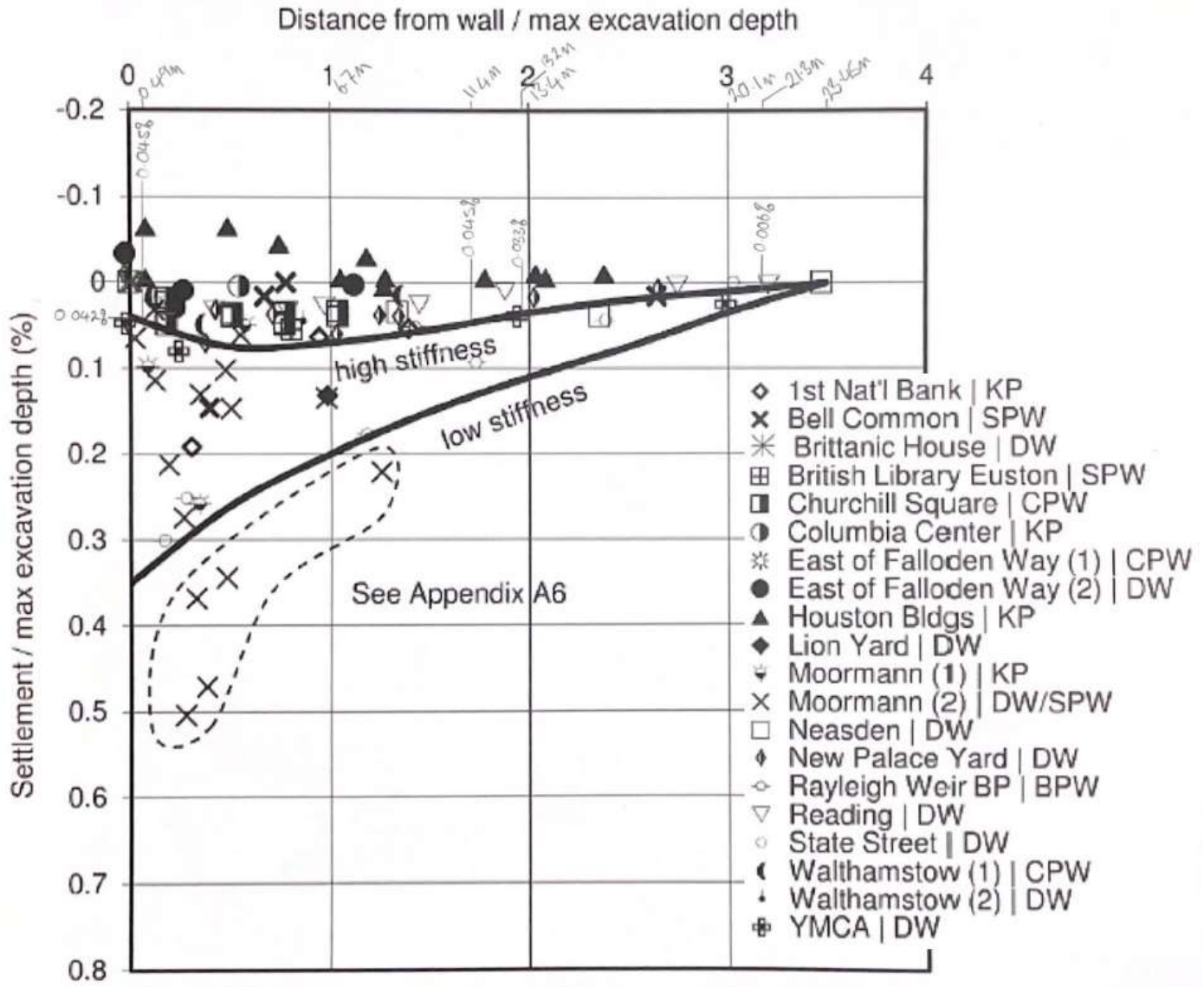


Figure 6.15b Vertial surface movements due to excavation

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CALCULATION SHEET

Project: **42 Elsworthy Road**	Job No: P17-1308	Sheet No: 15	Rev.
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Ground Surface Movement Due To Wall Construction – CIRIA C580

Depth of planar wall relative to No.40 = 6.7m.

Planar diaphragm wall

Table 6.1 Horizontal surface movement = 0.05%

$$\delta_h = \frac{0.05}{100} \times 6700 = \boxed{3.35mm}$$ x

Table 6.1 Distance to negligible horizontal movement = 1.5 x 6.7m = 10.05m x

Vertical surface movement = 0.05%

$$\delta_v = \frac{0.05}{100} \times 6{,}700 = \boxed{3.35\text{mm}}$$ x

Table 6.1 Distance to negligible vertical movement = 1.5 x 6.7m = 10.05m x

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CALCULATION SHEET

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Ground Surface Movement Due To Excavation – CIRIA C580

Max depth of excavation = 6.7m

Table 6.2

A high support stiffness category has been adopted, based on top-down basement construction and permanent props at high level.

Table 6.3

Horizontal surface movement = 0.15%

$$\delta_h = \frac{0.15}{100} \times 6{,}700 = \boxed{10.05\text{mm}}$$

Distance to negligible horizontal movement: 4 x 6.7m = 26.8m

Fig. 6.15b

Vertical surface movement @ 13.2m = 0.033%

$$\delta_v = \frac{0.033}{100} \times 6{,}700 = \boxed{2.21mm}$$

Table 6.3

Distance to negligible vertical movement = 3.5 x 6.7m = 23.45m

Planar Wall **No.40 Elsworthy Road**

Ground Surface Movement due to Wall Construction - B2 basement area

					At 13.2 m		At 21.3 m	
					Horizontal	Vertical	Horizontal	Vertical
	Depth of adjacent foundations		46.1	m aOD				
	Excavation formation level		39.4	m aOD				
	Wall formation level		39.4	m aOD				
	Relative depth of wall		6.7	m				
Table 6.1	Horizontal surface movement	0.050%	3.35	mm				
	Distance to neg. movement	1.5	10.05	m				
			0.33	mm/m	0.00 mm		0.00 mm	
Table 6.1	Vertical surface movement	0.050%	3.35	mm				
	Distance to neg. movement	1.5	10.05	m				
			0.33	mm/m		0.00 mm		0.00 mm

Ground Surface Movement due to Excavation in front of Wall - B1 basement area

	Relative depth of Excavation		6.7	m				
Fig 6.15a	Horizontal surface movement	0.150%	10.05	mm				
	Distance to neg. movement	4	26.8	m				
			0.375	mm/m	4.88 mm		2.0625 mm	
Fig. 6.15b	Vertical surface movement @ 13.2m	0.033%	2.211	mm				
	Distance to neg. movement	3.5	23.45	m				
			0.09	mm/m		0.91 mm		0.20 mm
					4.88 mm	0.91 mm	2.06 mm	0.20 mm

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CALCULATION SHEET

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Fig 6.27

Sheet No.13

Sheet No.13

Max Δ_v/l

Horizontal Movements @ 40 Elsworthy Rd

$$\frac{L}{H} = \frac{8.1}{15.5} = \boxed{\mathbf{0.5}}$$

Horizontal Strains

$$\varepsilon_h = \frac{\Delta}{l} = \frac{4.88-2.06}{8100} = 0.00035 = \boxed{\mathbf{0.035\%}}$$

very slight category $\quad \frac{\varepsilon_h}{\varepsilon_{lim}} = \frac{0.035}{0.075} = \boxed{\mathbf{0.47}}$

very slight category $\quad \frac{\varepsilon_h}{\varepsilon_{lim}} = \frac{0.035}{0.05} = \boxed{\mathbf{0.7}}$

Vertical Strains

$$\frac{\Delta v}{l} = \frac{0.91-0.2}{8100} = 0.000088 = \boxed{\mathbf{0.009\%}}$$

Very slight category $\quad \frac{\Delta/l}{\varepsilon_{lim}} = \frac{0.009}{0.075} = \boxed{\mathbf{0.12}}$

Very slight category $\quad \frac{\Delta/l}{\varepsilon_{lim}} = \frac{0.009}{0.05} = \boxed{\mathbf{0.18}}$

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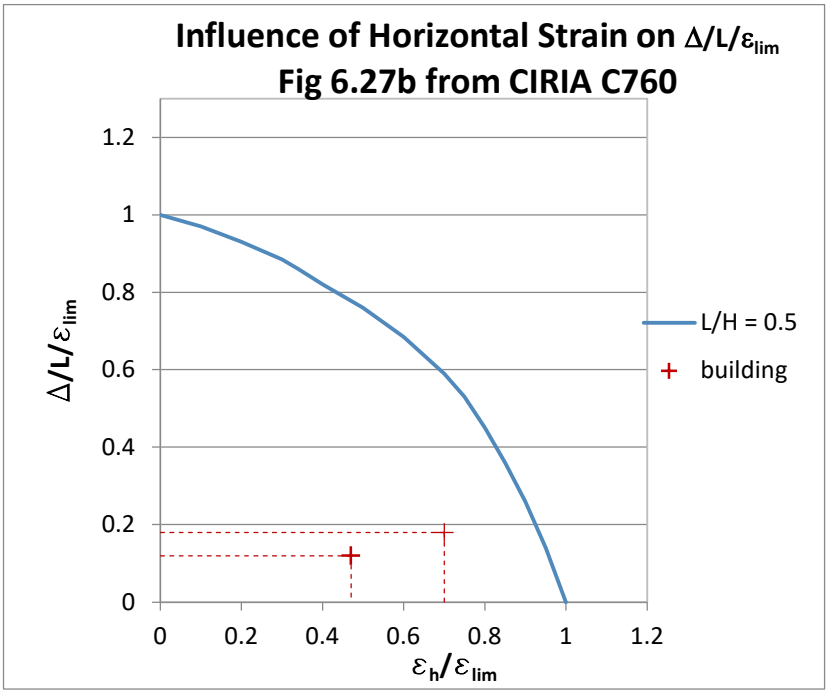

The influence of horizontal strain places the damage category at No.40 Elsworthy from the B2 basement construction is Category 1 (very slight).

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CALCULATION SHEET

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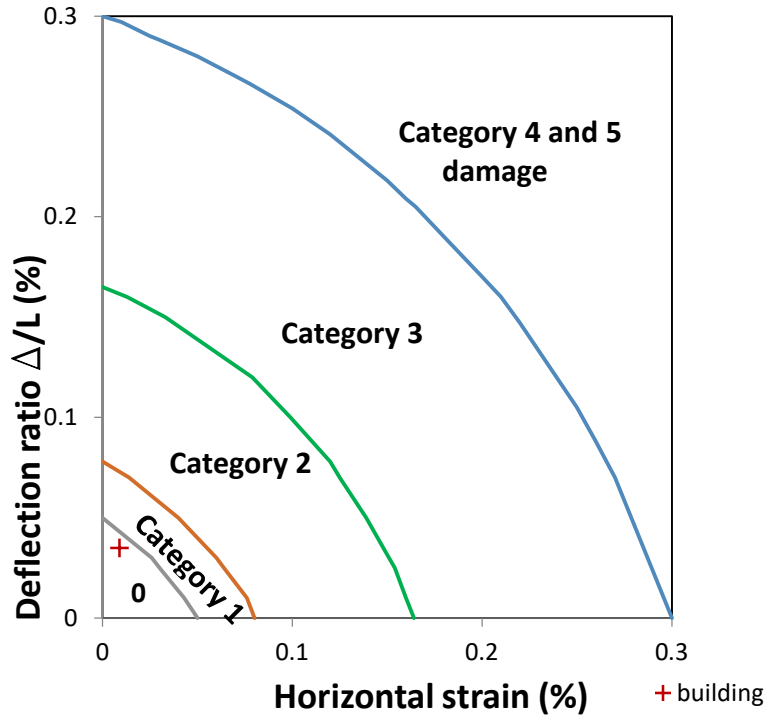
Fig 6.27c Relationship between damage category and deflection ratio and horizontal tensile strain (L/H) = 0.5



Plotting the influence of horizontal strain against the deflection ratio for the B2 basement indicates No.40 Elsworthy Road will be subject to **Category 0**, '**negligible**' damage. Anticipated damage of: '*hairline cracks of less than about 0.1mm are classed as negligible*'.

x

Planar Wall **No.40 Elsworthy Road**

Ground Surface Movement due to Wall Construction - B2 basement area

Depth of adjacent foundations 46.1 m aOD
Depth of wall 28.8 m aOD

Relative depth of excavation 17.3 m

					At 19.8 m		At 28.7 m	
					Horizontal	Vertical	Horizontal	Vertical
Table 6.1	Horizontal surface movement	0.040%	6.92	mm				
	Distance to neg. movement	1.5	25.95	m				
			0.27	mm/m	1.64 mm		0.00 mm	
Table 6.1	Vertical surface movement	0.040%	6.92	mm				
	Distance to neg. movement	2	34.6	m				
			0.20	mm/m		2.96 mm		1.18 mm
					1.64 mm	2.96 mm	0.00 mm	1.18 mm

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CALCULATION SHEET

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Project: **42 Elsworthy Road**	Job No: P17-1308	Sheet No: 21	Rev.
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CIRIA C760

Fig. 6.27

Sheet 20

Sheet No.20

Max Δ_v/l

Horizontal Movements @ 40 Elsworthy Rd

$$\frac{L}{H} = \frac{8.1}{15.5} = \boxed{\mathbf{0.5}}$$

Horizontal Strains

$$\varepsilon_h = \frac{\Delta}{l} = \frac{1.64}{8100} = 0.0002 = \boxed{\mathbf{0.02\%}}$$

slight category $\quad \frac{\varepsilon_h}{\varepsilon_{lim}} = \frac{0.02}{0.075} = \boxed{\mathbf{0.27}}$

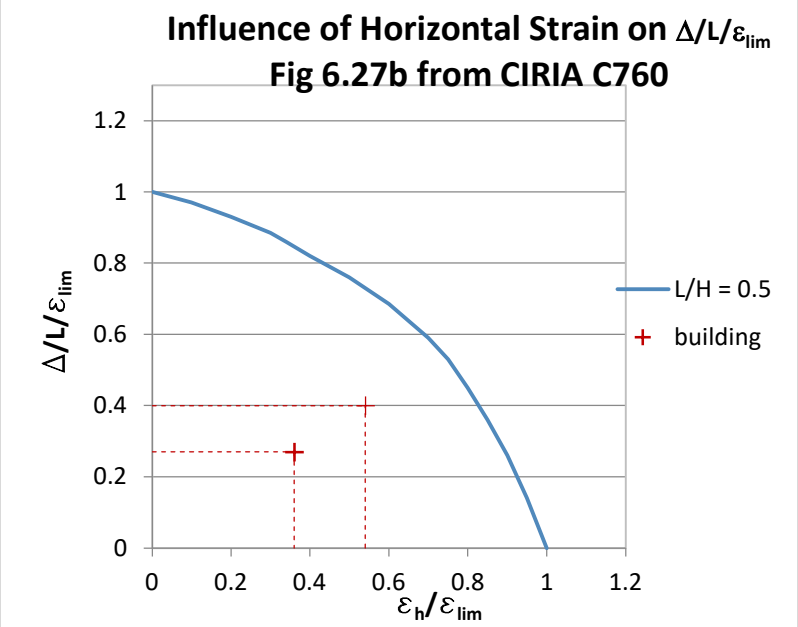
slight category $\quad \frac{\varepsilon_h}{\varepsilon_{lim}} = \frac{0.02}{0.05} = \boxed{\mathbf{0.4}}$

Vertical Strains

$$\frac{\Delta}{l} = \frac{2.96-1.18}{8100} = 0.0002 = \boxed{\mathbf{0.02\%}}$$

slight category $\quad \frac{\Delta/l}{\varepsilon_{lim}} = \frac{0.02}{0.075} = \boxed{\mathbf{0.27}}$

slight category $\quad \frac{\Delta/l}{\varepsilon_{lim}} = \frac{0.02}{0.05} = \boxed{\mathbf{0.4}}$



The influence of horizontal strain places the damage category at No.40 Elsworthy from contiguous piled wall construction as Category 1 (very slight).

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CALCULATION SHEET

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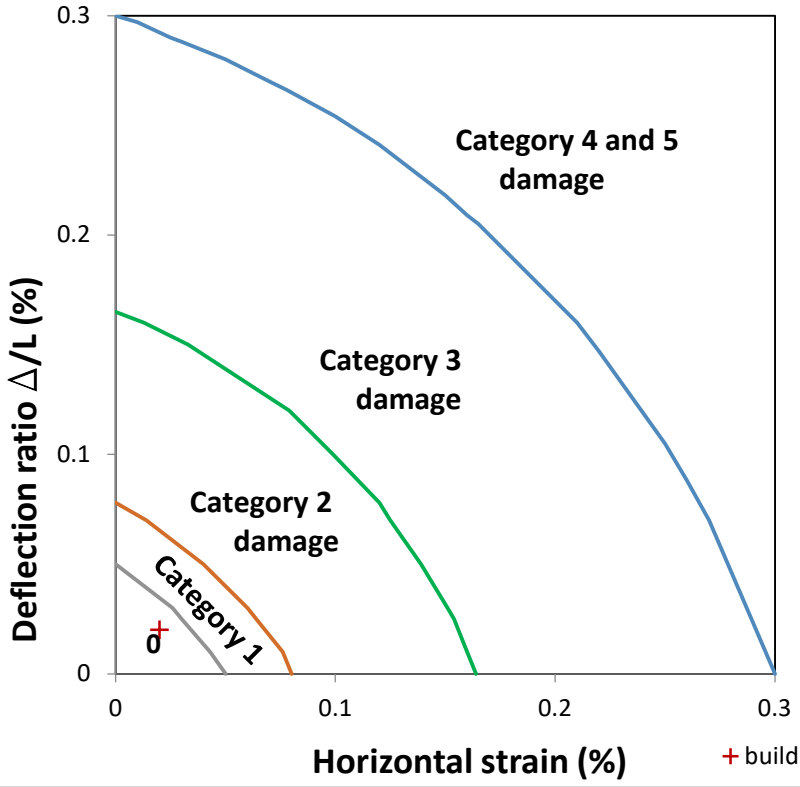
Fig 6.27c Relationship between damage category and deflection ratio and horizontal tensile strain (L/H) = 0.5



Plotting the influence of horizontal strain against the deflection ratio indicates No.40 Elsworthy Road will be subject to **Category 0**, '**negligible**' damage. Anticipated damage of: '*hairline cracks of less than about 0.1mm are classed as negligible*'.

x

+

CALCULATION SHEET

CONSULTING ENGINEERS LTD

Project: **42 Elsworthy Road**	Job No: P17-1308	Sheet No: 23	Rev.
Subject: **Ground Movement Assessment - S**	AW	Checked by: RHG	
	Date: 24.10.22	Date: 10/11/22	

Effects on services within adjacent roads from basement construction

Minimum distance to Elsworthy Road = 7.0m

	Ground movement from wall construction	Ground movement from excavation	Total
Horizontal	2.14mm	2.83mm	5.66mm
Vertical	2.83mm	2.83mm	5.66mm

These are the maximum movement expected from basement construction, which would generate very low strains, well within what can be tolerated by services within the road.

Therefore, **negligible** expected effect on services within adjacent roads.

x

APPENDIX M

FLOOD RISK ASSESSMENT, MARCH 2022

PROPOSED BASEMENT TOGETHER WITH EXTENSIONS AND ALTERATIONS AT 42 ELSWORTHY ROAD, LONDON

FLOOD RISK ASSESSMENT

MARCH 2022

REPORT REF: 2909/RE/03-22/01

Evans Rivers and Coastal Ltd
T: 07896 328220
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CONTRACT

Evans Rivers and Coastal Ltd has been commissioned by Bela Mongia to carry out a Flood Risk Assessment for a proposed basement together with extensions and alterations at 42 Elsworthy Road, London.

QUALITY ASSURANCE, ENVIRONMENT AND HEALTH AND SAFETY

Evans Rivers and Coastal Ltd operates a Quality Assurance, Environmental, and Health and Safety Policy.

This project comprises various stages including data collection; hydrological and hydrogeological assessments; surface water drainage designs; and reporting. Quality will be maintained throughout the project by producing specific methodologies for each work stage. Quality will also be maintained by initiating internal quality procedures including the validation of third party deliverables; creation of an audit trail to record any changes made; and document control using a database and correspondence log file system.

To adhere to the Environmental Policy, data will be obtained and issued in electronic format and alternatively by post. Paper use will also be minimised by communicating via email or telephone where possible. Documents and drawings will be transferred in electronic format where possible and all waste paper will be recycled. Meetings away from the office of Evans Rivers and Coastal Ltd will be minimised to prevent unnecessary travel, however for those meetings deemed essential, public transport will be used in preference to car journeys.

The project will follow the commitment and objectives outlined in the Health and Safety Policy operated by Evans Rivers and Coastal Ltd. All employees will be equipped with suitable personal protective equipment prior to any site visits and a risk assessment will be completed and checked before any site visit. Other factors which have been taken into consideration are the wider safety of the public whilst operating on site, and the importance of safety when working close to a water source and highway. Any designs resulting from this project and directly created by Evans Rivers and Coastal Ltd will also take into account safety measures within a "designers risk assessment".

Report carried out by:

Rupert Evans, BSc (Hons), MSc, CEnv, C.WEM, MCIWEM, PIEMA

DISCLAIMER

This report has been written and produced for Bela Mongia. No responsibility is accepted to other parties for all or any part of this report. Any other parties relying upon this report without the written authorisation of Evans Rivers and Coastal Ltd do so at their own risk.

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DRAWINGS **1851–01**
2164-DE-202-0
2164-DE-208-0
2164-DE-209-0
2164-DE-210-0

1. INTRODUCTION

1.1 Project Scope

1.1.1 Evans Rivers and Coastal Ltd has been commissioned by Bela Mongia to carry out a Flood Risk Assessment for a proposed basement together with extensions and alterations at 42 Elsworthy Road, London.

1.1.2 Specifically, this assessment intends to:

1) Carry out an appraisal of flood risk from all sources such as fluvial/tidal, groundwater, surface water/sewers, artificial sources in accordance with NPPF and other documents such as the SFRA and SWMP;

2) Recommend mitigation measures where appropriate;

3) Report findings and recommendations.

1.1.3 This assessment is carried out in accordance with the requirements of the National Planning Policy Framework (NPPF) dated 2021. Other documents which have been consulted include:

- DEFRA/EA document entitled *Framework and guidance for assessing and managing flood risk for new development Phase 2 (FD2320/TR2)*, 2005;
- DEFRA/Jacobs 2006. *Groundwater flooding records collation, monitoring and risk assessment (ref HA5)*.
- National Planning Practice Guidance – Flood Risk and Coastal Change.
- Woods-Ballard., et al. 2015. *The SUDS Manual, Report C753*. London: CIRIA.
- National SUDS Working Group. 2004. *Interim Code of Practice for Sustainable Drainage Systems*.
- London Borough of Camden Preliminary Flood Risk Assessment (PFRA) Version 0.2 dated 2011.
- London Borough of Camden Strategic Flood Risk Assessment (SFRA) dated 2014.
- London Borough of Camden Surface Water Management Plan (SWMP) Version 1 dated 2011.
- London Borough of Camden flood risk management strategy (FRMS) dated 2013.
- *Camden Planning Guidance – Water and Flooding* dated 2018.
- *Camden Planning Guidance – Basements* dated 2021.

2. DATA COLLECTION

2.1 To assist with this report, the data collected included:

- 1:250,000 *Soil Map of South Eastern England* (Sheet 6) published by Cranfield University and Soil Survey of England and Wales 1983.
- 1:625,000 *Hydrogeological Map of England and Wales*, published in 1977 by the Institute of Geological Sciences (now the British Geological Survey).
- British Geological Survey Online Geology Viewer.
- British Geological Survey Groundwater Susceptibility Map.
- LIDAR data at 1m resolution.
- Ordnance Survey 1:10,000 street view map (Evans Rivers and Coastal Ltd OS licence number 100049458).
- Topographical survey of the site as shown on Drawing Number 1851–01.

3. SITE CHARACTERISTICS

3.1 Existing Site Characteristics and Location

3.1.1 The site is located at 42 Elsworthy Road, London. The approximate Ordnance Survey (OS) grid reference for the site is 527307 184068 and the location of the site is shown on Figure 1.

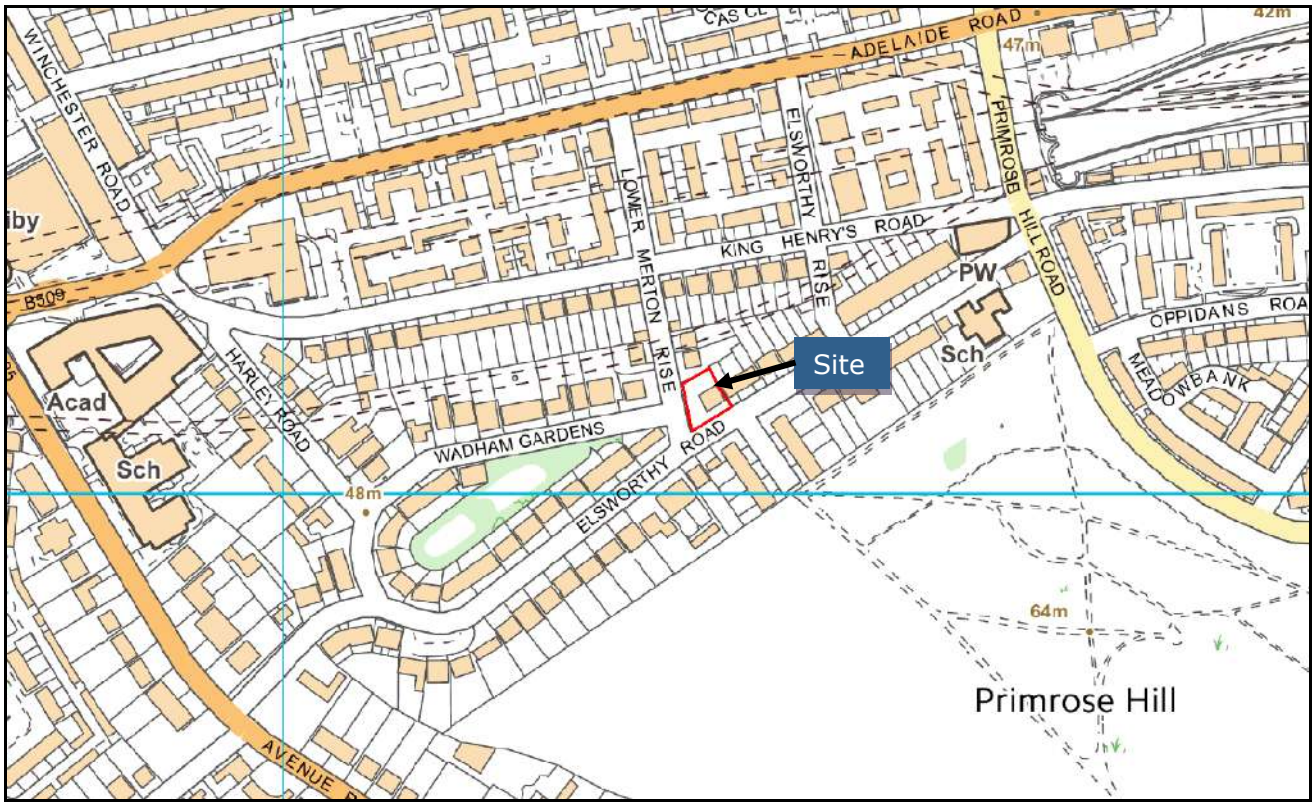

Figure 1: Site location plan (Source: Ordnance Survey)

3.1.2 The site is located within a residential area and comprises a large multi-storey dwelling which includes a lower ground floor level and upper ground floor level.

3.1.3 The site is accessed from Elsworthy Road located adjacent to the south east frontage of the site. Access into the lower ground floor is available externally as well as internally. The existing site layout can be seen on Drawing Number 1851–01.

3.1.4 A topographical survey of the site is shown on Drawing Number 1851–01. Filtered LIDAR data at 1m resolution has also been obtained to determine and illustrate the topography of the site and surrounding area (Figure 2).

3.1.5 Inspection of the data indicates that ground levels typically fall in a north easterly direction away from Elsworthy Road.

Figure 2: Filtered 1m LIDAR survey data where higher ground is denoted as orange and yellow colours and lower areas denoted by blue and green colours

3.2 Site Proposals

3.2.1 It is the Client's intention to undertake internal alterations and extensions and to lower the existing lower ground floor level from >47m AOD to 46.765m AOD. Part of the rear garden adjacent to the lower ground floor will also be lowered to 46.615m AOD.

3.2.2 Below part of the lower ground floor footprint there will be a basement set at 43.202m AOD and will be accessed from an external staircase to the rear of the building as well as an internal staircase.

3.2.3 The site proposals can be seen on Drawing Numbers 2164-DE-202-0, 2164-DE-208-0, 2164-DE-209-0 and 2164-DE-210-0.

4. SOURCES OF FLOODING

4.1 Fluvial/Tidal

4.1.1 The Environment Agency Flood Map (Figure 3) shows that the site is located within the NPPF Flood Zone 1, 'Low Probability' which comprises land as having less than a 1 in 1000 year annual probability of fluvial or tidal flooding (i.e. an event more severe than the extreme 1 in 1000 year event). NPPF states that all uses of land are appropriate in this zone.

4.1.2 The SFRA also states that there has been no historical flooding within the Borough from fluvial or tidal sources.

4.1.3 The SFRA and SWMP states that all main rivers historically located within the Borough are now culverted and incorporated into the sewer network. The SWMP discusses the River Fleet which is one of London's "lost rivers" and which historically originates from springs on Hampstead Heath and drains to the Thames through the Borough. The Fleet is entirely incorporated within the sewer network.

4.1.4 The SFRA continues to discuss the Borough's historic rivers and in addition to the Fleet, the Tyburn, Kilburn and Brent were also located in the area of Hampstead Heath. All of these "lost rivers" are also now incorporated into the local sewer system maintained by Thames Water. It is for these reasons that the Borough is located entirely within Flood Zone 1.

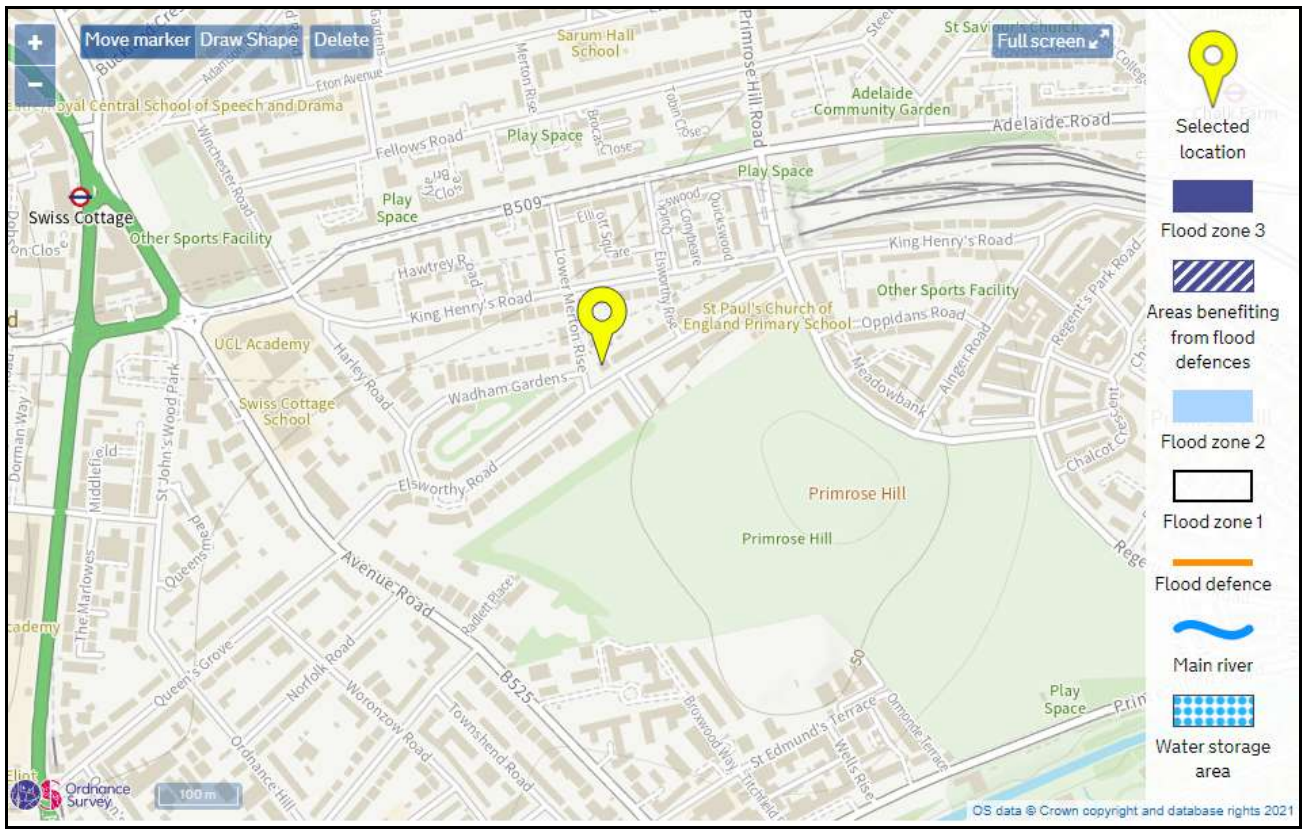

Figure 3: Environment Agency Flood Map (Source: Environment Agency)

4.2 Critical Drainage Areas (CDA)

4.2.1 Despite the site being located within Flood Zone 1, it is understood from Figure 6/Rev 2 of the SFRA and Figure 3.1 of the SWMP, that the site is located within the Group3-005 Critical Drainage Area (CDA).

4.2.2 The SWMP defines the CDA as:

"A discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure."

4.3 Groundwater Flooding

4.3.1 In addition to the information provided in the SFRA and SWMP, in order to assess the potential for groundwater flooding, the Jacobs/DEFRA report entitled *Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study*, published in May 2004, was consulted, together with the guidance offered within the document entitled *Groundwater flooding records collation, monitoring and risk assessment (ref HA5)*, commissioned by DEFRA and carried out by Jacobs in 2006.

4.3.2 The various soil and geological data outlined in Chapter 2, together with Figure 4b/Rev 1 of the SFRA indicates that the soils beneath the site comprise London Clay.

4.3.3 Figure 4e/Rev 1 of the SFRA shows that the site has not been affected in the past from groundwater flooding incidents, and that the site is not located within an area of increased susceptibility to elevated groundwater.

4.3.4 The basement will need to be designed to achieve a Grade 3 level of waterproofing protection as outlined in BS8102:2009. A new reinforced concrete lining wall and ground-bearing concrete slab should be constructed using water resistant concrete to form the primary barrier. Appropriate groundwater control such as sump pumping may be required especially during the construction phase.

4.4 Surface Water Flooding and Sewer Flooding

4.4.1 Surface water and sewer flooding across urban areas is often a result of high intensity storm events which exceed the capacity of the sewer thus causing it to surcharge and flood. Poorly maintained sewer networks and blockages can also exacerbate the potential for sewer flooding.

Surface Water Flooding

4.4.2 It has been established that the site lies within the Group3-005 Critical Drainage Area. The SFRA notes that the surface water mapping indicates that the surface water flood extent broadly follows the natural topography of the borough and man-made features such as roads and rail lines. During extreme modelling scenarios, the SFRA states that there is increased ponding in areas of properties.

4.4.3 The SFRA discusses the two large surface water flooding events in the Borough, which occurred in 1975 and 2002 and caused widespread damage. It is understood that during these events the sewers reached maximum capacity, however, Figure 3ii/Rev 1 of the SFRA shows that the site, adjacent properties and the adjacent highway of Elsworthy Road were not affected during these events.

4.4.4 Figure 3ii/Rev 1 of the SFRA and the Agency's Surface Water Flooding Map (Figure 4) indicates that the site could be affected during very low to low surface water flood risk events (i.e. between a less than 1 in 1000 year chance and 1 in 100 years).

4.4.5 It is generally accepted that the low risk flood event (i.e. between 1 in 1000 years and 1 in 100 years) on the Agency's map is used as a substitute for the climate change 1 in 100 year event to provide a worst-case scenario.

4.4.6 By reviewing the EA map it is evident that the surface water flood risk is attributed to surface water ponding at the rear of the property and not from major overland flow routes from other parts of the CDA.

4.4.7 Further more detailed data has been obtained via the Data.gov.uk site (https://environment.data.gov.uk/DefraDataDownload/?Mode=rofsw). The flood extent, depth and hazard GIS *shape file* was downloaded from Data.gov.uk (for tile TQ_28).

4.4.8 The depth adjacent to the rear of the building is confirmed to be between 0.15m and 0.60m. The flood level could be up to 47.50m AOD (however, this flood level could reduce to 47.22m AOD as a result of the proposed external ground level modifications).

4.4.9 Therefore, it is possible for floodwater to enter the proposed basement and the lower ground floor area during flood events via external pathways. The upper ground floor will be set above the flood level.

Figure 4: Environment Agency Surface Water Flooding Map (Source: Environment Agency, 2022)

Surface Water Flood Risk Mitigation

4.4.10 The evidence indicates that during worst-case low risk surface water flood events the external depth of floodwater at the rear of the property could reach 0.6m, although it is unclear what exact depth would be reached across the basement and lower ground floor level.

4.4.11 It is not practical to avoid the surface water flood risk by raising floor levels above the flood depth. However, the upper ground floor of building will be set above the flood depth thus providing safe refuge.

4.4.12 The DEFRA/EA document entitled *Improving the Flood Performance of New Buildings*, dated 2007, suggests that there is some damage to buildings if the depth differential between the outside and inside water levels exceeds 0.6m. Severe damage can occur if this reaches 1m even if the buildings are flood proofed.

4.4.13 In order to reduce the differential depth to safe limits across the basement and lower ground floor level, it is proposed that a *Water Entry Strategy* is adopted.

4.4.14 In order to provide additional flood protection, it is possible that a *Water Exclusion Strategy* as discussed further in the aforementioned DEFRA/EA document, can be adopted up to the critical differential depth threshold of 0.6m. This will allow occupants to prevent shallower depths of floodwater from entering the basement and lower ground floor by installing flood barriers across external doors and windows (or using flood resilient doors) and using air brick covers.

Water Entry Strategy

4.4.15 In accordance with the ODPM guidance document *Preparing for Floods* and the DEFRA/EA document entitled *Improving the Flood Performance of New Buildings*, a *Water Entry Strategy* in this case aims to allow floodwater to enter the building and flood resilience techniques are incorporated to reduce the consequences of flooding.

4.4.16 Durable fittings which are not affected by floodwater could be used internally (e.g. plastic or stainless steel units). Wood fittings should be avoided; however sacrificial fittings can be installed which can then be replaced easily after the flood. There should be gaps behind the fittings to promote drainage and drying.

4.4.17 It may be practical to raise lower ground floor electrical sockets above the flood depth. However, the supply of electricity should be turned off in the event of a flood. Wiring for communications should also be insulated to prevent damage.

4.4.18 It is recommended that after the event, a structural survey is carried out in order to assess any damage due to prolonged periods of flood water exposure. The CIRIA guidance document (C623) entitled *Standards for the repair of buildings following flooding* outlines the various approaches.

Reducing Vulnerability to the Hazard

4.4.19 Flood Warnings for surface water flooding do not currently exist, however, the occupants should sign up to the Met Office weather warning system https://www.metoffice.gov.uk/public/weather/warnings and safe refuge is available at all times.

4.4.20 There are additional ways in which the residents can reduce the risk themselves. The occupants should develop a *Family Flood Plan*. Further guidance is offered in the Environment Agency's guidance document entitled *What to do before, during and after a flood*. The *Family Flood Plan* should consider, for example, information about vital medication needed and a *Flood Kit*.

Table 1: Flood Event Action Plan

Alert	Level Definition	Action	Responsibility
Yellow: be aware	Yellow warnings can be issued for a range of weather situations. Many are issued when it is likely that the weather will cause some low level impacts, including some disruption to travel in a few places. Other yellow warnings are issued when the weather could bring much more severe impacts to many people but the certainty of those impacts occurring is much lower. It is important to read the content of yellow warnings to determine which weather situation is being covered by the yellow warning.	Monitor flood risk through media. Locate family members and inform them of risk. If away from the site make assessment on risk if considering returning to site (i.e. how long it will take to return etc). Check flood kit, check occupants, check pets – BE PREPARED in case the situation gets worse.	Occupants
Amber: be prepared	There is an increased likelihood of impacts from severe weather, which could potentially disrupt your works plans. This means there is the possibility of travel delays, road and rail closures, power cuts and the potential risk to life and property.	Monitor weather through media and local observations. Consider advice given from authorities including Council, Environment Agency and emergency services. Begin to implement Flood Plan. Check insurance, Check	Occupants

		flood kit, Check Pets.	
Red: Take Action	Dangerous weather is expected and, if you haven't already done so, you should take action now to keep yourself and your works force safe from the impact of the severe weather. It is very likely that there will be a risk to life, with substantial disruption to travel, energy supplies and possibly widespread. You should avoid travelling, where possible, and follow the advice of the emergency services and local authorities.	Follow advice given by Emergency Services, Environment Agency and Council. Maintain communication through the media. Occupants can evacuate themselves if they feel unsafe providing that they make a judgement in relation to any external flood hazard. Take flood kit, occupants and pets with you. People who do not evacuate should reside across building.	Occupants

Safe Access/Egress

4.4.21 The EA surface water flood map shows that Elsworthy Road adjacent to the site would be affected during low risk surface water flood events.

4.4.22 The flood hazard is calculated based on different combinations of floodwater depth and velocity, and subsequently by using the hazard equation as cited in the DEFRA/EA R&D Document *Framework and guidance for assessing and managing flood risk for new development Phase 2 (FD2320/TR2).* The numerical hazard rating is then categorised into four degrees of flood hazard in accordance with *FD2320/TR2*, shown on Table 1 overleaf.

4.4.23 The hazard rating across the site has been extracted from the surface water hazard map which was downloaded from Data.gov.uk and is identified as being 0.50-0.75 during worst-case low risk events.

4.4.24 Therefore, according to Table 1 below the hazard to people would therefore be *Very low*.

Table 1: Hazard to people categories (based on *FD2320/TR2)*

Hazard Rating	Degree of Flood Hazard	Description
< 0.75	Very low hazard	Caution "Flood zone with shallow flowing water or deep standing water"
0.75 – 1.25	Danger for Some	Dangerous for some (i.e. children) "Danger: Flood zone with deep or fast flowing water"
1.25 – 2.0	Danger for Most	Dangerous for most people (i.e. general public) "Danger: Flood zone with deep fast flowing water"
> 2.0	Danger for All	Dangerous for all "Extreme danger: flood zone with deep fast flowing water"

4.4.25 People at the site will need to make a judgment themselves with regards to the flood hazard if evacuation is attempted and not solely rely on the emergency services.

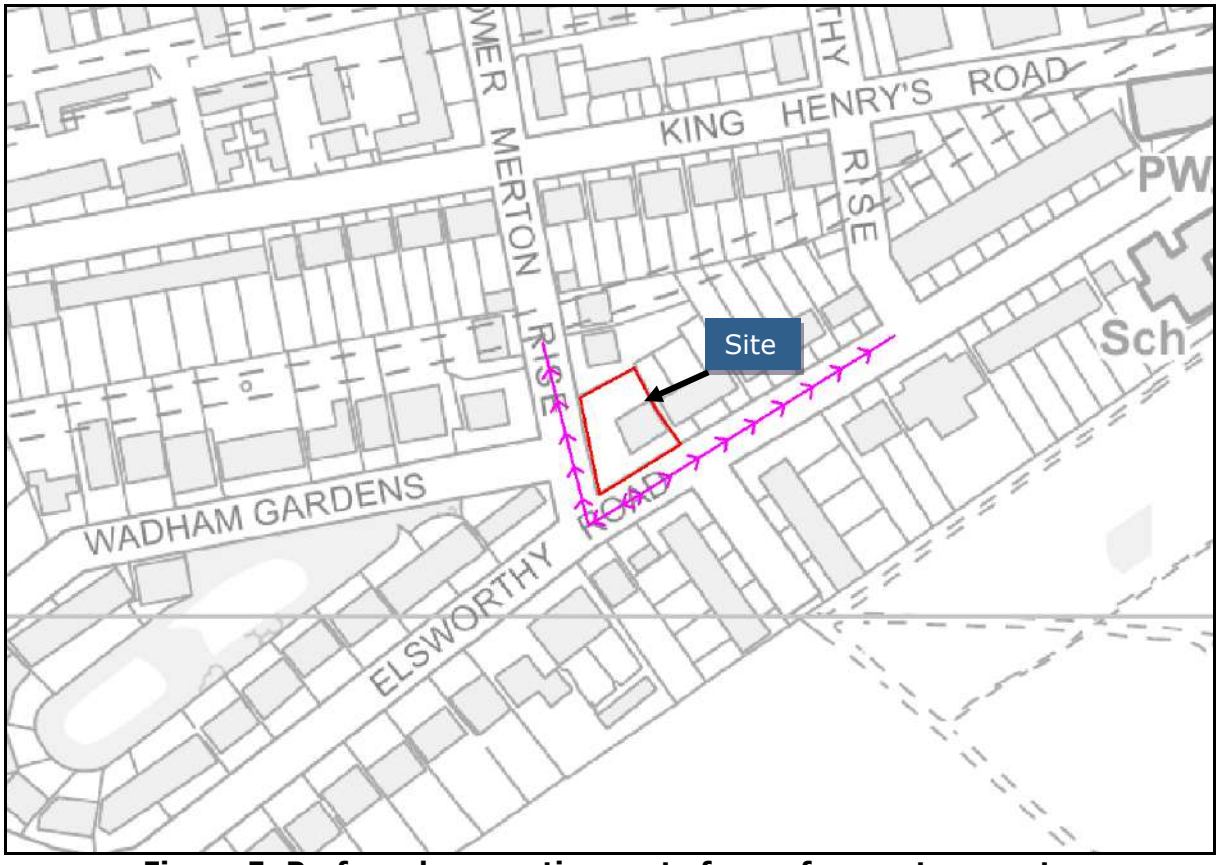

Figure 5: Preferred evacuation route for surface water events

Sewer Flooding

4.4.26 The SFRA states that the majority of the Borough is served by a combined surface and foul water system which is designed to accommodate rainfall events of up to 1 in 30 years return period.

4.4.27 The combined sewer network outfalls into the River Thames during intense rainfall events when the sewer network reaches capacity. The evidence suggests that as the sewer capacity becomes exceeded this results in surcharging of the network prior to sufficient discharge into the Thames.

4.4.28 Figure 5a/Rev 1 of the SFRA indicates that the site is located across an area which has had up to 8 recorded internal sewer flooding incidents. Figure 5b/Rev 1 of the SFRA that the site is located across an area which has had no external sewer flooding incidents.

4.4.29 It is considered that the site should be fitted with a positive pumped device so that it will be protected further from sewer flooding.

4.4.30 In addition to the pumped device there should be a non-return valve (e.g. http://www.forgevalves.co.uk/) installed so that if the sewers become completely full during a heavy storm, foul water does not backflow into the property.

4.4.31 This approach is recommended in section 6.13 of the *Camden Planning Guidance – Basements* dated 2021.

4.5 Reservoirs, Canals And Other Artificial Sources

4.5.1 The failure of man-made infrastructure such as flood defences and other structures can result in unexpected flooding. Flooding from artificial sources such as reservoirs, canals and lakes can occur suddenly and without warning, leading to high depths and velocities of flood water which pose a safety risk to people and property.

4.5.2 The Environment Agency's "Risk of flooding from reservoirs" map suggests that the site is not at risk from reservoirs.

5. CONCLUSIONS

- A review of the relevant guidance documents and various types of data collected at the site has enabled a full assessment of the flood risks to be quantified.

- The site is located within the Flood Zone 1 therefore all uses of land are appropriate in this zone.

- This assessment has investigated the possibility of groundwater flooding and flooding from other sources at the site. It is considered that there will be a low risk of groundwater flooding, however it is considered that the proposed basement should be tanked as a precaution.

- There is a low risk of flooding from other sources such as sewers, and as a precaution the risk from sewer flooding should be mitigated further by introducing a non-return valve and positive pumped device.

- There is a very low to low risk of surface water flooding across the site. A more detailed analysis of the flood risk has been undertaken using the Data.gov.uk GIS data. The low risk (1000yr/100yr plus climate change) flood depth adjacent to the rear of the building is confirmed to be between 0.15m and 0.60m.

- The flood level could be up to 47.50m AOD (however, this flood level could reduce to 47.22m AOD as a result of the proposed external ground level modifications). Therefore, it is possible for floodwater to enter the proposed basement and the lower ground floor area during flood events via external pathways. The upper ground floor will be set above the flood level.

- The risk to the basement and lower ground floor will be mitigated by flood resilience measures and *Water Entry Strategy*.

- There is scope to prevent shallower depths of flooding from entering these areas by including a *Water Exclusion Strategy* up to the differential depth limit of 0.6m. This may reduce the flood depth internally during the event thus improving flood recovery.

- As a precaution a warning and evacuation strategy has been developed within this assessment. It is proposed that the occupants prepare a *Family Flood Plan*.

- Safe refuge is available via the internal staircases and subsequently across the upper ground floor level which will remain dry during the event and set above the flood level.

- Safe access/egress can be achieved during the peak of the low risk surface water flood event.

6. BIBLIOGRAPHY

i. *Camden Planning Guidance – Basements* dated 2021.

ii. *Camden Planning Guidance – Water and Flooding* dated 2018.

iii. Communities and Local Government 2018. *National Planning Policy Framework.*

iv. DEFRA/EA 2005. *Framework and guidance for assessing and managing flood risk for new development, Phase 2, Flood and Coastal Defence R&D Programme, R&D Technical Report FD2320/TR2*. Water Research Council.

v. DEFRA/Jacobs 2004. *Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study (LDS), Final Report, Volumes 1 and 2*.

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vii. Institute of Geological Sciences 1977. *Hydrogeological Map of England and Wales,* 1:625,000. NERC.

viii. London Borough of Camden Preliminary Flood Risk Assessment (PFRA) Version 0.2 dated 2011.

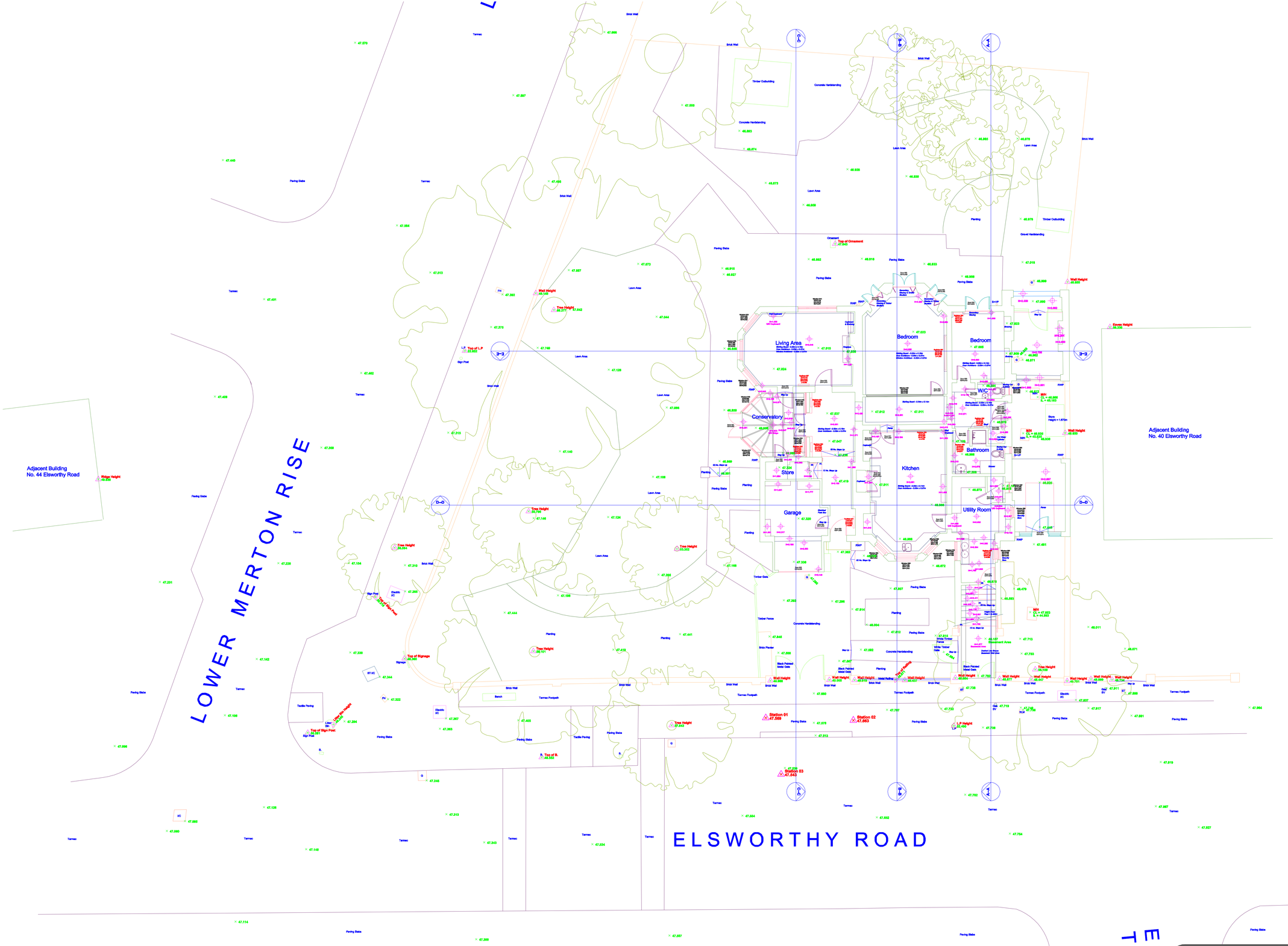
ix. London Borough of Camden Strategic Flood Risk Assessment (SFRA) dated 2014.

x. London Borough of Camden Surface Water Management Plan (SWMP) Version 1 dated 2011.

xi. London Borough of Camden flood risk management strategy (FRMS) dated 2013.

xii. Water UK 2012. *Sewers for Adoption 7th Edition, A design and construction guide for developers*. Water Research Council.

DRAWINGS



Lower Ground Floor

1:100 Scale

This drawing is to be read in conjunction with all relevant specifications and drawings issued.
For discrepancies or omissions contact Mobile CAD Surveying Solutions Ltd prior to work commencing.
The contractor is to check and verify all building and site dimensions and levels before work commences.

DO NOT SCALE THIS DRAWING - CHECK ALL DIMENSIONS ON SITE

Note:
Areas drawn indicatively noted and indicated by grey dashed line as line below

Compass Note:
Survey position and orientation co-ordiated to World Co-ordinates

Abbreviations Key:

I/C	-	Inspection Chamber	GAS	-	Gas Supply
M/H	-	Manhole	ES	-	Electrical Supply
G	-	Drainage Gully	PO	-	Post Office
CD	-	Channel Drain	CATV	-	Community Antenna Television
RE	-	Rodding Eye	TSSU	-	Traffic Light Signals
RWP	-	Rain Water Pipe	T.P	-	Telegraph Pole
S+VP	-	Soil & Vent Pipe	B.	-	Bollard
WM	-	Water Meter	L.P.	-	Lamp Post
ST	-	Stop Tap			
SV	-	Stop Valve			
FH	-	Fire Hydrant			
IL	-	Invert Level			
BT	-	British Telecoms			

Levels:
Levels co-ordinated to OS using GPS equipment, permanent stations located in positions indicated on plan details as follows:-

Station 01	-	E-527314.821, N-184051.927, Height - 47.569m
Station 02	-	E-527318.896, N-184054.323, Height - 47.663m
Station 03	-	E-527317.053, N-184049.775, Height - 47.543m

Rev	Date	Amendments

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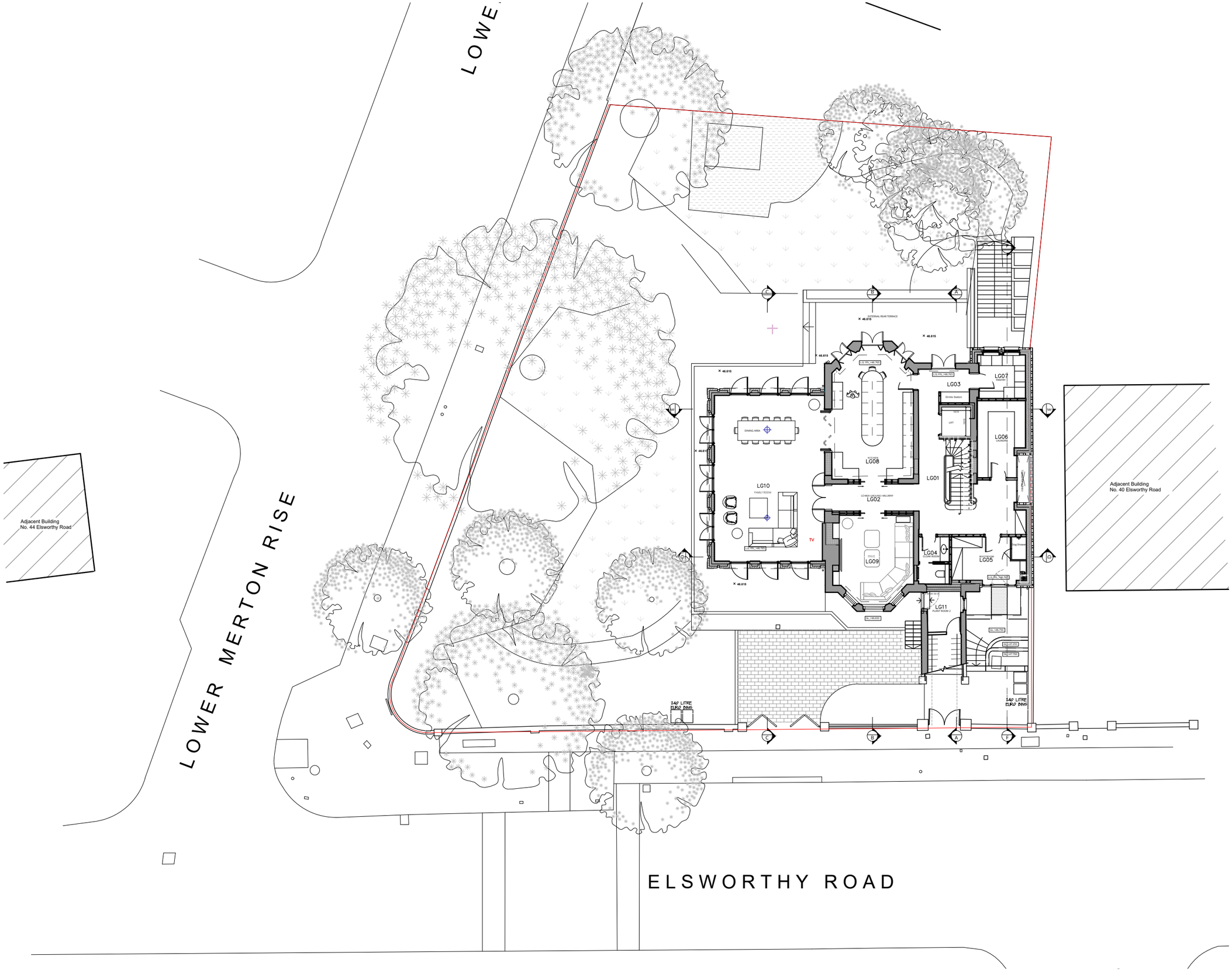
020 3198 1197

Project:	**Measured Building Survey**
Address:	**42 Elsworthy Road, London, NW3 3DL**
Drawing No:	**1851 - 01**
Drawing Title:	**Lower Ground Floor Plan**
Drawing Date:	**December 2016**
Drawing Size:	**1:100 @ A1**
Drawn By: JM	**Checked By: SC** Issue -



PROPOSED SITE LAYOUT

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KEY

existing

demolished

proposed

N

0 5m 10m

Rev.	Description	Date
0	First issue.	25.10.21

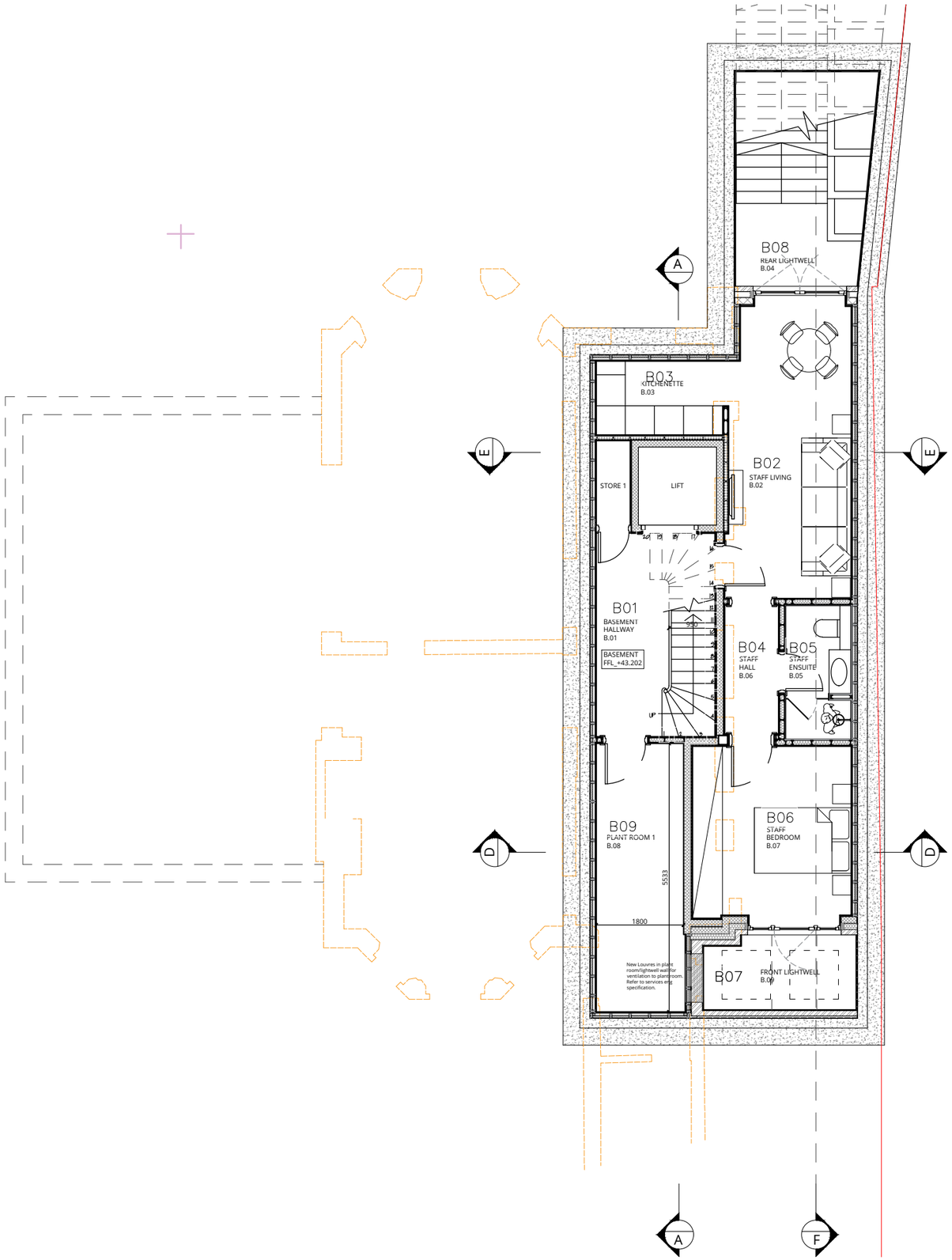
Project Title
42 Elsworthy Road
London NW3 3DL

Drawing Title
Proposed
Site Layout

Status
DESIGN

Drawn by	Checked by	Scale
AW	NP	1:200 @ A3

Project No.	Work Stage	Dwg. No.	Rev.
2164	DE	202	0



PROPOSED BASEMENT FLOOR LAYOUT

WOLFF ARCHITECTS

London 16 Lambton Place Notting Hill
London W11 2SH
T +44 (0)20 7229 3125

Oxford Chandos Yard 83 Bicester Road
Long Crendon HP18 9EE
T +44 (0)1844 203310

W www.wolffarchitects.co.uk
E info@wolffarchitects.co.uk

KEY

existing

demolished

proposed

0 1 2 3 4 5m

Rev.	Description	Date
0	First issue.	25.10.21

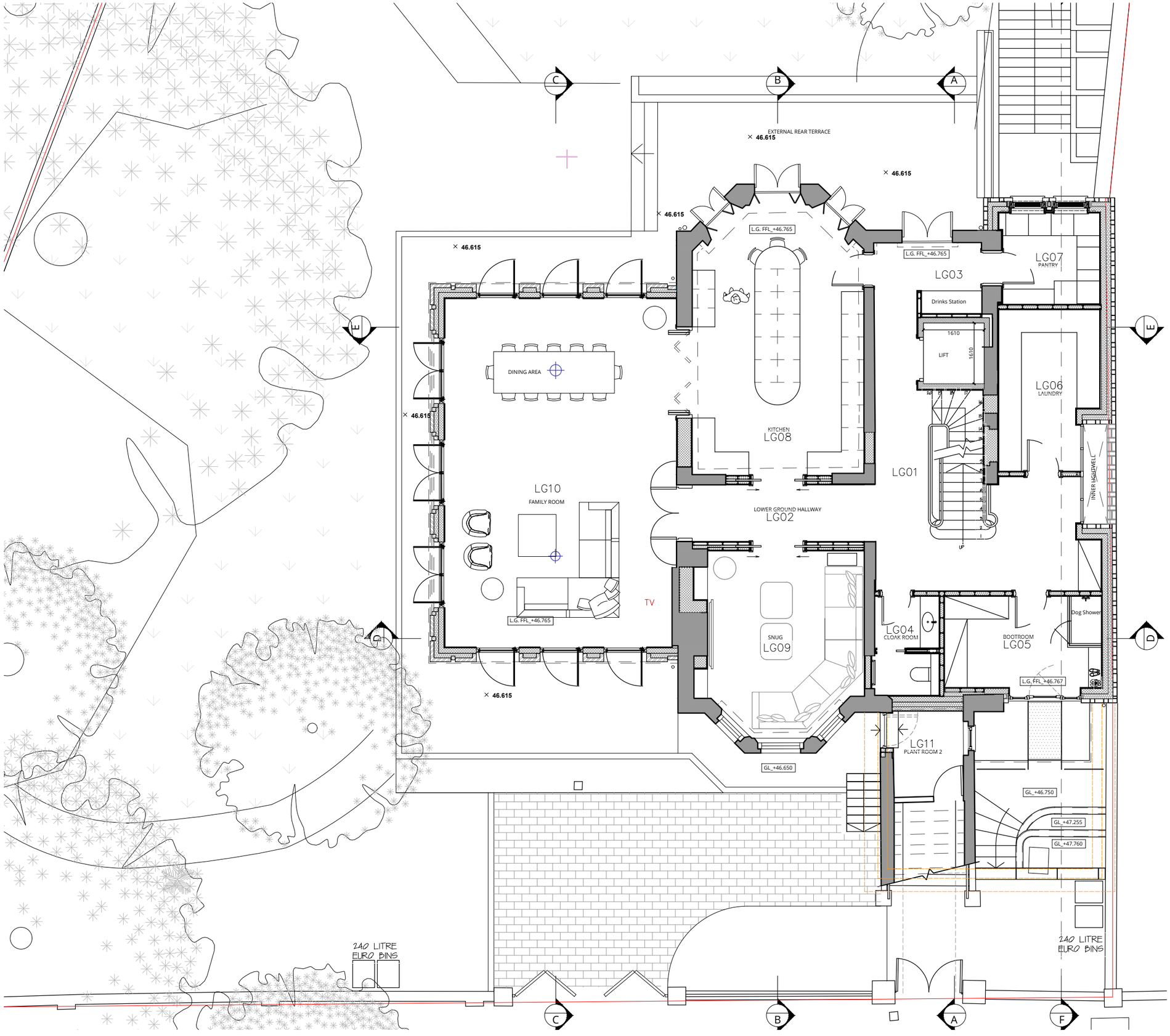
Project Title
42 Elsworthy Road
London NW3 3DL

Drawing Title
Proposed
Basement Floor Plan

Status
DESIGN

Drawn by	Checked by	Scale
AW	NP	1:100 @ A3

Project No.	Work Stage	Dwg. No.	Rev.
2164	DE	208	0



PROPOSED LOWER GROUND FLOOR LAYOUT

WOLFF ARCHITECTS

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KEY

- existing
- demolished
- proposed

0 1 2 3 4 5m

Rev.	Description	Date
0	First issue.	25.10.21

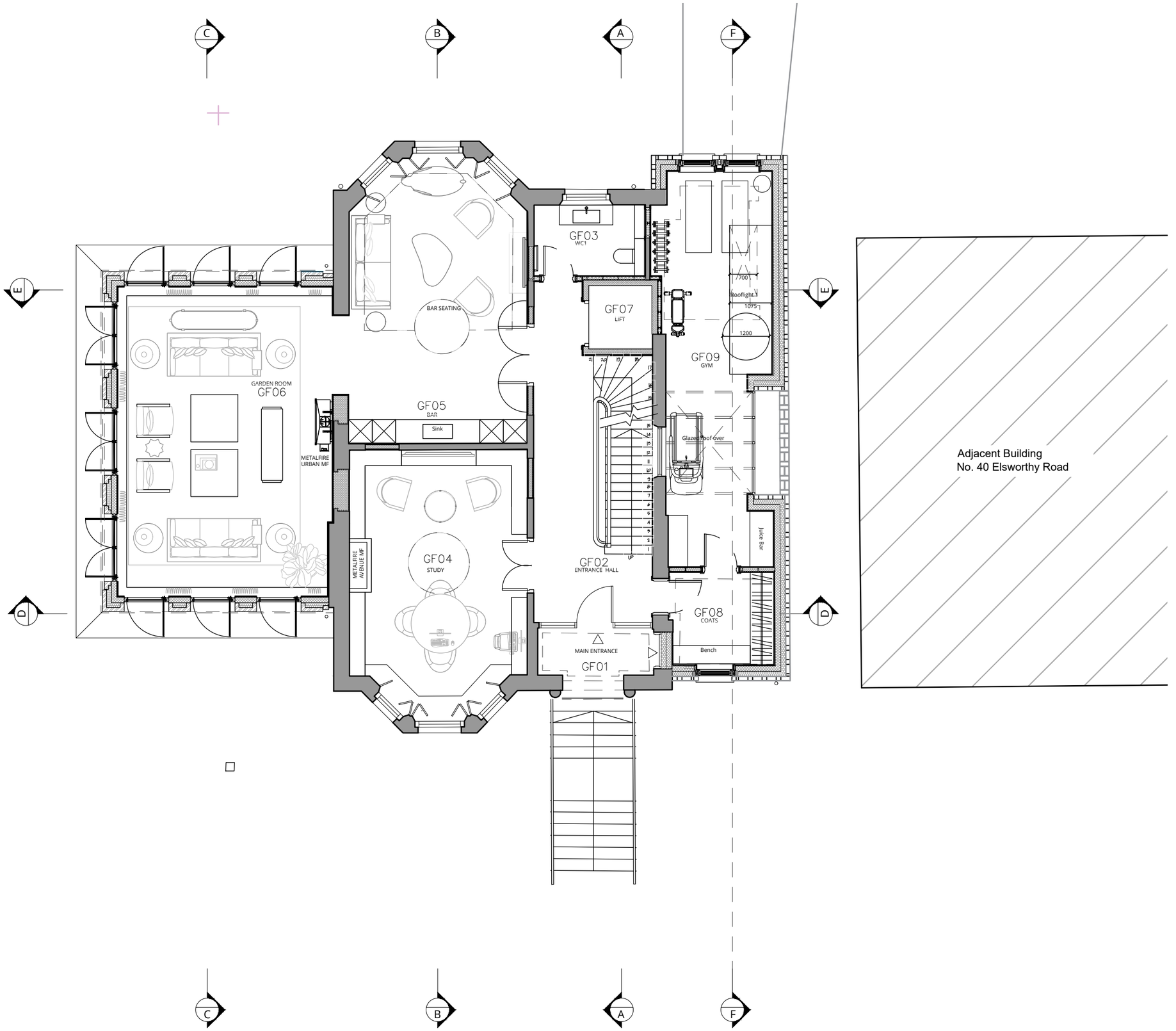
Project Title
42 Elsworthy Road
London NW3 3DL

Drawing Title
Proposed
Lower Ground Floor Plan

Status
DESIGN

Drawn by	Checked by	Scale
AW	NP	1:100 @ A3

Project No.	Work Stage	Dwg. No.	Rev.
2164	DE	209	0



PROPOSED GROUND FLOOR LAYOUT

WOLFF ARCHITECTS

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KEY

existing

demolished

proposed

N

0 1 2 3 4 5m

Rev.	Description	Date
0	First issue.	25.10.21

Project Title
42 Elsworthy Road
London NW3 3DL

Drawing Title
Proposed
Ground Floor Plan

Status
DESIGN

Drawn by	Checked by	Scale
AW	NP	1:100 @ A3

Project No.	Work Stage	Dwg. No.	Rev.
2164	DE	210	0


EVANS
Rivers and Coastal