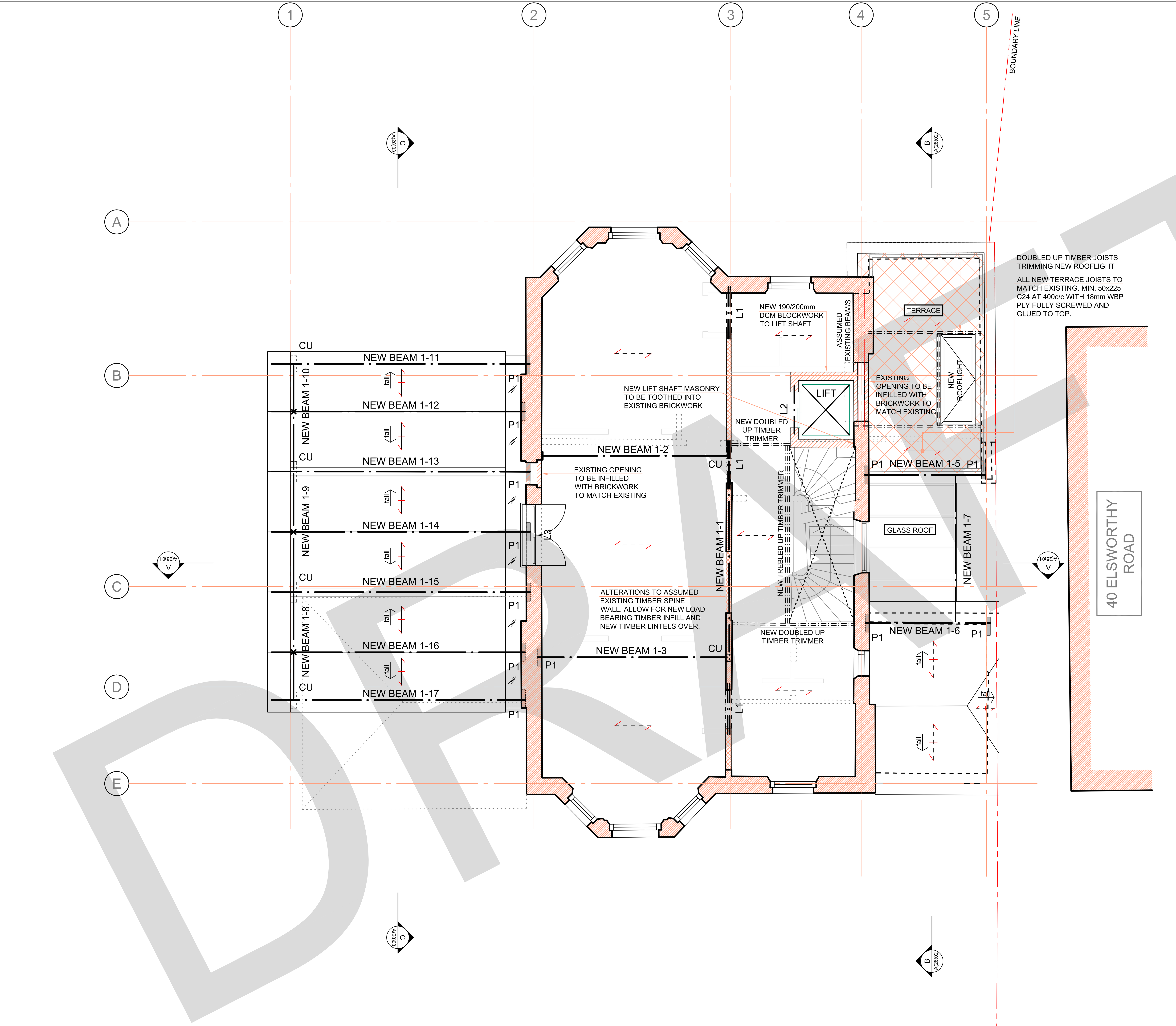


Proposed First Floor Plan
1:50 (A1) 1:100 (A3)

0m 1.0m 2.0m 3.0m 4.0m 5.0m

## COLUMN SCHEDULE

| MARK | DESCRIPTION |
|---|---|
| C1 | 152x152 UC37 |
| C2 | 330x330 R.C. COLUMN |
| C3 | 500x150 R.C. COLUMN |
| C4 | 400x150 R.C. COLUMN |
| CU | COLUMN UNDER |

## PADSTONE SCHEDULE

| MARK | DESCRIPTION |
|---|---|
| P1 | 450x100x225dp MASS CONCRETE |
| P2 | 450x330x225dp MASS CONCRETE |
| P3 | 550x225x225dp MASS CONCRETE |
| P4 | 660x225x225dp MASS CONCRETE |

## LINTEL SCHEDULE

| MARK | DESCRIPTION |
|---|---|
| L1 | 2No. 50x150 C24 TIMBERS OVER. BOLTED TOGETHER WITH M10 BOLTS AND DOUBLE SIDED TOOTHED PLATE CONNECTORS AT 300c/c. |
| L2 | LINTEL OVER LIFT DOOR OPENING T.B.C. |
| L3 | CN71A EXTERNAL WALL LINTEL OVER BY CATNIC O.S.A + 150dp PRE-STRESSED P.C LINTEL OVER (INTERNAL FACE). |
| L4 | 150dp PRE-STRESSED P.C LINTEL/S OVER TO SUIT WIDTH OF WALL. |
| L5 | CN71A EXTERNAL WALL LINTEL OVER BY CATNIC O.S.A |

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## KEY

**WALL TYPES**
EXISTING WALL.
EXISTING WALL TO BE REMOVED.
NEW 20N/mm² BRICKWORK IN DESIGNATION (iii) MORTAR U.N.O.
NEW 7N/mm² MEDIUM DENSE BLOCKWORK IN DESIGNATION (iii) MORTAR U.N.O.
NEW LOADBEARING TIMBER STUD PARTITION. 75x100 C24 STUDS AT 400c/c WITH 12mm WBP PLY BOTH SIDES U.N.O.
NEW NON LOAD BEARING PARTITION.
LOAD BEARING WALL UNDER.
NEW BRICKWORK TO BE FULLY TOOTHED IN AND PACKED UP TO EXISTING BRICKWORK.
W STAINLESS STEEL WALL EXTENSION PROFILES.
ALL MASONRY BELOW DPC LEVEL TO BE FROST RESISTANT AND IN DESIGNATION (i) MORTAR.

**LEGEND**
EXISTING BEAM UNDER.
NEW BEAM UNDER.
DENOTES ASSUMED SPAN OF EXISTING TIMBER JOISTS T.B.C. ON SITE.
DENOTES SPAN OF EXISTING TIMBER RAFTERS T.B..C ON SITE.
DENOTES SPAN OF NEW 50x225 C24 TIMBER JOISTS AT 400c/c WITH 18mm WBP PLY FULLY SCREWED AND GLUED TO TOP U.N.O.
DENOTES SPAN OF NEW 50x150 C24 TIMBER RAFTERS AT 400c/c U.N.O.

## 1st FLOOR BEAM SCHEDULE

| MARK | DESCRIPTION |
|---|---|
| 1-1 | 254x254 UC73 |
| 1-2 | 203x133 UB25 |
| 1-3 | 203x133 UB25 |
| 1-4 | NOT REQUIRED |
| 1-5 | 203x133 UB25 WITH 12mm WELDED BOTTOM PLATE |
| 1-6 | 203x133 UB25 WITH 12mm WELDED BOTTOM PLATE |
| 1-7 | GLAZING BEAM TO SPECIALIST DETAIL |
| 1-8 | 203x133 UB30 (CRANKED) |
| 1-9 | 203x133 UB30 (CRANKED) |
| 1-10 | 203x133 UB30 (CRANKED) |
| 1-11 | 203x133 UB30 |
| 1-12 | 203x133 UB30 |
| 1-13 | 203x133 UB30 |
| 1-14 | 203x133 UB30 |
| 1-15 | 203x133 UB30 |
| 1-16 | 203x133 UB30 |
| 1-17 | 203x133 UB30 |

NOT FOR CONSTRUCTION

| Rev. | Date | Amendment | Drawn | Chkd |
|---|---|---|---|---|
| P1 | 17.07.18 | PRELIMINARY ISSUE | SMR | P.G |

Drawing Status
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**Form**

Job Title
42 ELSWORTHY ROAD
LONDON
NW3 3DL

Drawing Title
PROPOSED FIRST FLOOR PLAN

Form Structural Design Ltd 77 St John Street London EC1M 4NN
T:020 7253 2893 E:studio@form-sd.com W:www.form-sd.com

| Date | Scale | Drawn | Checked |
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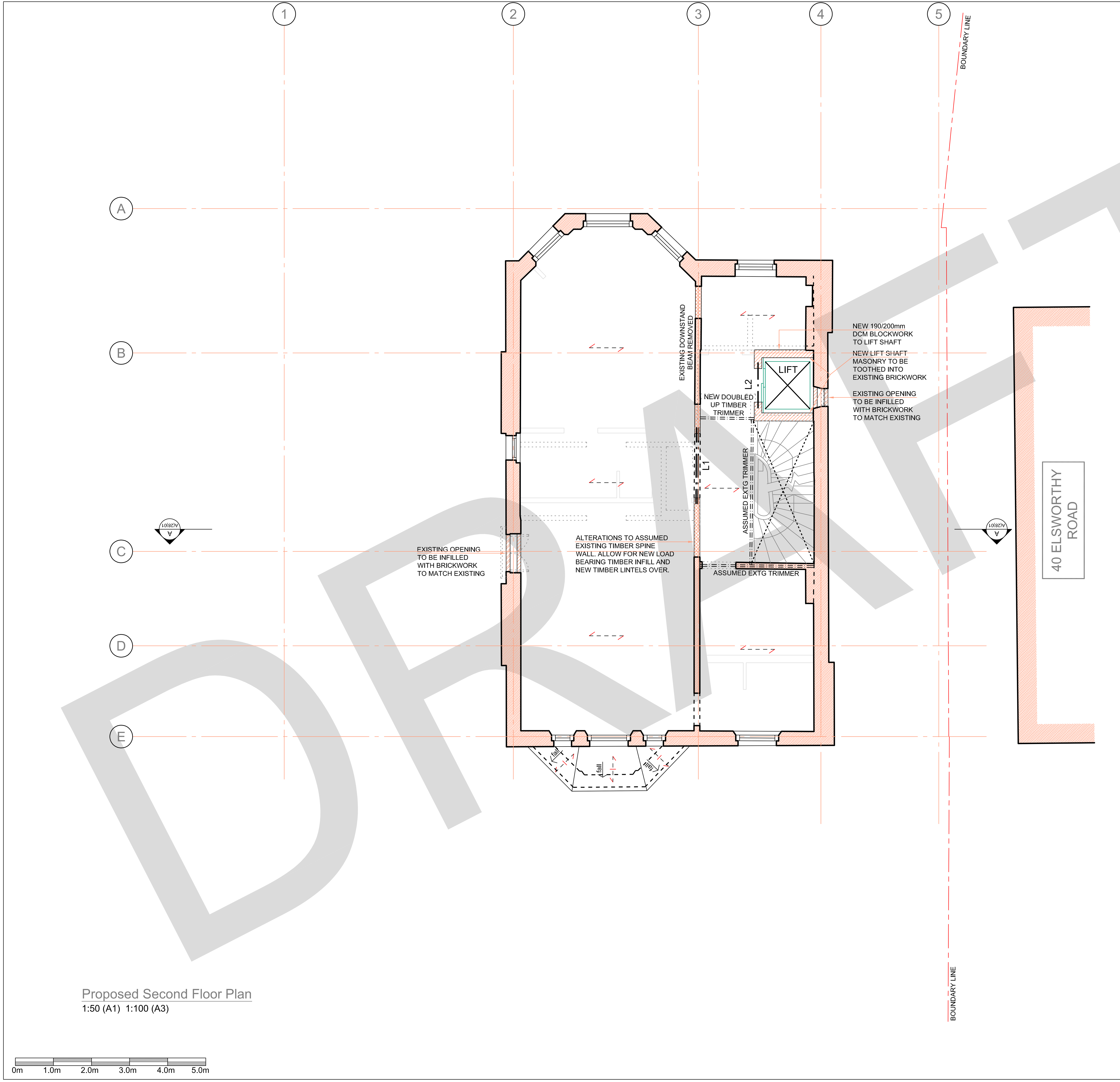
| Job No. | Drawing No. | | Revision |
| 172843 | L(23)03 | | P1 |




Proposed Second Floor Plan
1:50 (A1) 1:100 (A3)

## COLUMN SCHEDULE

| MARK | DESCRIPTION |
|---|---|
| C1 | 152x152 UC37 |
| C2 | 330x330 R.C. COLUMN |
| C3 | 500x150 R.C. COLUMN |
| C4 | 400x150 R.C. COLUMN |
| CU | COLUMN UNDER |

## PADSTONE SCHEDULE

| MARK | DESCRIPTION |
|---|---|
| P1 | 450x100x225dp MASS CONCRETE |
| P2 | 450x330x225dp MASS CONCRETE |
| P3 | 550x225x225dp MASS CONCRETE |
| P4 | 660x225x225dp MASS CONCRETE |

## LINTEL SCHEDULE

| MARK | DESCRIPTION |
|---|---|
| L1 | 2No. 50x150 C24 TIMBERS OVER. BOLTED TOGETHER WITH M10 BOLTS AND DOUBLE SIDED TOOTHED PLATE CONNECTORS AT 300c/c. |
| L2 | LINTEL OVER LIFT DOOR OPENING T.B.C. |
| L3 | CN71A EXTERNAL WALL LINTEL OVER BY CATNIC O.S.A + 150dp PRE-STRESSED P.C LINTEL OVER (INTERNAL FACE). |
| L4 | 150dp PRE-STRESSED P.C LINTEL/S OVER TO SUIT WIDTH OF WALL. |
| L5 | CN71A EXTERNAL WALL LINTEL OVER BY CATNIC O.S.A |

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## KEY

**WALL TYPES**

- EXISTING WALL.
- EXISTING WALL TO BE REMOVED.
- NEW 20N/mm² BRICKWORK IN DESIGNATION (iii) MORTAR U.N.O.
- NEW 7N/mm² MEDIUM DENSE BLOCKWORK IN DESIGNATION (iii) MORTAR U.N.O.
- NEW LOADBEARING TIMBER STUD PARTITION. 75x100 C24 STUDS AT 400c/c WITH 12mm WBP PLY BOTH SIDES U.N.O.
- NEW NON LOAD BEARING PARTITION.
- LOAD BEARING WALL UNDER.
- NEW BRICKWORK TO BE FULLY TOOTHED IN AND PACKED UP TO EXISTING BRICKWORK.
- W STAINLESS STEEL WALL EXTENSION PROFILES.

ALL MASONRY BELOW DPC LEVEL TO BE FROST RESISTANT AND IN DESIGNATION (i) MORTAR.

**LEGEND**

- EXISTING BEAM UNDER.
- NEW BEAM UNDER.
- DENOTES ASSUMED SPAN OF EXISTING TIMBER JOISTS T.B.C. ON SITE.
- DENOTES SPAN OF EXISTING TIMBER RAFTERS T.B..C ON SITE.
- DENOTES SPAN OF NEW 50x225 C24 TIMBER JOISTS AT 400c/c WITH 18mm WBP PLY FULLY SCREWED AND GLUED TO TOP U.N.O.
- DENOTES SPAN OF NEW 50x150 C24 TIMBER RAFTERS AT 400c/c U.N.O.

NOT FOR CONSTRUCTION

| Rev. | Date | Amendment | Drawn | Chkd |
|---|---|---|---|---|
| P1 | 17.07.18 | PRELIMINARY ISSUE | SMR | P.G |

Drawing Status PRELIMINARY

**Form**

Job Title
42 ELSWORTHY ROAD
LONDON
NW3 3DL

Drawing Title
PROPOSED SECOND FLOOR PLAN

Form Structural Design Ltd 77 St John Street London EC1M 4NN
T:020 7253 2893 E:studio@form-sd.com W:www.form-sd.com

| Date | Scale | Drawn | Checked |
|---|---|---|---|
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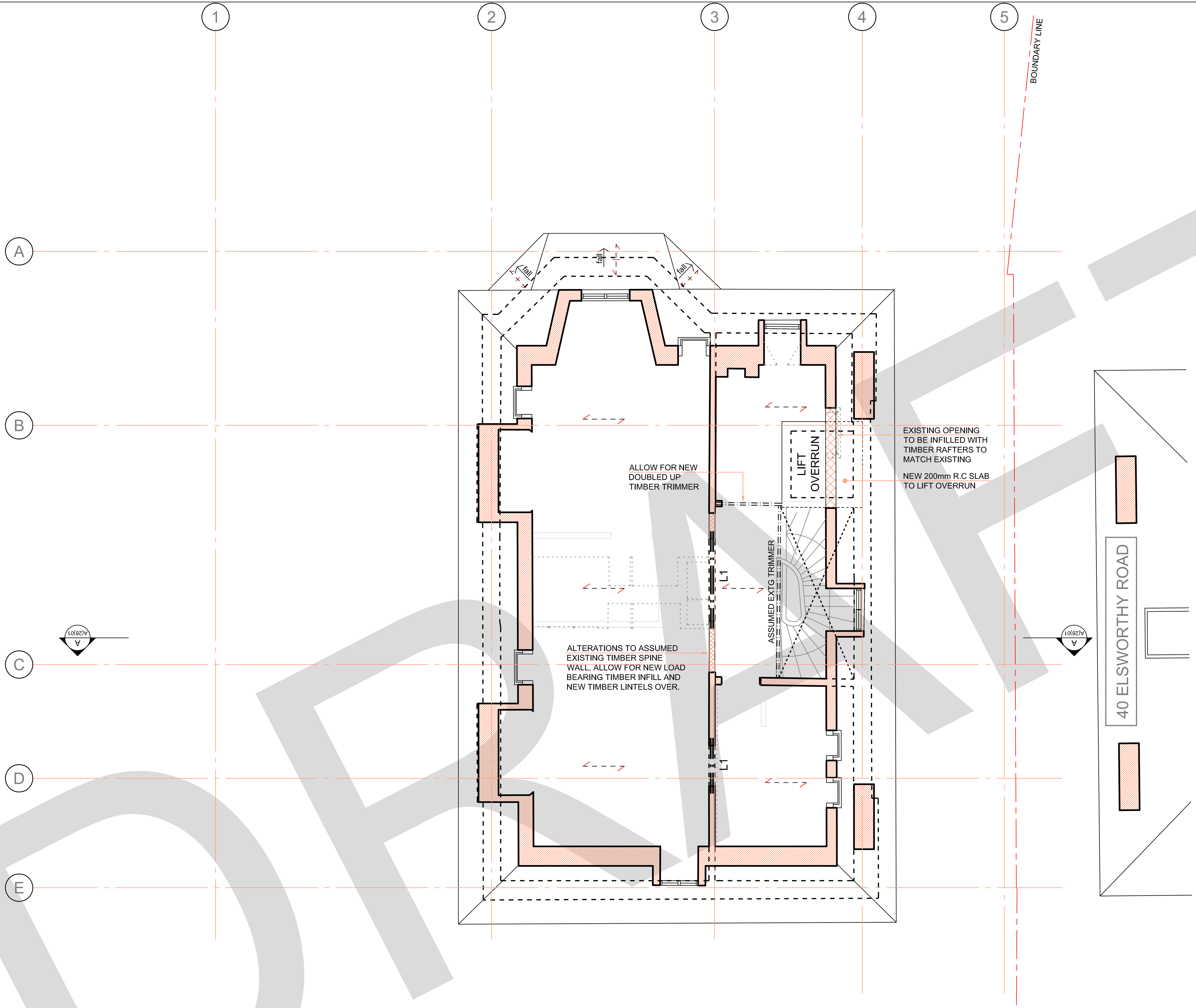


Proposed Third Floor Plan

1:50 (A1) 1:100 (A3)

0m 1.0m 2.0m 3.0m 4.0m 5.0m

## COLUMN SCHEDULE

| MARK | DESCRIPTION |
|---|---|
| C1 | 152x152 UC37 |
| C2 | 330x330 R.C. COLUMN |
| C3 | 500x150 R.C. COLUMN |
| C4 | 400x150 R.C. COLUMN |
| CU | COLUMN UNDER |

## PADSTONE SCHEDULE

| MARK | DESCRIPTION |
|---|---|
| P1 | 450x100x225dp MASS CONCRETE |
| P2 | 450x330x225dp MASS CONCRETE |
| P3 | 550x225x225dp MASS CONCRETE |
| P4 | 660x225x225dp MASS CONCRETE |

## LINTEL SCHEDULE

| MARK | DESCRIPTION |
|---|---|
| L1 | 2No. 50x150 C24 TIMBERS OVER. BOLTED TOGETHER WITH M10 BOLTS AND DOUBLE SIDED TOOTHED PLATE CONNECTORS AT 300c/c. |
| L2 | LINTEL OVER LIFT DOOR OPENING T.B.C. |
| L3 | CN71A EXTERNAL WALL LINTEL OVER BY CATNIC O.S.A + 150dp PRE-STRESSED P.C LINTEL OVER (INTERNAL FACE). |
| L4 | 150dp PRE-STRESSED P.C LINTEL/S OVER TO SUIT WIDTH OF WALL. |
| L5 | CN71A EXTERNAL WALL LINTEL OVER BY CATNIC O.S.A |

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## KEY

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- EXISTING WALL.
- EXISTING WALL TO BE REMOVED.
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- NEW 7N/mm² MEDIUM DENSE BLOCKWORK IN DESIGNATION (iii) MORTAR U.N.O.
- NEW LOADBEARING TIMBER STUD PARTITION. 75x100 C24 STUDS AT 400c/c WITH 12mm WBP PLY BOTH SIDES U.N.O.
- NEW NON LOAD BEARING PARTITION.
- LOAD BEARING WALL UNDER.
- NEW BRICKWORK TO BE FULLY TOOTHED IN AND PACKED UP TO EXISTING BRICKWORK.
- W STAINLESS STEEL WALL EXTENSION PROFILES.

ALL MASONRY BELOW DPC LEVEL TO BE FROST RESISTANT AND IN DESIGNATION (i) MORTAR.

**LEGEND**

- EXISTING BEAM UNDER.
- NEW BEAM UNDER.
- DENOTES ASSUMED SPAN OF EXISTING TIMBER JOISTS T.B.C. ON SITE.
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NOT FOR CONSTRUCTION

| Rev. | Date | Amendment | Drawn | Chkd |
|---|---|---|---|---|
| P1 | 17.07.18 | PRELIMINARY ISSUE | SMR | P.G |

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**Form**

Job Title
42 ELSWORTHY ROAD
LONDON
NW3 3DL

Drawing Title
PROPOSED THIRD
FLOOR PLAN

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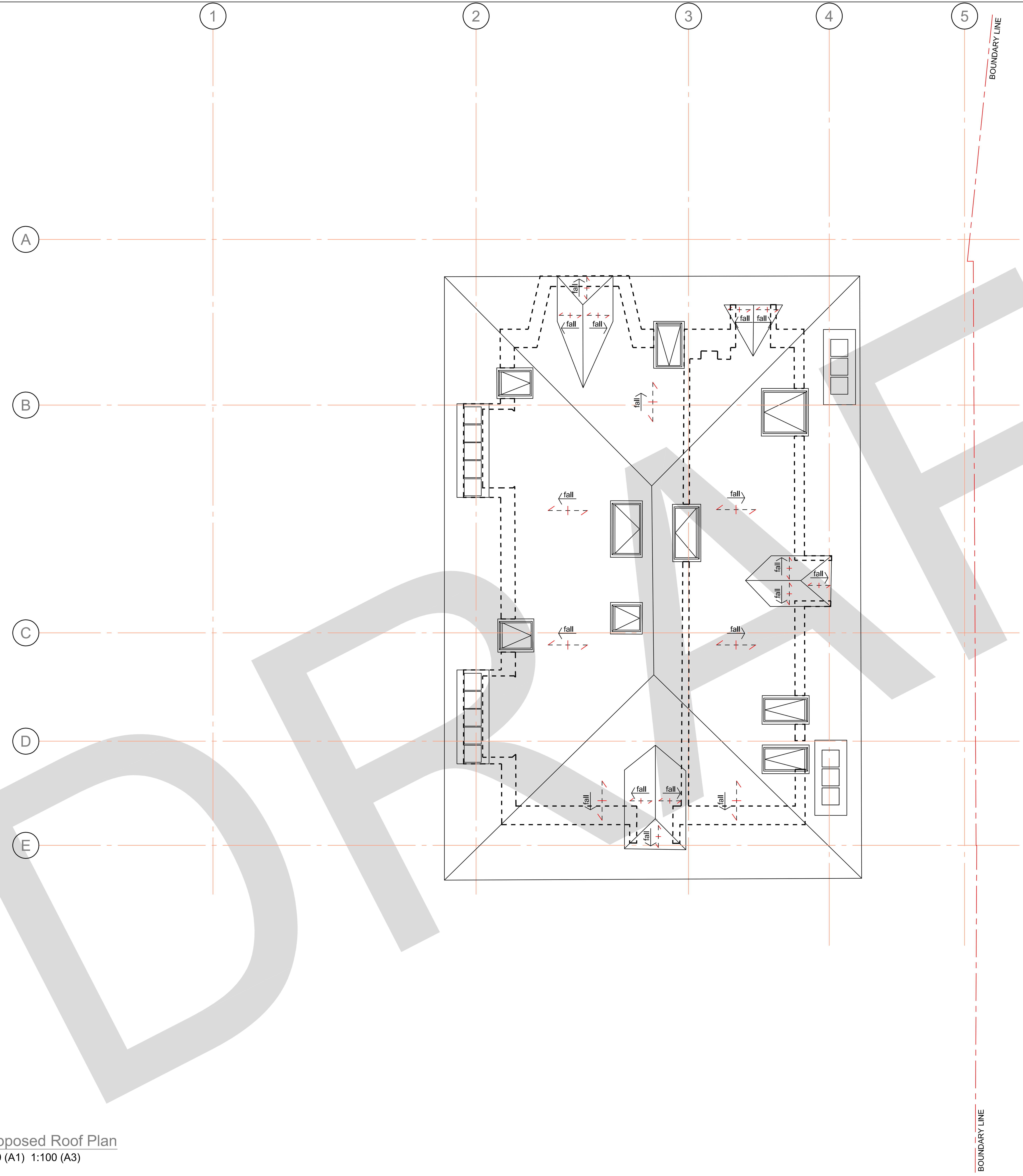


## Proposed Roof Plan

1:50 (A1) 1:100 (A3)

0m 1.0m 2.0m 3.0m 4.0m 5.0m

## COLUMN SCHEDULE

| MARK | DESCRIPTION |
|---|---|
| C1 | 152x152 UC37 |
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**LEGEND**

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NOT FOR CONSTRUCTION

| Rev. | Date | Amendment | Drawn | Chkd |
|---|---|---|---|---|
| P1 | 17.07.18 | PRELIMINARY ISSUE | SMR | P.G |

Drawing Status: PRELIMINARY

**Form**

Job Title
42 ELSWORTHY ROAD
LONDON
NW3 3DL

Drawing Title
PROPOSED ROOF
FLOOR PLAN

Form Structural Design Ltd 77 St John Street London EC1M 4NN
T:020 7253 2893 E:studio@form-sd.com W:www.form-sd.com

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|---|---|---|---|
| June 18 | 1:50 (A1) | SMR | PG |

| Job No. | Drawing No. | Revision |
|---|---|---|
| 172843 | L(23)06 | P1 |

# Appendix C

## Card Geotechnics Limited – Ground Movement Assessment

Fort   Two Point Five Elswort  y Limited

# 42 Elsworthy Road, Camden

*Ground Movement Assessment*

December  2018

Card Geotechnics Limited
4 Godalming Business Centre
Woolsac   Way, Godalming GU7 1  W
Telephone  01483 310600
www.cgl-uk.com

| | | |
|---|---|---|
| Author | Thomas Perry, Graduate Engineer<br>*MEng (Hons) GMICE* | Thomas Perry |
| Checked | Richard Ball Technical Director<br>*MSc BSc CEng MICE FGS* | |
| Approved | Ian Mar church, Director<br>*MSc BSc CEng MICE CGeol FGS CMgr MCMI MIoD Dip IoD* | Ian Marychurch |
| Re erence CG/28854 | Revision 0 | Issue Date December 2018 |

*Contents*



**FIGURES**

## APPENDICES

# 1. INTRODUCTION

Card Geotechnics Limited (CGL) has been instructed by Marek Wojciechowski Architects Limited on behalf of Forty Two Point Five Elsworthy Limited ("the Client") to undertake a Ground Movement Assessment (GMA) as part of a Basement Impact Assessment (BIA) for a proposed development at a site on Elsworthy Road, Camden, London. The proposed development involves the excavation of a split level basement to include a pool and plant level. The development also involves the demolition of a conservatory, garage and room above the garage along the western side of the existing building at lower ground and ground level, with a new two storey extension constructed in its place.

The site is located in the London Borough of Camden which has produced a Planning Guidance document for Basements and Lightwells[1] and a Supplementary Planning Document (SPD)[2].

A Site Investigation and Basement Impact Assessment (BIA) has already been undertaken by Create Consulting Limited (CCL)[3]. This report is supplementary to the CCL BIA, and provides details of calculations carried out to determine ground movements and to assess their impact on adjacent structures and infrastructure.

[1] Camden Council. (2015). *Camden Planning Guidance – Basements and lightwells.* (July 2015)
[2] Camden Council. (2017). *Camden Planning Guidance.* (November 2017).
[3] Create Consulting Engineers Limited. (2018). *42 Elsworthy Road, London, NW3 3DL – Basement Impact Assessment.* (August 2018).

# 2. SITE CONTEXT

## 2.1 Site location

The site is located at 42 Elsworthy Road, Camden, London, NW3 3DL within the London Borough of Camden. The Ordnance Survey Reference for the approximate location of the site is 52310E, 184065N.

The location of the site is shown in Figure 1.

## 2.2 Site layout

The site is located on the corner between Elsworthy Road (to the south of the site) and Lower Merton Rise (to the west of the site ) with the property accessed from Elsworthy Road. To the north of the site there is a neighbouring property at 2 Lower Merton Road and to the east there is another property at 40 Elsworthy Road. 2 Lower Merton Road and 40 Elsworthy Road are approximately 18.3 and 1.7m to the north and east of the existing property and 42 Elsworthy Road respectively. Along the western and southern boundary around the site there is a pedestrian footpath which is approximately between 3.0 and 7.3m wide and with a highway approximately 7.5m to 9.3m wide.

The site is currently occupied by a five storey residential house, including a lower ground level. Along the western side of the property there is a single storey conservatory and a garage, with the garage having a single storey above it. Around the western and northern sides of the house there is a garden which is approximately 27.4m wide and 34.7m long. The total area of the site is approximately 1,019m$^2$ and the approximate area of the house is 234m$^2$.

The topography of the site is relatively flat measuring approximately 46.87m above Ordnance Datum (mOD) to 47.75mOD externally. Internally the lower ground level is approximately between 46.93mOD and 47.00mOD. For the purpose of this assessment the ground level has been assumed to be 47mOD.

The site layout plan depicting the information above is presented in Figure 2.

## 2.3 Proposed development

The proposed development involves the partial demolition of the conservatory and garage on the western side of the existing building at the lower ground level. This demolished section is to be replaced by a two storey above ground section.

A split level basement is proposed with the footprint of the first basement level (referred to hereafter as “basement level”) extending to the footprint of the proposed lower ground level. The footprint of the second below ground level will extend to the footprint of the reconstructed section on the western side of the building. This second below ground level (hereafter referred to as “pool/plant level”) will contain the swimming pool and pool plant. The formation level for the two below ground levels is 42.40mOD for the basement level and 39.879mOD for the pool/plant level.

The eastern side boundary wall closest to 40 Elsworthy Road will be underpinned, a contiguous pile wall will be constructed around the southern, western and northern side of the proposed basement, as well as along the along the eastern side of the pool/plant level. A new stairway allowing access to the basement level is to be constructed below the existing main entrance stairway at the front of the property. It is understood that the underpin foundations will be installed in a hit and miss fashion, with each section around 1m wide. The underpin and pile wall foundations will be propped at the top during construction using steel props and in the long term using the lower ground floor slab.

All ground bearing loads are to be transferred to the basement slabs which will act as raft foundations, loads will also be transferred onto the pile retaining walls and the underpin foundations. Temporary piles are to be constructed to support the internal walls of the existing building while the basement is excavated and constructed. Once construction is completed these pile foundations will become redundant.

A copy of the proposed structural plans and sections are provided in Appendix A.

# 3. GROUND AND GROUNDWATER CONDITIONS

## 3.1 Ground conditions

A ground investigation was carried out by Create Consulting Limited[3] between 3rd and 5th July 2017. The investigation included two Cable Percussion (CP) boreholes (BH01 and BH02) to 15mbgl and two Window Sample (WS) boreholes (WS01 and WS02) to 5mbgl. In-situ testing was undertaken in the form of Standard Penetration Tests (SPTs) at regular intervals, as well as recovering disturbed and undisturbed U100 soil samples for laboratory testing. Monitoring standpipes were installed in all four boreholes from ground level to the base of each hole.

The borehole locations are presented in Figure 2. BH01 was located in northern area of the garden, BH02 and WS02 were located just to the west of the existing building, and WS01 was located close to the western boundary of the site. A brief summary of the ground conditions encountered is presented in Table 1. Reference should be made to the ground Create Consulting report for full detailed findings.

***Table 1. Summary of ground conditions***

| *Stratum* | *Depth to top of stratum (mbgl) [mOD]* | *Thickness (m)* |
|---|---|---|
| Topsoil present between 0.1 to 0.15mbgl.<br>Loose to medium dense dark brown sandy gravelly clay. Gravel is fine to coarse of red brick fragments, flint and coal.<br>**[MADE GROUND]** | 0<br>[46.92 to 47.12] | 1.2 to 1.4 |
| Firm to stiff brown orange silty CLAY. Claystone present at 2.5mbgl in BH01 and occasional rounded, coarse flint gravel present in WS02.<br>**[WEATHERED LONDON CLAY FORMATION]** | 1.2 to 1.4<br>[45.52 to 45.92] | 7.6 to 9.8 |
| Stiff blue-grey silty CLAY.<br>**[LONDON CLAY FORMATION]** | 9.0 to 11.0<br>[35.12 to 37.92] | Proven to a depth of 15.0mbgl [31.92mOD] |

## 3.2 Groundwater conditions

During the drilling of all four boreholes no groundwater was encountered. Monitoring wells were installed to monitor groundwater and ground gas levels. Three monitoring visits were undertaken on 13th July, 10th August and 20th September 2017. The groundwater level records for all three visits are shown below in Table 2. In all four boreholes the groundwater increased over time and it is noted that the top of the standpipe response zone in all three boreholes was in the Made Ground stratum, which is likely to be more permeable than London Clay Formation stratum. Therefore the groundwater present in the standpipes is likely to be perched water infiltrating through the Made Ground into the top of the standpipe.

***Table 2. Summary of groundwater monitoring record***

| Well | Bottom of response zone (mbgl) [mOD] | Date | Depth to groundwater (mbgl) [mOD] |
|---|---|---|---|
| BH01 | 15.0<br>[31.92] | 13/07/2017<br>10/08/2017<br>20/08/2017 | 11.16 [35.76]<br>8.4 [38.52]<br>5.32 [41.6] |
| BH02 | 15.0<br>[32.12] | 13/07/2017<br>10/08/2017<br>20/08/2017 | Dry<br>10.2 [36.92]<br>7.6 [39.52] |
| WS01 | 5.0<br>[42.12] | 13/07/2017<br>10/08/2017<br>20/08/2017 | Dry<br>Dry<br>4.56 [42.56] |
| WS02 | 5.0<br>[42.10] | 13/07/2017<br>10/08/2017<br>20/08/2017 | 4.61 [42.49]<br>4.33 [42.77]<br>3.74 [43.36] |

## 3.3 Geotechnical design parameters

The geotechnical design parameters for the proposed development are based on the results of the in-situ and laboratory testing carried during the site investigation. A plot of SPT 'N' values versus level is presented in Figure 3. The values for the WS01 and WS02 are lower than for BH01 and BH02. This is likely due to the higher energy efficiency of the WS rig which resulted in lower 'N' values compared to the CP rig; the CCL report does not include energy ratio data for the rigs used, however in CGL's experience, window sample rigs often impart higher energy to the ground than would a standard Cable Percussion rig with trip hammer. Therefore 'N' values from the window sampling rig have been treated as conservative. A plot of undrained shear strength, $c_u$ versus level is shown in Figure 4.

A summary of the parameters used within this report is presented in Table 3. The parameters presented in the table are unfactored (Serviceability Limit State).

***Table 3. Geotechnical design parameters***

| Stratum | Design Level (mOD) | Bulk Unit Weight, $\gamma_b$ (kN/m$^3$) | Undrained Cohesion, $c_u$ (kPa) [c'] | Angle of Friction, φ' (°) | Undrained Young's Modulus, $E_u$ (MPa) | Drained Young's Modulus, E' (MPa) |
|---|---|---|---|---|---|---|
| Made Ground (cohesive) | 47.0 | 18 | 65 | 25$^b$ | 26$^c$ | 19.5$^e$ |
| Weathered London Clay/ London Clay Formation | 45.6 | 20 | 70 + 7z$^a$<br>[5] | 21$^b$ | 42 + 4.2z$^{a,d}$ | 31.5 + 3.15z$^{a,e}$ |

a. Depth below top of stratum
b. BS 8002:2015, Code of practice of earth retaining structures
c. Based on 400$c_u$
d. Based on 600$c_u$ – 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 Publication 200.
e. 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 Publication 200.

# 4. GROUND MOVEMENT ASSESSMENT

## 4.1 Introduction

The following sections present the ground movements predicted to occur due to the proposed development and impact on neighbouring properties. The assessment considers the ground movements due to the installation of the contiguous pile wall, underpins, basement excavation and application of the structural loads in the long term.

The analysis of the ground movements has been conducted in PDISP (Pressure Induced Displacement) numerical analysis software. The program can calculate the vertical movements caused by vertical pressures using the Boussinesq method to resolve stress distributions in an elastic half-space, using linear elastic soil conditions.

Each of the following sections describes how the ground movements attributed to each construction stage have been calculated and the results assessed. The construction stages considered in the Ground Movement Assessment (GMA) are as follows:

- Stage 1 – Installation of the pile walls and underpins around the basement perimeter, generating lateral and vertical (settlement) ground displacements – this assessment is based on CIRIA C760[4] case histories and on a Finite Element analysis carried out by CGL;
- Stage 2 – Excavation of the basement, resulting in heave movements due to the removal of overburden soil pressure, as well as vertical and lateral ground movements behind the retaining wall due to lateral wall deflection;
- Stage 3 – In the long term following the application of new structural loads, further ground movements will occur due to net stress changes in the ground and dissipation of excess pore water pressure within the London Clay.

## 4.2 Stage 1 – Ground movements due to installation of retaining walls

The installation of the contiguous pile wall will result in both lateral and vertical ground displacements, based upon the principals of the CIRIA guidance C760[4]. The guidance indicates that the vertical and lateral ground movements reduce to negligible values at a distance of 2 and 1.5 times the total length of the piles respectively. The amount of vertical and lateral displacement that occurs at ground level

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

along the contiguous pile wall is recorded to be equal to 0.04% of the total pile length in both vertical and horizontal orientations.

The installation of the underpin wall will also result in lateral and vertical displacements. It should be noted that the neighbouring property (No. 40) will not be underpinned, the new wall will be constructed 1.7m in front of the foundation.

Underpin installation movements have been modelled using PLAXIS 3D Finite Element analysis software as described in Appendix B. The results predict a horizontal and vertical displacement due to installation deflection along the nearside boundary at 40 Elsworthy Road of between 1mm and 2mm. The model predicts no vertical movements other than heave movements, suggesting that elastic relaxation of the clay does not give rise to settlements.

## 4.3 Stage 2 – Basement excavation

### *4.3.1 Movements due to deflection of retaining walls*

The excavation of the proposed basement will result in both lateral and vertical ground movements. To model these movements a combination of CIRIA C760 guidance and the results from PDISP were used to calculate the ground movements at this stage. Additionally the lateral deflection of the underpin foundation has been assessed using specialist soil-structure software WALLAP. The WALLAP analysis output is provided in Appendix C. The results from the WALLAP analysis predict a horizontal displacement of 2mm along the underpin foundation, which is consistent with the total movements of between 2mm to 4mm predicted by the PLAXIS analysis in  Appendix B.

As the pile wall will be propped at the capping beam during construction and in the long term, the ground movements associated with high support in CIRIA C760[4] have been adopted. Lateral movements due to excavations along a contiguous pile wall are taken to be 0.15% of the maximum excavation depth. The distance from the pile wall to negligible lateral movements is taken to be 4 times the maximum excavation depth.

### *4.3.2 PDISP analysis*

PDISP models the vertical ground movements that occur unloading pressure due to the excavation of the basement. The unloading pressures were calculated by multiplying the depth each excavated stratum by the unit weight of each respective stratum shown in Table 3. The results are shown in Table 4 and the PDISP model layout showing the location of the respective unloading pressures is shown in Figure 5.

**Table 4. Excavation unloading pressure**

| *Excavation Area* | *Total Depth of Excavation (m)* | *Depth of Excavated Made Ground (m)* | *Uplift Pressure from Made Ground Excavation (kPa)* | *Depth of Excavated London Clay Formation (m)* | *Uplift Pressure from London Clay Formation Excavation (kPa)* | *Total Pressure (kPa)* |
|---|---|---|---|---|---|---|
| Basement Level | 4.45 | 1.4 | -25.2 | 3.05 | -61 | -86.2 |
| Plant/Pool Level | 6.97 | 1.4 | -25.2 | 5.57 | -111.4 | -136.6 |

Note: Negative pressures values represent pressures acting in the opposite direction to gravity

The results at this stage are shown below in Section 4.3.3 and 4.3.4, which combines the results from this stage only and the previous stage.

### *4.3.3 Undrained ground condition movements*

In the short term after excavating the basement the ground conditions will be undrained, resulting in elastic deformation of the ground. This stage has been modelled in PDISP to include excavation loads as illustrated in Figure 5. The results from the PDISP analysis are shown in Figure 6.

### *4.3.4 Drained ground condition movements*

In the long term after excavating the basement pore pressure recovery will occur in the London Clay under the net loading of the basement excavation and applied structural loads. This stage has been modelled in PDISP to include the structural loads and excavation loads as illustrated in Figure 5. Results are illustrated in Figure 7.

#### 4.3.4.1 Structural loading - raft

The structural loads from the proposed development will be transferred to the ground through the pile retaining wall and underpins, as well as the ground bearing basement slabs. The Structural Engineer (Form SD) has provided the structural loads that will be applied to the pile wall and underpin foundations, which can be found in Appendix D. In addition to these loads the following structural loads have been provided:

- Self-weight of slab = 25kN/m$^3$ x Thickness of slab (m)
- Dead load due to services and finishes = 1.35kPa
- Live load due to internal partitions and activity = 2.5kPa
- Live load of swimming pool (assuming full capacity of water) = Depth of water x 10kPa

The structural loads applied in the PDISP model are shown in Figure 5.

#### 4.3.4.2 Structural loading – piled walls

In order to model the pile loads transferred from the piled retaining wall in PDISP it is necessary to produce a preliminary pile design. The preliminary pile design has assumed the following:

- Contiguous pile wall piles with 450mm diameter at 0.6m centre-to-centre spacing;
- Line load (Dead and Live) of 126kN/m and 26kN/m respectively. Based on the maximum unfactored line load as mentioned in Appendix D.
- Continuous Flight Auger (CFA) cast in place piles will be used;
- Only the fully embedded length of the pile extending below the base of the lowest basement level (assumed to be 40.03mOD) will provide bearing capacity;
- The pile capacity calculations have been undertaken in accordance with Eurocode 7 Design Approach 1, Combination 1 and Combination 2 assuming no working or preliminary pile load tests:
    - Combination 1 applies partial factors to the dead and live loads of 1.35 and 1.5 respectively, while applying a partial factor to the geotechnical parameters of 1.0;
    - Combination 2 applies partial factors to the dead and live loads of 1.0 and 1.3, with geotechnical partial factors of 1.6 for the skin friction, 2.0 for the base capacity and 1.4 for the model factor (assumes no working or preliminary pile load tests);
- The analysis calculation assumes the pile wall acts as a continuous strip, with a reduced end bearing capacity factor, $N_c$ of 7.5[5] to account for group effects;
- An adhesion value of 0.5 and a limiting skin friction of 110kPa has been assumed for the London Clay;
- The geotechnical parameters provided in Table 3 have been used.

Based on these assumptions the percentage of the total pile load carried by the pile shaft is 75%, while the pile end bearing carries 25%.

To model the loads applied from the pile wall to the ground, the pile retaining wall was broken down into separate load zones. The load applied to each pile wall zone was split into the portion of load

[5] Skempton, A.W. (1951). *The bearing capacity of clays.* Proceedings of the Building Research Congress, Vol. 1 pp 18-189.

taken by pile end bearing and pile shaft friction. The percentage of total load carried by the pile end bearing and friction load was determined using the process described in Section 4.3.4.2. To calculate the pile end bearing pressure, the end bearing line load was divided by the width of the pile wall (0.35m). In order to model the skin friction along the pile wall, an equivalent vertical pressure annulus was produced by assuming that at a depth of 2/3 of the embedment length of the piles a rectangular pressure field is applied. The width of this rectangle is equal to 1/2 of the depth at which this field is applied plus the width of the wall. This line load carried by the skin friction portion of the pile wall is divided by the width of this rectangular pressure field to determine the equivalent pressure for application in PDISP. The pressure is applied at the depth of 2/3 of the embedment length of the pile wall. A summary of the skin friction and end bearing pressures is shown in Table 5.

**Table 5. Pile wall end bearing shaft pressures**

| *Pile Wall Zone* | *Total Load (kN/m)* | *Pile Shaft Load (kN/m)* | *End Bearing Load (kN/m)* | *Level at which Equivalent Shaft Friction is Applied (mOD)* | *Equivalent Pile Shaft Pressure (kPa)* | *End Bearing Pressure (kPa)* |
|---|---|---|---|---|---|---|
| Pile Zone 1 | 152 | 114 | 38 | 37.33 | 67 | 109 |
| Pile Zone 2 | 80 | 60 | 20 | 37.33 | 35 | 57 |
| Pile Zone 3 | 152 | 114 | 38 | 37.33 | 67 | 109 |
| Pile Zone 4 | 152 | 114 | 38 | 37.33 | 67 | 109 |
| Pile Zone 5 | 152 | 114 | 38 | 37.33 | 67 | 109 |

## 5. BUILDING DAMAGE ASSESSMENT

The calculated ground movements have been used to assess the potential 'damage categories' that may apply to the neighbouring properties due to the proposed development. The methodology proposed by Burland and Wroth[6] and later supplemented by the work of Boscardin and Cording[7] has been used, as described in CIRIA Special Publication 200[8] and CIRIA C760[4]. General damage categories are summarised below in Table 6

**Table 6. Classification of damage visible to walls (reproduction of Table 2.5, CIRIA C760)**

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

40 Elsworthy Road is the nearest building to the proposed development and is understood to have no below ground levels. The foundations have been assumed to be 0.5m below ground level and 1m wide. Figure 8 shows the vertical deflection profile across 40 Elsworthy Road and Figure 9 shows the total (installation and excavation) horizontal displacement across 40 Elsworthy Road.

The Damage category for 40 Elsworthy Road was determined by plotting the horizontal net strain and deflection ratio values as summarised in Table 7 and presented graphically in Figure 8. The Building Interaction Chart in Figure 12 shows that the critical section A-A' across 40 Elsworthy Road is within Category 1, which is within the acceptable limit.

**Table 7. Summary of ground movements and corresponding damage category**

| *Property* | *Critical Construction Stage* | *Net Horizontal Movement (mm)* | *Maximum Deflection (mm)* | *Horizontal Strain, $\delta_h/L$ (%)* | *Deflection Ratio, $\Delta/L$* | *Damage Category* |
|---|---|---|---|---|---|---|
| 40 Elsworthy Road (Section A-A') | Stage 3 - Drained | 2.0 to 4.0 | <1 | 0.053 | 0.029 | Category 0 to Category 1 |

Assuming a good standard of workmanship and controlling lateral deflection of the walls to within the values derived from this assessment, the predicted Damage Category is expected to fall within the

[6] Burland, J.B., and Wroth, C.P., (1974). *Settlement of buildings and associated damage, Stage of the art review*. Conference on Settlement of Structures, Cambridge, Pentrech, London, pp 611-654.

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

[8] 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.

range of Category 0 'negligible' to Category 1 'very slight' damage including fine cracks that can be easily repaired during normal decoration. Regular monitoring of the retaining walls, underpins and the neighbouring property should be undertaken during construction to confirm the values are not exceeded and to manage risk.

## 5.1 Monitoring strategy

The results of the ground analysis suggest the likely Damage Category to the neighbouring properties can be controlled to within Damage Category 0 to Damage Category 1. This is dependant on providing high level temporary propping to the retaining wall, construction control, and a good standard of workmanship. To manage this during the works it is recommended that a monitoring strategy be put in place to observe and control ground movements during construction.

The monitoring strategy should be in broad accordance the 'Observational Method' defined in CIRIA Report R185[9]. Monitoring can be undertaken by installing survey targets to the top of the basement wall and face of adjacent buildings. Prior to construction baseline readings should be established. Once construction commences regular readings should be taken and analysed to determine whether unacceptable horizontal/vertical movements or tilting has occurred. Mitigation strategies should be prepared prior to construction and implemented if unacceptable movements occur.

Monitoring data should be check against predefined trigger limits and reviewed regularly to assess and manage the damage category of the adjacent buildings as construction progresses. Appropriate trigger limits for key stages of construction can be set based on the values presented in this assessment.

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

[9] Nicholson, E., Tse, Che-Ming, Penny, C., *The Observational Method in ground engineering: principals and applications.* CIRIA report R185, 1999.

# 6. CONCLUSION AND RECOMMENDATIONS

This report has assessed the possible impact caused by the partial-demolition of an existing five storey building and the construction of a two storey extension to replace the demolished section, as well as two basement levels. The report has used information provided by the Structural Engineer and an existing ground investigation and assessment report. The assessment has assumed that the construction work will be carried out to a good standard of workmanship, with a hit and miss installation methodology adopted for the underpin foundations and high level temporary propping of the wall during construction and in the long term.

The analysis of the possible ground movements the key findings are as follows:

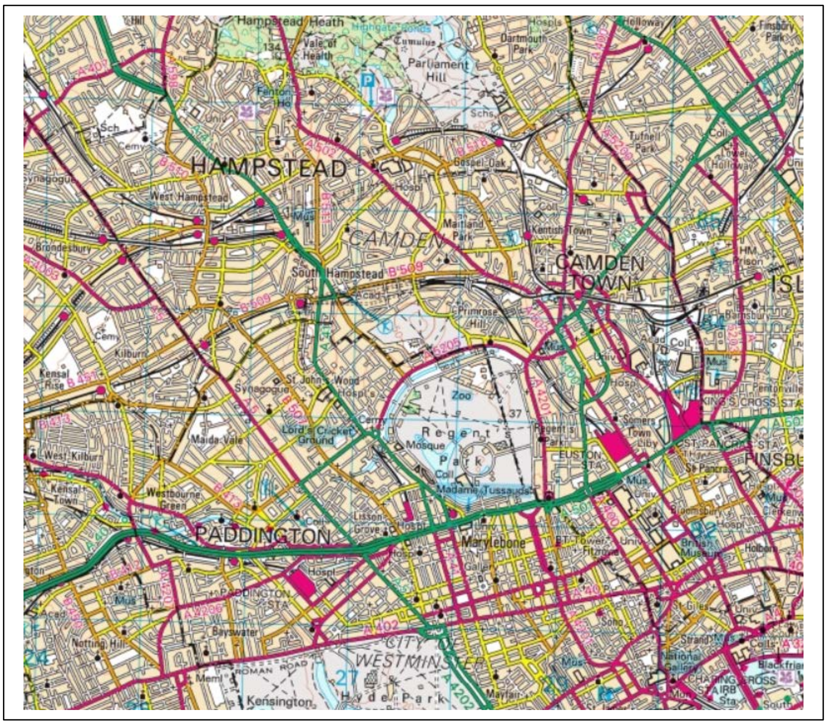
- The maximum settlement deflection across the neighbouring property at 40 Elsworthy Road is anticipated to be <1 mm. The maximum net horizontal ground movement across the single-storey bedroom due to the installation and deflection of the retaining wall is anticipated to be in the range of 2mm to 4mm. Therefore it is predicted that the Damage Category would be Category 0 to Category 1 'negligible' to 'very slight' damage;

- The maximum settlement deflection across footpath at the front of the property along Elsworthy Road is anticipated to be 0.5mm. The maximum net horizontal ground movement due to installation and deflection of the retaining wall is anticipated to be 1.65mm, these movements are effectively negligible;

- The maximum settlement deflection across highway at the front of the property along Elsworthy Road is anticipated to be 0.5mm. The maximum net horizontal ground movement due to installation and deflection of the retaining wall is anticipated to be 1.13mm, these movements are effectively negligible;

It is recommended that prior to construction commencing, a condition survey be conducted and an observation strategy be put in place. Once construction begins the movements of the walls and the façades of the neighbouring properties should be regularly monitored.

# FIGURES

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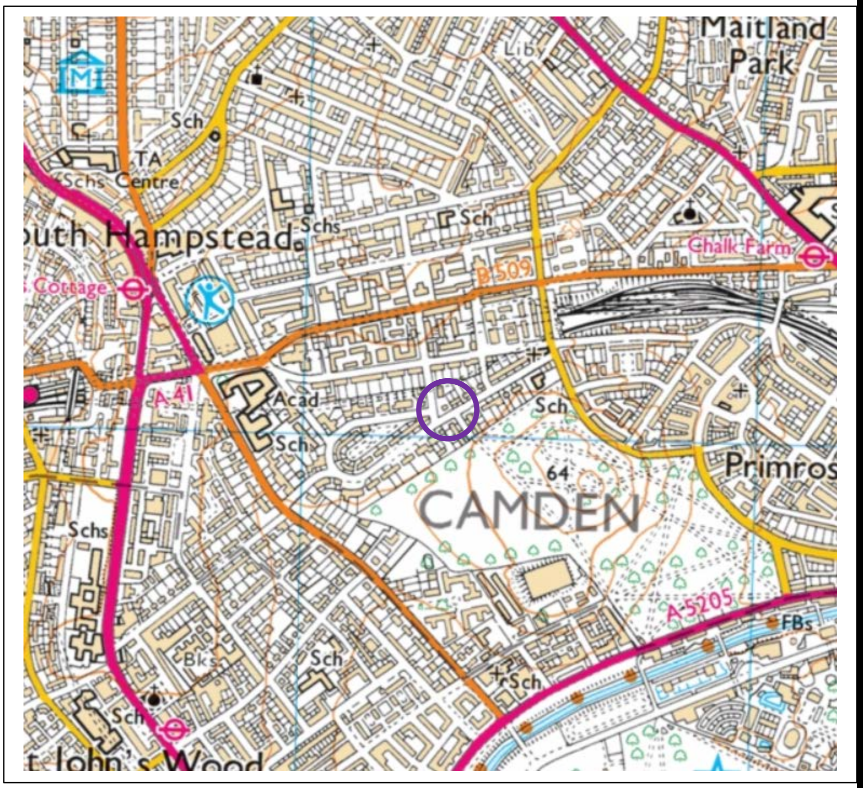


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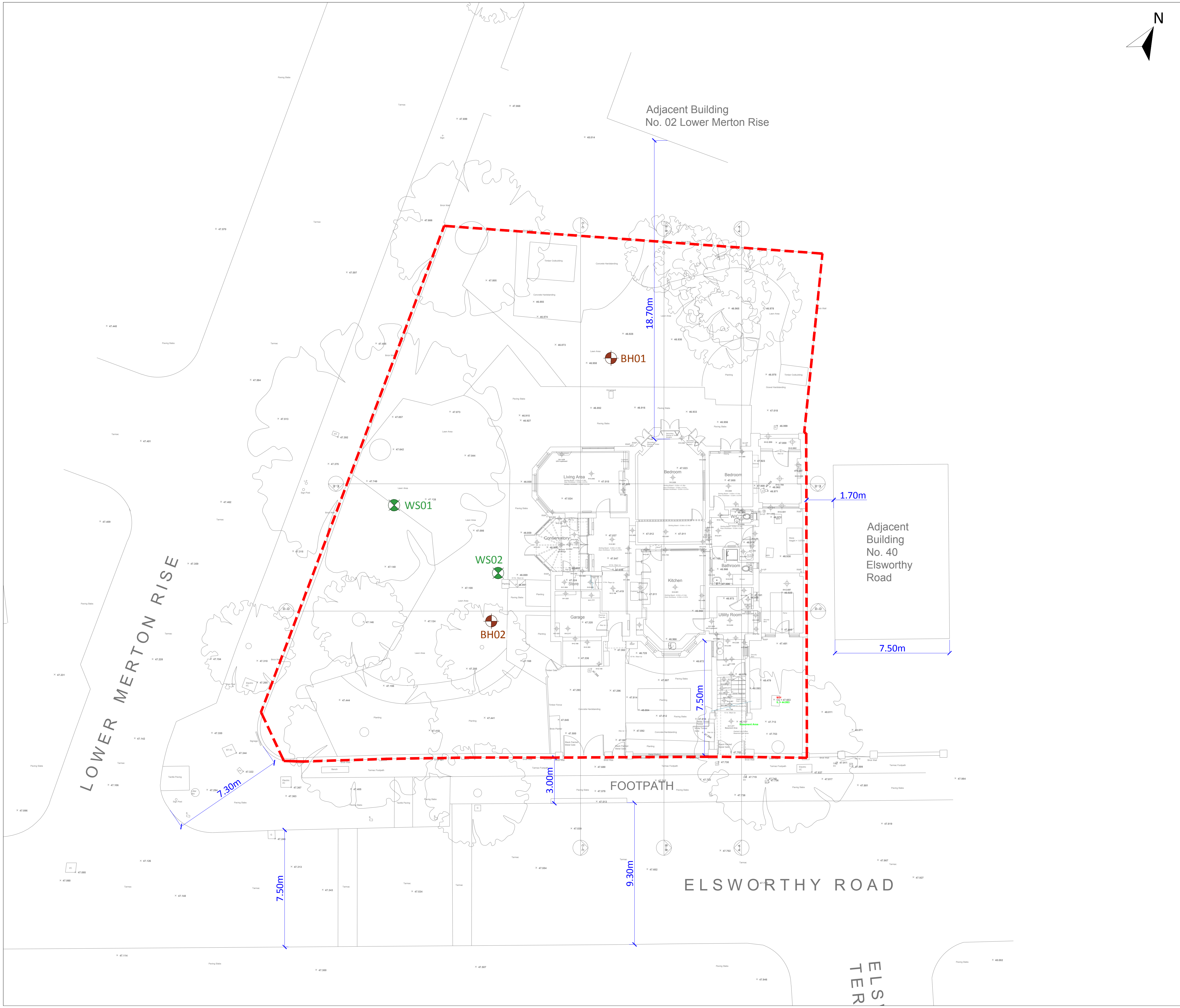
| Client | Project | Job No |
|---|---|---|
| **Forty Two Point Five Elsworthy Limited** | **42 Elsworthy Road, Camden** | **CG/28854** |
| CGL | Title<br>**Site lo  ation plan** | **Figure 1** |




## KEY

- Site Boundary
- Borehole
- Window Sample

**Notes**

1. Do not scale from this drawing.
2. Topographical baseplan taken from Mobile Cad Surveying drawing '1851-01' (December 2016).

| Rev | Date | Comments |
|---|---|---|
| 0 | 13/12/18 | |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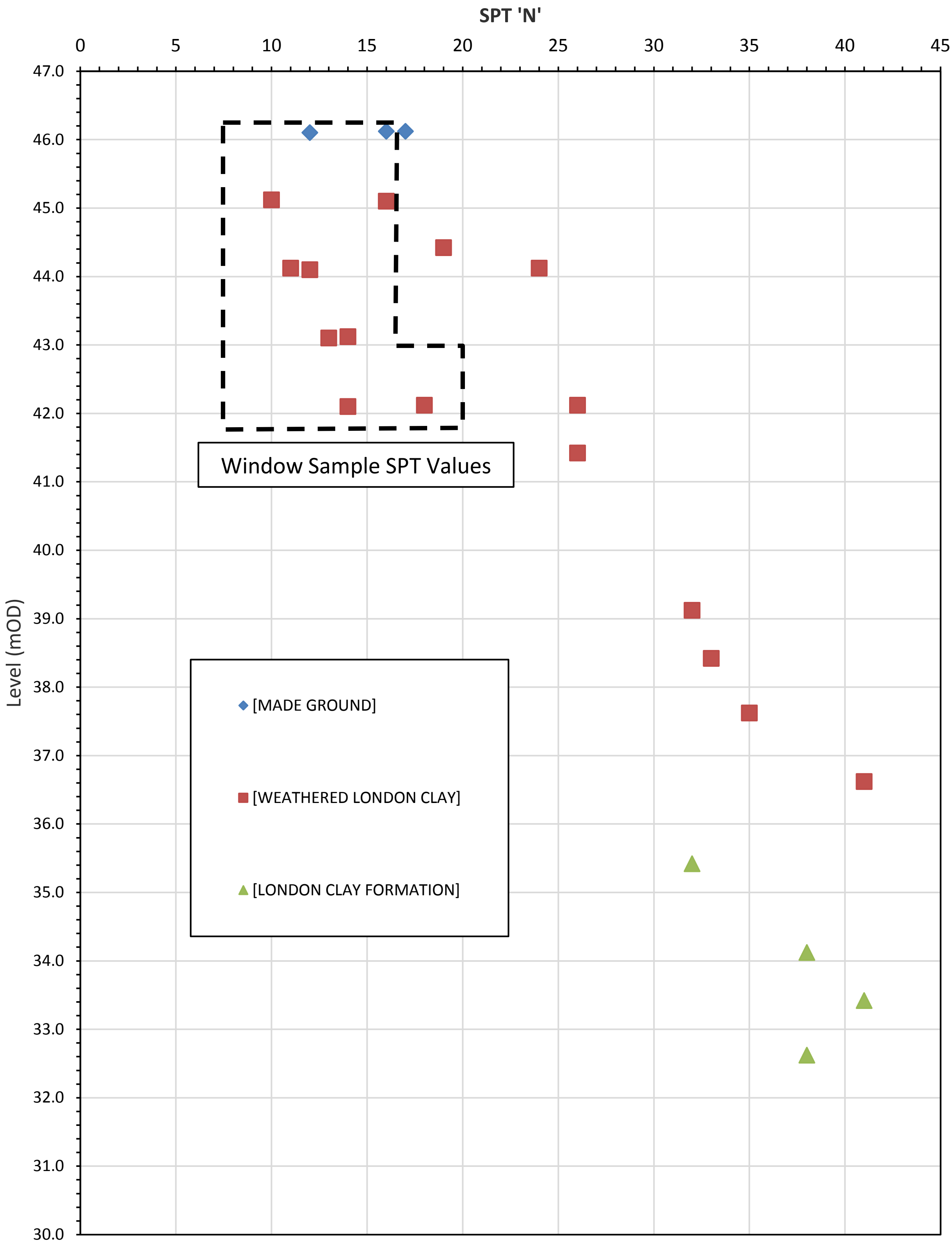
Project: **42 Elsworthy Road, Camden**

Client: **Forty Two Point Five Elsworthy Limited**

Drawing title: **Figure 2 - Site Layout and Exploratory Hole Location Plan**

| Scale(s) | Job No. |
|---|---|
| **NTS** | **CG/28854** |

| | | | |
|---|---|---|---|
| Drawn | TSB | 13/12/18 | Dwg No. **CG/28854-001** |
| Checked | RJB | 14/12/18 | Rev. **0** |
| Approved | IMM | 14/12/18 | |




| Client | Project | Job No |
|---|---|---|
| **Forty Two Point Five Elsworthy Limited** | **42 Elsworthy Road, Camden** | **CG/28854** |
| CGL | Title<br>**SPT ‘N’ value versus level** | **Figure 3** |