38 Pilgrims Lane, London NW3

Construction Method Statement

Revision D

07 October 2011

0585

HEYNE | TILLETT | STEEL
STRUCTURAL ENGINEERS

1. Introduction:

1.1 Heyne Tillett Steel Limited has been asked by Charlton Brown Architects, on behalf of Ms Allyson Kaye, the client and property's owner, to consider the construction aspects of the proposed development of the site, in support of a planning application.

1.2 The client is considering two options for the proposed development:

Option 1: The extension and refurbishment of the existing building on the site with the addition of a new basement below the existing lower ground floor level.

Option 2: The extension and refurbishment of the existing building only

In order to meet the requirements of policy DP27, this document focuses on the methodology for Option 1 - with basement scheme. However, explanation is also provided in relation to Option 2 where appropriate. The drawings in Appendix C indicate the proposed structural works for Option 1. The proposed structural works for Option 2 is the same but without the basement foundation works.

2. Existing Conditions

2.1 The existing end of terrace building is located on the south side of Pilgrim's Lane in Hampstead. It is a four storey semi-detached property comprising lower ground floor, upper ground floor, first floor and second floor, the latter being formed within a pitched roof. There is an existing three storey extension to the rear of the property.

2.2 The structure to the existing building comprises timber floors and roofs supported on external masonry walls and internal timber spine stud wall. Stability is provided by masonry external walls, spine wall and diaphragm action of the timber floors. Existing footings are shallow masonry corbelled spread footings. The south flank wall constitutes a party wall; the north flank wall constitutes a boundary wall.

2.3 The existing footprint of the building is approximately 6m wide x 9.5m long; the extension to the rear is 3m wide by 5m long. The overall site, including front patio and rear garden, is 6m wide and approximately 32m long. The rear garden extends approximately 14-17.5m beyond the existing extension and rear façade respectively. The approximate area of the garden is 100m2.

2.4 The existing building shares a party wall with 34 Pilgrims Lane. 34 Pilgrims Lane (No. 34) is a four storey Victorian Terrace building which is likely to be of similar construction to No. 38, with timber floors supported on load-bearing masonry walls. The separating party wall is likely to be of brick construction with lime mortar. This wall includes a number of chimney flues.

2.5 There is a paved pathway between the north flank wall of No. 38 and 40 Pilgrims Lane (No. 40). The north flank wall forms the boundary between the two sites. Along the rear garden there is a boundary freestanding masonry wall. No.40 is likely to be of similar construction to No. 38 and 34.

2.6 The existing front, flank and rear masonry walls to No.38 contain significant number of large cracks and some walls are out of plumb. This is likely to be due to historical settlement caused by the effect of local trees on existing shallow foundations. Historical alterations to the building appear to have also contributed to this. Generally the building is in a state of significant dilapidation, with evidence of extensive internal damp damage and movement.

2.7 The garden consists of grass and low level shrubs. There are no trees in the garden. The external area around the existing extension is paved with concrete pavers.

2.8 The site is relatively flat, however levels across the width of the site fall by approximately 500mm.

2.9 Pilgrim's Lane is a narrow road predominately occupied by large terraced town houses. The access road directly in front of the property is set at a higher level to the lower ground floor, and is at a steep gradient.

2.10 The existing drainage is a combined gravity system and runs below the lower ground floor slab to the front of the property and into a combined public sewer below Pilgrim's Lane. The invert level of the last manhole before the sewer is approximately 1.6m below existing external level.

2.11 Historical alterations to the building appear to be limited to widening of an opening in the rear façade and partial removal of the lower ground floor bay projection to the front façade for the construction of a garage space.

2.12 Geotechnical site investigation revealed the existing ground conditions to be up to 1.2m of made ground, lying on top of London Clay (proven to a depth of 15m). All depths were measured from the top of the existing lower ground floor slab. The result of the investigation by Geotechnical and Environmental Associates (GEA) is provided in Appendix D of this report.

2.13 Water was encountered in borehole BH1, 4.9m below the level of the existing garage slab. A standpipe was installed by GEA to measure water levels.

2.14 GEA revisited site on 4th July 2011 to measure the ground water level in the standpipe. Ground water level in the standpipe was found to be at the interface between the London Clay and the made ground. GEA's analysis of this measurement is provided in Appendix C and further discussion is provided in Section 5 of this report.

3. Structural Proposal

3.1 Option 1: Existing Building Extension, Refurbishment and New Basement

3.1.1 The proposal is to demolish the existing walls, roofs and floors to the rear extension; the rear external wall to the main building; internal walls at various levels within the main building and the rear bay of the main pitched roof. The existing timber floors within the main building will generally be retained, strengthened (where required) and re-supported on new internal steel frames.

3.1.2 Above upper ground floor level, a new rear extension will be constructed within the same footprint as the original rear extension. A new rear external wall to the main building will be constructed approximately 1.0m further out than the original wall. At lower ground floor a new rear single storey extension will extend approximately 2.0 m further into the garden from the external face of the new rear extension over. The new extensions are to consist of load bearing masonry, timber floors, with some steel framing.

3.1.3 Lateral stability of the proposed building is to be provided by new internal steel portal frames and the existing party and flank walls. The retained timber floors are to act as horizontal diaphragms and are to be laterally tied to the existing and new masonry walls.

3.1.4 A new single storey basement is to be constructed and will extend approximately 3.6 m below the existing lower ground floor level. The new basement will be approximately 6m wide and 17m long. The new basement is to be underneath the entire footprint of the existing building. The basement extends beyond the front and rear façade.

3.1.5 The plan area of basement extending beyond the existing rear façade is approximately 30m2 and this is approximately equal to the existing area of external hard paving.

3.1.6 Basement retaining walls will be constructed using three principle methods:

3.1.6.1 Along the party wall, mass concrete underpins will be installed with a separate 200mm thick reinforced concrete (RC) liner wall cast along the inside face of the underpins.

3.1.6.2 Along the existing flank wall and front façade, 300 mm thick RC retaining walls will be installed, cast in an under pinning sequence.

3.1.6.3 The proposed rear basement retaining wall is to be a 250mm thick RC wall. This may be constructed in an under pinning sequence. Alternatively the ground at the back of the retaining wall can be battered back as excavation progresses down to an agreed depth. Temporary steel sheet piles can installed at the base of the temporary slope to retain the ground during further excavation.

3.1.7 The new ground bearing basement slab will be 250thk and connected to the RC retaining walls at the extent and with the RC liner wall. The slab will be designed to support any clay heave and to be at a depth outside the influence of tree roots. Two RC strip footings, approximately 1200mm wide, are to be constructed underneath and cast monolithically with the basement slab.

3.1.8 A new 250thk RC slab will be cast at new lower ground level supported on the new basement RC retaining walls, underpins and liner walls. Externally, this will be formed at a minimum level of 500mm below existing garden level in accordance with the planning requirements, to allow for suitable depth of garden planting over.

3.1.9 Supported on the new lower ground floor RC slab will be load bearing masonry walls and new steel columns supporting the existing and new superstructure.

3.1.10 The new basement structure will provide new foundations to the existing walls retained, which are located beyond the influence of tree roots. This will eliminate future damage to the existing walls and re-instate structural stability to the retained building.

3.1.11 New drainage from the basement would be collected beneath the basement slab and run via gravity to a sump, where it will be raised to connect into the retained/reconstructed last front manhole. Elsewhere the drainage from the main house would be collected and run via gravity below the structural slab, penetrating the front retaining wall and joining into the last manhole. The existing connection into the public sewer would be reused, with a new interceptor trap.

3.2 Option 2: Existing building extension and refurbishment

3.2.1 The discussion in Section 3.1.1 – 3.1.3 applies to this development option.

3.2.2 The proposed steel columns against the party wall and within the existing or new external walls are to have mass concrete pad foundation. The top of the new mass concrete pads are likely to coincide with the underside of the existing lower ground floor slab. The depth of the footings will vary dependent on their size on plan.

3.2.3 The new load bearing masonry walls are to have mass concrete strip footings.

3.2.4 The existing party wall and boundary garden wall may require new underpins locally due to the adjacent new mass concrete pad or strip footings being deeper than the existing foundations.

3.2.5 The existing lower ground floor slab is to be retained except the high level existing garage slab which is to be re moved. New ground bearing concrete slabs cast on void formers will be introduced for the new rear extensions.

3.2.6 The existing below ground drainage system is to be re-used and refurbished. There may be a requirement to install new manholes and drainage runs to connect to the existing system.

4. Temporary Works & Stability of Existing Buildings

4.1. Option 1: Existing Building Refurbishment and New Basement

4.1.1 Temporary vertical propping will be required to support the existing timber floors prior to demolition of existing internal and external load bearing walls. The main line of propping will be on both sides of the internal spine wall and just inside of the rear elevation of the main house.

4.1.2 The temporary vertical props are to support existing floors at each level and extend down to existing lower ground floor level. Temporary foundations would be required to support the props and these will extend to below the proposed basement excavation level. These may be of mass concrete spread footings or piles. The exact nature of the temporary foundations will be subject to the appointed contractor’s preference.

4.1.3 Temporary vertical bracings will be required to laterally support the external boundary and party wall. These are mainly to be located along the lines of vertical props and are to be provided at each floor level. They are to be supported on the temporary foundations.

4.1.4 Temporary bracings will also be required to the party wall between the existing rear extensions of No. 38 and No. 34. This may be in the form of horizontal raking struts, connected to the party wall and to the temporary vertical props along the rear elevation of the main building.

4.1.5 The existing internal and external walls are to be demolished post installation of the temporary support structures. The temporary props, bracings and foundations will provide vertical and lateral stability of the retained superstructure of No. 38 throughout construction. The stability of the neighbouring No. 34 will also be ensured via the same temporary structure.

4.1.6 The existing ground is predominantly clay, which is relatively stable under excavations. However, temporary supports will be provided to all faces of excavation for the construction of temporary foundations and permanent basement retaining walls and underpins. The temporary supports will be installed as excavation progresses in 1.0m deep sections, to ensure stability of the retained ground outside the excavations.

4.1.7 The party wall is to be underpinned in 1.2 m sections and in a sequence such that no two adjacent pins are cast within 48 hours of one another. The excavations are to be backfilled after each underpins are installed. The underpins are to extend beneath the proposed basement excavation level. They will support all vertical loads from the existing party wall and ensure that retained structure of No. 38 and No. 34 are stable during and after construction.

4.1.8 The RC retaining walls underneath the existing front façade, flank wall and along the rear of the new basement will be constructed in a similar manner to the underpins.

4.1.9 To prevent lateral movement and provide lateral stability of the ground throughout excavation, underpins underneath the party wall will be propped horizontally at the head. The horizontal temporary props will be connected to the RC retaining walls opposite (under the existing flank wall). Props will be located just below the proposed 250 mm thick lower ground floor slab and are to remain in place until the permanent basement structure is constructed. The props will ensure that the ground outside the excavation is continuously supported throughout construction hence ensuring the stability of No. 38 and No. 40.

4.1.10 The RC retaining walls underneath the front façade and along the rear of the basement are to have L-shaped profile and designed to be free standing during excavations. Therefore they are to support the surrounding ground without temporary lateral props.

4.1.11 A new basement RC liner wall will be constructed to the inside face of the underpins. This will be laterally propped by the new top and bottom basement RC slabs, and is to support the ground behind the underpins. The new basement slabs will provide a similar function for the RC retaining walls opposite. The basement RC structure will provide permanent lateral restraint to the underpins and RC retaining walls, maintaining the lateral stability of the surrounding ground underneath the neighbouring properties.

4.1.12 The temporary vertical props can be left supported onto the temporary foundations post construction of the RC basement box. Alternatively they can be re-supported onto the new RC lower ground floor slab and the temporary foundations demolished.

4.1.13 New steel frames are to be installed to provide permanent vertical and lateral support to the existing structure retained. The frames will also re-instate lateral restraint to No. 34.

4.1.14 From the above the stability and structural integrity of the surrounding ground, the neighbouring properties (No. 34 and No. 40) and the retained structure to 38 Pilgrims Lane will be maintained throughout construction, without any detrimental effect to existing conditions.

4.1.15 As a precautionary measure a set of monitoring targets can be installed onto the external elevations of No 34, 38 and 40. These would be monitored throughout the building process for 3 dimensional movements. This would act as an early warning system to identify any unexpected movement allowing time for remedial action to be taken. This would be agreed as part of the party wall negotiations.

4.2 Option 2: Existing building refurbishment

4.2.1 The discussion in Section 4.1.1 – 4.1.7 applies to this option, the only difference being that temporary foundations are to be shallow and do not need to extend down to basement level. The underpins are local mass concrete underpins and the excavations are not as deep and therefore require less temporary works.

5. Hydrology

5.1 The proposed basement will be predominantly in the London Clay. London Clay has very low horizontal and vertical permeability, such that any groundwater flow rate is negligible. The presence of groundwater within the London Clay is generally restricted to within fissures, silty bands or associated with the presence of localized clay stones. The claystones, fissures or silty bands are not continuous within the London Clay and any water is constrained in these features.

5.2 The presence of the groundwater within Borehole No 1 at 4.9 m is likely to be due to the presence of a fissure or claystone within the London Clay and it is unlikely to represent a significant quantity of water. No water was found in Borehole 2 which reinforces the fact that the water struck in Borehole 1 is associated with localized features. The localized fissures or claystone is unlikely to significantly extend to neighbouring sites.

5.3 A standpipe has been installed in Borehole 1 in order to monitor the level of the localised water struck. Measurements made on 4th July 2011 indicated that the water level in the standpipe close to the interface between the made ground and London Clay. This result is seen as not representative of the ground conditions and may be due to localized water in the clay or surface water within the made ground entering the standpipe. A letter from GEA discussing this result is provided in Appendix D.

5.4 Approximately 250 mm of made ground overlays the London Clay in the rear garden. Surface water may flow through the made ground from the rear garden of 34 Pilgrims Lane, which is at a higher level. This surface water is likely to pass from the external rear garden of 34 Pilgrims Lane, through the rear garden of 38 Pilgrims Lane and to the rear garden of 40 Pilgrims lane. This potential flow is does not occur within areas subtended by the existing buildings and brick boundary walls on the sites. The proposed basement does not extend significantly into the rear garden and beyond the rear of existing adjacent buildings and boundary walls, to affect the movement of this water across the site.

5.5 The site is located approximately 350 m West of the River Fleet, 550 m North of River Tyburn and 600 m North East of River Westbourne. Refer to Appendix E.

5.6 Based on the above, the construction of the proposed basement would therefore have no effect on the existing local hydrology.

5.7 The local hydrology will not be affected by the second development option (without the proposed basement.)

6. Assumed Sequence of Construction

The following is the assumed construction sequence for the first development option which includes a basement.

6.1 Site Set Up

6.1.1. Access is only available from Pilgrim's Lane so it is assumed that all deliveries, removals and access for operatives will be made from here. The front entrance will be manned by a banksman during operational hours to ensure construction deliveries do not pose potential risk to pedestrians.

6.1.2. Site hoarding will be constructed along the pavement boundary to provide protection from passers-by. It is assumed that site accommodation will need to be located in the rear garden for the duration of the works.

6.1.3. It is assumed that the car parking bay to the front of the property would be suspended for the duration of the works and a skip located within it. A passenger tunnel would be constructed over the pavement.

6.1.4 Terminate and divert existing services as required.

6.1.5 Strip out existing building

6.2 Temporary Works and Demolition

6.2.1 Locally remove the existing lower ground floor slab and install temporary foundations where required.

6.2.2 Install temporary props and lateral bracings at each floor level

6.2.3 Remove existing structure as specified including the lower ground floor slab.

6.2.4 Clear and level existing lower ground floor. Debris and excavated materials may be removed from site via a conveyor belt and it is envisaged that this will extend over pavement passenger tunnels and onto lorries or skips onto the main road.

6.3 Mass Concrete Underpins and Reinforced Concrete Retaining Walls

6.3.1 All excavations for underpins and RC retaining walls are to be constructed in an agreed sequence, be a maximum of 1.2m wide and 2m off the internal face of the party wall. The sequence is to be such that no two adjacent pins are cast within 48 hours of one another. Typically the underpins are cast in a 1 3 5 2 4 1 3 sequence.

6.3.2 Underpins and RC walls are to extend beyond the underside of the proposed basement excavation level. Proprietary side shutter would be used to provide protection to operatives and retain stability to ground.

6.3.3 Dry-pack to be installed tight between top of pins / RC retaining walls and underside of existing walls at least 24hours after casting. Back fill excavations to top of existing lower ground floor slab level.

6.3.4 Excavate and construct underpins under party walls. Rear face of underpinning to be aligned with edge of corbelled foundation on No 34 side of the party wall. Front face of underpin to align with internal face of the party wall within No 38. Existing corbels within No 38 to be removed and proposed base of underpins are be the same width as the existing footings. Pins to be cast approximately 75mm below base of existing foundations.

6.3.5 Excavate and construct RC retaining walls under existing front and flank walls. Method to be as per new underpins. Starter bars to be left projecting from the face of the toe and head of the walls to allow fixing of basement and lower ground floor slabs respectively.

6.3.6 Excavate and construct RC retaining walls along the rear perimeter of the basement. Width of RC walls to be as specified. Starter bars to be left projecting from the face of the toe and head of the walls to allow fixing of basement and lower ground floor slabs respectively. This may be constructed after the excavation is complete by battering back the existing ground and installing temporary steel sheet piles to support the ground behind the proposed wall.

6.3.7 The above may happen before the installation of temporary works in section 6.2. The final sequence will depend on the preference of the appointed contractor.

6.4 Basement Excavation

6.4.1 Install horizontal props at the head of new underpins and onto the new RC walls opposite. Props to be located just below the underside of the proposed lower ground floor slab.

6.4.2 Excavate ground to base level of proposed excavation. Excavated material may be conveyed to the front, over the pavement and into skips or lorries.

6.4.3 If required and as discussed in section 6.3, as excavation progresses, batter back existing ground behind the proposed location of the rear basement RC retaining wall. Install temporary sheet piles at the base of the temporary slope. Horizontal props may be required at head of the sheet piles and these are likely to connect to perpendicular underpins and RC retaining walls.

6.4.4 Remove soft and hard spots and infill with compacted hard-core or mass concrete. Install concrete blinding to protect bearing ground.

6.4.5 Install below ground drainage including manholes and pump chambers as required.

6.4.6 Locally excavate and cast RC strip footings.

6.5 Basement RC Box and Superstructure

6.5.1 Fix reinforcement and cast bottom basement slab throughout, with kickers and starter bars for RC liner walls and columns as required. Connect slab to starter bars within previously constructed RC perimeter retaining walls. Connect slab to temporary foundations if required.

6.5.2 Cast RC liner wall in front of mass concrete underpins.

6.5.3 Provide table-formwork to underside of lower ground floor slab and fix slab reinforcement. If required, install dowels to connect slab to temporary foundations.

6.5.4 Cast lower ground floor slab and connect to starter bars within previously constructed RC liner wall and retaining walls under. Allow for openings, penetrations and inserts as required.

6.5.5 Allow slab to cure and remove temporary foundations under if required. Re-support temporary props supporting superstructure, onto new slab.

6.5.6 Remove temporary horizontal props to underpin and RC retaining walls opposite. Infill voids and cast in any sacrificial fixings associated with the props.

6.5.7 Install superstructure steel frames and re-support existing structure. Construct new load bearing masonry walls and associated new floors and roofs. Strengthen existing floors where required.

6.5.8 Install galvanized steel straps to tie external walls to timber floors. Straps to be built into masonry walls. Glue and screw ply sheeting to top of joists to form diaphragms. Connect floors to steel frames as required.

6.5.9 Remove temporary bracings and props. Make good existing masonry walls as required.

6.5.10 Repair existing cracks and damage to external walls. This may be conducted early during installation of temporary works.

6.6 Follow on trades

6.6.1. The structural works are now complete and the work can concentrate on making the building weather tight, upon which the finishing trades can commence.

6.6.2. At this stage further discussion of these issues is premature and unnecessary.

6.7 For the second development option, which does not include the basement the following is the assumed sequence:

6.7.1 Site set up and temporary works are as per Section 6.1 – 6.2 above.

6.7.2 Mass concrete underpins are to be installed locally under existing footings as per Section 6.3 above.

6.7.3 Install mass concrete strip and pad footings. Install new lower ground floor slabs where required.

6.7.4 Install superstructure as per Section 6.5.7 – 6.5.10 above. Follow on trades are as Section 6.6 above.

Appendix A - Outline Specification

A.1 General:

A.1.1 The following design elements should be in accordance with the architects details:

- Water and damp proofing
- Setting-out
- Fire protection
- Floor separation and acoustic isolation
- External works
- Landscaping
- Finishes
- Internal partitions

A.2 Concrete:

A.2.1 The concrete grades to be used are as follows:

- Blinding, Gen1
- Mass concrete to underpinning, Gen3
- Insitu RC concrete slabs, underpinning and walls, RC40

A.2.2 All formed surfaces to be Type A (basic) finish in accordance with BS-8110. Tops of ground beams and floor slabs to be uniformly levelled and tamped to type 1u finish, subject to agreement with raised flooring manufacturer.

A.2.3. Caltite Waterproof concrete may be used for the retaining walls and basement slab.

A.3 Steelwork:

A.3.1 All steelwork to be grade S275 to BS EN 10025 and in accordance with BS-5950 UNO.

A.3.2 All connections to have minimum 2no. M16 bolts, with minimum 6mm leg length continuous fillet welds, unless specifically noted.

A.3.3 All steelwork to be blast cleaned to SA2.5. Internal steelwork painted with 75 µm of zinc phosphate primer, 75 µm sealant. External steelwork to be galvanised to 140µm.

A.4 Timber:

A.4.1. All timber members are to be grade C16 to BS 5268 unless noted otherwise. Timber to be pressure impregnated with preservative and cut ends brush treated

A.4.2. Lateral restraint straps for floors are to be minimum 900 long 30 x 5 galvanized MS straps at 1200crs with 150 bob end.

A.5 Temporary Works:

A.5.1 The contractor is responsible for the design, installation and maintenance of all necessary temporary works to ensure the strength and stability of the building throughout the construction process

Appendix B - Outline design Parameters

B.1 Codes of Practice:

B.1.1 British Standards:

Loading	BS6399Part 1 (Dead & Imposed Loads) Part 2 (Wind Loads) Part 3 (Imposed Roof Loads)
Concrete	BS8110
Basements	BS8102
Foundations	BS8004
Steelwork	BS5950
Masonry	BS5628
Timber	BS5268
Balustrades	BS6180

B.1.2 Building Regulations 2000:

Approved Document A – Structure (2004 edition)
Approved Document H – Drainage & Waste Disposal (2002 edition)

B.1.3 Temporary Works

Façade retention works should be designed in accordance with the recommendations set out in CIRIA guide C579 (2003 'Retention of Masonry Facades).

The deflection of the retained façade should be limited to Span/750 under full loading.

B.2 Design Loadings:

B.2.1 Imposed Loadings: kN/m2

a.	All floors	1.5
b.	Partition Allowance	0.5

B2.3 Deflection:

Imposed load deflections will be limited to:

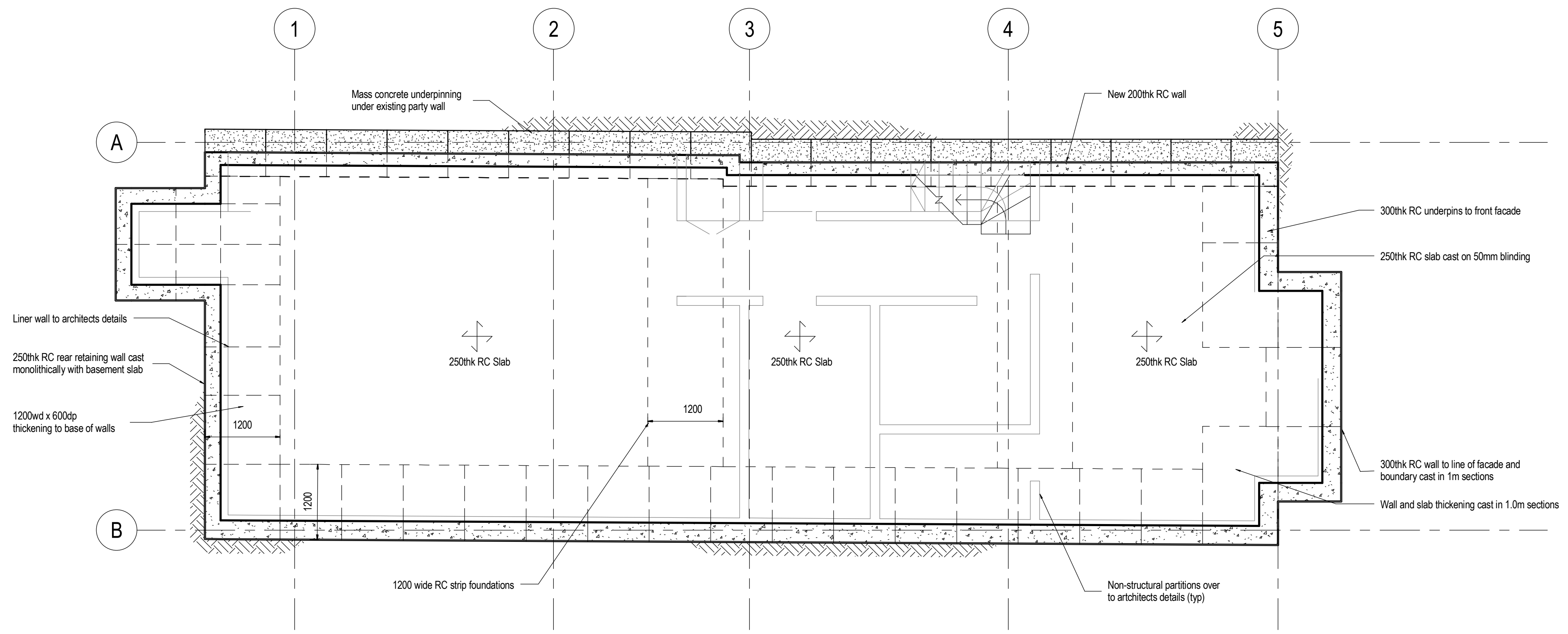
Timber:

Typical Floors	- Span / 360 or 14mm, whichever is less
Steel	- Span / 360 or 25mm, whichever is less

B.2.4 Wind Loading to BS 6399-part 1

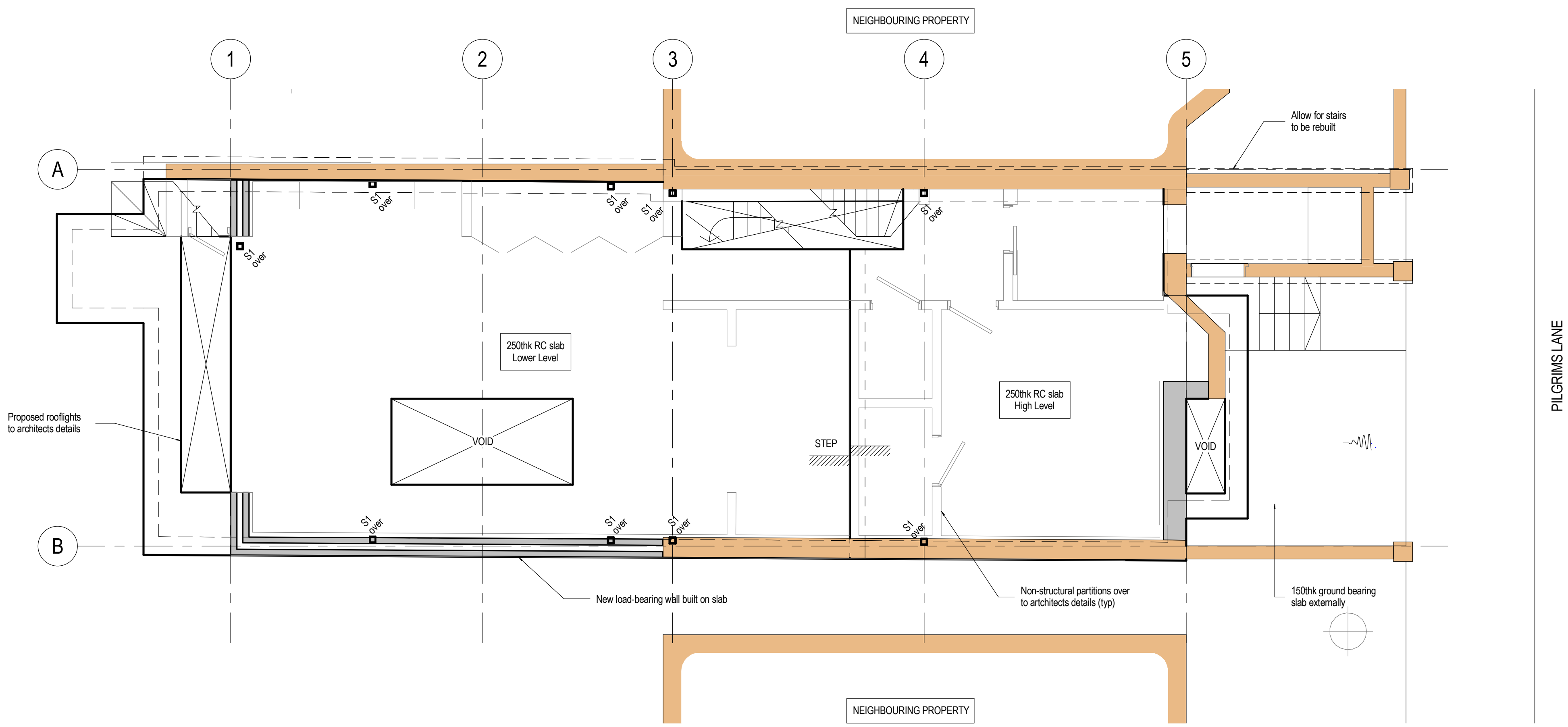
Appendix C - Proposed Structural Drawings

100mm @ A1 (50mm @ A3)



BASEMENT PLAN

1 : 50



LOWER GROUND FLOOR PLAN

1 : 50

NOTES

1 This Drawing is to be read in conjunction with all relevant Architect's Engineer's and specialists' drawings and specifications.

2 Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check drawing has been printed to the intended scale the above bar should be 100mm long @A1 or 50mm long @ A3

3 Underpinning and temporary works to sides of basement to be propped at head during excavation.

Proposed external walls

Existing structure to be retained

S1 - New steel column

SB1 - New steel beam

New joists

Existing joists

Rev	Date	Drawn	Eng	Amendments
P3	23.08.11	BVB	DC	Revised generally
P2	19.04.11	SLS	DC	Revised generally
P1	07.04.11	MC	DC	PRELIMINARY ISSUE

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STRUCTURAL ENGINEERS

Job Name:

38 PILGRIMS LANE
LONDON, NW3

Drawing Title:

PROPOSED BASEMENT & LOWER GROUND FLOOR PLANS

Scale: 1 : 50 @A1

Purpose of Issue: PRELIMINARY

Drawing No. 0585 / 100

Rev. P3

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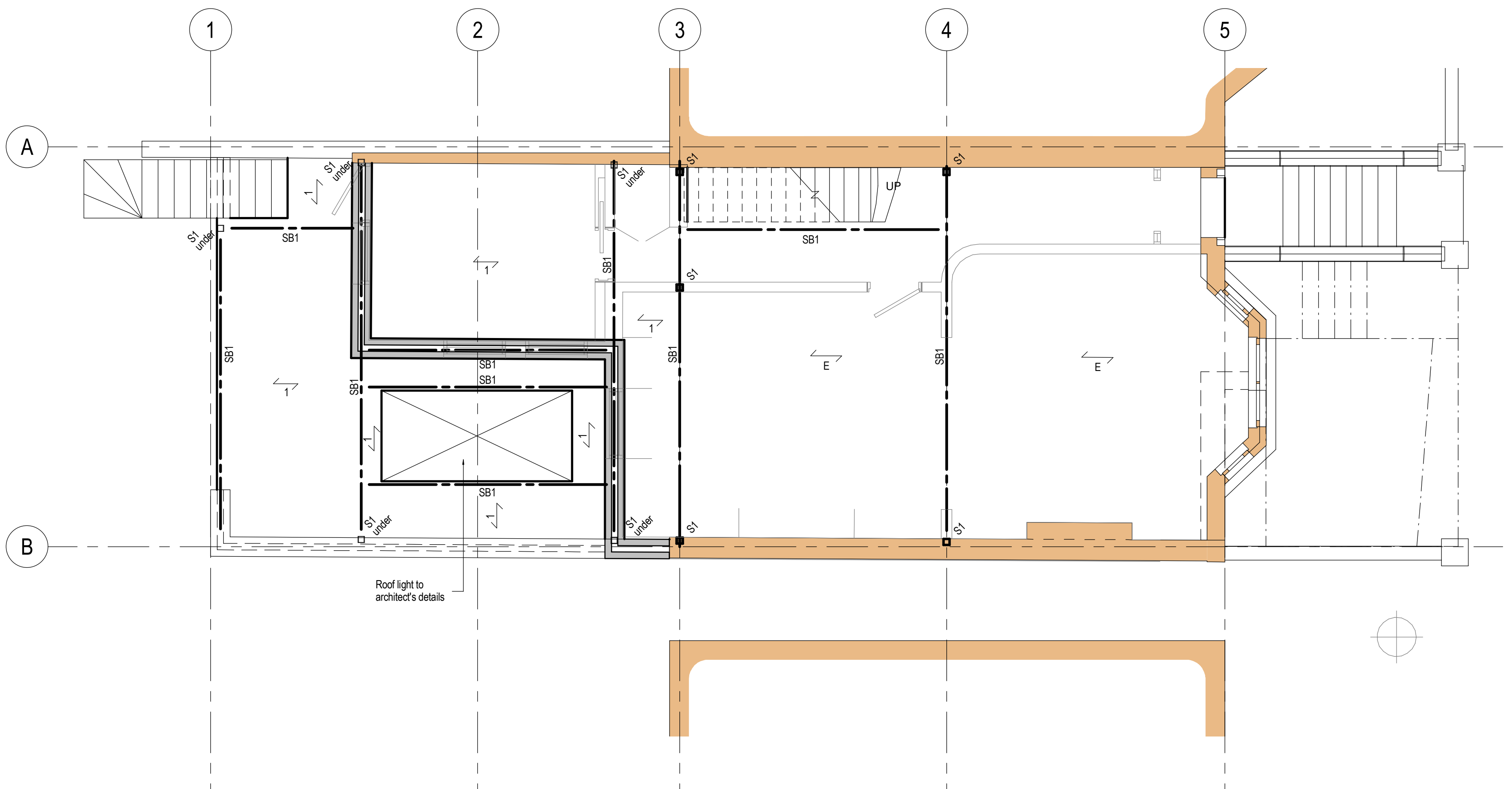
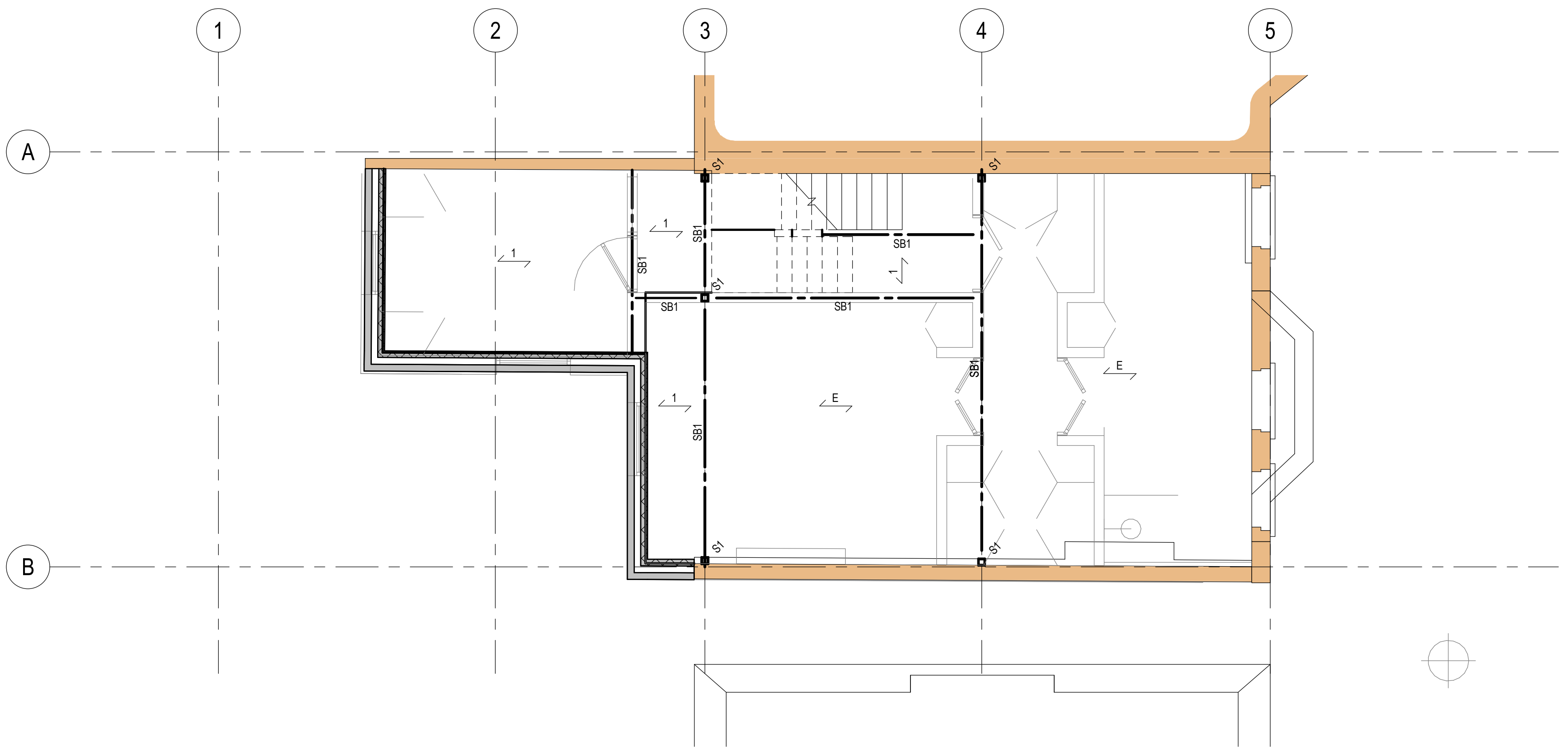


UPPER GROUND FLOOR PLAN

1 : 50



FIRST FLOOR PLAN

1 : 50

100mm @ A1 (50mm @ A3)

NOTES

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3 Underpinning and temporary works to sides of basement to be propped at head during excavation.

Proposed external walls

Existing structure to be retained

S1 - New steel column

SB1 - New steel beam

1 — New joists

E — Existing joists

Rev	Date	Drawn	Eng	Amendments
P1	23.08.11	BVB	DC	PRELIMINARY ISSUE

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STRUCTURAL ENGINEERS

Job Name:
38 PILGRIMS LANE
LONDON, NW3

Drawing Title:
PROPOSED UPPER GROUND & FIRST FLOOR PLANS

Scale: 1 : 50 @ A1

Purpose of Issue: PRELIMINARY

Drawing No. 0585 / 110

Rev. P1

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100mm @ A1 (50mm @ A3)

NOTES

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Proposed external walls

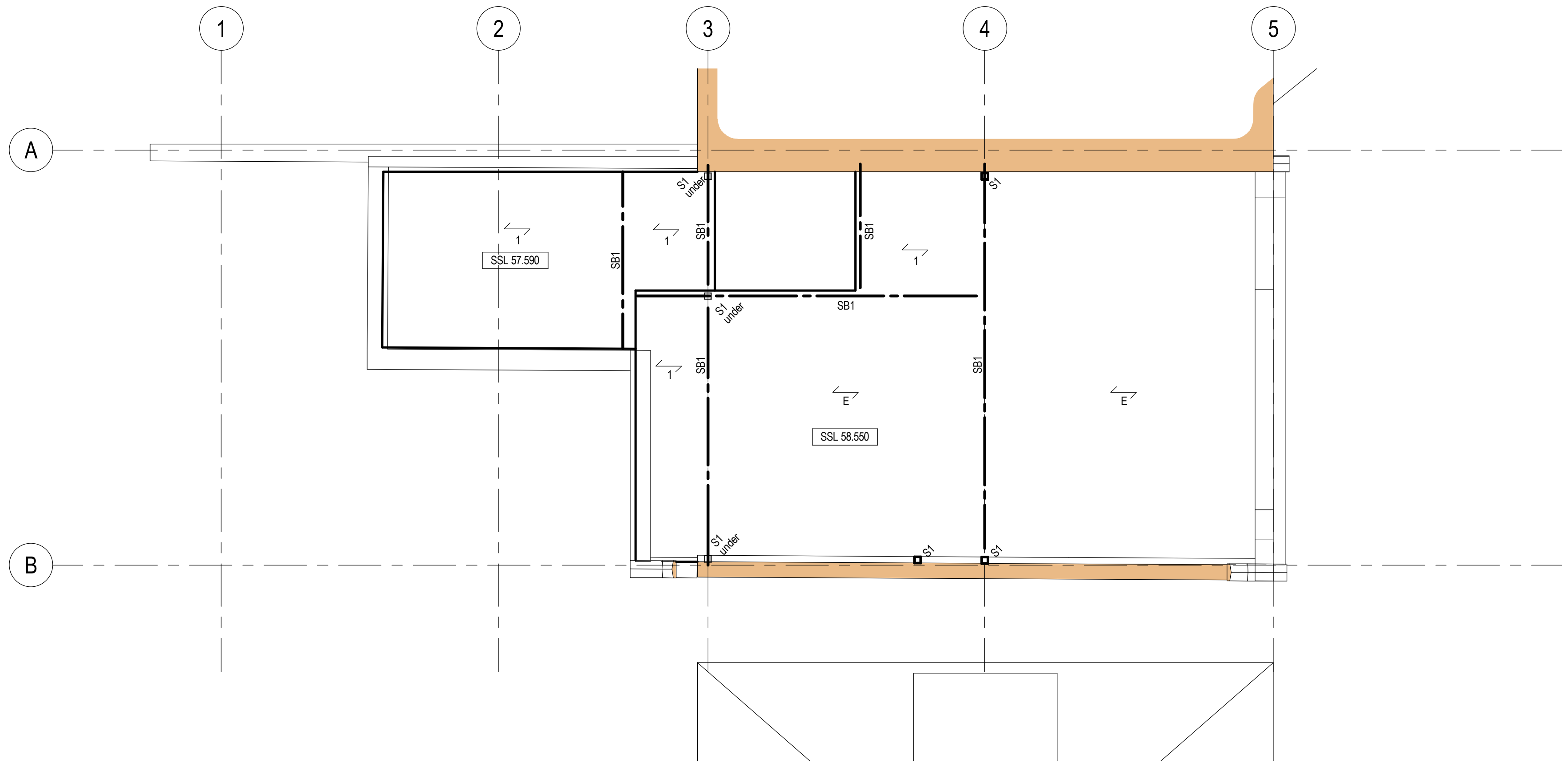
Existing structure to be retained

S1 - New steel column

SB1 - New steel beam

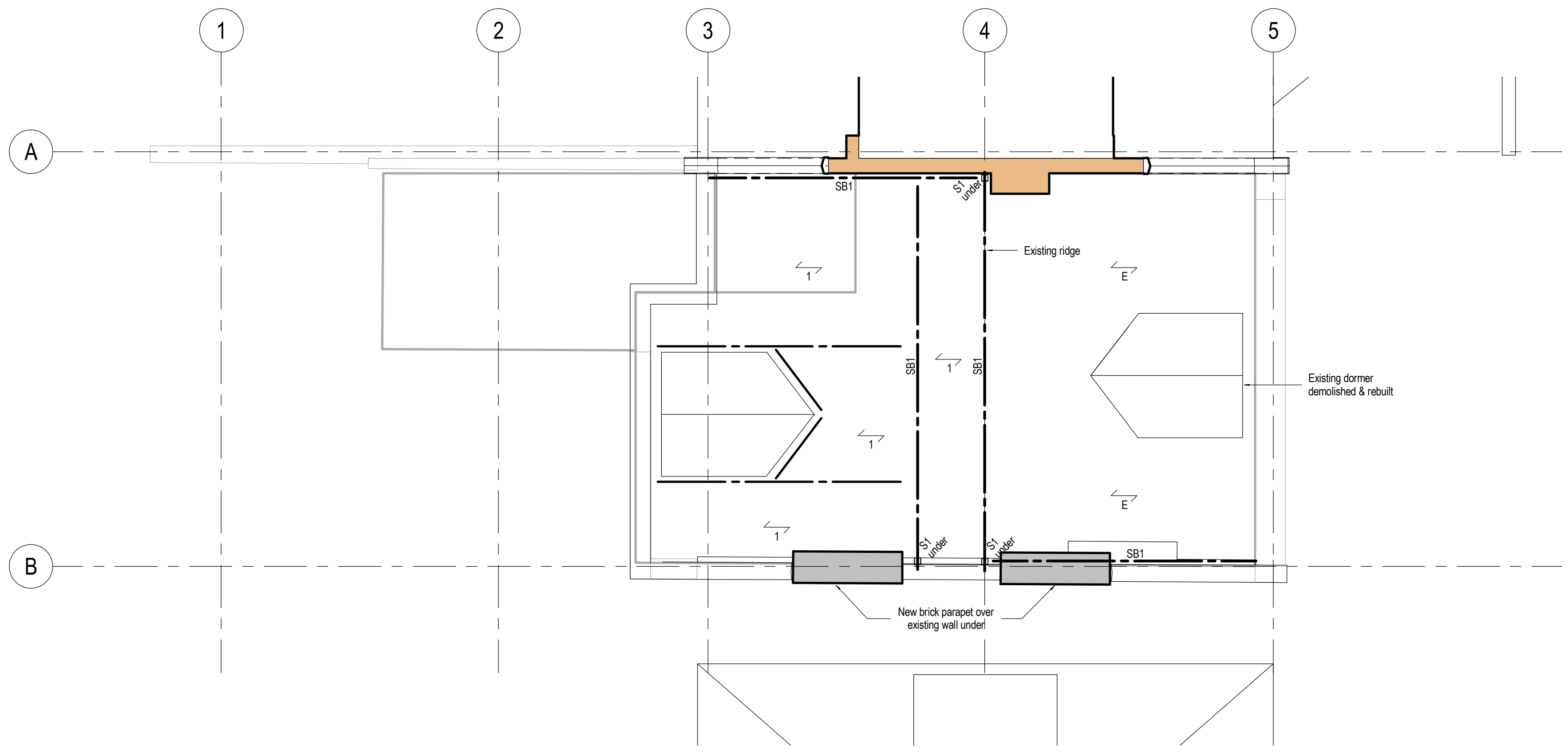
New joists

Existing joists



SECOND FLOOR PLAN

1 : 50



ROOF PLAN

1 : 50

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HEYNE|TILLETT|STEEL
STRUCTURAL ENGINEERS

Job Name:
38 PILGRIMS LANE
LONDON, NW3

Drawing Title:
PROPOSED SECOND FLOOR & ROOF PLANS

Scale: 1 : 50 @ A1

Purpose of Issue: PRELIMINARY

Drawing No. 0585 / 120

Rev. P1

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Appendix D - Geotechnical Report

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20 July 2011

Our ref: J11047/JF/2/2

Danny Coopoosamy
Heyne Tillett Steel
Unit 2, Compton Courtyard
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London
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Dear Danny

Re 38 PILGRIMS LANE, LONDON NW3

Further to the issue of our site investigation report (ref: J11047, dated 18 April 2011), we have recently returned to the site to carry out groundwater monitoring and update our recommendations as follows. This letter should be read in conjunction with the previous report.

Groundwater was not encountered during drilling of boreholes or excavation of the pits. However, monitoring of Borehole No 1 at the beginning of the second day of drilling, after a weekend with the borehole at a depth of 10.50 m, recorded groundwater at a depth of 4.9 m (45.15 m OD) below lower ground floor level. A standpipe was installed in Borehole No 1 to a depth of 6.0 m and monitoring carried out on 4 July indicated groundwater to be present at a depth of 1.3 m (48.75 m OD) below lower ground floor level. This level is close to the interface between the made ground and Lonodn Clay in Borehole No 1.

The site is underlain by London Clay which has a low horizontal permeability and an even lower vertical permeability, as such the rate of potential inflow is expected to be very slow.

It is difficult to determine whether the water level recently measured in the standpipe represents a true groundwater level, as any groundwater percolating through the made ground will travel along the surface of the clay and drain into the standpipe, particularly as the site is on a slope. In view of the low permeability of the clay, any such trapped water will be very slow to drain away. It is unlikely that groundwater in the London Clay is at the level measured in the borehole.

Potential groundwater flow within the London Clay is primarily along fissures or partings of fine sand / silt which are localised and unlikely to extend extensively across neighbouring sites. Experience of geotechnical investigations in London Clay and data from construction in such soil indicates that the recommendations and discussions in our report J11047, dated 18 April 2011 still apply to this site. It is recommended that allowance is made during the proposed basement excavation to mitigate the effects of any localised water within fissures or partings of sand within the London Clay.

We trust that this additional information is sufficient for your requirements. If you require any further advice please do not hesitate to contact us.

Yours sincerely
GEOTECHNICAL & ENVIRONMENTAL ASSOCIATES

J Fuller

Juliet Fuller

Document Control

Project title	38 Pilgrims Lane, London, NW3 1SN		Project ref	J11047
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Report checked and approved for issue by	Steve Branch BSc MSc CGeol FGS FRGS MIEnvSc			
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This report has been issued by the GEA office indicated below. Any enquiries regarding the report should be directed to the office indicated or to Steve Branch in our Herts office.

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CONTENTS

EXECUTIVE SUMMARY

This executive summary contains an overview of the key findings and conclusions. No reliance should be placed on any part of the executive summary until the whole of the report has been read. Other sections of the report may contain information that puts into context the findings that are summarised in the executive summary.

BRIEF

This report describes the findings of a site investigation carried out by Geotechnical and Environmental Associates Limited (GEA) on the instructions of Heyne Tillett Steel, on behalf of Ms Allyson Kaye, with respect to the redevelopment of the site through the demolition of the existing building, with the exception of the front façade, and the subsequent construction of a four-storey house across a similar footprint. The building will include a new basement level to a depth of about 3 m beneath the existing lower ground floor level. The purpose of the investigation has been to research the history of the site with respect to possible contaminative uses, to investigate the ground conditions, to assess the extent of any contamination and to provide information to assist with the design of suitable foundations and retaining walls.

DESK STUDY FINDINGS

The earliest map studied, dated 1873, shows the site to be undeveloped and to form part of open ground. Downshire Road and its associated semi-detached and terraced houses had been constructed by this time. At some time between 1879 and 1896 the site and surrounding area to the west was largely developed with the existing mix of terraced and semi-detached properties. Pilgrims Lane, at this time, was labelled Worsley Road and was renamed Pilgrims Lane at some time between 1970 and 1973. The site appears to have been developed with the existing semi-detached house from 1896 onwards. The adjacent site to the north was redeveloped with two semi-detached houses between 1915 and 1934. The site and immediate surrounding areas have remained in essentially the same layout through to the present day.

GROUND CONDITIONS

Beneath a nominal to moderate thickness of made ground, London Clay was encountered and extended to the full depth investigated of 15 m. Beneath a concrete ground slab of between 50mm and 350mm thickness, the made ground comprised brown silty sandy clay with fragments of ash and brick and extended to depths of between 0.3 m and 1.2 m. The underlying London Clay initially comprised a firm brown silty clay with abundant selenite crystals and partings of orange-brown silt and extended to depths of 5.2 m and 5.75 m in Borehole Nos 1 and 2 respectively, whereupon stiff becoming very stiff dark grey silty fissured clay was encountered and extended to 25.0 m.

A series of trial pits was excavated at lower ground floor level and encountered brick corbel footings bearing on firm brown silty clay at depths of between 0.30 m and 0.68 m below lower ground floor level. Groundwater was not encountered during drilling of the boreholes or excavation of the pits; however, groundwater was measured in Borehole No 1 after a weekend at a depth of 4.9 m (45.15 m OD) below lower ground floor level. Elevated concentrations of copper, lead, benzo(a)pyrene and PAH have been recorded in the made ground samples tested from the site.

RECOMMENDATIONS

In view of the anticipated columns loads there are a number of suitable foundation options. The London Clay at basement level should provide a suitable bearing stratum for spread foundations. Alternatively, with the reduction in load at basement formation level as a result of the removal of overburden, the use of a basement raft foundation bearing on the clay may be a suitable foundation solution. The viability of a raft will be governed by the net load from the new structure and the amount of ground movement that arises. A bored pile retaining wall may be a suitable means of temporary support for the basement excavation and it may therefore be appropriate to also consider the use of piles to support structural loads.

The contamination testing has recorded elevated concentrations of, copper, lead, PAH and benzo(a)pyrene which could pose a potential risk to human health through direct contact, accidental ingestion or inhalation of soil or soil-derived dust. Some remediation measures are likely to be required in the soft landscaped garden area and also to protect buried services.

Part 1: INVESTIGATION REPORT

This section of the report details the objectives of the investigation, the work that has been carried out to meet these objectives and the results of the investigation. Interpretation of the findings is presented in Part 2.

1.0 INTRODUCTION

Geotechnical and Environmental Associates (GEA) has been commissioned by Heyne Tillett Steel, on behalf of Ms Allyson Kaye, to carry out a desk study and ground investigation at 38 Pilgrims Lane, London, NW3 1SN.

1.1 Proposed Development

It is proposed to demolish the existing building, with the exception of the front façade, and redevelop the site with a four storey house across a similar footprint. The building will include a new basement level beneath the existing lower ground floor level, which will extend to about 3 m below existing lower ground floor level. The development will include the retention of the existing garden to the rear of the property.

This report is specific to the proposed development and the advice herein should be reviewed once the development proposals have been finalised.

1.2 Purpose of Work

The principal technical objectives of the work carried out were as follows.

- to check the history of the site with respect to previous contaminative uses;
- to determine the ground conditions and their engineering properties;
- to determine the depth and design of the footings of the existing structures;
- to provide advice with respect to the design of suitable foundations and retaining walls;
- to provide an indication of the degree of soil contamination present; and
- to assess the risk that any such contamination may pose to the proposed development, its users or the wider environment.

1.3 Scope of Work

In order to meet the above objectives, a desk study was carried out, followed by a ground investigation. The desk study comprised:

- a review of readily available geological maps;
- a review of historical Ordnance Survey (OS) maps and environmental searches sourced from the Landmark database; and
- a walkover survey of the site.

In the light of this desk study an intrusive ground investigation was carried out which comprised, in summary, the following activities:

- a single cable percussion borehole, advanced to a depth of 15.00 m (35.05 m OD);
- a single window sample borehole advanced to a depth of 6.6 m (43.51 m OD);
- four trial pits excavated by hand to expose the existing footings;
- standard penetration tests (SPTs), carried out at regular intervals in the cable percussion borehole, to provide quantitative data on the strength of the soils;
- laboratory testing of selected soil samples for geotechnical purposes and for the presence of contamination; and
- provision of a report presenting and interpreting the above data, together with our advice and recommendations with respect to the proposed development.

The report includes a contaminated land assessment which has been undertaken in accordance with the methodology presented in Contaminated Land Report (CLR) 11[1] and involves identifying, making decisions on, and taking appropriate action to deal with land contamination in a way that is consistent with government policies and legislation within the United Kingdom. The risk assessment is thus divided into three stages comprising Preliminary Risk Assessment, Generic Quantitative Risk Assessment, and Site-Specific Risk Assessment.

1.4 Limitations

The conclusions and recommendations made in this report are limited to those that can be made on the basis of the investigation. The results of the work should be viewed in the context of the range of data sources consulted, the number of locations where the ground was sampled and the number of soil, gas or groundwater samples tested; no liability can be accepted for information in other data sources or conditions not revealed by the sampling or testing. Any comments made on the basis of information obtained from the client or other third parties are given in good faith on the assumption that the information is accurate; no independent validation of such information has been made by GEA.

2.0 THE SITE

2.1 Site Description

The site is located approximately 500 m to the east of Hampstead London Underground Station and fronts onto Pilgrims Lane to the west. It is bounded to the south by an attached four storey house, to the north by a two storey semi-detached house and to the east by a garden associated with houses to the east. The site may be additionally located by National Grid Reference 526907, 185749 and is shown in the location map below

1 *Model Procedures for the Management of Land Contamination* issued jointly by the Environment Agency and the Department for Environment, Food and Rural Affairs (DEFRA) Sept 2004

The western and central parts of the site are occupied by a three-storey semi-detached house that comprises a lower ground floor, upper ground floor and first floor, with an extension to the rear. A garage is located at lower ground floor level and the eastern part of the site is occupied by the rear garden. The garage has clearly been constructed after the main house, with a concrete lintel installed below the front bay window. A small concrete driveway is located in the north-western corner of the site, which leads down from street level at a level of about 50.7 m OD to lower ground floor level, which is at about 50 m OD.

The rear garden is level with the lower ground floor level and comprises a concrete paved patio extending approximately 2 m beyond the edge of the existing rear extension with a lawn area and plant beds occupying the central and far parts of the garden. An open coal store is located within the patio area along the northern boundary, although it was found to be contained well within a concrete bund, although no roof was present over the store.

Vegetation at the site is limited to two hedgerows along the northern and southern boundary walls in the rear garden. An approximately 10 m high deciduous tree is located close to the south-western corner of the site.

Evidence of significant structural distress is apparent, with numerous cracks in the brickwork and cracking in the external flank wall; the movement is most likely as a result of poor construction of the garage.

2.2 Site History

The site history has been researched by historical Ordnance Survey Maps (OS) provided by the Landmark database.

The earliest map studied, dated 1873, shows the site to be undeveloped and forming part of open ground. Downshire Road and its associated semi-detached and terraced houses had been constructed by this time. At some time between 1879 and 1896 the site and surrounding area to the west was largely developed with the existing mix of terraced and semi-detached properties. Pilgrims Lane, at this time, was labelled Worsley Road and was renamed Pilgrims Lane at some time between 1970 and 1973. The site appears to have been developed with the existing semi-detached house from 1896 onwards. The adjacent site to the north was redeveloped with two semi-detached houses some time between 1915 and 1934. The site and immediate surrounding areas have remained in relatively the same layout through to the present day.

2.3 Other Information

A search of public registers and databases has been made via the Envirocheck database and extracts from the results of the search are appended. More detailed information on the search can be provided if required.

The search has indicated that there are no landfills, waste transfer, treatment, management or disposal sites within 1 km of the site.

The search has indicated that the site is located in an area where less than 1% of homes are affected by radon emissions; which is the lowest classification given by the Health Protection Agency (HPA) and therefore no radon protective measures will be necessary.

The site is not shown to be within any source protection zones and is not at direct risk of flooding.

2.4 Geology and Hydrogeology

The Geological Survey map of the area indicates that the site is underlain by the London Clay, with the overlying Claygate Beds close to the west of the site.

The former National Rivers Authority (NRA) Ground Water Vulnerability map suggests that the site is underlain by a non-aquifer with soils of negligible permeability. The London Clay is classified as unproductive strata by the Environment Agency. The Claygate Beds to the west are classified as a secondary 'A' aquifer by the Environment Agency.

A figure provided in the BGS memoir showing groundwater contours in 1965 indicates groundwater beneath the site to be at a level of -60 m OD (i.e. approximately 110 m below ground level). This reflects the level of groundwater within the chalk aquifer at depth; the London Clay effectively acts as a barrier to flow between the lower (chalk) aquifer and superficial groundwater. However a more recent contour map of groundwater levels provided by the Environment Agency[2] indicates that by 2009, groundwater in the London area had risen by approximately 30 m and is more likely to be at around -30 m OD, currently 80 m below ground level. Groundwater is unlikely to be present within the London Clay, except within localised fissures and silt bands.

Due to the cohesive nature of the soils, the groundwater flow rate is likely to be negligible. Published data for the permeability of the London Clay indicates the horizontal permeability to generally range between 1×10^{-10} m/s and 1×10^{-8} m/s, with an even lower vertical permeability.

2.5 Preliminary Risk Assessment

Part IIA of the Environmental Protection Act 1990, which was inserted into that Act by Section 57 of the Environment Act 1995, provides the main regulatory regime for the identification and remediation of contaminated land. The determination of contaminated sites is based on a "suitable for use" approach which involves managing the risks posed by contaminated land by making risk-based decisions. This risk assessment is carried out on the basis of a source-pathway-receptor approach.

2 Environment Agency Status Report (2009) *Management of the London Basin Chalk Aquifer*

2.5.1 Source

The historical usage of the site that has been established by the desk study and the site walkover indicates that the site does not have a potentially contaminative history by virtue of it having been developed with the existing house for its entire developed history. However, as with any previously developed site localised areas of dumping or spillages could be present which could provide an isolated contaminant source. A coal store was noted in the rear garden which represents a potential source of contamination, although this was noted to be well contained within a concrete bund.

2.5.2 Receptor

The proposed use of the site as a single residential dwelling with areas of soft landscaping would potentially result in exposure to the soil for residents and thus represents a relatively high sensitivity end-use. Buried services are likely to come into contact with any contaminants present within the soils through which they pass and site workers are likely to come into contact with any contaminants present in the soils during construction works. With the site being underlain by a non-aquifer groundwater is unlikely to be considered as a sensitive target.

2.5.3 Pathway

The development will include the retention of an area of soft landscaping in the in the rear garden so there is a potential for end users to come into direct contact with contaminated soil in this area. There will be a limited potential for contaminants to move onto or off the site, except horizontally within any made ground or topsoil layer, or upon the interface with the underlying London Clay, possibly in association with perched water movements. However, the area to remain soft landscaped has been soft landscaped for the sites entire developed history and as such any leachable contaminants are likely to have already been mobilised. There is thus considered to be limited potential for a significant contaminant pathway to be present between any potential contaminant source and a target for the particular contaminant.

2.5.4 Preliminary Risk Appraisal

On the basis of the above it is considered that there is a low risk of there being a significant contaminant linkage at this site which would result in a requirement for major remediation work. Furthermore, as there is no evidence of filled ground within the vicinity and as it is anticipated to be underlain by cohesive soils at shallow depth there is not considered to be a significant potential for hazardous soil gas to be present on or migrating towards the site: there should thus be no need to consider soil gas exclusion systems.

3.0 EXPLORATORY WORK

In order to meet the objectives described in Section 1.2, a single cable percussion borehole was advanced to a depth of 15.0 m (35.05 m OD) below lower ground floor level by means of a dismantlable cable percussion drilling rig. The drilling rig was set up within the garage and an opening made in the ceiling above to provide sufficient working headroom. Standard Penetration Tests (SPTs) were carried out at regular intervals in the borehole and disturbed and undisturbed samples were recovered for subsequent laboratory examination and testing.

A groundwater monitoring standpipe was installed within Borehole No 1 to a depth of 6.00 m (44.05 m OD). Attempts to monitor the standpipe have been made on two occasions, on 11 April 2011 and on 12 April 2011, but on neither occasion was it possible to gain entry to the site. A visit will be rescheduled and reported as an addendum once access has been confirmed.

In addition, a single window sample borehole was advanced to a depth of 6.6 m (43.51 m OD) within the rear garden and a series of four trial pits was manually excavated to expose the foundations of the existing building and boundary wall on the site.

All of the work was carried out under the full-time and part-time supervision of a geotechnical engineer from GEA.

The borehole and trial pit records and results of the laboratory analyses are appended, together with a site plan indicating the exploratory positions. The Ordnance Datum (OD) levels shown on the borehole and trial pit records have been interpolated from spot heights shown on a site plan drawing (reference 585-SK06-P2, dated February 2011) which was provided by the consulting engineers.

3.1 Sampling Strategy

The locations of the boreholes and trial pits were specified by the consulting engineers and were confirmed on site by GEA to be away from underground services.

Four samples recovered from the made ground were subjected to analysis for a range of common industrial contaminants and contamination indicative parameters. For this investigation the analytical suite for the soil included a range of metals, speciation of total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), total cyanide and monohydric phenols.

The soil samples were selected to provide a general view of the chemical conditions of the soils that are likely to be involved in a human exposure or groundwater pathway and to provide advice in respect of re-use or for waste disposal classification. The samples are considered to represent the general fill material that may be encountered across the site. The contamination analyses were carried out at an MCERTs accredited laboratory with the majority of the testing suite accredited to MCERTS standards. Details of the MCERTs accreditation and test methods are included in the Appendix together with the analytical results.

4.0 GROUND CONDITIONS

The investigation has confirmed the expected ground conditions in that, beneath a nominal to moderate thickness of made ground, London Clay was encountered and extended to the full depth investigated of 15 m (35.05 m OD).

4.1 Made Ground

Beneath a concrete ground slab of between 50mm and 350mm thickness, the made ground comprised brown silty sandy clay with fragments of ash and brick and extended to depths of between 0.3 m (49.57 m OD) and 1.2 m (48.85 m OD).

No evidence of significant contamination was observed within these soils. Samples of the made ground were analysed for a range of contaminants and the results are summarised in section 4.4.

4.2 London Clay

The underlying London Clay initially comprised a weathered horizon of firm brown silty clay with abundant selenite crystals and partings of orange brown silt which extended to depths of 5.2 m (44.85 m OD) and 5.75 m (44.36 m OD) in Borehole Nos 1 and 2 respectively.

The upper weathered zone was underlain by typical unweathered London Clay, which comprised stiff becoming very stiff brownish grey and grey silty fissured clay with traces of pyrites and pockets of brown and grey silt which was proved to the full depth investigated of 15.00 m (35.05 m OD).

Laboratory plasticity index testing of samples of the shallow reworked clay and the underlying ''undisturbed'' London Clay indicated these soils to be of high shrinkability.

4.3 Groundwater

Groundwater was not encountered during drilling of boreholes or excavation of the pits; however, monitoring of Borehole No 1 at the beginning of the second day of drilling, after a weekend with the borehole at a depth of 10.50 m, recorded groundwater at a depth of 4.9 m (45.15 m OD) below lower ground floor level.

It was not possible to monitor the groundwater level within the standpipe on two subsequent visits due to access constraints. A visit will be rescheduled once access is available and the results reported as an addendum.

4.4 Soil Contamination

The table below sets out the values measured within four samples analysed; all concentrations are in mg/kg unless otherwise stated.

Determinant	BH2 @ 0.4 m	TP1 @ 0.6 m	TP2 @ 0.25 m	TP4 @ 0.3 m
pH	6.6	10.5	9.9	11.6
Arsenic	19	27	25	21
Cadmium	0.28	0.40	0.30	0.22
Chromium	18	22	20	21
Copper	76	**3300**	39	19
Mercury	1.9	0.61	1.1	0.28
Nickel	20	24	20	23
Lead	**680**	**600**	**710**	260
Selenium	<0.2	<0.2	<0.2	<0.2
Zinc	200	1100	190	81
Total Cyanide	0.5	<0.5	<0.5	<0.5
Total Phenols	<0.3	<0.3	<0.3	<0.3
Total Sulphate	1300	6000	7000	12000
Sulphide	1.3	1.5	1.6	0.68

Extractable Chloride (g/l)	0.042	0.067	0.022	0.041
TPH C5–C35	21	<10	18	13
Benzo(a)Pyrene	**1.3**	0.41	**2.2**	**1.6**
Total PAH	**15**	4.5	**23**	**15**
Total Organic Carbon %	2.7	0.89	1.1	0.66

Note: Figure in bold indicates concentration in excess of risk-based soil guideline values, as discussed below

The results of statistical analysis indicate that the elevated concentration of copper of 3300 mg/kg in the sample tested from Trial Pit No 1 at 0.6 m is a statistical outlier and not representative of the made ground tested as a whole.

4.4.1 Generic Quantitative Risk Assessment

The use of a risk-based approach has been adopted to provide an initial screening of the test results to assess the need for subsequent site-specific risk assessments. To this end the table below indicates those contaminants of concern that have values in excess of a generic human health risk based guideline values which are either that of the CLEA[3] Soil Guideline Value where available, or is a Generic Guideline Value calculated using the CLEA UK Version 1.06 software assuming a residential end use. The key generic assumptions for this end use are as follows:

- that groundwater will not be a critical risk receptor;
- that the critical receptor for human health will be a young female child (zero to six years old);
- that the exposure duration will be 6 years;
- that the critical exposure pathways will be direct soil and indoor dust ingestion, skin contact with soils and dust, and inhalation of dust and vapours; and
- that the building type equates to a two storey small terraced house.

It is considered that these assumptions are acceptable for this generic assessment of this site. The tables of generic screening values derived by GEA and an explanation of how each value has been derived are included in the Appendix.

Where contaminant concentrations are measured at concentrations below the generic screening value it is considered that they pose an acceptable level of risk and thus further consideration of these contaminant concentrations is not required. However where concentrations are measured in excess of these generic screening values there is considered to be a potential that they could pose an unacceptable risk and thus further action will be required which could include;

- additional testing to zone the extent of the contaminated material and thus reduce the uncertainty with regard to its potential risk;

3 *Updated Technical Background to the CLEA Model (Science Report SC050021/SR3) Jan 2009* and Soil Guideline Value reports for specific contaminants; all DEFRA and Environment Agency.

- site specific risk assessment to refine the assessment criteria and allow an assessment to be made as to whether the concentration present would pose an unacceptable risk at this site; or
- soil remediation or risk management to mitigate the risk posed by the contaminant to a degree that it poses an acceptable risk.

The concentration ranges of the contaminants of concern highlighted by a comparison of the measured concentrations against the generic screening values are tabulated below. This assessment is based upon the potential for risk to human health, which as this site is underlain by a non-aquifer is considered to be the critical risk receptor.

Contaminant of Concern	Maximum concentration recorded (mg/kg)	Location(s) where elevated concentration recorded	Generic Risk-Based Screening Value
Lead	770	BH2, TP1, TP2	450
Copper	3300	TP1	2330
Benzo(a)Pyrene	2.2	BH2, TP2, TP4	0.94
PAH	23	BH2, TP2, TP4	6.3

**Threshold values marked thus are for compounds with a limited human toxicity hence the threshold values adopted are not derived on a risk based methodology. Justification for all of the values quoted is provided in the appended table of Generic Risk Based Threshold Soil Guideline Values*

The significance of these results is considered further in Part 2 of the report.

4.5 Existing Structures

The trial pits have revealed that the existing structure is founded at relatively shallow depth within the naturally reworked London Clay.

Trial Pit Nos 1, 2 and 4 were excavated on internal flank walls of the existing main part of the house. They encountered brick corbel footings bearing on firm brown silty clay at depths of between 0.35 m and 0.68 m below lower ground floor level.

Trial Pit No 3 was excavated on the northern boundary wall in the rear garden and encountered the brick wall to be on a concrete strip footing bearing on firm brown silty clay at a depth of 0.3 m below lower ground floor level.

Part 2: DESIGN BASIS REPORT

This section of the report provides an interpretation of the findings detailed in Part 1, in the form of a ground model, and then provides advice and recommendations with respect to foundation options and contamination issues.

5.0 INTRODUCTION

It is proposed to demolish the existing building, with the exception of the front façade, and redevelop the site with a four storey house across a similar footprint. The building will include a new basement level beneath the existing lower ground floor level, which will extend to about 3 m below existing lower ground floor level or to approximately 47 m OD. The development will include the retention of the existing soft landscaped garden to the rear of the property.

Loads for the new development have not been provided but are anticipated to be moderate and thus typical of this type of development.

6.0 GROUND MODEL

The desk study has indicated that the site has only ever been developed with the existing residential property. On the basis of the fieldwork, the ground conditions at this site can be characterised as follows.

- Beneath a nominal to moderate thickness of made ground, London Clay is present and extended to the full depth investigated of 15 m (35.05 m OD);
- the concrete ground slab ranges between 50mm and 350mm thickness
- the underlying made ground extended to depths of between 0.3 m (49.57 m OD) and 1.2 m (48.85 m OD) and contained variable amounts of ash and brick fragments;
- the London Clay initially comprises naturally reworked firm brown silty clay with abundant selenite crystals which extended to depths of 5.2 m (44.85 m OD) and 5.75 m (44.36 m OD) in Borehole Nos 1 and 2 respectively;
- the upper zone is underlain by typical unweathered London Clay, which comprises stiff becoming very stiff brownish grey and grey silty fissured clay with traces of pyrites and pockets of brown and grey silt extending to the full depth investigated of 15.00 m (35.05 m OD);
- groundwater was not encountered during drilling of boreholes or excavation of the pits; however, monitoring of Borehole No 1 at the beginning of the second day of drilling recorded an overnight level of 4.9 m (45.15 m OD) below lower ground floor level;
- it has not been possible to monitor the standpipe installed in Borehole No 1; and
- the contamination analyses have indicated that there are elevated concentrations of lead, copper, benzo(a)pyrene and PAH within samples of the made ground tested which could pose a risk to human health.

7.0 ADVICE AND RECOMMENDATIONS

The basement is anticipated to extend to a depth of about 3.0 m below existing ground level, to an OD level of approximately 47 m OD. In view of the anticipated column loads there are a number of suitable foundation options: the London Clay at basement level should provide a suitable bearing stratum for spread foundations; with the reduction in load at basement formation level as a result of the removal of overburden, the use of a basement raft foundation bearing on the clay may be a suitable foundation solution; or, as a bored pile retaining wall may be a suitable means of temporary support for the basement excavation it may therefore be appropriate to also consider the use of piles to support structural loads.

7.1 Basement Construction

7.1.1 Basement Excavation

Groundwater was not encountered during the drilling of the boreholes or excavation of the trial pits, but an overnight level of 4.9 m (45.15 m OD) was recorded in the cable percussion borehole. Based on this measurement it is unlikely that groundwater will be encountered within the basement excavation, although monitoring of the standpipe should be carried out once access is available to confirm the groundwater level. However, it is not possible to draw wholly meaningful conclusions from the measurements made in the standpipe, as the level of the water table is not as significant as the volume of water that may flow into the excavation. For example, a high level of water measured in a standpipe may not be significant if this represents only a small volume of water. It would therefore be prudent to carry out a number of trial excavations, to depths as close to the full basement depth as possible, to provide an indication of the likely ground water conditions.

There are a number of methods by which the sides of the basement excavation could be supported in the temporary and permanent conditions. The choice of wall may be governed to a large extent by whether it is to be incorporated into the permanent works and have a load bearing function.

Consideration will need to be given to a retention system that maintains the stability at all times of the neighbouring properties to the north and south, and of Pilgrims Lane to the west. Due to the extent of the proposed basement there is insufficient space on the northern, western and southern sides of the site to excavate the basement in an open cut but sheet piling would probably be a cost effective alternative. Consideration will need to be given to the noise and vibrations associated with some techniques, given the close proximity of the adjacent buildings to the north and south. Consideration could be given to using pressing techniques, although pressing techniques that use water jetting should be treated with caution in view of the risk of causing heave or settlement of the surrounding structures. If groundwater is not considered to be a significant problem a kingpost type wall could alternatively be considered.

For the eastern extent of the basement it may be possible to construct insitu retaining walls within an open cut excavation with the sides battered to a safe angle. Slopes within the made ground should be excavated at 1 in 2, and slopes within the London Clay could theoretically be cut at 1 in ½, although this would not eliminate the risk of minor slips, which is unlikely to be acceptable in view of the proximity of existing structures. It would therefore be prudent to cut the London Clay at an angle 1 in 2, although in any case any cut slopes should be subject to daily inspections and it is assumed that surface loads, for example from heavy plant, will not be applied to the top of the cut slopes.

Alternatively it may be preferable to adopt a contiguous bored pile wall and deal with any inflows through the wall by means of sump pumping, as this would have the benefit of providing support for structural loads.

The ground movements associated with the basement excavation will depend on the method of excavation and support, and the overall stiffness of the basement structure in the temporary condition. Thus, a suitable amount of propping will be required to provide the necessary rigidity. In this respect the timing of the provision of support to the wall will have an important effect on movements. The stability of the foundations of the neighbouring buildings to the north and south and the road to the east will need to be ensured at all times and the retaining walls will need to be designed to accommodate the loads from these foundations unless they are underpinned.

7.1.2 Basement Retaining Walls

The following parameters are suggested for the design of the permanent basement retaining walls.

Stratum	Bulk Density (kg/m^3)	Effective Cohesion (c' – kN/m^2)	Effective Friction Angle (Φ' – degrees)
Made ground	1800	Zero	25
London Clay	2000	Zero	25

An overnight level of 4.9 m (45.15 m OD) was recorded within Borehole No 1, although it has not been possible to monitor the standpipe to confirm the groundwater level. Once access is available, monitoring should be carried to establish an appropriate design water level.

7.1.3 Basement Heave

It has been estimated that the excavation of a 3.0 m depth of soil will lead to an unloading of approximately 60 kN/m^2 over the new basement area. This will result in short term elastic heave and long term swelling of the London Clay, although long term movements will be mitigated to some extent by the loads applied by the new development. A heave analysis should be carried out once final loads and levels are known.

7.2 Basement Raft Foundation

Consideration could be given to the use of a basement raft foundation for the entire building. The weight of the soil removed is unlikely to be balanced by the applied loads from the proposed three-storey house and there may be a net unloading, resulting in potential heave. Therefore, the use of a raft foundation will be governed by the applied load from the new development, the amount of ground movement and the extent to which the movement can be tolerated or resisted by the structure. A detailed ground movement analysis should therefore be carried out once final dimensions and loadings are known, if this option is preferred.

7.3 Spread Foundations

It should be possible to use spread foundations bearing within the stiff London Clay below basement level. Moderate width pad or strip foundations bearing on the stiff clay at this depth may be designed to apply a net allowable bearing pressure of 140 kN/m^2. This value incorporates an adequate factor of safety against bearing capacity failure and should ensure that settlement remains within normal tolerable limits.

Once the final levels are known the depth of founding should be checked to ensure that it provides sufficient protection against tree root growth.

7.4 Piled Foundations

For the ground conditions at this site consideration could be given to the use of a driven or bored pile, although the noise and vibrations associated with the use of driven piles may render them unsuitable due to the close proximity of the neighbouring buildings and roads on the northern, western and southern sides of the site. Conventional rotary augered piles may be considered as only nominal amounts of casing will be required through the made ground; alternatively, piles installed by continuous flight auger (cfa) techniques may be considered.

The following table of ultimate coefficients may be used for the preliminary design of cfa piles, based on the SPT / cohesion depth graph in the appendix. All depths are shown relative to existing lower ground floor level.

Ultimate Skin Friction		*kN/m^2*
Basement Excavation	GL to 3.0 m	Ignore
London Clay (α = 0.5)	3.0 m to 15.0 m	Increasing linearly from 30 to 100

Ultimate End Bearing		*kN/m^2*
London Clay	12.0 m to 15.0 m	Increasing linearly from 1485 to 1800

In the absence of pile tests, guidance from the London District Surveyors Association[4] (LDSA) suggests that a factor of safety of 2.6 should be applied to the above coefficients in the computation of safe theoretical working loads and that the average ultimate skin friction within the clay should be limited to 110 kN/m^2.

On the basis of the above coefficients and a factor of safety of 2.6 it has been estimated that a 300 mm diameter pile founding at a depth of 12 m below existing lower ground floor level should provide a safe working load of about 225 kN and a 300 mm diameter pile founding at a depth of 15 m should provide a safe working load of about 325 kN. Alternatively, 450 mm diameter piles founding at similar depths should provide safe working loads of about 370 kN and 530 kN respectively.

These examples are not intended to constitute any form of recommendation with regard to pile size or type, but merely serve to illustrate the use of the above coefficients. Specialist piling contractors should be consulted with regard to the design of an appropriate piling scheme.

4 LDSA (2009) *Foundations No 1 – Guidance notes for the design of straight shafted bored piles in London Clay*. LDSA Publications

7.5 Excavations

On the basis of the borehole and trial pit findings it is considered likely that it will be feasible to form relatively shallow excavations within the made ground and London Clay without the requirement for lateral support, however small scale instabilities may occur within the made ground. Where personnel are required to enter excavations, a risk assessment should be carried out and temporary lateral support or battering of the excavation sides considered in order to comply with normal safety requirements.

Inflows of groundwater are unlikely to be encountered in shallow excavations except within the vicinity of existing foundations and other buried structures, although any such inflows should be suitably dealt with by sump pumping.

7.6 Basement Floor Slab

Following the excavation of the basement it should be possible to adopt a ground bearing floor slab on the London Clay. The formation level should be proof rolled in any case and any soft spots should be replaced with compacted granular fill. Further consideration may need to be given to the need to design the slab to take account of heave due to unloading and to the possible requirement to design with respect to a ground water table at a theoretical depth of 1 m below ground level.

7.7 Hydrogeological Assessment

The current development proposal includes the construction of a single storey basement beneath the entire footprint of the new house, which will extend into the rear garden and to a depth of approximately 3.0 m below present lower ground floor level.

The desk study research has indicated that significant movement of groundwater is unlikely to be occurring within the soils of the London Clay beneath the site, except for relatively minor movements associated with fissures within the clay. This has been confirmed by the investigation, in which groundwater was not encountered during drilling of any boreholes or excavation of trial pits. An overnight level of 4.9 m (45.15 m OD) was however recorded in Borehole No 1 and further monitoring should be carried out to check the water level.

The basement construction and underlying foundations are unlikely to encounter groundwater and in any case the basement will not provide a barrier to any shallow water moving through the London Clay. The construction of the basement should therefore have no effect on the local groundwater regime.

7.8 Effect of Sulphates

Chemical analyses of selected soil samples have indicated moderate to very high concentrations of soluble sulphate, corresponding to Class DS-3, ACEC class AC2s and Class DS-5, ACEC class 4s of Table C2 of BRE Special Digest 1: Part C (2005). The guidelines contained in the above digest should be followed in the design of any new foundation concrete.

The guidelines contained in the above digest should be followed in the design of foundation concrete.

38 Pilgrims Lane, London, NW3 1SN
Ms Allyson Kaye
Desk Study and Ground Investigation Report

7.9 Site Specific Risk Assessment

The chemical analyses have highlighted the presence of lead, copper, PAH and benzo(a)pyrene concentrations within samples of the made ground from the site, including within a sample tested from within the soft landscaped rear garden area which is to remain upon completion of the works. These concentrations could thus pose a potentially unacceptable risk to human health through direct contact, accidental ingestion or inhalation of soil or soil derived dust. The majority of the made ground will be removed as part of the basement excavation, however, the made ground is likely to remain the rear garden area.

The development will include a soft landscaped private garden to the rear of the house and as such it is considered that the critical pathways for exposure to these contaminants will be realised following the completion of the development and thus remedial action will be required in this respect.

These contaminants could also pose a potential risk to ground workers in the short term and could potentially affect the integrity of buried plastic services were they to pass through areas rich in ash that have not been removed as part of the site strip.

7.9.1 Protection of End Users and Landscaped Areas

End users will only come into contact with any remaining made ground in soft landscaped areas. At this stage it is considered that in any areas of soft landscaping some precautions will be required in order to protect end users.

It is recommended that a cover thickness of imported subsoil and topsoil of 300 mm should be specified in grassed areas, increasing to 600 mm where trees or shrubs are to be planted and private gardens, to ensure successful plant growth and protect end users, in accordance with recommendations from BRE[5]. It may be possible to reduce the final thickness of cover required, but this will need to be determined once final levels have been established and the concentrations of potential contaminants within the imported material are known.

7.9.2 Site Workers

Potentially harmful concentrations of contaminants have been measured in the made ground soils. Site workers should be made aware of the contamination and a programme of working should be identified to protect workers handling any soil. The method of site working should be in accordance with guidelines set out by HSE[6] and CIRIA[7] and the requirements of the Local Authority Environmental Health Officer.

7.9.3 Services

Consideration may need to be given to the protection of buried plastic services laid within the made ground. However, following the site strip there is likely to be only a limited thickness of made ground remaining and it may be prudent to carry out further testing of the soils within the service trenches once the location and formation level has been confirmed in order to eliminate the need for protective measures for buried plastic services.

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5 BRE (2004) *Cover systems for land regeneration. Thickness of cover systems for contaminated land.* BRE pub 465
6 HSE (1992) HS(G)66 *Protection of workers and the general public during the development of contaminated land* HMSO
7 CIRIA (1996) *A guide for safe working on contaminated sites* Report 132, Construction Industry Research and Information Association

7.10 Waste Disposal

Any spoil arising from excavations or landscaping works will need to be disposed of to a licensed tip. Under the European Waste Directive landfills are classified as accepting inert, non-hazardous or hazardous wastes in accordance with the EU waste Directive.

Based upon the results of the analyses carried out and the technical guidance provided by the Environment Agency[8] it is considered likely that the made ground will be classified as a Non-Hazardous waste and the natural soils may be classified as an Inert waste. However, this classification should be confirmed by the receiving landfill once the soils to be discarded have been identified. In order to finalise this classification it will probably be necessary to carry out further analyses including WAC CEN method bulk leaching tests if a classification of Inert waste is to be considered for the made ground. Such tests should be carried out upon representative samples from the waste stream once the extent of the materials to be discarded has been established.

Under the European Waste Directive all waste going to landfill requires pre-treatment. The pre-treatment process must be physical, thermal, chemical or biological, including sorting. It must change the characteristics of the waste in order to reduce its volume, hazardous nature, facilitate handling or enhance recovery. The only exceptions to this requirement are for inert waste where it is technically not feasible to do so, or for any other waste where the quantity or hazardous nature of the waste cannot be reduced. The waste producer can carry out the treatment but they will need to provide documentation to prove that this has been carried out. Alternatively, the treatment can be carried out by an approved contractor. The Environment Agency has issued a position paper[9] which states that in certain circumstances, segregation at source may be considered as pre-treatment and thus excavated material may not have to be treated prior to landfilling if the soils can be "segregated" onsite prior to excavation by sufficiently characterising the soils insitu prior to excavation.

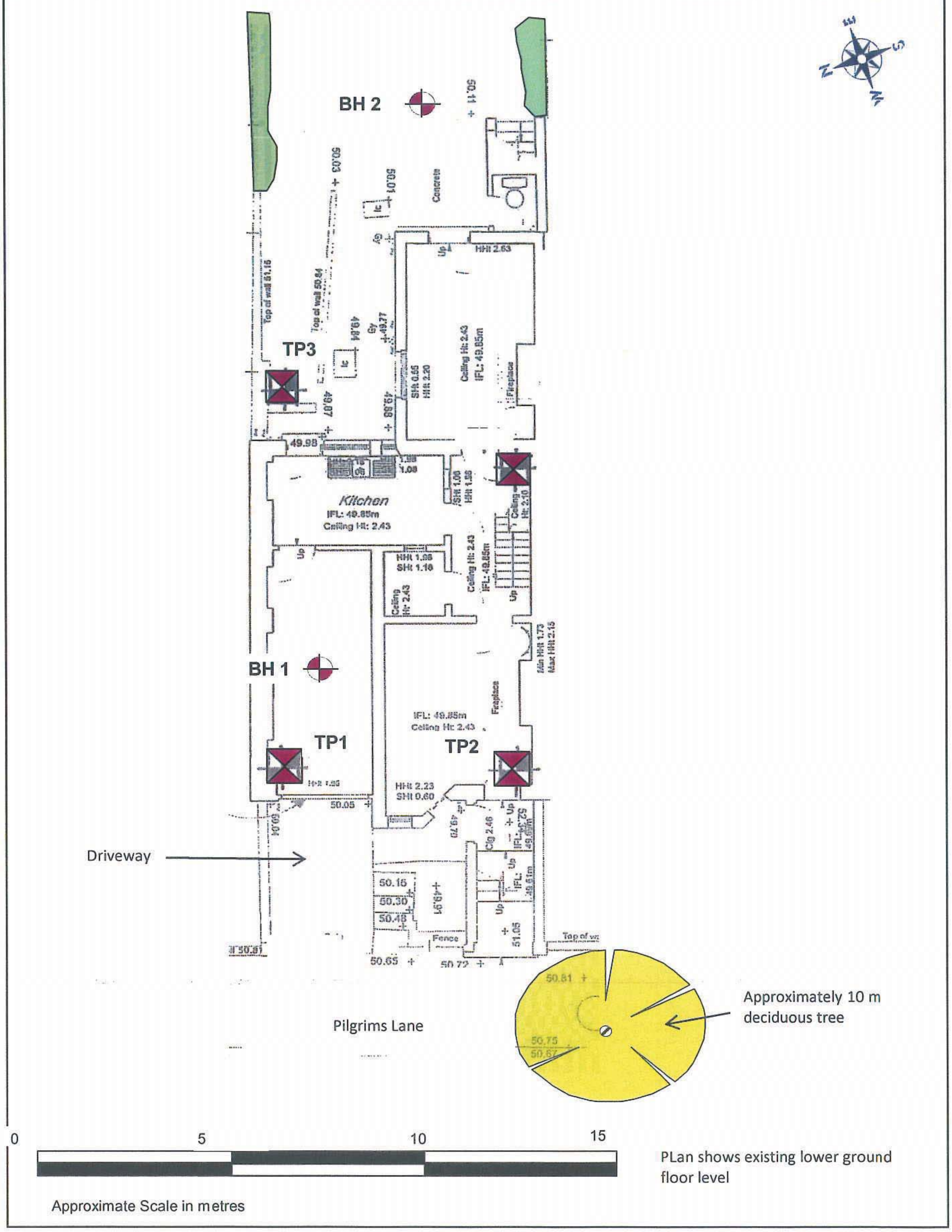
The local waste regulation department of the Environment Agency (EA) should be contacted to obtain details of tips that are licensed to accept the soil represented by the test results. The tips will be able to provide costs for disposing of this material and may require testing to be carried out.

[8] Environment Agency 2008. *Hazardous Waste: Interpretation of the definition and classification of hazardous waste.* Technical Guidance WM2 Version 2.2

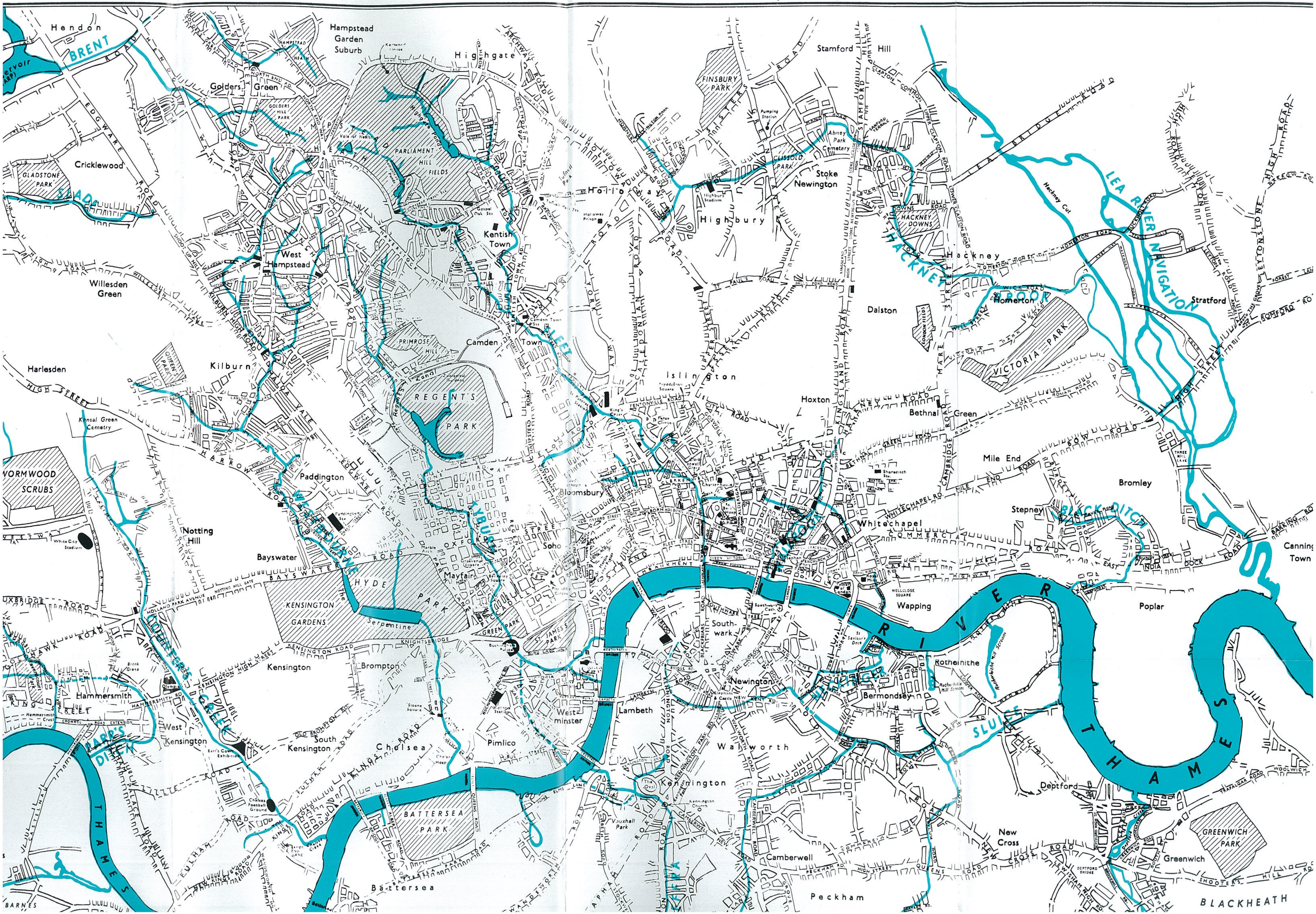
[9] Regulatory Position Statement *'Treating non-hazardous waste for landfill - Enforcing the new requirement'* Environment Agency 23 Oct 2007

APPENDIX

GEA Geotechnical & Environmental Associates	Tyttenhanger House, Coursers Road, St Albans, AL4 0PG	**Site Plan**
Site 38 Pilgrims Lane, London, NW3 1SN		**Job Number** J11047
Client Ms Allyson Kaye		**Sheet** 1 / 1
Engineer Heyne Tillett Steel		



Appendix E : Historical Map of London Underground Rivers


Hendon
BRENT
Hampstead Garden Suburb
Highgate
Golders Green
Golders Hill Park
Cricklewood
Gladstone Park
Parliament Hill Fields
Finsbury Park
Stamford Hill
Abney Park Cemetery
Clissold Park
Stoke Newington
Holloway
Highbury
Kentish Town
West Hampstead
Willesden Green
Hackney Downs
Hackney
Hackney Brook
Homerton
Hackney Cut
Lea River Navigation
Stratford
Dalston
Victoria Park
Camden Town
Primrose Hill
Regent's Park
Fleet
Kilburn
Harlesden
Kensal Green Cemetery
Islington
Hoxton
Bethnal Green
Mile End
Bromley
Paddington
Wormwood Scrubs
Westbourne
Tyburn
Bloomsbury
Stepney
Black Ditch
Whitechapel
Notting Hill
Bayswater
Hyde Park
Kensington Gardens
Serpentine
Mayfair
Soho
Green Park
St James's Park
Canning Town
Wapping
Poplar
River Thames
Southwark
Kensington
Brompton
Hammersmith
Counters Creek
Rotherhithe
Newington
Bermondsey
Lambeth
Westminster
Pimlico
Chelsea
South Kensington
West Kensington
Walworth
Sluice
Kennington
Deptford
Battersea Park
Battersea
Vauxhall Park
New Cross
Camberwell
Greenwich Park
Greenwich
Peckham
Blackheath
Barnes
Thames