soiltechnics

environmental and geotechnical consultants

Proposed basement
109 King Henry's Road, London

Basement Impact Assessment Report
(Revision 02 Updated August 2016)

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Soiltechnics Ltd. Cedar Barn, White Lodge, Walgrave, Northampton. NN6 9PY.
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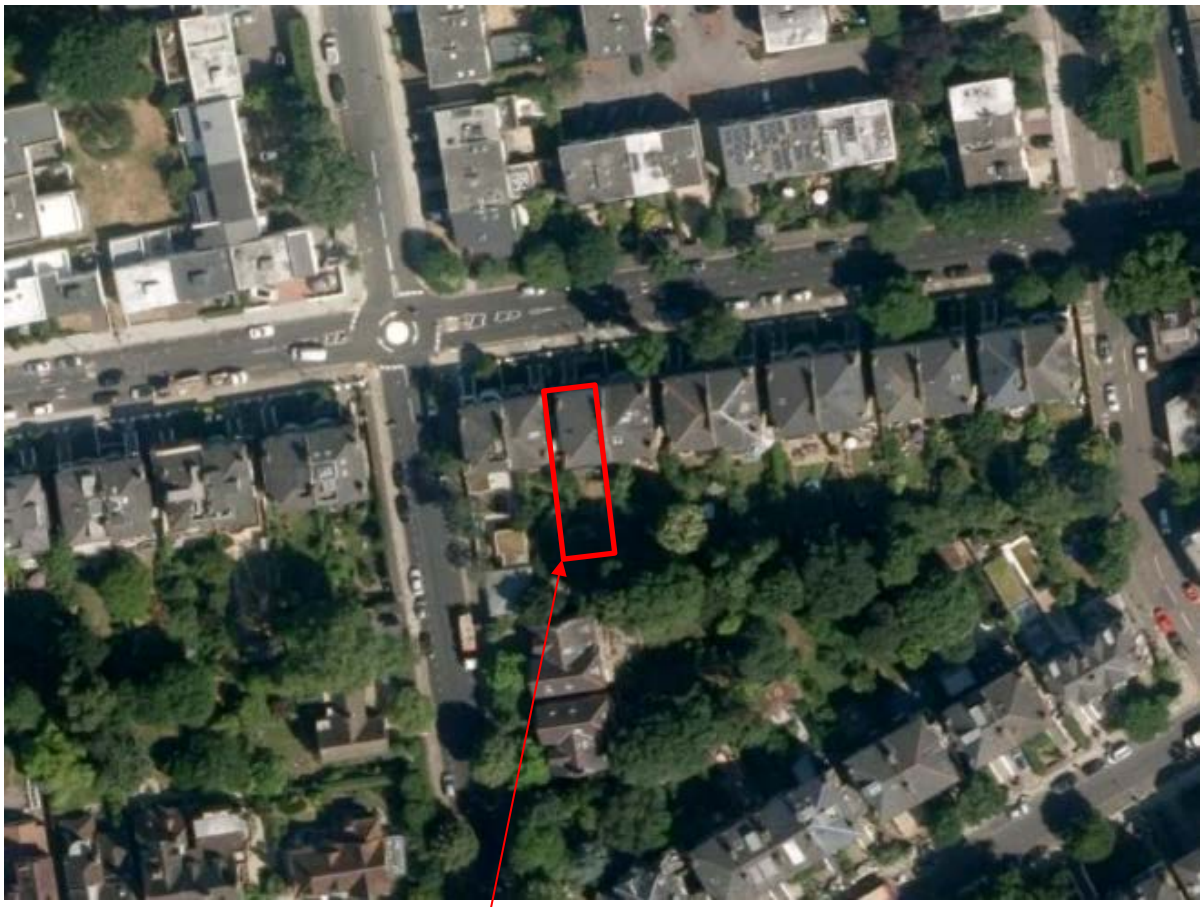
Aerial photograph of site



Report status and format

Report section	Principal coverage	Report status	
		Revision	Comments
0	Contents page		Updated to address audit comments by Campbell Reith.
1	Introduction and brief		
2	Description of the property and project proposals		
3	Desk study information and site observations		
4	Ground Investigations		
5	External ground movements around the basement		
6	Hardened areas		
7	Tree removal		
8	Existing damage to adjacent buildings		
9	Railway tunnels		
10	Summary of screening		
11	Subterranean (Groundwater flow) screening		
12	Stability impact identification		
13	Surface flow and flooding impact identification		
14	Summary and Conclusion		
15	Audit tracker		

List of appendices

Appendix	Content
A	Copy of drawings illustrating proposal
B	Copy of CV of Nigel Thornton and examples of Soiltechnics commissions on basement investigations and analysis
C	Copy of comments on this report by Chartered Geologist
D	Plan showing location of exploratory points (drawing 02) and borehole and trial pit records.
E	Plan showing estimated surface settlement contours as a result of basement excavations (drawing 01A)
F	Calculations to determine strains in masonry
G	Copy of Network Rail showing location of rail tunnels in the area

1 Introduction and brief

1.1 Objectives

1.1.1 This report presents a Basement Impact Assessment (BIA) for a proposed basement at 109 King Henry's Road, London.

1.1.2 The principal objective of the assessment is to present evidence to support a planning application for the project as required by Camden Planning Guidance (CPG4) '*Basements and lightwells'*.

1.2 Client instructions and confidentiality

1.2.1 This report has been produced following instructions received from Starlit Properties Ltd. This report has been updated following receipt of comments received as a result of an audit report by Campbell Reith dated July 2016. Amendments to the report text are highlighted with a single vertical line adjacent to the paragraph. Amendments dated September 2015 are marked with a black line in the left hand margin. Amendments dated July 2016 are marked with a red line.

1.2.2 This report has been prepared for the sole benefit of our above named instructing client, but this report, and its contents, remains the property of Soiltechnics Limited until payment in full of our invoices in connection with production of this report.

1.3 Author qualifications

1.3.1 This report has been reviewed by a Chartered Civil Engineer, (C.Eng., M.I.C.E) who is also a Fellow of the Geological Society (FGS) and a practising Civil Engineer with specialist experience (35 years) in geotechnical engineering (including basement construction), flood risk and drainage. A copy of a CV with examples of experience in basement construction is presented in Appendix B. This report has been reviewed by John Evans of Chord Environmental who is a Chartered Geologist and expertise in hydrogeology. A copy of his comments are presented in Appendix C.

1.4 Guidance used for scoping exercise

1.4.1 As described in paragraph 1.1.2 above we have followed Camden Planning Guidance (CPG4) '*Basements and lightwells'*, and Camden geological, hydrogeological and hydrological study report '*Guidance for subterranean development,*' produced by Arup on behalf of the London Borough of Camden. We have also referred to the '*Strategic Flood Risk Assessment Report for North London*' dated August 2008 prepared by Mouchel, as well as other readily available information on websites. This report has considered all four stages of the BIA process as described in CPG4. This report has also been prepared to satisfy the following parts of Camden's policy DP27, on basements and lightwells:

a) Maintain the structural stability of the building and neighbouring properties;

b) Avoid adversely affecting drainage and run-off or causing other damage to the water environment;

c) Avoid cumulative impacts upon structural stability or the water environment in the local area;

1.4.2 In order to satisfy part a) a construction method statement has been prepared by a Structural Engineer which is separately presented.

1.5 Format of this report in relation to CPG4

1.5.1 Sections 3 to 9 of this report describes project proposals and presents desk study and investigation data, information required to answer flow chart questions posed in figures 1, 2 and 3 of GPG4. Answers for these flow chart questions are provided in sections 10 to 12.

2 Description of the property and project proposals

2.1 Description of the property

2.1.1 The site is currently occupied by a four storey semi-detached residential property within an urban area of Camden. The property includes a lower ground floor as part of the four storeys. Based on inspection of old Ordnance Survey maps the building was probably constructed in the late 1800s. The building occupies much of the northern part of the property, with a gravelled garden to the front (north of the property) and rear gardens principally laid to grass with some trees to the south. General topographical levels fall in a southerly direction by about 2 degrees.

2.1.2 The lower ground floor is located marginally above rear garden levels. Main front garden levels are located about 1.6m above the rear garden levels, with a change in ground levels in this area provided by a cutting slope within the garden.

2.2 Project proposals

2.2.1 The property has the benefit of planning permission for a lower ground floor extension to the south western corner of the existing building (planning ref 2014/3978/P granted on 28th August 2014). The current application is for a single storey deep basement in the southern half of the current house footprint extending below the single storey extension (for which planning permission has been granted) and includes the construction of two new light wells to the rear.

2.2.2 Underpinning will be required to perimeter load bearing walls to the existing building and new foundations below the permitted lower ground floor extensions allowing basement excavation. Once excavation is complete, a new basement floor will be constructed together with a new reinforced concrete lower ground floor slab to essentially produce a concrete basement box.

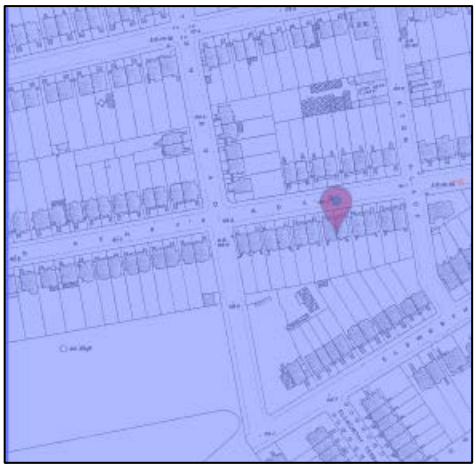
2.2.3 Copies of our client's Engineer's drawings showing project proposals outlining construction details are presented in Appendix A. A construction method statement is separately presented.

3 Desk study information and site observations

3.1 Site history

3.1.1 Review of Ordnance Survey and London town maps dating back to 1850s indicate the property was first recorded on the 1895 map. Extract copies of key mapping is presented below with property position defined by the red marker.

Extract copy of 1850 map



Extract copy of 1895 map

3.1.2 At this stage it is important to note there are no water courses recorded on the 1895 map close to the property, and no evidence of any opencast quarrying activities in the locality.

3.2 Geology and geohydrology of the area

3.2.1 Geology of the area

3.2.1.1 Inspection of the geological map of the area published by the British Geological Survey (BGS) indicates the following sequence of strata. The thickness of the strata has been obtained from a combination borehole record data formed within 500m of the property available on the BGS website, and geological sections shown on the BGS map.

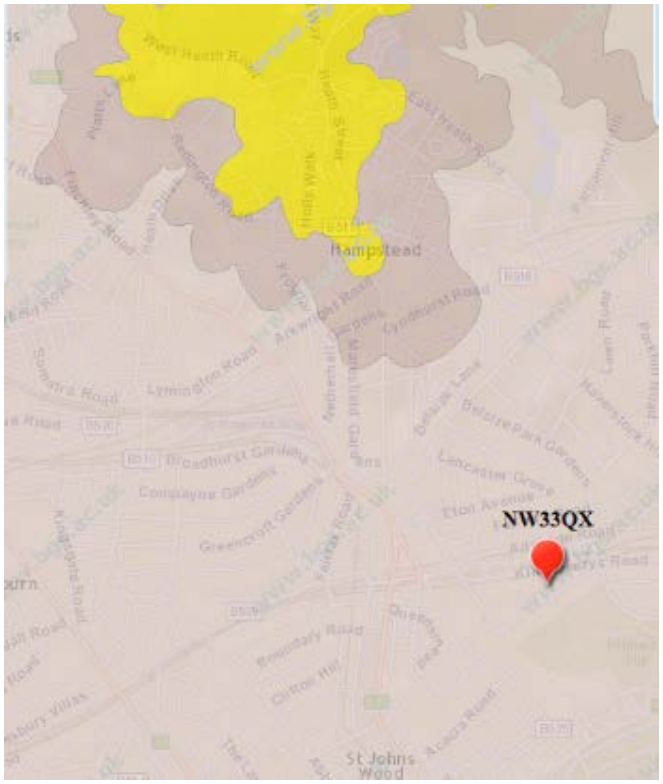
Summary of Geology and likely aquifer containing strata

Strata	Bedrock or drift	Approximate thickness	Typical soil type	Likely permeability	Likely aquifer designation
London Clay Formation	Bedrock	85m	Clays	Low	Unproductive strata
Lambeth Group	Bedrock	15	Clays, occasionally sands	Low	Unproductive strata
Thanet Sands	Bedrock	10	Fine sands	Low/moderate	Secondary Aquifer
Chalk	Bedrock	200	Chalk	High	Principal Aquifer

Table 3.2.1.1

3.2.1.2 Soil types and assessments of permeability are based on geological memoirs, in combination with our experience of investigations in these soil types.

3.2.1.3 An extract copy of the geological map is presented below, with brown shading representing the outcrop of the London Clay Formation. The yellow represents the Bagshot Beds which overlie the Claygate beds shaded dark brown (both on higher ground to the north) with the property located on London Clays (light brown shading). The property position is shown by the red marker.



3.2.1.4 Based on the above any excavations within the property will be located within London Clays.

3.2.2 Geohydrology

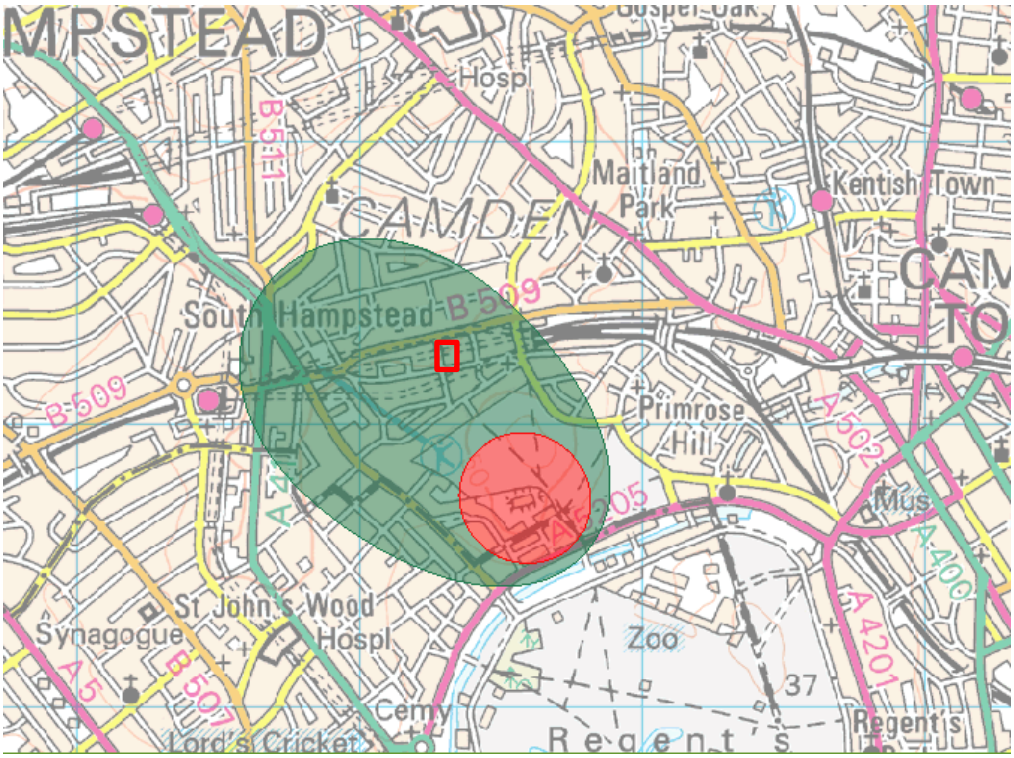
3.2.2.1 The Environment Agency website reports, the London Clay Formation deposits (bedrock) at the site are designated Unproductive strata.

3.2.2.2 Unproductive strata are defined as deposits exhibiting low permeability with negligible significance for water supply or river base flow. Unproductive Strata are generally regarded as not containing groundwater in exploitable quantities.

3.2.2.3 Chalk is classified a Principal Aquifer. Principal aquifers are defined as deposits exhibiting high permeability capable of high levels of groundwater storage. Such deposits are able to support water supply and river base flows on a strategic scale.

3.2.3 Source protection zone

3.2.3.1 The site is recorded as being located within a source protection zone 2 (outer zone) which the Environment Agency define as a 400 day travel time from a point below the water table. An extract of the plan recording source protection zones is presented below, with green shading representing outer protection zones and red inner protection zones.



This abstraction will be from the Chalk aquifer located at least 100m below the property. The basement extending to about 3.5m below lower ground floor levels in London Clays will have no influence on the Chalk aquifer.

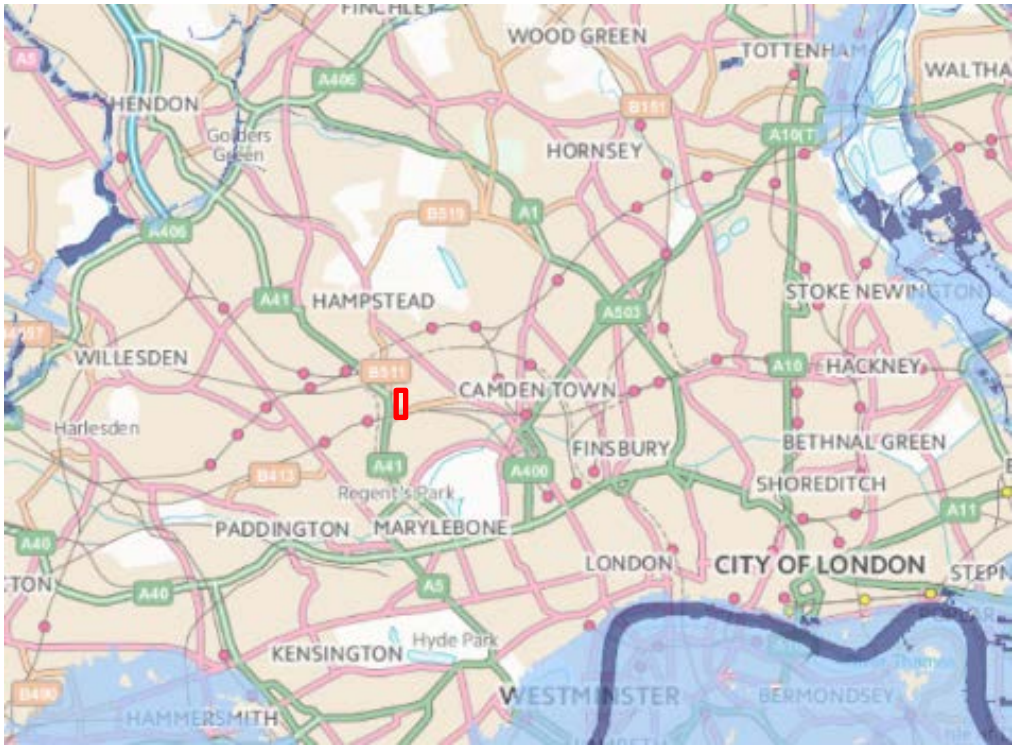
3.3 Quarrying/mining

3.3.1 With reference to the coal mining and brine subsidence claims gazetteer for England and Wales, available on the Coal Authority web site, the area has not been subject to exploitation of coal or brine. Inspection of old Ordnance Survey maps dating back to the first editions (late 1800s) does not record any quarrying activities within 250m of the property.

3.4 Flood risk

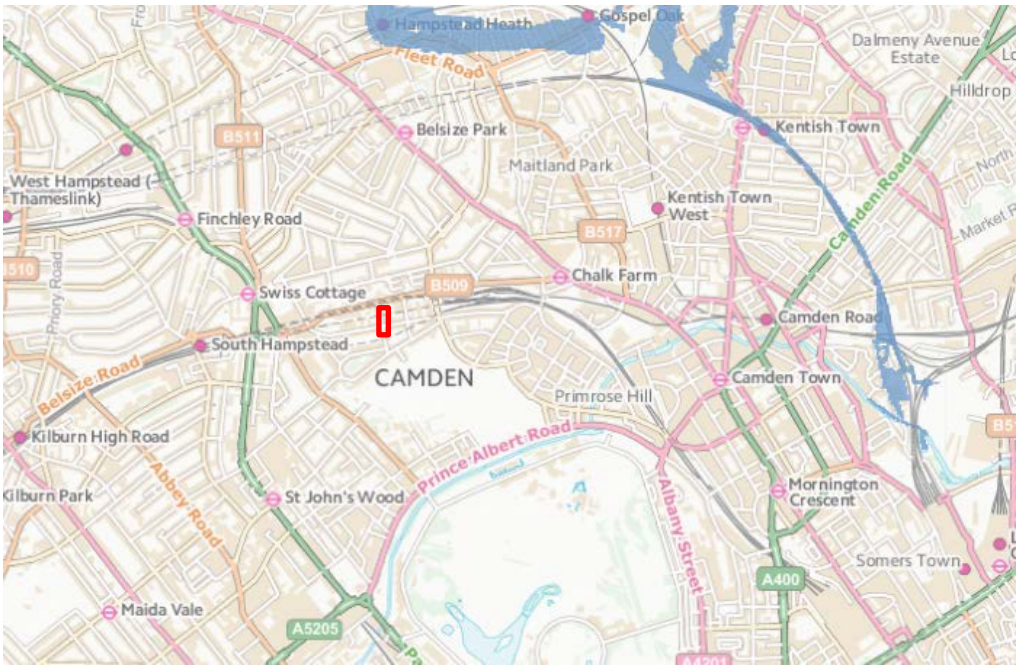
3.4.1 Fluvial/tidal flooding

3.4.1 The Environment Agency website indicates the site is not located within a fluvial or tidal flood plain. An extract copy of the flood risk map is presented below which shows no blue shading representative of flooding. The property is located within the red square.



3.4.2 Flooding from Reservoirs, Canals and other Artificial Sources

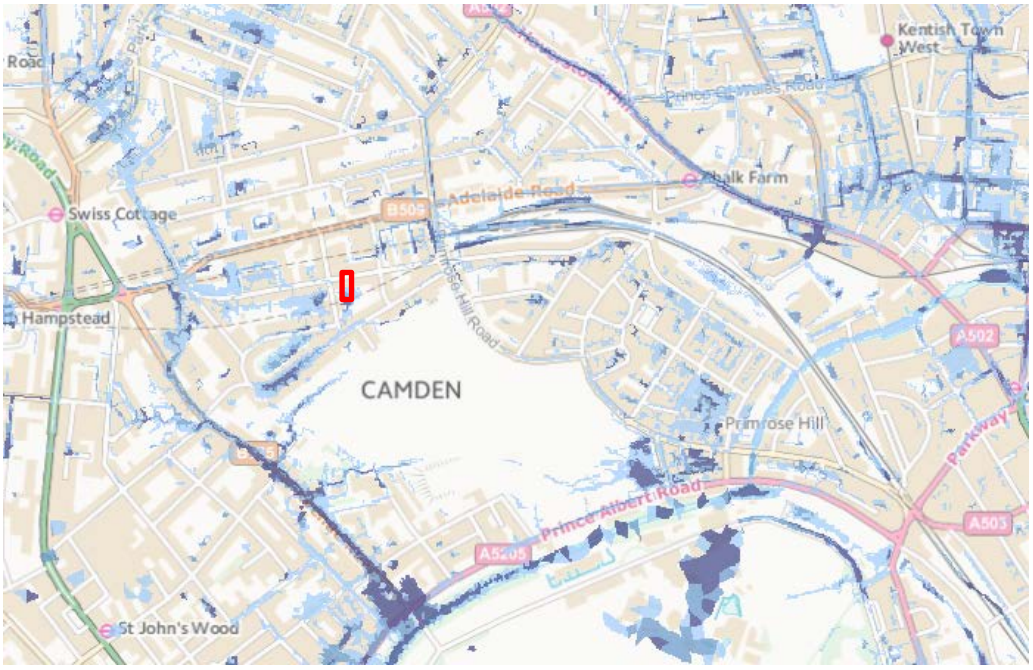
3.4.2.1 The Environment Agency website indicates the site is not located within an area considered at risk of flooding from breach of reservoir containment systems. An extract copy of the flood risk map is presented below which shows no blue shading representative of flooding as a result of failure of containment systems close to the site. The property is located within the red square.



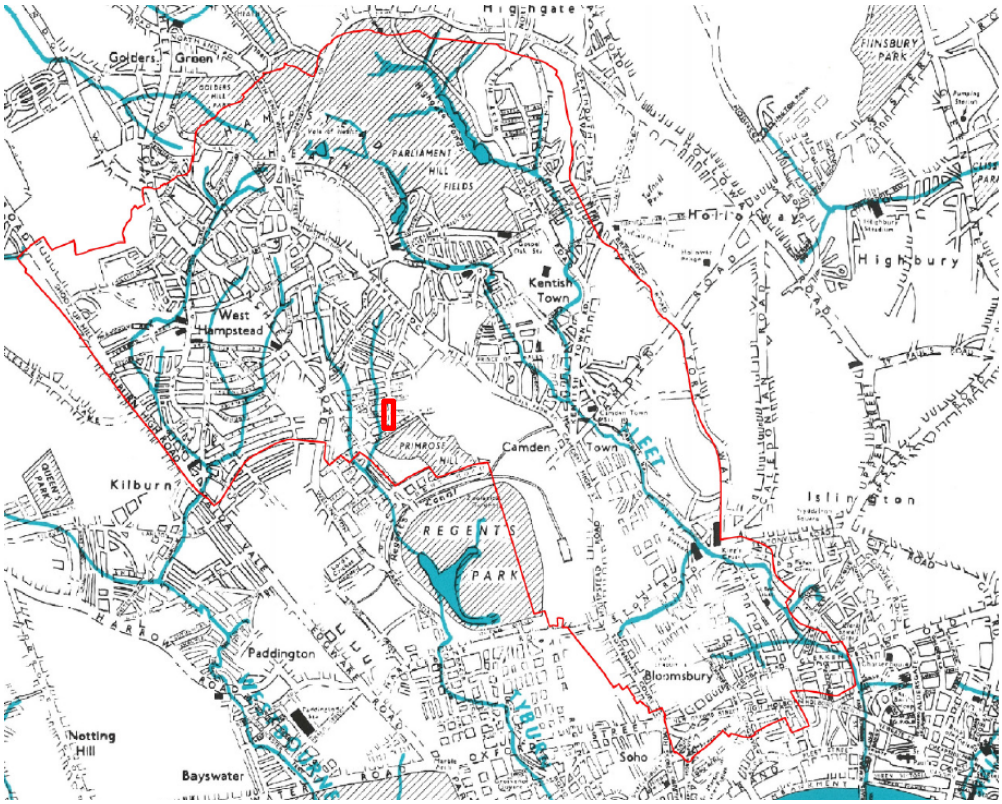
3.4.3 Flooding from Groundwater and surface waters

3.4.3.1 The site is underlain with a substantial thickness (85m) of relatively impermeable London Clay Formation. On this basis groundwater is not likely to be available at the site and thus is unlikely to present a risk of causing groundwater flooding.

3.4.3.2 We have viewed the Environment Agency web site which provides maps showing areas at risk of flooding from surface waters. An extract of the map is presented below. The property is located within the red square and blue shading represents areas at risk of surface water flooding. The property is located in a low risk area, shown by the light blue shaded areas.

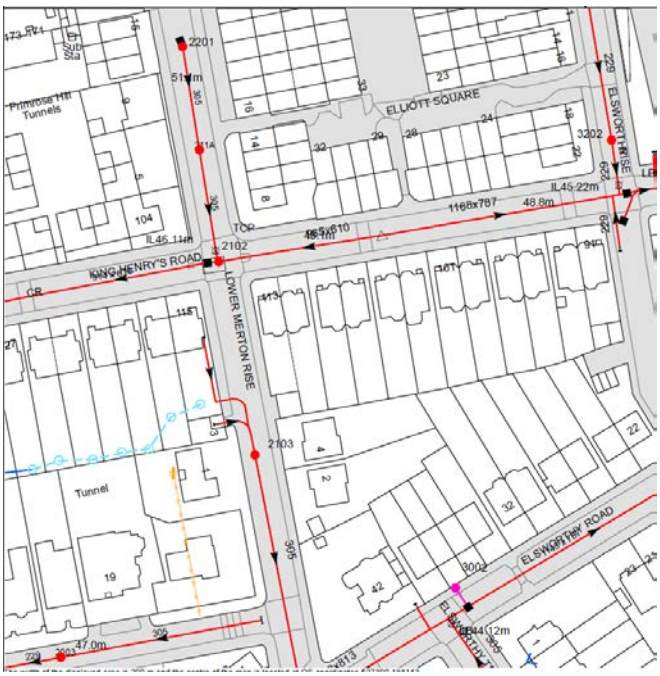


3.4.3.3 An extract of figure 11 from the Camden Geological, Hydrogeological and Hydrological Study (referenced in Section 1.4) is presented below. The blue lines show the locations of branches of formers in the area. The property is located within the red box and seems to be at the head waters of an upper branch of the River Tyburn.

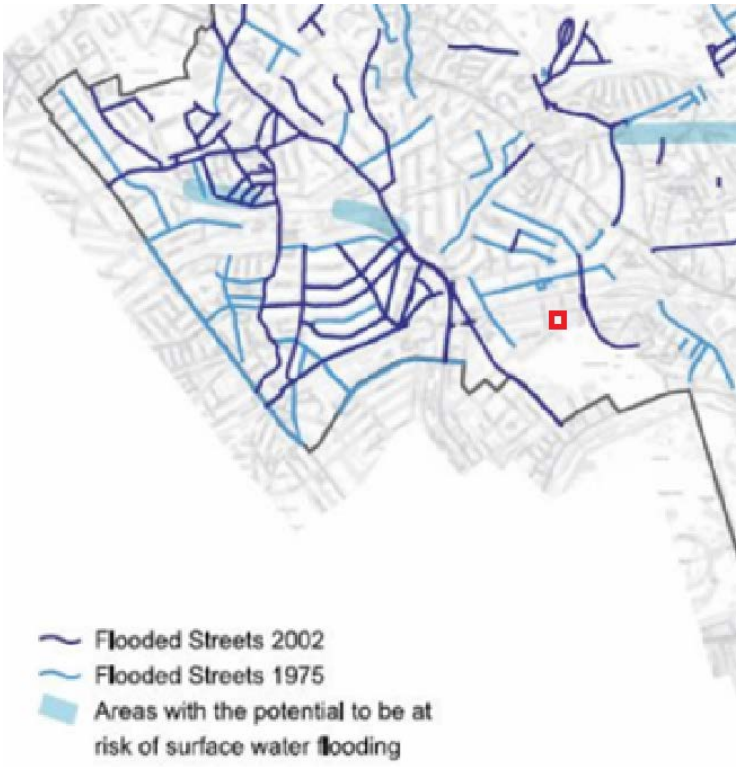


3.4.3.4 With reference to old mapping of the area described in section 3.1 above, the 1850 map (predevelopment) does not record any water courses close to or within the immediate area of the property. Development of London has resulted in original watercourses being culverted, with culverts following, in the majority of cases, road infrastructure routes.

3.4.3.5 There is a 965 x 610 culvert in King Henry's Road recorded on Thames Water Asset register, an extract copy of which is presented below. The culvert follows a westerly route from the property.



3.4.3.6 An extract of figure 15 from the Camden Geological, Hydrogeological and Hydrological Study (referenced in Section 1.4) is presented below (property marked in a red box). The map records King Henry's Road has not historically been subject to flooding or is within an area with the potential to be at risk from surface water flooding.



Extract copy of figure 15 from the Camden Geological, Hydrogeological and Hydrological Study

3.4.3.7 There is a 4" below ground water supply pipe operated by Thames Water in King Henry's Road to the north of the property. It is considered that the property is unlikely to be at enhanced risk of flooding due to ruptures in the potable water supply system in the area.

3.4.4 Conclusions

3.4.4.1 Based on the above, in our opinion, the property is considered unlikely to be at enhanced risk of being flooded by exceedances in capacity of sewers or water supply pipes. Evidence presented above demonstrates the property is not at an enhanced risk of being affected by tidal or fluvial flooding or indeed from artificial sources. The property and indeed proposals will not be affected by groundwater flooding.

4 Ground investigations

4.1 Scope

4.1.1 Two boreholes have been excavated at the property; both in rear gardens to 7m depth. A series of four hand dug trial pits was also excavated externally to expose foundation arrangements both the house and boundary walls in the vicinity of the proposed basement. The scope of the investigations was determined by our Client's Structural Engineer

4.1.2 Fieldwork records are presented in Appendix D. Drawing 02 (also presented in Appendix D) shows the location of the exploratory points.

4.2 Ground conditions encountered

4.2.1 Each of the two boreholes (excavated on 18th May 2015) encountered a similar soil profile of naturally deposited London Clays capped with a thin covering of made ground extending to depths of between 1 and 1.5m. The London Clays essentially comprised medium strength brown grey silty clays. No groundwater was encountered in the excavations. A water level monitoring standpipe was installed to 7m depth in borehole BH02 and on a return visit to site on 22nd May 2015 no water was observed in the standpipe.

4.2.2 The investigations confirmed published geological maps for the near surface geology.

4.3 Existing foundations.

4.3.1 Trial pit excavations exposed corbelled brickwork foundations to the house and boundary walls to depths of between 0.23 and 0.55m below ground levels constructed on Made Ground overlying London Clays.

4.4 Summary of basement retaining wall design parameters

4.4.1 The following table provides soil parameters for foundation design purposes

Parameter	Value	Origin
Presumed bearing value for underpin L section (as proposed) assuming 1m wide base (temporary scenario)	125kN/m^2	Based on undrained shear strength measurements and section of underpinning
Characteristic constant volume angle of shearing resistance (made ground and London Clays)	21^o	Based on plasticity measurements and with reference to BS8002:2015
Earth pressure at rest (London Clay)	1	CIRIA report C580 (over consolidated clays)
Earth pressure at rest (Made ground)	0.65	CIRIA report C580 (normally consolidated clays)
Characteristic weight density of soils above the groundwater table	19kN/m^3	Derived from BS8002;2015

5 External ground movements around basement

5.1 Construction proposals

5.1.1 The property has the benefit of planning permission for a lower ground floor extension to the south western corner of the existing building (planning ref 2014/3978/P granted on 28th August 2014). The current application is for a single storey deep basement in the southern half of the current house footprint extending below the single storey extension (for which planning permission has been granted) and includes the construction of two new light wells to the rear. The basement excavation will extend into the rear garden resulting in an excavation of around 3.5m deep. Our client's Structural Engineer proposes to underpin load bearing walls to the existing building and install new foundations outside the existing building footprint.

5.2 Settlement around and inward yielding of basement excavations

5.2.1 The following analysis is based on observations of ground movements around basement excavations in clays as reported in Tomlinson 'Foundation design and construction' (seventh Edition).

5.2.2 It is recognised that some inward yielding of supported sides of strutted excavations and accompanying settlement of the retained ground surface adjacent to the excavation will occur even if structurally very stiff piles and props / strutting is employed. The amount of yielding for any given depth of excavation is a function of the characteristics of the supported soils and not the stiffness of the supports. Based on observations of other excavations in over consolidated clay soils (which will be the case at this site) the average maximum yield / excavation depth (%) was 0.16, with a range of 0.06 to 0.3. Assuming a maximum excavation depth of 3.5m then the likely inward yield will be in the order of 3.5 x 0.16/100 x1000 = 5.6mm.

5.2.3 Coincidental with the inward yield, some settlement of the retained soils around the excavation will occur. Again, based on published observations, the ratio of surface settlement to excavation depth in over consolidated clays is about 0.3% (range 0.1 to 0.6). Adopting the average of 0.3, and a maximum 3.5m deep excavation, then surface settlement in the order of 3.5 x 0.3/100 x 1000 = 10mm will occur. Importantly, whilst some surface settlement will occur around the excavation, this settlement profile will extend for a distance of about 4 times the depth of excavation i.e. about 14m in a reasonably linear fashion.

5.2.4 Whilst it is acknowledged that settlement and inward yielding movement observations are generally for embedded piled or diaphragm retaining walls, we are not aware of any published observational data for underpinning walls and insitu concrete retaining walls, but consider a propped embedded piled wall would afford more onerous movements. The value of making a finite element analysis to determine the amount of inward yielding of excavation supports in all routine cases of basement excavations is questionable requiring estimates of soil moduli and other factors such as poisons ratio.

5.2.5 We have produced a plan showing estimated surface settlement contours considering the basement excavation which is presented on Drawing 01a in Appendix E.

5.2.6 The adjoining properties at No107 and No111 will be mostly affected (in terms of the effects of surface settlement) by the basement excavations. We have visited Camden Council's web site and there are no records of planning being granted for basement installations to neighbouring properties (No107 and No111). We have produced a set of calculations to estimate the tensile strain on masonry forming the rear elevation walls resulting from movements derived above. These calculations are presented in Appendix F. The calculations indicate damage would generally fall into category 0 as described in the following table (extract from CIRIA report 580). If both surface settlement and inward yielding movements are taken in combination there is a risk that damage could fall into category 2 (slight damage). In order to reduce this risk, monitoring of the basement walls will be required during basement excavation works and the walls propped with adjustable props. If horizontal movement exceeds values in the range of 2 to 4mm (refer calculation sheet 4) then props will require adjustment to compensate for this movement and maintain potential damage to adjacent properties within damage category 0 or 1.

Table 2.5 *Classification of visible damage to walls (after Burland* et al, *1977, Boscardin and Cording, 1989; and Burland, 2001)*

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

Notes

1. In assessing the degree of damage, account must be taken of its location in the building or structure.
2. Crack width is only one aspect of damage and should not be used on its own as a direct measure of it.

6 Hardened areas

6.1 We understand there will be an increase in hardened and drained areas resulting from the extension of the basement into the rear garden area. The property is underlain with a substantial thickness of relatively impermeable London Clays, which is not amenable to disposal of stormwater using soakaways. Proposals are to intercept roof drainage systems (rain water down pipes), and install a restrictor limiting flows to match current rain water runoff, and attenuate any additional water on site in a below ground storage facility, probably located in rear gardens. On this basis the development will not increase that rate of discharge to stormwater to sewers and thus not contribute to flood risk downstream of the property. Details of how this will be executed are shown on the Forge Architect Drawing (to be issued separately).

7 Tree removal

7.1 No major vegetation will be removed to accommodate the extension of the building. Some small shrubs close to the garden boundary between 109 and 107 will however be removed together with an ornamental pear which is currently about 3m high.

7.2 It is likely that foundation arrangements to the subject property and the attached house at no 107 will be similar on the basis that the two houses were constructed at the same time with foundations constructed on fine grained (cohesive) soils which will exhibit plasticity. The volume of plastic soils will change with changes in water content. Changes in water content are promoted by seasonal weather conditions but also water demands of trees. Following National House Building Standards (chapter 4.2) which provides a good guide to the influence of trees on plastic soils, a pear tree is classified as moderate water demand and the theoretical root radius of such a tree is 75% of its height ie 0.75 x 3m = 2.25m. The Pear tree is located 3m distance from the rear south facing elevation of 107 and 109, thus beyond the current influence of the root systems of the tree. It is important to note that should this tree remain and grow to a mature height, then root systems could extend into soils below foundations to no107 and 109, with the result that the tree will cause shrinkage of foundation supporting soils local to the tree and promote subsidence damage to these buildings and on this basis the tree requires removal irrespective if the basement installation to 109 proceeds.

8 Existing damage to adjacent buildings

8.1 We are not aware of any subsidence damage to existing buildings.

9 Railway Tunnels

9.1 We have contacted Network Rail and obtained a plan showing the location of rail tunnels in the area. A copy of the plan is presented in Appendix G. Primrose Hill railway tunnel follows a route just to the south of the rear gardens some 17m to south of the southern extent of the proposed basement. On this basis the basement construction will not affect rail tunnels.

10 Summary of screening

10.1 The above report sections present factual data to demonstrate there are no areas of concern which require investigation to support a planning application.

11 Subterranean (Groundwater) flow screening

11.1 General overview

11.1.1 The property is positioned on gently sloping ground (approximately 2^{o}) to the north west of central London. The property is outside areas considered to be at risk of being affected by tidal and fluvial flooding associated with the Thames or its tributaries, or artificial water sources (canals/reservoirs). In addition the property is not considered to be at enhanced risk of flooding from sewers or water supply pipes.

11.1.2 Geological records indicate the site is underlain by deposits of London Clay Formation extending to depths of approximately 85m. Borehole excavtions within the property confirm published geological records. The property (being underlain with a substantial thickness of London Clay Formation) is not considered to be at risk of flooding from groundwater and the proposals will not affect any groundwater flows.

11.2 Responses to flow chart questions

The following provides site specific responses to questions posed in figure 1 of CPG4

Question and response		Text reference
Question 1a	**Is the site located directly above an aquifer?**	
Response.	No. The property is directly underlain by over 80m thickness of London Clays which are classified Unproductive Strata (formerly Non Aquifer) by the Environment Agency.	3.2

Question and response		Text reference
Question 1b	**Will the proposed basement extend beneath the water table surface?**	
Response	No. The London Clay Formation comprises reasonably homogenous relatively impermeable clays which are not able to transmit groundwater under normal hydraulic gradients.	3.2
Question 2	**Is the site within 100m of a watercourse, well or potential spring line?**	
Response	No. Although the property is recorded to be relatively close to a tributary of the River Tybury, (based on historical maps) Ordnance Survey records of the area prior to development do not record any watercourses in the area and indeed Thames Water asset maps do not record any significant surface water sewers in the area. Additionally, the geology of the area is not conducive to spring lines or wells for extraction of water. Based on this there are no matters of concern.	3.4.3
Question 3	**Is the site within the catchment of the pond chains on Hampstead Heath?**	
Response	No. Based on figure 14 within the Camden geological, hydrogeological and hydrological study report, the property is not within the catchment of the pond chains on Hampstead Heath. The property is located about 1.75km distance from the pond chains on Hampstead Heath	3.4.2
Question 4	**Will the proposed basement development result in a change in the proportion of hard surfaced/paved areas?**	
Response	Yes. The extensions to the property will increase the hardened area of the site, however proposal are to manage on site stormwater collected by the development so as not to increase the rate of stormwater discharge to sewers off site. Details are shown on the Forge Architect Drawing (to be issued separately).	5

Question and response		Text reference
Question 5	**As part of the site drainage, will more surface water (e.g. rainfall and run off) than present be discharged to the ground (e.g. via soakaways/SUDS)?**	
Response	No. The site is underlain by London Clays which are not amenable to disposal of stormwater using infiltration systems. Rainwater falling onto the garden area will be disposed of using natural absorption and natural run off (which is currently the case).	5
Question 6	**Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to or lower than the mean water level in any local pond (not just the pond chains on Hampstead Heath) or spring line?**	
Response	No. The London Clay Formation comprises reasonably homogenous relatively impermeable clays which are not able to transmit groundwater under normal hydraulic gradient. Basement excavations will be formed in the London Clays. Based on this there are no matters of concern.	3.4.3

12 Stability impact identification

12.1 General overview

12.1.1 The property is positioned on gently sloping ground in the north west of central London. Ground levels in the area fall in a general southerly direction (to the south of King Henry's Road) at a slope of approximately 2 degrees.

12.1.2 No significant trees will be removed as part of the development.

12.1.3 The property has the benefit of planning permission for a lower ground floor extension to the south western corner of the existing building (planning ref 2014/3978/P granted on 28th August 2014). The current application is for a single storey deep basement in the southern half of the current house footprint extending below the single storey extension (for which planning permission has been granted) and includes the construction of two new light wells to the rear.

12.2 Responses to flow chart questions

The following provides site specific responses to questions posed in figure 2 of CPG4

Question and response		Text reference
Question 1	**Does the existing site include slopes, natural or manmade greater than 7° (approximately 1 in 8).**	
Response	No. The topography of the area falls by about 2 degrees in a southerly direction. Based on this there are no matters of concern.	2.1
Question 2	**Will the proposed profiling of landscaping at the site change slopes at the property boundary to more than 7°?**	2.2
Response	No. The proposed basement will not change the current topographical conditions. Based on this there are no matters of concern.	
Question 3	**Does the development neighbour land including railway cuttings and the like with slopes greater than 7° (approximately 1 in 8)?**	
Response	No. The topography of the area falls by about 2 degrees in a southerly direction, and there are no manmade cuttings in the area. Based on this there are no matters of concern.	2.2

Question and response		Text reference
Question 4	**Is the site within a wider hillside setting in which the slope is greater than 7^{o}?**	
Response	No. The topography of the area falls by about 2 degrees in a southerly direction with the slope (to the south of King Henry's Road) being reasonably uniform. Based on this there are no matters of concern.	2.1
Question 5	**Is the London Clay the shallowest strata at the site?**	
Response	Yes. The property is underlain with London Clays, extending to depths of over 80m in the area. Given the shallow (natural) slope angles in the area, the property is not considered to be at risk of slope instability. Based on this there are no matters of concern.	2.1
Question 6	**Will any trees be felled as part of the development and/or are there any works proposed within any tree protection zones where trees are to be retained?**	
Response	No works are proposed within tree protection zones. We understand that five shrubs and an ornamental pear tree, (3m in height) will be removed as part of the development. Following guidance in NHBC Chapter 4.2, if the tree height is less than 50% of its maximum height, then the actual height of the tree can be used. The Ornamental Pear is Classified as a moderate water demand tree, which influences soils a distance of 75% of its height away from the centre of the tree. Therefore, soils up to a distance of 2.25m away from the tree, may be affected following its removal. The tree is recorded approximately 3m from the extent of the proposed basement and is therefore not within the influence from the tree. Based on this there are no matters of concern.	6
Question 7	**Is there a history of any seasonal shrink swell subsidence in the local area and/or evidence of such effects on site?**	
Response	No. We are aware that London Clay Formation deposits exhibit shrink/swell characteristics. We are not aware of, or seen any evidence of damage attributable to subsidence either on the subject property or on adjacent properties. Based on this there are no matters of concern.	

Question 8	**Is the site within 100m of a watercourse, well or potential spring line?**	
Response	No. Although the property is recorded to be relatively close to a tributary of the River Tybury, (based on historical maps) Ordnance Survey records of the area prior to development do not record any watercourses in the area and indeed Thames Water asset maps do not record any significant surface water sewers in the area. Additionally, the geology of the area is not conducive to spring lines or wells for extraction of water. Based on this there are no matters of concern.	3.4.3

Question and response		Text reference
Question 9	**Is the site within an area of previously worked ground?**	
Response	No. There is no evidence to indicate the site has been subject to quarrying activities in the area. Based on this there are no matters of concern.	3.3.1
Question 10	**Is the site located above an aquifer? If so will the proposed basement extend beneath the water table such that dewatering may be required during construction?**	
Response	No. The property is directly underlain by over 80m thickness of London Clays which are classified Unproductive Strata (formerly Non Aquifer) by the Environment Agency. The London Clay Formation comprises reasonably homogenous relatively impermeable clays which are not able to transmit groundwater under normal hydraulic gradient. New basement excavations will be formed in the London Clays. Based on this there are no matters of concern.	3.2
Question 11	**Is the site within 50m of Hampstead Heath ponds?**	
Response	No. The property is located about 1.75km to the south of the pond chain on Hampstead Heath. Based on this there are no matters of concern.	3.4.2
Question 12	**Is the site within 5m of a public highway or pedestrian right of way?**	
Response	No. The proposed basement will not be located within 5m of a public highway/footway. The basement excavation is located about 12m from the highway (back of footway).Based on this there are no matters of concern.	2.2

Question and response		Text reference
Question 13	**Will the proposed basement significantly increase the differential depth of foundations relative to adjacent properties?**	
Response	No. Traditional underpinning will be used to extend existing foundations down to proposed basement floor levels. Although there will be differences in ground / basement level floors between the new build and adjacent properties, the proposed basement construction solution will not affect neighbouring properties, and estimates of movements which may occur during the construction phase are described in section 5 which indicate acceptable levels of differential movement. Based on this there are no matters for concern. A copy of the project Engineer's drawings illustrating proposed foundations for the basement are presented in Appendix A. Tree removal will not influence the differential depth of foundations.	4
Question 14	**Is the site over (or within the exclusion zone of) any tunnels e.g. Railway lines?**	
Response	We have contacted Network Rail and obtained a plan showing the location of rail tunnels in the area. A copy of the plan is presented in Appendix G. Primrose Hill railway tunnel follows a route just to the south of the rear gardens some 17m to south of the southern extent of the proposed basement. On this basis the basement construction will not affect rail tunnels.	9

13 Surface flow and flooding impact identification

13.1 General overview

13.1.1 There will be an increase in hardened and drained areas resulting from the development. The property is underlain with a substantial thickness of relatively impermeable London Clays, which is not amenable to disposal of stormwater using soakaways. Proposals are to intercept roof drainage systems (rain water down pipes), and install a restrictor limiting flows to match current rain water run-off, and attenuate any additional water on site in a below ground storage facility, probably located in rear gardens. On this basis the development will not increase that rate of discharge to stormwater to sewers and thus not contribute to flood risk downstream of the property. Details of how this will be executed are shown on Forge Architects drawing (to be issued separately).

13.2 Responses to flow chart questions

The following provides site specific responses to questions posed in figure 3 of CPG4

Question and response		Text reference
Question 1	**Is the site within the catchment of the pond chains on Hampstead Heath?**	
Response	No. The property is not located within the catchment of the pond chains.	3.4.2
Question 2	**As part of the site drainage, will surface water flows (e.g. rainfall and run off) be materially changed from the existing route?**	
Response	No. Proposals will not have a material impact on surface water flows.	5
Question 3	**Will the proposed basement development result in a change in the proportion of hard surfaced/paved areas?**	
Response	Yes. Refer 13.1 above.	13.1

Question and response		Text reference
Question 4	**Will the proposed basement result in changes to the profile of the inflows (instantaneous and long term) of surface water being received by adjacent properties or downstream water courses?**	
Response	No. Proposals will have no impact on surface water received by adjacent properties or downstream watercourses.	11.1
Question 5	**Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream water courses?**	
Response	No. Proposals will have no impact on surface water flows to adjacent properties or downstream water courses.	11.1

14 Summary and Conclusions

14.1 The property has the benefit of planning permission for a lower ground floor extension to the south western corner of the existing building (planning ref 2014/3978/P granted on 28th August 2014). The current application is for a single storey deep basement in the southern half of the current house footprint extending below the single storey extension (for which planning permission has been granted) and includes the construction of two new light wells to the rear.

14.2 Ordnance Survey mapping of the area records the site undeveloped prior to 1895, after which the existing residential property is recorded.

14.3 Published BGS maps of the area record topography local to the property is formed in deposits of London Clays which probably extend depths of over 80m in the area. Borehole excavations on site confirm London Clays below a thin covering of made ground. The London clays are classified as unproductive strata by the Environment Agency. The London Clay Formation comprises reasonably homogenous relatively impermeable clays which are not able to transmit groundwater under normal hydraulic gradient. Basement excavations will be formed in the London Clays and based on the above, not affected by groundwater. Similarly, installation of the proposed basement will not affect any subterranean ground water flows.

14.4 Ground levels do fall in a southerly direction by about 2 degrees, and slope instability is not considered to present a risk. Installation of the basement will not induce any slope instability.

14.5 There is no evidence of any subsidence to any adjacent properties or indeed the existing buildings on the site.

14.6 No major vegetation will be removed to accommodate the extension of the building. Some small shrubs close to the garden boundary between 109 and 107 will however be removed together with an ornamental pear which is currently about 3m high.

14.7 It is likely that foundation arrangements to the subject property and the attached house at no 107 will be similar on the basis that the two houses were constructed at the same time with foundations constructed on fine grained (cohesive) soils which will exhibit plasticity. The volume of plastic soils will change with changes in water content. Changes in water content are promoted by seasonal weather conditions but also water demands of trees. Following National House Building Standards (chapter 4.2) which provides a good guide to the influence of trees on plastic soils, a pear tree is classified as moderate water demand and the theoretical root radius of such a tree is 75% of its height ie 0.75 x 3m = 2.25m. The Pear tree is located 3m distance from the rear south facing elevation of 107 and 109, thus beyond the current influence of the root systems of the tree. It is important to note that should this tree remain and grow to a mature height, then root systems could extend into soils below foundations to no107 and 109, with the result that the tree will cause shrinkage of foundation supporting soils local to the tree and promote subsidence damage to these buildings and on this basis the tree requires removal irrespective if the basement installation to 109 proceeds.

14.8 Installation of the basement will generate some ground movement close to the perimeter of the basement excavation. The amount of movement has been predicted based on records of observed movement in other basements during construction. If both surface settlement and inward yielding movements are taken in combination there is a risk that damage could fall into category 2 (slight damage). In order to reduce this risk monitoring of the basement walls will be required during basement excavation works and the walls propped with adjustable props. If horizontal movement exceeds values in the range of 2 to 4mm then props will require adjustment to compensate for this movement and maintain potential damage to adjacent properties within damage category 0 or 1.

14.9 The property is considered to be at no enhanced risk of being subject to flooding.

14.10 There will be an increase in hardened and drained areas resulting from the development. The property is underlain with a substantial thickness of relatively impermeable London Clays, which is not amenable to disposal of stormwater using soakaways. Proposals are to intercept roof drainage systems (rain water down pipes), and install a restrictor limiting flows to match current rain water runoff, and attenuate any additional water on site in a below ground storage facility, probably located in rear gardens. On this basis the development will not increase that rate of discharge to stormwater to sewers and thus not contribute to flood risk downstream of the property. Details of how this will be executed are shown on Forge Architects drawing (to be issued separately).

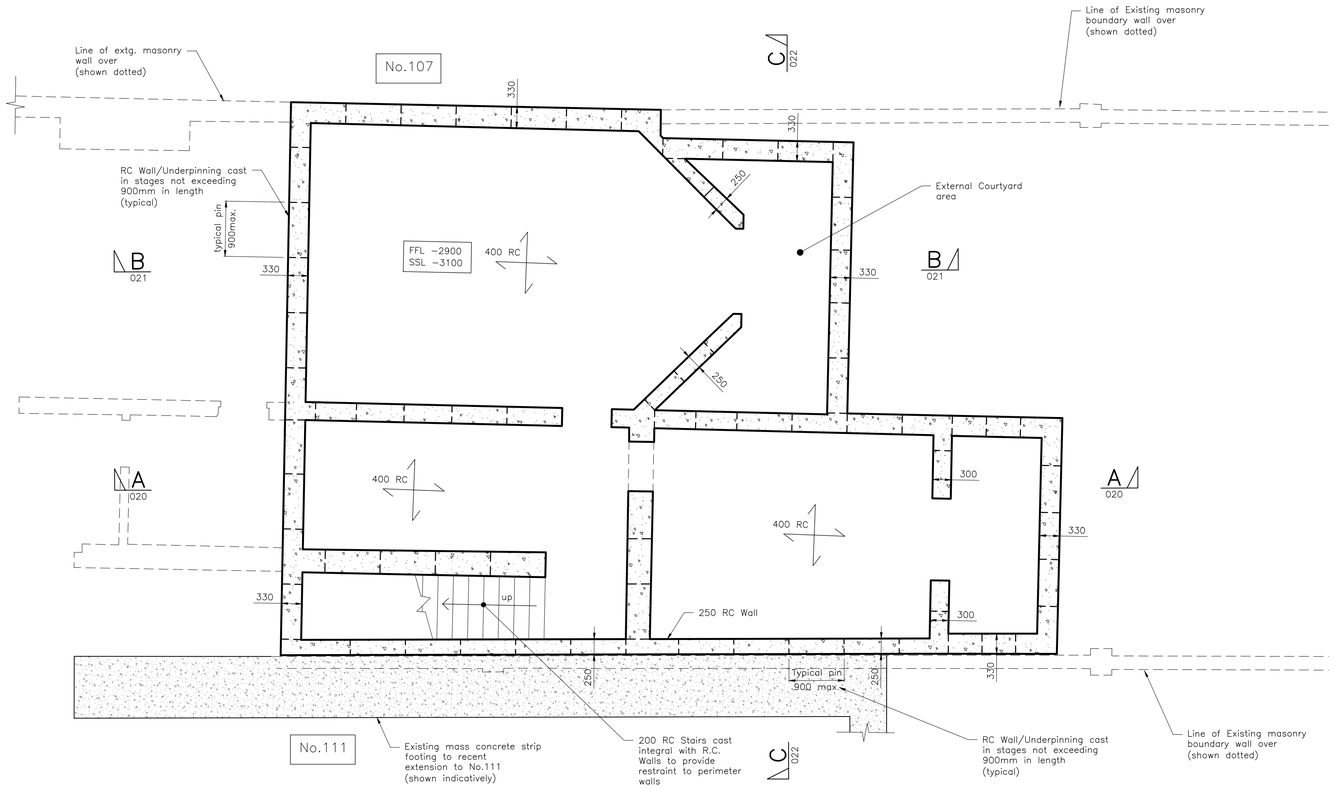
14.11 We have contacted network Rail and obtained a plan showing the location of rail tunnels in the area. A copy of the plan is presented in Appendix G. Primrose Hill railway tunnel follows a route just to the south of the rear gardens some 17m to south of the southern extent of the proposed basement. On this basis the basement construction will not affect rail tunnels.

14.12 In overall conclusion there are no outstanding issues of concern (singularly or cumulatively) from a stability, groundwater or surface water perspective.

15 Audit Query tracker

15.1 The following table is an extract from Campbell Reith identifying resolution to queries raised by the audit.

Query no	Subject	Query	Responsibility for resolution	Status	Response in report section
1	BIA	Indicative construction programme required	Sinclair Johnson	Open	N/A
2	Stability	BIA states no trees to be removed but Arboricultural statement notes one tree removed. Clarification and assessment of potential impact required	Soiltechnics	Open	Report section 7. Question 6
3	Stability	London Clay is susceptible to shrink / swell. Clarify any impact	Soiltechnics	Open	Report section 7 Question 7
4	Stability	No information on adjacent properties foundations noted - clarify	Soiltechnics	Open	Paragraph 5.2.6 Question 13
5	Surface water / groundwater flow	Restriction of surface water runoff to existing rate – clarification required	Soiltechnics	Open	Report section 6 Questions 3 and 4-
6	Stability	What is sequence of works to ensure support – clarification required	Sinclair Johnson	Open	
7	Surface water	How will basement be protected from public sewer surcharging – clarification required	Sinclair Johnson	Open	
Section 2.	Proposals	LBC's Audit Instruction described the planning proposal as 'Erection of a proposed side and rear extension and excavation of a basement level.'	Soiltechnics	N/A	Paragraph 2.2.1
Section 2	BIA	It is noted in section 5.2.6 that it is understood that there are no adjacent basements but it is not confirmed.	Soiltechnics	N/A	Section 2.2.1. Planning portal does not indicate basement construction on adjacent properties
Section 4	BIA	Whilst the ground sequence is noted, no soil parameters for foundation or retaining wall design have been determined.	Soiltechnics	N/A	Section 4.4
Section 3	Stability	Ground movement assessment has been provided. Stability of bay window to the rear of the property during basement construction requires clarification.	Sinclair Johnson	N/A	



NOTES:

1. All structural engineering drawings are to be read with the specification and with all relevant Architect's and Service Engineer's drawings and specifications.
2. Do not scale from this drawing in either paper or digital form. Use written dimensions only.
3. All dimensions are in millimetres and levels in metres.

LEGEND:–

Denotes existing masonry wall.

Denotes new brick wall.

Denotes new R.C. walls.

400 R.C. — Denotes new 400 thick R.C. Insitu solid slab on 50 thick mass concrete blinding

NOTE:–
LIGHTWEIGHT NON–LOADBEARING PARTITIONS ARE NOT SHOWN ON THIS DRAWING REFER TO ARCHITECTS DRAWINGS FOR DETAILS

Rev	Date	Issued	Amendment
–	18.06.15	DJP	ISSUED FOR PLANNING

Status: PLANNING

SINCLAIR JOHNSTON
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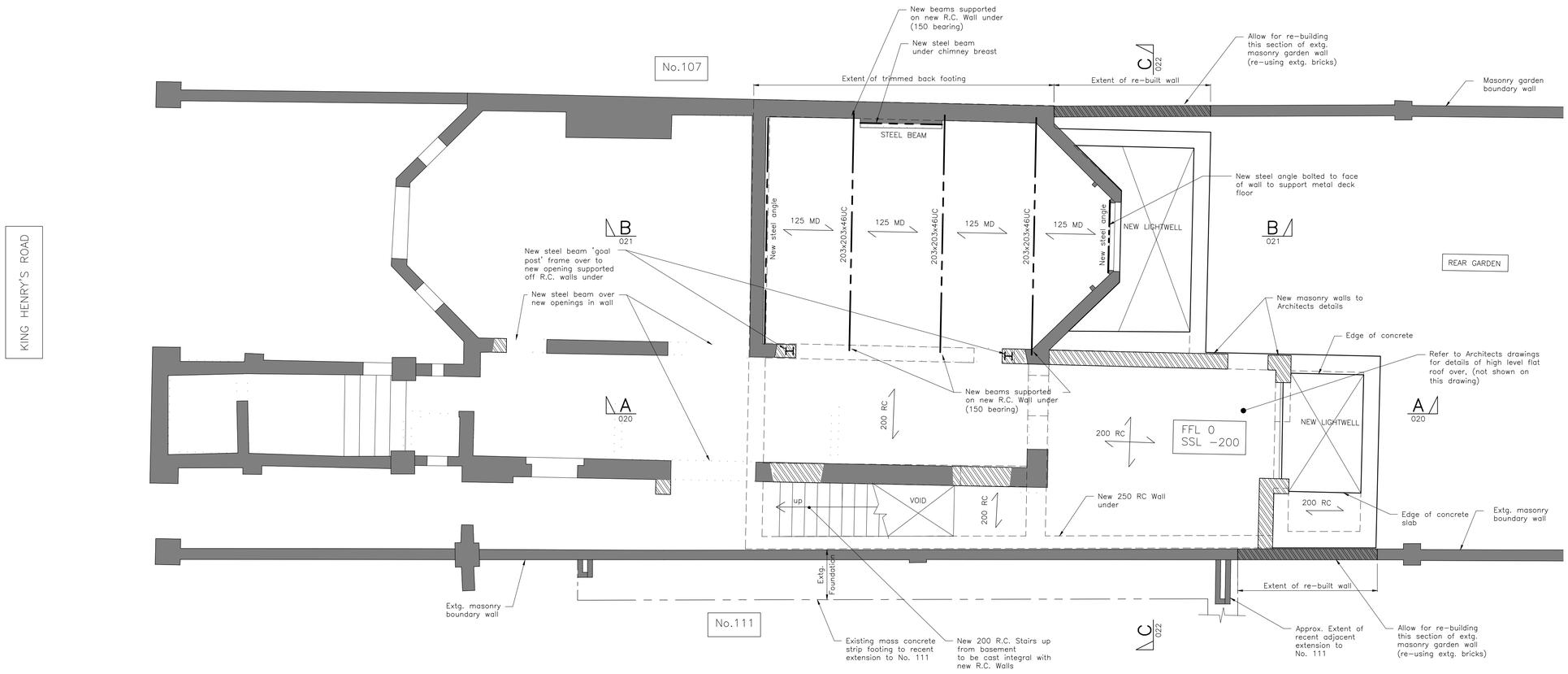
109 KING HENRY'S ROAD LONDON NW3

PROPOSED BASEMENT FLOOR PLAN

Drawn: D Phillips
Scale: 1:50 at A1

Project No./Drawing No.: 8438/008
Rev: –



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2. Do not scale from this drawing in either paper or digital form. Use written dimensions only.
3. All dimensions are in millimetres and levels in metres.

LEGEND:–

- Denotes existing masonry wall.
- Denotes new brick wall. (to be fully tooth bonded into existing)
- Denotes new structure under
- Denotes walls to be demolished
- Denotes new steel beam
- 200 R.C. — Denotes new 200 thick R.C. Insitu suspended solid slab
- 125 M.D. — Denotes span of new 125 overall thick R.C. Insitu metal deck slab comprising of 51 deep metal deck 0.9mm gauge reinforced with one layer of A193 mesh in top with 25 top cover

NOTE:–
LIGHTWEIGHT NON–LOADBEARING PARTITIONS ARE NOT SHOWN ON THIS DRAWING REFER TO ARCHITECTS DRAWINGS FOR DETAILS

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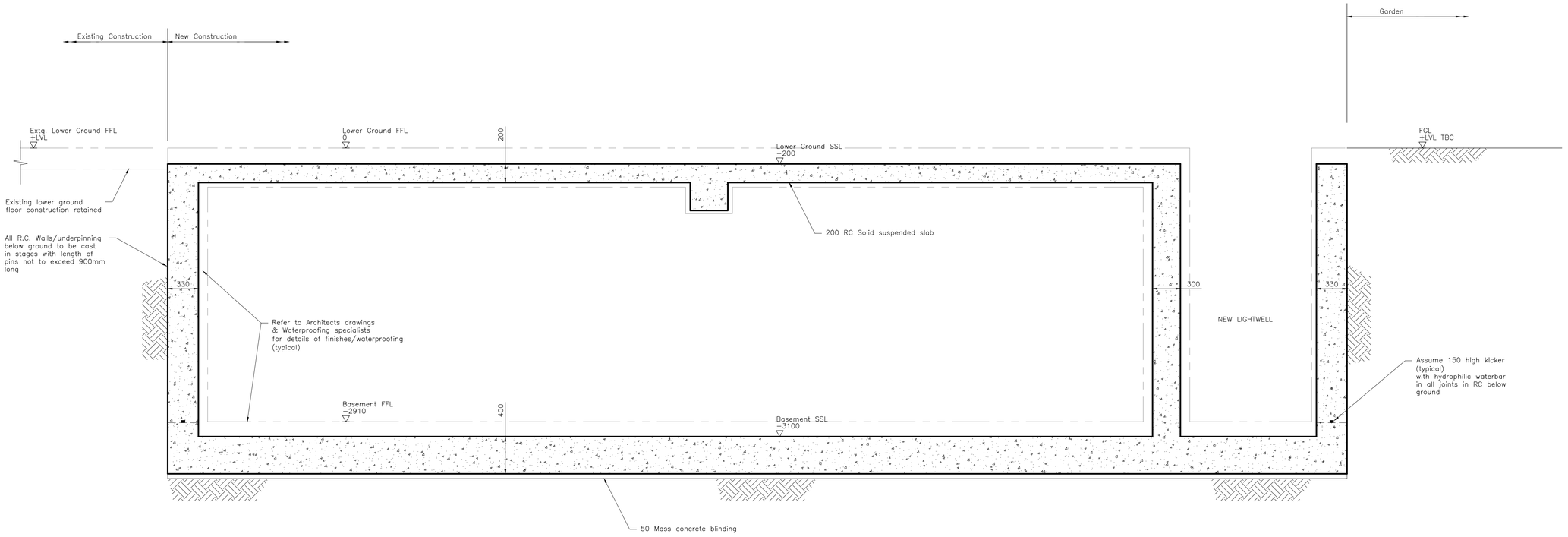
PROPOSED LOWER GROUND FLOOR PLAN

Drawn D Phillips | Scale 1:50 at A1

Project No./Drawing No. 8438/009 | Rev –



SECTION A−A

NOTES:

1. All structural engineering drawings are to be read with the specification and with all relevant Architect's and Service Engineer's drawings and specifications.
2. Do not scale from this drawing in either paper or digital form. Use written dimensions only.
3. All dimensions are in millimetres and levels in metres.

LEGEND:−

Denotes existing masonry wall.

Denotes new brick wall. (to be fully tooth bonded into existing)

Denotes new reinforced concrete

NOTE:−
WATERPROOFING TO BE TO ARCHITECTS DETAILS TO BE CARRIED OUT BY SPECIALIST.

Rev	Date	Issued	Amendment
–	18.06.15	DJP	ISSUED FOR PLANNING

Status
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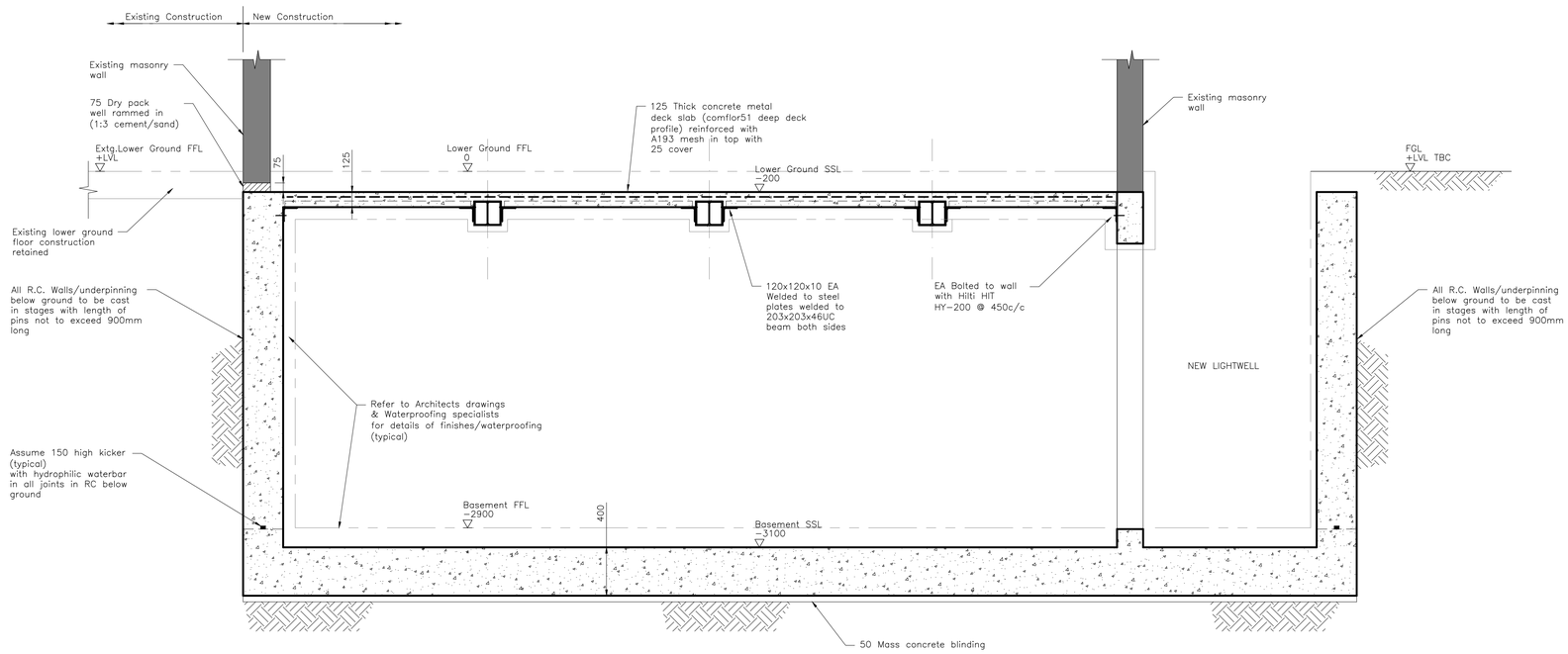
PROPOSED SECTION A−A

Drawn D Phillips
Scale 1:25 at A1

Project No./Drawing No. 8438/020
Rev –



SECTION B−B

NOTES:

1. All structural engineering drawings are to be read with the specification and with all relevant Architect's and Service Engineer's drawings and specifications.
2. Do not scale from this drawing in either paper or digital form. Use written dimensions only.
3. All dimensions are in millimetres and levels in metres.

LEGEND:−

Denotes existing masonry wall.

Denotes new brick wall. (to be fully tooth bonded into existing)

Denotes new reinforced concrete

NOTE:−
WATERPROOFING TO BE TO ARCHITECTS DETAILS TO BE CARRIED OUT BY SPECIALIST.

Rev	Date	Issued	Amendment
−	18.06.15	DJP	ISSUED FOR PLANNING

Status: PLANNING

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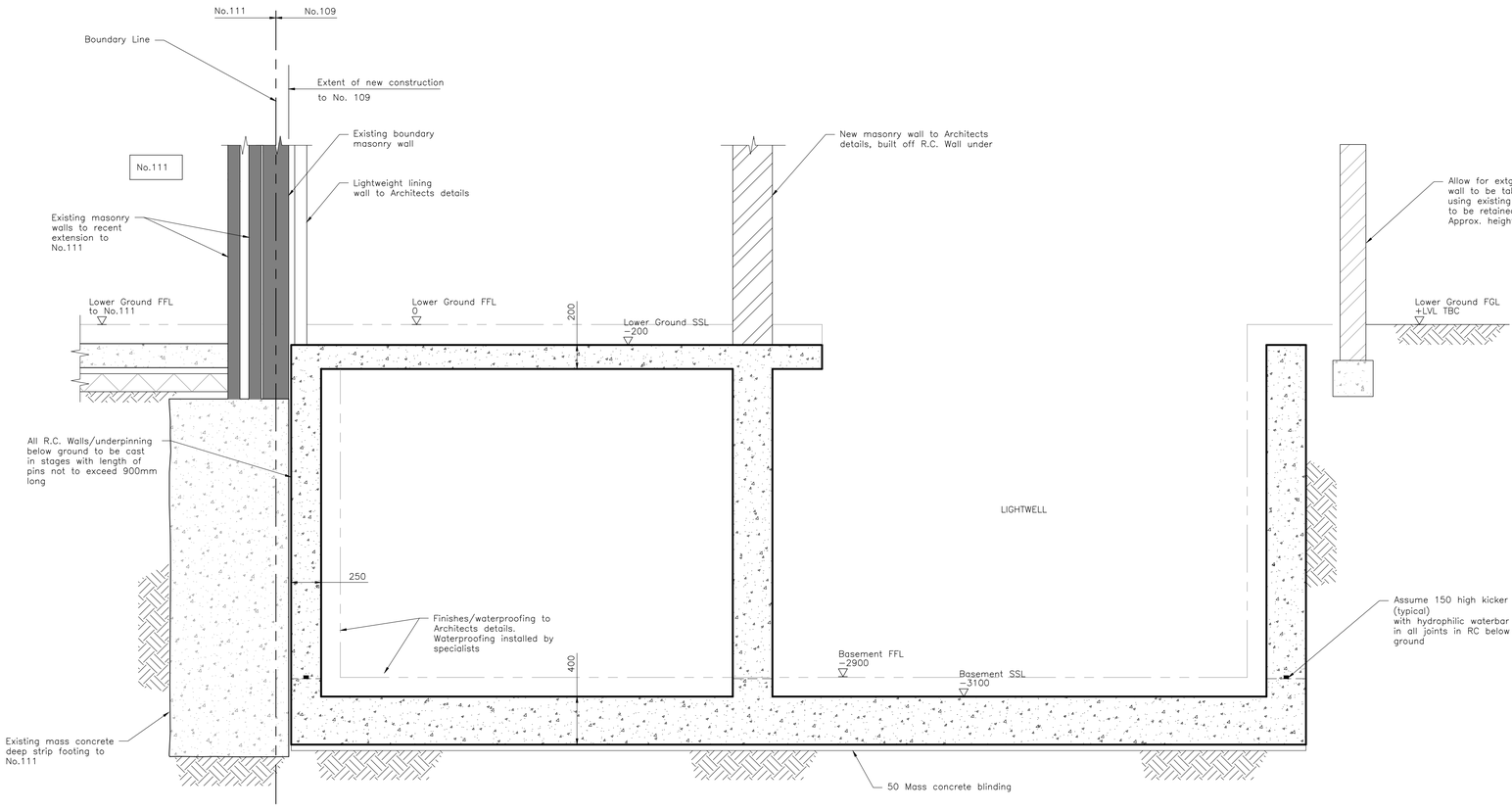
PROPOSED SECTION B−B

Drawn D Phillips | Scale 1:25 at A1

Project No./Drawing No. 8438/021 | Rev −



SECTION C−C

NOTES:

1. All structural engineering drawings are to be read with the specification and with all relevant Architect's and Service Engineer's drawings and specifications.
2. Do not scale from this drawing in either paper or digital form. Use written dimensions only.
3. All dimensions are in millimetres and levels in metres.

LEGEND:−

Denotes existing masonry wall.

Denotes new brick wall.
(to be fully tooth bonded into existing)

Denotes new reinforced concrete

Denotes existing reinforced concrete

NOTE:−
WATERPROOFING TO BE TO ARCHITECTS DETAILS TO BE CARRIED OUT BY SPECIALIST.

Rev	Date	Issued	Amendment
−	18.06.15	DJP	ISSUED FOR PLANNING

Status
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PROPOSED SECTION C−C

Drawn D Phillips
Scale 1:25 at A1

Project No./Drawing No.
8438/22
Rev
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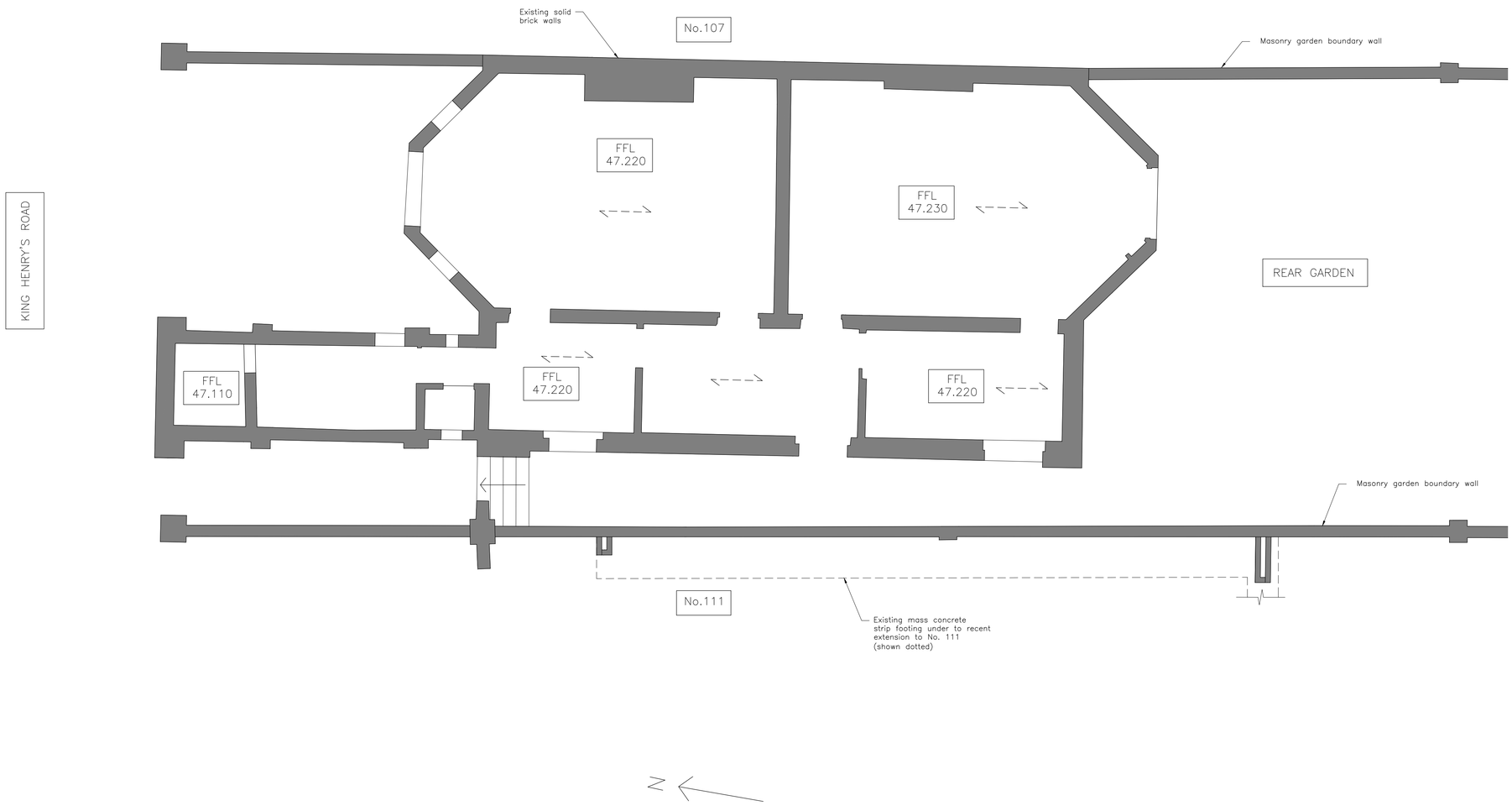

NOTES:

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3. All dimensions are in millimetres and levels in metres.

LEGEND:–

Denotes existing masonry wall.

Denotes assumed span of existing timber floor

Rev	Date	Issued	Amendment
–	18.06.15	DJP	ISSUED FOR PLANNING

Status

PLANNING

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109 KING HENRY'S ROAD LONDON NW3

EXISTING LOWER GROUND FLOOR PLAN

Drawn D Phillips

Scale 1:50 at A1

Project No./Drawing No.
8438/059

Rev
–

Statement of experience on basements

Soiltechnics have carried out a large number of investigations for basement constructions throughout the UK and in more recent years outside the UK

The following table provides a limited number examples (for illustration purposes) of investigations carried out for basements which include interpretative reports providing parameters for detailed design such as settlement / heave, ground movements around basements, hydrological effects and in some cases preliminary design of piles.

Location	ground conditions	Basement	Approx size (m)	Date
Northamptonshire	Glacial Till	Single storey archive store for Rolls Royce. Part open excavation for construction of reinforced concrete box subsequently backfilled	10 x 8	Circa 1992
Central London (Kings Road)	Terrace sands and gravels over London Clays	Two storey deep car park with gardens at ground level. Contiguous pile wall with subsequent insitu concrete box	40 x 20	Circa 2000
Central London (Finsbury square)	Terrace sands and gravels over London Clays	Two storey deep basement below multi storey building with adjacent buildings. Contiguous pile wall with subsequent insitu concrete box	30 x 20	Circa 2002
Central London (Union Street)	Terrace sands and gravels over London Clays	Two storey deep basement below multi storey building with adjacent buildings including tube tunnels. Contiguous pile wall with subsequent insitu concrete box	40 x 30	2009
Central London (Blackfriars)	Terrace sands and gravels over London Clays	Two storey deep basement below multi storey building with adjacent buildings including railway viaduct . Contiguous pile wall with subsequent insitu concrete box	40 x 20	2005
Central London (Imperial College)	Terrace sands and gravels over London Clays	Single storey deep basement below multi storey residential block. Sheet pile walls with subsequent insitu concrete box	60 x15	2005
Coventry University	Mercia Mudstones	Single storey deep basement with three storey building over. Part cut and part sheet piled with subsequent insitu concrete box	50 x50	2010
Rabat Grand theatre Bouregrerg Morrocco	Alluvial gravels over sandstone	Single storey deep basement. Open excavations and sheet piles walls with subsequent insitu concrete box. Piled foundation for super structure. Area subject to earthquakes and liquefaction. Outline design of piles, specification for piling and testing.	50 x50	2012
Central London (various locations)	London Clays occasionally overlain with terrace sands and gravels	Various existing terraced semi and detached domestic properties. New single and two storey deep basements under building foot prints and extending into gardens. Construction using traditional underpinning techniques and contiguous / secant piled walls	Various	2000 to date
Central London (Holland Park)	London Clays	Two locally three storey deep basement below new four storey block of flats. Secant piled walls and insitu concrete box	70 x 20	2014

Curriculam Vitae
Nigel Thornton
B.Sc, C.Eng, MICE, MCIHT, FGS.

soiltechnics
environmental and geotechnical consultants

Qualifications

- Awarded degree in Civil Engineering., City University, London in 1980
- Elected Member of the Institution of Civil Engineers in 1983 (Chartered Civil Engineer)
- Member of the Chartered Institution of Highways and Transportation since 1984
- Fellow of the Geological Society since 1986

Employment History

• Northampton Borough Council	1975 - 1980
• Northamptonshire County Council	1980 - 1989
• The John Parkhouse Partnership	1989 - 1989
• Associate Partner	1989 - 1993
• Partner	1993 - 2005
• JPP Consulting (Director)	2005 to date
• Soiltechnics (Director)	1993 to date

Note

- In 2005, the John Parkhouse Partnership was incorporated into JPP Consulting Ltd (current complement 28 staff)
- Founding Director of Soiltechnics Ltd, a company specialising in geotechnical and geo-environmental matters. (Current complement 27 staff)

Relevant Experience

Bridgeworks

General design, contract administration and site supervision of various highway bridges and retaining structures.

Geotechnical and Geo-environmental

As Geotechnical Project Manager for Engineering Services Laboratory at NCC (ESL). (1985 - 1989)

Control of ground investigations for major highway schemes for local authority including implementation of fieldwork, direction of laboratory testing and production of factual and interpretative reports, following and satisfying geotechnical certification procedures for Department of Transport (schemes up to £15m)

Generally, at ESL, Soiltechnics and JPP.

Design and specification of earthworks, including determination of slope stability. Investigation and remediation of unstable slopes.

Control, implementation of fieldwork and production of geotechnical reports for industrial and commercial developments, housing schemes and water authority infrastructure (scheme values up to £80m).

Investigations for outline designs of landfill sites. Investigations for redevelopment of chemically contaminated sites, assessment of the same, design and verification of remediation works. Production of tender and contract documents for ground investigations.

	Investigations into mine workings and assessment of their stability. Specifications for ground improvement works (vibrotreatment) and piling. Investigations and reporting on a wide range of basement constructions for commercial and residential buildings 1 to 4 stories deep. Producing basement impact reports. Lecturing to other professionals on the investigation assessment and remediation of contaminated land, and EPA part IIA Lectures to local ICE branch on geotechnical aspects.
Materials Management	Production of construction material specifications, primarily in concrete, aggregates and bituminous mixtures, but including masonry, timer, steel and protective systems. Control and implementation of investigations into failures of construction materials including scheduling and analysing test data, and production of technical reports providing specifications for appropriate remedial measures.
Building Structures	Structural inspections and surveys on a wide range of commercial, domestic, industrial and military buildings including direction of appropriate investigations and production of details repairs/construction specifications. Design and checking of building structures in timber, steel, concrete and masonry including supervision of works on site. Design works carried out both manually and using computerised systems following current British Standards and other recognised design standards.
Road Pavement Structures	Direction and implementation of condition surveys and investigations of road pavement using falling weight deflectometer, deflectograph bump integrator and coring. Direction of testing regimes for bituminous and cement bound and unbound pavement materials. Production of reports on condition and assessment of load carrying capacity of existing roadways and specification and structural design for new roadways for both highway and industrial use. Design of various road pavement structures (flexible and rigid) using Highways Agency guidelines and British Ports Federation guidelines.
Drainage and Flood Risk Assessments	Design of main (adoptable) and private foul and stormwater infrastructure for housing, commercial and industrial schemes, including detention basins, infiltration systems, pumping stations etc. Production of flood risk assessment reports.
Quality Assurance	Assisting in production of main laboratory procedures to obtain NAMAS accreditation for large spectrum of soils and materials testing. Geotechnical contributions to Quality Assurance Manual for Soiltechnics/JPP and implementation of procedures.
CPD and Health and Safety	Attendance of in house CPD Seminars and production of Health and Safety Plans/files for building works. Author of in house risk assessment and Practice policies.
Litigation	Acting as expert witness on numerous construction related matters.
Publications	Co-author of a book entitles 'Cracking and Building Movement' published by the Royal Institution of Chartered Surveyors, in late 2004.

Chord Environmental Ltd

Stuart Hadley
Soiltechnics Ltd
Cedar Barn
White Lodge
Walgrave
Northampton
NN6 9PY

Your Ref: 109 King Henry's Road
Our Ref: 1127/LJE160915

For the attention of: Stuart Hadley

16th September 2015

109 King Henry's Road BIA Review

Dear Stuart,

Further to your instruction to proceed on behalf your client (Starlit Properties Ltd) I have undertaken a review of the Basement Impact Assessment (BIA) prepared by Soiltechnics Ltd for the proposed basement development at 109 King Henry's Road.

I have reviewed the design of the proposed basement development, together with the information presented within the above documents, against the requirements of the Camden BIA guidance set out within DP27 and CPG4 (2015).

Chord Environmental specialise in the provision of hydrogeological services with extensive experience in the UK supporting both private and public sector clients. I am a geologist and hydrogeologist and have a BSc. in geology from the University of Bristol, a MSc. in hydrogeology from the University of East Anglia and am also a Chartered Geologist and fellow of the Geological Society. I am Managing Director at Chord Environmental and was previously a Technical Director with Paulex Environmental Consulting and managed Hyder Consulting (UK) Ltd's groundwater team.

I have been a hydrogeologist for 17 years. During that time I have advised on over 90 basement developments. Much of my career has been spent assessing the impact of development on the quality and quantity of groundwater resources. I have worked for both promoters and regulators of schemes and have acted as an expert witness for the Highways Agency and on BIA schemes.

Development proposal

The site is occupied by a four storey semi-detached house including a lower ground floor which is c.1.6m below ground level at the front and north of the property and marginally above ground level to the south and rear of the property. I understand the proposed development comprises a single storey, 3.5m deep basement, fully extending beneath the ground floor footprint and 6m into the rear gardens including lightwells.

Environmental Site Setting

The BIA screening assessment and site investigation interpretation has identified 109 King Henry's Road to be underlain by the Eocene London Clay as shown on the British Geological Survey 1:50,000 scale map (Sheet 256 – North London) to a depth of c.80m. The London Clay is classified as Unproductive Strata by the Environment Agency, strata with low permeability that have negligible significance for water supply or base flow to rivers. The very low permeability of the London Clay results in very low rates of rainfall infiltration and correspondingly, very high rates of rainfall runoff.

The London Clay, together with the clays of the Lambeth Group, acts as an effectively impermeable confining layer over the Chalk which lies at a depth of over 100m beneath the site.

There are no surface water features within 500m of the site. Figure 11 of the "Camden Geological, Hydrogeological and Hydrological Study", shows a headwater tributary of the former Tyburn watercourse to have run just over 200m to the west of the proposed development. The Tyburn is now culverted beneath South Hampstead and discharges to the Thames.

King Henry's Road does not lie within an area of flood risk as designated by the Environment Agency and was not identified as being one of the roads affected by the surface water flooding events of the area which occurred during 1975 and 2002.

Surface Flow and Flooding Assessment

The BIA screening, scoping and risk assessments have followed the CPG4 guidance criteria and screening questions. The potential surface flow and flooding issue raised by the screening and scoping exercises have been appropriately addressed by Soiltechnics within the report and no areas of concern relating to the proposed development were identified.

Subterranean (Groundwater) Flow Screening Assessment

The BIA screening, scoping and risk assessments have followed the CPG4 guidance screening questions. I have commented on the answer to each question below.

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

  As the Site is mapped as being underlain by a significant thickness of London Clay, designated as Unproductive Strata by the Environment Agency, I agree it is not located above an aquifer. The geology of the areas is well understood and the published geological map is based on extensive borehole data.

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

  No. No groundwater was encountered within the London Clay during the site investigations. The London Clay is not capable of transmitting groundwater but because it is predominantly clay, it does hold water. As such there is not generally a water table present within it. Monitoring boreholes drilled within the London Clay often slowly fill with groundwater over time; however there is little or no hydraulic continuity between boreholes due to the very low permeability of the clay and ability of the clay matrix to hold or adsorb water.

- **Question 2: Is the site within 100m of a watercourse, well (used/disused) or potential spring line?**

  No surface water features are present within 500m of the site. The London Clay is not capable of providing groundwater baseflow to watercourses and is classified Unproductive Strata. The proposed basement would therefore not act to prevent groundwater flow to any watercourses, wells or spring lines.

- **Question 3: Is the site within the catchment of the pond chains on Hampstead Heath?**

  No. The Site is located more than 1.5 km south, and down topographic gradient, of the Hampstead Heath ponds and therefore lies outside their hydrological catchment area.

- **Question 4: Will the proposed development result in a change in the proportion of hard surfaced / paved area?**

  The proposed basement development would result in a net increase in hard surfaced area. In relation to the assessment of the proposed development on groundwater flow, the purpose of this question is to determine whether rainfall recharge to an underlying aquifer would be reduced. However, the London Clay's low permeability results in a negligible rate of rainfall infiltration and a correspondingly high rainfall runoff rate, therefore the proposed basement would not have an impact on groundwater resources.

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

  No. The lowly permeable nature of the London Clay strata is unsuitable for receiving surface water discharge to ground due to extremely low infiltration rates.

- **Question 6: Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond (not just the pond chains on Hampstead Heath) or spring line?**

  I agree there are no mapped local groundwater dependent ponds or spring lines present within 100m of the Site. This is consistent with the geology and hydrogeology of the area.

Slope Stability Assessment

The BIA screening, scoping and risk assessments have followed the CPG4 guidance criteria and screening questions. The potential slope stability issues raised by the screening and scoping exercises have been appropriately addressed by Nigel Thornton (C.Eng) of Soiltechnics Ltd within the BIA report and no areas of concern relating to the proposed development were identified.

Conclusions

The BIA report has appropriately characterised 109 King Henry's Road with respect to its geological and groundwater site setting. As the site is underlain by low permeability London Clay, the geological and hydrogeological setting of 109 King Henry's Road is not sensitive with respect to groundwater resources or flow.

The purpose of the Basement Impact subterranean or groundwater flow assessment is to identify the potential for the proposed basement development to cause groundwater impacts and subsequently identify areas which require further investigation. The proposed development would be sited within a significant thickness of London Clay and no potential adverse groundwater impacts have been established by these assessments.

Yours sincerely,

John Evans BSc MSc CGeol.

Director

THE GEOLOGICAL SOCIETY
CGeol
CHARTERED GEOLOGIST
Fellow No. 1012979

Proposed development,
109 King Henry's Road

soiltechnics
environmental and geotechnical consultants

Key

TP — Approximate location of trial pit excavation

BH — Approximate location of borehole formed by Cable and Tool percussive techniques

Title	Scale	Drawing number
Plan showing observed site features and location of exploratory points	1:200 @ *A3*	02

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Key to legends

Composite materials, soils and lithology

Topsoil	Made Ground	Boulders
Chalk	Clay	Coal
Cobbles	Cobbles & Boulders	Concrete
Gravel	Limestone	Mudstone
Peat	Sand	Sand and Gravel
Sandstone	Silt	Silt / Clay
		Siltstone

Note: Composite soil types are signified by combined symbols.

Key to 'test results' and 'sampling' columns

Test result	
Depth	Records depth that the test was carried out *(i.e.: at 2.10m or between 2.10m and 2.55m)*
Result	PID - Photo Ionisation Detector result (ppm equivalent Isobutylene) PP – Pocket penetrometer result (kN/m^2) HVP – Hand held shear vane result (kN/m^2) *PP result converted to an equivalent undrained shear strength by applying a factor of 50. Where at least 3 results obtained at same depth then an average value may be reported.*
	SPT – Standard Penetration Test result (uncorrected)[1,2,3] *SPT(c) – Standard Penetration Test result (solid cone) (uncorrected)*[1,2,3]

Sampling		
From (m) To (m)	Records depth of sampling	
Type	D	Disturbed sample
	B	Bulk disturbed sample
	ES	Environmental sample comprising plastic and/or glass container
	W	Water sample
	U (32)	Undisturbed sample 100mm diameter sampler with number of blows of driving equipment required to obtain sample

Note [1]: Seating blows recorded in brackets.
Note [2]: Casing depth records depth of casing when SPT or SPT(c) was carried out.
Note [3]: Water depth records depth of water when SPT or SPT(c) was carried out.

Water observations

Described at foot of log and shown in the 'water strike' column.

▼ = water level observed after specified delay in drilling

▽ = water strike

Standpipe details

Gravel filter

Arisings

Bentonite

Slotted pipe

Unslotted pipe

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WELL	DESCRIPTION	LEGEND	DEPTH (m)	WATER STRIKE	TEST RESULTS				SAMPLING		
					TYPE/ DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	FROM (m)	TO (m)	TYPE
	Grass onto dark brown slightly silty slightly sandy CLAY with rare gravels of fine to medium sub-angular brick.		0.20						0.20	0.50	B
	MADE GROUND		0.50								
	Medium strength dark brown slightly silty slightly gravelly CLAY. Gravel consists of fine to medium sub-angular brick and organic matter.		1.00		PP 1.00	75					
	MADE GROUND								1.20		D
	Medium strength brown and orange brown mottled light grey silty CLAY with rare gravels of fine to couarse angular to sub-angular brick.				PP 1.80	75					
	MADE GROUND				PP 2.00	100			2.00	2.45	U(65)
	Medium becoming high strength brown mottled grey slightly silty CLAY.								2.00		D
	LONDON CLAY FORMATION								2.50		D
					PP 2.80	100					
					PP 3.00	100			3.00		D
					PP 4.00	100			4.00		D
					SPT 5.00-5.45	(4) 18	1.60	DRY	5.00	5.50	D
									5.00		D
					PP 5.00	117					
					PP 6.00	125			6.00	6.50	D
									6.00		U(100)
	BOREHOLE TERMINATED AT 7.00m		7.00		PP 7.00	175			7.00		D

Notes:

Ground level (mAOD)

Co-ordinates

Title
Borehole record

Method of excavation
Cable and tool percussion rig

Groundwater observations
No groundwater encountered.

Date of excavation (range if applicable)
18/05/2015

Appendix
C

Location plan on drawing number
02

BH01

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WELL	DESCRIPTION	LEGEND	DEPTH (m)	WATER STRIKE	TEST RESULTS				SAMPLING		
					TYPE/ DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	FROM (m)	TO (m)	TYPE
	Grass onto medium strength brown and grey slightly silty slightly sandy slightly gravelly CLAY. Gravel consists of fine to coarse angular to sub-angular brick, organic matter and rare fine to medium sub-rounded to rounded quartzite. MADE GROUND				PP 0.50	50					
			0.50						0.80	1.00	B
	Grass onto medium strength brown and grey slightly silty slightly sandy slightly gravelly CLAY with rare roots up to 7mm in diameter. Gravel consists of fine to coarse angular to sub-angular brick, organic matter and rare fine to medium sub-rounded to rounded quartzite. MADE GROUND				PP 1.20	50			1.20		D
			1.50		SPT	(2) 12	1.50	DRY	1.50	2.00	D
					1.50-1.95				1.50		D
					PP 1.50	75					
					PP 1.80	100			2.00		D
					PP 2.00	100					
	High strength becoming very high strength brown occasionally mottled grey slightly silty CLAY with occasional fine to medium mudstone gravels to 3m depth. LONDON CLAY FORMATION										
					SPT	(3) 14	1.50	DRY	3.00	3.50	D
					3.00-3.45				3.00		D
					PP 3.00	125					
					PP 3.50	125					
					PP 4.00	125			4.00	4.45	U(63)
									4.00		D
									4.50		D
					PP 4.60	125					
					PP 5.00	125			5.00		D
					PP 6.00	150			6.00		D
	BOREHOLE TERMINATED AT 7.00m		7.00		PP 7.00	150			7.00		D

Notes: Standpipe installed to 7m depth.

Ground level (mAOD)

Co-ordinates

Title
Borehole record

Method of excavation
Cable and tool percussion rig

Groundwater observations
No groundwater encountered.

Date of excavation (range if applicable)
19/05/2015

Appendix
C

Location plan on drawing number
02

BH02

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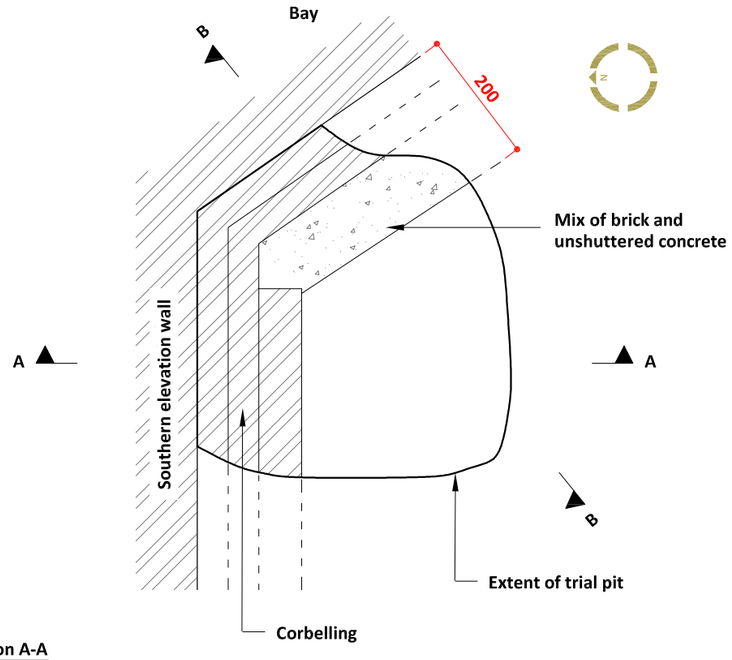
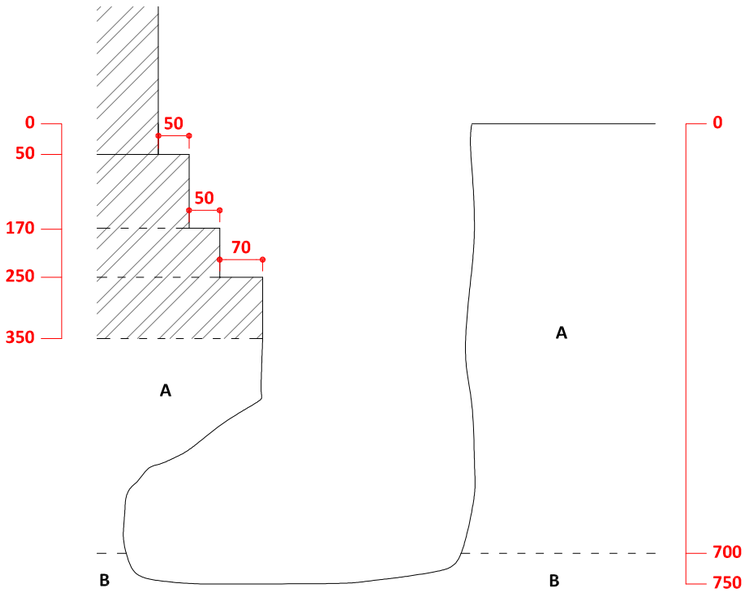
Plan

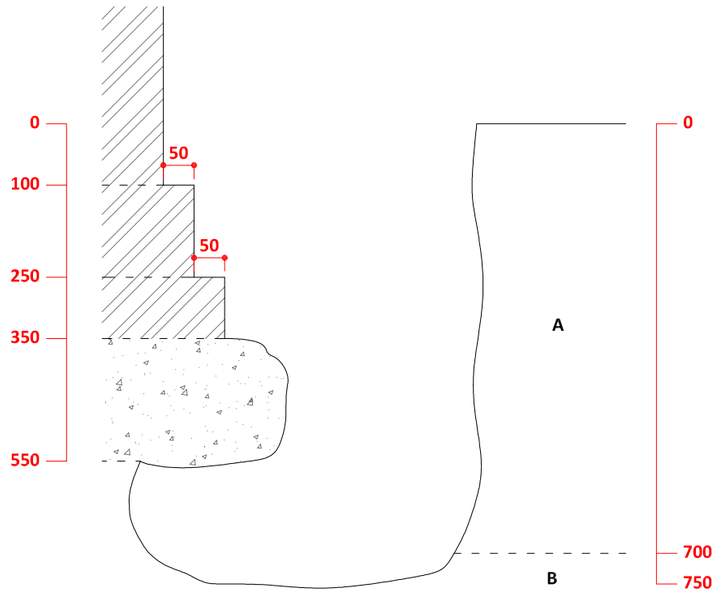


Photographic record

Section A-A



Section B-B



Key

A. Medium strength brown and grey silty sandy very gravelly CLAY with occasional cobbles of brick and concrete. Gravel consists of sub-angular to sub-rounded brick, flint and concrete.
(MADE GROUND)

B. Medium strength brown mottled grey slightly silty slightly sandy slightly gravelly CLAY. Gravel consists of fine to medium sub-angular to sub-rounded flint.
(LONDON CLAY FORMATION)

Observed features
Assumed features

Denotes brickwork

Denotes concrete

Notes

1. All dimensions shown in millimetres
2. Disturbed sample taken from 0.4m depth

Method of excavation	
Hand tools	
Trial pit dimensions	
As shown	
Groundwater observations	
No groundwater encountered	

Title	Trial pit number
Trial pit record	TP01
Date of excavation	Location plan on drawing number
09.04.2015	02
Scale	Appendix
1:10 at A3	B

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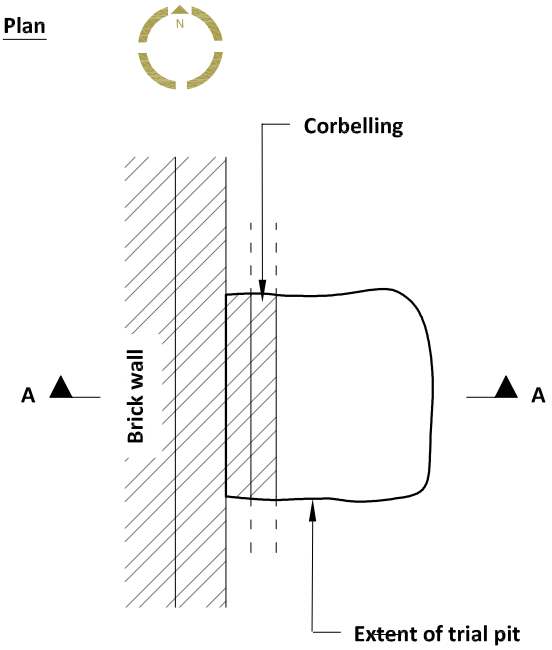
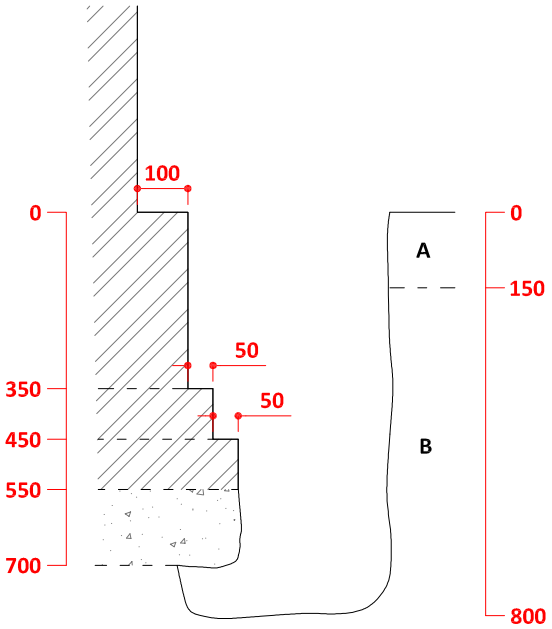
Plan



Section A-A



Photographic record

Key

A. Brown and grey silty sandy very gravelly CLAY with occasional cobbles of brick and concrete. Gravel consists of fine to coarse sub-angular to sub-rounded brick, flint and concrete.
(MADE GROUND)

B. Medium strength brown mottled grey slightly silty sandy gravelly fine to medium CLAY with occasional cobbles of brick. Gravel consists of brick, sub-angular to sub-rounded flint and concrete.
(MADE GROUND)

Observed features
Assumed features

Denotes brickwork
Denotes concrete

Notes

1. All dimensions shown in millimetres
2. Disturbed samples taken from 0.1m and 0.4m depths
3. Pocket penetrometer testing:
   - PP 0.2m = 58 kN/m²
   - PP 0.4m = 50 kN/m²
   - PP 0.6m = 68 kN/m²

Method of excavation	
Hand tools	
Trial pit dimensions	
As shown	
Groundwater observations	
No groundwater encountered	

Title	Trial pit number
Trial pit record	TP02
Date of excavation	Location plan on drawing number
09.04.2015	02
Scale	Appendix
1:15 at A4	B

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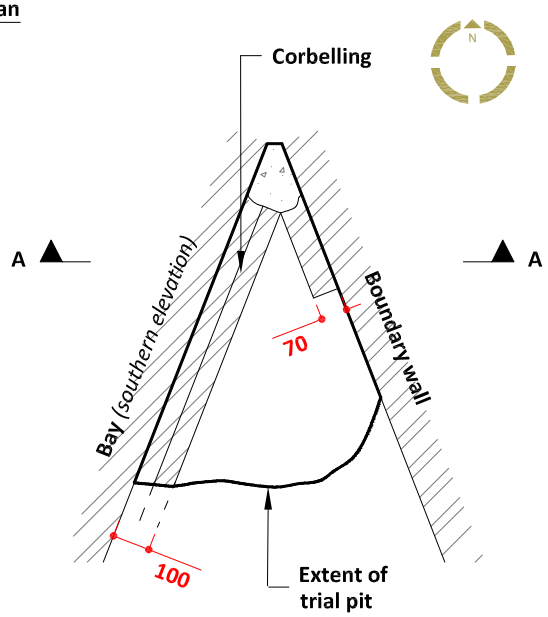
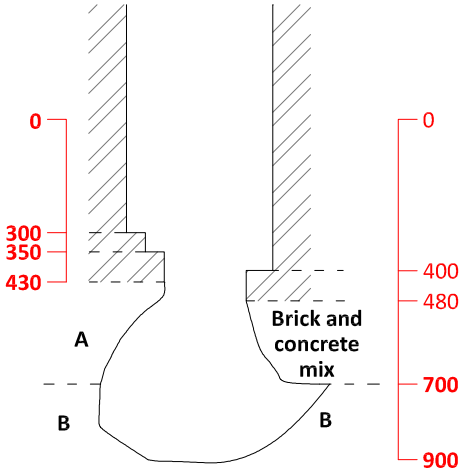
Plan



Photographic record

Section A-A



Key

A. Medium strength brown and grey silty sandy very gravelly CLAY with occasional cobbles of brick and concrete. Gravel consists of sub-angular to sub-rounded brick, flint and concrete.
(MADE GROUND)

B. Medium strength brown mottled grey slightly silty slightly sandy slightly gravelly CLAY. Gravel consists of fine to medium sub-angular to sub-rounded flint.
(LONDON CLAY FORMATION)

Observed features
Assumed features

Denotes brickwork
Denotes concrete

Notes

1. All dimensions shown in millimetres
2. Disturbed samples taken from 0.2m and 0.8m depth

Method of excavation	
Hand tools	
Trial pit dimensions	
As shown	
Groundwater observations	
No groundwater encountered	

Title	Trial pit number
Trial pit record	TP03
Date of excavation	Location plan on drawing number
09.04.2015	02
Scale	Appendix
1:20 at A4	B

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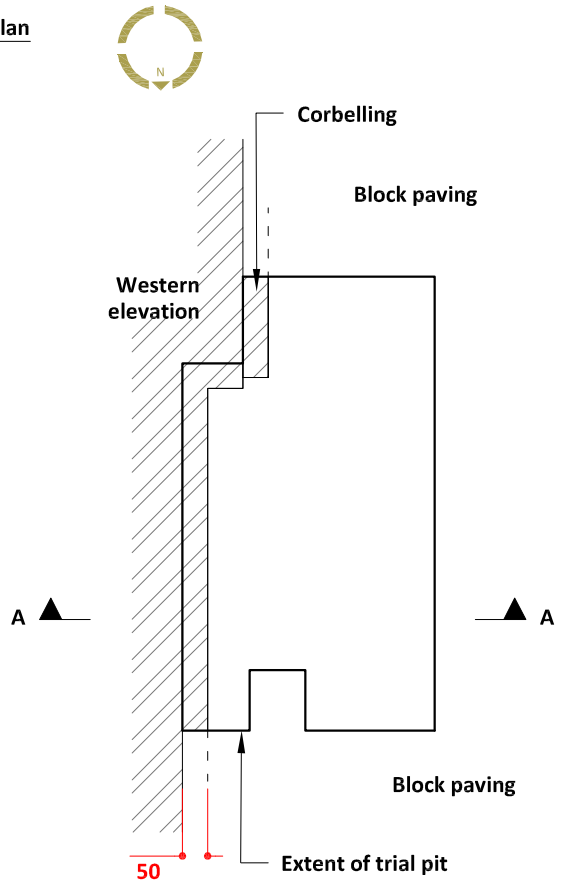
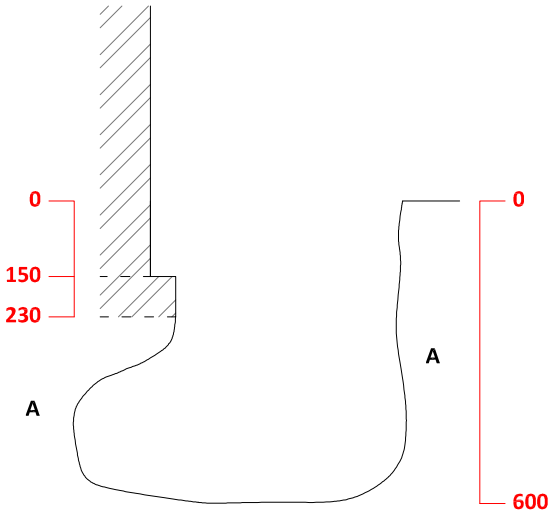
Plan



Photographic record

Section A-A



Key

A. Medium to low strength brown and grey silty sandy very gravelly CLAY with occasional cobbles of brick and concrete. Gravel consists of sub-angular to sub-rounded fine to coarse brick, flint and concrete.
(MADE GROUND)

Observed features
Assumed features

Denotes brickwork
Denotes concrete

Notes

1. All dimensions shown in millimetres
2. Disturbed samples taken from 0.4m depth
3. Pocket penetrometer testing:
   - PP 0.2m - 1.0/1.0/1.0 (50 kN/m²)
   - PP 0.4m - 0.5/0.5/0.3 (21 kN/m²)
   - PP 0.5m - 0.3/0.5/0.5 (21 kN/m²)

Method of excavation	
Hand tools	
Trial pit dimensions	
As shown	
Groundwater observations	
No groundwater encountered	

Title	Trial pit number
Trial pit record	TP04
Date of excavation	Location plan on drawing number
09.04.2015	02
Scale	Appendix
1:15 at A4	B

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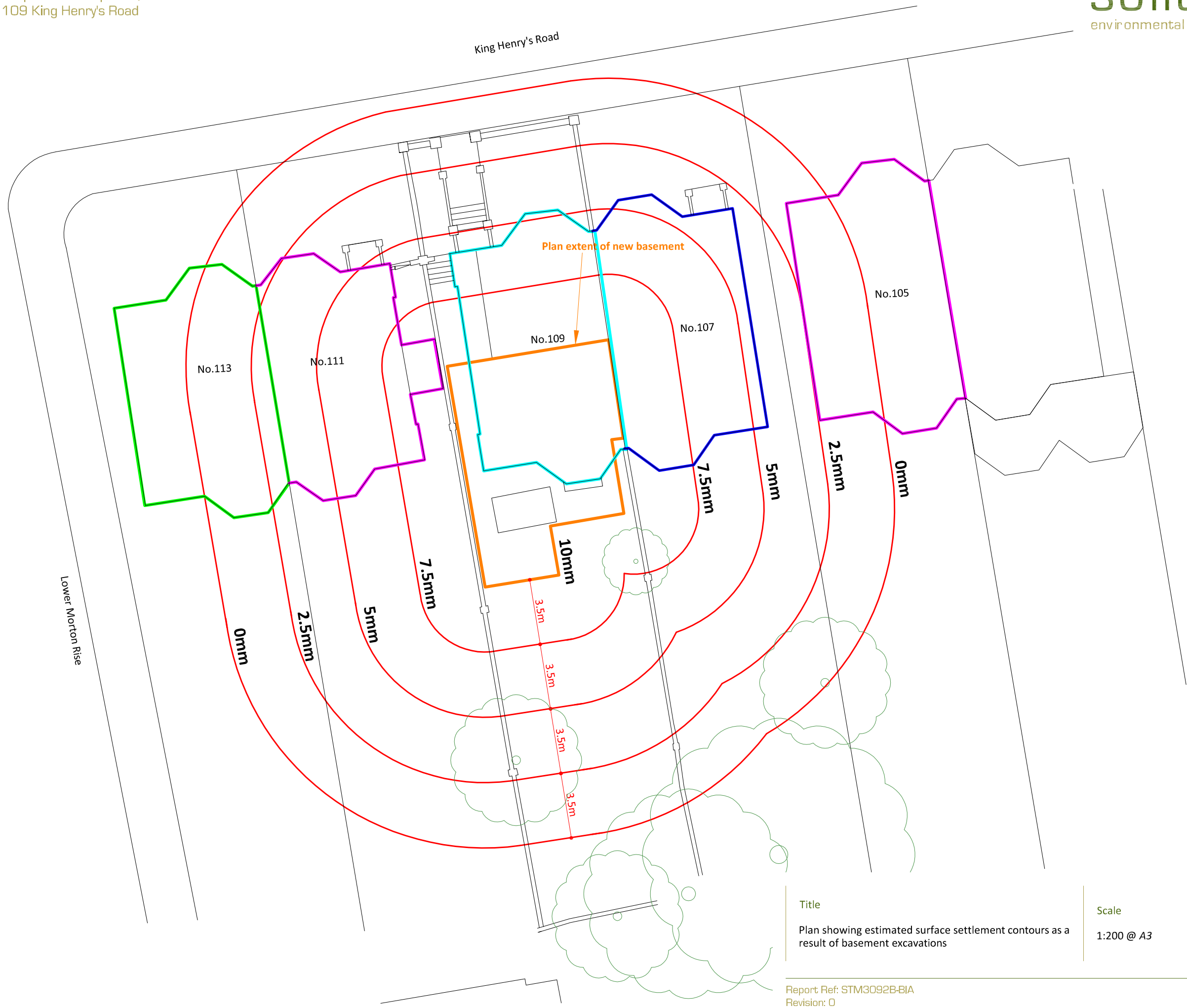

Title	Scale	Drawing number
Plan showing estimated surface settlement contours as a result of basement excavations	1:200 @ *A3*	01

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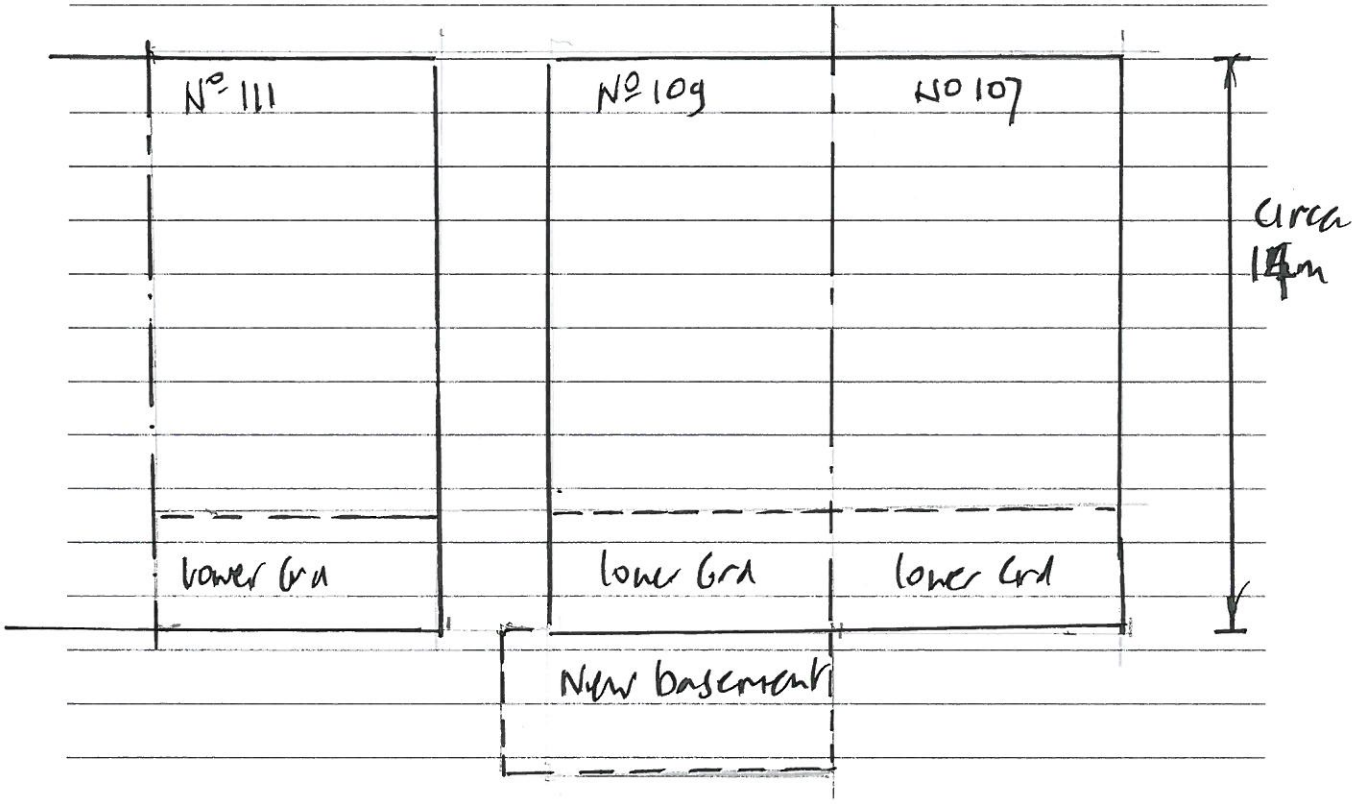
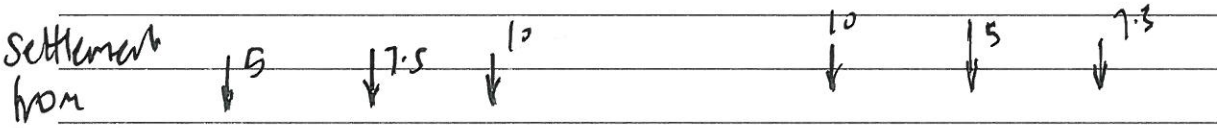
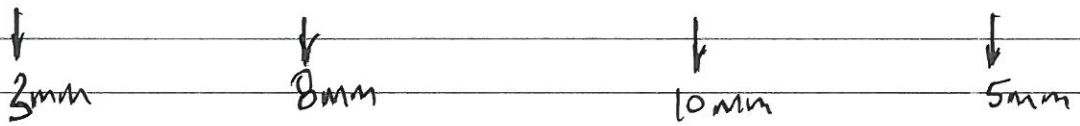
Rear Elevations on Nº111, 109 and 107 King Henry's Road







settlements on end wall / party wall lines

Originator SH	Checked NLT	Title Estimate of tensile strain in masonry
Sheet number 10f4		Date: September 2015

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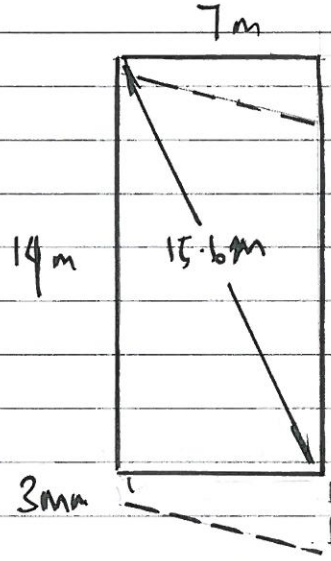
Elevations on page 1 considered to be most vulnerable to movement damage due to excavation of basement at N° 109. Refer drawing 01 for predicted movement / settlement contours

Consider rear elevation of N° 111.

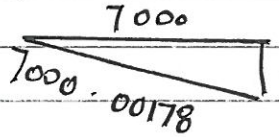


Deformation - vertical component only

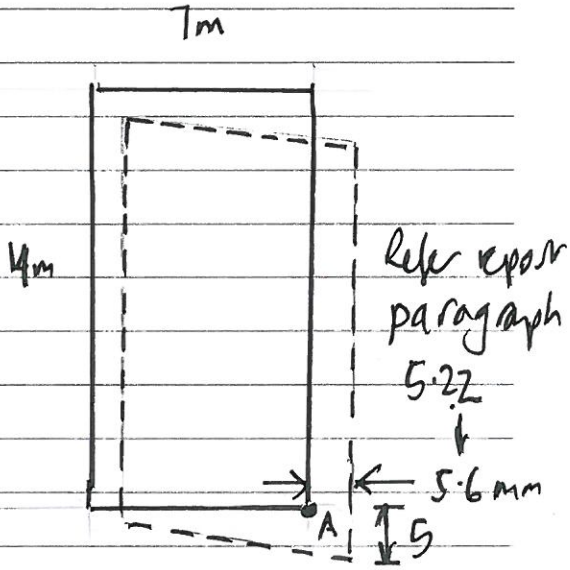
tensile strain on diagonal

$\frac{5}{15600} \times 100 = 0.032\%$

tensile strain on horizontal

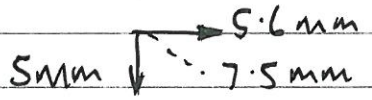


$\frac{1.78}{7000} \times 100 = 0.0254\%$



Deformation for horizontal and vertical components

At A



tensile strain on diagonal

$\frac{7.5}{15600} \times 100 = 0.048\%$

tensile strain on horizontal

$\frac{(1.78+5.6)}{7000} \times 100 = 0.105\%$

Originator SH	Checked NLT	Title Estimate of tensile strain in masonry
Sheet number		Date: September 2015

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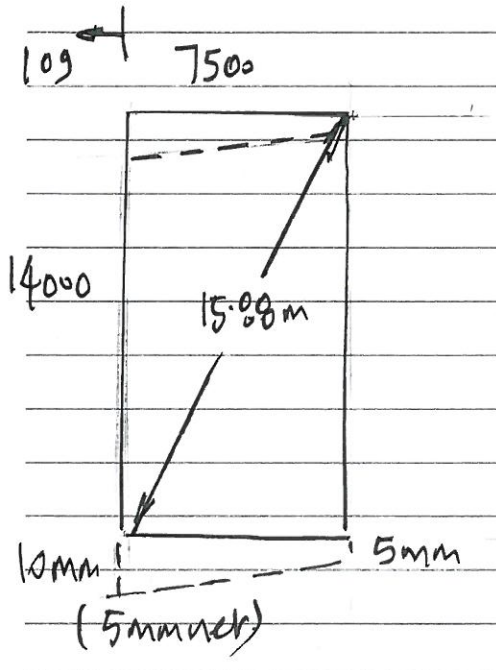
Consider elevation of N° 107

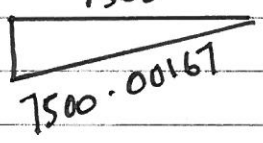


Deformation for vertical component only.

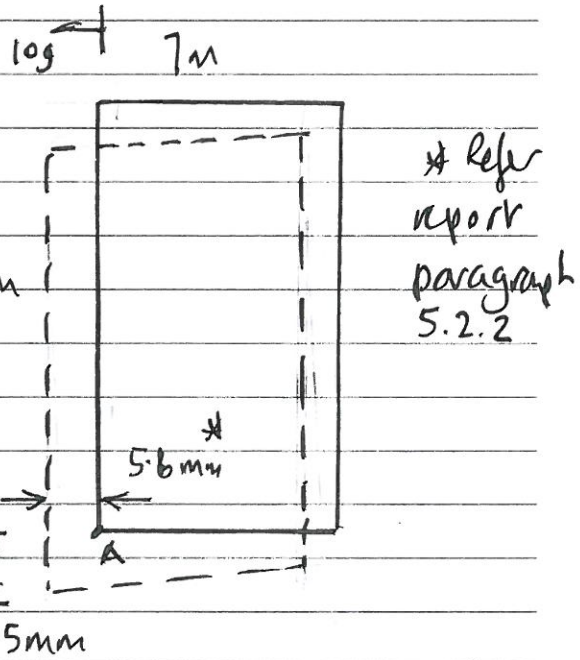
tensile strain on the diagonal

$= \frac{5}{15880} \times 100 = 0.031\%$

tensile strain on horizontal

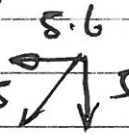


$\frac{1.67}{7500} \times 100 = 0.022\%$



* Refer report paragraph 5.2.2

Deformation for horizontal and vertical components at A



tensile strain on diagonal

$= \frac{7.5}{15880} \times 100 = 0.047\%$

tensile strain on horizontal

$\frac{(1.67+5.6)}{7500} \times 100 = 0.096\%$

Originator SH	Checked NLT	Title Estimate of tensile strain in masonry
Sheet number		Date: September 2015

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Tensile strain in horizontal direction considering horizontal and vertical components of predicted movements exceeds Burlands category 1 damage (exceeds 0.075% strain)

Determine amount of horizontal movement which would reduce damage to category 0 or 1

Consider № 107 only.

Horizontal (inward yielding movement) limit for Burland category 0

$$\frac{(1.67 + x)}{7500} \times 100 = 0.05\%$$

$$x = 2\text{mm}$$

for Burland category 1

$$\frac{(1.67 + x)}{7500} \times 100 = 0.075\%$$

$$x = 4\text{mm}$$

Monitor inward yield movements to less than 4mm by adjustable propping to compensate.

Date 13 March 2015

Our Ref 20878-NG-4-130315

Your Ref STM3092B

To Rachel Brown

soiltechnics

Rachel.Brown@soiltechnics.net

London Underground Limited

Hello Rachel,

109 King Henry's Road, London NW3 3QX.

Thank you for your communication of 12th March 2015.

I can confirm that London Underground has no assets within 50 metres of your site as shown on the plan you provided.

However, there are Network Rail assets close to this site.

Please contact the following to query what affect if any your proposals will have on the railway:

Asset Protection Anglia Route
Network Rail
Floor 11
One Stratford Place
Stratford
London
E20 1EJ

Telephone number 0203 356 2510

Email: AssetProtectionAnglia@networkrail.co.uk

Should you have any further enquiries, please do not hesitate to contact me.

Nicole Gaskin
Assistant Information Manager
LUL Infrastructure Protection
E-mail: Locationenquiries@tube.tfl.gov.uk
Tel: 020 7027 8535