soiltechnics

environmental and geotechnical consultants

Proposed development including basement
Land adjoining No. 43 Carol Street
London
NW1 0HT

Basement Impact Assessment Report

Revision 05 updated 16th February 2018

Cedar Barn, White Lodge, Walgrave, Northamptonshire NN6 9PY

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Soiltechnics Ltd. Cedar Barn, White Lodge, Walgrave, Northampton. NN6 9PY.
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RISQS RAILWAY INDUSTRY SUPPLIER QUALIFICATION SCHEME AUDITED

ACM Registered to: ISO 9001 ISO 14001 OHSAS 18001 UKAS MANAGEMENT SYSTEMS 245 OCCUPATIONAL HEALTH & SAFETY MANAGEMENT

Aerial photograph of property

Approximate property boundaries edged in **red**

Report status and format

Report section	Principal coverage	Report status	
		Revision	Comments
1	Introduction and brief	1	Location reference amended, and reference added to Structural Engineers Design Statement for planning
		2	Section 1.2 updated.
2	Description of the property and project proposals		
3	Desk study information and site observations		
4	Ground investigations		
5	Ground movement analysis	1	Retitled
		2	Services impact added
6	Hardened areas		
7	Tree removal		
8	Existing damage to adjacent buildings		
9	Conceptual model		New addition
10	Subterranean (Groundwater flow) screening		
11	Stability impact identification	1	Reference added to Structural Engineers Design Statement for planning
12	Surface flow and flooding impact identification		
13	Non-technical Summary and Conclusion.		Revised section heading
14	Audit query tracker		New addition

Revision 02- minor text changes and reference to Camden's policy A5
Revision 03 – minor text correction and inclusion of Chord Environmental report
Revision 04 – Updates in response to LPA audit queries
Revision 5 – Updates to address comments by eHRW

List of appendices

Appendix	Content
A	Copy of drawings illustrating development proposals provided by Engineers HRW
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	Borehole and trial pit records and plot of characteristic undrained shear strength (drawing BIA 02)
E	Plan showing estimated surface settlement contours as a result of basement excavations (drawing BIA 01)
F	Copy of calculations to estimate damage to adjacent properties as a result of basement excavation.
G	Details of groundwater level monitoring standpipe installed at the site and records of monitoring.
H	Copy of below ground services plan (by Randall Services ltd)

1 Introduction and brief

1.1 Objectives

This report presents a Basement Impact Assessment (BIA) for a proposed development on land adjoining No. 43 Carol Street in Camden, London.

The principal objective of the assessment is to present evidence to support a planning application for the project as required by Camden local plan adopted version (June 2017) policy A5.

A ground investigation report (Ref STM3348D-G01, September 2017) has also been produced considering potential chemical / gaseous contamination and engineering considerations to satisfy the requirements of 'guidance for subterranean development' (GSD) appendix G.

1.2 Client instructions and confidentiality

This report has been produced following instructions received through Engineers HRW on behalf of our mutual client Make Some Space Ltd.

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.

This report has been updated in response to queries raised by Campbell Reith (Consulting Engineers) appointed by the London Borough of Camden as part of the planning application process to review this basement impact assessment report.

1.3 Supervisors qualifications

This report has been prepared by a Geo-Environmental Engineer (B.Sc.) who is also a Fellow of the Geological Society (FGS). The report preparation was supervised Chartered Civil Engineer, (C.Eng., M.I.C.E) who is also a Fellow of the Geological Society (FGS). The supervising engineer is a practising Civil Engineer with specialist experience (37 years) in geotechnical engineering (including basement construction), flood risk and. A copy of the CV of all involved in the preparation of the report and 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 is presented in Appendix C.

1.4 Guidance used

As described in paragraph 1.1.2 above we have followed the requirements of Camden Local Plan -Adopted version (June 2017) – policy A5 (basements) and the following documents referenced in A5:

- Camden Planning Guidance (CPG4) '*Basements and lightwells'*,
- 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.

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;

In order to satisfy part a) a construction method statement has been prepared by a Structural Engineer which is separately presented, please refer to the Structural Engineer's Design Statement for planning.

1.5 Format of this report in relation to CPG4

Sections 3 to 8 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 CPG4. Answers for these flow chart questions are provided in sections 9 to 11.

2 Description of the property and project proposals

2.1 Description of the property

The site is currently an undeveloped site previously used as a garden area. The site is currently grassed with some concrete paving. Several trees are present on site of various maturity and species and a row of dense shrubbery is present along the north-west boundary. A shallow dip in ground level (approximately 0.7m deep) is present along the north-east boundary of the site.

The north-west boundary is marked by a 2m high steel railing fence with a timber hording fence to the south west. A brickwork wall marks the south-east boundary that is some 2m in height. The north-east boundary of site is marked by the adjacent property to the north and a 2m high timber fence to the south.

Residential properties are present to the north east which are three storeys in height and of traditional brick construction. There are light industrial units to the southwest with perimeter walls in masonry. Carol Street runs along the north-west boundary of the site with further terraced residential housing beyond. To the south is an area of public open space named as St Martin's Gardens.

Levels within the site fall by about 1m in a northerly direction, however general ground levels in the area fall in a north easterly direction by about 2.2 degrees generally following Carol Street. Garden levels are reasonably uniform. The adjacent properties show no evidence of basements.

2.2 Project proposals

A new mixed use three storey structure is proposed with a single storey deep basement. The basement, and ground floor are to be studio/workshops with a residential apartment above. The basement excavation (to basement slab formation level) will extend to depths of between 3.85 and 4.85m.

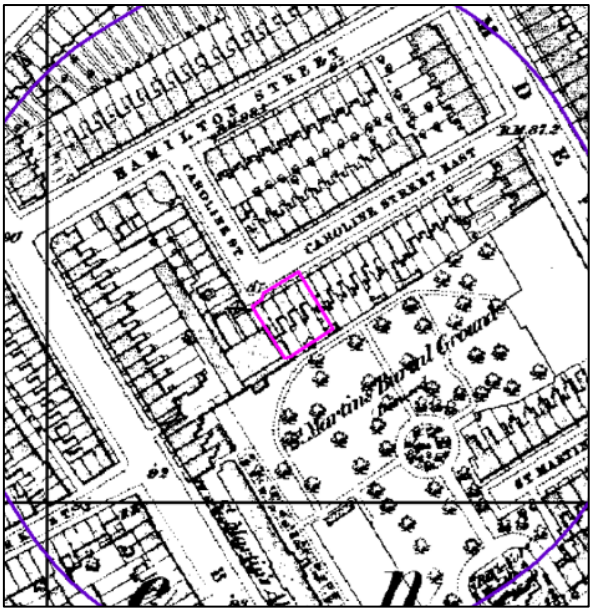
The front, north-west, facing elevation of the property is approximately 3m distance from the road with the basement adjacent to the footpath at the front of the building on Carol Street.

Copies of our client's Architects drawings showing project proposals are presented in Appendix A.

3 Desk study information and site observations

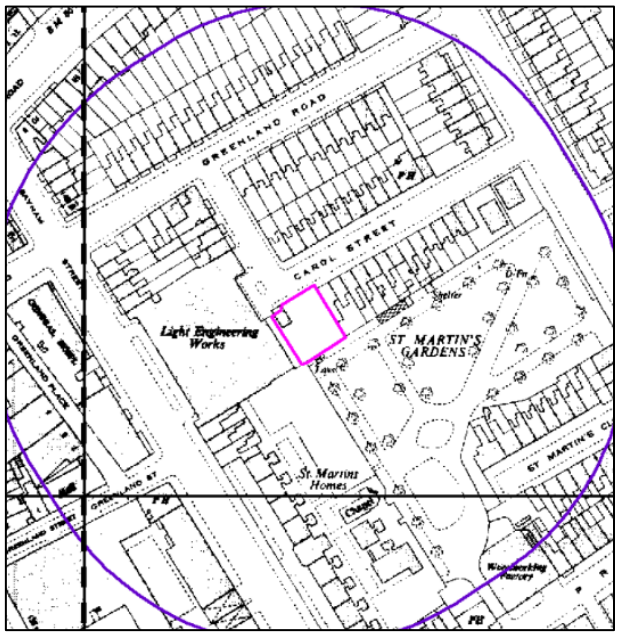
3.1 Site history

Review of Ordnance Survey and London town maps dating back to 1870s indicate the property was occupied with terraced housing until the late 1940s when the buildings were demolished. The site has remained undeveloped except for a small building on the north-west corner noted first in the early 1950s and apparently demolished during the late 1960s. Extract copies of key mapping is presented below with property position defined by a pink boundary.

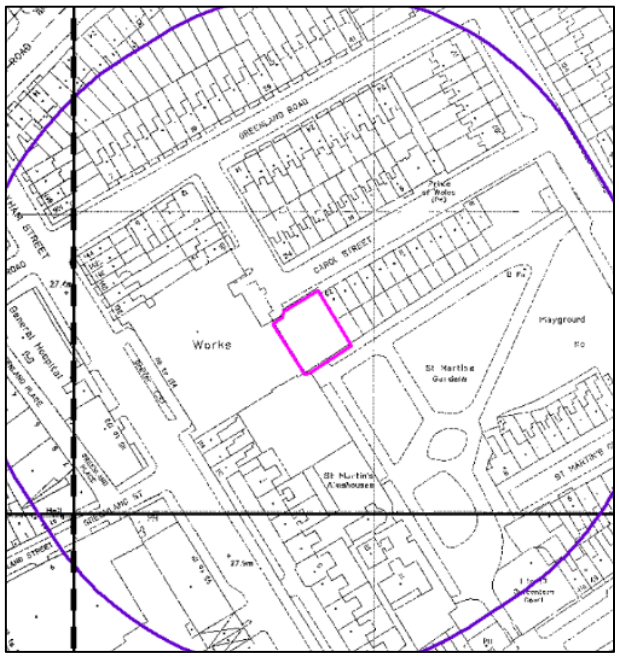


Extract copy of 1875 map

Extract copy of 1946 aerial photo



Extract copy of 1954 map



Extract copy of 1994 map

At this stage is important to note there are no water courses recorded the historical maps close to the property, and no evidence of any opencast quarrying activities in the vicinity. We have reviewed bomb damage maps (1939-1945) produced by The London County Council, and the site has not been affected by bomb damage during WWII.

3.2 Geology and geohydrology of the area

3.2.1 Geology

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.

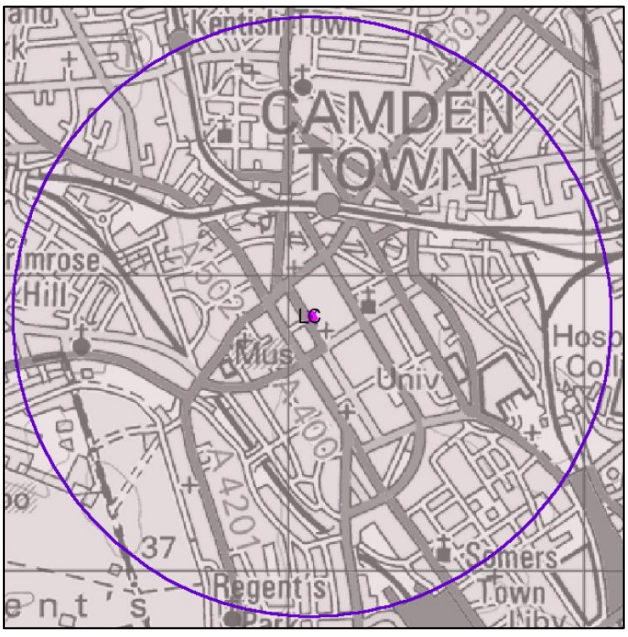
Summary of Geology and likely aquifer containing strata

Strata	Bedrock or drift	Approximate thickness	Typical soil type	Likely permeability	Likely aquifer designation
London Clay Formation	Bedrock	30	Clays	Low	Unproductive
Lambeth Group	Bedrock	12	Clays occasionally sandy	Low	Unproductive
Thanet sands	Bedrock	4	Fine sands	Low/moderate	Secondary Aquifer
Chalk	Bedrock	>80	Chalk	High	Principal

Table 3.2

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

An extract copy of the geological map is presented below, with brown shading representing the outcrop of the London Clay Formation (LC). The site is shown by the pink edging.



Based on the above any excavations within the site will be located within London Clays, however is it is acknowledged that a covering of made ground is inevitable associated with development of the area.

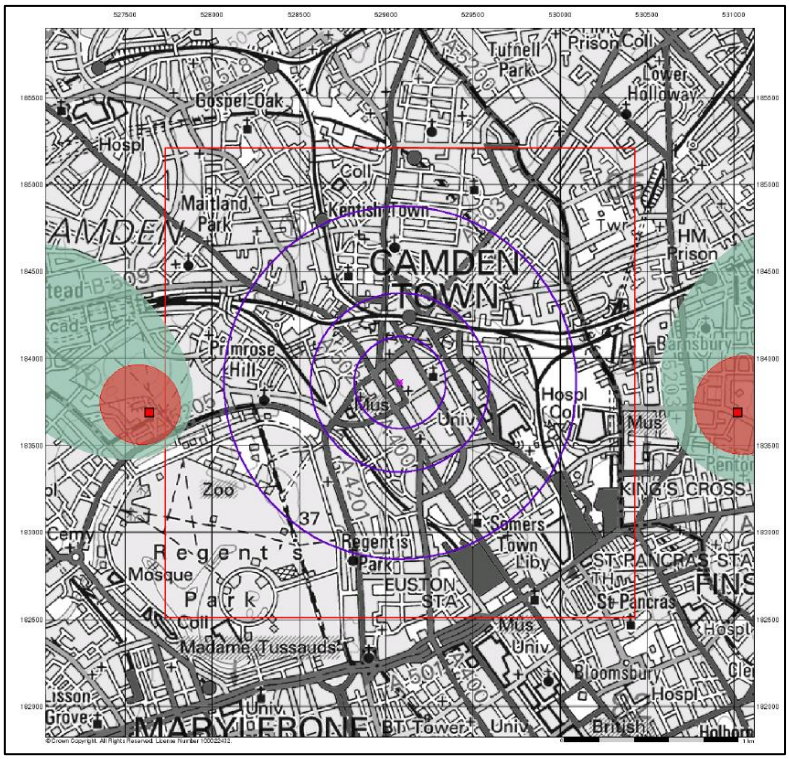
3.2.2 Geohydrology

The London Clay is classified as unproductive and regarded as not containing groundwater in exploitable quantities.

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

The site is not recorded as being located within or close to a zone protecting a potable water supply abstracting from a principle aquifer (i.e. a source protection zone). An extract of the plan recording source protection zones is presented below, with green shading representing outer protection zones and red inner protection zones. The site is located within the magenta square centrally and remote from source protection zones. The purple coloured concentric contours around the site represent distances of 250m, 500m and 1000m from the site.



3.3 Quarrying/mining

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

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 site is located within the black square.

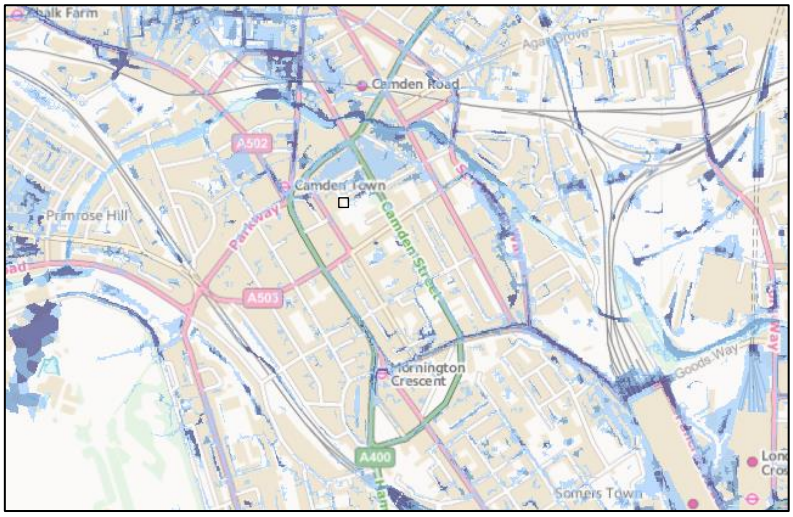
3.4.2 Flooding from Reservoirs, Canals and other Artificial Sources

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 site is located within the black square.

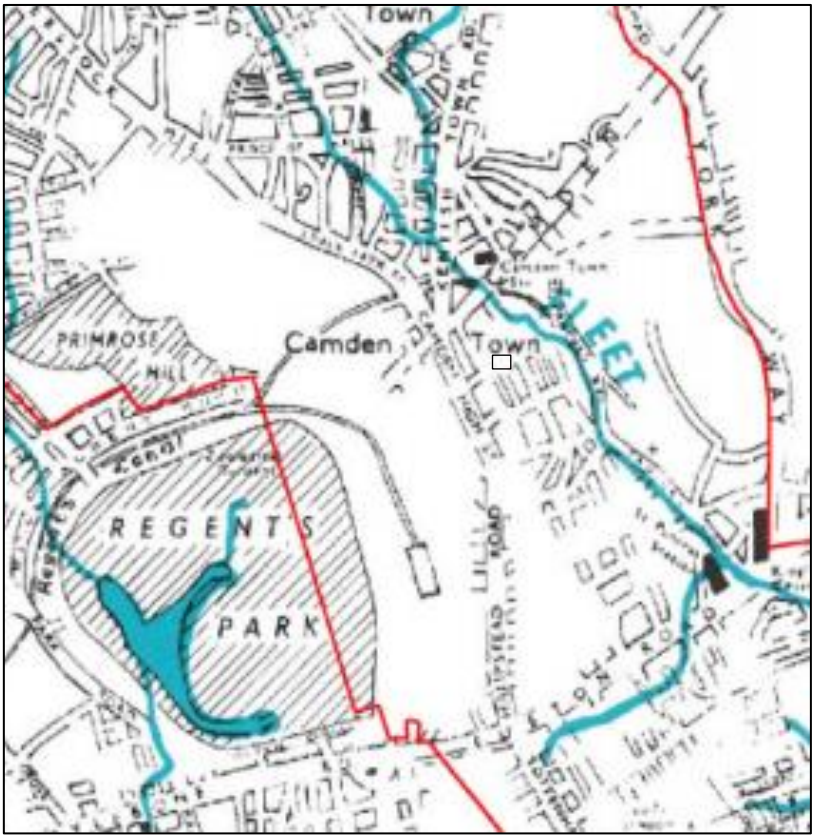
3.4.3 Flooding from Groundwater and surface waters

The site is underlain with a substantial thickness (30m) 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.

We have viewed the Environment Agency web site which provides maps showing areas a 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. There is some low risk area of flooding noted along Carol Street to the north and in St Martins Garden to the immediate south of the site.

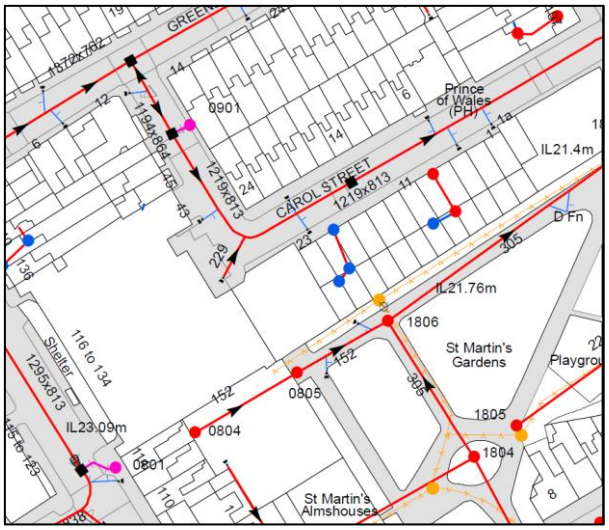


An extract of figure 11 from the Camden Geological, Hydrogeological and Hydrological Study (referenced in Section 1.4) is presented below. The blue lines show the locations of branches of the former River Fleet (to the east of the property). The property is located within the black box. The property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

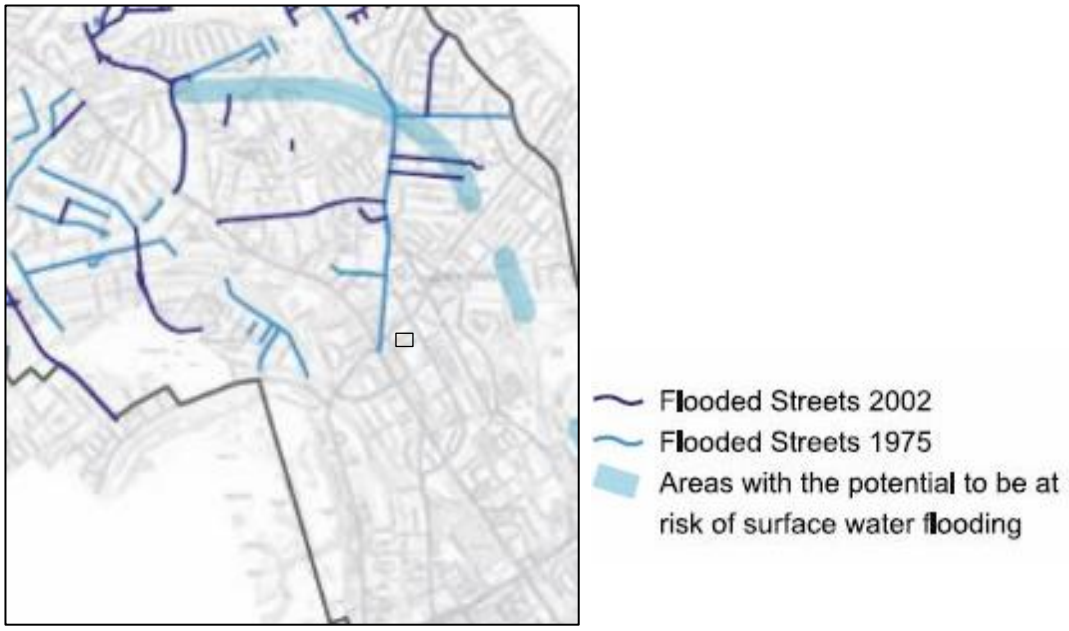


With reference to old mapping of the area described in section 3.1 above, the 1882 map does not record any water courses close to or within the immediate area of the property.

There are no major culverts in Carol Street recorded on Thames Water Asset register, an extract copy of which is presented below. There is a 1219mm x 813mm combined sewer in the road following an easterly route.



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 Carol Street was not subject to flooding in either the 1975, nor in 2002.



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

There will be below ground water supply pipes operated by Thames Water in public highways around the property. These are generally relatively small diameter pipes. 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

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 foul and stormwater drainage 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

One borehole has been excavated at the site to a depth of 15m. A series of hand dug trial pits and trenches were also undertaken by the client in order to determine foundation arrangements of the boundary wall and also to investigate the origin of roots from trees on and adjacent to the southern site boundary. The report on tree root origins was produced by Marcus Foster Arboricultural Design consultancy. The investigations concluded that roots for the three Plane trees located close to the southern site boundary (in St Martins Gardens) do not extend into the site, and the deep foundations to the boundary wall in this location have probably prevented root spread into the site.

The borehole and trial pit records together with a plot summarising undrained shear strength (drawing BIA02) is presented in appendix D.

A water level monitoring stand pipe has been installed to a depth of 10m at the site. We have returned to the site to measure any water levels. No water was observed in the standpipe during the return visit. Details of the standpipe are presented in appendix G.

4.2 Ground conditions encountered

The borehole encountered Made Ground to 1.5m depth over naturally deposited London Clay comprising stiff high strength silty clay becoming stiff/very stiff high strength with depth. A groundwater seepage was observed at 8m depth rising to 7.9m in 20 minutes. The borehole was progressed without sealing groundwater with casing and inflow was insufficient to build up within the borehole as drilling progressed. A water level monitoring standpipe was installed to 10m depth within the borehole.

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

4.3 Foundations

Given the close proximity of the basement excavation to neighbouring properties, and ground conditions encountered at the site an embedded piled wall will be required to the perimeter of the basement. This will allow for subsequent excavation of the basement with the top of the piled wall propped at or about ground levels. Following excavation, a concrete box will form the permanent basement with the basement floor effectively acting as a raft. Our Client's appointed Structural Engineers will provide a construction method statement.

5 Ground movement analysis

5.1 Construction proposals

The basement is to be single storey. The basement will extend to depths of between 3.85m and 4.85m (including floor construction) below ground levels accounting for variation in grounds level on site.

5.2 Settlement around and inward yielding of basement excavations

The following analysis is based on case study observations of ground movements around excavations in clays as reported in CIRIA report C760 – '*Guidance on embedded retaining wall design'* (2017). The London clays at the site in which the perimeter embedded piles will be installed are considered competent ground and comprise stiff clays by exceeding an undrained shear strength of 75kN/m^2, thus assessment of movements at pile heads will be determined using table 6.3 in CIRIA report C760.

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 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 is the case at this site) and typical maximum yield / excavation depth (%) is 0.15 for excavations classified as high support stiffness (high propped wall, top down construction) as described in table 6.3 (CIRIA report C760). Assuming a maximum excavation depth of 4.85m then the likely inward yield will be in the order of 4.85 x 0.15/100 x 1000 = 7.3mm. This will diminish in a reasonably linear fashion over a horizontal distance from the pile head equal to 4 times the depth of excavation ie 4 x 4.85m = 19.4m. Movement will reduce with corresponding reduction in depth of excavation.

Coincidental with the inward yield of embedded perimeter piles, some settlement of the retained soils around the excavation will occur. Again, based on published observations in similar soils, the ratio of surface settlement to excavation depth in over consolidated clays is typically 0.1%. For a maximum 4.85m deep excavation, then surface settlement in the order of 4.85 x 0.1/100 x 1000 = 4.85mm will occur. Importantly, whilst some surface settlement will occur around the excavation, this settlement profile will extend for a horizontal distance of about 3.5 times the depth of excavation i.e. about 16.9m in a reasonably linear fashion. Movement will reduce with corresponding reduction in depth of excavation.

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 Poisson's ratio. It is on this basis we have used observational techniques to determine wall movements.

We have produced a plan showing estimated surface settlement contours as a result of the basement excavation which is presented on drawing BIA-01 in appendix E.

The adjacent property at No23 will be most affected (in terms of the effects of surface settlement) by the basement excavation. We have produced a set of calculations to estimate the tensile strain (and derive a prediction of potential damage) on a masonry panel forming the front elevation walls resulting from movements derived above. As No23 is part of a terrace and is connected to several other houses within the predicted zone of surface settlement is possible that the terrace may act more as a single panel across the affected area. As such we have also produced calculations to estimate tensile strain on the masonry forming the front elevation of the whole terrace out to the distance of predicted zero surface movement. As the basement is shallower adjacent to 23, (at 3.85m) the inward yield is correspondingly reduced to 5.7mm and surface settlement to 3.85mm. These calculations are presented in appendix F.

Masonry panel forming facade to No23
Considering the combination of surface settlement and inward yielding of perimeter embedded piling we estimate a maximum strain of about 0.046% on the main front elevation of No23. (rear elevation will be similar). At this strain, the damage will fall into Burland category 0) as described in the following table (reproduced from CIRIA report C760).

Masonry panel forming combined facade to Nos23, 21 and 19.
Considering the combination of surface settlement and inward yielding of perimeter embedded piling we estimate a maximum strain of about 0.042% on the main front elevation of Nos23, 21 and 19. (rear elevation will be similar). At this strain, the damage will fall into Burland category 0) as described in the following table (reproduced from CIRIA report C760).

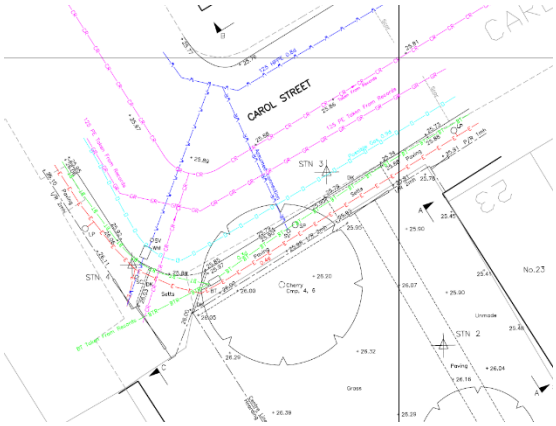
Based on the above damage to neighbouring properties is predicted as negligible.

Table 6.4 - Classification of visible damage to walls (after Burland et al, 1977, Boscardin and Cording, 1989; and Burland, 2001)			
Category of damage	**Description of typical damage (ease of repair is underlined)**	**Approximate crack width (mm)**	**Limiting tensile strain ε_{lim} (per cent)**
0 Negligible	Hairline cracks of less than about 0.1mm 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. Crack in external brickwork visible on inspection.	< 1	0.05 - 0.075
2 Slight	Cracks easily filled. Redocoration probably required. Several slight fractures showing inside of building. Crack 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 section of walls, especially over doors and windows. Window and frames distorted, floor sloping noticeable. 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, wall 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.			

Reproduction of Table 6.4 from CIRIA C760– Guidance on embedded retaining wall design.

Nearby services

Our client has instructed a below ground, off site services survey with a copy of the survey drawing presented in appendix H, with an extract presented below. We have reviewed the services survey with predicted surface settlement contours (refer appendix E). For services perpendicularly crossing contours the distortion will be about 1 in 3500 which in our opinion will have no effect on these services.



A silent piling method which is a non-impact piling method, vibration free and noise free is proposed for installation of an embedded piled wall to facilitate excavation and construction of the basement. This method of installation will not affect the neighbouring properties or services within Carol Street.

6 Hardened areas

There will be an increase in hardened and drained areas resulting from the proposed development. Our client's appointed Consulting Civil and Structural Engineers have determined a drainage strategy for the development to minimise contribution to flood risk details of which will accompany a planning submission.

7 Tree removal

Trees and vegetation within the site will be removed to accommodate the proposed development. Investigations have been carried out to determine if roots from the Plane trees in the neighbouring St. Martin's Gardens. The report on tree root origins was produced by Marcus Foster Arboricultural Design consultancy. The investigations concluded that roots for the three Plane trees located close to the southern site boundary (in St Martins Gardens) do not extend into the site, and the deep foundations to the boundary wall in this location have probably prevented root spread into the site.

8 Existing damage to adjacent buildings

We are not aware of any subsidence damage to neighbouring buildings.

9 Conceptual model

9.1 Site setting

The site is currently undeveloped site and recently used as a garden.

Residential properties are present to the north east which are three storeys in height and of traditional brick construction. There are light industrial units to the southwest with perimeter walls in masonry. Carol Street runs along the north-west boundary of the site with further terraced residential housing beyond. The adjacent properties show no evidence of basements. There is no evidence of any subsidence to any adjacent properties or indeed the existing buildings on the site.

To the south is an area of public open space named as St Martin's Gardens. There are Plane trees in these gardens close to the site. Investigations have been carried out to show the roots from these trees do not extend into the site.

Levels within the site fall by about 1m in a northerly direction, however general ground levels in the area fall in a north easterly direction by about 2.2 degrees generally following Carol Street.

9.2 History of the site

Old mapping of the area records the site was occupied by terraced housing from the 1870s which were demolished sometime around the late 1940s. Published mapping show the area not affected by WW2 bombing. There is no evidence of any watercourses or ponds close to the site.

9.3 Geology of the site

Published geological maps of the area record topography local to the property is formed in deposits of London Clays which probably extend to depths in the order of 30m in the area. The London clays are classified as unproductive strata (formerly Non Aquifer) by the Environment Agency. A borehole excavated at the site confirms the site is directly underlain with London Clays. The London Clay Formation comprises reasonably homogenous relatively impermeable clays which are not able to transmit groundwater under normal hydraulic gradient.

9.4 Development proposals

A new mixed use three storey building is proposed with a single storey deep basement. The basement excavation (to basement slab formation level) will extend to depths of between 3.85 and 4.85m.

The front, north-west, facing elevation of the property is approximately 3m distance from the road with the basement adjacent to the footpath at the front of the building on Carol Street.

9.5 Basement construction

Given the close proximity of the basement excavation to neighbouring properties and ground conditions encountered at the site an embedded piled wall will be required to the perimeter of the basement. A silent piling method which is a non-impact piling method, vibration free and noise free is proposed for installation of an embedded piled wall to facilitate excavation and construction of the basement. This method of installation will not affect the neighbouring properties or services within Carol Street.

Following excavation, a concrete box will form the permanent basement with the basement floor effectively acting as a raft. Our Client's appointed Structural Engineers will provide a construction method statement; please refer to the Structural Engineer's Design Statement for planning.

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. The amount of movement is small, and damage sustained by adjacent properties (if any) determined as negligible, and as such does not present a matter of concern.

9.6 Flood risk

The property is positioned on locally high ground 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.

Geological records indicate the site is underlain by deposits of London Clay Formation extending to depths of approximately 30m. 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.

There will be an increase in hardened and drained areas resulting from the proposed development. Our client's appointed Consulting Civil and Structural Engineers have determined a drainage strategy for the development to minimise contribution to flood risk details of which will accompany a planning submission.

9.7 Risk assessment

The following risks have been identified with the project and minimised where appropriate with mitigation measures.

Construction activity / feature	Risk	Mitigation
Embedded piled wall around basement installation	Vibration damage to services and adjacent properties and noise	Silent piling method adopted which is a non-impact piling method, vibration free and noise free. Monitoring for vibration during installation.
Inward yielding of pile heads during excavation to basement level	Inward movement causes ground surface settlement around excavation. Could affect adjacent properties / services	Pile heads propped to minimise movement. Movement of pile heads predicted based on past observations of similar installations and damage to adjacent properties /services predicted as negligible. Monitoring for movement carried out during works.
Ground water flows	Interruption of groundwater flows	No groundwater encountered on site.
Flooding	Increase in flood risk locally	Accumulated evidence shows the site not at risk of flooding from fluvial, stormwater or groundwater flooding. Control measures proposed to minimise risks of flooding from stormwater run-off for the developed site.
Tunnels		No tunnels close to the site

10 Subterranean (Ground water) flow screening

10.1 General overview.

The property is positioned on locally high ground 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.

Geological records indicate the site is underlain by deposits of London Clay Formation extending to depths of approximately 30m. 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.

10.2 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 30m thickness of London Clays which are classified Unproductive Strata (formerly Non-Aquifer) by the Environment Agency.	3.2
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. The site is remote (in excess of 200m) of any known watercourse. 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 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 2.6km 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 site is currently undeveloped and not drained. A drainage strategy has been developed for the site determined by our client's Consulting Civil and Structural Engineers with a view to minimise contribution to flood risk details of which will accompany a planning submission.	5
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 proposed courtyard 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

11 Stability impact identification

11.1 General overview.

The property is positioned on locally high ground to the north of central London. Ground levels in the area fall in a general north easterly direction (along Carol Street) at a slope of roughly 2.2 degrees.

Given the close proximity of the basement excavation to neighbouring properties, and ground conditions encountered at the site an embedded piled wall will be required to the perimeter of the basement. This will allow excavation of the basement using top down procedures with the top of the piled wall propped at or about ground levels. Following excavation, a concrete box will form the permanent basement with the basement floor effectively acting as a raft. Our Client's appointed Structural Engineers will provide a construction method statement, please refer to the Structural Engineer's Design Statement for planning.

11.2 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 2.2 degrees in a north easterly 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 and response		Text reference
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 2.2 degrees in a north easterly direction. There are no railway cuttings in the vicinity of the site. Based on this there are no matters of concern.	2.1
Question 4	Is the site within a wider hillside setting in which the slope is greater than 7°?	
Response	No. The topography of the area falls by about 2.2 degrees in a north easterly direction with the slope (along Carol Street) 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. Excluding a thin surfacing of Made Ground material the site is underlain with London Clays, extending to depths of around 30m 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.	3.2
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	Yes, three immature trees are present on site that will require felling prior to development. These are semi-mature ornamental trees (such as Cherry trees) and ornamental shrubbery.	6

Question and response		Text reference
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 not aware of and have not observed any evidence of damage attributable to subsidence 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. The site is remote (in excess of 200m) of any known watercourse. 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 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.	3.1
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 30m 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 2.6km to the south east of the pond chain on Hampstead Heath. Based on this there are no matters of concern.	3.4.2

Question and response		Text reference
Question 12	Is the site within 5m of a public highway or pedestrian right of way?	
Response.	Yes. The main basement is located adjacent to the footpath at the front of the building along Carol Street. Retaining walls will be designed to provide adequate support to the highway.	2.2
Question 13	Will the proposed basement significantly increases the differential depth of foundations relative to adjacent properties?	
Response	Yes, the adjacent properties do not appear to have basement and as such the proposed basement floor levels and foundation will be lower the adjacent properties. Although there will be differences in ground / basement level floors between the new build and adjacent properties, the proposed basement construction solution will not adversely affect neighbouring properties. Estimates of movements that may occur during the construction phase and control measures to limit such movement are described in section 5 which indicate acceptable levels of differential movement. Based on this there are no matters for concern.	5
Question 14	Is the site over (or within the exclusion zone of) any tunnels e.g. Railway lines.	
Response	No. The property is not located within 100m of an underground railway. Based on this there are no matters of concern.	

12 Surface flow and flooding impact identification

12.1 General overview

There will be an increase in hardened and drained areas resulting from the development, which is comparable to the previous development demolished during the 1940s. Our client's appointed Consulting Civil and Structural Engineers have determined a drainage strategy for the development to minimise contribution to flood risk details of which will accompany a planning submission.

The property is underlain with a substantial thickness of relatively impermeable London Clays, which is not amenable to disposal of stormwater using soakaways.

12.2 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.	4.2
Question 3	Will the proposed basement development result in a change in the proportion of hard surfaced/paved areas?	
Response.	Yes. Refer 11.1 above.	11.1
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 and response		Text reference
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

13 Non-technical Summary and Conclusions

13.1 Given the close proximity of the basement excavation to neighbouring properties, and ground conditions encountered at the site an embedded piled wall will be required to the perimeter of the basement. This will allow excavation of the basement using top down procedures with the top of the piled wall propped at or about ground levels. Following excavation, a concrete box will form the permanent basement with the basement floor effectively acting as a raft. Our Client's appointed Structural Engineers will provide a construction method statement.

13.2 Old mapping of the area records the site was occupied by terraced housing from the 1870s which were demolished sometime around the late 1940s. The site has remained undeveloped except for a small structure on the north west corner noted first in the early 1950s and apparently demolished during the late 1960s. Published mapping show the area not affected by WW2 bombing. There is no evidence of any watercourses or ponds close to the site.

13.3 Published geological maps of the area record topography local to the property is formed in deposits of London Clays which probably extend to depths in the order of 30m in the area. The London clays are classified as unproductive strata (formerly Non-Aquifer) by the Environment Agency. A borehole excavated at the site confirm the site is directly underlain with London Clays. 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.

13.4 Ground levels do fall in a north easterly direction by about 2.2 degrees, and slope instability is not considered to present a risk. Installation of the basement will not induce any slope instability.

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

13.6 Trees and vegetation within the site will be removed to accommodate the proposed development. Investigations have been carried out to determine if roots from the Plane trees in the neighbouring St. Martin's Gardens. The report on tree root origins was produced by Marcus Foster Arboricultural Design consultancy. The investigations concluded that roots for the three Plane trees located close to the southern site boundary (in St Martins Gardens) do not extend into the site, and the deep foundations to the boundary wall in this location have probably prevented root spread into the site.

13.7 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. The amount of movement is small, and damage sustained by adjacent properties (if any) determined as negligible, and as such does not present a matter of concern.

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

13.9 There will be an increase in hardened and drained areas resulting from the proposed development. Our client's appointed Consulting Civil and Structural Engineers have determined a drainage strategy for the development to minimise contribution to flood risk details of which will accompany a planning submission.

13.10 The site is remote from underground tunnels.

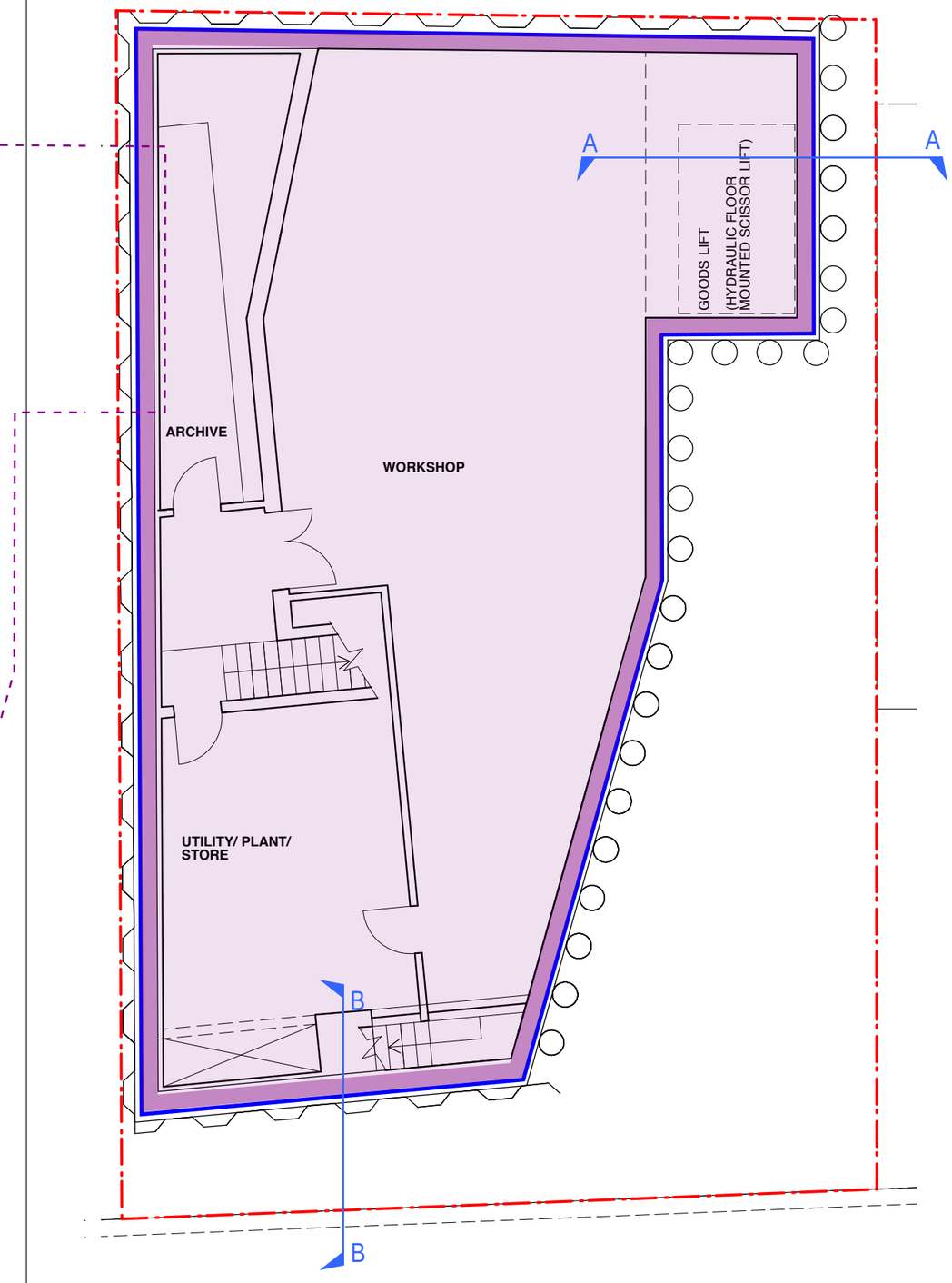
13.11 In overall conclusion there are no outstanding issues of concern (singularly or cumulatively) from a stability, groundwater or surface water perspective.

14 Audit Query tracker

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

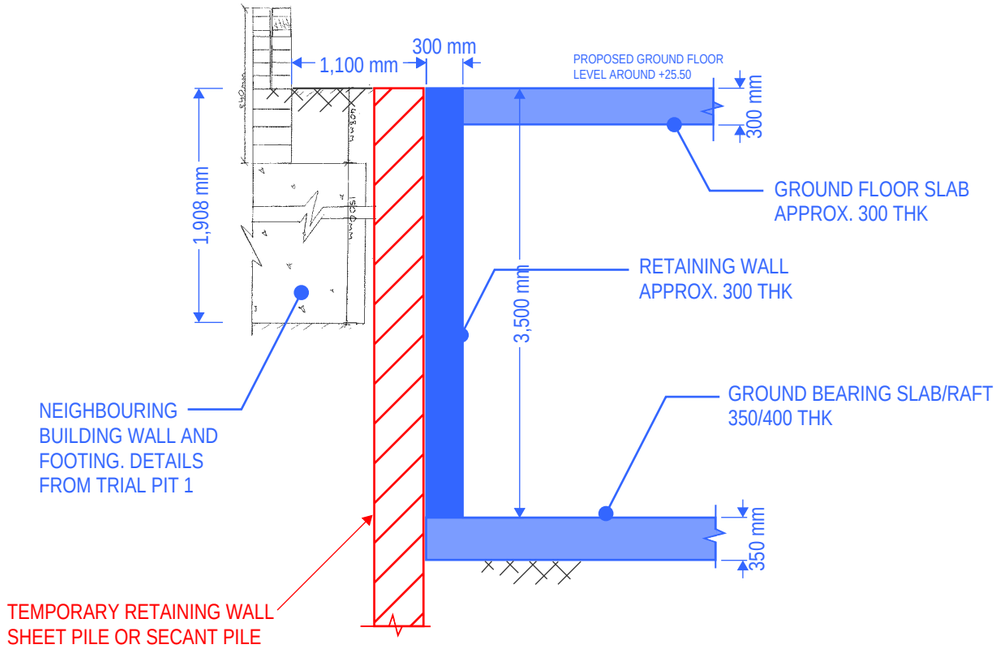
Query no	Subject	Query	Responsibility for resolution	Status	Response
1	Stability	Interpretative report on GI required	London Borough of Camden	Open	Issued to LBC. LBC to issue to Campbell Reith
2	Stability	Sheet piling methodology and outline design	eHRW	Open	
3	Stability	Presence of nearby services	Soiltechnics	Open	Refer appendix H and section 5
4	Stability	GMA update from piling installation impacts	eHRW and Soiltechnics	Open	Sections 5 and 9
5	Stability	Monitoring strategy	eHRW	Open	
6	Impact assessments		Soiltechnics	Open	Conceptual model added as section 9
7	BIA format	Non-technical summary	Soiltechnics	Open	Section 13 to this report

CAROL STREET



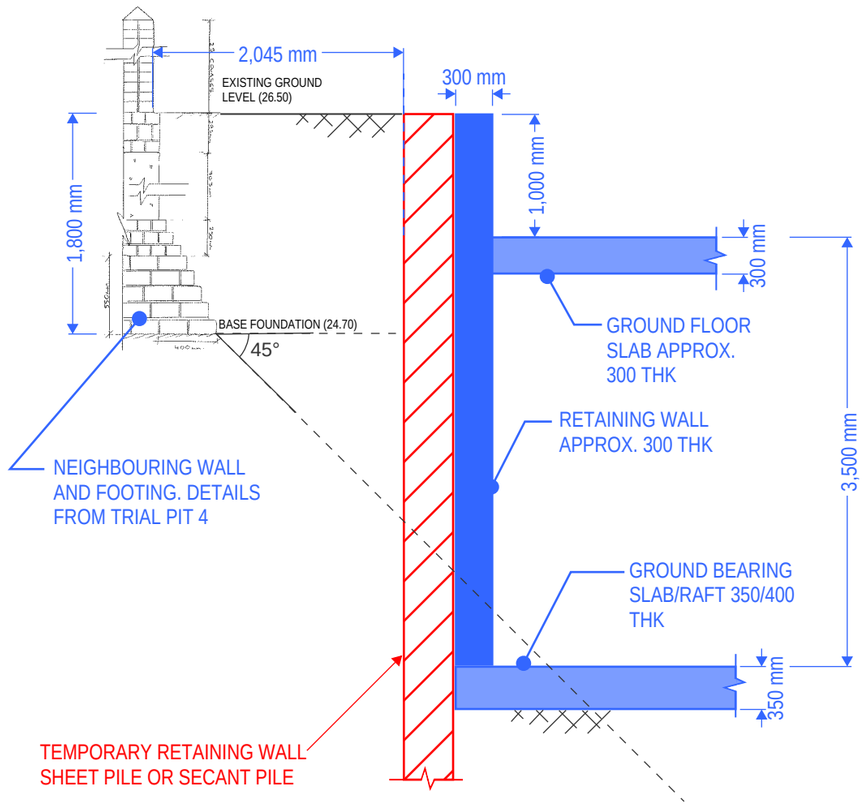
BASEMENT PLAN

1:100 AT A3



SECTION A-A

1:50 AT A3



SECTION B-B

1:50 AT A3

engineersHRW

Project Title:
Carol Street, London NW1

Drawing Title:
Basement Plan & Sections Through Neighbouring Walls

Scale at A3:	Drawn by:	Date:	Checked:
AS NOTED	AB	06/07/17	BS

Drawing Status:
Preliminary

Project No:	Drawing Type:	Drawing No:	Revision:
1402	SK	010	-

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 45 staff)
- Founding Director of Soiltechnics Ltd, a company specialising in geotechnical and geo-environmental matters. (Current complement 45 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, timber, 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 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.

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

Chord Environmental Ltd

Stephen Fisk
Soiltechnics Ltd
Cedar Barn
White Lodge
Walgrave
Northampton
NN6 9PY

Your Ref: 43 Carol Street
Our Ref: 1127/LJE150917

For the attention of: Stephen Fisk

15th September 2017

Land adjoining 43 Carol Street: BIA Review

Dear Stephen,

Further to your instruction to proceed on behalf your client (Make Some Space Ltd) I have undertaken a review of the Basement Impact Assessment (BIA) prepared by Soiltechnics Ltd for the proposed basement development at land adjoining 43 Carol Street.

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 Policy A5 (Basements) of the Camden Local Plan (2017), Camden Planning Guidance (Basements and Lightwells CPG4) and the Camden geological, hydrogeological and hydrological study report 'Guidance for subterranean development ', produced by Arup on behalf of the London Borough of Camden.

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 20 years. During that time I have advised on over 150 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 currently undeveloped, previously used as a garden area. The site is currently grassed with some concrete paving. Residential properties are present to the north east which are three storeys in height and of traditional brick construction. There are light industrial units to the southwest with perimeter walls in masonry. Carol Street runs along the north-west boundary of the site with further terraced residential housing beyond. To the south is an area of public open space named as St Martin's Gardens.

Levels within the site fall by about 1m in a northerly direction, however general ground levels in the area fall in a north easterly direction by about 2.2 degrees generally following Carol Street. Garden levels are reasonably uniform. The adjacent properties show no evidence of basements.

A new mixed use three storey structure is proposed with a single storey deep basement. The basement, and ground floor are to be studio/workshops with a residential apartment above. The basement excavation (to basement slab formation level) will extend to depths of between 3.85 and 4.85m.

Environmental Site Setting

The BIA screening assessment and site investigation interpretation has identified the land adjoining 43 Carol Street 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.30m. 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 40m beneath the site.

A ground investigation established the presence of London Clay beneath a 1.5m covering of Made Ground. A groundwater seepage was encountered within the London Clay at a depth of 8m below ground level. The well-known low permeability of the London Clay prevents it from transmitting groundwater flow or supporting a water table however localised pockets of groundwater may be encountered within impersistent relatively permeable horizons.

There are no surface water features within 200m of the site on the Ordnance Survey 1:25,000 scale map with the Regent's Canal c.210m north of the site being the closest water feature. Figure 11 of the "Camden Geological, Hydrogeological and Hydrological Study", shows the former river Fleet watercourse to have run approximately 250m to the east of the proposed development. The Fleet is now culverted and discharges to the Thames.

The land adjoining 43 Carol Street 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 and it does not lie within an area of fluvial or tidal flood risk as designated by the Environment Agency. However there is a low risk area of flooding noted along Carol Street to the north and in St Martins Garden to the immediate south of the site.

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 ground investigation has confirmed the presence of London Clay.

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

  No. Although a groundwater seepage was encountered at 8m below ground level within the London Clay during the site investigations, the cohesive London Clay is not capable of transmitting groundwater flow or supporting a water table. Monitoring boreholes drilled within the London Clay often fill slowly with groundwater over time or encounter isolated pockets within impersistent bands. 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 mapped surface water features are present within 200m 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 2.5km south, and down topographic gradient, of the Hampstead Heath ponds and therefore lies outside their hydrological catchment area (refer to Figure 14 of the Camden Geological, Hydrogeological and Hydrological Study).

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

  Yes. The proposed basement development would result in an increase in hard-standing. However, given the site is underlain by Unproductive Strata this is not considered important from a groundwater viewpoint.

- **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?**

  No - 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 the land adjoining 43 Carol Street 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 the land adjoining 43 Carol Street is not sensitive with respect to groundwater resources or flow. Isolated pockets of groundwater may be encountered during excavation and some form of groundwater control is likely to be required through sump pumping however significant inflows of groundwater are not anticipated.

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

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environmental and geotechnical consultants

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	PP – Pocket penetrometer result reported as an equivalent undrained shear strength (kN/m^2) SV – Hand held shear vane result reported as an undrained shear strength (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 (N value) (uncorrected)[1,2,3] SPT(c) – Standard Penetration Test result (solid cone) (N value) (uncorrected)[1,2,3]
	UT – Undisturbed sample 100mm diameter sampler with number of blows of driving equipment required to obtain sample

Sampling		
From (m) To (m)	Records depth of sampling	
Type	D	Disturbed sample
	B	Bulk disturbed sample
	ES	Environmental sample
	W	Water sample
	UT	Undisturbed thin walled sample 100mm diameter sampler

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	STRATA				WATER STRIKES	SPT TESTING				OTHER IN SITU TESTING		SAMPLING		
	DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND		TYPE / DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	TYPE / DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
	Grass onto soft sandy gravelly CLAY with frequent rootlets. Gravel consists of angular fine to coarse brick and sandstone. (MADE GROUND)											0.10	0.50	D
	Medium dense black, dark grey and dark brown slightly clayey SAND and GRAVEL. Gravel consists of angular to sub-rounded fine to coarse brick, flint, slag and occasional pottery fragments. (MADE GROUND)	0.50	25.70									0.60	1.00	D
						SPT (c) 1.20-1.65	(3) 8		DRY			1.20	1.50	D
	Stiff high strength brown mottled grey slightly silty CLAY. (LONDON CLAY FORMATION)	1.50	24.70									1.50	2.00	D
												2.00		D
										PP 2.45	PP=83	2.45		D
						SPT 3.00-3.45	(3) 10	1.50	DRY	PP 3.00	PP=121	3.00		D
						SPT 4.00-4.45	(4) 12	1.50	DRY			4.00		D
												5.00		D
	... becoming very high strength from 5.50m depth.									PP 5.50	PP=154	5.50		D
	CONTINUED ON NEXT SHEET													

Key

D Small Disturbed Sample
B Bulk Disturbed Sample
ES Environmental Sample
W Water Sample
C Core sample
UT Undisturbed Sample

S Standard Penetration Test
C Standard Penetration Test (solid cone)

PP Pocket Penetrometer test
SV Shear Vane test
PID Photo Ionisation Detector test

Notes

Chiselling undertaken between 10.1m and 10.4m taking 90 minutes. Standpipe installed to 10m depth. Inspection pit excavated from 0.0m to 1.2m depth. Terminated as target depth achieved.

Groundwater observations

Slow inflow of water observed at 8m depth, filling borehole to 7.9m in 20 minutes.

Chiselling details

Depth (m)	Duration (hh:mm)
10.10 - 10.40	01:30

Water added details

Depth (m)	Water Added (l)

Casing details

Diameter (mm)	Base depth (m)
150	1.50

Title

Borehole record

Method Cable tool percussion	**Logged by** SJF	**Date(s)** 29/09/2015
Level (m OD) 26.20	**Compiled by** LK	**Sheet number** Sheet 1 of 3
Co-ordinates 529079mE, 183867mN	**Checked by**	**BH01**

Report ref: STM3348D-

Revision: 0

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WELL	STRATA				WATER STRIKES	SPT TESTING				OTHER IN SITU TESTING		SAMPLING		
	DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND		TYPE / DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	TYPE / DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
										PP 6.00	PP=154	6.00		D
						SPT 6.50-6.95	(6) 15	1.50	DRY			6.50		D
	...occasional fine angular gravel sized grains of selenite from 7.5m depth.									PP 7.50	PP=154	7.50		D
												8.00		D
	...occasional approximately 1mm thick bands of brown fine sand from 8.5m depth.									PP 8.45	PP=188	8.45		D
										PP 9.00	PP=163	9.00		D
	Stiff very high strength dark grey silty CLAY. (LONDON CLAY FORMATION)	9.60	16.60			SPT 9.50-9.95	(8) 24	1.50	DRY	PP 9.50	PP=150	9.50		D
	Dark grey CLAYSTONE. (LONDON CLAY FORMATION)	10.10	16.10									10.10	10.40	D
	Stiff to very stiff very high strength dark grey silty CLAY with occasional approximately 1mm thick bands of brown fine sand. (LONDON CLAY FORMATION)	10.40	15.80							PP 10.50	PP=225	10.50		D
						SPT 11.00-11.45	(9) 25	1.50	DRY	PP 11.00	PP=204	11.00		D
	CONTINUED ON NEXT SHEET													

Key

D Small Disturbed Sample
B Bulk Disturbed Sample
ES Environmental Sample
W Water Sample
C Core sample
UT Undisturbed Sample

S Standard Penetration Test
C Standard Penetration Test (solid cone)

PP Pocket Penetrometer test
SV Shear Vane test
PID Photo Ionisation Detector test

Notes

Chiselling undertaken between 10.1m and 10.4m taking 90 minutes. Standpipe installed to 10m depth. Inspection pit excavated from 0.0m to 1.2m depth. Terminated as target depth achieved.

Groundwater observations

Slow inflow of water observed at 8m depth, filling borehole to 7.9m in 20 minutes.

Chiselling details

Depth (m)	Duration (hh:mm)
10.10 - 10.40	01:30

Water added details

Depth (m)	Water Added (l)

Casing details

Diameter (mm)	Base depth (m)
150	1.50

Title

Borehole record

Method Cable tool percussion	**Logged by** SJF	**Date(s)** 29/09/2015
Level (m OD) 26.20	**Compiled by** LK	**Sheet number** Sheet 2 of 3
Co-ordinates 529079mE, 183867mN	**Checked by**	**BH01**

Report ref: STM3348D-

Revision: 0

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WELL	STRATA				WATER STRIKES	SPT TESTING				OTHER IN SITU TESTING		SAMPLING		
	DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND		TYPE / DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	TYPE / DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
	Stiff to very stiff very high strength dark grey silty CLAY with occasional approximately 1mm thick bands of brown fine sand. (LONDON CLAY FORMATION)									PP 12.00	PP=188	12.00		D
						SPT 12.50-12.95	(10) 26	1.50	DRY	PP 12.50	PP=225	12.50		D
										PP 13.50	PP=196	13.50		D
										PP 14.00	PP=225	14.00		D
										PP 14.45	PP=192	14.45		D
	BOREHOLE TERMINATED AT 15.00m	15.00	11.20							PP 15.00	PP=225	15.00		D

Key

D Small Disturbed Sample
B Bulk Disturbed Sample
ES Environmental Sample
W Water Sample
C Core sample
UT Undisturbed Sample

S Standard Penetration Test
C Standard Penetration Test (solid cone)

PP Pocket Penetrometer test
SV Shear Vane test
PID Photo Ionisation Detector test

Notes

Chiselling undertaken between 10.1m and 10.4m taking 90 minutes. Standpipe installed to 10m depth. Inspection pit excavated from 0.0m to 1.2m depth. Terminated as target depth achieved.

Groundwater observations

Slow inflow of water observed at 8m depth, filling borehole to 7.9m in 20 minutes.

Chiselling details

Depth (m)	Duration (hh:mm)
10.10 - 10.40	01:30

Water added details

Depth (m)	Water Added (l)

Casing details

Diameter (mm)	Base depth (m)
150	1.50

Title

Borehole record

Method
Cable tool percussion

Logged by
SJF

Date(s)
29/09/2015

Level (m OD)
26.20

Compiled by
LK

Sheet number
Sheet 3 of 3

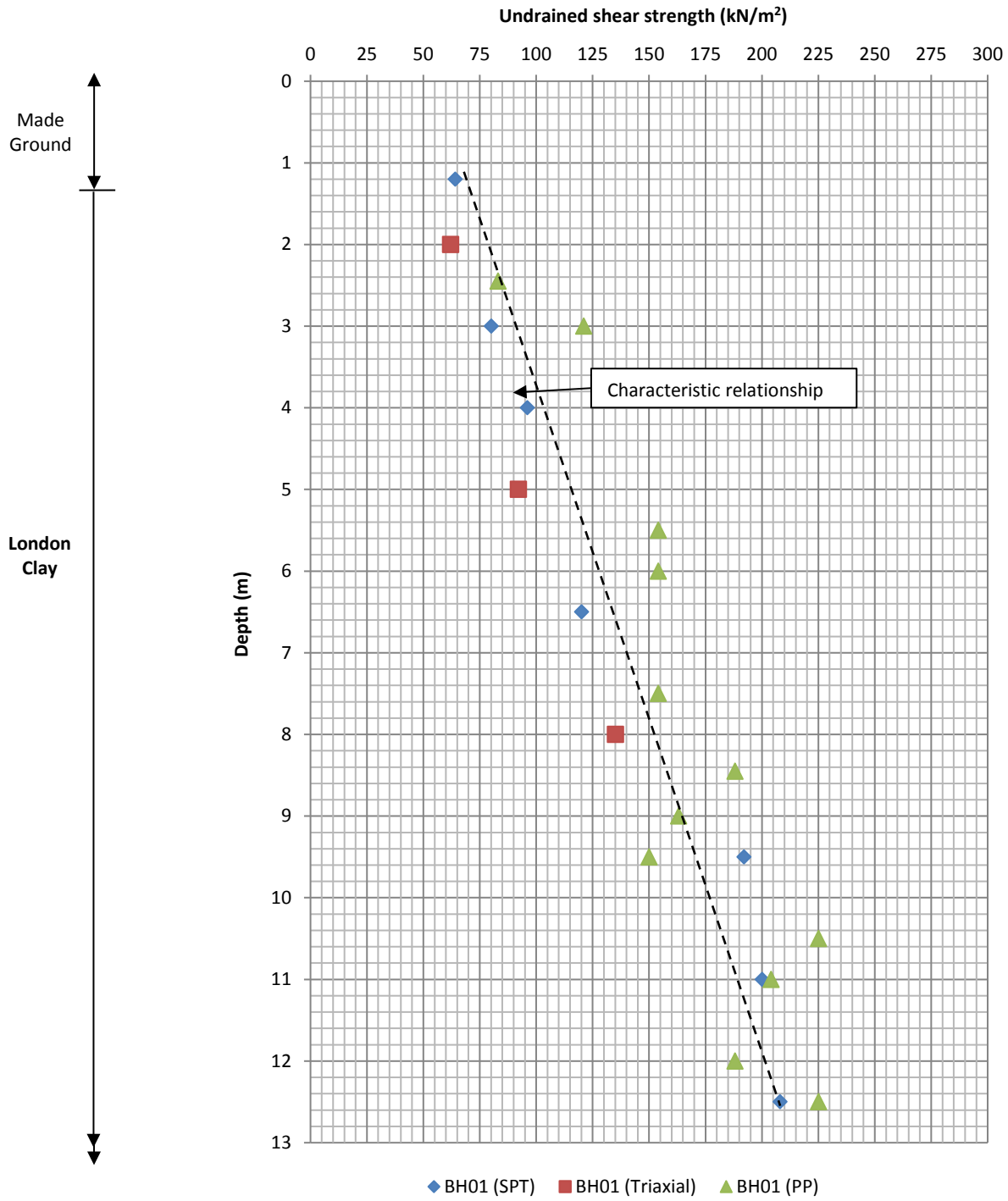
Co-ordinates
529079mE, 183867mN

Checked by

BH01

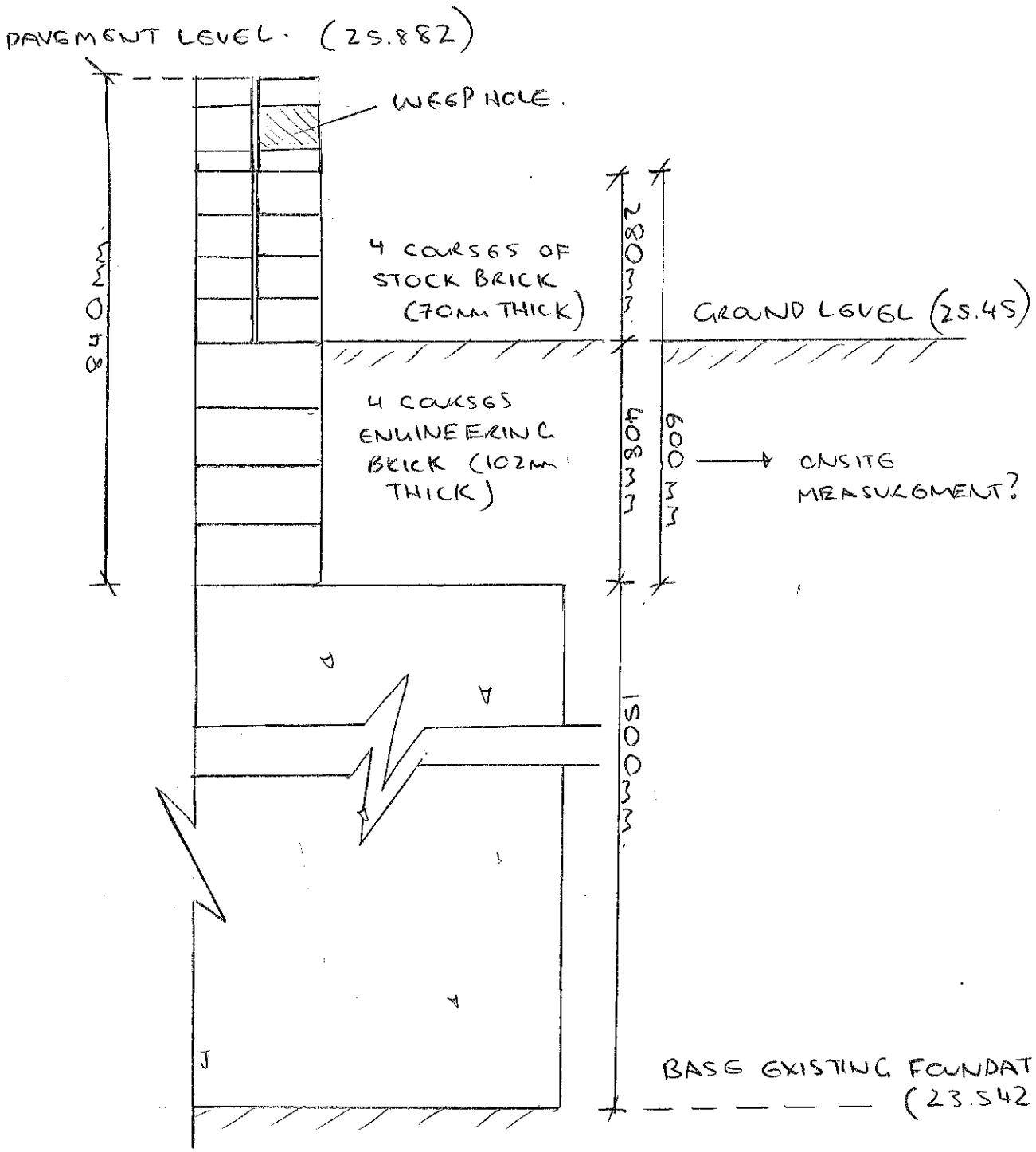
Report ref: STM3348D-

Revision: 0



Title	Scale	Drawing number
Plot summarising results of standard penetration test triaxial test results of pocket penetrometer determinations	As shown	BIA02

engineersHRW	Job No. 1407	Sheet No. TP1	Revision
	Member Location		
Job Title CAROL STREET	Drawing Ref.		
Section EXISTING FOUNDATIONS.	Made by	Date 8/09/15	Checked



TP1 — EXISTING FOUNDATION

TRIAL PIT ONE.

NB// BASE OF PROPOSED EXCAVATION (GRID D-D)
≈ 3.57m ∴ (21.89)

∴ EXCAVATION BELOW EXISTING FOUNDATION.
AND EXCAVATION WITHIN 3.0m EXISTING FOUNDATION.

engineersHRW

Job No.	Sheet No.	Revision
1402.	TP2	

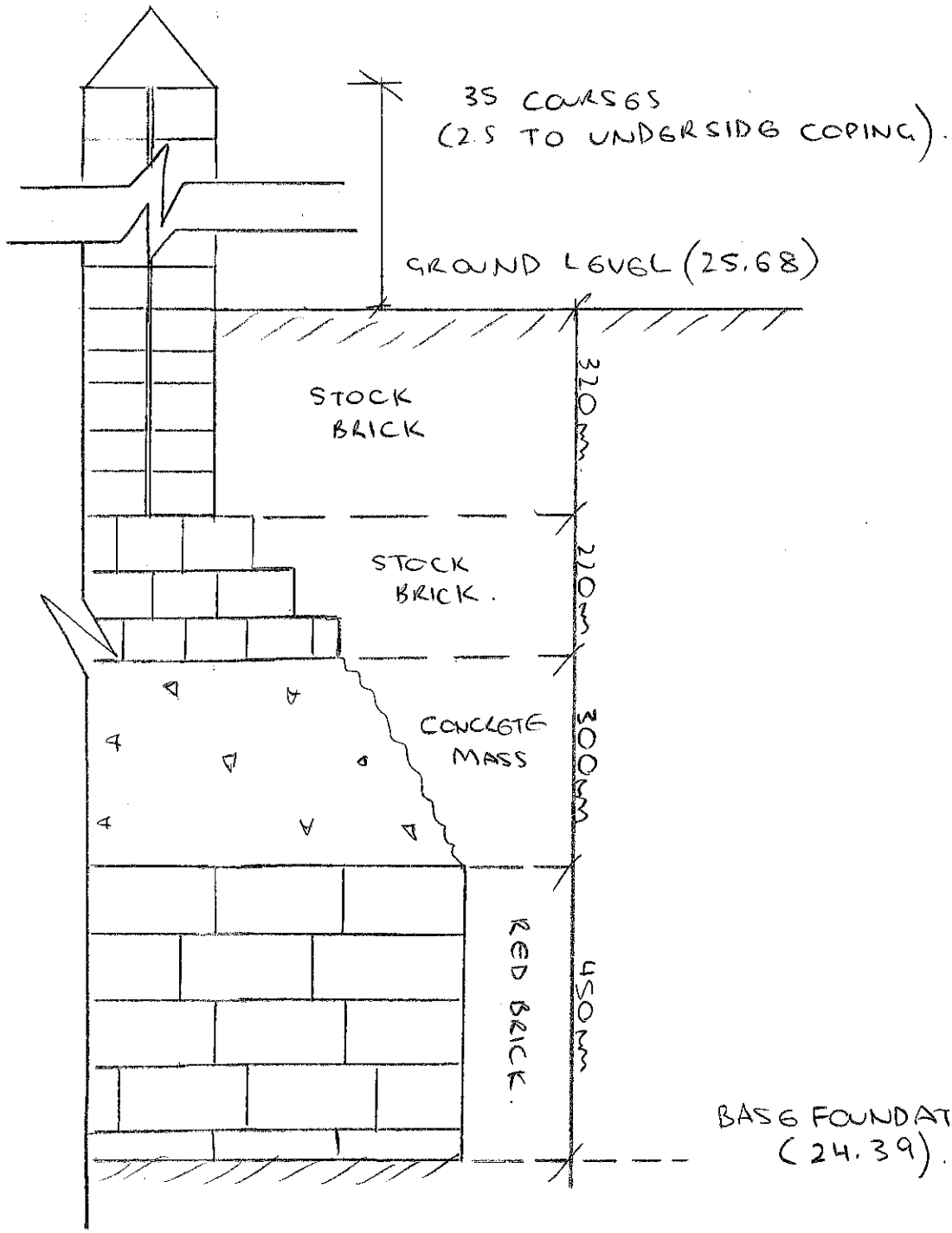
Member Location

Job Title: CAROL STREET

Drawing Ref.

Section: EXISTING FOUNDATIONS.

Made by | Date: 8/09/15 | Checked



TP2 — EXISTING FOUNDATION

TRIAL PIT TWO.

NB// BASE OF PROPOSED EXCAVATION (BETWEEN GRID H-H AND GRID I-I) ≈ 2.85M. ∴ (22.82)

∴ EXCAVATION BELOW EXISTING FOUNDATION.
AND EXCAVATION WITHIN 3.0M EXISTING FOUNDATION.

engineersHRW

Job No.	Sheet No.	Revision
1402	TP3.	

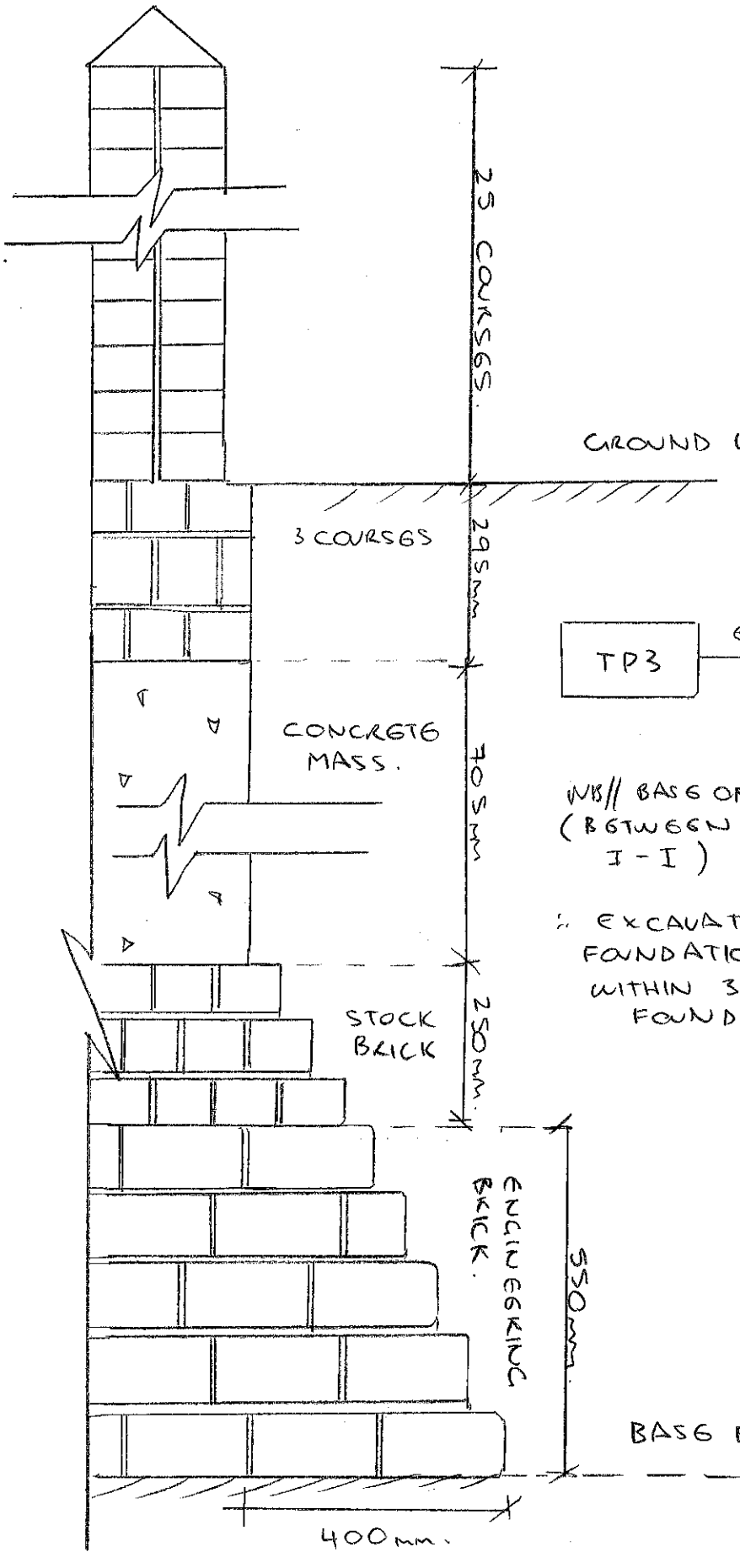
Member Location

Job Title: CAROL STREET

Drawing Ref.

Section: EXISTING FOUNDATIONS.

Made by | Date: 8/09/15 | Checked



TP3 — EXISTING FOUNDATION

TRIAL PIT THREE.

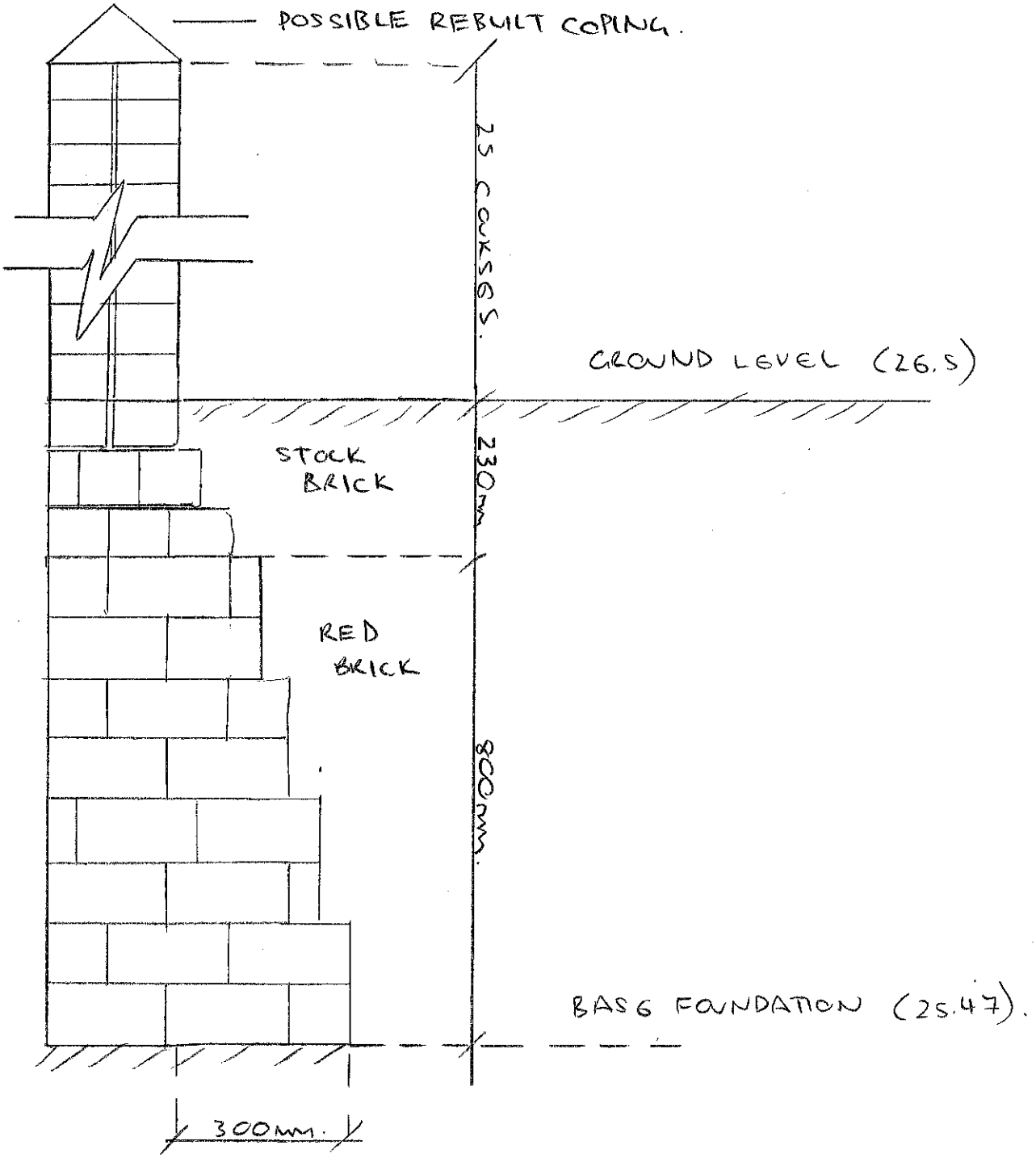
NB// BASE OF PROPOSED EXCAVATION (BETWEEN GRID H-H AND GRID I-I) ≈ 3.67m (22.83)

∴ EXCAVATION BELOW EXISTING FOUNDATION AND EXCAVATION WITHIN 3.0M EXISTING FOUNDATION.

BASE FOUNDATION (24.70)

engineersHRW

Job No. 1402	Sheet No. TP4	Revision	
Member Location			
Job Title CAROL STREET	Drawing Ref.		
Section EXISTING FOUNDATIONS.	Made by	Date 8/09/15.	Checked



TP4 — EXISTING FOUNDATION

TRIAL PIT FOUR.

NB// BASE OF PROPOSED EXCAVATION (BETWEEN GRID H-H AND GRID I-I) ≈ 3.67m ∴ (22.83)

∴ EXCAVATION BELOW EXISTING FOUNDATION AND EXCAVATION WITHIN 3.0m EXISTING FOUNDATION.

Proposed development including basement
Land adjoining No. 43 Carol Street, London

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environmental and geotechnical consultants

Key

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

Notes

Drawing exported from promap license number 100020449

Carol Street

Valley line

Industrial building duo pitched roof

Valley line

Industrial building duo pitched roof

Valley line

Approximate site boundary

Footprint of proposed basement

BH01

Residential properties

17

19

21

23

Residential gardens

Timber fence
(3m in height)

Brickwork boundary wall
(1.5m in height topped with ~0.5m high mesh security barrier)

Hoarding fence
(2m in height)

Industrial building
(masonry walls, northern light roof)

London plane trees

3.5m
3.5m
3.5m
2.275m

2.275m
3.5m
3.5m
3.5m
3.5m
3.5m

4mm
3mm
2mm
1mm
0mm

4mm
3mm
2mm
1mm
0mm

Title	Scale	Drawing number
Plan of basement also showing estimated ground settlement contours following excavation	1:200 at A3	BIA01

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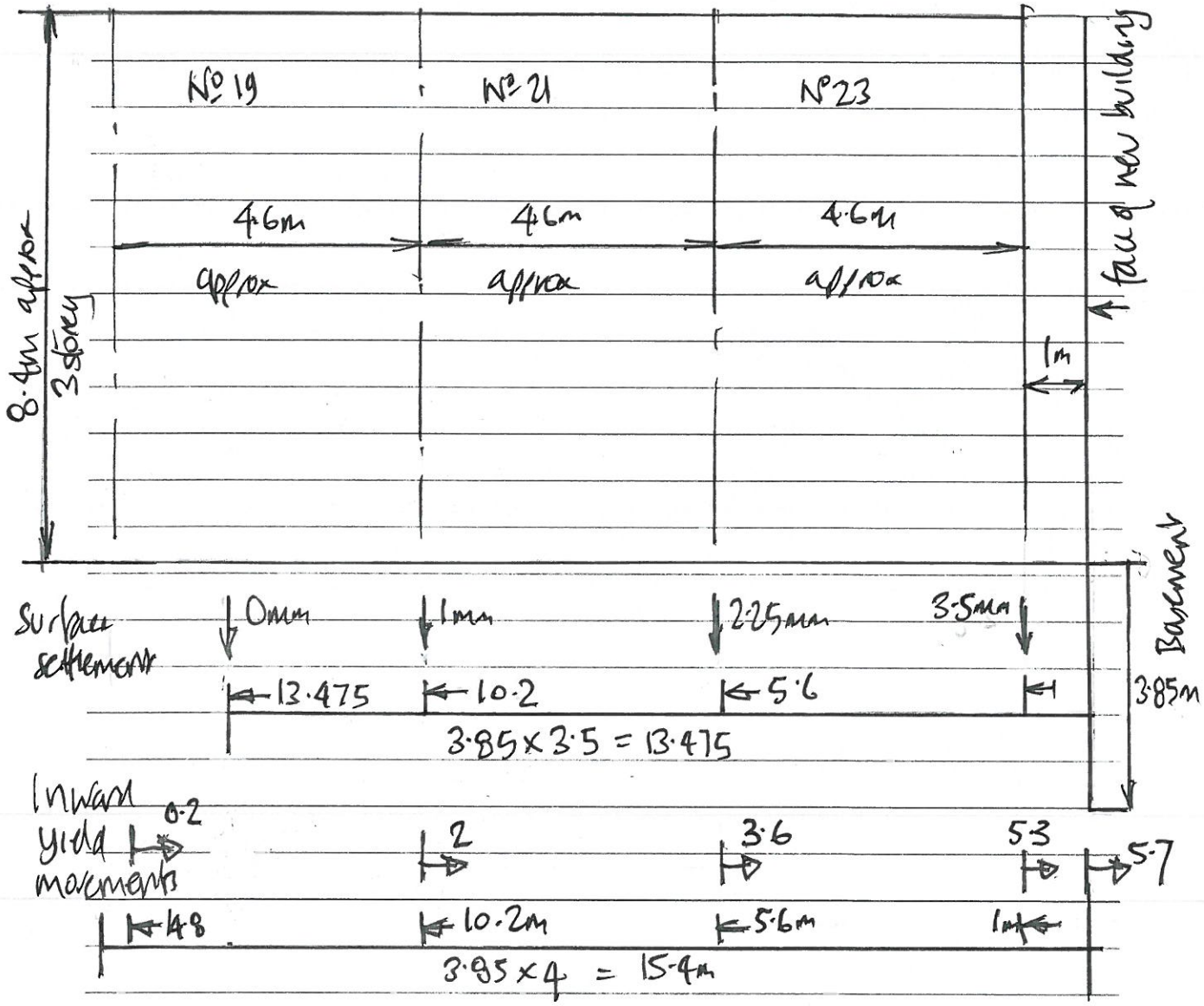
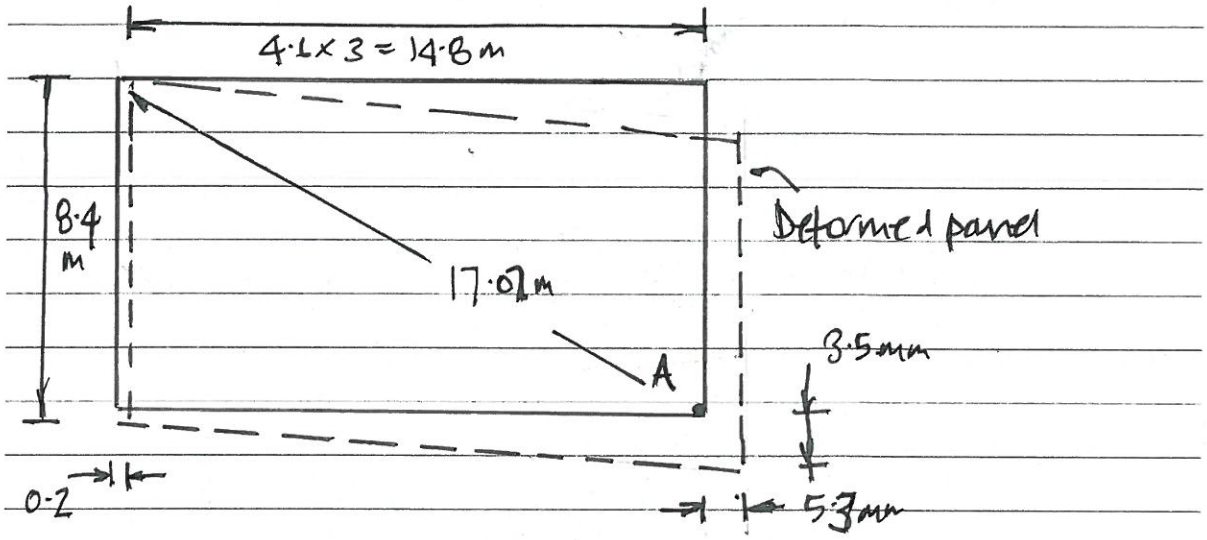
Consider front elevations of 19–23 Carol street
Masonry panels.



Front and rear elevations to 19 to 23 Carol street (neighboring properties) considered most vulnerable to movement damage due to excavation of basement - refer drawing B1A01.

Originator	NLT	Checked	Title: Estimate of damage to adjacent properties
Sheet number	1 of 3		Date August 2017

Consider full panel to front elevation Nos 19 to 23



net horizontal movement = 5.3 − 0.2 = 5.1 mm.

Deformation for horizontal and vertical components @ A.

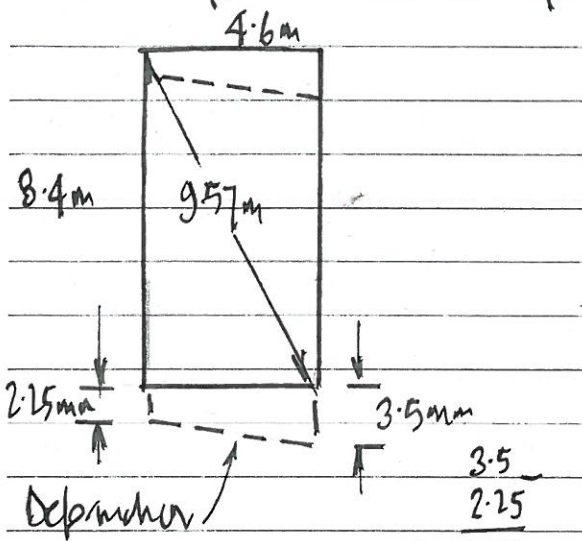
Tensile strain on diagonal = $\frac{6.2}{17020} \times 100 = 0.0364\%$

Burland category 0.

Tensile strain on horizontal = $\frac{6.2}{14800} \times 100 = 0.042\%$

Burland category 0.

Consider front elevation of № 23 (most vulnerable)



$3.5 - 2.25$

nett 1·25mm

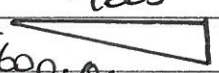
Deformation for vertical components only

tensile strain on diagonal

$\frac{1.25mm}{9570} \times 100 = 0.013\%$

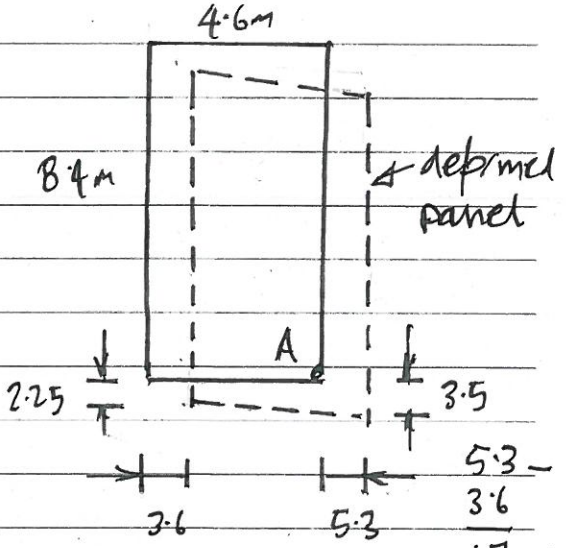
Burland category 0

Tensile strain on horizontal.



$\frac{0.0007}{4600} \times 100 \quad 0.0000036\%$

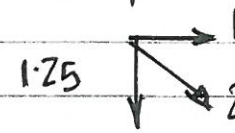
Burland category 0



$5.3 - 3.6$

1·7 nett.

Deformation for horizontal and vertical components @ A



Tensile strain on diagonal

$\frac{2.11}{9570} \times 100 = 0.022\%$

Burland category 0

Tensile strain on horizontal.

$\frac{2.11}{4600} \times 100 = 0.046\%$

Burland category 0.

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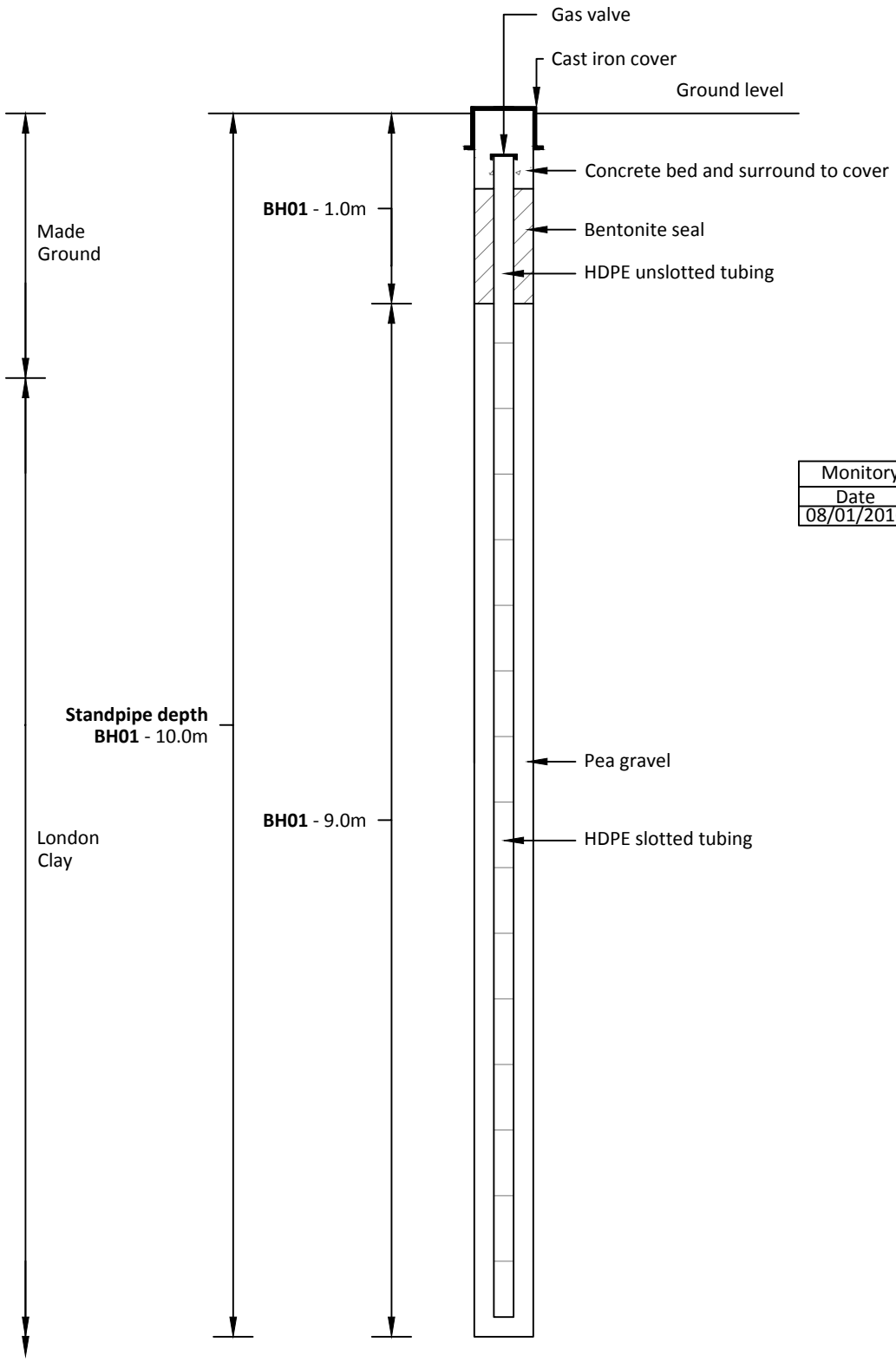
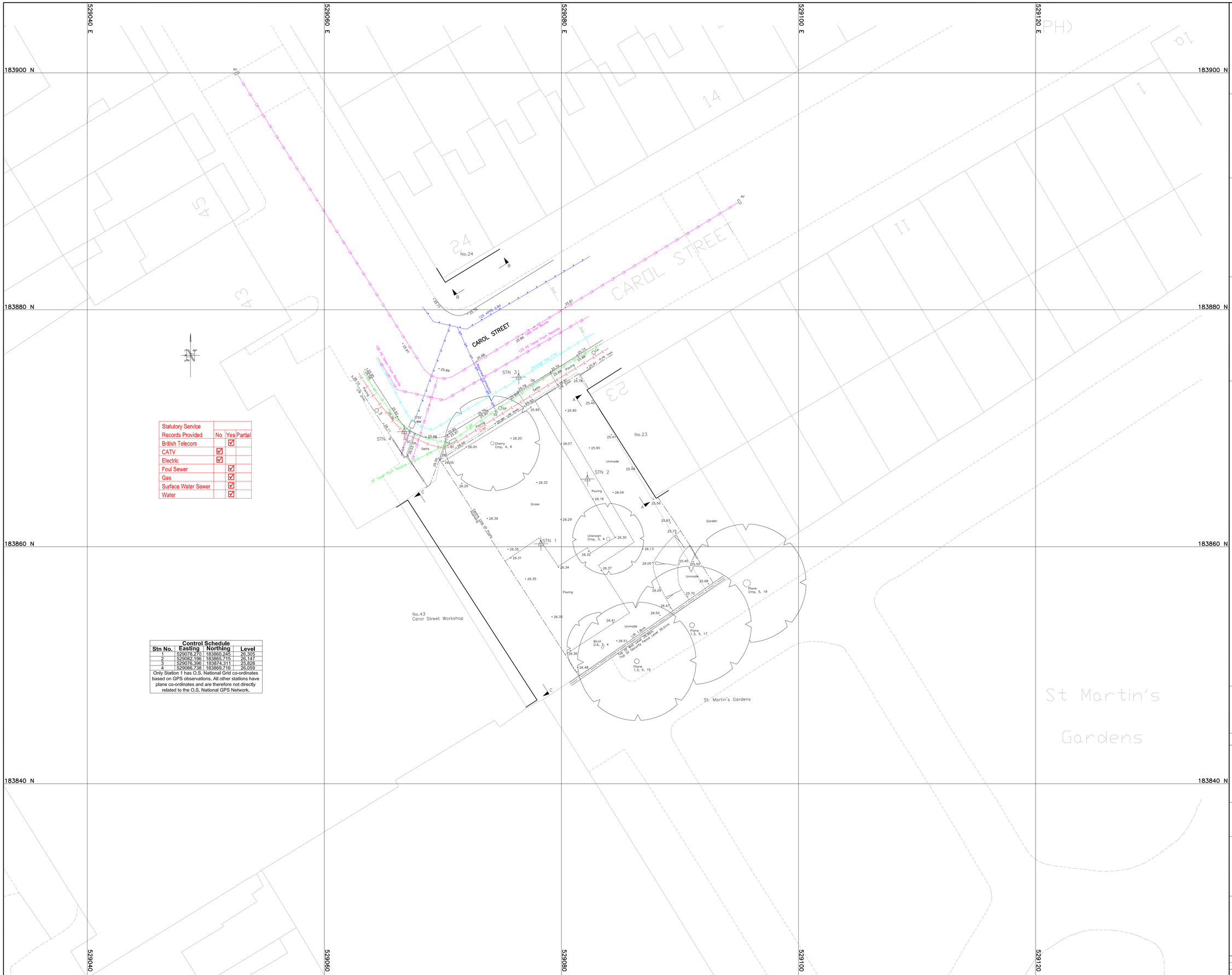


Monitory observation	
Date	Water level
08/01/2016	Dry

Title	Scale	Drawing number
Section showing construction of water monitoring standpipe installed in borehole BH01	Not to scale	BIA03

529040 E | 529060 E | 529080 E | 529100 E | 529120 E

183900 N | 183880 N | 183860 N | 183840 N



Statutory Service Records Provided	No	Yes	Partial
British Telecom		☑	
CATV	☑		
Electric	☑		
Foul Sewer		☑	
Gas		☑	
Surface Water Sewer		☑	
Water		☑	

Control Schedule

Stn No.	Easting	Northing	Level
1	529078.270	183860.245	26.305
2	529082.196	183865.715	26.147
3	529076.396	183874.311	25.828
4	529066.738	183869.716	26.059

Only Station 1 has O.S. National Grid co-ordinates based on GPS observations. All other stations have plane co-ordinates and are therefore not directly related to the O.S. National GPS Network.

CONTROL DATA

Survey stations — STN
Boundary posts — BP

LEVEL DATA

Spot levels — +43.62
Contours — 43
Steep slopes

TREES

1.4.7 Girth (Circumference) , spread (radius), height
Cmp Clump
Trees shown on this drawing have been Identified to the best of the surveyors' ability. Where guaranteed identification of species may become important in the construction stage we would recommend that the services of a specialist arboriculturist be employed. It should be noted that Randall Surveys LLP are not specialists in the field of tree identification.

Datum used : Newlyn. All units are metric.

FEATURES

Fences shown thus
Walls shown thus
Hedges shown thus
Undefined Boundary
Gates

OVERHEAD CABLES

British Telecom
Electric

FENCE TYPES

B/W	Barbed wire	IR	Iron railing
C/B	Close boarded	P/F	Picket fence
CI	Corrugated iron	P/R	Post and rail
C/L	Chain link	P/W	Post and wire
C/F	Chestnut paling	W/F	Wooden fence
C/W	Chicken Wire		

ABBREVIATIONS

AV Air valve
BB Bollards in beacon
BD Back drop
BH Borehole
Bol Bollard
BT British Telecom cover
BTJB BT junction box
CATV Cable TV cover
CDP Cable draw pit
CL Cover level
CM Cable marker
CNI Could not find
CNL Could not lift
CNT Could not trace
CPL Coping level
DC Drainage Channel
DK Drop kerb
EJB Elec. junction box
EOR End of record
EOT End of trace
EP Electricity pole
ER Earth rod
FB Flower bed
FE Final effluent
FH Fire hydrant
FL Floodlight
G Gulley
GV Gas valve
IC Inspection cover
IL Invert level
JB Junction box
KO Kerb outlet
LP Lamp post
MH Manhole
MM Marker
NB Name board
OF Outfall
PB Post box
PM Parking meter
PS Paving slabs
RC Rising cable
RE Rodding eye
Ret. Retaining
RS Road sign
RWP Rain water pipe
SC Stop cock
SL Sump level
SP Sign post
ST Stand pipe
SV Stop valve
SVP Soil vent pipe
TCB Telephone call box
TP Traffic paving
TL Traffic light
TP Telegraph pole
TPL Top of pipe level
TS Traffic signal
VP Vent pipe
WL Wall level
WO Washout
WM Water meter
WSC Water stop cock

IMPORTANT NOTES

The details and information shown hereon relating to underground drains, cables etc, are as obtained by normal field survey observations subject to the restrictions listed in the NJHSC guidelines. Service Co. and sewer records will only have been consulted on specific request and, although all reasonable effort will have been made, no guarantee of accuracy of these records can be given.

Sewer and manhole details shown on this drawing have been obtained by observation and measurement from the surface and as such cannot be guaranteed. Where precise sewer details will be critical to the project design we would recommend that entry into the chamber be undertaken using a specialist team, appropriately qualified for confined space entry. These teams can be supplied upon request.

The pipe and cable routes shown on this drawing have been located using electronic surface detection equipment and/or ground penetrating radar, no trial holes have been dug in order to confirm their presence and position. Whilst the information presented is believed to be correct at the time of the survey due care must be taken when any excavation is undertaken on the site. Trace depths are quoted in metres.

The portrayal of a service on this drawing may indicate the presence of multiple cables/pipes. The exact number will only be indicated where this could be accurately determined.

Hatching denotes an area containing possible services which could not be traced electronically or by GPR, where used, but have been abstracted from service drawings.

The plan position and depth of any service portrayed on this drawing is accurate to +/- 10% of the depth of that service.

Where the precise location and/or depth of a service is critical to design and/or construction, trial holes are recommended to confirm the details provided on this drawing.

This drawing should be read in conjunction with any record drawings available from the statutory authorities.

UNDERGROUND SERVICES – TRACED

CATV
Electric
Water
Telemetry
Gas
Others
British Telecom
Ground Probe Radar Trace
Foul Sewer
Surface Water Sewer
Combined Sewer
Overflow Sewer
Undetermined Sewer
Pumping Main
Washwater

UNDERGROUND SERVICES – NOT TRACED

CATV
Electric
Water
Telemetry
Gas
Others
British Telecom
Foul Sewer
Surface Water Sewer
Combined Sewer
Overflow Sewer
Undetermined Sewer
Pumping Main
Washwater

Where underground services have not been traced electronically or by GPR they have either been abstracted from record drawings or are assumptions based on local site conditions.

NOTES

1. Survey Grid is an arbitrary plane grid that approximates to the O.S. National Grid, with an origin at Station 1, with co-ordinates derived from the O.S. GPS Network.
2. Levels are related to the O.S. National GPS network.
3. Refer to Drawing No. 13445/SP/2 for the Outline elevations.
4. This drawing has been merged with O.S. Digital Mapping by graphical overlay, using best-fit techniques.
5. O.S. Digital Mapping is shown in halftone.

PLAN PRODUCTION BY

RANDALL SURVEYS LLP

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Architectural Building Surveyors
Underground Services Location

THE SURVEY ASSOCIATION | ISO 9001 REGISTERED FIRM | RICS

PROJECT NAME

SITE ADJACENT TO 43 CAROL STREET, NW1 OHT

DRAWING TITLE

EXISTING SITE & SERVICES LAYOUT

SCALE 1/100	DRAWN SJP	PAPER SIZE A0
DATE February 2015	CHECKED DRD	REVISION

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