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1. INTRODUCTION

It is proposed to redevelop 124 St Pancras Way in the London Borough of Camden (LBC). The proposed redevelopment includes the deepening and extending of the existing basement. Card Geotechnics Limited (CGL) has been instructed by Entuititve (the structural engineers) on behalf of Dr Shanthi Thomas to undertake a *Basement Impact Assessment* for the site.

The London Borough of Camden's guidance document *"CPG4, Basements and Lightwells"*[1], requires a Basement Impact Assessment (BIA) to be undertaken for new basements in the Borough and sets out 5 stages for a BIA to "enable the Borough to assess whether any predicted damage to neighbouring properties and the water environment is acceptable or can be satisfactorily ameliorated by the developer". The five stages are set out below:

1. Screening;
2. Scoping;
3. Site investigation;
4. Impact assessment; and
5. Review and decision making.

This report is intended to address the screening, scoping, site investigation and impact assessment stages identified above. It identifies the key issues relating to land stability, hydrogeology and hydrology as part of the screening process (Stage 1) and includes a review and interpretation of existing site investigation data to establish a conceptual site model (Stages 2 and 3). The report provides an impact assessment (Stage 4) of potential ground movements on adjacent structures and the hydrogeology of the surrounding area for the purposes of planning. In addition, the report provides recommendations for off-site disposal of excess arisings and for concrete design.

[1] Camden Planning Guidance, CPG4, Basements and Lightwells, July 2015.

2. SITE CONTEXT

2.1 Site location

The site is located at No. 124 St Pancras Way, Camden, London, NW1 9NB. The National Grid Reference for the approximate centre of the site is 529104E, 184411N. The site location is shown in Figure 1.

2.2 Site description

The site currently comprises a mid-terrace residential property with three above-ground storeys, a single storey basement of reduced head height and a rear garden. The property is some 5.4m wide and is generally level, with the exception of steps to the basement level, which extends to some 1.6 metres below ground level (mbgl) and includes a lightwell and secondary access to the front of the property. No mature trees are present on the site.

The property shares party walls with Nos. 122 and 126 St Pancras Way to the north and south of the site, respectively, and by the rear garden of No. 1A Reed's Place to the east. To the west, the property is directly bounded by the highway and pavement of St Pancras Way.

Visual observations of the surrounding properties indicates the presence of lower ground floor or basement levels at the neighbouring properties, similar to the subject site. A review of local planning applications suggests that these properties have not been significantly modified from their original design with additional basement levels or similar.

2.3 Topography

The site is located some 1.2km east of Primrose Hill and 1.7km southeast of Hampstead Heath. Spot height elevations of 28.5m metres above Ordnance Datum (mOD) and 30.4mOD are noted on Wilmot Place, to the southwest and east of the site respectively, indicating that ground levels in this area gradually rise towards the northeast. This is supported by Ordnance Survey mapping of the local area.

The slope angle map, included within CPG4[1], indicates that the site is in an area where slopes are within 1^{o} to 7^{o}.

2.4 Proposed development

The proposed development includes the extension of the existing basement level to cover the whole of the building footprint and approximately $16m^2$ of the rear garden, including a patio at basement level and steps leading up to the garden. Due to the level of the rear extension, the rear-most part of the proposed basement will be founded at some 1.7m below existing basement level.

The existing foundations to No. 124 St Pancras Way and both neighbouring buildings are to be underpinned, with new foundations along the rear boundary of the new basement and a cantilevered retaining wall to support the rear wall of the proposed patio. It is understood that the soils of the garden will be battered back during excavation of the patio and backfilled once the retaining wall has been constructed.

Proposed development plans are presented as Appendix A.

2.5 Site history

A review of available historical mapping indicates that the site was constructed in the mid-1800s, prior to which it comprised open farmland. The surrounding area was developed at a similar time, changing from a primarily rural environment to a residential area.

No significant changes were noted to the site since its construction and the site is not noted[2] to have suffered bomb damage during the Second World War. However, properties some 30m to 50m east of the site were noted to have suffered 'minor' blast damage or being 'damaged beyond repair'.

2.6 Published geology

The British Geological Survey (BGS) sheet[3] of the area indicates that the site is directly underlain by the London Clay Formation over the Lambeth Group, Thanet Sand and Upper Chalk at depth. No superficial deposits are mapped on the site, or within the immediate surrounding area.

The London Clay Formation is an over-consolidated firm to very stiff, becoming hard with depth, fissured, blue to grey, silty clay of low to very high plasticity. The upper and lower parts may contain silty or fine grained sand partings. The stratum may also contain laminated, structured, nodular claystone and rare sand partings. Crystals of gypsum

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[2] London County Council (2005) *The London County Council Bomb Damage Maps 1939-1945*
[3] British Geological Survey (2006) *North London.* England and Wales Sheet 256. Bedrock and Superficial Deposits.

(selenite) are often present within the weathered London Clay Formation. The stratum is generally horizontally bedded.

With reference to the contours presented on the BGS geological sheet[3], the base of the London Clay Formation is present below the site to a level of approximately -20.0mOD, suggesting an overall thickness of approximately 50m in the area of the site.

2.7 Unpublished geology

Records of historical boreholes within 500m of the site have been reviewed and are presented as Appendix B. A summary of the information from these records is provided in

Table 1.

Table 1. Summary of BGS borehole records

BH record reference	Distance (m)	Direction	Base of BH (mOD) [mbgl]	Ground water level (mOD) [mbgl]	Depth to top of stratum[1] (mOD) [mbgl]					
					Made Ground or Topsoil	Weathered London Clay	London Clay Formation	Lambeth Group	Thanet Sand Formation	Upper Chalk
TQ28SE4	260	NE	-97.54 [128.02]	NR[2]	-[3]	-	30.48 [0.0]	-15.52 [46]	-27.52 [58]	-38.52 [69]
TQ28SE525	310	NW	14.01 [15.0]	19.93 [9.08]	29.01 [0.0]	27.11 [1.9]	21.21 [7.8]	-	-	-
TQ28SE1203	330	S	5.15 [18.75]	22.83 [1.07]	23.9 [0.0]	-	21.31 [2.59]	-	-	-
TQ28SE1204	330	S	5.38 [18.47]	-	23.9 [0.0]	-	22.15 [1.7]	-	-	-
TQ28SE1206	330	S	14.63 [9.63]	23.16 [1.09]	24.3 [0.0]	-	23.16 [1.09]	-	-	-
TQ28SE1208	330	S	13.8 [9.45]	-	23.25 [0.0]	-	22.76 [1.6]	-	-	-
TQ28SE1491	330	S	-172.82 [198.73]	-58.82 [84.73]	25.91 [0.0]	-	25.30 [0.61]	-7.01 [32.92]	-22.25 [48.16]	-28.34 [54.25]
TQ28SE1242	360	W	- [3.0]	-	- [0.0]	- [0.6]	- [1.15]	-	-	-
TQ28SE5	370	SW	-66.44 [91.44]	NR	-	-	25.0 [0.0]	-18.0 [43]	-	-39.0 [64]
TQ28SE24	460	NW	-106.68 [137.68]	NR	-	-	30.48 [0.0]	-9.02 [39.5]	-	-31.02 [61.5]
TQ28SE26	490	SW	- [13.7]	NR	- [0.0]	-	- [3.2]	-	-	-
TQ28SE412	380	NW	-11.28 [40.08]	-6.56 [35.36]	28.8 [0.0]	27.28 [1.52]	22.1 [6.71]	-	-	-

Notes
1. Based on CGL interpretation of historical logs
2. NR = Not provided on borehole record
3. - = Not recorded

The local borehole records indicate the site area to be generally underlain by Made Ground from the ground surface which is in turn underlain by the London Clay Formation at a depth of typically 0.6m to 1.9m bgl, though a deepening of the London Clay to 2.59m to 3.2m bgl has been noted in two boreholes. This appears to be due to a deepening of Made Ground. In three of the logs it has been possible to distinguish the upper part of the London Clay as being weathered. It is noted that approximately the upper 5m to 6m of clay is weathered based on two logs, the third indicates only a 0.55m thickness of weathered soils.

The London Clay has been proven to be some 32m to 46m thickness in the site area. It is underlain by some 21m to 23m of Lambeth Group and Thanet Sand at levels of -7mOD to -18mOD. The surface of the chalk has been proven at depths of 54m to 69m bgl.

Groundwater was proven in five of the boreholes. These show that groundwater was encountered within the Made Ground, perched over the London Clay. A deeper groundwater table was also proven within the Chalk at some 85m bgl.

Groundwater was also noted within the London Clay in two logs. In TQ28SE412 seepage was noted within a 0.3m thickness sand layer toward the base of the London Clay. In TQ28SE525 it is noted that groundwater was only recorded on a fifth monitoring visit. The installation details are not given and so it is not clear what volume of water was within the well. It is however anticipated that this does not represent a groundwater table in the London Clay, and instead may be due to a faulty installation.

2.8 Hydrogeology and Hydrology

The Environment Agency[4] (EA) has produced an aquifer designation system consistent with the requirements of the Water Framework Directive. The designations have been set for superficial and bedrock geology and are based on the importance of aquifers for potable water supply, and their role in supporting surface water bodies and wetland ecosystems.

The London Clay Formation is designated a ‘non-productive stratum’ by the Environment Agency.

[4] http://www.environment-agency.gov.uk (accessed November 2016)

The site does not fall within a Groundwater Vulnerability Zone as indicated by EA mapping, nor is the site located within a groundwater source protection zone (GSPZ).

The closest significant body of water is the *Regent's Canal*, some 300m south of the site. The *Hampstead Ponds* are some 2.3km to the northwest of the site. Environment Agency mapping[5] indicates that the site is not located within a zone at risk of flooding by river or sea and is within Flood Zone 1 ("low probability"), defined as land having a less than 1 in 1000 annual probability of flooding. CPG4[1] indicates that *St Pancras Way* was not flooded during extreme rainfall events in 1975 and 2002 and therefore it is considered that the risk due to surface water flooding is relatively low.

Based on historic borehole logs, groundwater is anticipated to be perched over the London Clay, within the Made Ground, if present. The regional groundwater table is anticipated to be within the Chalk at some 59mOD. Localised confined aquifers are possible within the granular layers towards the base of the London Clay though these are considered to be unlikely to be present within typical basement excavation depths.

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[5] https://flood-map-for-planning.service.gov.uk/summary/529104/184411

3. SCREENING – STAGE 1

3.1 Introduction

A screening assessment has been undertaken based on structured guidance presented in Camden Borough Council's CPG4[1]. Responses to the questions posed by the flowcharts are presented below and where 'yes' or 'unknown' may be simply answered with no analysis required, these answers have been provided.

3.2 Subterranean (Groundwater) flow

This section answers questions relating to groundwater flow (Figure 3 in CPG4).

Table 2. Responses to Figure 3, CPG4

Question	Response	Action required
1a. Is the site located directly above an aquifer?	No. The site is directly underlain by the London Clay Formation, designated an unproductive stratum by the Environment Agency, although some Made Ground may be present associated with the construction of the properties.	None
1b. Will the proposed basement extend beneath the water table surface?	No. The shallowest mapped stratum is the London Clay Formation, which is an unproductive stratum.	None
2. Is the site within 100m of a watercourse, well or potential spring line?	No The closest significant body of water is the Regent's Canal, some 300m south of the site.	None
3. Is the site within the catchment of the pond chains on Hampstead Heath?	No. Hampstead Heath is located approximately 1.8km to the north of the site.	None
4. Will the proposed basement development result in a change in the proportion of hard surfaced/paved areas?	No. The garden is currently paved	None
5. As part of site drainage, will more surface water than at present be discharged to ground (e.g. via soakaways and/or SUDS)?	No. Soakaways are not likely to prove effective in the London Clay due to low infiltration rates.	None
6. Is the lowest point of the proposed excavation close to or lower than, the mean water level in any local pond or spring-line?	No.	None

3.2.1 Non-technical summary: Groundwater

In summary, the site is underlain by the relatively impermeable London Clay Formation, which is an unproductive stratum, and there is therefore no anticipated groundwater table or general flow to be affected by basement construction. Localised perched groundwater may be encountered within Made Ground or fine sand laminations within the London Clay Formation, however this is not expected to be laterally pervasive.

The site is directly underlain by the London Clay Formation, therefore infiltration rates are unlikely to be affected by minor changes in surface impermeability caused by the proposed basement.

3.3 Slope/land stability

This section answers questions relating to site topography, trees, neighbouring infrastructure and quality of underlying soils onsite with regard to the proposed basement development (Figure 4 in CPG4).

Table 3. Responses to Figure 4, CPG4

Question	Response	Action required
1. Does the site include slopes, natural or man-made, greater than about 1 in 8?	No.	None
2. Will the proposed re-profiling of the landscaping at site change slopes at the property boundary to greater than about 1 in 8?	No.	None
3. Does the development neighbour land including railway cuttings and the like with a slope greater than about 1 in 8?	No.	None
4. Is the site within a wider hillside setting in which the general slope is greater than about 1 in 8?	No.	None
5. Is the London Clay the shallowest strata on site?	Yes. The proposed development is part of a terrace of houses, and therefore the effect of heave in the underlying London Clay due to basement excavation will need to be considered.	Investigation and assessment
6. Will any trees be felled as part of the proposed development and/or are any works proposed within any tree protection zones where trees are to be retained?	No.	None
7. Is there a history of shrink/swell subsidence in the local area and/or evidence of such at the site?	Unknown. The shallowest stratum beneath the site is the London Clay Formation and therefore the effect of heave in the underlying London Clay due to basement excavation will need to be considered.	Investigation and assessment

Question	Response	Action required
	However, local structures to the basement also have basements and the deepening/extension of the new basement is unlikely to affect seasonal shrink/swell movements.	
8. Is the site within 100m of a watercourse or a potential spring line?	No. The closest significant body of water is the Regent's Canal, some 300m south of the site.	None
9. Is the site within an area of previously worked ground?	No.	None
10. Is the site within an aquifer?	No. The London Clay Formation is considered to be an 'Unproductive Stratum'.	None
11. Is the site within 50m of the Hampstead Heath ponds?	No.	None
12. Is the site within 5m of a highway or pedestrian right of way?	Yes. The site fronts directly onto St Pancras Way, however the basement excavation is only in the rear of the property, some 9.6m from the highway and is therefore outside the zone of influence (assuming a 45^{o} zone of influence) of the basement and will therefore not be impacted.	None
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Yes. The proposed works include the excavation of material to the rear of the existing basement and is part of a terrace of houses, and therefore the effect of heave in the underlying London Clay due to basement excavation will need to be considered.	Impact Assessment
14. Is the site over (or within the exclusion zone of) any tunnels?	No.	None

3.3.1 Non-technical summary: Slope/land stability

In summary, an investigation is required to confirm ground conditions within the site. An impact assessment is required to investigate the magnitude of ground movements resulting from excavations required for the deepening of the existing basement excavation.

The basement excavation will result in unloading of the London Clay Formation at depth without significant structural reloading and may result in heave movements. The construction of the basement will increase the differential depth of foundations between the site and neighbouring properties. The impact assessment will assess potential damage caused by ground movements to adjacent properties and will recommend measures to mitigate such potentially damaging movements.

3.4 Surface flow and flooding

This section answers questions relating to the impact of the proposed development on existing drainage, permeable surfacing (Figure 5, CPG4).

Table 4. Responses to Figure 5, CPG4

Question	Response	Action required
1. Is the site within the catchment area of the pond chains on Hampstead Heath?	No.	None
2. As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off), be materially changed from the existing route?	No. The rear garden is currently paved and the proposed basement will therefor result in no increase in the amount of hardstanding.	None
3. Will the proposed development result in a change in the proportion of hard surfaced/paved external areas?	No. The garden is currently paved	None
4. Will the proposed basement result in a change to the profile of the inflows of surface water being received by adjacent properties or downstream watercourses?	No.	None
5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No. The proposed excavation would remove a large proportion of the Made Ground that may be present on site and as such will not impact on water quality.	None
6. Is the site in an area known to be at risk from surface flooding, or is it at risk from flooding because the proposed basement is below the static water level of a nearby surface water feature?	No EA surface water flooding maps indicate the site to be within Flood Zone 1 (less than 1 in 1000 annual probability of a flood event). It is noted that St Pancras Way did not flood during the significant flooding events of 1975 and 2002, and therefore the risk of flooding is considered to be relatively minor.	None

3.4.1 Non-technical summary: Surface flow and flooding

In summary the proposed development will not increase the proportion of impermeable surfaces. In addition the site is not known to be at risk of flooding.

Detailed drainage design will be undertaken by others.

3.5 Conclusions

The items summarised below in Table 5 were identified as part of the Stage 1 screening process.

Table 5. Summary of Basement Impact Assessment requirements

Item	Description
	Subterranean (Groundwater) Flow
1.	Confirm the ground conditions and if groundwater is present within the shallow soils and, therefore, whether groundwater will be a consideration for the basement design, and if the basement will affect groundwater flows in and around proposed structures.
	Slope (land stability)
2.	Assessment of potential ground movements associated with construction in the London Clay Formation, including short term and long term heave movements, settlement associated with underpin construction and wall deflections.
3.	Impact assessment of the impact the proposed excavation and basement installation may have on neighbouring structures and their foundations.
	Cumulative impacts
4.	The proposed development is not expected to affect surface water flow and flooding.

4. SCOPING – STAGE 2

On the basis of the screening report, an intrusive investigation is required on site.

The intrusive investigation should:

1. Determine the ground conditions on site and their variability;
2. Install a groundwater monitoring standpipe to determine perched water/groundwater levels;
3. Undertake in-situ testing to assess the strengths of the ground and to support geotechnical assessment; and
4. Obtain soil samples for geotechnical laboratory testing in order to classify the soils on site and to support geotechnical design.

5. PRESENT GROUND INVESTIGATION

5.1 Current site investigation

An intrusive investigation was undertaken by CGL in October 2016 and comprised one window sampler borehole (WS1) to 8.45mbgl. The borehole was undertaken in the rear garden, with ground level at the borehole position raised approximately 0.2m above the general garden ground level. In addition, five hand-excavated foundation inspection pits (TP2 to TP6) were excavated within the existing building and one pit in the rear garden against the party wall of No. 126 St Pancras Way. TP1 was abandoned due to poor access and suspected Asbestos Insulation Board within the cupboard in which the pit was proposed. The ground investigation was undertaken in general accordance with BS 1377:1990[6] and BS 5930:2015[7].

Standard Penetration Tests (SPTs) were undertaken within the borehole and Hand Shear Vane (HSV) tests undertaken on representative samples retrieved from it. A groundwater monitoring standpipe was installed on completion of drilling.

The borehole log and foundation inspection pit logs are presented as Appendix C and Appendix D respectively, and the exploratory hole location plan is presented in Figure 2.

5.2 Monitoring

The groundwater levels in the borehole were recorded on two occasions following the site works (15 and 31 March 2017). The results of the monitoring are included as Appendix E and are summarised in Section 6.5.

[6] British Standards Institution. (1990). *Methods of Test for Soils for Civil Engineering purposes*. BS1377:1990.
[7] British Standards Institution. (2015). *Code of practice for ground investigations*. BS5930:2015

5.3 Laboratory testing

5.3.1 Chemical

Three representative soil samples were submitted to i2 Analytical Limited (a UKAS and MCERTS accredited laboratory) for chemical testing. The analysis included the following determinants:

- Soil Organic Matter (SOM);
- Heavy metals including; arsenic, barium, beryllium, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium, vanadium and zinc;
- Total Petroleum Hydrocarbons (TPH) and Polycyclic Aromatic Hydrocarbons (PAH);
- Total Monohydric Phenols;
- Total Cyanide;
- Sulfate;
- pH determination;
- Asbestos screen; and
- Waste Acceptance Criteria (WAC) suite

The chemical results are included as Appendix F.

5.3.2 Geotechnical

Selected soil samples were submitted to an accredited laboratory for geotechnical testing including the following:

- Atterberg Limits tests;
- Moisture content; and
- BRE analysis in accordance with BRE SD1.

The geotechnical analysis results are included as Appendix G.

6. GROUND AND GROUNDWATER CONDITIONS – STAGE 3

6.1 Summary

The ground conditions encountered during the intrusive investigation broadly corresponded to the published geology however, Possible Head Deposits were recorded above the London Clay Formation, characterised by a reduced shear strength compared to the Weathered London Clay Formation and the presence of a horizon flint gravel which is not consistent with the London Clay Formation. The ground conditions encountered are summarised in Table 6 below.

Table 6. Summary of ground conditions

Stratum	Depth to top of stratum (mbgl)	Thickness (m)
Paving slabs over pale orange brown fine to coarse sand. *Over* Loose dark brown silty gravelly fine to coarse sand. Gravel is angular to subrounded fine to coarse of brick, flint and rare concrete. Slightly ashy. [MADE GROUND]	0.0 0.1	0.1 0.9
Soft dark brown with occasional orange brown mottling silty CLAY. *Over* Medium dense dark orange brown slightly sandy clayey angular to subrounded fine to coarse GRAVEL of flint. Sand is fine to coarse. [POSSIBLE HEAD DEPOSITS]	1.0 1.9	0.9 0.25
Firm brown with occasional blue grey mottling silty CLAY. *becoming* Firm to stiff very closely to extremely closely fissured dark brown with blue grey and orange brown mottling silty CLAY. Fissures are closed, planar and unpolished with a 'blocky' fabric. Fine to coarse sand sized selenite crystals noted [WEATHERED LONDON CLAY FORMATION]	2.15 3.5	1.35 Proven to 8.45m bgl

The ground conditions are discussed in the following sections together with the results of the in-situ and laboratory geotechnical tests. Plots of SPT 'N' values and undrained shear strength (c_u) against level are presented as Figure 3 and Figure 4, respectively.

The plot of c_u against level includes the results of HSV testing and c_u values correlated from SPT 'N' values (based on established correlations[8]). It is noted that the HSV and SPT 'N' values are not in agreement, with the HSV values consistently higher than the SPT 'N' derived c_u values. It was noted during the site works that the consistency of the soils was in

[8] Stroud, M.A. (1975). The standard penetration test in insensitive clays and soft rocks. Proceedings of the European Symposium on Penetration Testing, 2, pages 367-375.

agreement with the HSV test results, and on this basis, the SPTs are considered to be unrepresentatively low. It is possible that the low SPT 'N' values are due to a high energy ratio (e_r) of the drilling rig used (e_r of 95%). It is noted that if corrected (i.e. SPT N60[9]) for this high e_r, the SPT derived c_u values would be in good agreement with the HSV tests results, and this has been considered in the adoption of appropriate geotechnical design parameters (see Section 6.8). For clarity, the SPTs discussed further in this report are based on the 'N' values recorded by the drilling contractor, and are not corrected for energy ratio.

6.2 Made Ground

Made Ground was found to comprise paving slabs set in sand underlain by loose silty gravelly sand with frequent brick. No visible or olfactory evidence of contamination was recorded with the exception of general building rubble.

6.3 Possible Head Deposits

Underlying the Made Ground, a 0.9m thick layer of brown, silty clay was identified. This was in turn underlain by 0.25m of flint gravel.

A HSV test within the cohesive Possible Head Deposits indicated a c_u value of 56kPa, which is consistent with the relative consistency of 'firm' noted during intrusive works. An single SPT 'N' value of 6 was recorded in the cohesive Possible Head Deposits, correlating to a cu value of 27kPa (where f_1 = 4.5), or a relatively consistency of 'soft', which as discussed in Section 6.1, is not considered to be representative of the Possible Head Deposits.

Laboratory testing identified a natural moisture content of 34%, Plastic Limit of 22%, Liquid Limit of 69% and Plasticity Index of 47%, corresponding to a clay of 'high plasticity'[7] with a high volume change potential[10]. It is noted that the moisture content is greater than 40% of the Liquid Limit, and is above the Plastic Limit and is therefore not considered to be significantly desiccated.

[9] British Standards Institution. (2010). Geotechnical investigation and testing. Field testing. Standard Penetration Test. BS EN ISO 22476-3:2005+A1:2011

[10] NHBC. (2016). NHBC standards, Chapter 4.2 building near trees

6.4 Weathered London Clay Formation

The Weathered London Clay Formation was encountered at a depth of 2.15m bgl. A reduced shear strength (relative to the Weathered London Clay identified at greater depth) was recorded to a depth of 3.5m and generally comprised firm, brown with occasional grey mottling, silty clay.

From 3.5m the Weathered London Clay comprised firm, becoming stiff with depth, extremely closely to very closely fissured, dark brown, silty clay with occasional orange brown mottling. Fine selenite crystals were noted throughout. The London Clay Formation was proven to a maximum depth of 8m bgl, and is anticipated to be between 30m and 50m thick based on geological records (see Section 2.7).

HSV testing in the Weathered London Clay indicated c_u values in the range of 54kPa to 58kPa, increasing to between 70kPa and 108kPa (generally increasing with depth) in the underlying firmer Weathered London Clay. These values are consistent with the firm, and firm becoming stiff relative consistencies noted during the intrusive works for the Weathered London Clay.

SPT 'N' values in the Weathered London Clay were between 6 and 7, increasing to between 12 and 16 below 3.5m bgl. The SPT 'N' values correspond to c_u values of 27kPa to 32kPa (relative consistency of 'soft') in the Weathered London Clay, and 54kPa to 72kPa (relative consistency of 'firm') below 3.5m bgl, based on established correlations (where f_1 = 4.5[8]). As discussed in Section 6.1, the SPT 'N' values (and subsequently correlated c_u values) are not considered to be representative of the London Clay Formation.

The results of the geotechnical laboratory analyses have indicated index properties for the Weathered London Clay in the following ranges:

- Moisture Contents between 29% and 32%;
- Liquid Limits between 75% and 80%;
- Plastic Limits between 27% and 30%; and
- Plastic Indices between 48% and 52%.

Based on the above data, the London Clay may be classified as a clay of 'very high' plasticity[7] with a 'high' volume change potential[10]. Moisture contents are generally greater than 40% of the Liquid Limit, although the samples from 4m and 5.5m bgl are marginally below (within 1%), and are above the Plastic Limits. Additionally, positive Liquidity Indices are calculated for all samples. On this basis, the London Clay is not considered to be significantly desiccated.

6.5 Groundwater

Groundwater was not encountered in the window sampler borehole or hand dug foundation inspections during the intrusive works.

The window sampler borehole was installed within a groundwater monitoring well, with a response zone over the granular Possible Head Deposits. Groundwater monitoring undertaken on 15 March 2017 recorded a groundwater level of 1.86m bgl, resting just above the base of the cohesive Possible Head Deposits. The water levels had risen to 1.21m bgl during a subsequent visit undertaken on 31 March 2017, resting within the cohesive Possible Head Deposits.

6.5.1 Permeability testing

The rising head permeability test was undertaken on 31 March 2017, utilising the monitoring well installed in the window sampler borehole. The water in the borehole was bailed to a depth of 2.21m bgl (below the base of the granular Possible Head Deposits) and the water levels was then measured at regular intervals, with a total test duration of 35 minutes.

The water level recovered to 2.18m bgl after 15 minutes, and then stabilised at this depth until the end of the test. A permeability for the screened soils of 10^{-8} m/s has been calculated, indicating therefore that recharge is slow. Implications for the development are discussed in Section 7.

6.6 Sulfate and pH conditions

Three samples of Weathered London Clay Formation were analysed for pH and sulfate. The laboratory results are included in Appendix G and are summarised in Table 7.

Table 7. Summary of pH and sulfate results

Sample location	Sample depth (mbgl)	Strata	pH	Total sulfate as SO_4 (%)	Water Soluble sulfate as SO_4 (2:1 leachate equivalent) (mg/l)	Total potential sulfate (%)	Total sulfur (%)
WS1	0.5-0.8	MG	7.1	NA	47	NA	NA
WS1	1.5	PHD	7.9	0.085	240	0.144	0.048
WS1	2.5	WLC	7.9	0.11	540	0.129	0.043
WS1	3	WLC	7.9	0.16	700	0.165	0.055
WS1	3.5	WLC	7.6	2.2	3,000	2.22	0.74
WS1	4	WLC	7.8	0.42	2,000	0.57	0.19
WS1	5	WLC	7.6	1.7	2,900	1.74	0.58

MG = Made Ground, PHD = Possible Head Deposits, WLC = Weathered London Clay

Based on the pH and sulfate testing undertaken on samples of the Made Ground and Possible Head Deposits, concrete design classes of DS-1/AC-1 have been calculated for both these strata.

Based on the pH and sulfate testing undertaken on samples of London Clay Formation (see Table 7), a concrete design class of DS-3/AC-2s has been calculated.

6.7 Material management

A preliminary assessment of the Made Ground for off-site waste characterisation purposes indicates that the Made Ground in the rear garden is not hazardous. Waste acceptance criteria (WAC) testing indicates that the Made Ground is suitable for disposal at an inert waste facility, subject to confirmation during the works that the Made Ground is chemically consistent across the site. No visual or olfactory evidence of contamination was noted in the natural soils and laboratory testing did not identify contamination. On this basis, the natural soils may be classified as inert for off-site disposal.

It should be noted that in May/June 2012 HMR&C issued Briefs 15/12 and 18/12 clarifying how construction spoil and excess soils will be assessed for landfill tax purposes. Detailed accurate descriptions of waste are required for all wastes to support the landfill tax assessment. Uncontaminated naturally occurring soils will remain inert by default and eligible for the lower rate of landfill tax. Similarly ‘reworked soils’ and demolition ‘stone’ comprising ONLY materials listed in the Schedule of the Landfill Tax (Qualifying Material)

Order 2011 (SI 2011/1017) will also be eligible for the lower rate of landfill tax. However, Made Ground containing soil and foreign objects such as timber, plastic, rubber, metal, paper, plasterboard, asbestos, etc., regardless of the results of chemical analysis for waste classification purposes, will be eligible for the standard (higher) rate of landfill tax. Therefore, to maximise eligibility for lower rate landfill tax on waste construction spoil/ reworked ground, careful waste segregation and controls are necessary.

All material intended for offsite disposal should be transported and disposed in accordance with the Environmental Protection (Duty of Care) Regulations, 1991 and the Landfill (England and Wales) Regulations, 2002 (as amended). Waste legislation stipulates that hazardous and not hazardous waste should be pre-treated prior to disposal. Pre-treatment can be undertaken either at the site of origin or may be carried out at a licensed off-site facility and can include selective segregation of soils conducted on site.

6.8 Geotechnical design parameters

Geotechnical design parameters are recommended based on the available information from the intrusive investigation and published information, and are summarised in Table 8. The values are unfactored (Serviceability Limit State) parameters and are considered to be characteristic values for the local soils. Design levels are relative to the site datum, taken as ground level at the borehole position on the raised area of the rear garden. This level is approximately 0.2m above the general level of the lower section of rear garden and the ground level of the existing rear extension.

Table 8. Geotechnical design parameters

Stratum	Design Level (mSD)	Bulk Unit Weight γ_b (kN/m^3)	Undrained Cohesion c_u (kPa) [c']	Friction Angle ϕ' (°)	Young's Modulus E_u (MPa) [E']
Made Ground	0	18	NA	29[a]	[12]
Possible Head Deposits	-1	20	40 [0]	NA	20 [12]
Weathered London Clay	-2.15	20	40 [5]	24[b]	24[d] [20.25][e]
London Clay	-3.5	20	60 + 7.8z [5]	24[b]	36 + 4.7z[c+d] [27 + 3.5z][c+e]

a. *Peck, R.B. et al. (1967). Foundation Engineering. Second Edition. John Wiley.*
b. *BS 8002:2015 Code of practice for Earth retaining structures, British Standards institution.*
c. *z = depth below upper surface of the stratum*
d. *Based on 600 Cu - Burland, Standing J.R., and Jardine F.M. (eds) (2001), Building response to tunnelling, case studies from construction of the Jubilee Line Extension London, CIRIA Special Publication 200.*
e. *Based on 0.75Eu - Burland, Standing J.R., and Jardine F.M. (eds) (2001), Building response to tunnelling, case studies from construction of the Jubilee Line Extension London, CIRIA Special Publication 200.*

The design c_u profile is a moderately conservative line taken as the lower bound of the recorded HSV test results (see Section 6). This is consistent with published values for the well-studied London Clay Formation.

It is recommended that the formation level is inspected by a suitably qualified geotechnical engineer prior to casting foundations, particularly if soft or discoloured material is encountered.

It is understood that the existing property will be retained and the deepened basement will be supported by underpinning the existing foundations. The impact of this is further assessed in Section 8 of this report.

For the purposes of design, it is recommended that a presumed allowable bearing pressure of 90kPa is taken, assuming shallow foundations formed in the Weathered London Clay Formation. The shear strength of the underlying soils should be confirmed as foundation formation levels are exposed.

6.9 Conceptual site model

A conceptual site model (CSM), relating to potential ground movement, has been developed based on the available data. The CSM comprises a plan (Figure 5) and sections (Figure 6 and Figure 7) indicating the basement construction and the location of neighbouring properties in relation to the proposed development.

Critical section lines were selected for the assessment of anticipated vertical ground movements and deflection resulting from basement construction. The placement of these lines was in order to pick up the foundations of surrounding structures within the zone of influence of the basement excavation, assuming a 45° stress distribution from the base of the basement excavation. It is noted that the both the St Pancras Way roadway and No. 1a Reed’s Place (to the rear of the site) are beyond the zone of influence of the basement excavation and thus have not been assessed in the same detail as Nos 122, 124, and 126 St Pancras Way.

7. IMPACT ASSESSMENT – SUBTERRANEAN (GROUNDWATER) FLOW

7.1 Introduction

This section provides a qualitative assessment of the effect the basement will have on the local hydrogeological regime and whether this will affect adjacent properties.

7.2 Impact on groundwater flow

Based on the observations during the site investigation and monitoring, no significant aquifers or groundwater has been encountered beneath the site. Water was identified within the granular Possible Head Deposits during monitoring visits, however, the calculated permeability of these soils encountered within the borehole indicates a low permeability which is likely to be of low hydrological significance.

On this basis, it is considered that the proposed basement will not have a significant negative impact on groundwater flow or level in the vicinity of the site, and no further assessment is considered to be necessary.

7.3 Perched water control during construction

Based on observations of perched water at the site during the site investigation and subsequent monitoring, the basement excavation is expected to encounter perched water within the granular Possible Head Deposits (0.25m thick at a depth 1.9m). However, the infiltration of the perched water rate into WS01 appeared to be relatively slow, of the order of 10^{-8} m/s.

As such, it is considered likely that a limited volume of water will be encountered by the excavation and that this can be adequately accommodated with pumping from locally excavated sumps. The design of perched water control measures should be undertaken by a suitably qualified and experienced contractor.

8. IMPACT ASSESSMENT – LAND STABILITY

8.1 Introduction

This section describes calculations undertaken to assess ground movements that may result from the construction of the basement and how these could affect the adjacent structures and infrastructure. It is understood that reinforced concrete underpinning will be used to construct the new basement walls and provide support to the existing perimeter foundations.

The following construction processes could give rise to ground movements; the impacts of which will be assessed in this report:

- Heave movements: The Possible Head Deposits and London Clay are susceptible to short term heave and time dependant swelling on unloading, which will occur as a result of basement excavation, generating upward ground movements.

- Underpin deflection: Underpins act as stiff concrete retaining walls, which limits the potential for wall deflection. Appropriate temporary works are critical in controlling such deflections.

- Underpin settlement: construction of underpins beneath existing foundations can lead to settlement. The amount of settlement depends primarily on the quality of workmanship in constructing the underpins, in particular in dry-packing between the existing foundation and the new underpins. In addition, there may be settlement as structural loads are transferred to greater depth, on to soils that have not previously been loaded.

8.2 Analysis sections

The ground movement sections have been analysed for the proven foundation depths for Nos 122, 124, and 126 St Pancras Way, taken as the depth to the underside of the existing footing identified in the foundation inspection pits. The lateral stress distribution has been assumed to be parabolic, decreasing to zero at 5m from the edge of the excavation and on this basis all other nearby properties are considered to be outside of the zone of influence of the basement excavation.

Table 9 below provides a summary of the assumptions made within the analysis for each critical section.

Table 9. Summary of critical sections

Critical section line	Underpin location	Assumed existing foundation level (mSD)	Assumed underpin foundation level (mSD)
A – A’	Rear wall of No. 126	-2.1	-3.8
B – B’	Rear extension of No. 126	-1.0	-3.8
C – C’	Rear wall of No. 124	-2.1	-3.8
D – D’	Rear wall of No. 122	-2.1	-3.8

8.3 Assumed construction sequence

The basement deepening beneath the existing property will be constructed using traditional staged underpinning techniques with underpins excavated in sequence in bays typically 0.9m to 1.1m wide and will be propped in the temporary condition. The excavation will be undertaken in a single lift.

The underpins will be propped in the permanent condition by the basement floor slabs for the basement deepening and the basement floor slab and ground floor slabs for the basement extension, which should be cast before removing the temporary propping.

The wall of the extension of the basement into the rear garden will not be underpinned as there are no existing structures in this area. Instead this will be constructed as a reinforced concrete cantilevered retaining wall.

8.4 Assumed underpin and slab net loadings

Structural loads have been provided by the structural engineer. These are provided as Appendix H and are summarised in Table 10.

The proposed development gives rise to both net loading and net unloading of the underlying strata during construction and over the long term. Allowing for underpin thickness, the excavation beneath the existing basement will result in a dig depth of 1.7m below existing basement level and will result in unloading the soils at the underpin formation level by some 34kPa. In the area of basement extension, the dig depth is 3.1m below the existing ground level, resulting in an unloading of 62kPa at the underpin formation level. These depths have been scaled off drawings supplied by the architect and assumes a bulk unit weight of 20kN/m^3 for all excavated soils.

The underpin, basement wall, and slab loads have been provided by the structural engineer and are summarised in Table 10 below.

Table 10. Summary of underpin loads and unloading due to excavation

Load location	Underpin loading (kPa)	Unloading due to excavation[a] (kPa)	Net loading (kPa)[b]
Party wall with No 126 St. Pancras Way	110[c]	24	86
Rear wall of No 124 St Pancras Way	34.1	34 to 62	0.1 to -27.9
Wall retaining garden of No 122 St. Pancras Way	61.5	34 to 62	27.5 to 9.5
Rear Basement wall	34.5	62	-27.5
Basement floor slab	12.0[d]	34 to 62	-22 to -50

Notes

a. Assumes 1m wide underpins
b. Positive numbers represent loading and negative numbers represent unloading
c. Loading exceeds allowable bearing pressure. Analysis assumes consolidation of soils beneath existing footing
d. Slab load only, no underpins in this area

8.5 Ground movements arising from basement excavation

A ground movement assessment has been undertaken using OASYS Limited *PDISP* analysis software. *PDISP* assumes that the ground behaves as an elastic material under loading, with movements calculated based on the applied loads and the soil stiffness (E_u and E') for each stratum input by the user. *PDISP* assumes perfectly flexible loaded areas and as such tends to overestimate movements in the centre of loaded areas and underestimate movements around the perimeter. To address this the loads from the underpins around the perimeter, as summarised in the previous sections, have been accounted for and modelled in the analysis.

The maximum short term settlements beneath the underpins are predicted to be of the order of 0.5mm at the rear wall of No. 124. The underpins along No. 122 and No. 126 are both predicted to heave by the order of 0mm to 2mm. Heave beneath the basement slab is predicted to be of the order of 0mm to 2.5mm; the greater value is anticipated at the rear of the proposed basement extension.

The maximum long term settlements beneath the underpins are predicted to be of the order of 1mm at the rear wall of No. 124. The underpins along No. 122 and No. 126 are both predicted to heave by up to 4mm. Heave beneath the basement slab is predicted to be up to 5mm; the greater value is anticipated at the rear of the proposed basement extension.

Contour plots showing the variation of both short and long term heave for the whole basement are presented in Figure 8.

8.6 Ground movements arising from underpin construction

The heave/settlement assessment undertaken within *PDISP* does not account for workmanship in the underpin construction and the effect of settlement of the dry pack between existing footings and the new concrete has therefore been included separately.

With good construction practice, actual settlements would be expected to not exceed 5mm per lift. This value has been applied to the overall ground movement and corresponding impact assessment to calculate a predicted damage category for the adjacent properties.

8.7 Summary of vertical ground movements

The result of the settlement analysis along the party wall with 126 St Pancras Way and the rear wall of 122 St Pancras Way, located adjacent to the basement excavation, are summarised in Table 11. These ground movements include the anticipated settlement due to workmanship associated with construction of the underpins.

Table 11. Summary of underpin settlements

Location	Predicted vertical displacement[a] (mm)			Assumed maximum workmanship settlement = 5mm (per lift)
	Short term conditions	Long term conditions	Total displacement (mm)	Total displacement (inc. workmanship) (mm)
A – A’	0.5	0.8	1.3	6.3
B – B’	-0.3	-0.7	-1.0	4.0
C – C’	0.6	1.0	1.6	6.6
D – D’	0.7	1.1	1.8	6.8

a. A positive number denotes settlement and a negative number denotes heave

Full *PDISP* output can be provided upon request.

8.8 Ground movement due to underpin wall deflection

Due to the relatively high stiffness of the reinforced concrete underpins, long term deflection is considered to be negligible (i.e. <3mm). This is based on CGL's experience with similar underpinned basement developments in the area.

During the works, lateral displacements will be resisted by sequential propping of the underpinned foundations. Trench sheeting will be employed where required to prevent localised collapse of the soil and will be supported with appropriate propping. As the underpin stems are cast, the props will be removed, seeing that the excavation is continually controlled, and will be replaced whilst the concrete cures. Initially, the underpins will be propped against the central soil retained in the centre of the site. Once this has been excavated, the props should be relocated to a sacrificial thrust block constructed beneath the level of the proposed floor slab.

A detailed temporary works strategy should be developed as part of the structural design to ensure the underpins are stable prior to casting of the basement and ground floor slabs.

8.9 Damage category assessment

The calculated ground movements have been used to assess potential 'damage categories' that may apply to neighbouring properties due to the proposed basement construction. The methodology proposed by Burland and Wroth[11] and later supplemented by the work of Boscardin and Cording[12] has been used, as described in *CIRIA Special Publication 200*[13] and *CIRIA C760*[14]. General damage categories are summarised in Table 12 below:

---

[11] Burland, J.B., and Wroth, C.P. (1974). *Settlement of buildings and associated damage*, State of the art review. Conf on Settlement of Structures, Cambridge, Pentech Press, London, pp611-654

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

[13] Burland, Standing J.R., and Jardine F.M. (eds) (2001), *Building response to tunnelling, case studies from construction of the Jubilee Line Extension London*, CIRIA Special Publication 200.

[14] CIRIA C760 (2017) Guidance on e*mbedded retaining wall design*

Table 12. Classification of damage visible to walls (reproduction of Table 6.4, CIRIA C760)

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

For the critical perimeter underpin wall sections, the combined impacts of short-term and long-term ground movements and assumed settlement due to workmanship have been combined to determine the overall ground movement of the underpins and adjacent properties due to the construction of the basement.

Table 13 incorporates superimposed horizontal and vertical movements derived from the underpin wall construction (i.e. 5mm settlement per lift due to workmanship) and short term movements due to excavation. The method of deriving these values and establishing an appropriate deflection ratio for the neighbouring structures is illustrated graphically in Figure 9 for Nos 122 and 126 St Pancras Way.

The spans between the footings of the adjacent party wall properties (Nos 122 and 126 St Pancras Way) have been taken as 5.5m for the rear wall of each property, and 2.6m has been taken for the width of the rear extension part wall of No 126 St Pancras Way. These spans have been taken as perpendicular to the basement footprint.

Based on the calculated maximum deflections, a maximum limiting value for the horizontal deflection of each underpin has been calculated to limit the predicted damage category for the adjacent properties to Category 1 'very slight' damage. Regular monitoring of the underpins should be undertaken during construction against these values. Good quality workmanship with staged propping of the underpins is essential in controlling horizontal movements and rotation. It is critical that the basement wall is propped over the long term (i.e. with the floor slab) to prevent long term deflection.

Table 13. Summary of ground movements and corresponding damage category

Critical Section	Limiting horizontal movement (mm)	Calculated maximum vertical deflection (mm)	Horizontal Strain ε_h [b] (%)	Deflection ratio Δ/L[a] (%)	Damage category
126 St Pancras Way rear wall	3.0	2.0	0.055	0.036	Category 1 ('very slight')
126 St Pancras Way rear extension	1.8	0.8	0.058	0.026	Category 1 ('very slight')
124 St Pancras Way	6.5	2.5	0.036	0.023	Category 1 ('very slight')
122 St Pancras Way rear wall	3.0	2.0	0.055	0.036	Category 1 ('very slight')

a. See Box 6.3 (5) CIRIA C760 (2017) Guidance on embedded retaining wall design. (δ_h = horizontal movement in metres)
b. See Figure 6.27 (a) CIRIA C760 (2017) Guidance on embedded retaining wall design. (L = length of adjacent structure in metres, perpendicular to basement; Δ = relative deflection)

The predicted damage category imposed on the neighbouring properties due to the proposed basement developments, assuming a good standard of workmanship, is 'Category 1', corresponding to 'very slight' damage, characterised by very small cracks that can easily be repaired during normal decoration. The building interaction chart, showing both critical sections, is presented in Figure 10. It is noted that that building interaction chart is plotted assuming limiting horizontal movement is fully realised.

It is noted that the extension to No 126 St Pancras Way is some 2.6m wide and is therefore potentially more sensitive to differential ground movement due to the adjacent basement. However, the assessment is conservative and lateral ground movements are therefore not anticipated to realise the values in the above table, provided that suitable propping is installed at the top of the excavation to prevent loss of the granular Made Ground around the existing foundations.

8.10 Construction monitoring

The results of the ground movement analysis suggest that with good construction control, damage to adjacent structures generated by the assumed construction methods and sequence can be controlled to within Category 1 ('very slight'). To confirm that movements do not start to fall outside of those predicted, it is recommended that a formal monitoring strategy is implemented on site in order to observe and control ground movements during construction.

The monitoring system should operate broadly in accordance with the 'Observational Method' as defined in CIRIA Report 185[15]. Monitoring can be undertaken by using positional surveys compared to baseline values established before any excavation work is undertaken onsite. Regular monitoring of these positions will determine if any horizontal translation, tilt or differential settlement of the neighbouring structure is occurring as the construction progresses. Monitoring data should be checked against predefined trigger limits and can also be further analysed to assess and manage the damage category of the adjacent buildings as construction progresses.

As discussed previously, the horizontal deflection/translation of the underpins during construction should be limited to 3.0mm along the rear walls of Nos. 122 and 126 St Pancras Way, 6.5mm along the rear wall of No. 124 St Pancras Way and 1.8mm along the party wall with the rear extension of No. 126 St Pancras Way to restrict the damage category for these properties to within 'Category 1', corresponding to 'very slight' damage, characterised by very small cracks that can easily be repaired during normal decoration. These values should form the basis of the 'traffic light' trigger levels established prior to underpinning works commencing onsite.

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

[15] Nicholson, D., Tse, Che-Ming., Penny, C., The Observational Method in ground engineering: principles and applications, CIRIA report R185, 1999.

9. NON-TECHNICAL SUMMARY

9.1 General impacts

The results of this Basement Impact Assessment are informed by ground investigation data and supplemented with published and unpublished records. The analysis is also informed by drawings and loadings provided by the structural engineer.

- The ground conditions beneath the site comprise Made Ground over cohesive Possible Head Deposits which is underlain in turn by a layer of granular Possible Head Deposits

- The construction of the basement will generate ground movements due to a variety of causes including heave, settlement and underpin deflection during and after excavation. Calculations indicate that these can be controlled to within a damage category within Category 1 ('very slight') for Nos 122, 124 and 126 St Pancras Way. The above assumes a good standard of workmanship during construction.

- The remaining neighbouring properties and roadway are significantly distant from the proposed basement that they are not considered to be at risk from the development.

- In order to control ground movements to within the predicted range, it is recommended that a formal monitoring strategy is implemented on site in order to observe and control ground movements during construction.

- It is considered that the proposed basement will not significantly impact upon subterranean groundwater flow and surface flow and flooding.

- The granular Possible Head Deposits contain confined groundwater, though infiltration rates calculated within the borehole indicate that significant dewatering is unlikely to be required. Notwithstanding this, allowance should be made for sump pumps during excavation.

9.2 Cumulative impacts

Based on the available information, it is understood that the surrounding properties adjacent to the proposed basement also include basement levels adjacent to the proposed basement deepening.

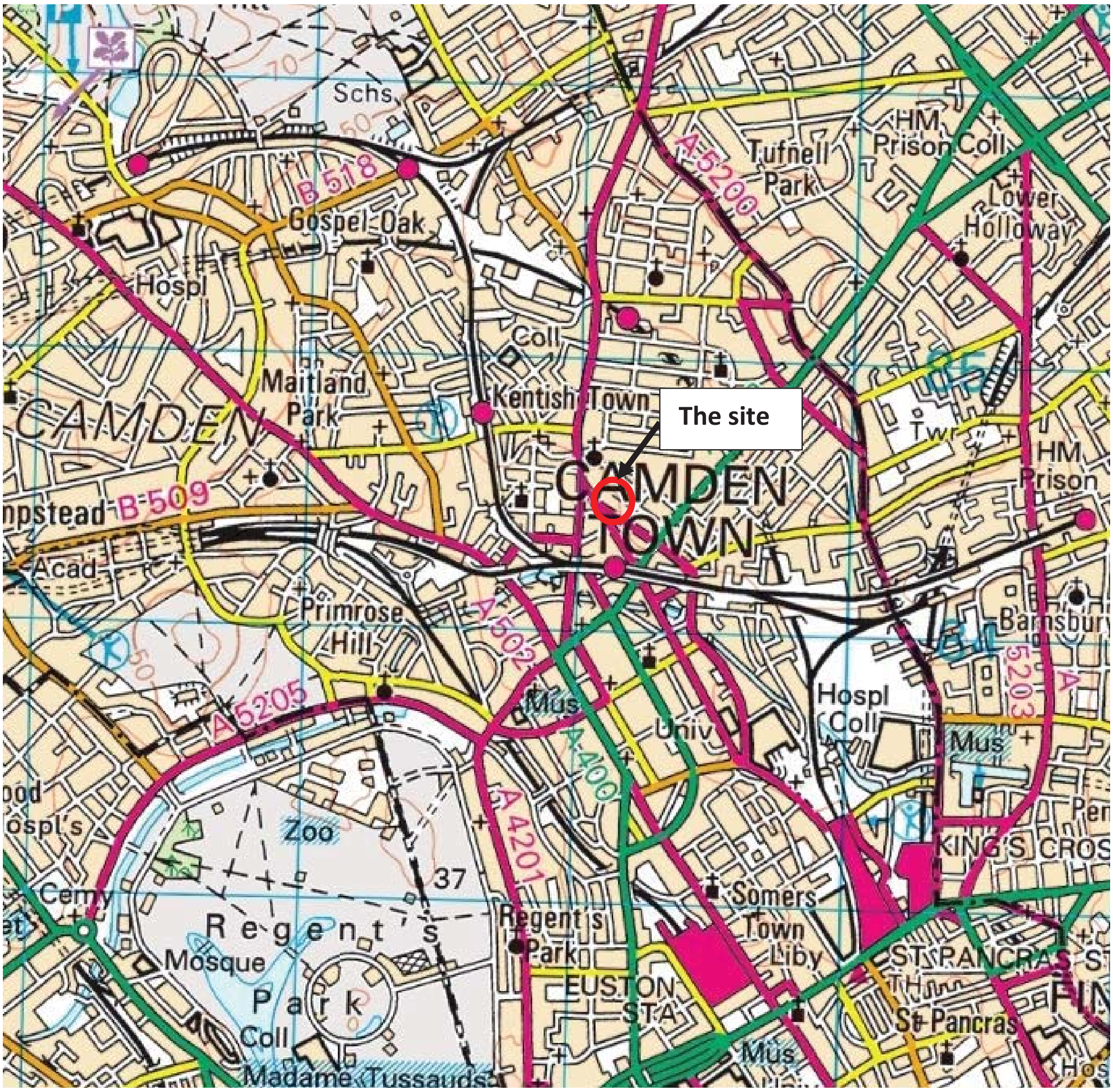
Assuming a good quality of workmanship, particularly the underpinning of the corners of the basements of No. 122 and 126, and also underpinning the rear extension of No. 126, it is considered that there are no significant cumulative impacts in respect of ground or slope stability due to the proposed development.

Given the relative positions of the existing basements and proposed basements (i.e. generally no sharing of party walls), it is considered that there are no significant cumulative impacts in respect of ground or slope stability due to the proposed development.

Only confined water has been identified beneath the site within Possible Head Deposits, which were noted to be 0.25m thickness and have a slow infiltration rate. On this basis it is considered that these soils are not of great hydrological significance and it is therefore considered that the proposed development would not contribute further to any cumulative effects on groundwater.

The proposed development will not materially alter the proportion of hardstanding across the site. It is understood that the existing surface water run-off is currently, and will be, discharged to the drainage network through existing connections. On this basis, the development is not considered to contribute to any significant cumulative impact with regard to surface flow or flooding.

FIGURES



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N

Client	Project	Job No
Dr Shanthi Thomas	**124 St Pancras Way, Camden**	**CG/28111**
CGL	Title **Site location plan**	**Figure 1**

KEY

Trial pit

Window sample

Rev	Date	Comments
0	17/03/17	

CGL

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Project: **124 St Pancras Way, Camden**

Client: **Dr Shanthi Thomas**

Drawing title: **Exploratory hole location plan**

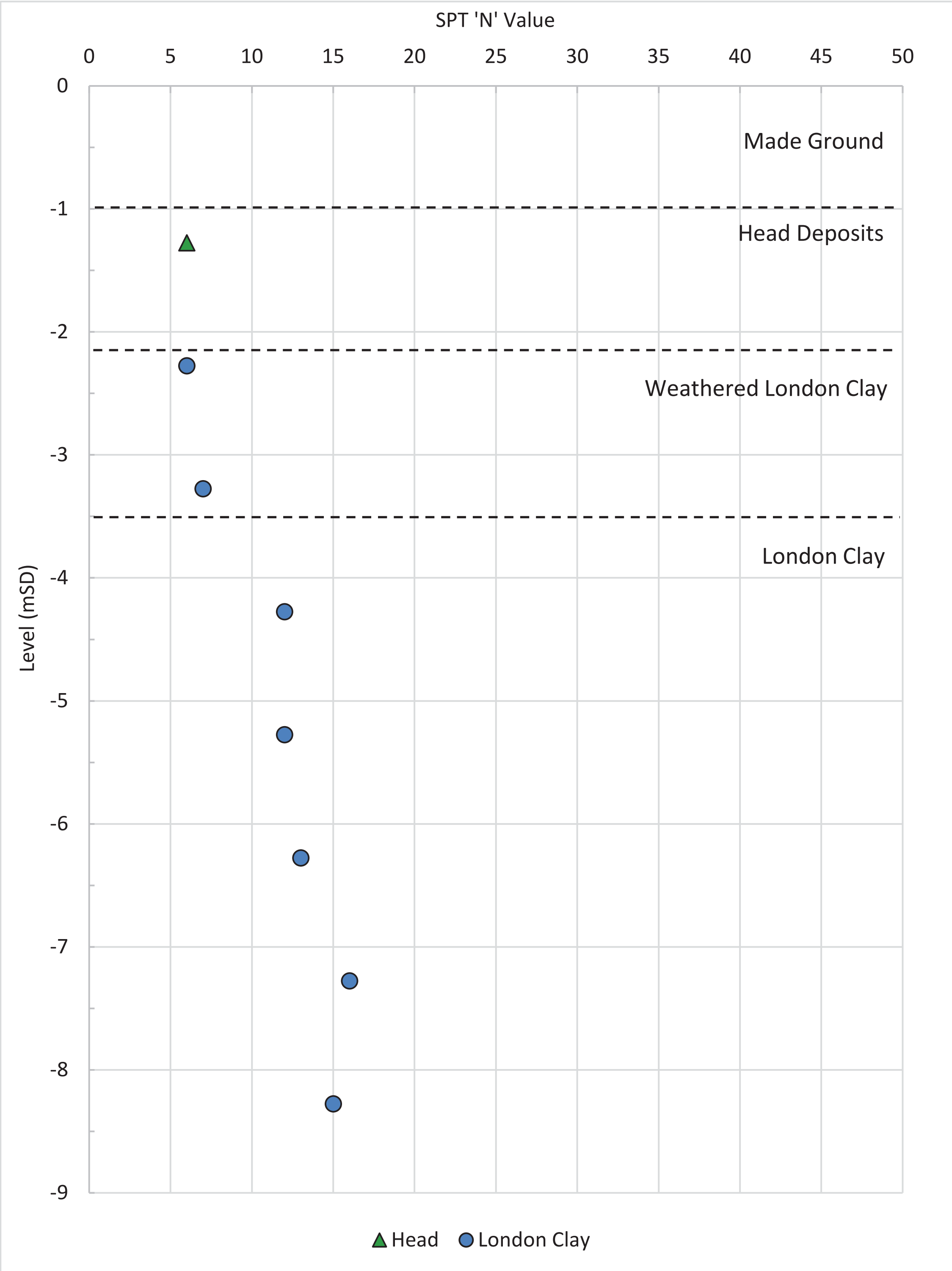
Scale(s): **NTS**

Job No.: **CG/28111**

Drawn	TSB	17/03/17
Checked		DRAFT
Approved		DRAFT

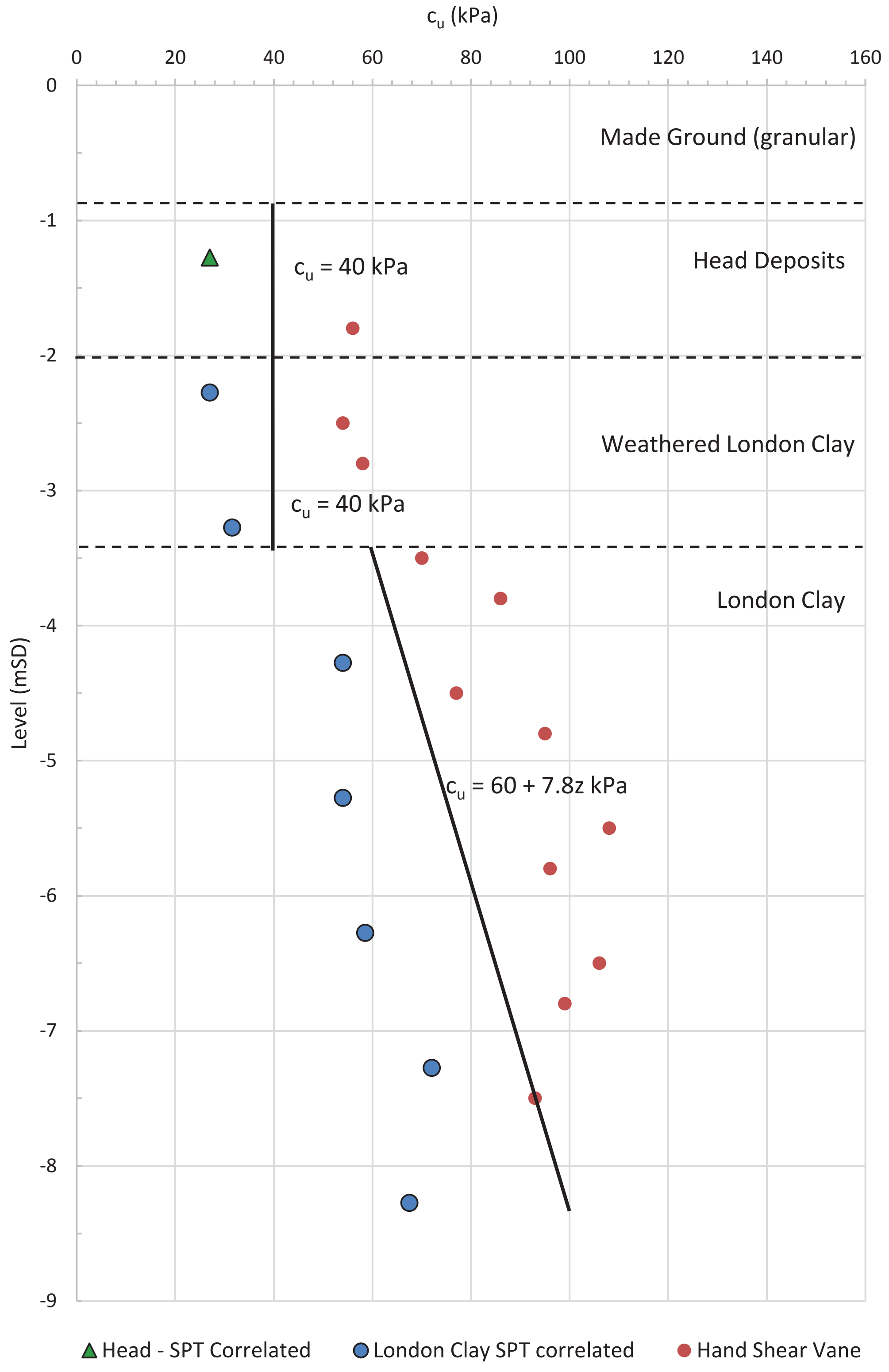
Dwg No.: **Figure 2**

Rev.: **0**



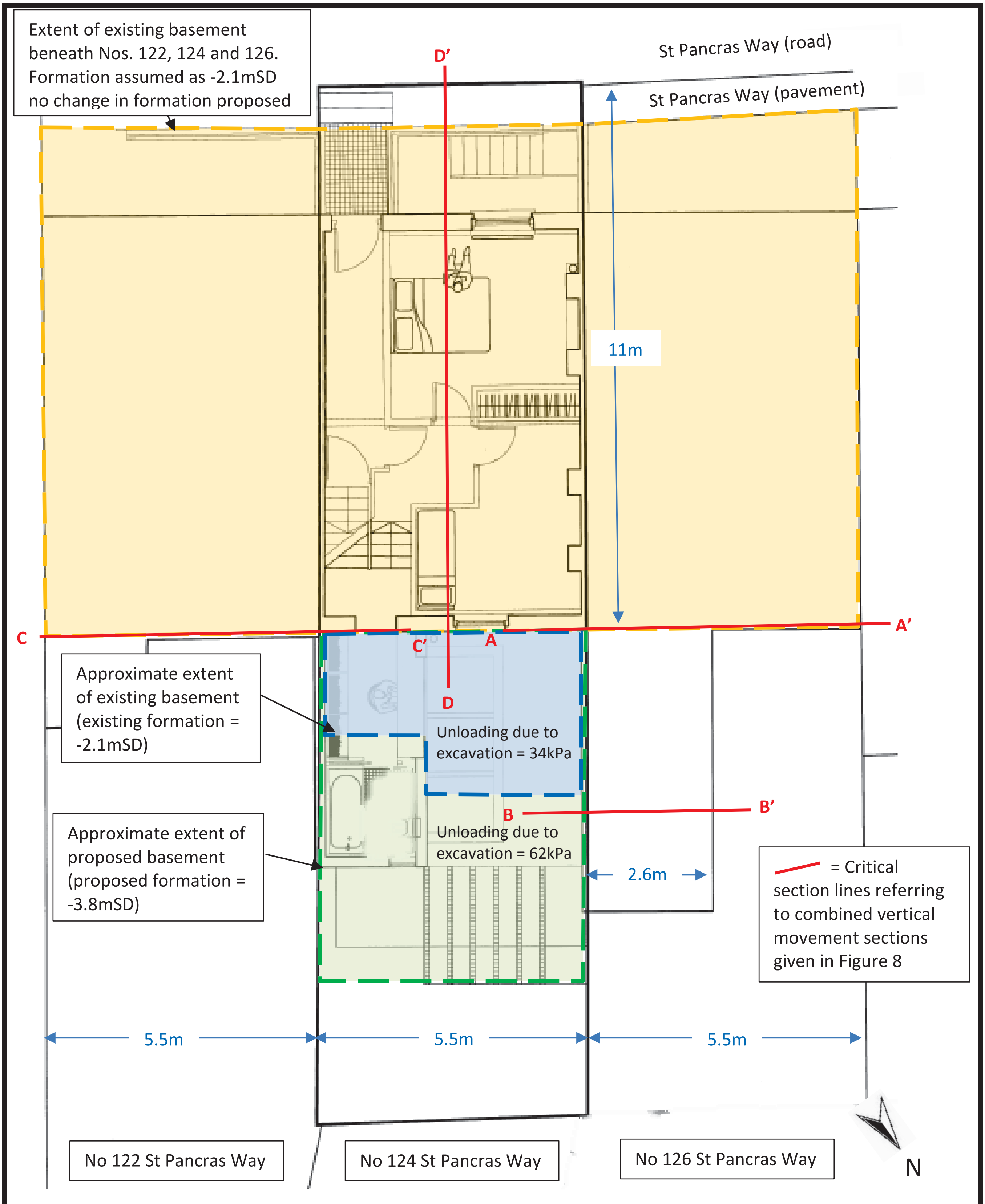
Level is relative to site datum which has been taken as ground level at the borehole position on the raised area of the rear garden

Client	Project	Job No
Dr Shanthi Thomas	124 St Pancras Way, Camden	CG/28111
CGL	Title: SPT vs level (mSD)	Figure 3

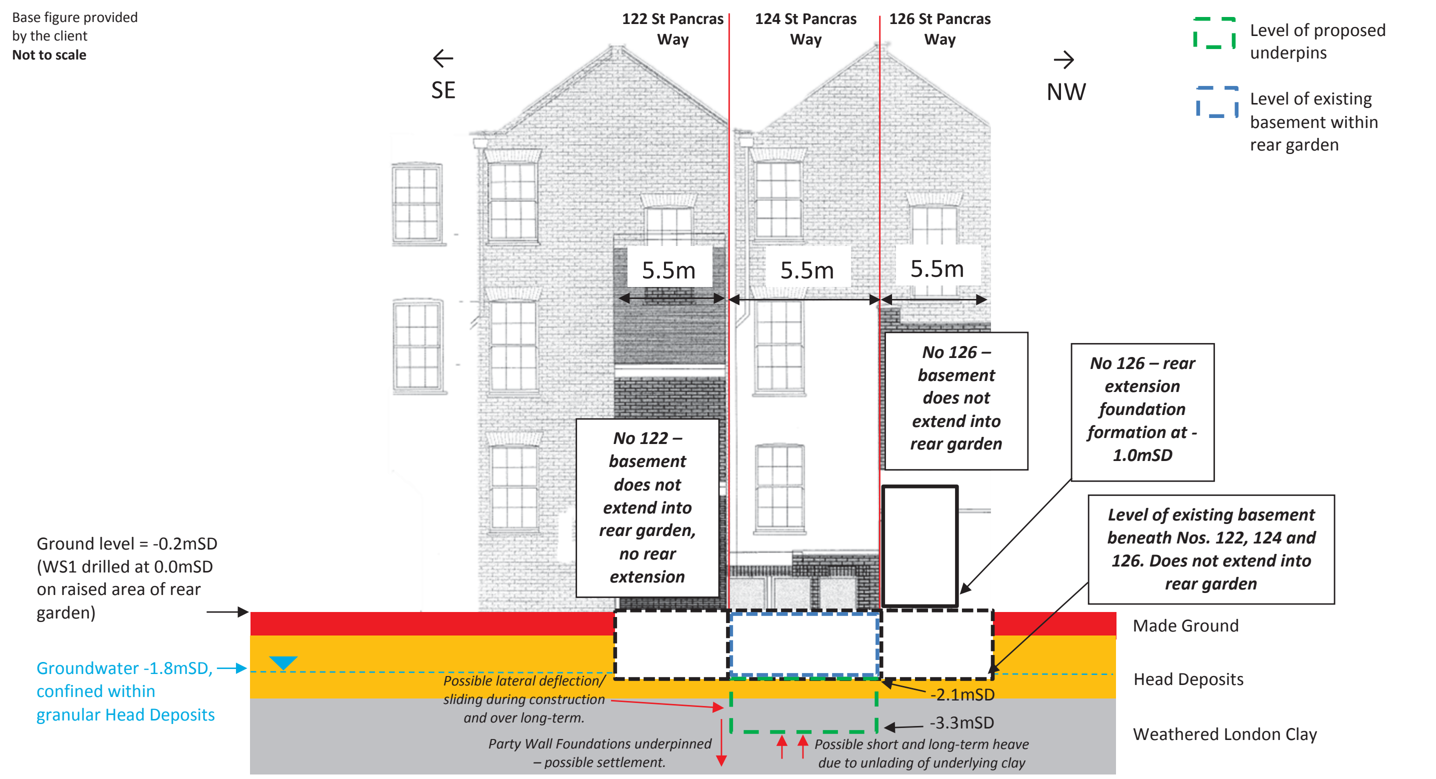


Level is relative to site datum which has been taken as ground level at the borehole position on the raised area of the rear garden

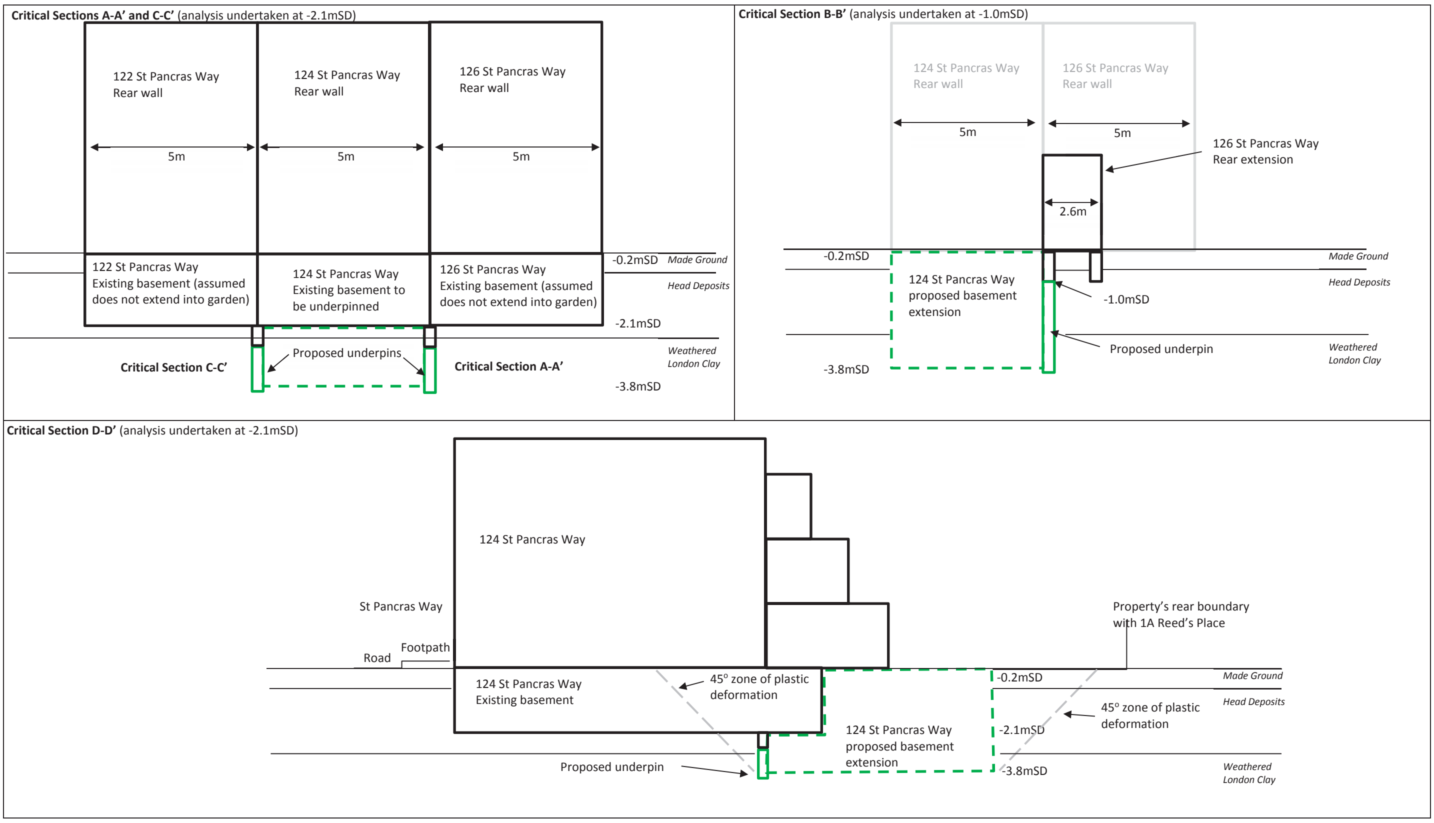
Client	Project	Job No
Dr Shanthi Thomas	**124 St Pancras Way, Camden**	**CG/28111**
CGL	Title **Plot of c_u against level**	**Figure 4**



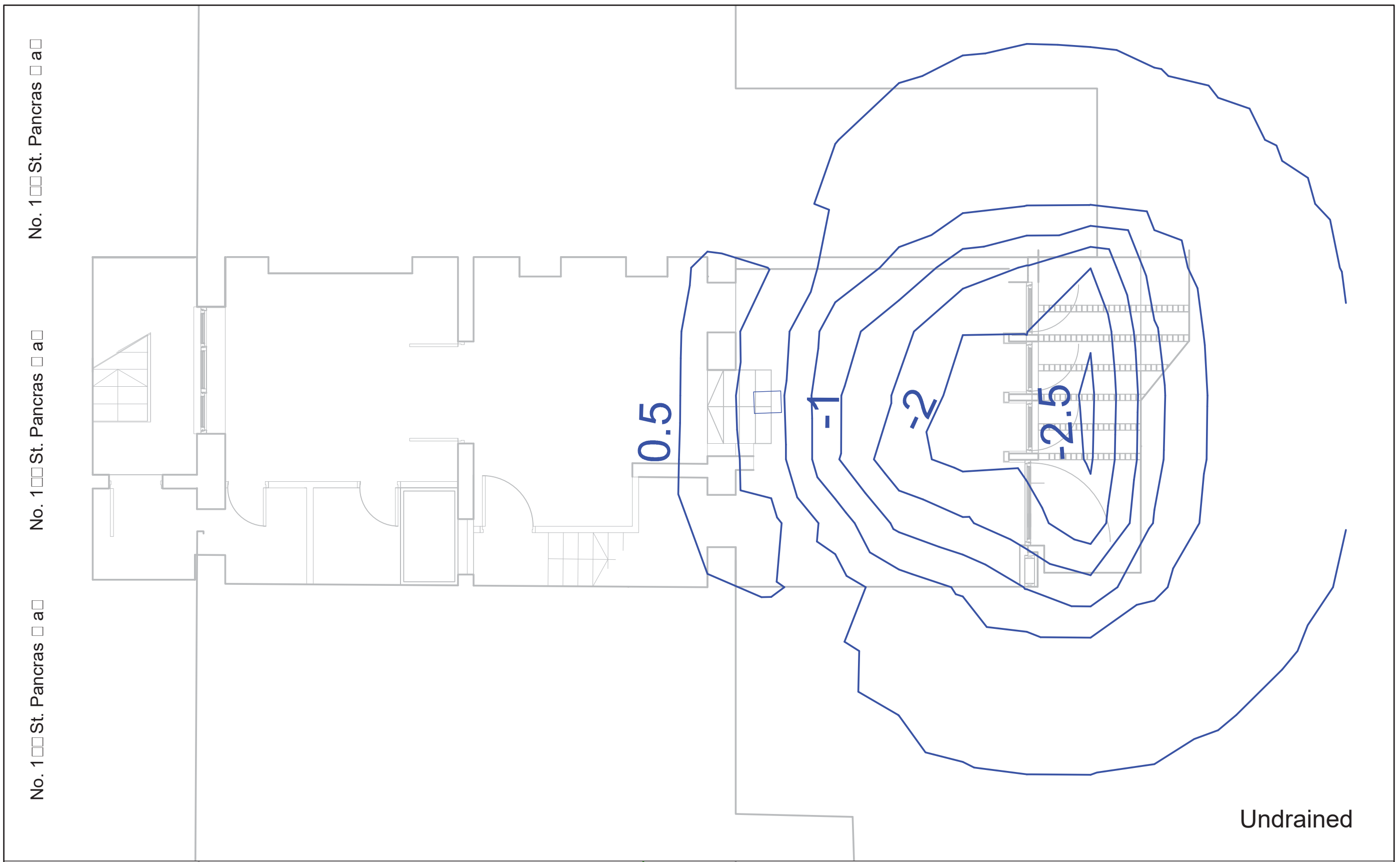
Client	Project	Job No
Dr Shanthi Thomas	**124 St Pancras Way, Camden**	**CG/28111**
CGL	Title **CSM Plan**	**Figure 5**

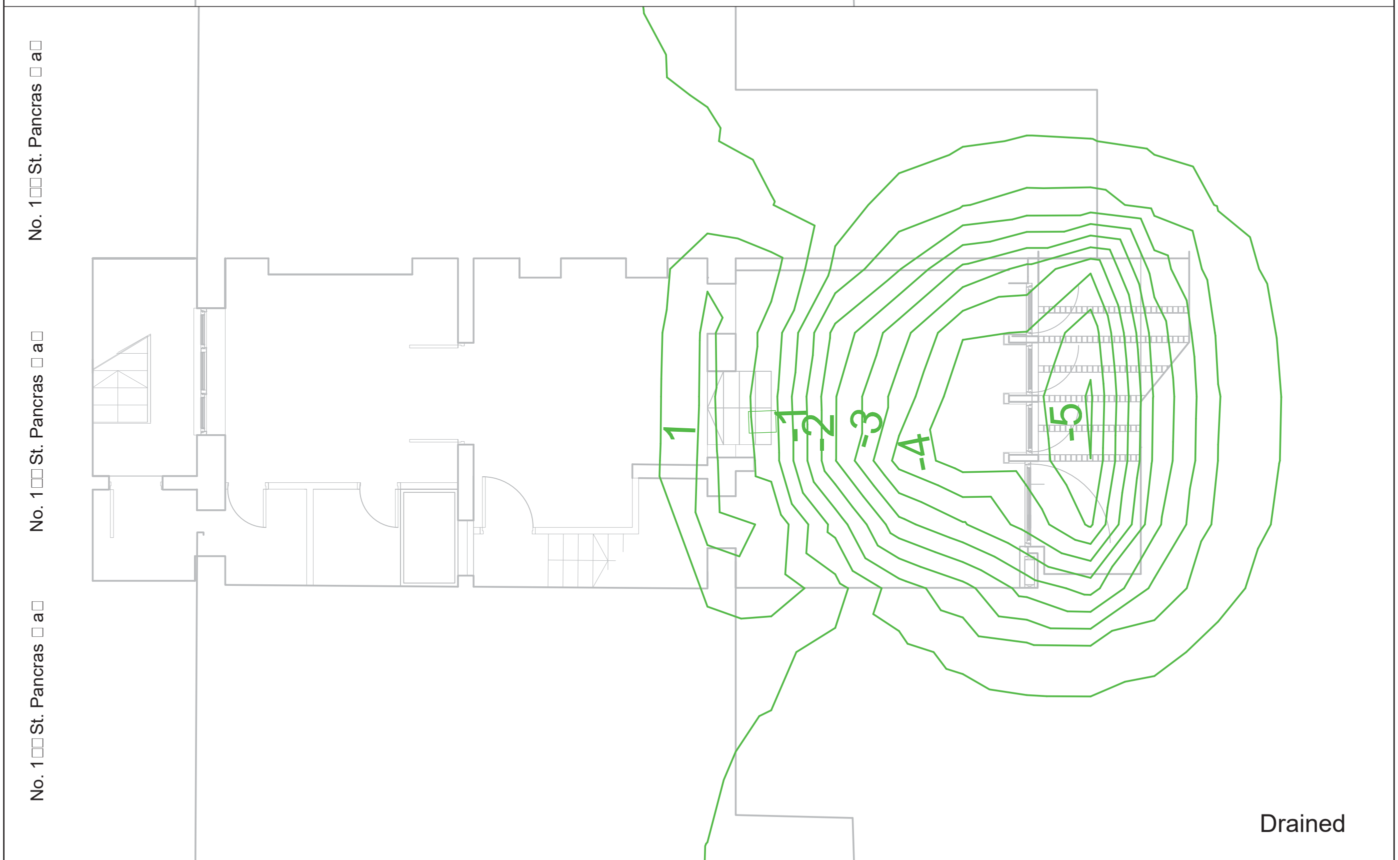


Client	Project	Job No
Dr Shanthi Thomas	124 St Pancras Way, Camden	CG/28111
CGL	Title CSM section	Figure 6



Client	Project	Job No
Dr Shanthi Thomas	124 St Pancras Way, Camden	CG/28111
CGL	Title: CSM critical section lines	Figure 7





Notes

Contours sho□ ground movements at underpin □ormation level □ith positive contours indicating settlement and negative contours indicating heave

Rev	Date	Comments
*	*	*

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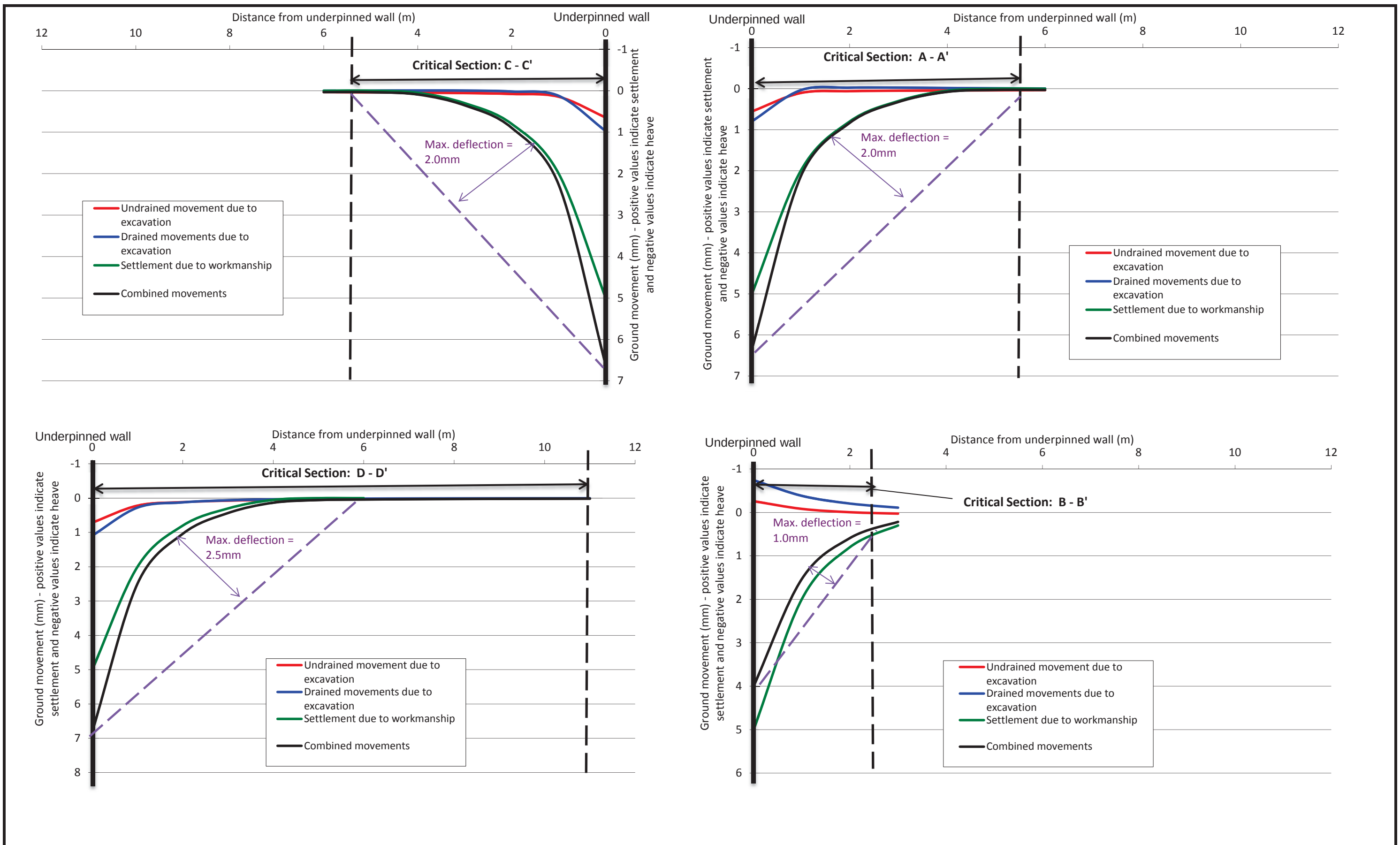
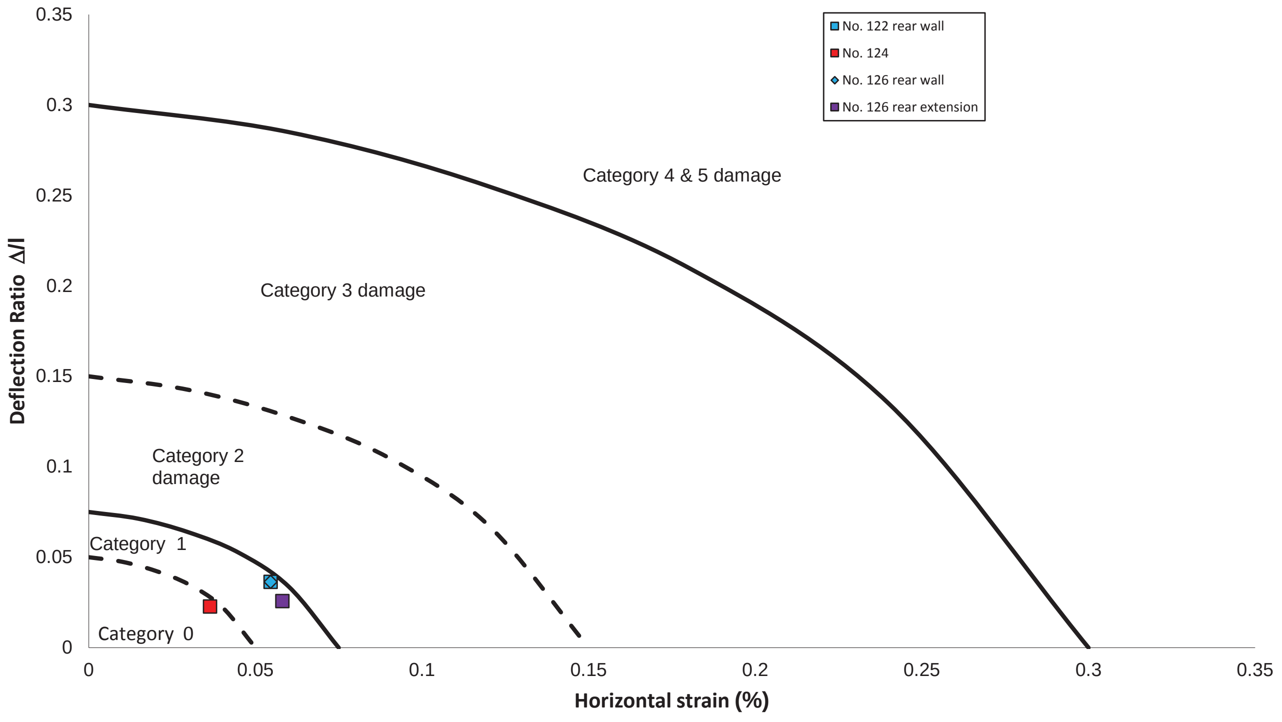
Project	124 St Pancras Way, Camden
Client	Dr. Shanthi Thomas
Drawing title	Figure 8 - Contour plot of vertical displacements
Scale(s)	NTS
Job No.	CG/28111
Drawn	DJR 03/04/17
Checked	
Approved	
Dwg No.	CG/28111-001
Rev.	*



Client	Project	Job No
Dr Shanthi Thomas	124 St Pancras Way, Camden	CG/28111
CGL	Title: Combined vertical ground movements	Figure 9



Client	Project	Job No
Dr Shanthi Thomas	124 St Pancras Way, Camden	CG/28111
CGL	Title: Building Interaction Chart	Figure 10