Providing Ground Solutions

CRL Asset Finance Limited

21-23 Cressy Road, Camden, London

Basement Impact Assessment

November, 2014

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1. INTRODUCTION

The Client, CRL Asset Finance Limited, is proposing to carry out redevelopment works at Nos.21 – 23 Cressy Road in the London Borough of Camden. The works comprise remodelling of the existing property to create a new basement level, with formation level approximately 3.0 metres below ground level (mbgl). Card Geotechnics Limited (CGL) has been instructed to undertake a Basement Impact Assessment (BIA), including a detailed ground movement analysi,s for the proposed development to determine its potential effect on nearby structures, services, surface water run-off and groundwater flow.

The London Borough of Camden's guidance document *"CPG4, Basements and Lightwells[1]",* requires a BIA to be undertaken for new basements in the Borough and sets out 5 stages for a Basement Impact Assessment 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
5. Review and decision making

This report is intended to address the screening, scoping, site investigation and impact assessment stages of the BIA. It identifies key issues relating to land stability, hydrogeology and hydrology as part of the screening process (Stage 1). Site investigations have been carried out by CGL, and the scoping process herein critically reviews the adequacy of the physical investigations. This report also forms 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.

[1] Camden Planning Guidance, CPG4, Basements and Lightwells, September 2013.

2. SITE CONTEXT

2.1 Site location

The site is located at 21 – 23 Cressy Road, London Borough of Camden, NW3 2NB. Access to the site is via a front door opening onto Cressy Road. The National Grid Reference for the approximate centre of the site is 527589, 185626.

The site location is shown in Figure 1.

2.2 Site description

The site is broadly triangular in plan measuring approximately 190m^2. The site currently comprises a two storey early 20th century end-of-terrace residential property with a single storey annex and garage.

The site is bounded to the north and west by masonry boundary walls to gardens of residential properties along Constantine Road. To the east the site is bounded by approximately 2m of pavement beyond which lies the carriageway of Cressy Road. To the southern extent of the site the property adjoins 19 Cressy Road. The site boundary is marked by a party wall some 8m in length. A review of local planning applications does not record existing basements within the immediate proximity of the site.

A site layout plan is provided in Figure 2.

2.3 Proposed development

It is proposed to excavate a basement beneath the existing property to a maximum depth of 3.0mbgl (53.0mOD).

The basement will be formed using conventional sectional underpinning techniques. It is understood that the basement will be excavated entirely beneath the footprint of the existing property. No excavations are proposed within 2m of the party wall shared with No. 19 Cressy Road i.e. the party wall of No.19 Cressy Road will not be underpinned.

No trees are to be removed as part of the proposed works.

Proposed development plans can be found in Appendix A.

2.4 Topography

Ordnance Survey topographical mapping for the area indicates a spot height elevation of 57.5 metres Ordnance Datum (mOD) some 40m to the west on Constantine Road and 54.5mOD some 60m to the south on Agincourt Road. The elevation on site is taken to be approximately 56.0mOD.

Local topographical mapping indicates the site is located on a wider hillslope with levels reducing to the south-east at a typical gradient of 1 in 25.

Locally the highest point is 95mOD recorded at Parliament Hill 500m to the north, with local ground levels increasing towards this point. The topography continues to fall to the south and south-east of the site towards Regents Canal located 1.8km away.

Figure 16 of the Camden Geological, Hydrogeological and Hydrological Study[2] records that the site is not located on a slope of greater than 7 degrees. Figure 17 of the same study records the site as not being located within an area of significant landslide potential.

Shallow valleys are recorded towards the southern extent of Hampstead Heath, representing relict river channels of the *River Fleet, River Tyburn* and the *River Westbourne* and associated tributaries.

2.5 Underground Infrastructure

With reference to CGL's in-house archive and mapping, there are no known tunnels in the immediate vicinity of the site. A sewer is located approximately 135m to the southwest of the site aligned north-west to south-east.

[2] Ove Arup and Partners. (2010) Camden Geological, Hydrogeological and Hydrological Study: Guidance for subterranean development. London Borough of Camden.

2.6 Site History

A brief historical review of the site has been undertaken. The findings are summarised as follows:

The site is recorded as being occupied by green fields labelled 'Southend Green' in the 1870's. The River Fleet is recorded some 100m to the south originating from a spring some 180m south-east. A railway cutting has been excavated some 90m to the north.

Maping dated c.1891 record the partial construction of Constantine Road. The site remains undeveloped; however, a row of terraced properties on Constantine Road is located some 30m to the north east. The River Fleet is no longer a surface feature, and is likely to have been culverted prior to ongoing residential development.

The property of 21-23 Cressy Road is recorded as occupying the site c.1911, with terraced housing constructed upon the remaining green space surrounding the site.

The property occupying the site is recorded as sustaining general blast damage (non-structural) during Second World War bombings[4]. Several properties located 15m to the west are recorded as having sustained 'serious damage' and two properties are categorised as 'damaged beyond repair'. The risk of unexploded ordnance (UXO) remaining on site is therefore considered to be low.

2.7 Published Geology

The British Geological Survey (BGS) sheet[5] of the area indicates the site to be underlain by the London Clay Formation with no record of superficial deposits on site.

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

BGS basal contour mapping demonstrates the base of the London Clay Formation is present below the site to an elevation of approximately -15.0mOD, suggesting an overall thickness of approximately 70.0m. The surface of the Upper Chalk is recorded at

[4] London Topographical Society (2005). *Bomb Damage Maps 1939-1945*. The London City Council.
[5] British Geological Survey Sheet 256 (1993) *North London – Solid and Drift Geology* 1:50,000. Keyworth, BGS.

-40.0mOD, suggesting a cumulative thickness of the Lambeth Group and underlying Thanet Formation of approximately 25.0m.

The overlying Claygate Member is recorded at 450m north and west of the site at approximately 25m above the level of the site (80.0mOD).

Alluvial deposits may be present to the south of the site, along the route of the historic *River Fleet* and associated tributaries. If present, these are likely to comprise silty sandy clay and gravels and will directly overlie the London Clay.

Due to a regional hillslope setting, it is considered Head Deposits may be present on site, formed by solifluction and hill creep in a periglacial environment. These are likely to comprise clay dominated deposits resulting from the reworking of the London Clay with overlying clays and sands of the Claygate Member and River Terrace Gravels from the locally overlying Stanmore Gravel Formation. Head Deposits are typically less than 2m in thickness and described as clays incorporating occasional angular frost shattered flints, often with basal gravelly clays of approximately 0.2m in thickness derived from local outcrops of high-level gravels[6].

2.8 Unpublished geology

A number of historical British Geological Survey (BGS) borehole records exist within 300m of the site boundary and are included in Appendix B with a location plan.

A series of three boreholes at surface levels between 52.3mOD and 54.5mOD were excavated in Cressy Road some 80m south of the site. Borehole TQ28NE77 at 52.3mOD is excavated to a depth of 15.25mbgl and recorded 0.3m of Made Ground, which comprised concrete and hardcore over the London Clay Formation. The London Clay was encountered at 52.0mOD and was described as firm brown and blue clay with selenite crystals, becoming fissured and stiff below 3.9mbg (48.0mOD). A standing water level was recorded at 12.2mbgl (40.1mOD), and is likely to represent seepage from sand partings within the London Clay Formation.

Borehole TQ28NE78 at 54.5mOD recorded 3.0m of Made Ground comprising sandy clay with brick fragments. The London Clay was encountered at 51.5mOD and was described as firm brown and blue clay with selenite crystals, becoming fissured and stiff below 4.9mbgl

[6] Ellison, R.A. et al. (2004). *Geology of London*. Memoir of the British Geological Survey, Sheets 256 (North London), 257 (Romford), 270, (South London) and 271 (Dartford). British Geological Survey, Keyworth, Nottingham.

(49.1mOD). A standing water level was recorded at 2.2mbgl (52.3mOD) and is likely to represent a shallow perched groundwater within Made Ground.

Borehole TQ28NE79 at 54.5mOD recorded 1.8m of Made Ground comprising concrete and hardcore over firm brown and grey silty clay. Underlying this, a 0.35m thick deposit of 'orange brown sandy clay with stones' is interpreted as alluvium from the River Fleet. The London Clay Formation was encountered at 52.38mOD and was described as a stiff brown and blue clay with selenite crystals, becoming fissured and very stiff below 7.0mbgl (47.5mOD). A standing water level was recorded at 1.5mbgl (53.0mOD) and is likely to represent a shallow perched groundwater within Made Ground.

2.9 Hydrogeology and hydrology

The Environment Agency (EA)[7] 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 is classified as an unproductive stratum. These are rock layers or drift deposits with low permeability that has negligible significance for water supply or river base flow. The site is not within a Groundwater Source Protection Zone.

The nearest significant surface water bodies is Hampstead No.1 Pond located 350m northwest of the site at its closest point.

The site lies approximately 100m north and east of a major tributary of the historical *River Fleet*. Reference to Barton's 'Lost Rivers of London'[8] indicates that the historical *River Fleet* previously flowed south and south-east from Hampstead Heath into the River Thames at Blackfriars. The former watercourse of the *River Fleet* is no longer open having been culverted and constrained, however owing to local topography, it is considered that surface waters will drain towards the line of watercourse in a general southeast trend. This is confirmed in Figure 11 of the Guidance for Subterranean Development[2].

The boundary between the impermeable London Clay Formation and the overlying permeable sands, silts and clays of the Claygate member is recorded as producing spring lines which are identified as the source of the *River Fleet*.

[7] http://www.environment-agency.gov.uk/wiyby (accessed October 2014)
[8] Barton, N. (1983) *The Lost Rivers of London* Hertfordshire Historical Publications

The Environment Agency[9] flood maps indicate that the immediate site area is not at risk of flooding by river or sea. The site lies approximately 50m east of areas designated to be of low flood risk. Furthermore Cressy Road is not identified as at risk of flooding from surface waters, and Figure 15 of the Guidance for Subterranean Development[2] indicates the street was not flooded during extreme rainfall events in 1975 and 2002.

As the London Clay Formation is identified below the site, it is assumed this forms an impermeable boundary and will form the base of an overlying groundwater table where any permeable superficial deposits permit the transit of groundwater.

Historical borehole record TW28SE1769 indicates that standing groundwater is present at a depth of 90mbgl within the Lambeth Group. Borehole TQ28SE892 indicates no groundwater is encountered to a depth of 21.0mbgl (base of borehole).

If present, groundwater is likely to be present as a shallow perched groundwater within Made Ground or resting upon the surface of the London Clay Formation. This is not expected to be laterally pervasive.

[9] The Environment Agency (2012) *Risk of Flooding from River and Sea*. Online. Accessed 25/6/13. Available from http://www.environment-agency.gov.uk

3. SCREENING – STAGE 1

3.1 Introduction

A screening assessment has been undertaken based on structured guidance presented in Camden Borough Council's CPG4, based on the flowcharts presented in that document. 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 posed by Figure 1 in CPG4:

Table 2. Responses to Figure 1, 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 as an unproductive stratum by the Environment Agency.	None
1b. Will the proposed basement extend beneath the water table surface?	No. The proposed basement is proposed to extend to approximately 3.0mbgl. Local historical ground investigations have encountered standing groundwater within the shallow Made Ground at depths of between 1.5m bgl to 2.2m bgl, likely present as perched groundwater resting upon cohesive deposits.	None
2. Is the site within 100m of a watercourse, well or potential spring line?	Yes. The nearest watercourse is the *River Fleet* located approximately 100m southwest.	Impact assessment
3. Is the site within the catchment of the pond chains on Hampstead Heath?	No. Hampstead No.1 Pond is located 350m northwest of the site at its closest point.	None
4. Will the proposed basement development result in a change in the proportion of hard surfaced/paved areas?	No. The basement is beneath the footprint of the existing building; therefore, the proportion of hard surfaced area will not change.	None

Question	Response	Action required
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. It is anticipated that surface waters will be discharged through the existing public drainage network.	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. The closest local pond is Hampstead No.1 Pond and is located 350m northwest of the site at its closest point.	None

The proposed development is underlain by the London Clay Formation, designated an 'unproductive stratum' by the EA. A review of available data has been conducted to determine groundwater conditions on site and suggests that shallow perched groundwater may be encountered within Made Ground or resting above the surface of the London Clay Formation, this is not expected to be laterally pervasive.

The former watercourse of the River Fleet is recorded some 90m to the south and south west of the site. This has been culverted at this location into the Fleet Sewer, and is considered unlikely be impacted the proposed development.

3.3 Slope/land stability

This section answers questions posed in Figure 2 in CPG4.

Table 3. Responses to Figure 2, CPG4.

Question	Response	Action required
1. Does the site include slopes, natural or man-made, greater than about 1 in 8?	No. The gradient of the site is less than 7°	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. There is no re-profiling or landscaping proposed that would affect the site boundary.	None
3. Does the development neighbour land including railway cuttings and the like with a slope greater than about 1 in 8?	No. There are no artificial cuttings or embankments in the vicinity.	None

Question	Response	Action required
4. Is the site within a wider hillside setting in which the general slope is greater than about 1 in 8?	No. The highest gradient is less than 1 in 8.	None
5. Is the London Clay the shallowest stratum on site?	Yes. Historical records show the site to be directly underlain by the London Clay.	None
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. No trees will be felled as part of the development.	None
7. Is there a history of shrink/swell subsidence in the local area and/or evidence of such at the site?	No. There is no evidence of shrink/swell behaviour at the site.	None
8. Is the site within 100m of a watercourse or a potential spring line?	Yes. The *River Fleet* is located approximately 100m south to south west of the site.	Impact Assessment
9. Is the site within an area of previously worked ground?	No.	None
10. Is the site within an aquifer?	No. The site is directly underlain by the London Clay Formation, designated as an unproductive stratum by the Environment Agency.	None
11. Is the site within 5m of a highway or pedestrian right of way?	Yes. The site is bounded to the east by Cressy Road. The carriageway of Cressy Road is located approximately 2m away from the proposed basement excavation.	Impact Assessment
12. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Unknown. The foundations of the neighbouring property are not known. The proposed basement does not underpin the party wall of 19 Cressy Road.	Investigation and assessment
13. Is the site over (or within the exclusion zone of) any tunnels?	No. The site lies outside the exclusion zones of any tunnels.	None

A review of local topography and reference to Figure 16 of Guidance for subterranean developments[3] demonstrates the local and wider hillslopes do not exceed a gradient of 1 in 8 (approximately 7˚).

Figure 17 of the study indicates the site is not located in an area of landslide potential. No trees are to be felled as part of the proposed works. In summary, an impact assessment is required to investigate the magnitude of ground movements resulting from the basement excavation. The basement excavation will result in an unloading of the London Clay Formation at depth which without significant structural reloading may result in heave movements.

The impact assessment will assess potential damage caused by ground movements to adjacent properties and public highway and will recommend measures to mitigate such potentially damaging movements.

3.4 Surface flow and flooding

This section covers the main surface flow and flooding issues as set out in CPG4.

Table 4. Responses to Figure 3, CPG4.

Question	Response	Action required
1. 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. Existing drainage routes will remain unchanged.	None
2. Will the proposed development result in a change in the proportion of hard surfaced/paved external areas?	No. Current proposals appear to leave the garden area of no.21 unchanged. The excavation is entirely beneath the footprint of the existing property.	None
3. 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. The nearest downstream watercourse is the subterranean River Fleet 80m south and southwest. Shallow groundwater underlying the site is not anticipated to be laterally pervasive.	None
4. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or	No. The basement excavation would remove the majority of any Made Ground that may be present on site and as such will not impact on	None

downstream watercourses?	water quality.	
5. 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. The site is not located within an area of risk from surface water flooding[10].	None

The proposed development will remain a residential property, therefore no significant change of use is anticipated that may increase discharge loads to the existing sewer and drainage network. The basement is to be excavated within the footprint of the existing structure; therefore, it is considered the proposed development will have a negligible impact upon the infiltration and attenuation characteristics of the site.

3.5 Summary

On the basis of this screening exercise, further stages of basement impact assessment are required for this site. These should address the following:

Table 5. Summary of Basement Impact Assessment requirements

Item	Description
1.	*Groundwater flow* Impact assessment to determine the effect of the construction on local controlled water bodies.
2.	*Slope (land stability)* Impact assessment to determine the effect of construction on neighbouring properties and infrastructure.
3.	*Surface flow and flooding* None.

The outcomes of the screening assessment are carried forward into the Basement Impact Assessment in the following report sections.

[10] Environment Agency (2013). *What's in your backyard?* [accessed October 2014] Accessed: http://watermaps.environment-agency.gov.uk/wiyby/wiyby.aspx?&topic=ufmfsw#x=357683&y=355134&scale=2

4. SCOPING – STAGE 2

4.1 Introduction

This section of the report covers the scoping process (Stage 2) of the BIA, which is used to identify potential impacts of the proposed scheme and establish a conceptual site model. The scoping stage also informs the scope of the site investigation; however, a site specific investigation has already been undertaken at the site.

Based on the output of the screening process (Table 4), the site investigation should comprise the following:

- Due to the unknown thickness of the Made Ground and London Clay, a minimum of one borehole to a depth beyond the level of the basement formation should be drilled to provide details on ground conditions and stratum levels. Soil and groundwater conditions should be logged by an appropriately qualified geotechnical engineer.

- In-situ geotechnical testing and laboratory testing to provide adequate information to derive geotechnical design parameters. This will inform the retaining wall and foundation design and subsequent impact on adjacent structures, and should include Standard Penetration Tests (SPTs) at regular intervals.

- Installation of standpipes within the boreholes and subsequent groundwater monitoring to confirm the hydrogeological regime beneath the site.

5. GROUND INVESTIGATION (STAGE 3)

5.1 Current site investigation

An intrusive investigation was undertaken by CGL on Thursday 9th October 2014. The investigation included two window sampling boreholes (BH1 and BH2) to depths of 7.0mbgl (49mOD) and 4.0mbgl (52mOD) for boreholes BH1 and BH2 respectively. Borehole BH1 was excavated to a depth of approximately 4.0m below the proposed basement formation level. Borehole BH1 was located in the north of the site and borehole BH2 was located in the southwest of the site. The ground investigation was undertaken in accordance to BS 5930:1999[11].

In-situ Standard Penetration Testing (SPT) was undertaken at 1m intervals and follow on dynamic probing was undertaken in borehole BH1 from 7.0mbgl to 10.0mbgl (-46mOD).

A groundwater monitoring well was installed in borehole BH1 with a response zone of between 0.5mbgl to 2.0mbgl. A single ground gas and groundwater monitoring visit was undertaken on 21st October 2014.

Small disturbed samples were taken at regular intervals for geotechnical laboratory testing, and the results used to in part to determine parameters for geotechnical design.

Two foundation inspection pits were also excavated to determine footing depths. Foundation pit FP1 was excavated adjacent to the party wall of 19 Cressy Road to a depth of 0.9mbgl and foundation pit FP2 was excavated to a depth of 0.5mbgl adjacent to the masonry wall bounding the site to the north.

Copies of CGL borehole records are provided in Appendix C.

Groundwater monitoring records are included in Appendix D.

5.2 Geotechnical laboratory analysis

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

- Atterberg Limit tests;

[11] British Standards Institution. (1999). *Code of practice for site investigations*. BS5930:1999 Inc. Amendment 2. British Standards Institution.

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

Geotechnical test results are included in Appendix E.

5.3 Chemical laboratory analysis

Representative soil samples were sent to i2 Analytical Limited (a UKAS and MCERTS accredited laboratory) for chemical testing. The analysis included the following potential contaminants.

- Soil Organic Matter (SOM);
- Heavy metals including; arsenic, barium, beryllium, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium, vanadium and zinc;
- Benzene, Toluene, Ethylbenzene, Xylenes (BTEX) compounds;
- Total Petroleum Hydrocarbons (TPH) and Polycyclic Aromatic Hydrocarbons (PAH);
- Total Monohydric Phenols;
- Total Cyanide;
- Sulfide and sulfate;
- pH determination;
- Asbestos screen and ID; and

The chemical testing results are presented in Appendix F of this report.

6. GROUND AND GROUNDWATER CONDITIONS (STAGE 3)

6.1 Summary

The ground conditions encountered during the intrusive investigation are summarised in Table 6 below.

Table 6. Summary of ground conditions

Stratum	Depth to top of stratum (mbgl) [mOD]	Typical thickness (m) [mOD]
MADE GROUND Comprising bound surfacing of bricks overlying a soft to firm dark red brown gravelly sandy clay. Gravel comprised of subangular to subrounded fine to coarse brick, concrete and occasional ceramic.	0.0 [56.0]	0.6 – 0.8
Firm to stiff light orange brown silty CLAY with fine to medium selenite crystals. **[WEATHERED LONDON CLAY FORMATION]**	0.6 – 0.8 [55.4 – 55.2]	6.35 proved

The ground conditions are discussed in the following sections together with the results of the insitu and laboratory geotechnical tests. A plot of undrained shear strength c_u (kPa) versus level (mOD) is presented in Figure 3.

6.2 Made Ground

Made Ground generally comprising sandy gravelly clay was encountered directly below a brick paved surface. The thickness of the Made Ground was between 0.5m and 0.6m in the trial pits, whilst in the boreholes the Made Ground was found to be 0.6m and 0.8m in thickness. No visible or olfactory evidence of contamination was noted.

6.3 London Clay Formation

The surface of the London Clay Formation was encountered at 0.6mbgl to 0.8mbgl (55.4mOD to 55.2mOD). The London Clay Formation generally comprised firm to stiff light orange brown silty clay.

SPT 'N' values within the London Clay Formation were found to gradually increase with depth from 14 near the top of the stratum to 30 at 6.0mbgl, corresponding to undrained shear strength (c_u) values in the order of 63kPa to 135kPa (based on f_1 = 4.5[12]). This is

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

consistent with observations made on site. Hand shear vane testing recorded undrained shear strength between 90kPa and 140kPa from 3.2m bgl to 6.8mbgl.

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

- Moisture Contents between 29.8% and 39.7%;
- Liquid Limits between 68% and 79%;
- Plastic Limits between 25% and 29%; and
- Plasticity Indices between 43% and 53%.

The results indicate the London Clay to be a 'high' to 'very high' plasticity clay which is consistent with published data.

Based on laboratory testing and established correlations for the London Clay[13], the following ground strength profile is recommended for the London Clay:

$$c_u = 36 + 8.7z \text{ (kPa)}$$

Where 'z' indicates the depth below the London Clay surface, as indicated on Figure 3.

6.4 Groundwater

No significant groundwater strikes were encountered during the ground investigation. However, slight water seepage with no significant flow was noted within the Made Ground in borehole BH2. This identifies the potential presence of perched groundwater within the Made Ground, resting upon the impermeable surface of the London Clay Formation.

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

6.5 Geotechnical design parameters

Geotechnical design parameters for the proposed development are summarised in Table 7 below, these are based on the results of laboratory and in-situ testing and published data for the well-studied London Geology.

Table 7. Geotechnical design parameters

Stratum	**Design Level mbgl [mOD]**	**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	0.0 [56.0]	19	20 [1]	-	15 [13.5]
London Clay Formation – Upper layer	0.7 [55.3]	20	$36 + 8.7z$[c] [5]	24[a]	$21.6 + 5.2z$[e] [$16.2 + 3.9z$][f]

a. BS 8002:1994 Code of practice for Earth retaining structures, British Standards institution.
b. Peck, R.B., Hanson, W.E., and Thornburn, T.H., Foundation Engineering, 2nd Edn, John Wiley, New York, 1967, p.310.
c. z = depth below upper surface of the London Clay
d. y = depth below lower surface of the London Clay
e. 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.
f. 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 parameters in Table 10 are unfactored (Serviceability Limit State) and considered to be 'moderately conservative' design values.

6.6 Allowable bearing pressure

Based on the detailed drawings and ground conditions encountered, the basement slab and underpins will be bearing into the weathered London Clay Formation. Based on a factor of safety of 3 to control settlements (i.e. <25mm) an allowable bearing pressure of 100kPa is recommended for the London Clay Formation at a level of 53.0mOD (minimum excavation of 3.0m).

6.7 Buried concrete

The design sulfate (DS) and ACEC classes for each stratum are presented in Table 8 below, based on the results of the geotechnical sulfate and pH testing, including DS and ACEC classes based on water soluble sulfate (WSS) and total potential sulfate (TPS).

Table 8. Geotechnical design parameters.

Stratum	Water soluble sulfate (WSS) Worst case soil/water values		Total potential sulfate (TPS) (Pyritic soil)	
	DS class	ACEC Class	DS class	ACEC Class
Made Ground	DS-1 (25 - 55)	AC-1 (6.8 - 7.4)[b]	NA	NA
London Clay Formation	DS-4 (320 - 3200)[a]	AC-4 (7.2 - 7.7)	DS-5 (0.108-2.43)	AC-4s (7.2 - 7.7)

a. Characteristic value soil/water (mg/l)
b. Characteristic value pH
c. Characteristic value total potential sulfate

The availability of total potential sulfate (TPS) in pyritic soils (i.e. London Clay) is dependent on the extent to which the soils are disturbed, and the level to which the soils may oxidise, resulting in sulfate ions that may reach the concrete. In this regard, BRE SD1 guidance[14] states that *"Concrete in pyritic ground which is initially low in soluble sulfate does not have to be designed to withstand a high potential sulfate class unless it is exposed to ground which has been disturbed to the extent that contained pyrite might oxidise and the resultant sulfate ions reach the concrete. This may prompt redesign of the structure or change to the construction process to avoid ground disturbance; for example, by using precast or cast-in-situ piles instead of constructing a spread footing within an excavation"*.

On this basis, the appropriate DS and ACEC class for the pyritic soils, i.e. based on WSS or TPS, should be adopted dependant on the extent to which the soils will be disturbed during construction.

Where open excavations may be required into the soils (i.e. basement excavation that may extend into the London Clay), the soils may be disturbed to the extent that contained pyrite might oxidise and allow the resultant sulfate ions to reach the concrete, and as such the TPS DS and ACEC classes should be adopted as outlined in Table 8. However, where concrete will be placed in soils that will not be disturbed to an extent that will allow pyrite

[14] Building Research Establishment. (2005). *Concrete in aggressive ground*. Special Digest 1, 3rd Ed.

to oxidise (i.e. precast and cast-in-situ piling) the WSS DS and ACEC classes may be adopted. Given the proposed development it is unlikely that piles will be required.

6.8 Potential contamination

No significant olfactory or visual evidence of gross contamination was noted during the intrusive works. Representative samples of the Made Ground were analysed for a suite of contaminants to assess the potential risk to long-term human health and to determine waste disposal requirements for off-site disposal.

The results have been compared against a residential with home grown produce land use category, as a suitable conservative situation for the existing and proposed site use, and details are presented in Appendix G. The results indicate that contaminant concentrations are generally below the relevant assessment criteria. However, two samples tested out of three from the Made Ground (borehole 1 at 0.4m and foundation pit 1 at 0.4m) recorded lead concentrations which marginally exceed the SGV assessment criteria. However, given the proposed basement extent and formation level, the Made Ground onsite will require offsite disposal as part of basement excavation. No asbestos was detected in any of the soil samples tested.

6.9 Waste classification

A waste classification analysis was carried out for samples within the Made Ground across the site, as well as from the upper natural soils. The results are given below and are based on the results of 'total soils' testing.

Table 9. Waste categorisation summary

Location and depth	**Strata**	**Categorization**
BH1 at 0.4m	Made Ground	Not-hazardous
FP1 at 0.4m	Made Ground	Not-hazardous
FP23 at 0.5m	Made Ground	Not-hazardous
BH2 at 0.3m	Made Ground	Not-hazardous

The soil samples tested are all 'not-hazardous' for disposal licensed landfill facilities. To determine the acceptability for disposal at an 'inert' landfill facilities additional WAC testing would be required.

6.10 Ground gas assessment

One gas monitoring visit has been undertaken and the result is summarised in Table 10 below.

Table 10. Gas monitoring summary

Date	Barometric pressure (mb) [pressure system]	Maximum flow (l/hr)	Minimum O_2 (%)	Maximum CO_2 (%)	Maximum CH_4 (%)	Maximum PID (ppm)
21/10/14	998 (falling)	0.2	19.6	<0.1	<0.1	<0.1

On the basis of a single monitoring visit, the site conforms to Characteristic Situation 1 in accordance with CIRIA C665[15] for gas protection and no specific gas protection measures are required. In order to comply with British Standards[16] and CIRIA guidance, to further establish the Characteristic Situation, additional monitoring visits would be required.

[15] CIRIA (2007). *Assessing risks posed by hazardous ground gases to buildings*.
[16] British Standards Institution. (2007). *Code of practice for characterisation and remediation of ground gas in affected developments.* BS 8485. British Standards Institution.

7. SUBTERRANEAN (GROUNDWATER) FLOW (STAGE 4)

7.1 Introduction

This section addresses outstanding issues raised by the screening process regarding groundwater flow.

7.2 Impact on groundwater flow

Standing groundwater is not likely to be encountered during excavation for the proposed basement. No groundwater was encountered during the ground investigation; however, slight water seepage was noted at 0.3mbgl which is likely to correspond to perched groundwater within the Made Ground. This concurs with monitoring records which recorded groundwater at a depth of 1.2mbgl (borehole BH1).

Based on the proposed basement formation depth of 3.0mbgl, groundwater is unlikely to be encountered during basement excavation, excluding perched water within the Made Ground, and the proposed basement is not likely to obstruct groundwater flow or levels in the region.

7.3 Recommendations for groundwater control

Observations on groundwater should be recorded during excavation and appropriate mitigation strategies put in place.

8. SURFACE FLOW AND FLOODING (STAGE 4)

It is understood that surface waters will join the existing drainage infrastructure (via basement pumping if a gravity fed solution is not feasible), with no significant changes in peak drainage outflows anticipated from the site. Current proposal drawings indicate that there will be no change in the area of permeable ground on the site following redevelopment.

The site lies outside any EA designated Flood Zone and does not need any specific or detailed Flood Risk Assessment.

It is considered that the development will have a negligible impact on surface water flow and flooding. In addition, the basement is likely to provide enhanced attenuation given its requirement to be drained in accordance with building regulations.

9. GROUND MOVEMENT ASSESSMENT (STAGE 4)

9.1 Introduction

This section provides calculations to assess ground movements that may result from the construction of the basement extension and how these may affect adjacent party wall structures.

The proposed excavation is to be retained by traditional single stage mass concrete underpinning which will support the existing perimeter foundations towards the north and east of the basement excavation.

Ground movements will be derived from:

- Heave movements: The London Clay at depth is 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.

- Settlement: construction of underpins beneath existing foundations can lead to settlement and the amount of settlement depends on the bearing pressure below the underpins as structural loads are transferred to greater depth; on to soils that have not previously been loaded and quality of workmanship in constructing the underpins, in particular in dry-packing between the existing foundation and the new underpins.

- Long term ground movement: The net loading on formation soils will generate ground movement, which could affect adjacent foundations. This takes into account existing stress conditions, additional loads from the basement structure and the weight of soil removed.

9.2 Conceptual Site Model and critical sections.

A conceptual site model (CSM) of the proposed site conditions has been developed based on the available data to illustrate the conceptual understanding of the ground model. Several critical sections are identified for assessment, shown on Figure 2:

- Critical Section A-A: Represents a line of section of some 8.0m in length orientated perpendicular to the proposed excavation, spanning the structure of 19 Cressy Road. Footings associated with the party wall are located 2.0m from the excavation. The analysis focuses on a section through the adjoining terraced property party wall footings spaced at 5.8m, formed at a level of approximately 1.0mbgl (55.0mOD). The section is taken mid span along the excavation, representing worst case conditions affecting 19 Cressy Road.

- Critical Section B-B: Line of section of some 10.0m in length orientated at approximately 45^{o} to the proposed excavation, spanning the garden boundary walls to Nos.66-68 Constantine Road. The analysis focuses on a section through the boundary wall footings formed at a depth of 0.5mbgl (55.5mOD). The section represents vertical ground displacements acting at the underside of the boundary wall foundations.

A visual representation of the conceptual site model is presented as Figure 4.

9.3 Underpin construction sequence

The basement beneath the existing property will be constructed using traditional underpinning techniques with pins excavated in sequence in bays typically 1.0m wide. It is assumed that the underpins will be constructed in a single lift within supported trenches. It is recommended that temporary propping be installed at the top, middle and bottom of the excavation to resist sliding and rotation of the wall prior to casting the lower and upper basement concrete floor slabs. Temporary propping should remain in place until the lower and upper basement floor slabs develop sufficient strength to sustain soil loads.

The underpins will be generally supported in the permanent condition by the ground floor and basement slab, which should be cast before removing the temporary propping.

9.3.1 Underpin loading

The proposed development gives rise to a net unloading of the underlying strata both during construction and over the long term. The excavation will unload the soils at the lower ground floor slab formation level (53.0mOD) by some 57kPa. This value assumes a total excavation depth of 3.0m and a typical bulk unit weight of 19kN/m^3 for the excavated Made Ground to 0.7mbgl and 20kN/m^3 for the London Clay Formation to formation level.

New underpins are calculated as generating line loads of 24kN/m, assuming 300mm thick underpins are formed from generally 1.0mbgl (55.0mOD) to 3.0mbgl (53.0mOD) with a 1.0m wide base with concrete of unit weight at approximately 25kN/m^3. Line loads to a maximum of 120kN/m for the existing structure have been provided by the structural engineers (Glencross and Hudson Limited) and are presented in Appendix H. This generates a maximum pressure of 144kPa at the base of the underpin.

A load of 7.5kN/m^2 has been applied in the long term to represent loads exerted by the ground floor slab upon underlying soils. This is based on an assumed thickness of 0.3m and a unit weight of concrete of 25kN/m^3.

9.4 Ground movements arising from basement excavation

A ground movement assessment has been undertaken using OASYS Limited *VDISP* (***V****ertical* ***DISP****lacement*) analysis software. *VDISP* 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. *VDISP* 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 account for this, the structure has not been modelled as an evenly loaded flexible raft and the loads from the underpins around the perimeter, as summarised in the previous sections, have been accounted for and modelled in the analysis.

It has been assumed in the analysis that the basement construction will be undertaken in one lift. During the analysis, the underpin loads are applied to the perimeter of the basement and the loads due to excavation (i.e. unloading of the ground) have been applied to the whole site, including below the underpins.

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.

The results of the settlement analysis are summarised in Table 11, showing predicted heave or settlement values beneath the perimeter underpins, which is represented visually as short term and long term displacement contours in Figure 5.

9.5 Short and long term vertical displacements

Short term heave is predicted to be approximately 4.0mm occurring in the central region of the proposed basement excavation at a level of 53.0mOD. Less than 1.0mm of heave occurs below the party wall of 19 Cressy Road at a level of 55.0mOD.

Long term heave is predicted to be approximately 5.0mm occurring in the central region of the proposed basement excavation at a level of 53.0mOD. Less than 1.0mm of settlement occurs below the party wall of 19 Cressy Road a level of 55.0mOD.

A maximum of 0.7mm short term settlement is predicted to occur beneath the boundary wall (Critical Section B-B). A further 1.1mm long term settlement is calculated to give a maximum total settlement of 1.8mm occurring approximately 7.5m along the analysed section.

It is noted that over the long-term, movements are likely to be restrained by the new structure and therefore, are unlikely to fully realise the predicted values. In addition, it may be considered that soils at basement formation have been subject to an element of loading from the existing footings, and have already experienced some level of settlement.

The heave/settlement assessment undertaken within *VDISP* assumes perfect workmanship in the underpin construction and does not allow for settlement of the dry pack between existing footings and the new concrete. With good construction practice, actual settlements would be expected to not exceed 5mm. This value is typically applied to the overall ground movement and corresponding impact assessment to calculate a predicted damage category for the adjacent properties. This value has not been applied to this assessment as the party wall to 19 Cressy Road is not directly underpinned.

Full *VDISP* output can be provided upon request.

9.6 Ground movement due to underpin wall deflection

Due to the relatively shallow basement depth and the high stiffness of the reinforced concrete underpins, long term deflection is considered to be negligible (i.e. <2mm). 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 should be employed where required to prevent localised collapse of the soil and should be supported with appropriately. As the underpin stems are cast, the props should be removed, ensuring 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 will be relocated to a sacrificial thrust block constructed beneath the level of the proposed floor slab.

10. BUILDING DAMAGE ASSESSMENT

The calculated ground movements have been used to assess potential 'damage categories' that may apply to neighbouring properties/infrastructure due to the proposed basement construction. The methodology proposed by Burland and Wroth[17] and later supplemented by the work of Boscardin and Cording[18] has been used, as described in *CIRIA Special Publication 200*[19] and *CIRIA C580*[20].

General damage categories are summarised in Table 12 below:

Table 12. Classification of damage visible to walls (reproduction of Table 2.5, CIRIA C580)

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 neighbouring developments (i.e. critical sections) the combined impact of short term heave, long term heave due to basement excavation have been combined to determine the overall ground movement and impact on adjacent properties due to the construction of the basement.

[17] 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
[18] Boscardin, M.D., and Cording, E.G., (1989). *Building response to excavation induced settlement*. J Geotech Eng, ASCE, 115 (1); pp 1-21.
[19] 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.
[20] CIRIA C580 (2003) *Embedded Retaining Walls – guidance for economic design*

10.1.1 Damage assessment of neighbouring structures

The maximum deflection ratio and horizontal strain of the neighbouring boundary party walls as derived from the ground movement assessment are summarised in Table 11. The method for calculating the deflection ratios for the structure of No. 19 Cressy Road is presented graphically in Figure 6. The deflection ratio is calculated by combining the ground movement profiles from heave due to excavation and settlement due to underpin loading.

Table 11: Summary of ground movements and corresponding damage category

Boundary Wall Reference	Maximum horizontal movements across footings (mm)	Maximum calculated deflection (mm)	Horizontal Strain Δ/L[b] (%)	Deflection ratio δ_h/L[a] (%)	Damage category
Section A-A: 19 Cressy Road	4.2	0.1	0.0724	0.002	1 – very slight

a. *See Figure 2.18 (a) CIRIA C580 (2003) Embedded retaining walls guidance for economic design. (L = length of adjacent structure in metres, perpendicular to basement; Δ = relative deflection)*
b. *See Box 2.5 (v) CIRIA C580 (2003) Embedded retaining walls guidance for economic design. (δ_h = horizontal movement in metres).*

Lateral movements are considered to represent potential deflection (sliding or rotation) of the underpin, and are presented as maximum limiting values to achieve the lowest possible category of damage. These movements are taken at footing levels across the span of adjacent structure which are used to calculate lateral strains.
With reference to published data[18] the limiting horizontal strain for a structure constructed of brickwork/blockwork set in cement mortar should not exceed 0.075%[19] to ensure the damage to the structure does not exceed Category 1 (very slight damage). This limiting value is applied to Critical Section A-A.

In Critical Section A-A, combined ground movements are likely to result in potential damage to the structure of 19 Cressy Road equivalent to Category 1 ‘very slight’ damage if lateral movements can be limited to 4.2mm. Further sensitivity analysis determines that if lateral deflections could be limited to 2.8mm for Critical Section A-A, damage Category 0 ‘negligible’ is not exceeded, as represented graphically in Figure 8.

The maximum deflection of 0.3mm occurs over a lateral extent of 2.0m (between -2.0m and 2.0m represented graphically in Figure 6) which represents the underpinned wall of 21 Cressy Road, and is equivalent to an angular distortion of approximately 1 in 6700. This is equivalent to damage Category 1 ‘very slight’ as proposed by Burland and Wroth[15].

In Critical Section B-B, combined ground movements are likely to result in a maximum settlement of 1.8mm along the 2.0m high masonry wall to the rear gardens of Nos. 66-68 Constantine Road that bounds the site in the north.

The maximum deflection occurs over a lateral extent of 2.0m (between 8.0m and 10.0m as shown in Figure 7), and is equivalent to an angular distortion of approximately 1 in 1800. This is equivalent to damage Category 1 ‘very slight’ as proposed by Burland and Wroth[15].

It is anticipated that total settlement movements affecting Cressy Road carriageway will not exceed 2mm. It is expected that this will have a negligible effect on both the roadway and underlying services.

11. MONITORING STRATEGY

The results of the ground movement analysis suggest that with good construction control, damage to adjacent boundary walls generated by the assumed construction methods and sequence can be controlled to within Category 1 ‘very slight’ damage.

A formal monitoring strategy should be implemented on site in order to observe and control ground movements during construction, and in particular movements of the adjacent properties.

The system should operate broadly in accordance with the ‘Observational Method’ as defined in CIRIA Report 185[21]. Monitoring can be undertaken by installing survey targets to the top of the wall and face of the adjacent buildings. Baseline values should be established prior to commencement of works. Monitoring of these targets should be carried out at regular time intervals and the results should be analysed to determine if any horizontal translation of the wall or tilt/settlement of the neighbouring walls is occurring. Regular monitoring of these targets will allow ground movement trends to be detected in a timely manner such that mitigation strategies may be implemented if required.

Monitoring data should be checked against predefined trigger limits and reviewed regularly to assess and manage the damage category of the adjacent buildings as construction progresses.

It is recommended that a condition survey is undertaken on all adjacent walls and property façades 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.

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

12. CONCLUSIONS

The findings of this Basement Impact Assessment are informed by site investigation data and proposed construction sequences and loadings provided by the structural engineer. The analysis is undertaken on the assumption of high quality workmanship during the construction of the basement.

- The results of the Stage 1 and 2 Screening and Scoping studies conclude that further assessment of the underlying ground conditions as well as the impacts on local infrastructure and neighbouring properties is required.
- The results from the contamination screening assessment indicate that contaminant concentrations in the samples tested are generally below the relevant assessment criteria.
- Two samples tested out of three from the Made Ground recorded lead concentrations which marginally exceed the SGV assessment criteria. However, given the proposed basement extent and formation level, the Made Ground onsite will require offsite disposal as part of basement excavation.
- No asbestos was detected in any of the soil samples tested.
- The development will have a negligible impact on surface water flow and flooding.
- For Critical Sections A-A and B-B the maximum damage category predicted based on combined lateral and vertical ground movement profiles is Category 1 ‘very slight’ damage.
- Based on the results of the ground movement assessment, it is considered that the neighbouring terrace properties on Cressy Road positioned greater than 6m from the excavation are located outside the zone of influence from ground movements and will be subjected to negligible damage (i.e. Category 0) from the proposed basement development.
- Short term heave movements within the excavation will occur instantaneously upon unloading and will be removed during the excavation process. They should therefore be discounted from any anticipated heave movements beneath the sub-

basement slab at formation level, where only long term heave movements to a maximum of 5mm at centre decreasing to 1mm at excavation perimeter will occur.

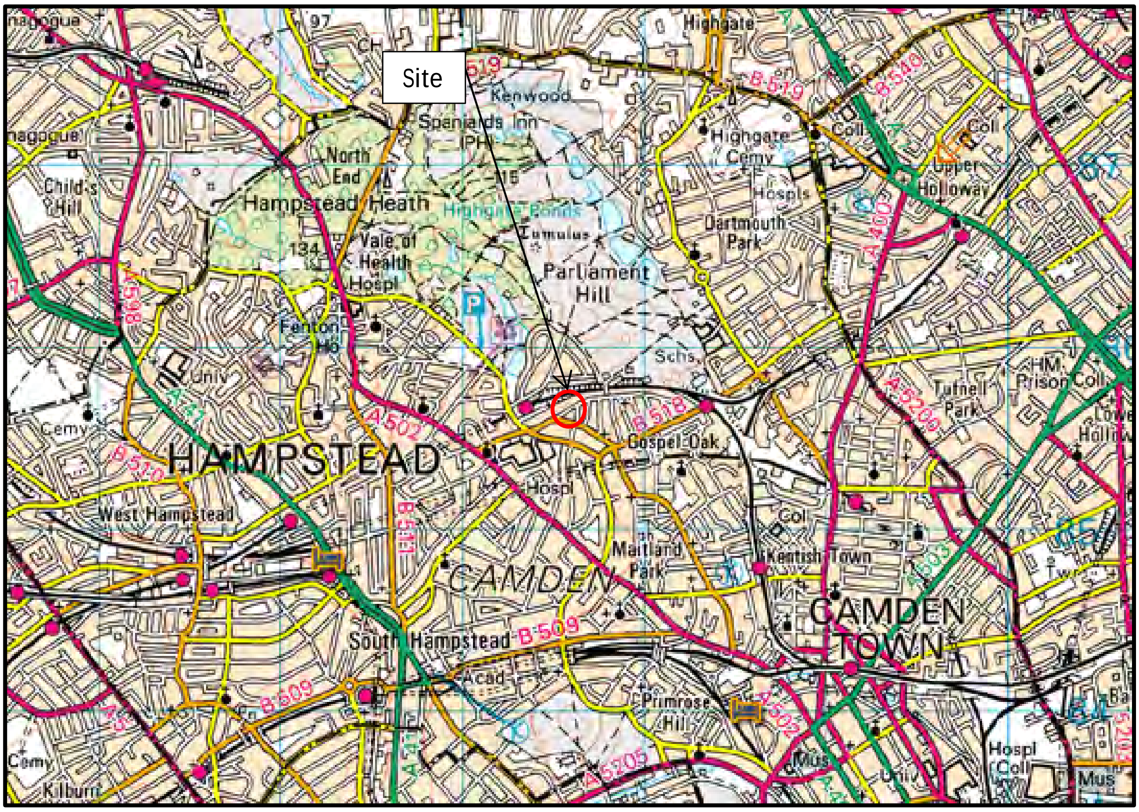
- Groundwater was recorded in borehole BH1 representing shallow perched groundwater within Made Ground. This is not anticipated to be laterally pervasive in a principally cohesive soil. The contractor must be aware of this potential for groundwater to exist at a shallow level prior to excavation.

- It is recommended that a condition survey is undertaken and an appropriate monitoring regime is adopted to manage risk and potential damage to the neighbouring structures as construction progresses onsite.

- The excavation is not expected to alter the local groundwater regime over the long term due to presence of impermeable London Clay and based on the groundwater observation during the current site investigation.

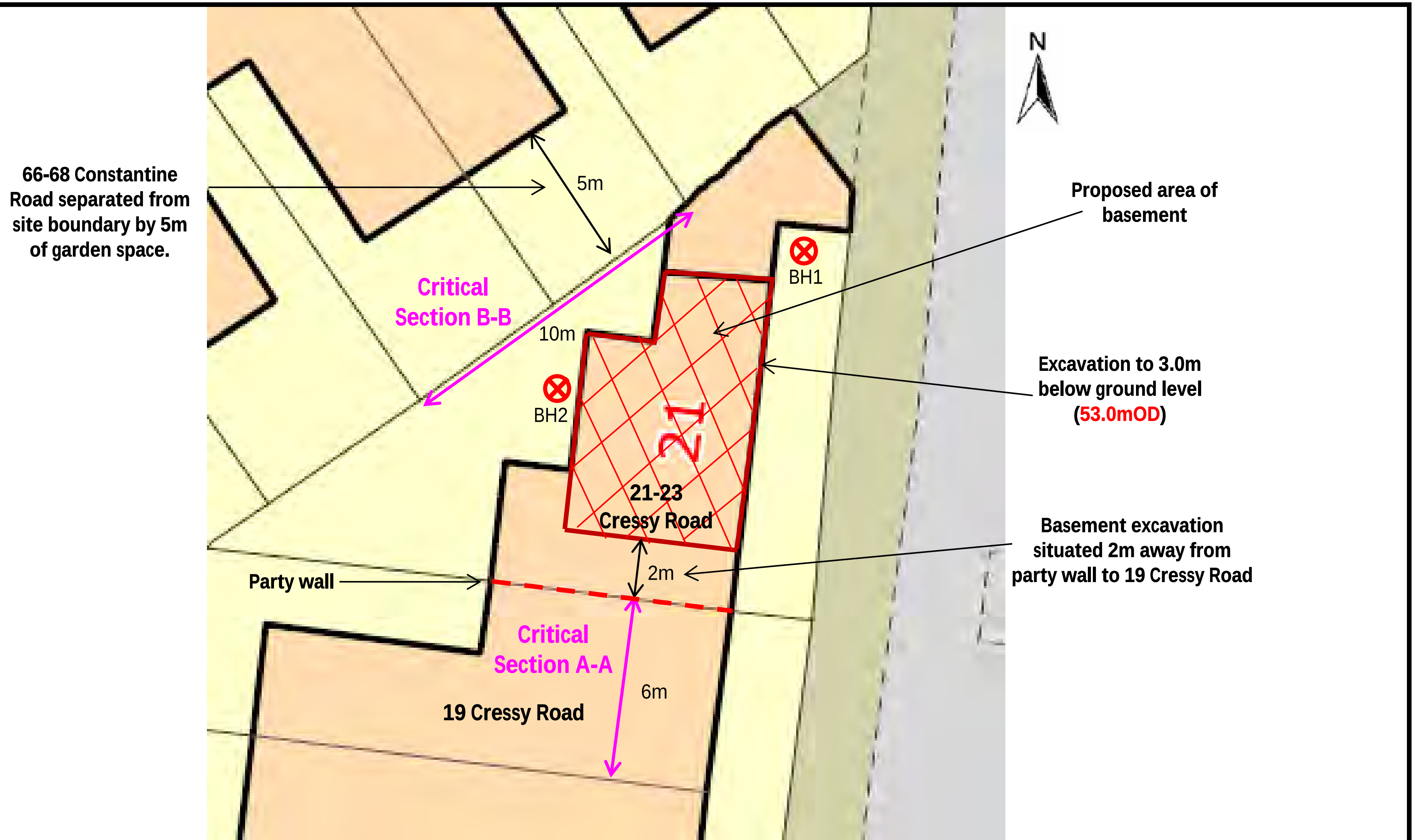
- An overall heave regime does not extend over the adjacent pavement into Cressy Road carriageway. It is considered the proposed works will have negligible impact upon the carriageway and underlying infrastructure.

FIGURES

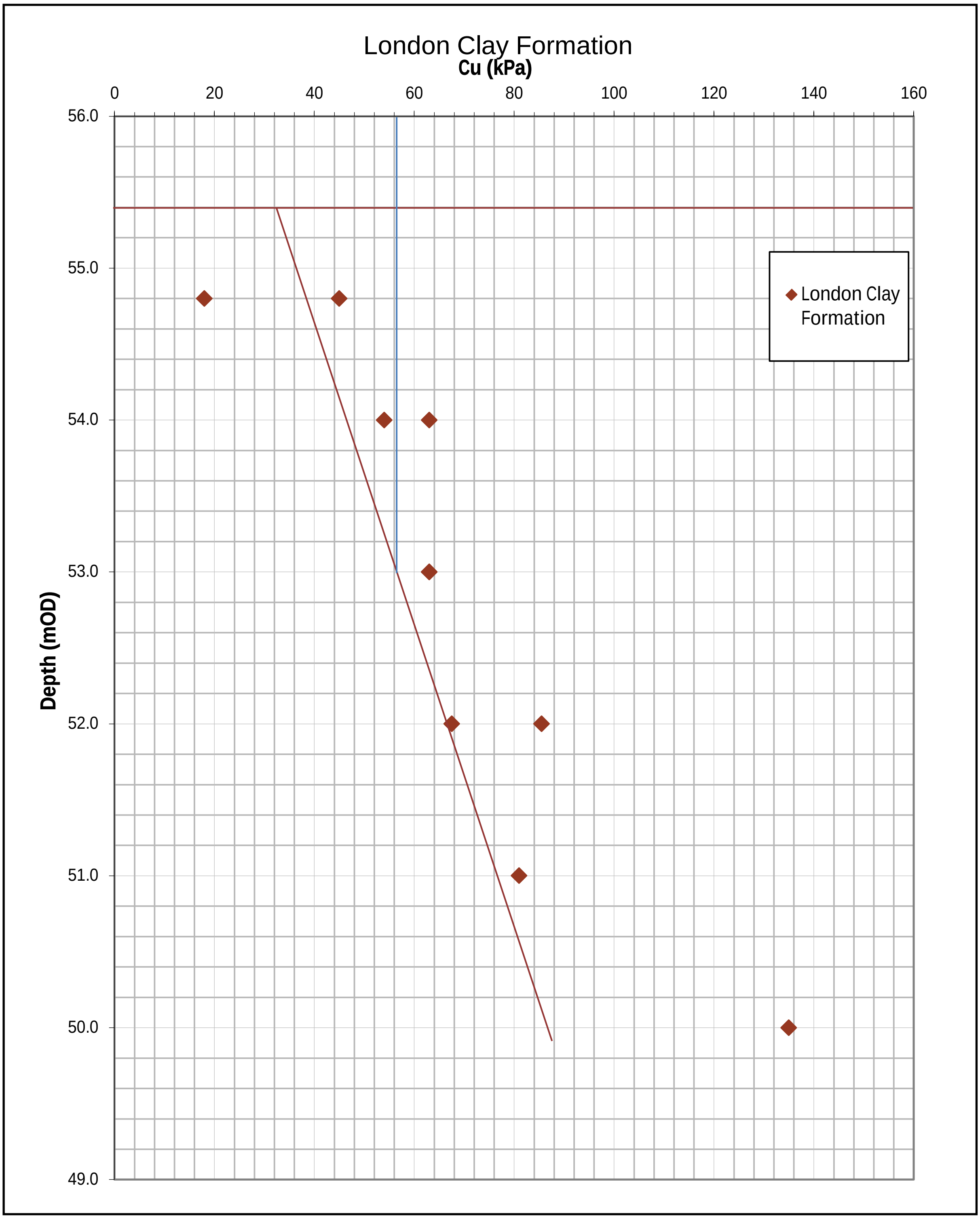


N

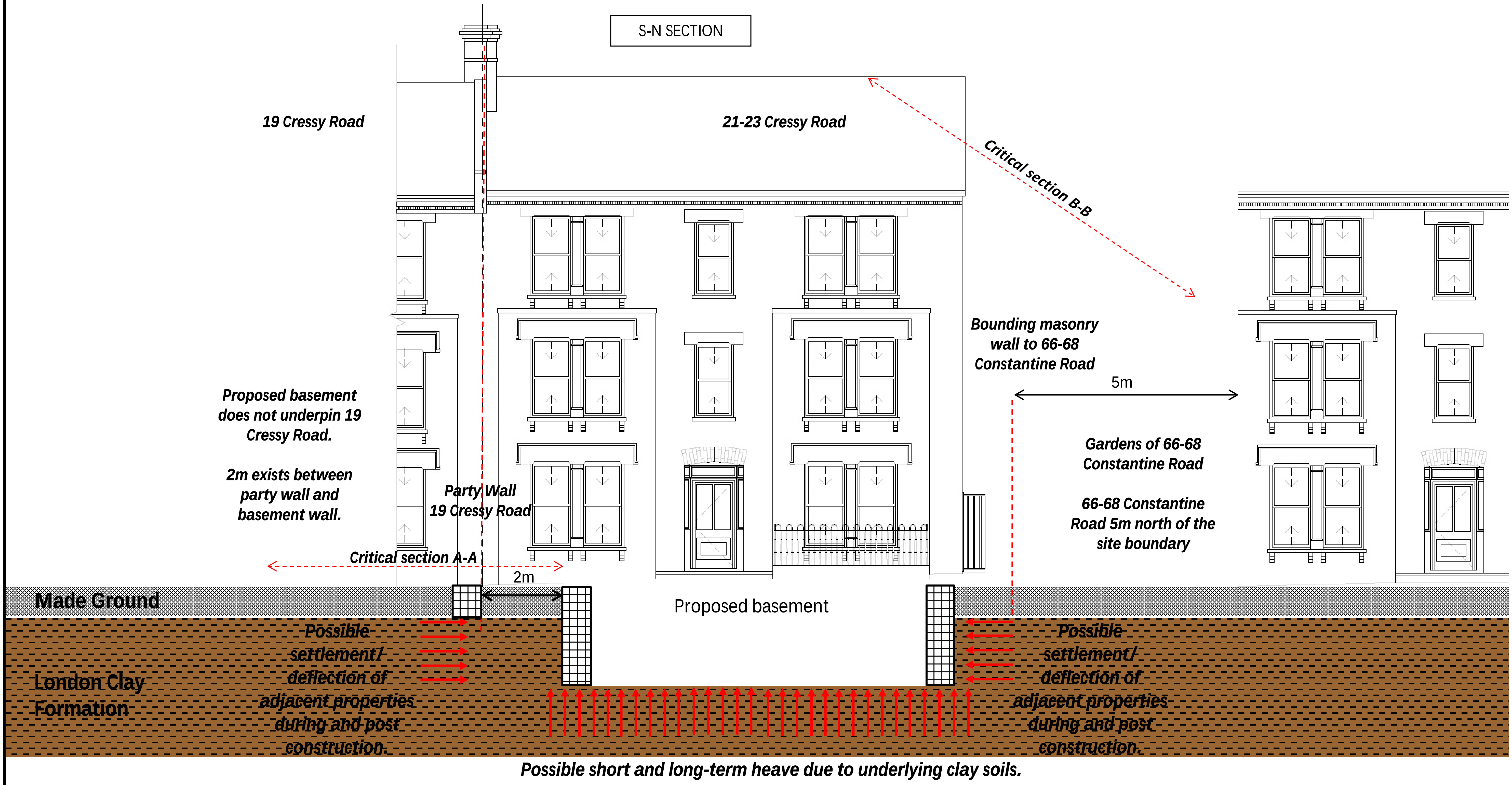
Client	Project	Job No
CRL Asset Finance Limited	**21-23 Cressy Road, Camden, London**	**CG/18104**
	Title **Site location plan**	**Figure 1**



Client	Project	Job No
CRL Asset Finance Limited	21-23 Cressy Road, Camden, London	CG/18104
	Title	
	Site layout plan, Critical Sections and borehole location plan	Figure 2



Client	Project	Job No
CRL Asset Finance Limited	**21-23 Cressy Road, Camden, London**	**CG/18104**
CGL	Title **Shear strength C_u vs level**	**Figure 3**



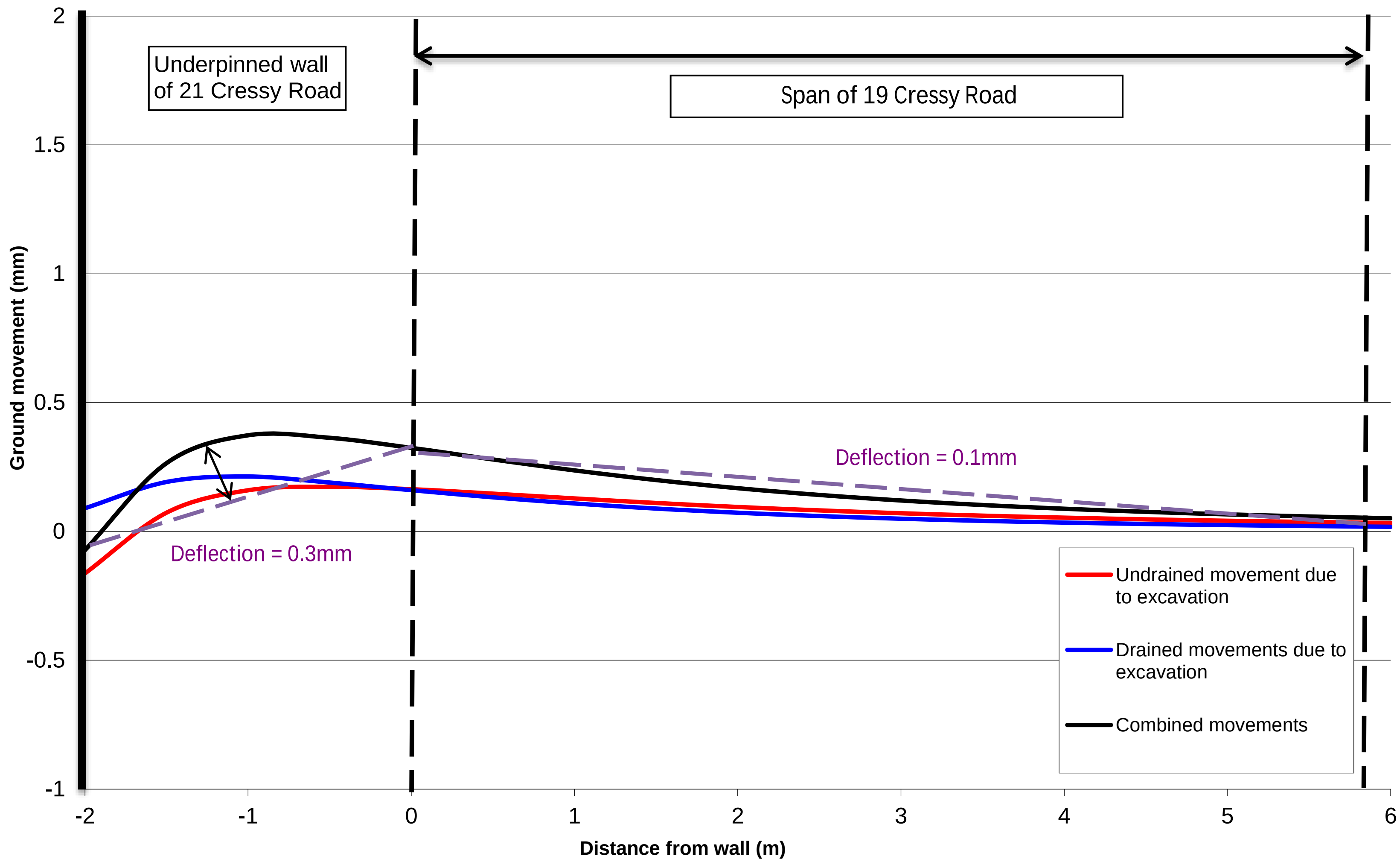
Client	Project	Job No
CRL Asset Finance Limited	21-23 Cressy Road, Camden, London	CG/18104
CGL	Title: Conceptual Site Model	Figure 4

Short Term Displacement Contours

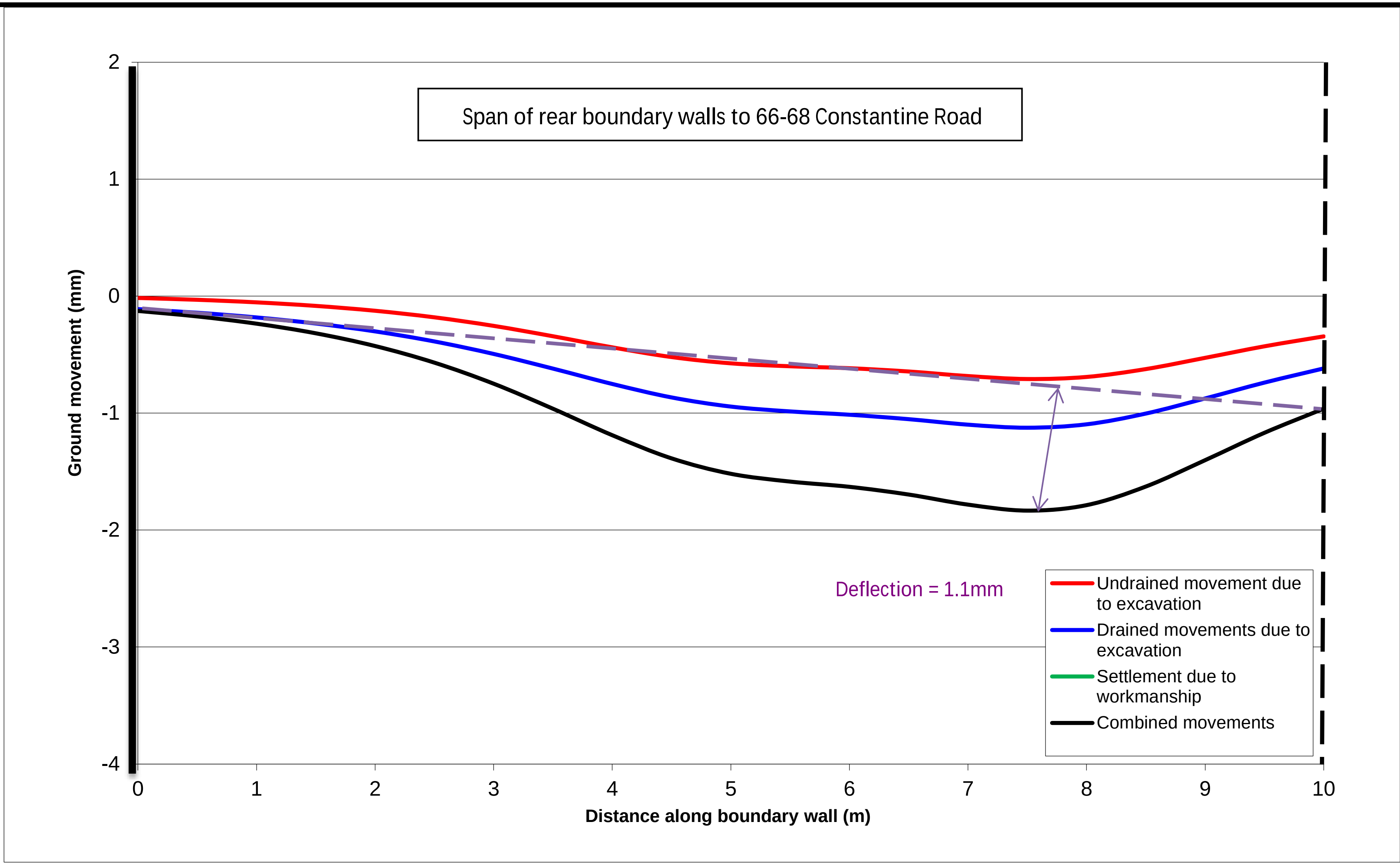
Long Term Displacement Contours

Negative Numbers indicate heave movements. Positive numbers indicate settlement

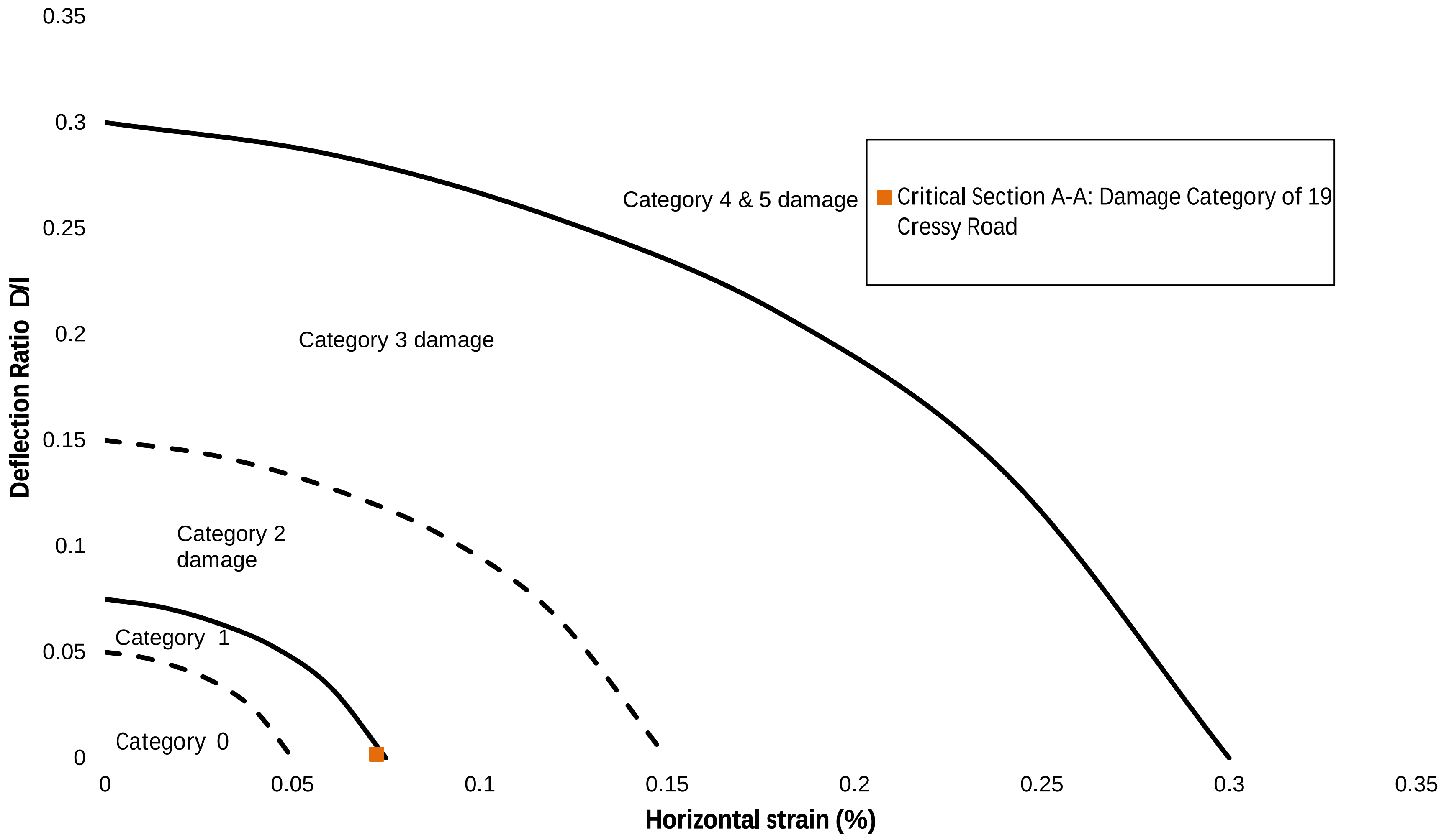
Client	Project	Job No
CRL Asset Finance Limited	**21-23 Cressy Road, Camden, London**	**CG/18104**
CGL	Title **Short and Long Term vertical displacement contours**	**Figure 5**



Client	Project	Job No
CRL Asset Finance Limited	**21-23 Cressy Road, Camden, London**	**CG/18104**
CGL	Title **Combined vertical displacements - Critical section A-A**	**Figure 6**



Client	Project	Job No
CRL Asset Finance Limited	**21-23 Cressy Road, Camden, London**	**CG/18104**
CGL	Title **Combined Vertical Displacements - Critical Section B-B**	**Figure 7**



Client	Project	Job No
CRL Asset Finance Limited	**21-23 Cressy Road, Camden, London**	**CG/18104**
CGL	Title **Building Damage Plot**	**Figure 8**

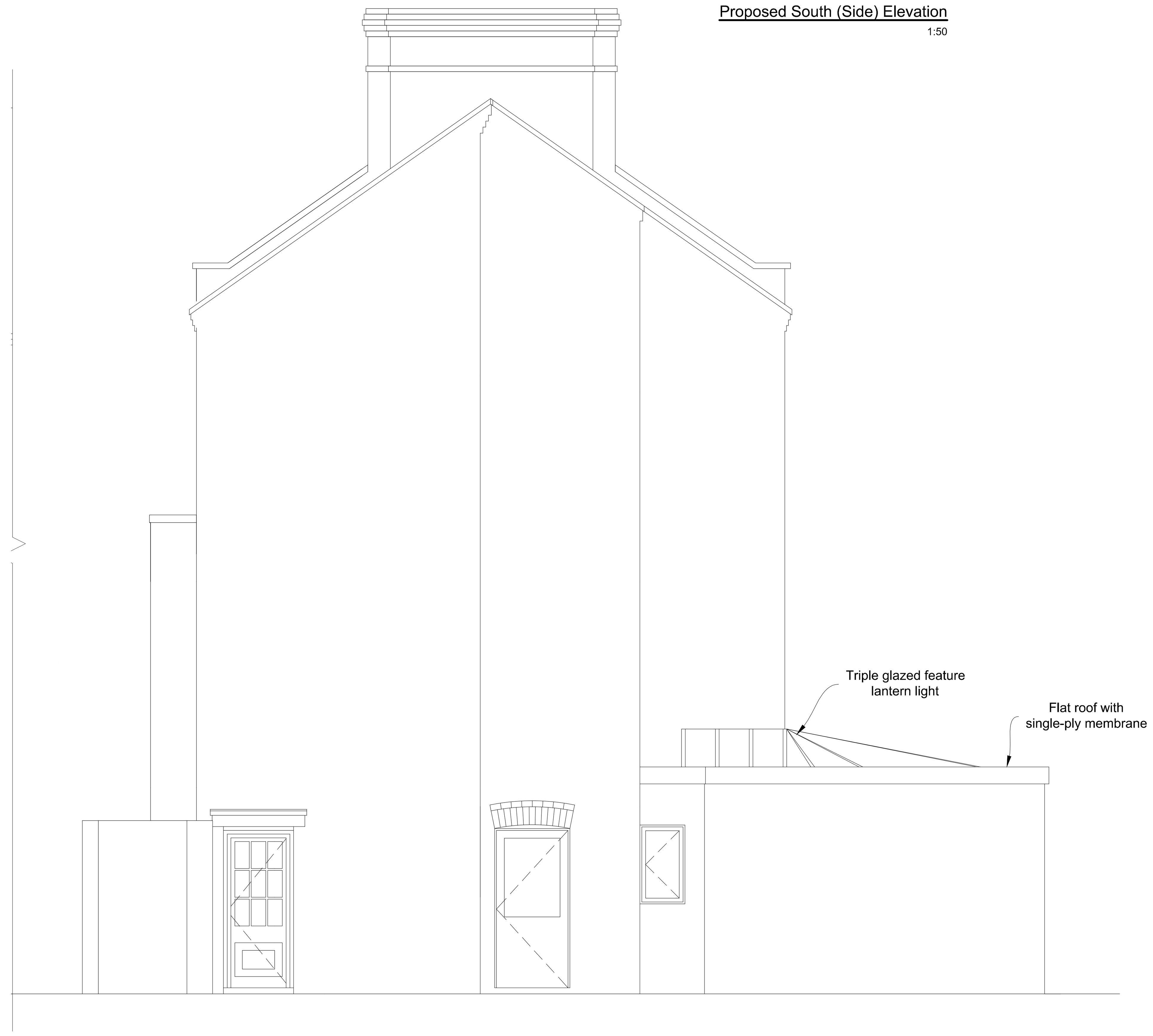
APPENDIX A

Proposed development plans

Proposed East (Front) Elevation
1:50

Proposed South (Side) Elevation
1:50

Proposed West (Rear) Elevation
1:50



Proposed South (Side) Elevation
1:50

Revision notes

Rev A:

Scale bars

1m
1:20

1m 2m 3m
1:50

2m 4m 6m
1:100

Client

CRL Asset Finance Ltd.
Mr C Lay

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Project

Re-development, extensions & alterations.

Drawing title

Proposed Elevations.

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Drawn by: MPG	Dwg size: A1

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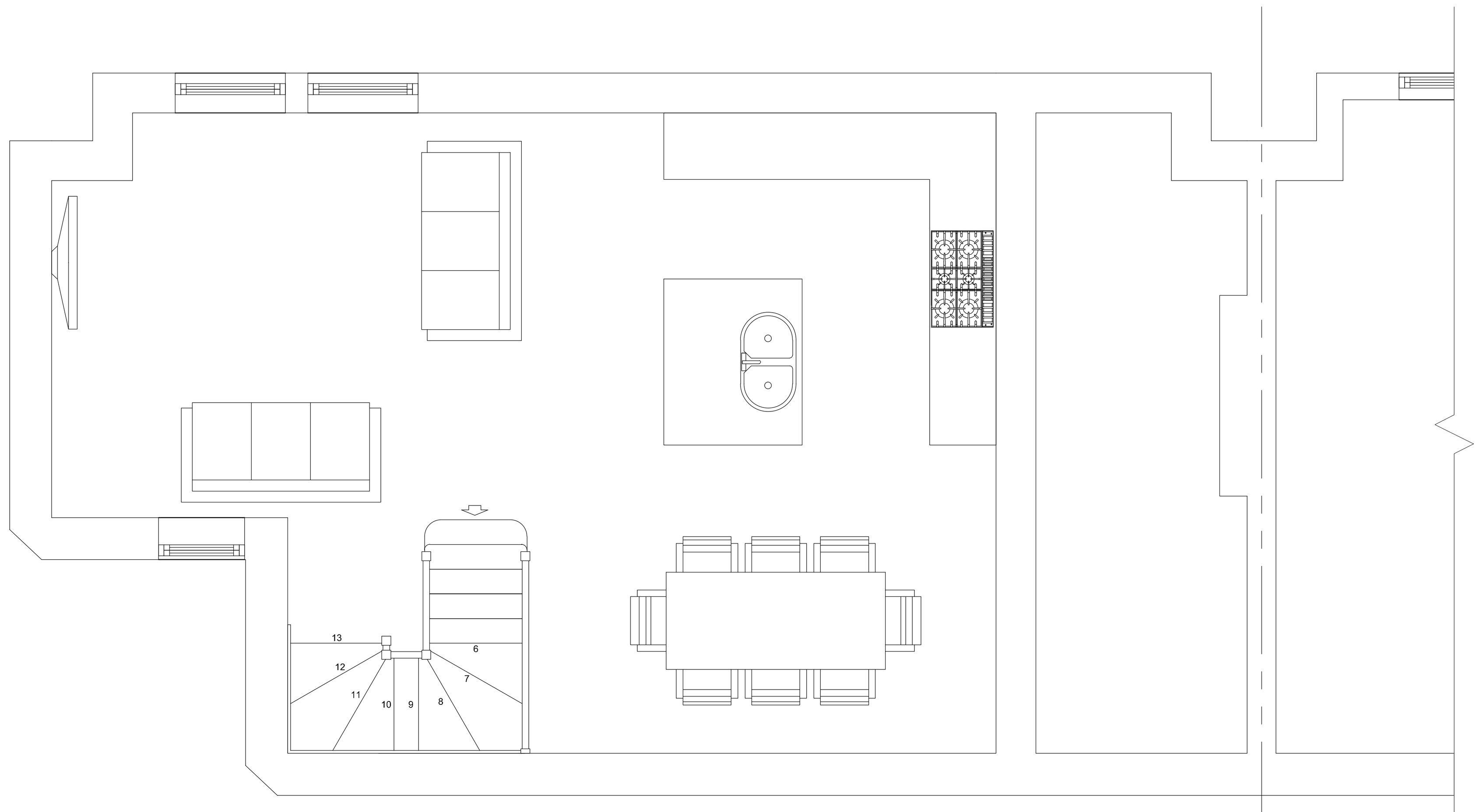
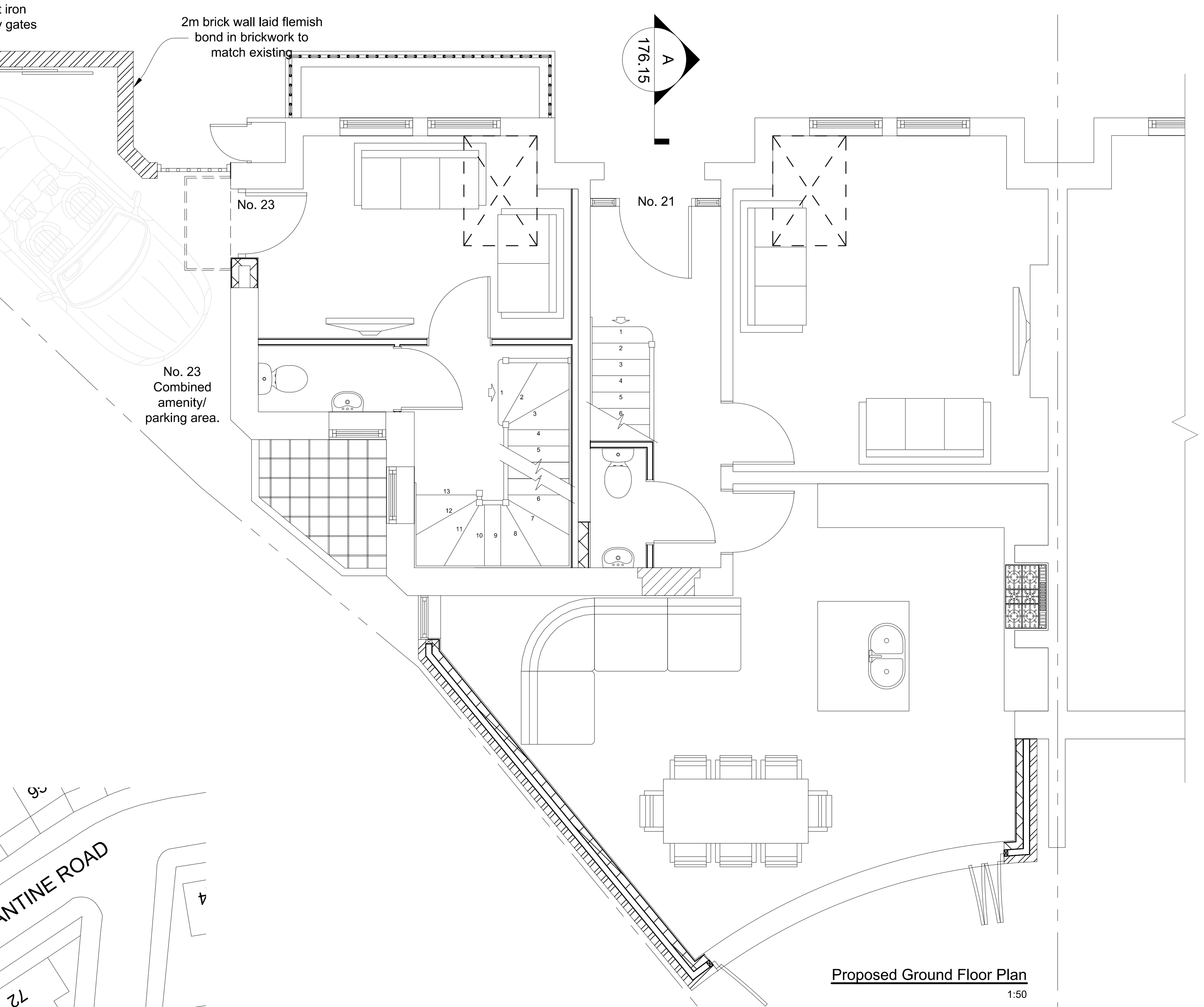
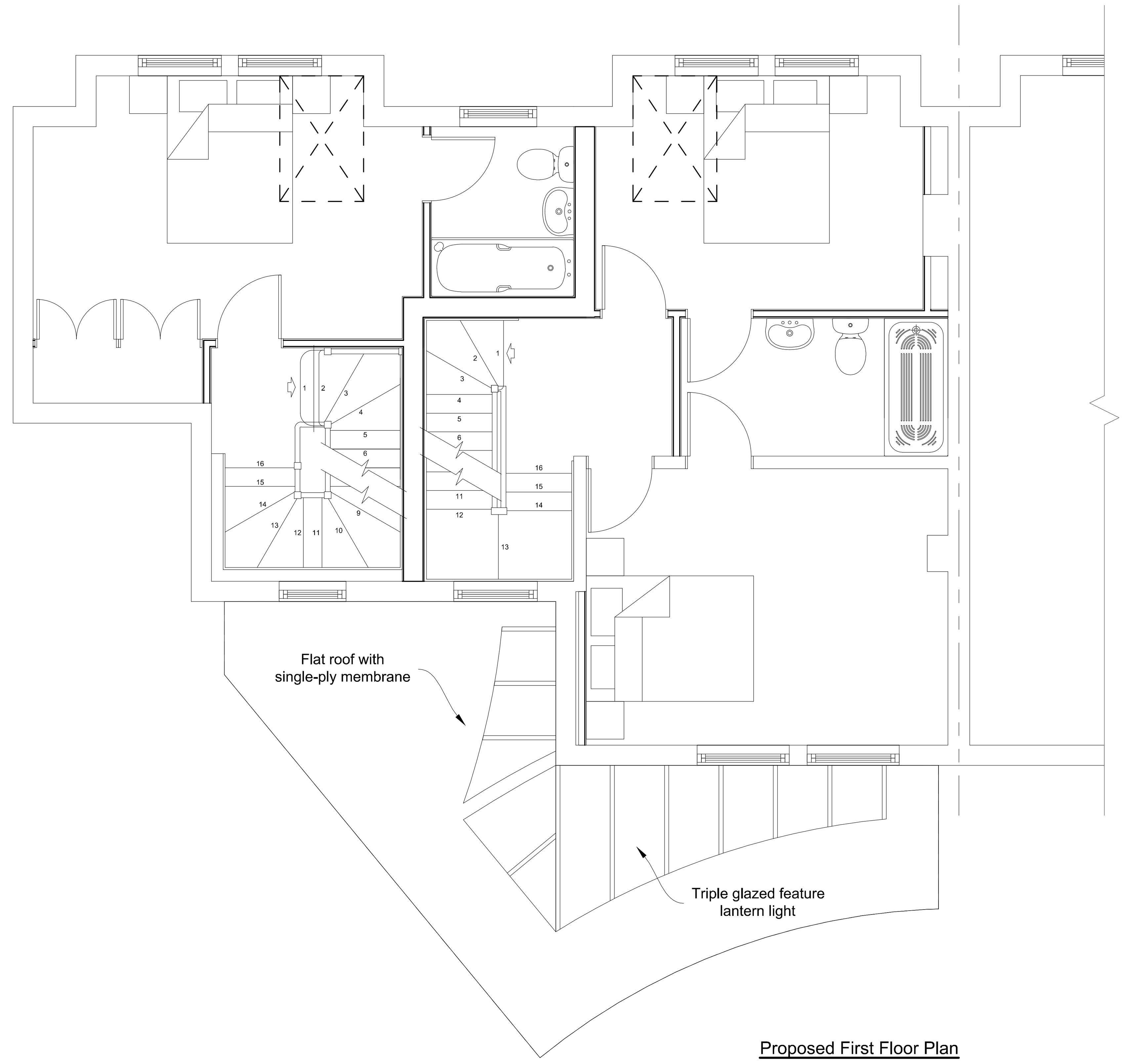


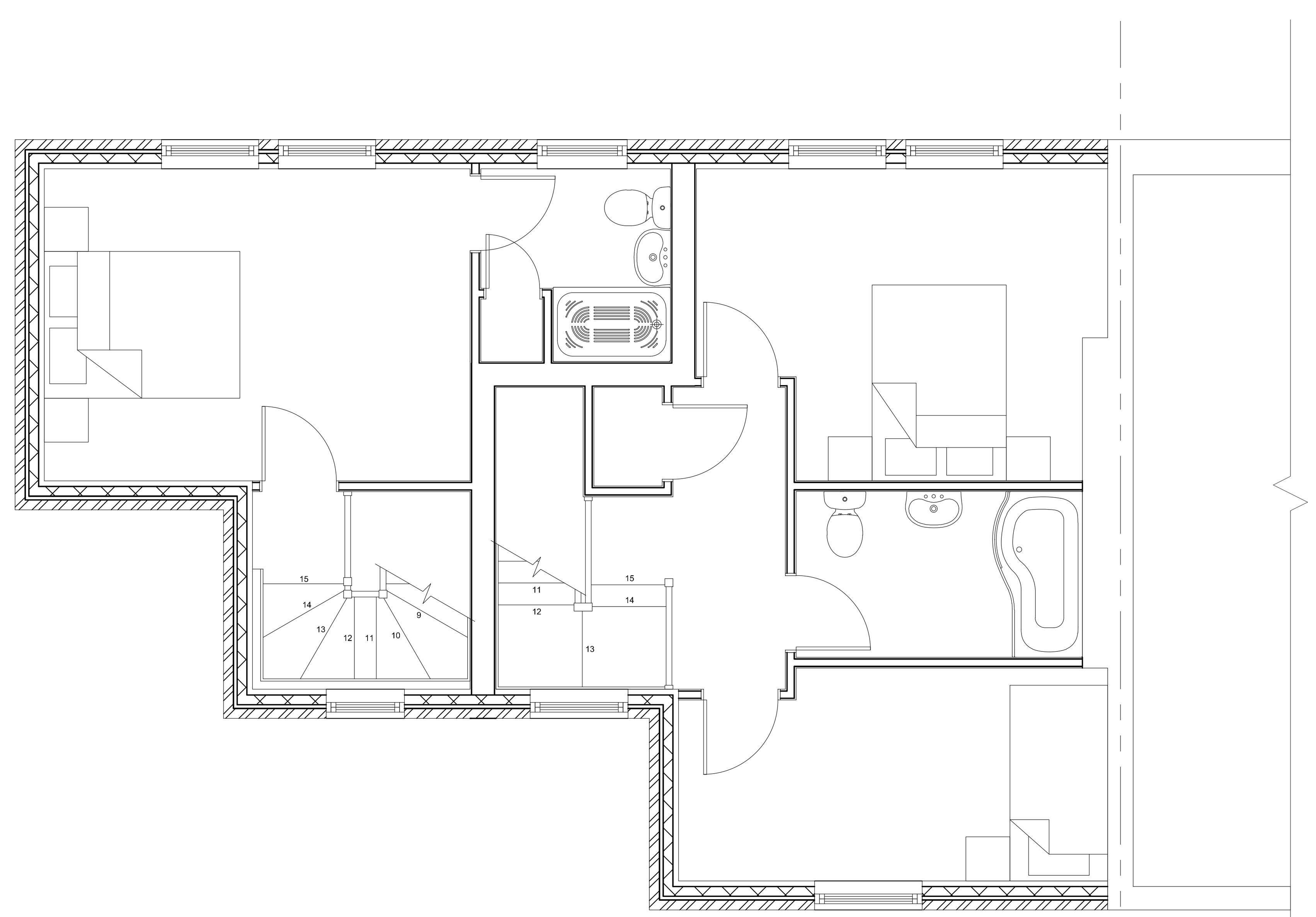
Proposed Basement Floor Plan
1:50



Proposed Ground Floor Plan
1:50

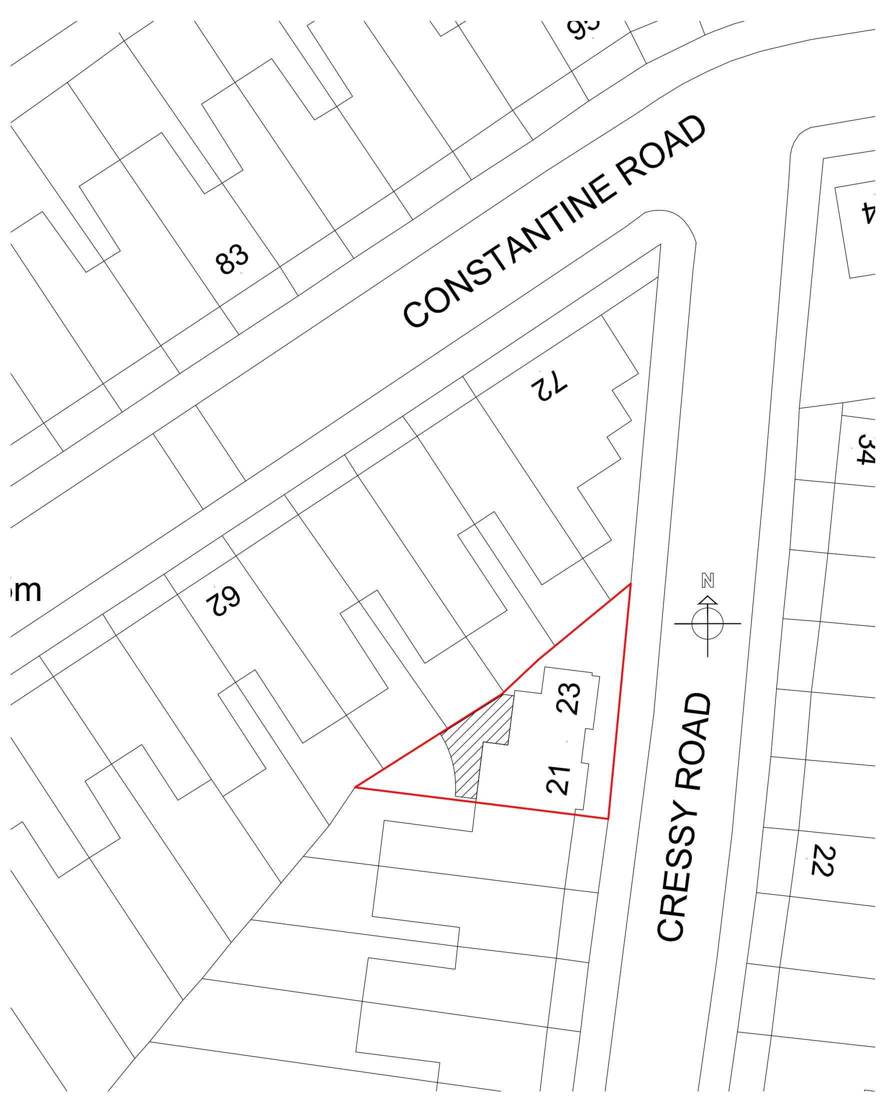


Proposed First Floor Plan
1:50



Proposed Second Floor Plan
1:50

Proposed Site Location Plan
1:1250



Proposed Block Plan
1:500

Revision notes

Rev A:

Scale bars

1m
1:20

1m 2m 3m
1:50

2m 4m 6m
1:100

Client

CRL Asset Finance Ltd.
Mr C Lay

Site Address

21 & 23 Cressy Road
Hampstead
London
NW3 2NB

Project

Re-development, extensions & alterations.

Drawing title

Proposed Floor Plans, Site Location & Block Plans.

rosser morris Ltd.
www.rossermorris.co.uk

Drawings prepared for:
Planning permission and building regulations
◊ New builds ◊ Extensions ◊ Alterations
◊ Loft conversions ◊ Structural calculations
◊Domestic and commercial.

The White House, Hockliffe Street,
Leighton Buzzard, Beds. LU7 1HD.

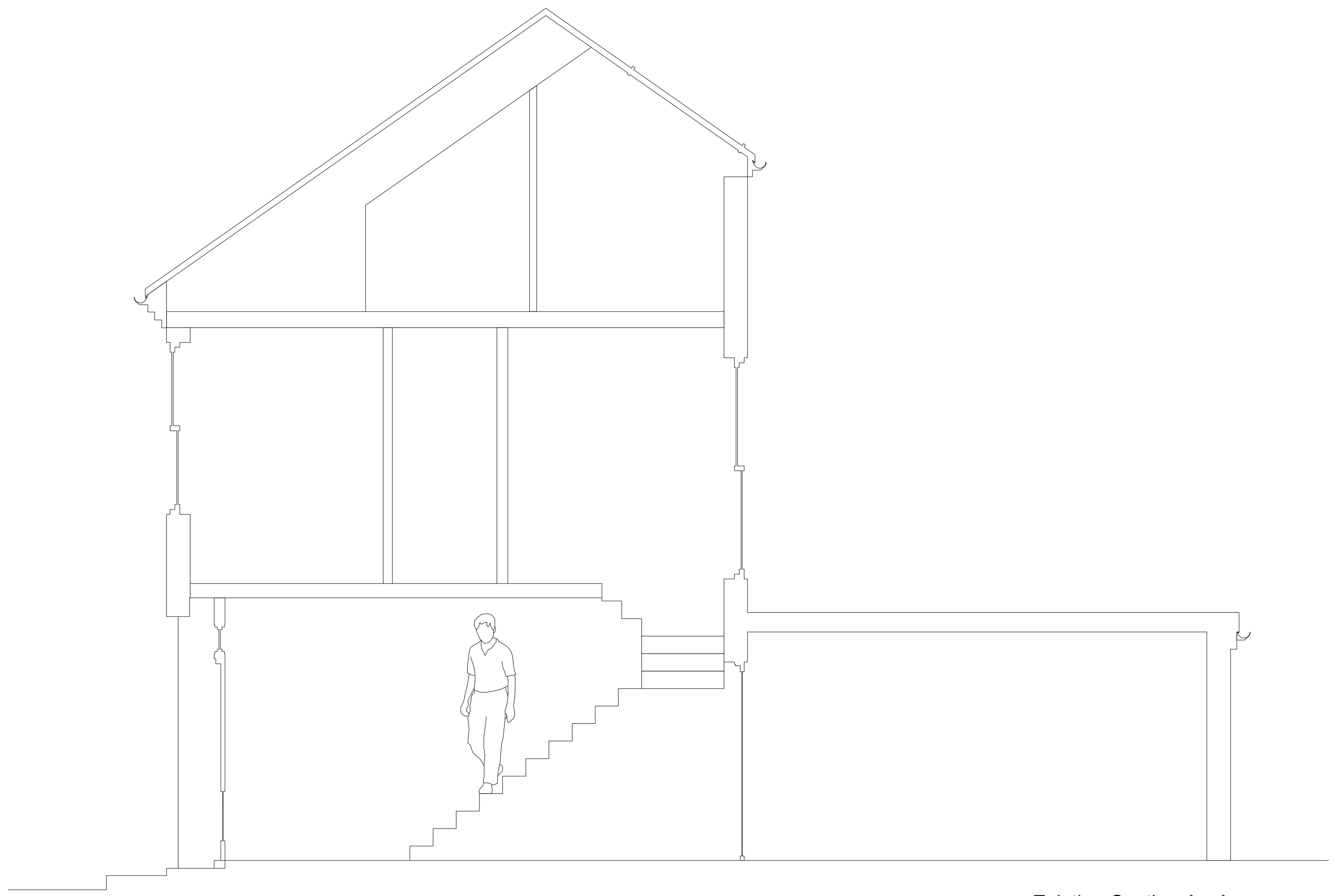
Email: graham@rossermorris.co.uk
Tel: +44(0) 1525 217904
Mob: +44(0) 7974 133872

RICS

Drawing number: RM 13 / 139.6	
Date: 26.09.2013	Scale: Varies
Drawn by: MPG	Dwg size: A1

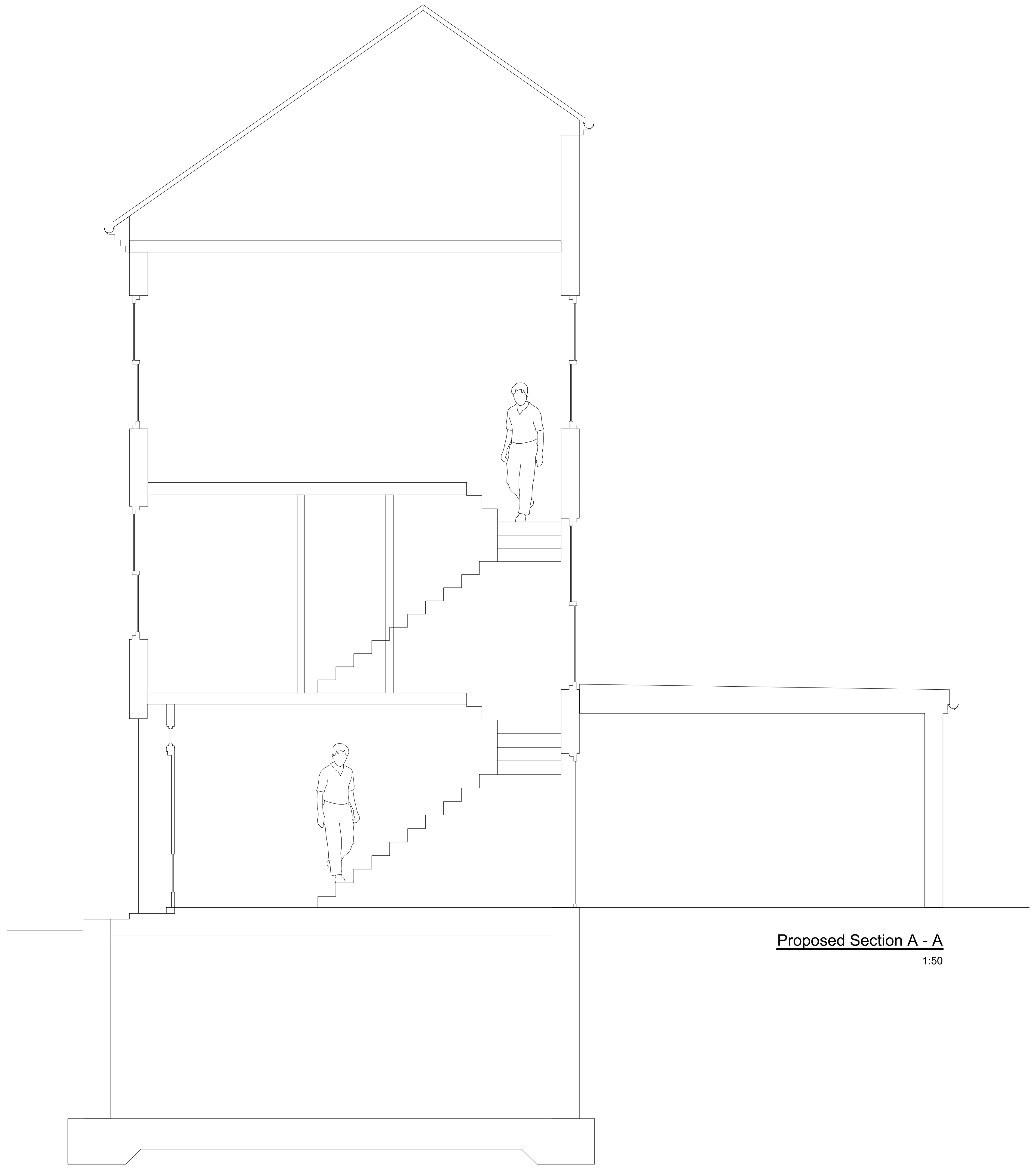
Registered Office: The White House, Hockliffe Street, Leighton Buzzard, Beds. LU7 1HD.

Registered in England No. 4970106



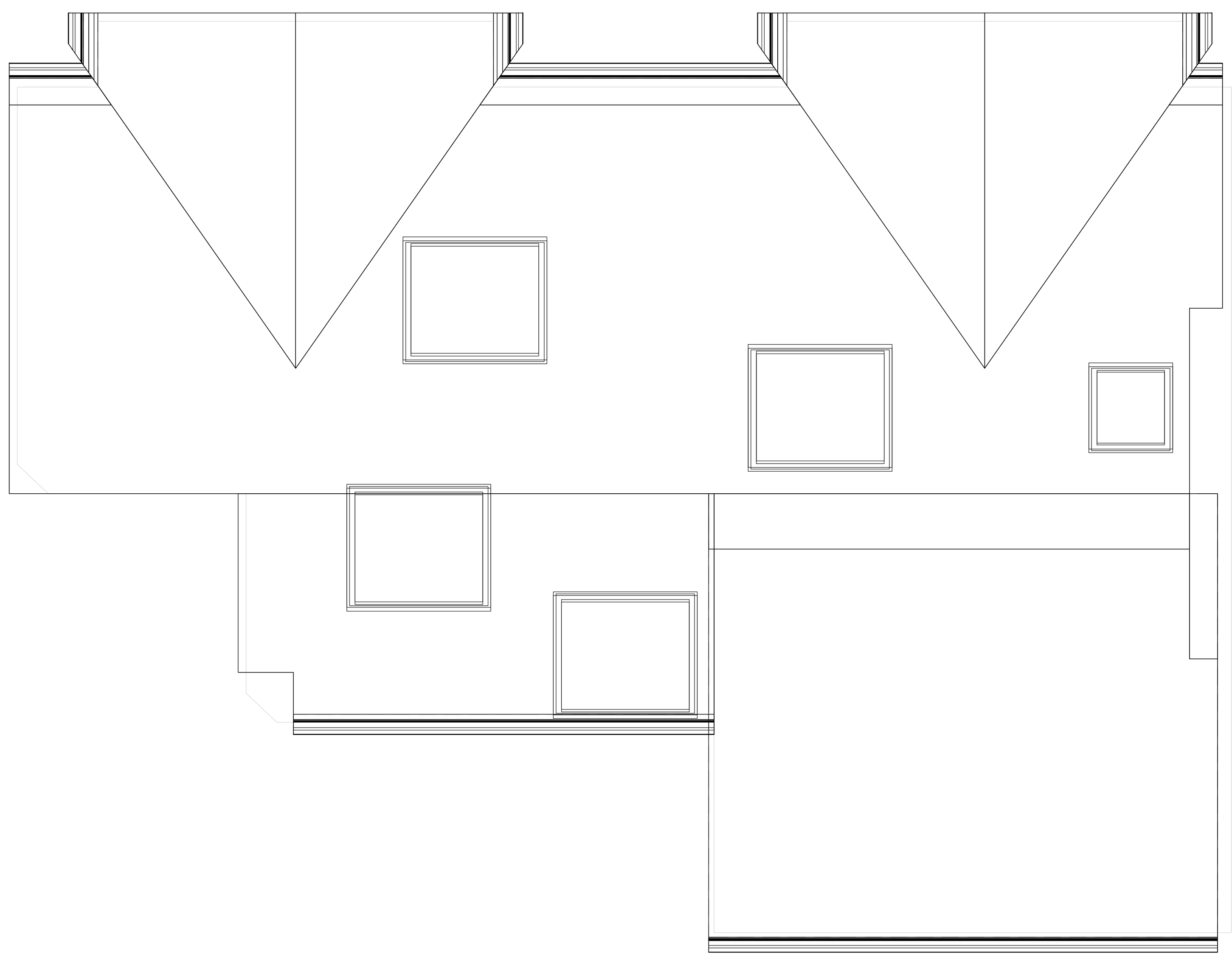
Existing Section A - A

1:50



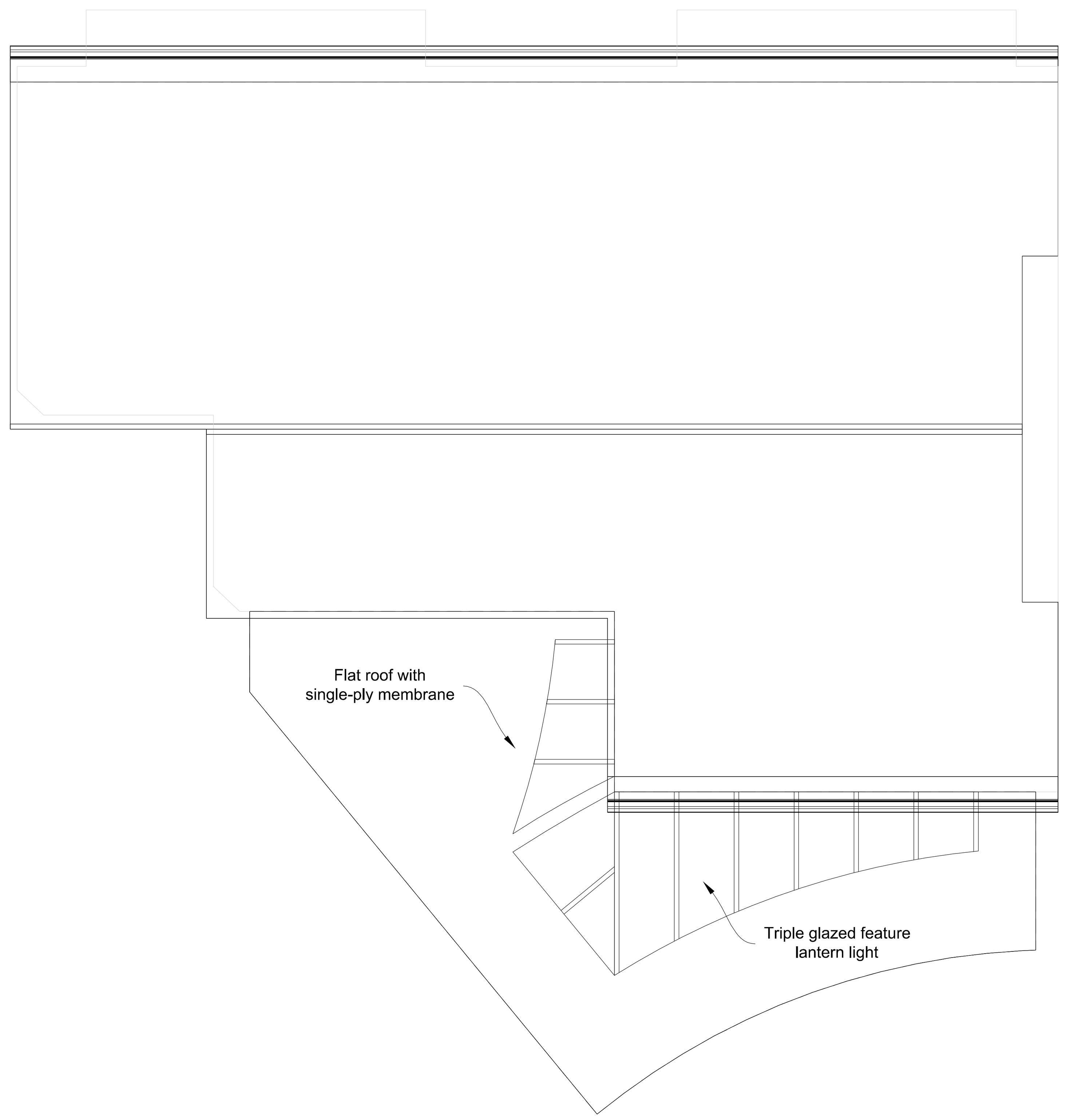
Proposed Section A - A

1:50



Existing Roof Section

1:50



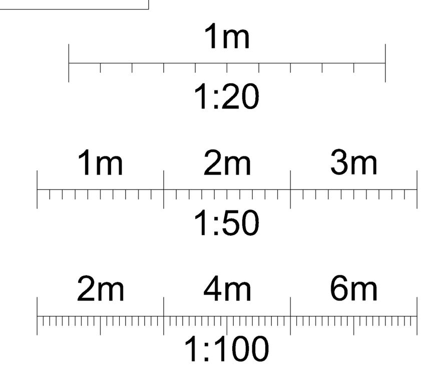
Proposed Roof Plan

1:50

Revision notes

Rev A:

Scale bars



Client

CRL Asset Finance Ltd.
Mr C Lay

Site Address

21 & 23 Cressy Road
Hampstead
London
NW3 2NB

Project

Re-development, extensions & alterations.

Drawing title

Existing & proposed sections and roof plans.

rosser morris Ltd.
www.rossermorris.co.uk

Drawings prepared for;
Planning permission and building regulations
◊ New builds ◊ Extensions ◊ Alterations
◊ Loft conversions ◊ Structural calculations
◊Domestic and commercial.

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RICS

Drawing number:	RM 12 / 139.8
Date: 26.09.2013	Scale: 1:50
Drawn by: MPG	Dwg size: A1

Registered Office: The White House, Hockliffe Street,
Leighton Buzzard, Beds. LU7 1HD.

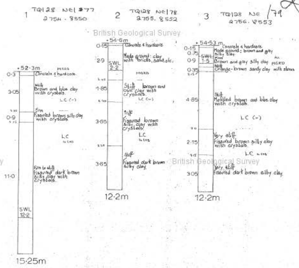
Registered in England No. 4970106

APPENDIX B

BGS historical borehole records

Client	Project	Job No
CLR Asset Finance Limited	**21-23 Cressy Road, Camden, London**	**CG/18104**
CGL	Title **Historical borehole location plan**	**Appendix B**

Size A2 16½" x 23¾" — 420mm x 594mm



KEY PLAN

Scale 1:1250

div	job no.	drg. no.	rev.
G	3287 SW	01	

JOB DMES OFFICES & WORKSHOPS CRESSY ROAD CAMDEN

TITLE TRIAL BORINGS 1-3 KEY PLAN & SECTIONS

scale VERTICAL 1:100

date	drawn	checked
21.7.1971		H.C.T.

GLC ILEA

Dept of Architecture and Civic Design

Architect Roger Walters

01-633 5000 Ext. 8381

NOTES

1 Newlyn Datum Levels
2 ⌖ Denotes Trial Boring
3 WS Denotes Water Strike
4 SWL Denotes Standing Water Level at the time of boring in July 1971

REVISIONS

no. date

COPY

reference

div.	job no.	drg. no.	rev.
G	3287 SW	01	

Size A2 16½" x 23¾" — 420mm x 594mm

APPENDIX C

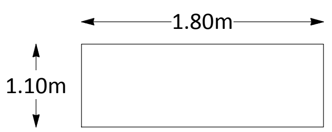
CGL borehole records

TRIAL PIT LOG

Project				TRIAL PIT No
21 - 23 Cressy Road				FP1
Job No: CG/18104	Date: 09-10-14	Ground Level (m)	Co-Ordinates (m)	
Client: CRL Asset Finance Ltd				Sheet: 1 of 1

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION
0.05	ES1					0.10	Dense dark red brown silty sandy gravel. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of brick, slate, concrete and ceramic. [MADE GROUND]
						0.30	0.00 - 0.60 Stepped foundation
0.40	ES2					(0.30) 0.60	Dark brown slightly clayey gravelly silt. Gravel is subangular to subrounded fine to medium of brick, ceramic and fibrous material. [MADE GROUND]
0.70	HSV	57				(0.30) 0.90	Dark brown gravelly silty clay. Gravel is subangular fine of brick. [MADE GROUND]
0.75	HSV	62					
0.80	HSV	63					Firm dark grey brown silty CLAY with iron staining. [WEATHERED LONDON CLAY FORMATION
0.85	HSV	61					*(Pit terminated at 0.9m)*

Plan



Stability: Good

General Remarks

1. No groundwater encountered.
2. Pit terminated at 0.9m due to base of foundation being encountered.
3. ES = environmental samples; HSV = Hand Shear Vane.

Method/ Plant Used	Field Crew	Logged By	Checked By
Archway Competitor	Gary Wheeler Drilling Ltd	TOP	RJB

TRIAL PIT LOG

CGL

Project				TRIAL PIT No
21 - 23 Cressy Road				FP2
Job No: CG/18104	Date: 09-10-14	Ground Level (m)	Co-Ordinates (m)	
Client: CRL Asset Finance Ltd				Sheet: 1 of 1

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION
						(0.40) 0.40	Soft dark grey brown gravelly silty clay. Gravel is subangular to subrounded fine to medium of brick and concrete. [MADE GROUND] 0.00 - 0.30 Stepped foundation
0.43 0.46 0.49 0.50	HSV HSV HSV ES1	24 28 38				0.50	Soft to firm light brown gravelly clay. Gravel is subangular to subrounded fine to coarse of brick. [MADE GROUND]
							(Pit terminated at 0.5m)

Plan

0.70m

0.70m

Stability: Good

General Remarks

1. No groundwater encountered.
2. Pit terminated at 0.5m due to base of foundation being encountered.
3. ES = environmental samples; HSV = Hand Shear Vane.

Method/ Plant Used	Field Crew	Logged By	Checked By
Archway Competitor	Gary Wheeler Drilling Ltd	TOP	RJB

WINDOW SAMPLE LOG

Project				HOLE No
21 - 23 Cressy Road				BH1
Job No: CG/18104	Date: 09-10-14	Ground Level (m)	Co-Ordinates (m)	
Client: CRL Asset Finance Ltd				Sheet: 1 of 2

Depth	Type No	Test Result (N/kPa/ppm)	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION
0.40	ES1					(0.65) 0.65	Dark brown silty gravelly clay. Gravel is subangular fine of brick, plastic and ceramic. [MADE GROUND]
						(0.55) 1.20	Soft becoming firm light brown mottled orange silty sandy CLAY with occasional organic matter. Sand is fine. [HEAD DEPOSIT]
1.20	D1						Firm becoming stiff light orange brown silty CLAY with fine to medium selenite crystals. [WEATHERED LONDON CLAY FORMATION]
1.20		N4					
1.50	D2						
2.00	D3						
2.00		N14					
2.50	D4						
3.00	D5						3.00 - 3.50 Becoming stiff mottled blue grey
3.00		N14					
3.20	HSV	92					
3.40	HSV	90					
3.50	D6						
3.60	HSV	94					
3.80	HSV	102					
4.00	D7					(5.80)	
4.00		N15					
4.10	HSV	102					
4.40	HSV	90					
4.50	D8						
4.70	HSV	110					

Boring Progress and Water Observations

Date	Strike depth	Casing depth	Comment	Time measured	Standing Depth

General Remarks

1. No groundwater encountered.
2. Window sample terminated at 7.0mbgl as requested.
3. D = Disturbed sample; ES = environmental samples; N = SPT 'N' value; HSV = Hand Shear Vane.
4. Installation details: 0 to 0.5mbgl 50mm plain pipe with bentonite seal, 0.5 to 2.0mbgl 50mm slotted pipe and gravel filter pack, 2.0 to 7.0mbgl backfilled with arisings. Gas tap, bung and flush cover.

Method/Plant Used	Field Crew	Logged By	Checked By
Archway Competitor	Gary Wheeler Drilling Ltd	TOP	RJB

WINDOW SAMPLE LOG

Project				HOLE No
21 - 23 Cressy Road				**BH1**
Job No: CG/18104	Date: 09-10-14	Ground Level (m)	Co-Ordinates (m)	
Client: CRL Asset Finance Ltd				Sheet: 2 of 2

SAMPLES & TESTS / STRATA

Depth	Type No	Test Result (N/kPa/ppm)	Water	Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument /Backfill
5.00	D9						Firm becoming stiff light orange brown silty CLAY with fine to medium selenite crystals. [WEATHERED LONDON CLAY FORMATION] *(continued)*	
5.00	HSV	112						
5.00		N18						
5.30	HSV	104						
5.50	D10							
5.60	HSV	108						
5.80	HSV	122						
6.00	D11							
6.00	HSV	117						
6.00		N30						
6.20	HSV	117						
6.40	HSV	126						
6.50	D12							
6.60	HSV	140						
6.80	HSV	112				7.00		
							(Window sample terminated at 7m)	

Boring Progress and Water Observations

Date	Strike depth	Casing depth	Comment	Time measured	Standing Depth

General Remarks

1. No groundwater encountered.
2. Window sample terminated at 7.0mbgl as requested.
3. D = Disturbed sample; ES = environmental samples; N = SPT 'N' value; HSV = Hand Shear Vane.
4. Installation details: 0 to 0.5mbgl 50mm plain pipe with bentonite seal, 0.5 to 2.0mbgl 50mm slotted pipe and gravel filter pack, 2.0 to 7.0mbgl backfilled with arisings. Gas tap, bung and flush cover.

Method/ Plant Used	Field Crew	Logged By	Checked By
Archway Competitor	Gary Wheeler Drilling Ltd	TOP	RJB

WINDOW SAMPLE LOG

CGL

Project				HOLE No
21 - 23 Cressy Road				BH2
Job No: CG/18104	Date: 09-10-14	Ground Level (m)	Co-Ordinates (m)	
Client: CRL Asset Finance Ltd				Sheet: 1 of 1

SAMPLES & TESTS / STRATA

Depth	Type No	Test Result (N/kPa/ppm)	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Instrument /Backfill
						(0.40)	Firm dark purple brown silty gravelly clay. Gravel is subangular to subrounded fine to medium of brick and ceramic. [MADE GROUND]	
0.30	ES1					0.40		
						(0.40)	Firm light orange brown to grey silty gravelly clay. Gravel is subangular to subrounded fine of brick. [MADE GROUND]	
						0.80	0.40 - 0.40 Slight seepage	
							Firm light brown mottled grey silty CLAY. [WEATHERED LONDON CLAY FORMATION]	
1.20	D1						1.20 Claystone band	
1.20		N10						
1.50	D2							
2.00	D3							
2.00		N12						
						(3.20)		
2.50	D4							
3.00	D5							
3.00		N14						
3.50	D6							
						4.00		
4.00		N19					*(Window sample terminated at 4m)*	

Boring Progress and Water Observations

Date	Strike depth	Casing depth	Comment	Time measured	Standing Depth

General Remarks

1. Very slight groundwater seepage encountered.
2. Window sample terminated at 4.0mbgl due to time restraints
3. D = Disturbed samples; ES = environmental samples; N = SPT 'N' value.

Method/ Plant Used	Field Crew	Logged By	Checked By
Archway Competitor	Gary Wheeler Drilling Ltd	TOP	RJB

APPENDIX D

Gas monitoring records

CGL

GAS MONITORING RECORD SHEET

JOB DETAILS			
Site:	Cressy Road	Job No:	18104
Date:	21.10.14	Engineer:	TOP
Time:	12.30pm	Client	

METEOROLOGICAL & SITE INFORMATION								
State of ground:	Dry	x	Moist		Wet			
Wind:	Calm		Light		Moderate		Strong	x
Cloud cover:	None		Slight	x	Cloudy		Overcast	
Precipitation:	None	x	Slight		Moderate		Heavy	
Barometric pressure (mb):	998		Local pressure system*:	rising			Air temperature (°C):	11

Well No.	Time (s)	Flow (l/hr)	dA (PA)	O_2 (% vol. in air)	CO_2 (% vol. in air)	CH_4 (% vol. in air)	PID (ppm)	Depth to GW (mbgl)	Comments
BH1	0	0.2	0.0	20.1	0.0	0.0	0.0	1.17	2.16m to base
	15	0.1	0.0	19.8	0.0	0.0	0.0		
	30	0.0	0.0	19.8	0.0	0.0	0.0		
	45	0.0	0.0	19.8	0.0	0.0	0.0		
	60	0.1	0.0	19.7	0.0	0.0			
	90	0.0	0.0	19.7	0.0	0.0			
	120	0.0	0.0	19.7	0.0	0.0			
	150			19.7	0.0	0.0			
	180			19.7	0.0	0.0			
	240			19.6	0.0	0.0			
	300			19.6	0.0	0.0			
	0								
	15								
	30								
	45								
	60								
	90								
	120								
	150								
	180								
	240								
	300								
	0								
	15								
	30								
	45								
	60								
	90								
	120								
	150								
	180								
	240								
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	120								
	150								
	180								
	240								
	300								
	0								
	15								
	30								
	45								
	60								
	90								
	120								
	150								
	180								
	240								
	300								

Notes:

The measurement of hydrogen sulphide and hydrocarbon free product is undertaken on a site specific basis, if deemed necessary.
** With reference to the Met Office rolling weather archive for Heathrow weather station.*

APPENDIX E

Geotechnical testing results

RESULTS OF INDEX PROPERTY AND WATER CONTENT TESTS

Contract: Cressy Road, London **Report No:** T14/1408

BH No	Sample		Water Content W,%	Liquid Limit W_L,%	Plastic Limit W_P,%	Plasticity Index IP%	% Passing 425micron sieve	Corrected Plasticity Index IPc %	Clay Fraction %	Colloidal Activity A	Soil Classification	Remarks
	Depth m	Description										
1 S1	1.50	Brown clay, occasional black flecking	39.7	78	25	53	100	53			CV	
1 S3	3.50	Brown clay, occasional selenite crystals	33.9	78	28	50	100	50			CV	
1 S4	4.50	Brown clay, very occasional selenite crystals	32.5	75	29	46	100	46			CV	
1 S5	5.50	Brown clay, very occasional selenite crystals	36.4	79	29	50	100	50			CV	
1 S6	6.50	Brown clay with very occasional seams of orange-brown silt and selenite crystals	24.8	76	27	49	100	49			CV	
2 S1	1.50	Brown clay	29.3	68	25	43	100	43			CH	
2 S2	2.50	Brown clay	33.8	78	27	51	100	51			CV	
2 S3	3.50	Brown clay with grey veining	33.6	76	25	51	100	51			CV	

*Key: *Soils:* C - Clay M - Silt S - Sand O - Organic *Plasticities* L - Low I - Intermediate H - High V - Very high E - Extremely high

APPENDIX F

Chemical testing results

Sarah Key
Card Geotechnics Ltd
4 Godalming Business Centre
Woolsack Way
Godalming
Surrey
GU7 1XW

t: 01483 310600
f: 01483 527285
e: sarahk@cgl-uk.com

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 14-61349

Project / Site name:	Cressy Road	**Samples received on:**	14/10/2014
Your job number:	CG18104	**Samples instructed on:**	14/10/2014
Your order number:	1420	**Analysis completed by:**	23/10/2014
Report Issue Number:	1	**Report issued on:**	23/10/2014
Samples Analysed:	4 soil samples		

Signed: CCStone

Dr Claire Stone
Quality Manager
For & on behalf of i2 Analytical Ltd.

Signed:

Rexona Rahman
Reporting Manager
For & on behalf of i2 Analytical Ltd.

Other office located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Analytical Report Number: 14-61349

Project / Site name: Cressy Road
Your Order No: 1420

Lab Sample Number				381497	381498	381499	382158	
Sample Reference				BH1	FP1	FP2	BH2	
Sample Number				1	2	1	1	
Depth (m)				0.40	0.40	0.50	0.30	
Date Sampled				09/10/2014	09/10/2014	09/10/2014	09/10/2014	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	
Moisture Content	%	N/A	NONE	18	24	25	31	
Total mass of sample received	kg	0.001	NONE	0.51	0.53	0.57	0.50	
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	-	
General Inorganics								
pH	pH Units	N/A	MCERTS	7.1	7.4	7.2	6.8	
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	-	
Total Sulphate as SO_4	mg/kg	100	ISO 17025	490	1700	440	-	
Water Soluble Sulphate (Soil Equivalent)	g/l	0.0025	MCERTS	0.050	-	-	0.11	
Water Soluble Sulphate as SO_4 (2:1)	mg/kg	2.5	MCERTS	50	-	-	110	
Water Soluble Sulphate (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.025	-	-	0.055	
Organic Matter	%	0.1	MCERTS	3.0	3.5	1.0	-	
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	-	
Acenaphthylene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	-	
Acenaphthene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	-	
Fluorene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	-	
Phenanthrene	mg/kg	0.1	MCERTS	0.59	< 0.10	0.30	-	
Anthracene	mg/kg	0.1	MCERTS	0.15	< 0.10	< 0.10	-	
Fluoranthene	mg/kg	0.1	MCERTS	1.4	< 0.10	0.70	-	
Pyrene	mg/kg	0.1	MCERTS	1.1	< 0.10	0.62	-	
Benzo(a)anthracene	mg/kg	0.1	MCERTS	0.74	< 0.10	0.48	-	
Chrysene	mg/kg	0.05	MCERTS	0.71	< 0.05	0.40	-	
Benzo(b)fluoranthene	mg/kg	0.1	MCERTS	0.77	< 0.10	0.48	-	
Benzo(k)fluoranthene	mg/kg	0.1	MCERTS	0.49	< 0.10	0.25	-	
Benzo(a)pyrene	mg/kg	0.1	MCERTS	0.72	< 0.10	0.39	-	
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	MCERTS	0.36	< 0.10	0.20	-	
Dibenz(a,h)anthracene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	-	
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.40	< 0.05	0.30	-	
Coronene	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05	-	
Total PAH								
Total WAC-17 PAHs	mg/kg	1.6	NONE	7.4	< 1.6	4.1	-	
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	14	19	18	-	
Barium (aqua regia extractable)	mg/kg	1	MCERTS	88	140	130	-	
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	1.2	1.7	1.5	-	
Boron (water soluble)	mg/kg	0.2	MCERTS	0.6	3.3	0.3	-	
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	-	
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	< 1.2	< 1.2	-	
Chromium (III)	mg/kg	1	NONE	70	38	53	-	
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	70	38	53	-	
Copper (aqua regia extractable)	mg/kg	1	MCERTS	47	73	29	-	
Lead (aqua regia extractable)	mg/kg	1	MCERTS	230	210	45	-	
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	0.5	0.4	< 0.3	-	
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	33	22	43	-	
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	67	80	76	-	
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	82	90	69	-	

Analytical Report Number: 14-61349

Project / Site name: Cressy Road
Your Order No: 1420

Lab Sample Number				381497	381498	381499	382158	
Sample Reference				BH1	FP1	FP2	BH2	
Sample Number				1	2	1	1	
Depth (m)				0.40	0.40	0.50	0.30	
Date Sampled				09/10/2014	09/10/2014	09/10/2014	09/10/2014	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Monoaromatics								
Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	
p & m-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	
o-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	-	
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	-	
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	-	
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	-	
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	-	
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	-	
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	< 10	< 10	-	

TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	-	
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	-	
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	-	
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	-	
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10	< 10	< 10	-	
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	< 10	< 10	< 10	-	
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	< 10	< 10	-	

Analytical Report Number : 14-61349

Project / Site name: Cressy Road

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and topsoil/loam soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 2 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
381497	BH1	1	0.40	Brown clay and topsoil with gravel.
381498	FP1	2	0.40	Brown clay and topsoil.
381499	FP2	1	0.50	Light brown clay and sand.
382158	BH2	1	0.30	Brown clay and topsoil with vegetation.

Analytical Report Number : 14-61349

Project / Site name: Cressy Road

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
BTEX and MTBE in soil	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073S-PL	W	MCERTS
chromium III in soil	In-house method by calculation from total Cr and Cr VI.	In-house method	L068-PL	D	NONE
Hexavalent chromium in soil (Lower Level)	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	D	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Organic matter in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L023-PL	D	MCERTS
pH in soil	Determination of pH in soil by addition of water followed by electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L005-PL	W	MCERTS
Speciated WAC-17 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Stones not passing through a 10 mm sieve is determined gravimetrically and reported as a percentage of the dry weight. Sample results are not corrected for the stone content of the sample.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil	Determination of water soluble sulphate by extraction with water followed by ICP-OES. Results reported corrected for extraction ratio (soil equivalent) as g/l and mg/kg; and upon the 2:1 leachate (g/l)	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	ISO 17025
TPHCWG (Soil)	Determination of pentane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method	L076-PL	W	MCERTS

Analytical Report Number : 14-61349

Project / Site name: Cressy Road

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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Analytical Report Number : 14-61475

Project / Site name:	Cressy Road	**Samples received on:**	16/10/2014
Your job number:	CG/18104	**Samples instructed on:**	16/10/2014
Your order number:	1420	**Analysis completed by:**	27/10/2014
Report Issue Number:	1	**Report issued on:**	27/10/2014
Samples Analysed:	3 soil samples		

Signed:

Dr Claire Stone
Quality Manager
For & on behalf of i2 Analytical Ltd.

Signed:

Rexona Rahman
Reporting Manager
For & on behalf of i2 Analytical Ltd.

Other office located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Analytical Report Number: 14-61475

Project / Site name: Cressy Road
Your Order No: 1420

Lab Sample Number				382378	382379	382380		
Sample Reference				BH1	BH1	BH2		
Sample Number				SPT1	SPT6	SPT3		
Depth (m)				1.20	6.00	3.00		
Date Sampled				09/10/2014	09/10/2014	09/10/2014		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1		
Moisture Content	%	N/A	NONE	22	17	20		
Total mass of sample received	kg	0.001	NONE	0.37	0.35	0.51		
General Inorganics								
pH	pH Units	N/A	MCERTS	7.7	7.2	7.3		
Water Soluble Sulphate (Soil Equivalent)	g/l	0.0025	MCERTS	0.65	3.5	6.4		
Water Soluble Sulphate as SO_4 (2:1)	mg/kg	2.5	MCERTS	650	3500	6400		
Water Soluble Sulphate (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.32	1.8	3.2		
Heavy Metals / Metalloids								
Magnesium (water soluble)	mg/kg	5	NONE	-	550	890		

Analytical Report Number : 14-61475

Project / Site name: Cressy Road

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and topsoil/loam soil types. Data for unaccredited types of solid should be interpreted with care.
Stone content of a sample is calculated as the % weight of the stones not passing a 2 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
382378	BH1	SPT1	1.20	Light brown clay.
382379	BH1	SPT6	6.00	Light brown clay.
382380	BH2	SPT3	3.00	Light brown clay.

Analytical Report Number : 14-61475

Project / Site name: Cressy Road

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Magnesium, water soluble, in soil	Determination of water soluble magnesium by extraction with water followed by ICP-OES.	In-house method based on TRL 447	L038-UK	D	NONE
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
pH in soil	Determination of pH in soil by addition of water followed by electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L005-PL	W	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Stones not passing through a 10 mm sieve is determined gravimetrically and reported as a percentage of the dry weight. Sample results are not corrected for the stone content of the sample.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil	Determination of water soluble sulphate by extraction with water followed by ICP-OES. Results reported corrected for extraction ratio (soil equivalent) as g/l and mg/kg; and upon the 2:1 leachate (g/l).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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Analytical Report Number : 14-61475

Replaces Analytical Report Number : 14-61475, issue no. 1

Project / Site name:	Cressy Road	**Samples received on:**	16/10/2014
Your job number:	CG/18104	**Samples instructed on:**	16/10/2014
Your order number:	1420	**Analysis completed by:**	03/11/2014
Report Issue Number:	2	**Report issued on:**	03/11/2014
Samples Analysed:	3 soil samples		

Signed: CStone

Dr Claire Stone
Quality Manager
For & on behalf of i2 Analytical Ltd.

Signed:

Rexona Rahman
Reporting Manager
For & on behalf of i2 Analytical Ltd.

Other office located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Analytical Report Number: 14-61475

Project / Site name: Cressy Road
Your Order No: 1420

Lab Sample Number				382378	382379	382380		
Sample Reference				BH1	BH1	BH2		
Sample Number				SPT1	SPT6	SPT3		
Depth (m)				1.20	6.00	3.00		
Date Sampled				09/10/2014	09/10/2014	09/10/2014		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1		
Moisture Content	%	N/A	NONE	22	17	20		
Total mass of sample received	kg	0.001	NONE	0.37	0.35	0.51		

General Inorganics

pH	pH Units	N/A	MCERTS	7.7	7.2	7.3		
Total Sulphate as SO_4	mg/kg	50	ISO 17025	810	4300	21000		
Water Soluble Sulphate (Soil Equivalent)	g/l	0.0025	MCERTS	0.65	3.5	6.4		
Water Soluble Sulphate as SO_4 (2:1)	mg/kg	2.5	MCERTS	650	3500	6400		
Water Soluble Sulphate (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.32	1.8	3.2		
Total Sulphur	mg/kg	50	NONE	360	1600	8100		

Heavy Metals / Metalloids

Magnesium (water soluble)	mg/kg	5	NONE	-	550	890		

Analytical Report Number : 14-61475

Project / Site name: Cressy Road

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation.
The laboratory is accredited for sand, clay and topsoil/loam soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
382378	BH1	SPT1	1.20	Light brown clay.
382379	BH1	SPT6	6.00	Light brown clay.
382380	BH2	SPT3	3.00	Light brown clay.

Analytical Report Number : 14-61475

Project / Site name: Cressy Road

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Magnesium, water soluble, in soil	Determination of water soluble magnesium by extraction with water followed by ICP-OES.	In-house method based on TRL 447	L038-UK	D	NONE
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
pH in soil	Determination of pH in soil by addition of water followed by electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L005-PL	W	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Stones not passing through a 10 mm sieve is determined gravimetrically and reported as a percentage of the dry weight. Sample results are not corrected for the stone content of the sample.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil	Determination of water soluble sulphate by extraction with water followed by ICP-OES. Results reported corrected for extraction ratio (soil equivalent) as g/l and mg/kg; and upon the 2:1 leachate (g/l)	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	ISO 17025
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, and MEWAM 2006 Methods for the Determination of Metals in Soil	L038-PL	D	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

APPENDIX G

Soil Assessment

Contaminant	SGV or GAC @ 2.5% SOM for Residential (with plant uptake) land-use (mg/kg)	Notes on soil saturation limits (SSL)[1]	Measured range (mg/kg)	Max value > Assessment Criteria? (Y/N)
SOM (%)	*[2]		1 – 3.5	*
Arsenic	32[3]	-	14 – 19	N
Cadmium	10[3]	-	< 0.2	N
Chromium (total)	37	-	38 – 70	Y
Chromium (III)	1,100	-	38 – 70	N
Chromium (VI)	3.0	-	< 1.2	N
Lead	200	-	45 – 230	Y
Mercury (inorganic)	170[3]	-	< 0.3 – 0.5	N
Selenium	350[3]	-	< 1	N
Boron	*		0.3 – 3.3	N
Copper	3,700	-	29 – 73	N
Nickel	130[3]	-	22 – 43	N
Zinc	18,000	-	69 – 90	N
Barium	*		88 – 140	N
Beryllium	23	-	1.2 – 1.7	N
Vanadium	130	-	67 – 80	N
Phenols[4]	290[3]	-	< 1	N
Cyanide	*		< 1	N
BTEX compounds				
Benzene	0.16	-	< 1	N
Toluene	270	-	< 1	N
Ethyl benzene	150	-	< 1	N
m-xylene6	100	-	< 1	N
o-xylene6	110	-	< 1	N
p-xylene6	98	-	< 1	N
Total Petroleum Hydrocarbons (TPH)				
TPH aliphatic EC5-6	41	-	< 0.1	N
TPH aliphatic EC>6-8	100	-	< 0.1	N
TPH aliphatic EC>8-10	25	-	< 0.1	N
TPH aliphatic EC>10-12	420	(b)	< 1	N
TPH aliphatic EC>12-16	4,300	(b)	< 2	N
TPH aliphatic EC>16-35	88,000	(b)	< 8	N
TPH aromatic EC5-7	0.16	-	< 0.1	N

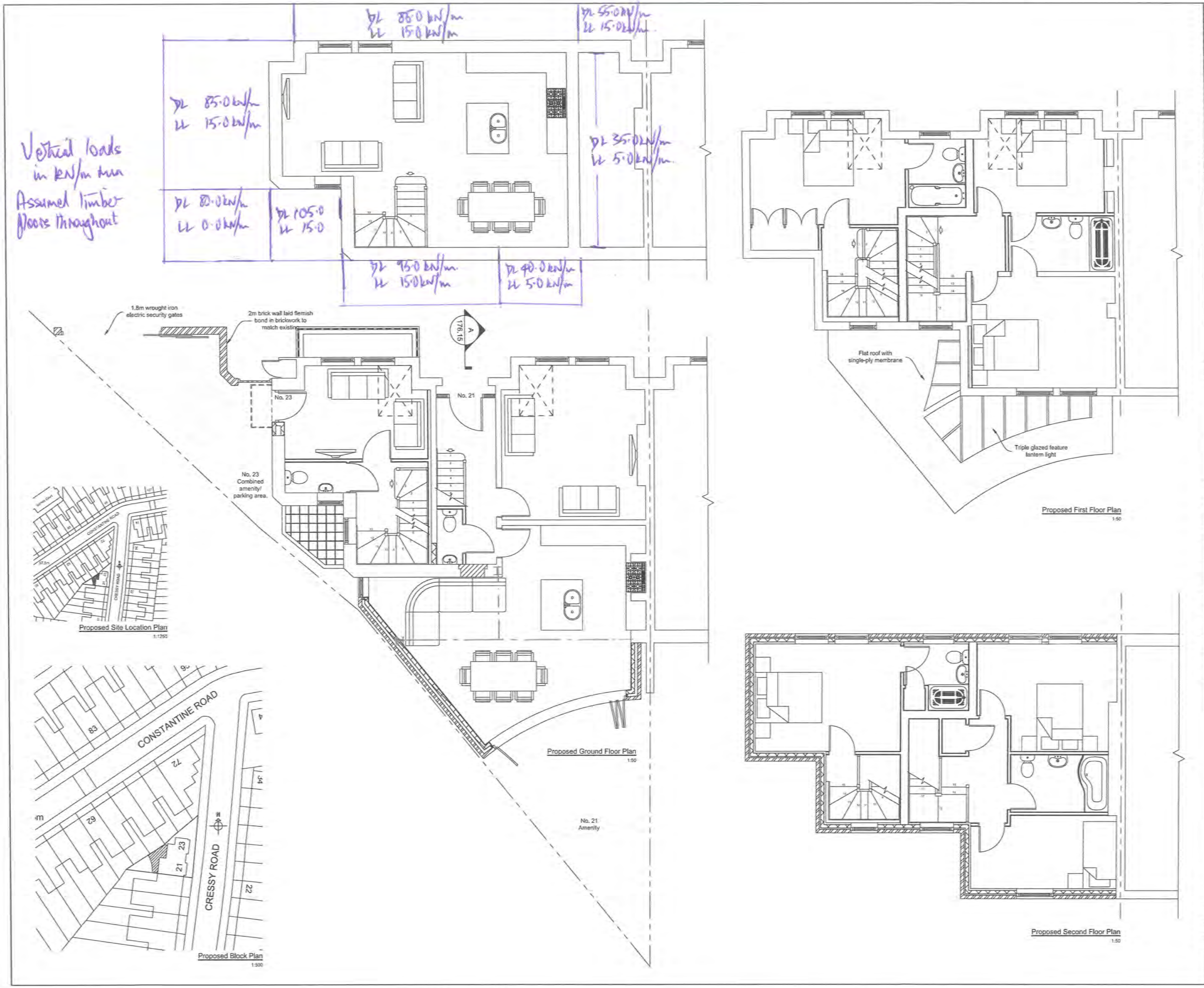
Contaminant	SGV or GAC @ 2.5% SOM for Residential (with plant uptake) land-use (mg/kg)	Notes on soil saturation limits (SSL)[1]	Measured range (mg/kg)	Max value > Assessment Criteria? (Y/N)
TPH aromatic EC>7-8	270	-	< 0.1	N
TPH aromatic EC>8-10	37	-	< 0.1	N
TPH aromatic EC>10-12	130	-	< 1	N
TPH aromatic EC>12-16	290	-	< 2	N
TPH aromatic EC>16-21	490 [150]	(a)	< 10	N
TPH aromatic EC>21-35	1,100 [12]	(a)	< 10	N
Polycyclic Aromatic Hydrocarbons (PAH)				
Acenaphthene	1,200	(b)	< 0.10	N
Anthracene	13,000 [19]	(a)	< 0.1 - 0.15	N
Benzo(a)anthracene	13 [4.3]	(a)	< 0.1 - 0.74	N
Benzo(a)pyrene	2.4 [2.3]	(a)	< 0.1 – 0.72	N
Benzo(b)fluoranthene	23 [3.0]	(a)	< 0.1 – 0.77	N
Benzo(g,h,i)perylene	240 [0.05]	(a)	< 0.05 – 0.4	N
Benzo(k)fluoranthene	24 [1.7]	(a)	< 0.1 – 0.49	N
Chrysene	200 [1.1]	(a)	< 0.05 – 0.71	N
Dibenzo(a,h)anthracene	2.3 [0.01]	(a)	< 0.1	N
Fluoranthene	1,500 [47]	(a)	< 0.1 – 1.4	N
Fluorene	1,200 [381]	(a)	< 0.1	N
Indeno(1,2,3-cd)pyrene	23 [0.15]	(a)	< 0.1 – 0.36	N
Naphthalene	3.7	-	< 0.05	N
Pyrene	1,000 [5.5]	(a)	< 0.1 – 1.1	N

Notes:

1. - = green; (a) = amber i.e. GAC set to model output, [SSL provided in square brackets] ; (b) = red i.e. SSL exceeded & considered to affect interpretation. GAC calculated in accordance with the CLEA Software Handbook ; (c) = based on direct contact; (d) GAC limited to SSL.
2. * = no value currently defined
3. Based on published Soil Guideline Value (Environment Agency, 2009), adjusted for 2.5% SOM
4. GAC relates to Phenol (C_6H_5OH) only.
5. Based on the published SGVs for BTEX at 6% SOM (Environment Agency, 2009), adjusted for 2.5% SOM
6. Concentrations for total xylenes should be compared to the value for m-xylene for fresh spills and to o-xylene for all other cases.
7. Published C4SL for lead (DEFRA, 2014)

APPENDIX H

Structural line loads



The builder/contractor is to check the plan and all dimensions on site at quotation stage and before commencement of work. Any errors, omissions or design changes required should be reported immediately to enable amended plans to be submitted to the Local Authority. All work shown on the plans, or any deviations from the design or materials specified, should comply with current building regulations, planning requirements, British Standards and Codes of Practice. The client should check any matters regarding title of the land and that work shown on the plan does not contravene or affect covenants or encroach on any boundaries, unless agreed. Procedures relating to The Party Wall Act are to be followed where appropriate. Works that commence before local authority approval has been obtained are under-taken solely at the owners/builders risk.

Revision notes

Rev A:

Scale bars

1m
1:20

1m 2m 3m
1:50

2m 4m 6m
1:100

Client

CRL Asset Finance Ltd.
Mr C Lay

Site Address

21 & 23 Cressy Road
Hampstead
London
NW3 2NB

Project

Re-development, extensions & alterations.

Drawing title

Proposed Floor Plans, Site Location & Block Plans.

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www.rossermorris.co.uk

Drawings prepared for:
Planning permission and building regulations
◊ New builds ◊ Extensions ◊ Alterations
◊ Loft conversions ◊ Structural calculations
◊Domestic and commercial.

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RICS

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