Basement Impact Assessment

at
28 Charlotte Street, Camden, London W1T 2NF

for
Mr Matteo Caraccia c/o Rodrigues Associates

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This is not a valid document for use in the design of the project unless it is titled Final in the document status box.

Current regulations and good practice were used in the preparation of this report. The recommendations given in this report must be reviewed by an appropriately qualified person at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

Commission

Soils Limited was commissioned by Rodrigues Associates on behalf of Mr Matteo Caraccia to undertake a Basement Impact Assessment on land at 28 Charlotte Street, London W1T 2NF. The scope of the investigation was outlined in the Soils Limited quotation reference Q23607, dated 5th November 2020.

This document comprises the Basement Impact Assessment (BIA) and incorporates the results, discussion and conclusions to this intrusive works.

This BIA report must be read in conjunction with the Basement Impact Assessment undertaken on the above site by Chelmer Consultancy Services for a different proposed scheme, report ref. BIA/6262, dated April 2016, on which Soils Limited assumed full reliance. In the following sections of this report, where required, Chelmer Consultancy Services will be identified simply as Chelmer.

The site investigation and laboratory testing undertaken by Chelmer for the production of their Basement Impact Assessment with report ref. BIA/6262, dated April 2016 and on which Soils Limited assumed full reliance responded to the standards, codes of practice, UKAS and MCERTS accredited test methods thereby specifically presented. Soils Limited does not accept any liability for activities, testing and studies not directly under their control and responsibility.

No Preliminary Investigation Reports, contamination laboratory tests or Conceptual Site Model (CSM) were undertaken at the site by Soils Limited, as this did not form part of the Client's brief at this stage.

Limitations and Disclaimers

This Basement Impact Assessment relates to the site located at 28 Charlotte Street, London W1T 2NF and was prepared for the sole benefit of Mr Matteo Caraccia (The "Client"). The report was prepared solely for the brief described in Section 1.1 of this report.

The contents, recommendations and advice given in the report are subject to the Terms and Conditions given in Quotation Q23607, dated 5th November 2020.

Soils Limited disclaims any responsibility to the Client and others in respect of any matters outside the scope of the above.

This report has been prepared by Soils Limited, with all reasonable skill, care and diligence within the terms of the Contract with the Client, incorporation of our General Conditions of Contract of Business and taking into account the resources devoted to us by agreement with the Client.

The report is personal and confidential to the Client and Soils Limited accept no responsibility of whatever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report wholly at its own risk.

The Client may not assign the benefit of the report or any part to any third party without the written consent of Soils Limited.

The ground is a product of continuing natural and artificial processes. As a result, the ground will exhibit a variety of characteristics that vary from place to place across a site, and also with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The investigation, interpretations, and recommendations given in this report were prepared for the sole benefit of the Client in accordance with their brief. As such these do not necessarily address all aspects of ground behaviour at the site.

Current regulations and good practice were used in the preparation of this report. An appropriately qualified and competent person must review the recommendations given in this report at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

If the term “competent person” is used in this report or any Soils Limited document, it means an engineering geologist or civil engineer with a minimum of three years post graduate experience in the understanding and application of the appropriate codes of practice.

Unless the site investigation works have been designed and specified in accordance with EC7, this report is a Geotechnical Investigation Report and is not necessarily a Ground Investigation Report as defined by EC7 (Eurocode 7 Part 1, §3.4, Part 2, §6.1) or a Geotechnical Design Report (Eurocode 7 Part 1, §2.8) as defined by Eurocode 7 and as such may not characterise the ground conditions and additional works may be required to comply with the requirements of EC7.

Within the report reference to ground level relates to the site level at the time of the investigation, unless otherwise stated.

Exploratory hole is a generic term used to describe a method of direct investigation. The term trial pit, borehole or window sample borehole implies the specific technique used to produce an exploratory hole.

The depth to roots and/or of desiccation may vary from that found during the investigation. The Client is responsible for establishing the depth to roots and/or of desiccation on a plot by plot basis prior to the construction of foundations. Supplied site surveys may not include substantial shrubs or bushes and is also unlikely to have data or any trees, bushes or shrubs removed prior to or following the site survey.

Where trees are mentioned in the text this means existing trees, substantial bushes or shrubs, recently removed trees (approximately 20 years to full recovery on cohesive soils) and those planned as part of the site landscaping).

The geotechnical laboratory testing directly commissioned by Soils Limited was performed by GEO Site & Testing Services Ltd (GSTL) in accordance with the methods given in BS 1377:1990 Parts 1 to 8 and their UKAS accredited test methods.

For the preparation of this report, the relevant BS code of practice was adopted for the geotechnical laboratory testing technical specifications, in the absence of the relevant Eurocode specifications (ref: ISO TS 17892).

The chemical analyses referring to the site investigation carried out by Soils Limited were undertaken by Derwentside Environmental Testing Services (DETS) in accordance with their UKAS and MCERTS accredited test methods or their documented in-house testing procedures. This investigation did not comprise an environmental audit of the site or its environs.

Ownership of land brings with it onerous legal liabilities in respect of harm to the environment. “Contaminated Land” is defined in Section 57 of the Environment Act 1995 (as updated 2021) as:

“Land which is in such a condition by reason of substances in, on or under the land that significant harm is being caused or that there is a significant possibility of such harm being caused or that pollution of controlled waters is being, or is likely to be caused”.

It must be noted that a detailed survey of the possible presence or absence of invasive species, such as Japanese Knotweed, is outside of the scope of investigation.

Deleterious materials may be present in any Made Ground that pose a potential risk to site workers, end users and adjacent vulnerable receptors. These could include a range of contaminants, including asbestos, especially if the material includes large fractions of demolition derived materials.

The investigation, analysis or recommendations in respect of contamination are made solely in respect of the prevention of harm to vulnerable receptors, using where possible best practice at the date of preparation of the report. The investigation and report do not address, define or make recommendations in respect of environmental liabilities. A separate environmental audit and liaison with statutory authorities is required to address these issues.

All environmental works are undertaken in the context of, and in compliance with, BS10175+A2 2017 and LCRM (EA 2021) and all other pertinent planning, standards, documentation and guidance appropriate to the site at the time of production which may include, but are not necessarily limited to, documents provided by BS/CEN/ISO, NHBC, AGS, CIEH, CIRIA, SoBRA and CLAIRE.

Sources of Information

The primary sources of information used within this report are:

1. Basement Impact Assessment, report ref. BIA/6262 dated April 2016, prepared by Chelmer Consultancy Services (Appendix E);
2. British Geological Survey, GeoIndex Website (accessed October 2022);
3. Ordnance Survey (OS) historic maps (Appendix B);
4. EA Website (accessed October 2022);
5. Defra Magic Map (accessed October 2022);
6. Google Earth™ (accessed October 2022);
7. The Lost Rivers of London, Historical Publications Ltd, 1992, N Barton;
8. National Library of Scotland (accessed October 2022);
9. LB Camden, Strategic Flood Risk Assessment (SFRA) (produced by URS, 2014);
10. LB Camden, Surface Water management Plan (2011);
11. LB Camden, Planning Guidance (CPG) – Basements (March 2018);
12. LB Camden, Camden Geological, Hydrogeological and Hydrological Study (GHHS) – Guidance for Subterranean Development (produced by Arup, 2010);
13. LB Camden, Local Plan Policy A5 Basements (2017).

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Non-Technical Summary

The site was located at 28 Charlotte Street, London W1T 2NF and had an approximate O.S Land Ranger Grid Reference of TQ 29495 81657.

The site comprised a six-storey, mid-terraced house (Grade II Listed) with an existing basement to the front and single storey rear extension. The proposal comprised the construction of a basement under the rear extension using an independent structure within the perimeter of the existing very deep brick foundations.

This BIA comprised the following elements:

- Desk Study;
- Screening;
- Scoping;
- Site investigation, monitoring and interpretation;
- Ground movement assessment;
- Damage category assessment;
- Impact assessment;
- Conclusions and recommendations.

The Desk Study reviewed desk-based sources, providing information to aid evaluation of the screening questions. This included site history, anticipated geology, topography, hydrogeology, hydrology, drainage, flood risk and other sources of information.

The screening stage reviewed a series of questions regarding issues on groundwater flow, land stability and surface flow and flooding and related flowcharts, to clarify whether a full BIA was required for the development.

The scoping stage addressed each of the issues that arose from the screening process, providing assessment methodology and wider discussion on how the impacts may be mitigated.

The site investigation comprised two separate phases. The first phase was undertaken by Chelmer Consultancy Services in January 2016 and represents the main investigation for the definition of ground conditions and groundwater regime. Soils Limited assumed full reliance on it. The second phase, undertaken by Soils Limited in December 2020, considered the digging of additional deep trial pits for foundation exposure purposes.

The ground conditions were established to be very deep Made Ground overlying the predominantly granular superficial soils of the Lynch Hill Gravel Member and the cohesive bedrock of the London Clay Formation in stratigraphical succession.

Groundwater was encountered during the drilling of the boreholes and the monitoring done by Chelmer at depths greater than the proposed basement formation level, within the Made Ground.

The established ground and groundwater conditions were compared against published data and geotechnical parameters determined for the ground movement assessment.

The geometry and proposed loads provided by the Clients consultants were used to calculate the ground movements that may result from the construction of the basement and to assess how these may affect the conditions of neighbouring buildings.

It must be noted that the term below ground level (bgl) within this and subsequent sections of this report, dealing with the works undertaken by Soils Limited during this phase of the investigation, relates to the floor level within the house and not within the basement level of the house.

OASYS Limited PDISP (Pressure induced DISPlacement analysis) analysis software was used to calculate vertical ground movements arisings from basement excavation, and WALLAP by Geosolve to calculate lateral ground movements from retaining wall lateral deflection.

The ground movements were then used to establish the damage category based on the Burland Scale. The critical scenario CS1 presented in Figure 30 was modelled, with damage category calculated as very slight. The damage category was considered acceptable based on the guidance from LB Camden.

The proposed basement would not impact the groundwater flow regime, with the groundwater level below the basement. The SFRA from LB Camden showed the site to be not at risk of slope instability.

The cumulative effects on the groundwater regime due to the ascertained presence of multiple basements of similar construction to the proposed basement, within the environs of the site, were considered to have limited effect on the groundwater regime.

The proposed basement was considered to have limited impact on neighbouring properties, groundwater flow, slope stability or surface water flow or flooding.

Section 1 Introduction

1.1 Scope

Soils Limited was commissioned by Rodrigues Associates on behalf of Mr Matteo Caraccia to undertake a Basement Impact Assessment (BIA). The objective of this investigation was to establish the impact and risk of the proposed basement at 28 Charlotte Street, London W1T 2NF.

The report provides details on the ground and groundwater conditions on-site and presents calculations to determine the potential impact of the proposed development on neighbouring properties. In addition, the report provides a qualitative risk assessment of the potential impacts the proposed development might have on groundwater levels, surface water flows and flooding.

It Is recognised that any Basement Impact Assessment Is a live document and that further detailed assessments will be ongoing, if appropriate, as the design and construction progresses.

It must be noted that the term below ground level (bgl) within this and subsequent sections of this report, dealing with the works undertaken by Soils Limited during this phase of the investigation, relates to the floor level within the house and not within the basement level of the house.

No Preliminary Investigation Reports, contamination laboratory tests or Conceptual Site Model (CSM) were undertaken at the site by Soils Limited, as this did not form part of the Client’s brief at this stage.

1.2 Location

The site was located at 28 Charlotte Street, London W1T 2NF, had an approximate O.S Land Ranger Grid Reference of TQ 29495 81657 and fell within the administrative boundaries of the London Borough of Camden (LBC).

The site location plan is given in Figure 1.

1.3 Site Description

The property at 28 Charlotte Street was a six-storey, mid-terraced, brick-built house with a single storey basement just under the front portion. The basement floor level was identified at an elevation of 7.91m above an arbitrary site datum (ASD) using drawings prepared by the Client’s engineer, corresponding to circa 2.10m below the ground level to the front of the property at Charlotte Street. Basement formation, therefore, was estimated at circa 2.60m below ground level. The site was set into a highly urbanised area with predominant hard landscaping. Vegetation was scarce to the front of the house, with just a few mature trees set into the pavements at Charlotte Street at >15m from the house. The vegetation was dense to the rear of the property within the area of Crabtree Fields playground and included mature trees. The site was bounded to the west by Charlotte Street, to the north and south by the adjoining houses at 30 and 26 Charlotte Street respectively and to the east by the Crabtree Fields playground and the development at Nos. 7-15 Whitfield Street.

An aerial photograph has been included in Figure 2.

1.4 Proposed Development

The drawings provided by the Client's engineer showed the proposed development to comprise the construction of a basement extension to the rear of the property within the footprint of the existing building. The proposed rear basement floor level was identified at an elevation of 7.03m ASD, with formation level evaluated at circa 3.50m below ground level, corresponding to approximately 0.90m below the one of the existing basement.

In compiling this report reliance was placed on drawings number 28CS(00)A00 to 28CS(00)A06, 28CS(10)A01 to 28CS(10)A06 and 28CS(20)A01 to 28CS(20)A06, all prepared by Studio Stassano and dated October 2022. Any change or deviation from the scheme outlined in the drawing could invalidate the foundation design and remediation recommendations presented within this report. Soils Limited must be notified about any such changes.

Development plans provided by the client are presented in Appendix E.

Section 2 Desk Study

2.1 Site History

A review of site history was carried out using the OS maps available on the National Library of Scotland website and Google Earth™ (GE).

The age of the property was determined to be pre-1868 and this was also confirmed by the information provided in the BIA report produced by Chelmer. A summary of pertinent information from the available OS maps and aerial photography is provided in Table 2.1.

Table 2.1 Site History

Map	Description
OS 1868 – 1873	The area was fully developed, but the map resolution was insufficient to describe site conditions at that time.
OS 1893-1895	
OS 1913-1914	
OS 1938	
Aerial 1999-2022 (GE)	No significant changes from the current status.

2.2 Topography

Onsite topography was flat and level. The offsite topography sloped downwards very gently in a south-easterly direction towards the River Thames. The slope angle was estimated as <1° using levelling data from Google Earth™ (GE). This was also confirmed by the report prepared by Chelmer, which considered the slope angle as circa 0.2°. In addition, Chelmer reported that the site was at an elevation of 27.4m Above Ordnance Datum (AOD).

2.3 Published Geological Data

The 1:50,000 BGS map showed the site to be located upon the bedrock London Clay Formation with anticipated overlying superficial deposits of the Lynch Hill Gravel Member.

No infilled ground, reworked ground or thick Made Ground was anticipated at the site by the BGS and the Camden Geological, Hydrogeological and Hydrological Study (GHHS) prepared by Arup. Geological data were presented on Figure 3 to Figure 6.

2.3.1 Lynch Hill Gravel Member

The rivers of the south-east of England, including the River Thames and its tributaries, have been subject to at least three changes of level since Pleistocene times. One result has been the formation of a complex series of River Terrace Gravels. These terraces represent ancient floodplain deposits that became isolated as the river cut downwards to lower levels.

The Lynch Hill Gravel approximates to the third level terrace gravel. The composition of the River Terrace Gravel varies greatly, depending on the source material available in the river's catchment. Deposits generally consist of sand and gravel of roughly bedded flint or chert gravel commonly in a matrix of silt and clay.

2.3.2 London Clay Formation

The London Clay Formation comprises stiff grey fissured clay, weathering to brown near surface. Concretions of argillaceous limestone in nodular form (Claystones) occur throughout the formation. Crystals of gypsum (Selenite) are often found within the weathered part of the London Clay, and precautions against sulphate attack to concrete are sometimes required.

The upper boundary member of the London Clay Formation is known as the Claygate Member and marks the transition between the deep water, predominantly clay environment and succeeding shallow-water, sand environment of the Bagshot Formation.

The lower boundary is generally marked by a thin bed of well-rounded flint gravel and/or a glauconitic horizon. The formation overlies the Harwich Formation or where the Harwich Formation is absent the Lambeth Group.

In the north London area the upper part of the London Clay Formation has been disturbed by periglacial action and may contain pockets of sand and gravel.

2.4 Web-Published Geology

A review of historic boreholes within 100m from the site was undertaken to provide information on the expected soil stratigraphy (BGS Ref. TQ28SE1043, TQ28SE1044, TQ28SE141, TQ28SE1553, TQ28SE884, TQ28SE885 and TQ28SE1648). Borehole logs suggest the following sequence and final depth of strata.

Made Ground/Superficial Deposits: 5.8m to 9.9m

London Clay Formation: >15.0m to 25.6m

Lambeth Group: >121.9m

2.4.1 Groundwater

Based on information from the BGS boreholes within 100m from the site, groundwater was recorded at depths ranging between 2.6m and 36.6m bgl, respectively within the soils of the Lynch Hill Gravel Member and of the Lambeth Group.

2.5 Neighbouring Properties

The site was adjoined to the north and south by the similar terraced properties at 30 and 26 Charlotte Street. A search was done on the Council's planning portal and showed that both the properties had existing basements underneath of similar characteristics and depth to the existing one at 28 Charlotte Street.

The rear of the building at 28 Charlotte Street also adjoined, to the south and east, the lower ground floor of the properties at 7-15 Whitfield Street, the depth of which exceeded the one of the propose basement.

Depending on the characteristics of the local area, the presence of further basements under the terrace and the neighbouring buildings is highly likely.

2.6 Listed Buildings and Structures

No. 28 and the adjoining No. 26 Charlotte Street were both classified as Grade II listed buildings. The next nearest listed buildings are Nos. 14, 15 and 16 Colville Place located >10m north-west of the site. Further Grade II listed buildings were located at Nos. 7 and 8 Windmill Street at >50m to the south-east, while 2No. lamps at 15-17 Charlotte Street were Grade II listed and located at circa 40m to the south.

A map of listed building from Hist”ric ’ngland was presented on Figure 7.

2.7 Hydrology

The nearest surface water features were the Boating Lake at Regents Park ~1300m to north-west at an elevation of circa 30m AOD, followed by the River Thames ~1500m to south-east at an elevation of circa 2m AOD, as reported in the Camden Geological, Hydrogeological and Hydrological Study (GHHS) and presented in Figure 8.

Two tributaries of the Fleet, a lost river of London, were estimated respectively at ~600m to the north and ~750m to the east, as reported by the book Lost Rivers of London (N. Barton). An extract of the Lost Rivers Of London map, also part of the GHHS, is presented in Figure 9.

A culverted watercourse, linking the Highgate Chain of Ponds to the River Thames was estimated at circa 850m to the east, as showed on Figure 10. The site was outside the Hampstead Heath Chain Catchment (GHHS, Figure 11).

Based on the Environmental Agency (EA) online catchment data explorer the site was within the London surface water management catchment area, but outside any operational catchment areas. The nearest operational catchment was Lee Lower Rivers and Lakes, circa 4700m to north-east.

Additional checks were also done using the Groundsure data presented in the Basement Impact Assessment produced by Chelmer. The data showed that there were no surface water features within 250m, detailed river networks within 500m or information on river quality within 1500m from the study site and this agrees with Soils Limited's findings.

2.8 Hydrogeology

The Environment Agency 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 water bodies and wetland ecosystems.

The London groundwater model was generally split into three aquifers, the Upper, Intermediate and Lower Aquifer.

- The Upper Aquifer comprises groundwater within the superficial River Terrace Deposits and granular deposits (including Bagshot Formation, which overly the London Clay Formation. The underlying London Clay Formation acts as an aquiclude to the underlying Intermediate and Lower Aquifers.
- The Intermediate Aquifer was generally associated with granular layers within the Lambeth Group.
- The Lower Aquifer was principally associated with the Chalk but can include the overlying Thanet Formation.

The superficial deposits of the River Terrace Deposits were anticipated at the site in the form of Lynch Hill Gravel Member overlaying the London Clay Formation. The predominantly granular soils of the Lynch Hill Gravel Member were generally permeable and classified by the Environment Agency as a Secondary A Aquifer.

Shallow groundwater could be present within the Lynch Hill Gravel Member. Any water infiltrating the underlying cohesive London Clay Formation will generally tend to flow either with the topography or vertically downwards at a very slow rate towards the Intermediate and subsequently Lower Aquifer. Data for the London Clay Formation indicates horizontal permeability of between 10^{-7} m/s close to the surface increasing to 10^{-10} m/s at depth.

The site was not within a source protection zone, as presented In Figure 12. Groundwater was anticipated to be flowing in a south easterly direction in alignment with the immediate surrounding land.

2.9 Drainage

The proposed development comprised the construction of a basement to the rear of the property and of the existing one, without exceeding the footprint of the existing building. The site area was expected to be impermeable. No surface water drainage, especially based on infiltration, was part of the proposal and no changes to the existing drainage were anticipated by the Client's engineer.

The site was anticipated to be underlain by bedrock of the London Clay Formation, with overlying superficial deposits of the Lynch Hill Gravel Member.

The drainage of surface water into the ground would depend on the exact ground conditions encountered. The Lynch Hill Gravel Member is classified as a Secondary A Aquifer and expected to be predominantly granular, with localised clay beds. Surface water was expected to penetrate any overlying Made Ground/Topsoil, into the Lynch Hill Gravel Member permeating down to any cohesive beds where it will then flow in alignment with the topography.

2.10 Flood Risk

The risk of flooding was assessed taking account of the information available from the EA flood maps, LB Camden SFRA, SWMP and Local Plan.

The site was situated in Flood Zone 1, an area with an overall low probability of flooding from rivers and seas. The EA and SFRA showed the site to have a very low risk from surface water flooding.

The Environment Agency (EA) considered the site to be located in an area not at risk of flooding from breaches at reservoirs, at very low risk of flooding for the action of rivers and sea and at low risk of flooding from surface water. Information from the EA was reported in Figure 13 to Figure 16.

According to the Strategic Flood Risk Assessment undertaken by URS for the London Borough of Camden, the site fell within Critical Drainage Area Group3_005 but outside of any Local Flood Risk Zone. The risk of flooding for surface water was recorded as very low. The hazard for 1 in 1000 year flood events was low to moderate. Sewer flooding incidents were not recorded in the area of 28 Charlotte Street. The susceptibility to elevated groundwater was negligible. Information on flood risk from the Strategic Flood Risk Assessment and the GHHS was reported on Figure 17 to Figure 24.

In conclusion, the site already included a basement, was located within Flood Zone 1, was <1 hectare and did not fall within areas with critical drainage problems therefore the undertaking of a detailed, site specific flood risk assessment would not be required.

2.11 Underground Infrastructure

The Transport for London asset map showed the nearest asset to be Northern underground line. The zone of influence was circa 90m east of the site. An extract of the asset map is presented in Figure 26, while in Figure 27 is reported a map extracted from the GHHS.

Information on the presence of public utilities, such as sewers or water mains, was not available at this stage.

2.12 Unexploded Ordnance

Review of Zetica UXO risk maps indicated the site to be within a moderate to high risk area from bomb strikes. An assessment by a UXO specialist is recommended for moderate and high-risk sites. A copy of the Zetica UXO risk map is presented in Figure 28.

It must be noted that when a bomb impacts the ground there is both a horizontal and vertical component to its trajectory which can result in bombs hitting the ground beyond the sites boundary but still travelling beneath a site.

Section 3 Screening

3.1 Introduction

The Ove Arup 2008 Scoping Study prepared for the London Borough of Camden and the 2021 Camden Planning Guidance: Basements, require that any development proposal that includes a basement should be screened to determine whether or not a full BIA is required.

Screening tools are included in the Arup document (Ref: Camden geological, hydrogeological and hydrological study, Issue01/November 2010) and the CPG, comprising a series of questions within a screening flowchart for three categories: Groundwater Flow, Land Stability and Surface Flow and Flooding. Responses to the questions are tabulated below.

3.2 Subterranean (Groundwater) Flow

The response to the Subterranean (Groundwater) Flow screening assessment is given in Table 3.1.

Table 3.1 – Subterranean (Groundwater) Screening

Question	Response
1a. Is the site located directly above an aquifer?	**Yes** – Superficial deposits capable of supporting local water supplies were anticipated by the BGS and the GHHS and could be present.
1b. Will the proposed basement extend beneath the water table surface?	**Unknown** – Superficial deposits capable of supporting local water supplies could be present.
2. Is the site within 100 m of a watercourse, well (used/ disused) or potential spring line?	No – No watercourses, surface water features or water abstractions were located within 250m at least.
3. Is the site within the catchment of the pond chains on Hampstead Heath?	No – The relevant map reported in Figure 11 showed the site to be set outside the catchment of the chain of ponds on Hampstead Heath.
4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	No – The proposed basement will develop within the footprint of the existing building.
5. As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)?	No – The Client's engineer informed Soils Limited that no soakaways or infiltration SUDS are part of the proposed development.
6. Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to or lower than, the mean water level in any local pond or spring line?	No – The nearest surface water feature was recorded >250m from the site.

3.3 Land Stability

The response to the Land Stability screening assessment is given in Table 3.2.

Table 3.2 – Slope Stability Screening

Question	Response
1. Does the existing site include slopes, natural or manmade, greater than 7° (approximately 1 in 8)?	No – No site slopes exceeded 7°.
2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7° (approximately 1 in 8)?	No – No reprofiling was part of the proposed development.
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7° (approximately 1 in 8)?	No – Average slope angles within the area of influence of the proposed development were <7°.
4. Is the site within a wider hillside setting in which the general slope is greater than 7° (approximately 1 in 8)?	No – Average slope angles within the area of influence of the proposed development were <7°.
5. Is the London Clay the shallowest strata at the site?	No – The BGS, the GHHS and the SFRA reported superficial deposits of the Lynch Hill Gravel Member to overlie the London Clay Formation.
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 – The proposed plans did not show any trees being removed.
7. Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site?	**Unknown** – The superficial deposits of the Lynch Hill Gravel Member are anticipated as predominantly granular and, therefore, unlikely to be subjected to shrink-swell subsidence. No information or clear evidence of previous subsidence was provided to Soils Limited.
8. Is the site within 100 m of a watercourse or potential spring line?	No – No watercourses, surface water features or water abstractions were located within >250m at least.
9. Is the site within an area of previously worked ground?	No – The relevant geological maps did not show any Made Ground or Worked Ground within or in close proximity to the site.
10. Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?	**Yes** – Superficial deposits capable of supporting local water supplies were anticipated by the BGS and the GHHS and dewatering could be required.
11. Is the site within 50m of the Hampstead Heath ponds?	No – The site was located outside of the catchment area as observed in Figure 11.
12. Is the site within 5m of a highway or pedestrian right of way?	No – Although the property adjoins Charlotte Street, the proposed excavation was at >5m from highways or pedestrian right of way.
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	**Yes** – Although the neighbouring properties had basements underneath and some of them were deeper than the proposed one, no basements were present at least under the rear portion of the adjoining building at 30 Charlotte Street.
14. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	No – The exclusion zone of the LUL Northern Line were 90m east of the site.

3.4 Surface Flow and Flooding

The response to the Surface Flow and Flood screening assessment is given in Table 3.3.

Table 3.3 – Surface Flow and Flooding Screening

Question	Response
1. Is the site within the catchment of the pond chains on Hampstead Heath?	No – The relevant map reported in Figure 11 showed the site to be set outside the catchment of the chain of ponds on Hampstead Heath.
2. As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?	No – There will be no changes to the ratio between paved and unpaved areas, no changes to the existing drainage and the site already included a basement.
3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	No – The proposed basement will develop within the footprint of the existing building.
4. Will the proposed basement development result in changes to the profile of the inflows (instantaneous and long term) of surface water being received by adjacent properties or downstream watercourses?	No – There will be no changes to the ratio between paved and unpaved areas, no changes to the existing drainage and the site already included a basement.
5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No – The quality of surface water would not be affected.
6. Is the site in an area known to be at risk from surface water flooding?	**Yes** – The risk of surface water flooding was recorded as very low.

3.5 Summary

Based on the screening exercise, further stages of the basement impact assessment are required. A summary of the basement impact assessment requirements has been provided in Table 3.4, Table 3.5 and Table 3.6.

Table 3.4 – Subterranean (Groundwater) Flow

Item	Description
Q1a	**Yes** – Superficial deposits capable of supporting local water supplies were anticipated by the BGS and the GHHS and could be present.
Q1b	**Unknown** – Superficial deposits capable of supporting local water supplies could be present.

Table 3.5 – Land Stability

Item	Description
Q5	**No** – The BGS, the GHHS and the SFRA reported superficial deposits of the Lynch Hill Gravel Member to overlie the London Clay Formation.
Q7	**Unknown** – The superficial deposits of the Lynch Hill Gravel Member are anticipated as predominantly granular and, therefore, unlikely to be subjected to shrink-swell subsidence. No information or clear evidence of previous subsidence was provided to Soils Limited.
Q10	**Yes** – Superficial deposits capable of supporting local water supplies were anticipated by the BGS and the GHHS and dewatering could be required.
Q13	**Yes** – Although the neighbouring properties had basements underneath and some of them were deeper than the proposed one, no basements were present at least under the rear portion of the adjoining building at 30 Charlotte Street.

Table 3.6 – Surface Flow and Flooding

Item	Description
Q6	**Yes** – The risk of surface water flooding was recorded as very low.

Section 4 Scoping

4.1 Introduction

The purpose of scoping is to assess in more detail the issues of concern identified in the screening process (i.e. where the answer is "yes" or "unknown" to any of the questions posed) to be investigated in the impact assessment. Potential hazards are assessed for each of the identified potential impact factors.

The scoping stage is furthermore to assist in defining the nature of the investigation required to assess the impact of the issues of concern identified in the screening process. The scope of the investigation must comply with the guidance issued by the London Borough of Camden Council and be a suitable basis on which to assess the potential impacts.

4.2 Potential Impacts

The following potential impacts were identified in Table 4.1.

Table 4.1 – Potential Impacts

Screening Flowchart Question	Potential Impacts	Discussion
Is the site located directly above an aquifer? Will the proposed basement extend beneath the water table surface?	Basement could extend into an underling aquifer and thus affect the groundwater flow regime. Alteration of an existing groundwater flow regime, which in turn could potentially cause local increase or decrease of groundwater levels.	The BGS data showed the presence of the soils of the Lynch Hill Gravel Member, classified by the EA as a Secondary "A" Aquifer and thus expected to be permeable allowing groundwater flow. Site investigation and groundwater monitoring to establish soil and groundwater conditions. **Effects mitigated at design stage.**
Is the London Clay the shallowest strata at the site? Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site?	Changes to moisture content in soils with a shrink-swell potential can cause damage to structures.	The anticipated ground conditions are indicated to be predominantly granular soils of the Lynch Hill Gravel Member, considered unlikely to have any significant cohesive content to pose a risk for shrink-swell induced subsidence. Site investigation establish soil conditions. **Effects mitigated at design stage.**

Screening Flowchart Question	Potential Impacts	Discussion
Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?	The proposed construction could require dewatering, which can cause ground subsidence.	Site investigation and groundwater monitoring to establish soil and groundwater conditions. **Effects mitigated at design stage.**
Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Basement construction can result in undermining of foundations of neighbouring properties and cause excessive ground movements resulting in structural instability.	Several of the neighbouring properties were known to have basements based on historic planning applications. The site had a complex of existing basement structures with the proposed extension within the existing basement structure. It is therefore considered unlikely that the proposed basement extension would have any material effect to the existing foundation structure relative to neighbouring properties. However, undertaking of a Ground Movement Assessment was recommended. For the highway structures, permanent and/or temporary works must be designed to ensure the induced ground movements are within tolerable limits and temporary works to prevent damage during construction. **Effects mitigated at design stage**.
Is the site in an area known to be at risk from surface water flooding?	Reduction of hard landscaping could increase the surface water flooding rise.	The proposed development will take place within the footprint of the existing building and will not change the proportion between hard and soft landscaping or the existing drainage. No further action is required from this point of view. The design activities must include active and passive protections for the ingress of surface water in the basement. **Effects mitigated at design stage**.

Section 5 Summary of the Intrusive Investigation by Chelmer

5.1 General

An intrusive site investigation was undertaken by Chelmer as part of the activities undertaken in the production of their Basement Impact Assessment with report ref. BIA/6262, dated April 2016. As already discussed, Soils Limited assumed full reliance on the above report and a summary of the findings thereby reported were presented in paragraph 5.2.

5.2 Summary of the Site Investigation

Chelmer Site Investigation carried out an intrusive investigation in January 2016 and comprised:

- 2No. hand dug trial pits for foundation exposure tests;
- 1No. continuous flight auger borehole;
- In-situ geotechnical testing in the form of Mackintosh Probes and hand vane measurements;
- Geotechnical laboratory testing;
- Contamination laboratory testing.

Please note that continuous flight auger boreholes result in soil disturbance of the sample bought to surface and depending on the configuration of the auger, undisturbed samples are typically unobtainable.

The final depths of the trial holes undertaken by Chelmer Site Investigation were presented in Table 5.1.

Table 5.1 Final Depth of Trial Holes

Trial Hole	Depth (m bgl)	Trial Hole	Depth (m bgl)
BH1 (w)	10.00	TP1	1.50
		TP2	2.10

Note(s): W - well installation. The depths given in this table are taken from the ground level on-site at the time of investigation.

For the purposes of discussion, the succession of conditions encountered in the trial holes in descending order can be summarised as:

Made Ground/Topsoil (MG)
Lynch Hill Gravel Member (LHGR)
London Clay Formation (LCF)

The ground conditions encountered in the trial holes are summarised in Table 5.2.

Table 5.2 Ground Conditions

Strata	Epoch	Depth Encountered (m bgl)		Typical Thickness (m)	Typical Description
		Top	Bottom		
MG	Anthropocene	GL	2.80	2.80	Dark brown gravelly silty SAND with abundant brick, concrete, mortar and slate.
		2.80	5.30	2.50	Moist dark brown gravelly sandy SILT with occasional brick fragments.
LHGR	Quaternary	5.30	7.70	2.40	Wet, medium dense mid-grey silty gravelly SAND.
LCF	Eocene	7.70	10.00[1]	Not proven[2]	Very stiff mid-grey silty CLAY with partings of grey and brown silt and fine sand.

Note: [1] Final depth of trial hole. [2] Base of strata not encountered

5.3 Roots
No roots were observed in either of the trial pits or BH1.

5.4 Groundwater
A groundwater strike was recorded in BH1 at 5.30m bgl, and the hole was noted to be wet and collapsed to 4.70m bgl on completion of drilling.

A metal standpipe was installed to a depth of 9.0m in BH1 with water level readings were taken on 28th January and 9th February 2016. During this short period of monitoring, the water level rose from 4.93m to 4.77m bgl.

5.5 Atterberg Limit Tests
Plasticity tests were performed on three samples from the London Clay Formation (BH1: 8.00m, 9.00m and 10.00m bgl). The lower two samples were found to be of High Plasticity as classified by BS5930 (2015), and Medium to High volume change potential, as defined by the NHBC (NHBC Standards, 2016, Chapter 4.2).

Sample BH1: 8.00m bgl had a passing at the 0.425mm sieve of 35% and a modified plasticity index of 5%, therefore was classified as low volume change potential in accordance with BRE Digest 240 and as non plastic according to NHBC Standards Chapter 4.2.

The remaining samples from the London Clay Formation were classified as medium volume change potential in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2.

5.6 Hand Vane Tests

Hand vane tests were done on BH1 cores at 8.00m, 9.00m and 10.00m bgl within the London Clay Formation. One reading was also taken on sample BH1: 10.00m bgl. The undrained strength reading exceeded the vane's maximum scale value of 130kPa for all the tests, therefore the soil undrained strength could be classified as at least high strength.

However, Chelmer commented that the hand vane reading could not take into account the clay's fabric characteristics such as fissures, so typically overestimate the soil's strength and should not be used for design purposes.

5.7 Particle Size Distribution Tests

Particle Size Distribution (PSD) tests were performed on one sample from the Lynch Hill Gravel Member (BH1: 5.50m bgl).

PSD tests classified the sample tested as having a volume change potential in accordance with BRE Digest 240. No volume change potential was identified in accordance with NHBC Standards Chapter 4.2 due to insufficient fine grained fraction. Note that a cohesive soil is only classified as having a volume change potential if it is also plastic and an Atterberg Limit test can be conducted on the strata.

5.8 Small Shearbox Tests

One test was done using the Small Shearbox on three samples from more cohesive beds of the Lynch Hill Gravel Member taken from BH1 at 7.00m bgl.

The test results showed for the sample had an effective cohesion of 1.1kPa and a peak shear resistance angle of 29° in drained conditions.

5.9 Sulphate and pH Tests and Subsurface Concrete Classification

Four samples were taken from the Made Ground, one from the Lynch Hill Gravel Member and one from the London Clay Formation for water soluble sulphate (2:1) and pH testing in accordance with Building Research Establishment Special Digest 1, 2005, 'Concrete in Aggressive Ground'.

The tests recorded water soluble sulphate of between 220mg/l and 1600mg/l with pH values ranging between 8.2 and 8.9.

The sulphate and pH tests carried out in accordance with BRE Special Digest 1, 2005, 'Concrete in Aggressive Ground', established the site concrete classifications for each stratum as presented in Table 5.3.

Table 5.3 Concrete Classification

Stratum	Design Sulphate Class	ACEC Class
MG	DS-3	AC-3
LHGR	DS-1	AC-1
LCF	DS-1	AC-1

Concrete to be placed in contact with soil or groundwater must be designed in accordance with the recommendations of Building Research Establishment Special Digest 1 2005, *'Concrete in Aggressive Ground'* taking into account any possible exposure of potentially pyrite bearing natural ground and the pH of the soils.

Section 6 Intrusive Investigation by Soils Limited

6.1 General

Soils Limited was appointed to undertake a reduced scope intrusive investigation due to the presence of the extremely deep Made Ground shown by the results of the site investigation done by Chelmer and the need for more detailed information on the existing foundation formation level.

It must be noted that the term below ground level (bgl) within this and subsequent sections of this report, dealing with the works undertaken by Soils Limited during this phase of the investigation, relates to the floor level within the house and not within the basement level of the house.

6.2 Proposed Project Works

The site investigation done by Chelmer showed very deep Made Ground within the investigatory holes. The proposed intrusive investigation was requested by the Client to clarify this aspect and the depth of the existing foundations in to aid the design of foundations for the proposed basement. The intended investigation, as outlined within the Soils Limited quotation (Q23607, dated 5th November 2020), was therefore to comprise the following items:

- Deep internal trial pits for foundation exposure tests to 3.00m bgl (maximum);
- Geotechnical laboratory testing.

6.2.1 Actual Project Works

The actual project works were undertaken on 7th December 2020 and comprised:

- 2No. internal trial pits for foundation exposure tests to depths respectively of 4.00m and 2.50m bgl;
- Geotechnical laboratory testing.

Two trial pits (TP101 and TP102) were hand dug, respectively, to depths of 4.00m and 2.50m bgl. After completion, the trial pits were backfilled with arisings.

Following completion of site works, soil cores were logged and sub sampled so that samples could be sent to the laboratory for both contamination and geotechnical testing.

6.3 Ground Conditions

On 7th December 2020 two trial pits (TP101 and TP102) were hand dug to depths of 2.50m (TP102) and 4.00m (TP101) below ground level (bgl) at locations selected by the Client's engineer and agreed with Soils Limited prior to attending the site. The maximum depths of trial holes have been included in Table 6.1.

Table 6.1 Final Depth of Trial Holes

Trial Hole	Depth (m bgl)
TP101	4.00
TP102	2.50

All trial holes were scanned with a Cable Avoidance Tool (C.A.T.) and GENNY prior to excavation to ensure the health and safety of the operatives.

The approximate trial hole locations are shown on Figure 29.

The soil conditions encountered were recorded and soil sampling commensurate with the purposes of the investigation was carried out. The depths given on the trial hole logs and quoted in this report were measured from ground level.

The soils encountered from immediately below ground surface have been described in the following manner. Where the soil incorporated an organic content such as either decomposing leaf litter or roots or has been identified as part of the in-situ weathering profile, it has been described as Topsoil both on the logs and within this report. Where man has clearly either placed the soil, or the composition altered, with say greater than an estimated 5% of a non-natural constituent, it has been referred to as Made Ground both on the log and within this report.

For more complete information about the soils encountered within the general area of the site reference should be made to the detailed records given within Appendix A, but for the purposes of discussion, the succession of conditions encountered in the trial holes in descending order can be summarised:

Made Ground/Topsoil (MG)
Lynch Hill Gravel Member (LHGR) – not encountered in trial pits

The ground conditions encountered in the trial holes are summarised in Table 6.2.

Table 6.2 Ground Conditions

Strata	Epoch	Depth Encountered (m bgl)		Typical Thickness (m)	Typical Description
		Top	Bottom		
MG	Anthropocene	GL	2.50[1] – 4.00[1]	Not proven[2]	Light to dark greyish brown clayey gravelly SAND with brick, flint, glass and metal gravel.

Note: [1] Final depth of trial hole. [2] Base of strata not encountered

6.4 Ground Conditions Encountered in Trial Holes

The ground conditions encountered in trial holes have been described below in descending order. The engineering logs are presented in Appendix C.1.

6.4.1 Made Ground

Soils described as Made Ground were encountered in both the trial pits to the full investigated depths of 2.50m (TP102) and 4.00m bgl (TP101). The Made Ground comprised light to dark greyish brown clayey gravelly SAND. Gravel was fine to coarse, angular to sub-rounded brick, flint, glass and metal. Rare brick cobbles.

The depths of Made Ground have been included in Table 6.3.

Table 6.3 Final Depth of Made Ground

Trial Hole	Depth (m bgl)
TP101	4.00[1]
TP102	2.50[1]

Note: [1] Final depth of trial hole.

6.5 Roots

Roots were not encountered within the trial pits. Roots may be found to greater depth at other locations on the site particularly close to trees and/or trees that have been removed both within the site and its close environs.

6.6 Groundwater

Groundwater was not encountered within the trial pits at the time of digging. Changes in groundwater level occur for reasons including seasonal effects and variations in drainage. The investigation was conducted in December (2020), when groundwater levels should be rising towards their annual maximum (highest) elevation, which typically occurs around March.

The installation of groundwater monitoring wells was not part of the Client's brief.

Groundwater equilibrium conditions may only be conclusively established if a series of observations are made via groundwater monitoring wells.

6.7 Foundation Exposures

Foundations exposures were carried out in TP101 and TP102 at locations selected by the Client's engineer and agreed with Soils Limited prior to arriving to site. The full foundations sketched for TP101 and TP102 are presented in Appendix C.1.

6.7.1 Foundation Exposure TP101

Foundation exposure in TP101 was undertaken in the corners of the kitchen, next to a monitoring well installed by others before Soils Limited were appointed.

The foundation exposure, therefore, included three cross sections, respectively identified as TP101 (Cross Section X), TP101 (Cross Section Y) and TP101 (Cross Section Z). The three cross sections were identified on the drawings provided in Appendix C.1, with TP101 (Cross Section Z) prepared only for showing the adjustment of the monitoring well present at the location.

In TP101 (Cross Section X), stepped brick foundations were encountered at a depth of 3.50m bgl and persisted to 4.05m bgl being 0.55m thick. Trial pit TP101 was slightly deepened just in correspondence of TP101 (Cross Section X) to allow the observation of the underside of the foundation. The stepped foundations comprised five individual steps and extended out of the wall by a total of 0.50m, with each step being 0.10m long and 0.11m thick. No concrete strip footings were observed underlying the brick foundations.

In TP101 (Cross Section Y), no stepped brick foundation was noted. The brick wall was set at a depth of 3.50m bgl without enlarging at the base.

No specific description was provided for TP101 (Cross Section Z), as no foundations were present in it.

6.7.2 Foundation Exposure TP102

Concrete strip footings were encountered from 1.70m bgl to a depth of 2.30m bgl, being 0.60m thick underlying stepped brick foundations. The concrete footings did not extend out of the brick wall/stepped brick foundations.

The full foundations sketched for TP101 and TP102 are presented in Appendix C.1.

Section 7 Discussion of Geotechnical In-Situ and Laboratory Testing

7.1 Atterberg Limit Tests

Atterberg Limit tests were performed on one sample obtained from the Made Ground. The results were classified in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2.

The Made Ground was classified as low volume change potential in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2.

A full interpretation of the Atterberg Limit tests are outlined in Table D.2.1, Appendix D.2 and the laboratory report in Appendix D.3.

7.2 Particle Size Distribution Tests

Particle Size Distribution (PSD) tests were performed on three samples from the Made Ground. One of the samples tested presented elevated fines content.

PSD tests classified two of the samples tested as having a volume change potential in accordance with BRE Digest 240. The results from grading analysis confirmed that one of them also had a volume change potential in accordance with NHBC Standards Chapter 4.2. Note that a cohesive soil is only classified as having a volume change potential if it is also plastic and an Atterberg Limit test can be conducted on the strata.

A full interpretation of the PSD tests are outlined in Table D.2.2, Appendix D.2 and the laboratory report in Appendix D.3.

7.3 Sulphate and pH Tests

Two samples were taken from the Made Ground for water soluble sulphate (2:1) and pH testing in accordance with Building Research Establishment Special Digest 1, 2005, ‘Concrete in Aggressive Ground’.

The tests recorded water soluble sulphate of 461mg/l and 1290mg/l with pH values respectively of 7.7 and 8.0.

The significance of the sulphate and pH Test results are discussed in Section 9.2 and the laboratory report in Appendix D.3.

Section 8 Engineering Appraisal

8.1 Established Ground Conditions

An engineering appraisal of the soil types encountered during the two stages of the site investigation and likely to be encountered during the redevelopment of this site is presented. Soil descriptions are based on analysis of disturbed samples taken from the exploratory holes.

8.1.1 Made Ground

Foundations must not be placed on non-engineered fill unless such use can be justified on the basis of a thorough ground investigation and detailed design. Foundations must be taken through any Topsoil and/or Made Ground and either into, or onto a suitable underlying natural stratum of adequate bearing characteristics.

Soils described as Made Ground were encountered in all the trial holes from ground level to depths ranging between 1.50m (TP1) and 5.30m bgl (BH1).

8.1.2 Lynch Hill Gravel Member

Soils described as Lynch Hill Gravel Member were encountered in borehole BH1 drilled by Chelmer directly below the Made Ground and persisted to a depth of 7.70m bgl.

The results of small shearbox test undertaken by Chelmer provided an effective cohesion of 1.1kPa and peak shear resistance angle of 29° in drained conditions.

The results from PSD tests showed that the granular soils of the Lynch Hill Gravel Member had a volume change potential in accordance with BRE Digest 240. No volume change potential was observed according to NHBC Standards Chapter 4.2.

Soils of the Lynch Hill Gravel Member are predominantly granular soils and as such are expected to display moderate bearing capacities with moderate settlement characteristics at this specific site. The soils of the Lynch Hill Gravel Member were considered as a suitable foundation layer for the proposed development in the case of the adoption of piled foundations.

This stratum was not encountered during the Soils Limited investigation.

8.1.3 London Clay Formation

Soils described as London Clay Formation were encountered in borehole BH1 drilled by Chelmer from directly below the Lynch Hill Gravel Member and persisted to the final investigated depth of 10.00m bgl.

The results of hand vane tests inferred that the cohesive soils of the London Clay Formation were at least of high strength, with undrained cohesions of >130kPa.

However, Chelmer commented that the hand vane reading could not take into account the clay's fabric characteristics such as fissures, so typically over-estimate the soil's strength and should not be used for design purposes.

The results from Atterberg Limits tests showed that the soils of the London Clay Formation had **medium volume change potential** in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2.

Soils of the London Clay Formation are overconsolidated, predominantly cohesive soils and as such are expected to display moderate bearing capacities with moderate settlement characteristics. The soils of the London Clay Formation were considered as a suitable foundation layer for the proposed development in the case of the adoption of piled foundations.

This stratum was not encountered during the Soils Limited investigation.

8.1.4 Guidance on Shrinkable Soils

The ground conditions were established as Made Ground, with a typical thickness of 5.30m , overlying the Lynch Hill Gravel Member, with a typical thickness of 2.40m, overlying the bedrock of the London Clay Formation.

Atterberg Limit and PSD testing were classified in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2 to determine the volume change potential.

The volume change potential for each strata was established and presented in Table 8.1.

Table 8.1 Established Volume Change Potential by Strata

Strata	Volume Change Potential		Established Lower Boundary (m bgl)
	BRE	NHBC	
MG	Low	Low	5.30
LHGR	Low	None	7.70
LCF	Medium	Medium	Not determined

8.1.5 Groundwater

A groundwater entry was recorded in BH1 at 5.30m bgl, and the hole was noted to be wet and collapsed to 4.70m bgl on completion of drilling.

A metal standpipe was installed to a depth of 9.0m in BH1 with water level readings were taken on 28th January and 9th February 2016. During this short period of monitoring, the water level rose from 4.93m to 4.77m bgl.

Section 9 Foundation Design

9.1 General

Foundation design was not part of Soils Limited appointment, as pile design was undertaken by others.

The presence of deep Made Ground did not allow the use of shallow foundations within the basement excavation, as the mechanical behaviour of Made Ground is intrinsically unpredictable and likely to be characterised by differential settlements. For that reason, the report prepared by Chelmer recommended the use of piled foundations to avoid overstressing the soils under the basement wall foundations.

The documents and drawings received by the Client's engineer, mentioned in paragraph 1.4, showed that the recommendation for piled foundation was received and included in the proposed development. No detail was provided about the pile bearing capacity, but the maximum loads in Table 9.1 were considered.

Table 9.1 Pile Loads

Pile Location	DL (kN)	LL (kN)	Total Load (kN)
Party wall at 28/26 Charlotte Street	82.99	22.13	105.12
Party wall at 28/30 Charlotte Street	72.43	19.13	91.56
Rear wall	57.28	10.69	67.97
Notes: Pile loads were unfactored. Partial factors of safety must be applied.			

No prescriptions, conclusions and recommendations about foundation design are presented in this report, as they must be provided in the specific documents produced for that purpose.

9.1.1 Stability Issues

The excavation of the basement must not affect the integrity of any adjacent structures or land beyond the site boundaries. Where there is a sufficient distance between the site boundary and the basement excavation, foundation support may be permitted using a wide strip foundation to form an earth retaining structure. In other cases, the most suitable form of construction could be within a coffer dam structure using a sheet piles, secant or contiguous concrete piled wall around the periphery of the structure.

In this specific case, the installation of cofferdam structures would be a complex exercise. It was acknowledged that the construction sequence provided by the Client's engineer considered the proposed basement structure to be independent from the existing foundations and set onto a piled raft, as presented in Appendix E. The existing foundations will be retained using temporary props at construction stage and by the basement structure in permanent conditions.

The excavation of the proposed basement was to be terminated at 3.50m below the ground level at Charlotte Street. Groundwater was not encountered at this depth during the investigation but could be through migration through the Lynch Hill Gravel Member. The groundwater level could be encountered at a higher elevation following periods of heavy rainfall or during winter months.

Groundwater levels could rise, particularly after prolonged periods of wet weather.

If the construction works take place during the winter months or during/after prolonged periods of wet weather perched water could accumulate or groundwater could be found migrating through the granular deposits of the Lynch Hill Gravel Member. If any water ingress is not prevented by dewatering, the basement slab could become “buoyant” whilst empty. This must be considered in the design. Support of excavation and dewatering with pumps from sumps introduced into the floor of the excavation must be considered.

9.2 Subsurface Concrete

The sulphate and pH tests carried out in accordance with BRE Special Digest 1, 2005, ‘Concrete in Aggressive Ground’, established the site concrete classifications for each stratum as presented in Table 5.3.

Table 9.2 Concrete Classification

Stratum	Design Sulphate Class	ACEC Class
MG	DS-3	AC-3
LHGR	DS-1	AC-1
LCF	DS-1	AC-1

Note: Concrete classification developed considering the results of both the site investigation done by Chelmer and by Soils Limited.

Concrete to be placed in contact with soil or groundwater must be designed in accordance with the recommendations of Building Research Establishment Special Digest 1 2005, *‘Concrete in Aggressive Ground’* taking into account any possible exposure of potentially pyrite bearing natural ground and the pH of the soils.

9.3 Excavations

Shallow excavations in the Made Ground likely to be marginally stable in the short term at best.

Deeper excavations taken into the Made Ground and/or the Lynch Hill Gravel Member are unlikely to be stable and required support in the temporary and permeant case. Unsupported earth faces formed during excavation may be liable to collapse without warning and suitable safety precautions must therefore be taken to ensure that such earth faces are adequately supported or battered back to a safe angle of repose.

Excavations beneath the groundwater table (if encountered) are likely to be unstable and dewatering of foundation trenches may be necessary.

Section 10 Basement Impact Assessment

10.1 General

The outcome of the Basement Impact Assessment is presented within this section of the report with reference to the results of the screening and scoping process and of the site investigation undertaken.

10.2 Potential Impacts Identified

This section of the report addresses the potential impacts identified by the scoping study, as presented in Table 4.1, and the relevant findings of the ground investigations and mitigation measures, where required.

The findings of this report are informed by data from the existing literature, from documents provided by the Council and the Client's consultants and from the results of site-specific intrusive investigations done by Chelmer in 2016 and by Soils Limited in 2020.

This Basement Impact Assessment report discussed the potential risks related to the proposed development. All the mentioned risks can be mitigated at detailed design stage.

10.3 Flood Mitigation

The site was considered at very low to low risk of flooding from sources like surface water and rivers and sea, with low to moderate hazard for 1 in 1000 years flooding events. The results of the intrusive investigation showed that the proposed development will take place within predominantly granular Made Ground and soils of the Lynch Hill Gravel Member, a Secondary A Aquifer, overlying the cohesive soils of the London Clay Formation, classified by the EA as unproductive strata. Groundwater was observed at a minimum (shallowest) depth of 4.77m bgl during the short monitoring carried out by Chelmer. Further rise during the wet period cannot be excluded. The high permeability of the granular soils of the Made Ground and of the Lynch Hill Gravel Member could therefore pose a risk to the safety of the workers at the time of construction and of the occupants during the lifetime of the structures.

Surface water runoff could also potentially affect the stability of the excavations. However, the proposed basement will be constructed within the footprint of the existing building and will not alter the ratio between hard and soft landscaped areas. The effects of the proposed development on surface water flow will therefore be negligible and not induce any relevant worsening.

It is recommended to carry out the excavations during the drier months to mitigate the risk of heavy rainfall. A dewatering strategy must be designed by a specialist drainage engineer to allow the excavation of the basement. The dewatering exercise must be intended to keep the excavation dry to allow for a safe and comfortable development and not to cause the lowering of the groundwater table within the wider area, if present, as this could trigger the development of consolidation settlements within eventual cohesive beds of the Made Ground, of the Lynch Hill Gravel Member or even within the cohesive soils of the London Clay Formation. In the long term, the premises must be waterproofed and protected with pumps introduced into sumps. A specialist drainage engineer could calculate the expected flood depth and propose an appropriate drainage strategy in case of particularly severe flooding events. Surface water could also be collected to public sewer, subject to approval from the Owner of the sewer. Further mitigation measures against the ingress of water within the premises could be required such as raised kerbs, flood doors and eventually a safe egress. Where drainage systems in the basement are to be considered, they must be protected using anti-return valves and/or positive pumped devices against the risk of flooding from sewers.

10.4 Cumulative Effects

The proposed basement development will be excavated within soils of high permeability and will take place within an area already characterised by the presence of several basements, including the site itself, the neighbouring properties and the wider area. The proposed basement, therefore, would not significantly alter the existing groundwater regime and groundwater could still flow around and beneath the proposed basement. Cumulative effects on the groundwater regime are therefore considered negligible.

10.5 Use of SuDS

The site was set into an area considered in the SFRA as highly compatible to the use of infiltration SuDS. However, the use of SuDS is not part of the proposed development, as informed by the Client’s engineer.

10.6 Shrink-Swell Potential

The results of the intrusive investigation showed the site to be set onto/into soils characterised by variable volume change potential. No roots/rootlets were recorded within the trial hole logs. In addition, the proposed development will not include interventions on vegetation or other activities supposed to affect the soil moisture content. However, the presence of vegetation within the Crabtree Fields playground does not allow to exclude some level of risk due to the actions of others, reminding that soil re-hydration caused by tree felling could cause shrink/swell induced movements that could develop over a period in excess of 20 years. It is therefore recommended to carry out the development in agreement with NHBC Standards Chapter 4.2. The advice of a specialised arboriculturalist is recommended in the case of relevant tree works within up to 30m from the property.

10.7 Stability

This paragraph considers the potential effects of basement construction on nearby properties and on the wider slope. The use of adequate temporary and permanent support of the excavations and of best practice construction methods put in place by a reputable specialist contractor would allow the development of the proposed works in a safe manner.

The neighbouring properties already included basements or lower ground floors according to online available imagery (Google Earth Pro) and documents available from the Council's planning portal. The construction of the proposed basement, however, is likely to increase the differential foundation depth at least to the adjoining property at 30 Charlotte Street, which was understood to have no basement under its rear area adjacent to the basement in question. The undertaking of a Ground Movement Assessment to estimate the movements induced by the excavation and construction of the proposed basement is therefore required in accordance with the Party Wall Act. The results of the Ground Movement Assessment are presented in Section 11 and Section 12.

The Client's engineer must prepare working drawings and construction method statements that will mitigate adverse effects on nearby properties.

Considering the type of development, the proposed construction of the basement as an independent structure inside the perimeter of the existing foundations, recorded to considerable depth, is considered a valid option to preserve the integrity of the existing building and avoid overstressing the deep Made Ground encountered by the site investigations. The choice of piled raft foundations would help minimising the effects both onsite and on the neighbouring properties by transferring the structural loads to soils of good mechanical behaviour at greater depth.

A specifically designed construction sequence was provided by the Client's engineer. That was created in order to safeguard the stability of the structures in both the temporary and permanent stages.

Great care must be taken during construction of the piles that vibration during the drilling or construction could induce a collapse mechanism in any loose Made Ground or could result in inundation collapse below the groundwater table causing movement of party walls.

Section 11 Ground Movement Assessment

11.1 Introduction

A ground movement assessment was carried out to provide an estimate of the expected damage on the neighbouring properties due to the excavation and construction of the proposed basement at 28 Charlotte Street. The ground movement assessment was developed on the basis of information from the Client and their Consultants.

This section provides calculations to determine ground movements that may result from the construction of the proposed basement development and to assess how these may affect the stability of neighbouring buildings. Movements are likely to occur through the following mechanisms:

11.1.1 Heave Movements

The construction of the proposed development will require the excavation of the soil under the rear portion of the existing building to match the formation levels presented on the drawings prepared by Studio Stassano. Soil removal was evaluated as not exceeding 3.50m. The excavation will cause the unloading of the Made Ground beneath formation level and of the soils of the Lynch Hill Gravel Member, which are anticipated as predominantly granular and unlikely to be subjected to significant heave. The London Clay Formation was then encountered at 7.70m bgl, circa 4.20m below basement formation level, and some residual heave could be induced by the residual effects of unloading at that depth.

11.1.2 Foundation Construction

Construction of foundations can lead to movements due to basement wall construction and any net increase in loading. The proposed foundations, however, will be piled raft, therefore foundation loads will be taken to soils of good mechanical behaviour at greater depth, reducing the effects onto shallow soils.

The nature of final movements depends on the level of loading achieved. Downwards movements (settlements) must be expected when the applied load is greater than the weight of soil removed. A certain degree of heave will remain in the long term when the applied load is lower than the weight removed. Settlement may potentially also occur where foundation loads are transferred to deeper, previously unloaded soil.

Workmanship will not affect the adjoining structures as the proposed basement construction will not include any underpinning implying the installation of dry pack between the existing foundations and the underpinning itself.

11.1.3 Lateral Wall Deflection

The bending of the basement walls would directly cause lateral movements within the retained ground. The relaxation in the soils induced by the transition to the active state then causes the settlement of the soils within the failure wedge and of the structures set onto them.

11.2 Site Model and Mechanical Properties

For this BIA, a thickness of 5.30m of Made Ground was recorded at the site, therefore present at the basement formation level. The Made Ground was observed as predominantly granular.

The Made Ground was underlain by the soils of the Lynch Hill Gravel Member, which were recorded as predominantly granular with localised cohesive lenses and rested over the cohesive soils of the London Clay Formation.

The stratigraphy and the mechanical parameters of the soils involved in the analyses under undrained and drained conditions were respectively presented in Table 11.1 and Table 11.2 as obtained from the Basement Impact Assessment produced by Chelmer and comparison with the available literature. In particular, the undrained Young's modulus of the Made Ground was reduced taking into account the suggested design parameters presented in CIRIA SP200, Table 5.4 due to the limited amount of testing available.

Then, the drained Young's modulus of the London Clay Formation was derived from the undrained one considering a conversion factor of 0.75, as per the recommended correlation presented in CIRIA SP200, Table 5.7.

Table 11.1 – Soil Parameters – Undrained Conditions

Stratum	Top of Stratum (m bgl)	Undrained Cohesion (kPa)	Young's Modulus (MPa)	Poisson's Ratio
MG[1]	0.00	-	18	0.33
LHG[1]R	5.30	-	40	0.30
LCF[2]	7.70	100 + 7.5z	50 + 3.75z	0.50

Note: [1] Undrained conditions not compatible with granular soils. [2] z represented the depth from the top of the stratum.

Table 11.2 – Soil Parameters – Drained Conditions

Stratum	Top of Stratum (m bgl)	Friction Angle (ϕ°)	Effective Cohesion (kPa)	Young's Modulus (MPa)	Poisson's Ratio
MG	0.00	28	0	18	0.33
LHGR	5.30	29[2]	0	40	0.30
LCF[1]	7.70	26	0	37.5 + 2.80z	0.28

Note: . [1] z represented the depth from the top of the stratum. [2] Based on the results of laboratory testing on cohesive samples.

Groundwater was encountered at a minimum depth of 4.77m bgl during the monitoring period but was considered at ground level for the development of the ground movement assessment. This therefore represents a very conservative approach. Should groundwater be encountered during further monitoring visits or at the time of the excavation, this would not negatively impact the ground movements presented in this report.

11.3 Ground Movement Arising from Basement Excavation

The ground movement assessment was carried out considering the construction sequence prepared by Rodrigues Associates presented in Appendix E, which was based on a top-down approach and comprised the following main stages:

- the removal of the existing ground floor slab;
- the installation of waling beams and horizontal temporary props;
- the construction of piles from the current ground level;
- the deepening of the excavation by 1.50m and the installation of an intermediate level of waling beams and temporary props;
- the further deepening of the excavation to the proposed basement formation level, the installation of temporary propping at the base and the subsequent construction of the pile supported basement slab;
- the construction of RC basement walls and the gradual removal of the temporary props, to be completed after the installation of the ground floor permanent slab.

The construction sequence complied with the definition of high stiffness structure as presented in CIRIA C760 and was prepared to avoid overstressing the changeable Made Ground encountered to 5.30m bgl.

The temporary props applied during the excavation cannot be removed from the walls before being replaced by suitable permanent supports or equivalent permanent restraints, before the concrete has reached a prescribed strength or when the Structural Engineers specify.

Ground movements will be caused by the excavation for reaching the desired basement depths and the construction of the piled raft. No workmanship errors will be considered in the analyses, as the construction of underpins was not part of the proposed development and this would not require the application of the dry pack between the existing foundations and the underpinning itself.

The proposed development considered the excavation of 3.50m of Made Ground, corresponding to an unloading of the soils at formation level evaluated as 65kPa, adopting for the removed soils an average unit weight of circa 18kN/m^3.

A ground movement assessment has been undertaken using OASYS Limited PDISP (Pressure induced DISPlacement analysis) analysis software. PDISP assumes that the ground behaves as an elastic material under loading, with movements calculated based on the applied loads and the soil stiffness (Eu and E') for each stratum input by the user. PDISP assumes perfectly flexible loaded areas and as such tends to overestimate movements in the centre of loaded areas and underestimate movements around the perimeters. If a different foundation/underpinning solution is adopted within the final design the ground movement assessment must be reviewed. The mechanical properties of the soils involved in the analyses were defined in Table 11.1 and Table 11.2 of this report.

The construction of the proposed basement to the rear of 28 Charlotte Street would interact with the neighbouring structures at 26 and 30 Charlotte Street and at 7-15 Whitfield Street. However, the building at 7-15 Whitfield Street already included a basement of similar depth to the proposed one and the adjoining building at 26 Charlotte Street did not extend alongside the proposed basement.

The most sensitive adjacent building, therefore, would be the adjoining property at 30 Charlotte Street, located to the north, which also included a basement but only under the front portion. The detail of the critical scenario considered for the development of the Ground Movement Assessment (GMA) and the undertaking of the Damage Category Assessment (DCA) using the approach on CIRIA C760 and the Burland scale are provided below.

11.3.1 Critical Scenario CS1

Critical scenario CS1 considered the effects of excavation and construction on the adjoining building at 30 Charlotte Street. The critical distance adopted for the development of the GMA and the DCA was considered equal to 5.50m based on public documents available from the Council's planning portal.

The critical section considered in scenario CS1 is presented in Figure 30.

The calculation of lateral movements in correspondence of the basement did not consider the presence of the inner structure or liner walls. The basement walls in correspondence of scenario CS1 were of a minimum of 0.25m thick based on the drawings provided by the Client and the second moment of inertia of the basement walls was evaluated as 130,208cm^4. The horizontal deflection was calculated considering a 3.50m high wall subjected to full excavation.

The excavations to the proposed basement formation level must be carried out by retaining the passive resistance of the soils in place, as prescribed In CIRIA C760.

It is the Client's responsibility to provide information on any changes to the layout and/or structural characteristics of the basement. Soils Limited must be immediately informed of any changes, as this could potentially invalidate the results of this Basement Impact Assessment.

An accurate monitoring of ground and structural movements is required before, during and for a certain period after the completion of the construction process to check that movements do not exceed those calculated and presented in this report and allow the design of remedial measures, should the calculated movement be exceeded. If a different construction process is adopted, Soils Limited must be immediately informed and a reassessment of ground movements and expected damage on neighbouring structures must be carried out.

Horizontal movements rapidly dissipate with the distance from the excavation face. However, in this report the expected damage was conservatively calculated using the horizontal deflection in correspondence of the excavation and not at the section of maximum vertical deflection, without applying any dissipation.

11.3.2 Short Term Heave

Calculated short term heave, due to the removal of soils above the formation level, was evaluated by adopting the parameters in Table 11.1 and intended as deriving from the unloading of the Made Ground and soils of the Lynch Hill Gravel Member.

The largest short-term heave across the footprint of the proposed development was predicted to be of a maximum of -8mm (negative values indicate an upwards movement throughout this text) near the centre of the excavation. The movement decreased towards the boundaries of the excavation, along the boundary lengths of the basement. Heave was noted to occur within these areas ranging between -6mm and -2mm due to the net increase of surcharge load. A contour plot showing the variation of short-term movements across the entire basement footprint is presented in Figure 31, which showed that ground movements reduce to zero within <8m from the excavation.

11.3.3 Long Term Ground Movement

Long term movements generally depend on the development of the increase of heave (negative settlements) in the long-term due to the reduction in stiffness of the soils, with the dissipation of negative pore-water pressures, and the development of (positive) settlements due to the construction of the basement and the application of the loads from the upper structure to greater depths. Those movements develop contemporarily and generally cannot be distinguished, but an evaluation of the long-term heave, as independent values, was also reported for completeness on the contour plot in Figure 32. The maximum expected heave was calculated as circa -10mm and was caused by the stress relief caused by up to 3.50m deep excavations. Ground movements dissipated to zero within <12m from the excavation.

The maximum overall long-term ground movements under the proposed building footprint were calculated as between -9mm near the centre of the excavation and -2mm in correspondence of the boundaries (residual upwards movement due to applied load lower than the weight removed in the area of the new storage vaults). The variation of movements along the excavation boundaries ranged between -8mm and -2mm. A contour plot with the variation of long-term movements across the basement footprint is presented in Figure 33, which showed the ground movements reducing to zero within <12m from the excavation.

The above values of the ground movements were cumulative and, therefore, included long-term heave and settlements caused by the structural loads.

11.3.4 Settlements Due To Workmanship

No settlements due to workmanship were considered in this ground movement assessment, as no underpinning will be constructed and no dry pack will be rammed between existing foundations and underpinning.

11.4 Ground Movement Due to Retaining Wall Lateral Deflection

The excavation of the proposed basement will comprise the construction of an independent structure inside the perimeter of the existing building foundations. During the excavation and construction stages, the soil on the active (outer) side of the basement will cause the deflection of the existing walls, which were considered a minimum of 0.25m thick. For the purpose of this GMA full excavations to 3.50m bgl were considered in the calculation of lateral wall deflection.

The basement walls were considered surcharged by loads representing the normal activities that could develop on neighbouring residential sites, considered equal to 2kPa. The lateral wall deflection was calculated using the dedicated software Wallap by Geosolve. The horizontal movement at the excavation were therefore evaluated as 1.5mm and was presented in Figure 35.

Horizontal movements then rapidly dissipate with the distance from the excavation, as presented in CIRIA C760, Figure 6.15. However, in this report the expected damage was conservatively calculated using the horizontal deflection in correspondence of the excavation and not at the section of maximum vertical deflection, without applying any dissipation.

It is the Client's responsibility to provide information on changes to the layout and structural characteristics of the basement. Soils Limited must be immediately informed of any changes, as this could potentially invalidate the results of this Basement Impact Assessment.

The analyses were developed considering information provided by the Client's consultants with regards to building layout, construction sequence and loads. The results are therefore site specific and provide ground movements to be considered as limit values for a satisfactory development and must not be exceeded.

Different solutions could be adopted by the structural consultants or the contractor, but it is recommended to undertake the monitoring of ground and structure movements before, during and after the construction in order to avoid the limit values to be exceeded. Soils Limited must be immediately notified in the case of unexpected large movements, or movements in excess of those presented within this report.

The calculated movements for the evaluation of the expected damage on the neighbouring structures were summarised within Table 11.3 and the related ground movements identified on Figure 34 and Figure 35. In particular, provided that the foundation loads will be applied to great depth and this would reduce the interaction between heave due to excavation and settlements caused by the foundations, it was chosen to maximise the absolute value of the vertical deflection adopted in the assessment of the damage category and consider it equal to the deflection caused by long-term heave.

Table 11.3 – Summary of Estimated Movements

Scenario	Distance from the Excavation (m)	Critical Distance (m)	Horizontal Deflection (mm)	Vertical Deflection (mm)
CS1	0.00	5.50	1.5	2.3

Note: Vertical and horizontal movements are reported as absolute values.

Section 12 Damage Category Assessment

12.1 Introduction

The ground movements presented in Section 10 were considered for assessing the expected potential damage category that the construction of a new basement was supposed to induce onto the adjoining property. The assessment was carried out considering the method described in CIRIA Special Publication 200 (Burland et al., 2001) and CIRIA C760 (Gaba et al., 2017), based upon the method proposed by Burland et al. (2001) and taking into account the works by Burland and Wroth (1974) and Boscardin and Cording (1989).

The general categories of damage entity were summarised in Table 12.1.

Table 12.1 – Classification of Visible Damage To Walls

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).

12.2 Summary of Ground Movements and Evaluation of Relative Deflection

The analysis of the ground movements reported in Section 10 allowed to estimate the relative vertical and horizontal deflections on the adjoining property at 30 Charlotte Street.

The evaluation of the vertical and horizontal deflections for the scenario considered was reported on Figure 34 and Figure 35.

The results of the assessment were presented in Table 12.2, while in Figure 36 was defined the expected damage category on the adjoining structure according to the classification by Burland (2001) reported within CIRIA SP200 and CIRIA C760, which was developed for buildings having L/H ratios between width (L) and height (H) of up to 0.5.

Table 12.2 – Expected Damage Category

Section	Distance from Excavation (m)	Critical Distance (m)	Horizontal Deflection (mm)	Vertical Deflection (mm)	Horizontal Strain ε_h (%)	Deflection Ratio Δ/L (%)	Damage Category
CS1	0.00	5.50	1.5	2.3	0.027	0.042	1 (Very slight)

Note: Vertical and horizontal movements are reported as absolute values. The distance from the excavation did not contribute to the evaluation of horizontal strain and deflection ratio.

The Camden Planning Guidance (CPG): Basements, January 2021 revised the general approach with regards to the acceptability of proposed basement developments, with the expected damage considered acceptable if not worse than Category 1 (very slight damage) of the Burland Scale. It can be observed that the critical section considered in this analysis presented the expected damage not exceeding Category 1. The values reported within Table 12.2 are indicative of the stiffness adopted in the calculations and refer to the ground movements calculated within the report.

The calculated ground movements must be considered as limit values for a satisfactory development considering the information provided to Soils Limited at the time of writing this report and must not be exceeded.

It is recommended to undertake the monitoring of ground and structure movements before, during and after the construction in order to avoid the limit values to be exceeded. A pre-construction survey of the properties potentially affected by the proposed development is also recommended. Soils Limited must be immediately notified in the case of unexpected large movements, or movements in excess of those presented.

The above reported was specifically determined for the case considered and can be invalidated if changes are applied to building layout and structures.

12.3 Monitoring of Ground and Structures

Anticipated ground movements are expected to be minimal and reduced by the stiffness of the above structure and those adjoining. It is recommended to appoint a specialist Surveyor for monitoring ground and structural movements at regular intervals to confirm limits presented in this report are not exceeded.

Movement monitoring of the property itself and nearby structures within a radius of 20m must be undertaken before construction starts, continued through the construction phase and for an appropriate period thereafter. The Surveyor will be required to monitor ground movements to check the validity of the ground movement analysis, the performance of the temporary works and working methods adopted by the chosen Contractor.

The proposed monitoring must also include:

- Visual inspection of relevant walls with a condition survey produced of each wall prior to work commencing,
- Vertical movement of each wall must be monitored using as a minimum standard optical equipment,
- Lateral movement must be measured using laser systems.

A traffic light system based on green, amber and red trigger levels must be set in order to confirm the total ground movements and deflections presented throughout this BIA will not be exceeded, with specific actions to be taken if exceeding the amber and red trigger values.

Soils Limited must be immediately notified in the case of unexpected large movements, or movements in excess of those presented. A reassessment of ground movements and expected damage to neighbouring structures should be then carried out to take into account evidence from the construction stage.

Section 13 Conclusions and Recommendations of BIA

13.1 General

The findings of this report are informed by site investigation data and information regarding construction methods, sequences and loading provided by the Client.

The existing property and neighbouring No.26 Charlotte Street where Grade II listed buildings and appropriate consideration will be required for development of the proposed basement.

The analysis was undertaken on the assumption of high-quality workmanship and showed that the proposed development would not harm the stability of the building itself and of the neighbouring properties provided that suitable construction methods, in accordance to the construction sequence and methodology prepared by the Client's engineer, and experienced constructors are chosen. The site did not fall into areas at risk of slope instability as showed by the SFRA from LB Camden.

The ground movement and damage category assessment established the proposed construction to have a damage category of very slight on the Burland Scale, which is considered acceptable by LB Camden. The proposed development, therefore, would not pose excessive risk to neighbouring properties and infrastructure.

The permanent works must be designed to ensure induced ground movements surrounding the site are within tolerable limits and temporary works sufficiently design to prevent damage during construction. It was recommended monitoring of surrounding structure was undertaken before, during and for a certain period after the completion of the construction works.

The proposed development will take place within the footprint of the existing building and would not change the percentage of permeable to impermeable surface areas cross the site. The risk of flooding from rivers and sea and surface water was low to very low, with low to moderate risk from 1 in 1000 years flooding events. No significant changes can be expected with regards to the current conditions of surface water flow. The development of a detailed, site-specific flood risk assessment was not required.

The presence of granular soils of anticipated high permeability suggests the need for a dewatering strategy of the excavation during the construction stage in presence of intense rainfall. The presence of several existing basements and the permeability of the granular soils allow to conclude that cumulative effects on the existing groundwater regime will be negligible.

Overall, it was considered the proposed development would have a limited impact on neighbouring properties provided a suitable basement construction was selected. This BIA was developed with reference to the information provided by the Client's consultant, presented in Appendix E. Soils Limited must be promptly informed in the case of different solutions be designed by the chosen contractor, as this could require the BIA to be reviewed.

List of Figures

List of Appendices

Figure 1 – Site Location Map

Job Number	**Project**
18860	28 Charlotte Street, London W1T 2NF
Client	**Date**
Mr Matteo Caraccia c/o Rodrigues Associates	October 2022

Figure 2 – Aerial Photograph

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

Approximate site location

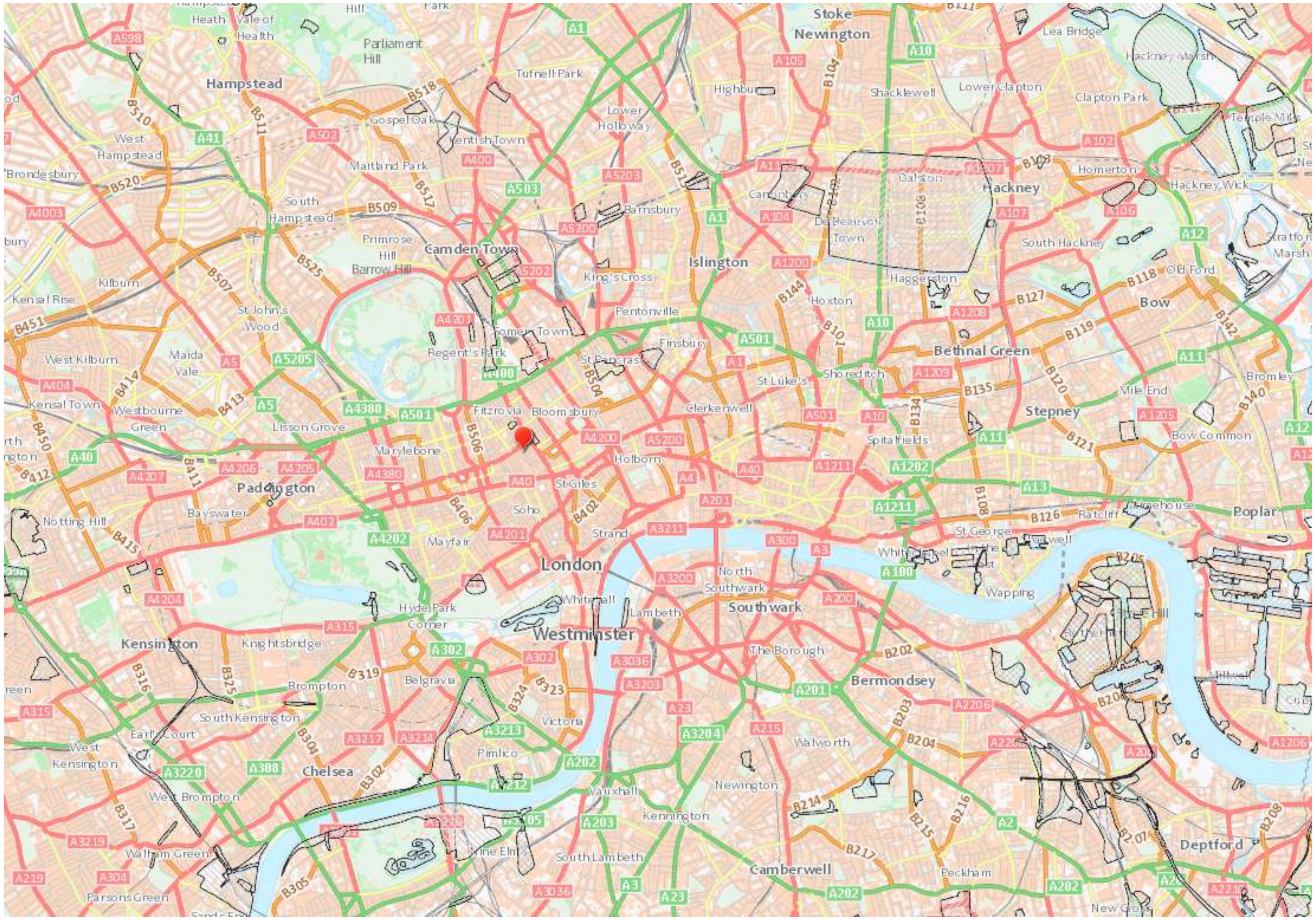

Figure 3 – BGS 1:50,000 Map, Artificial Geology

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

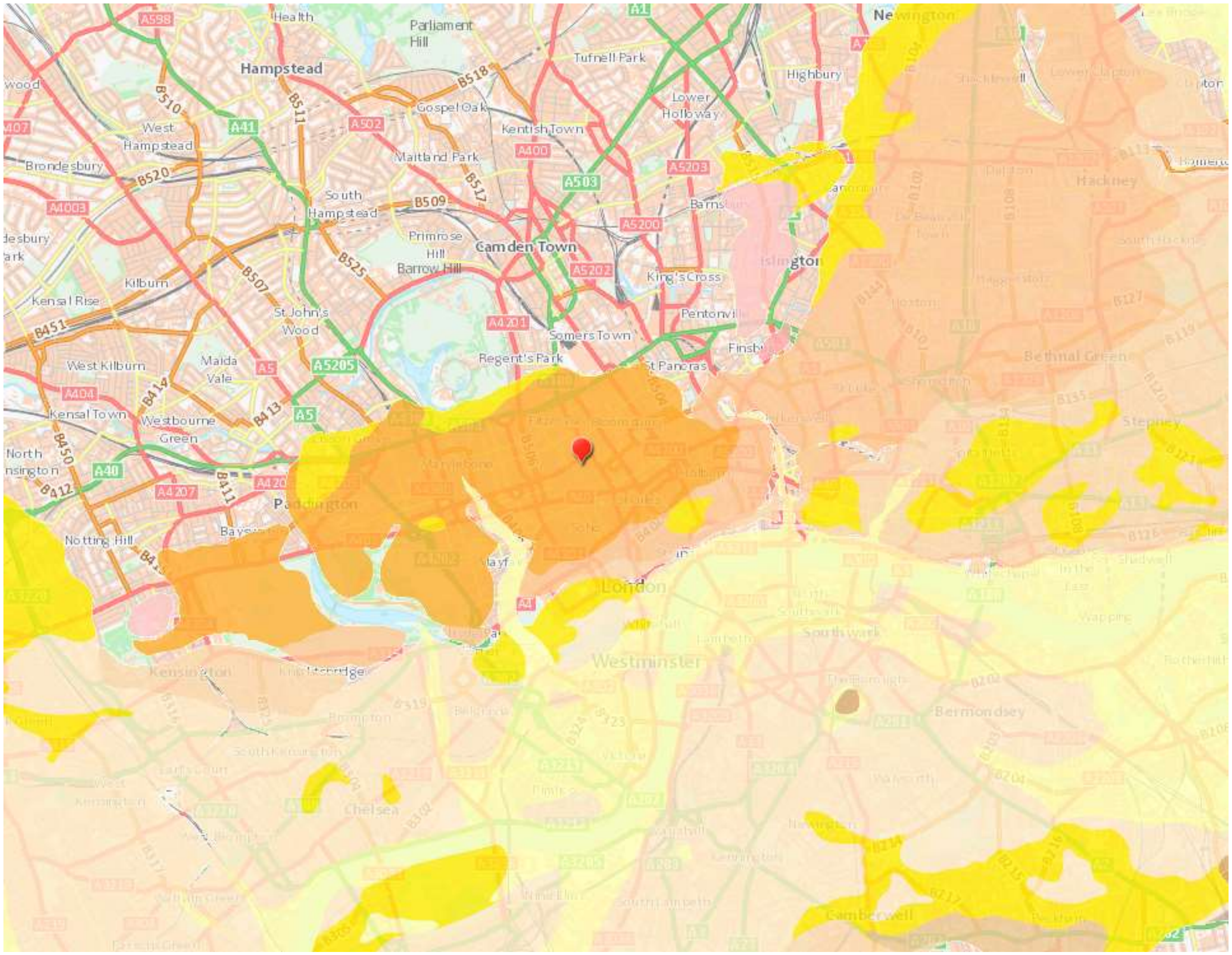

Figure 4 – BGS 1:50,000 Map, Superficial Geology

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

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October 2022

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Figure 5 – BGS 1:50,000 Map, Bedrock Geology

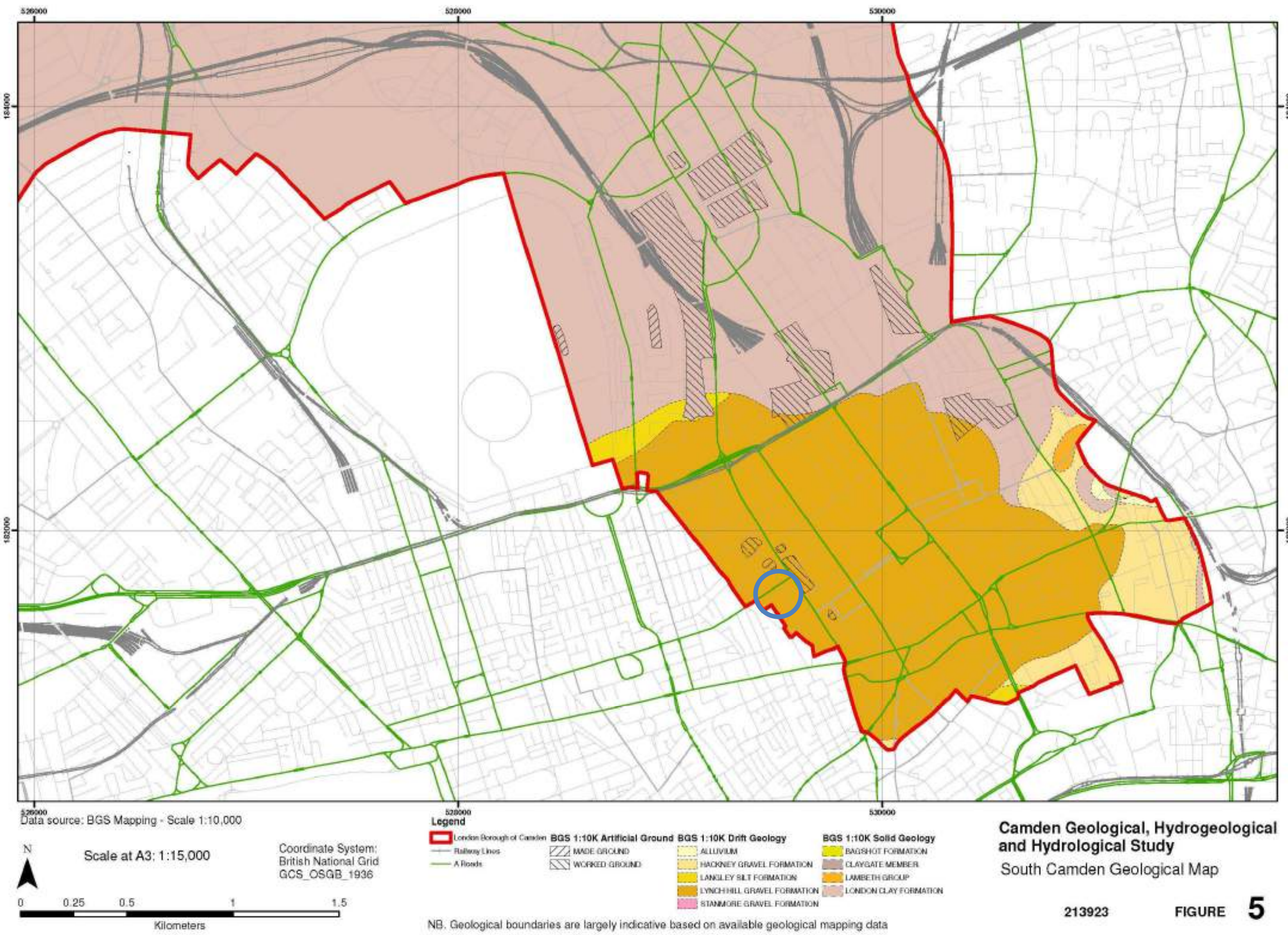
Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

Figure 6 – GHHS, Camden Geological Map



Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

Approximate site location

N

Figure 7 – Listed Buildings

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

N

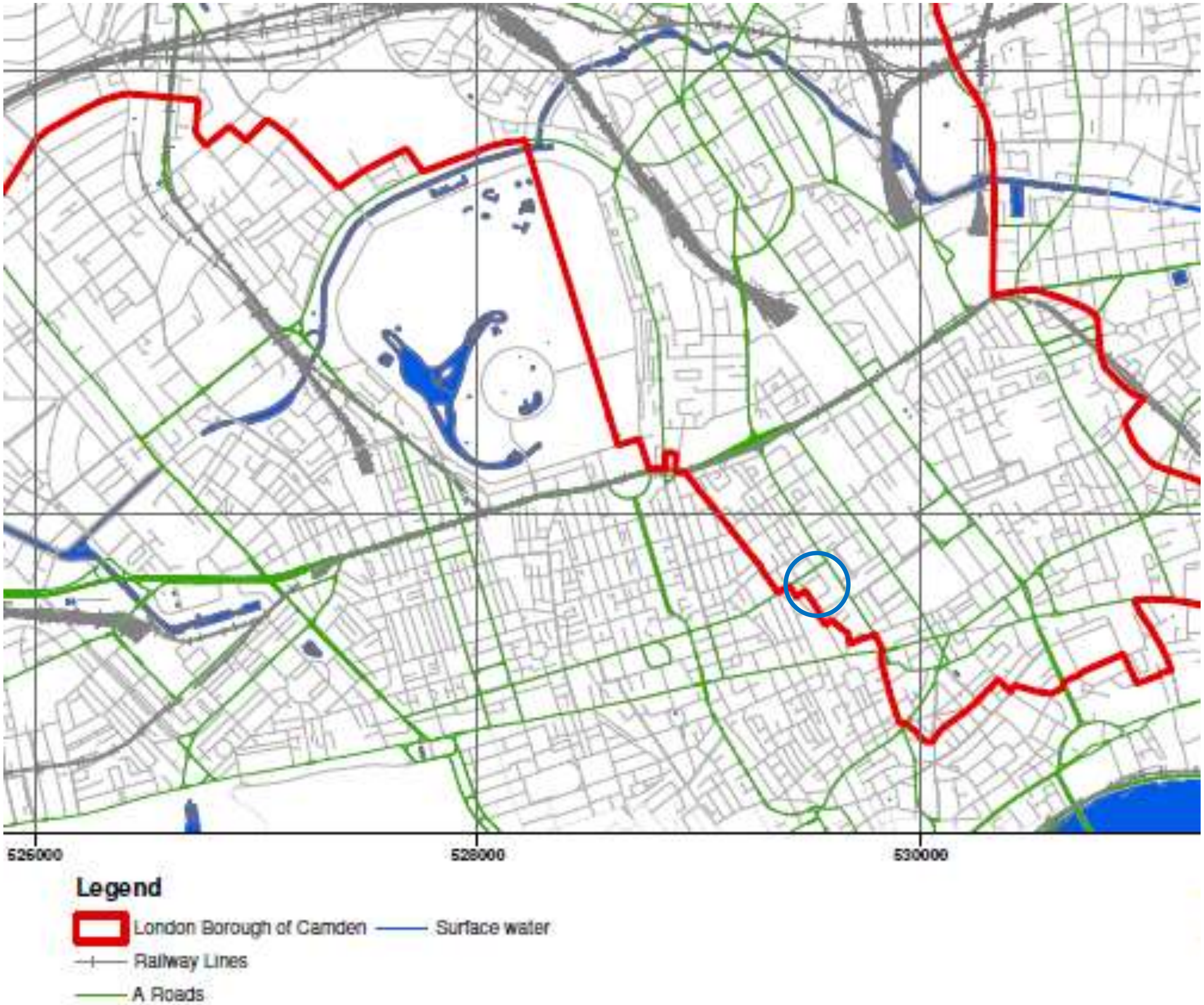


Figure 8 – GHHS, Surface Water Features

Project
28 Charlotte Street, London
W1T 2NF

Client
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c/o Rodrigues Associates

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October 2022

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18860

Approximate site location

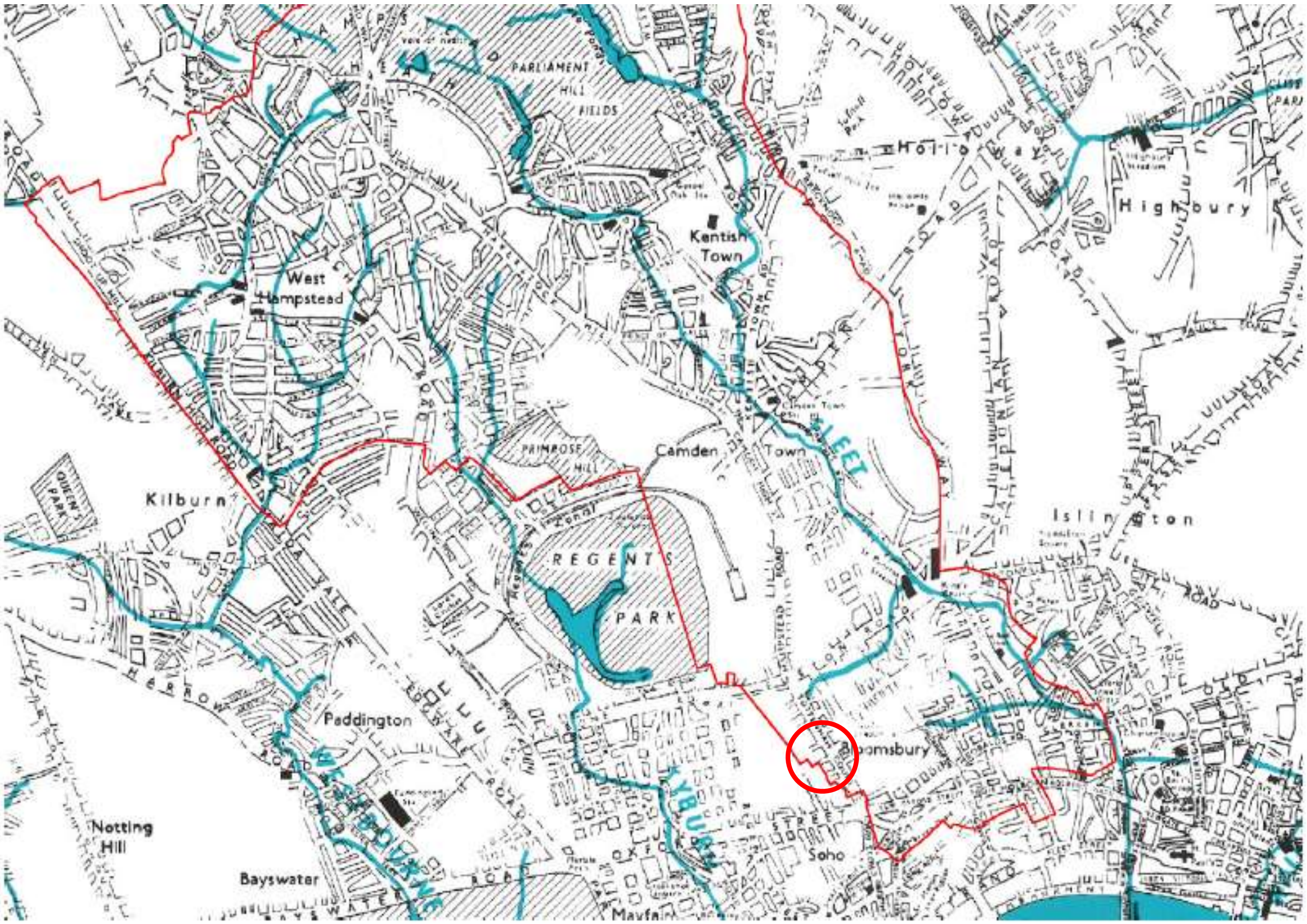

Figure 9 – GHHS, Lost Rivers

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

Approximate site location

Source – Barton, Lost Rivers of London

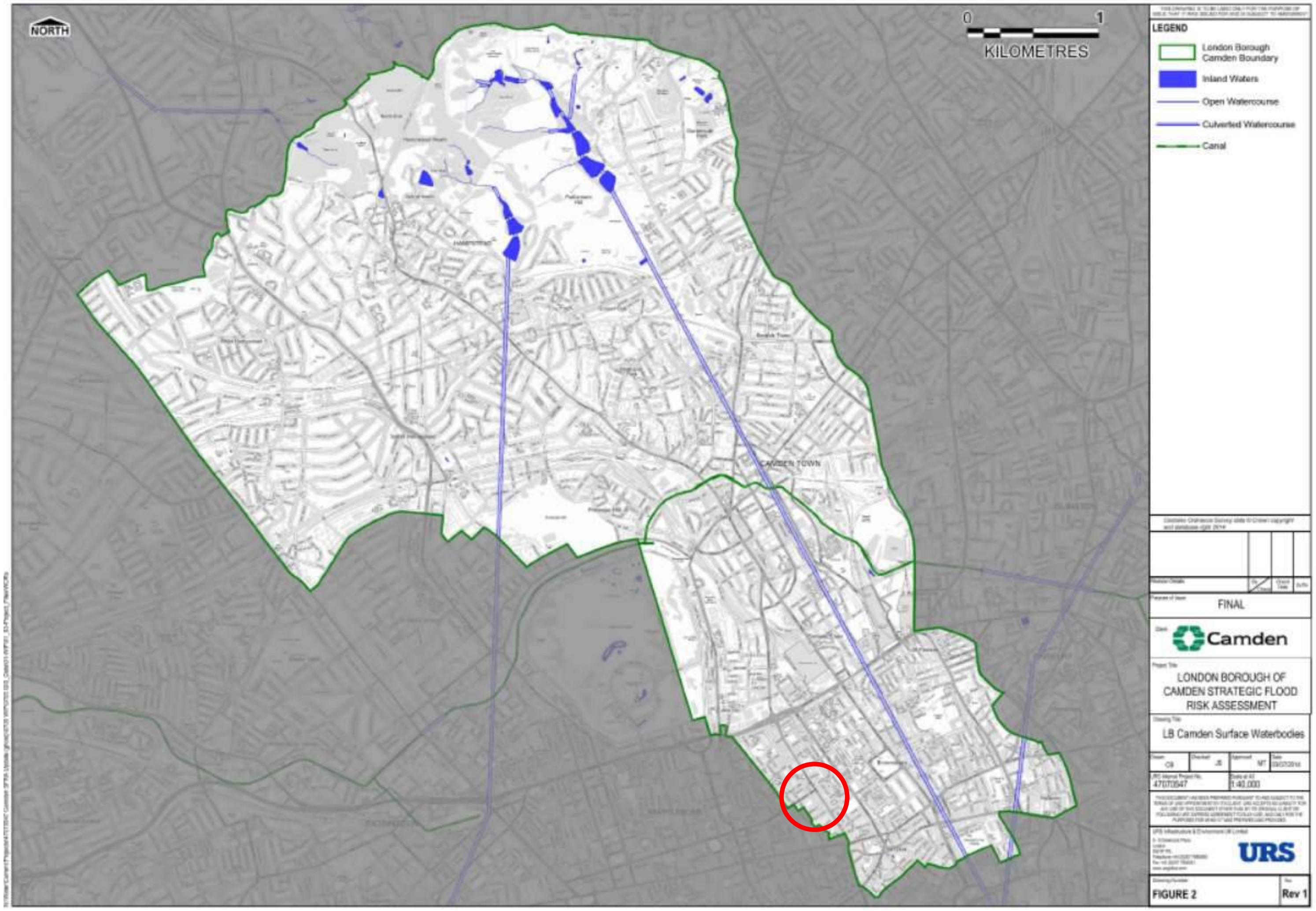

Figure 10 – SFRA, Surface Waterbodies

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
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October 2022

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18860

Approximate site location

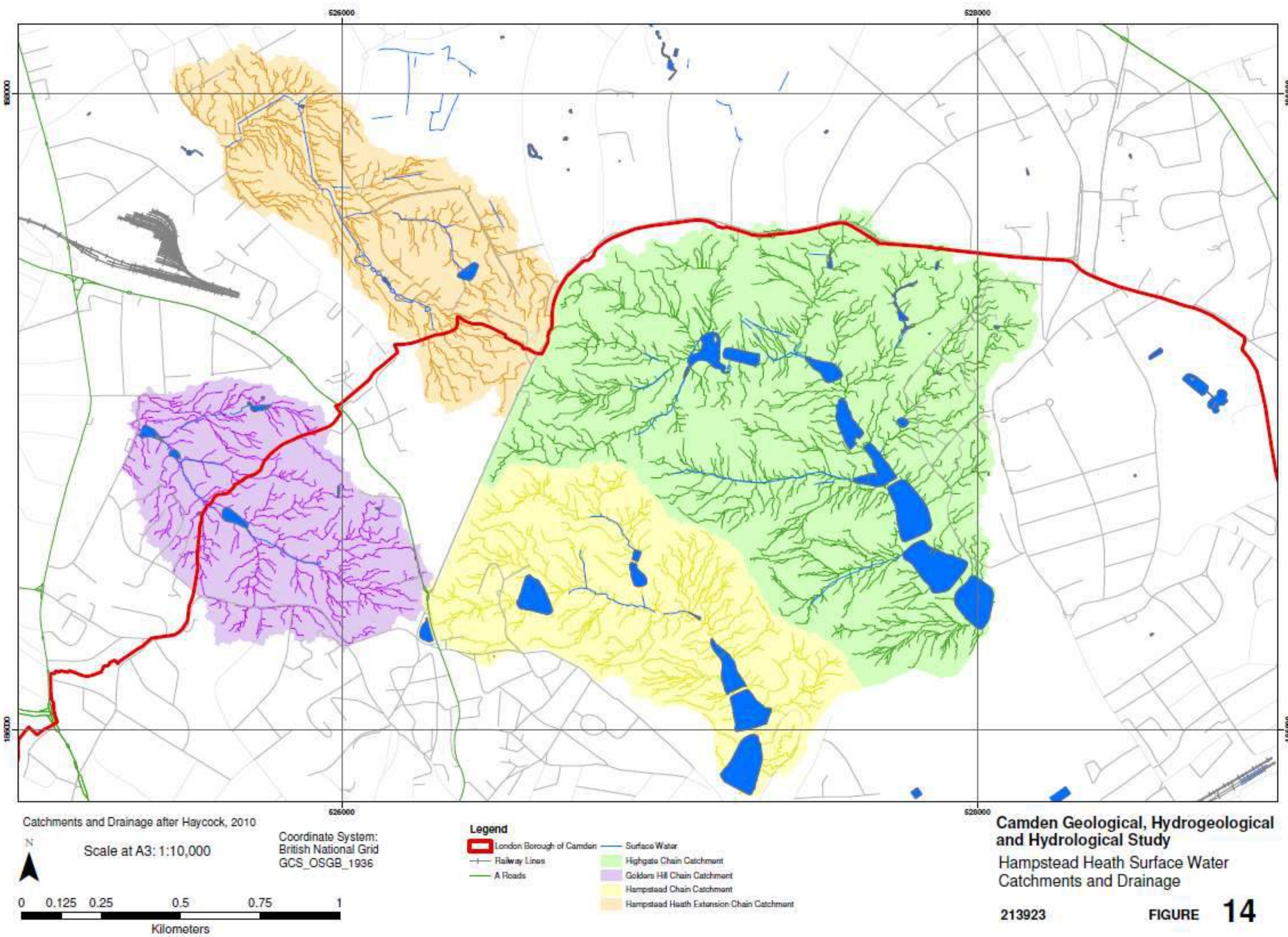

Figure 11 – GHHS, Hampstead Heath Pond Chains Catchment Area

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28 Charlotte Street, London
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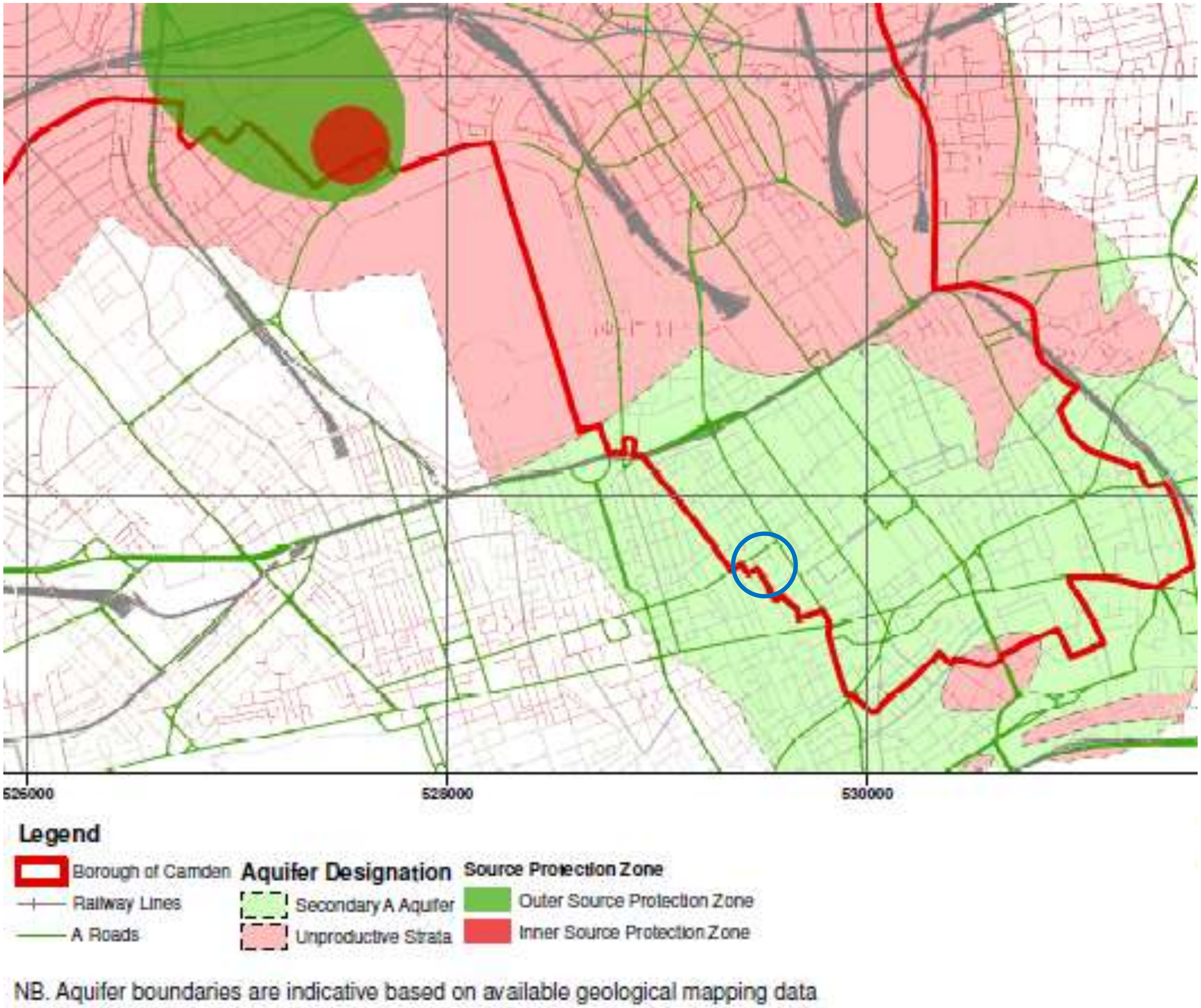


Figure 12 – GHHS, Aquifer Designation Map

Project
28 Charlotte Street, London
W1T 2NF

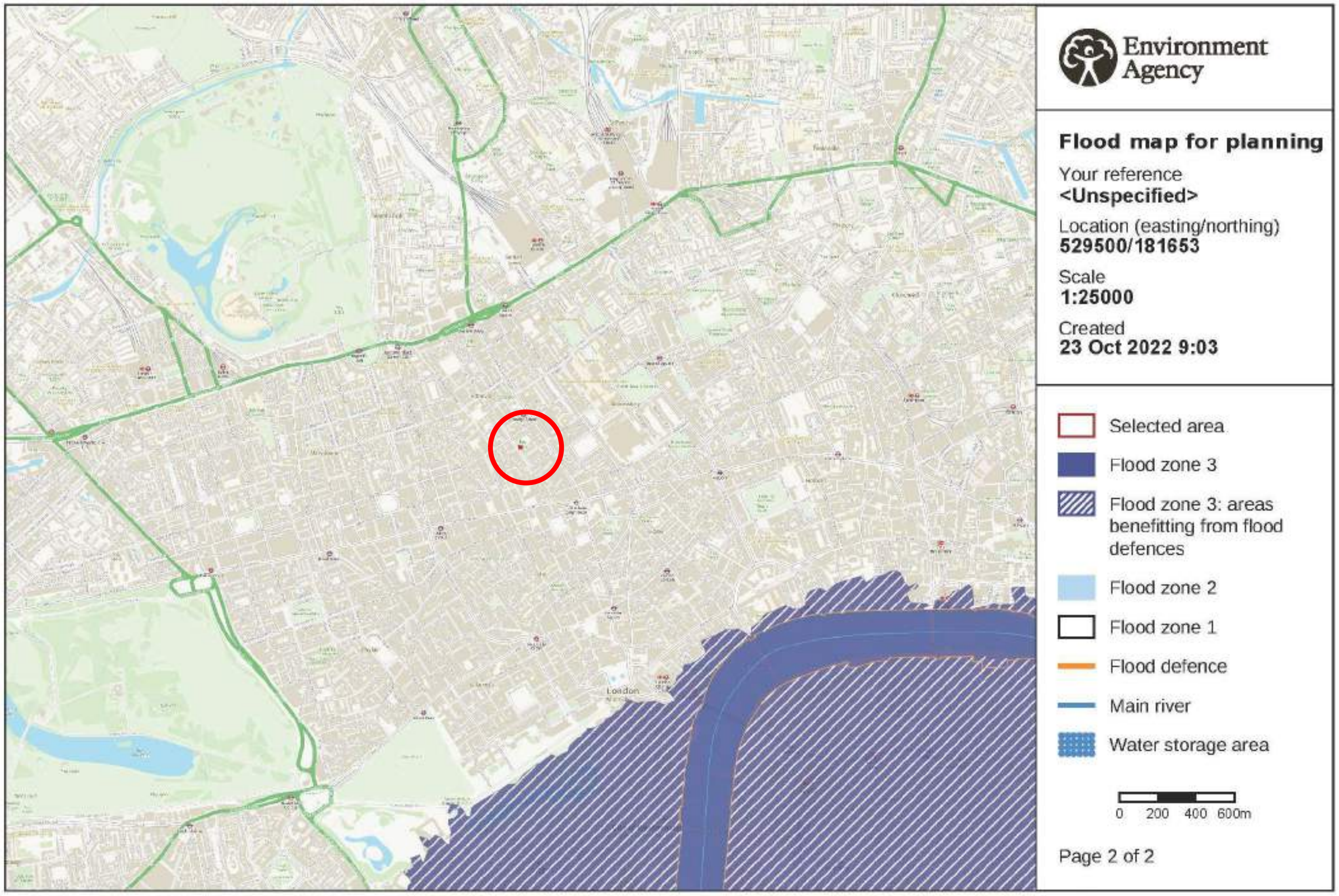
Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

Approximate site location

Figure 13 – EA, Flood Zones



Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

Approximate site location

N

Extent of flooding from rivers or the sea

High Medium Low Very low Location you selected

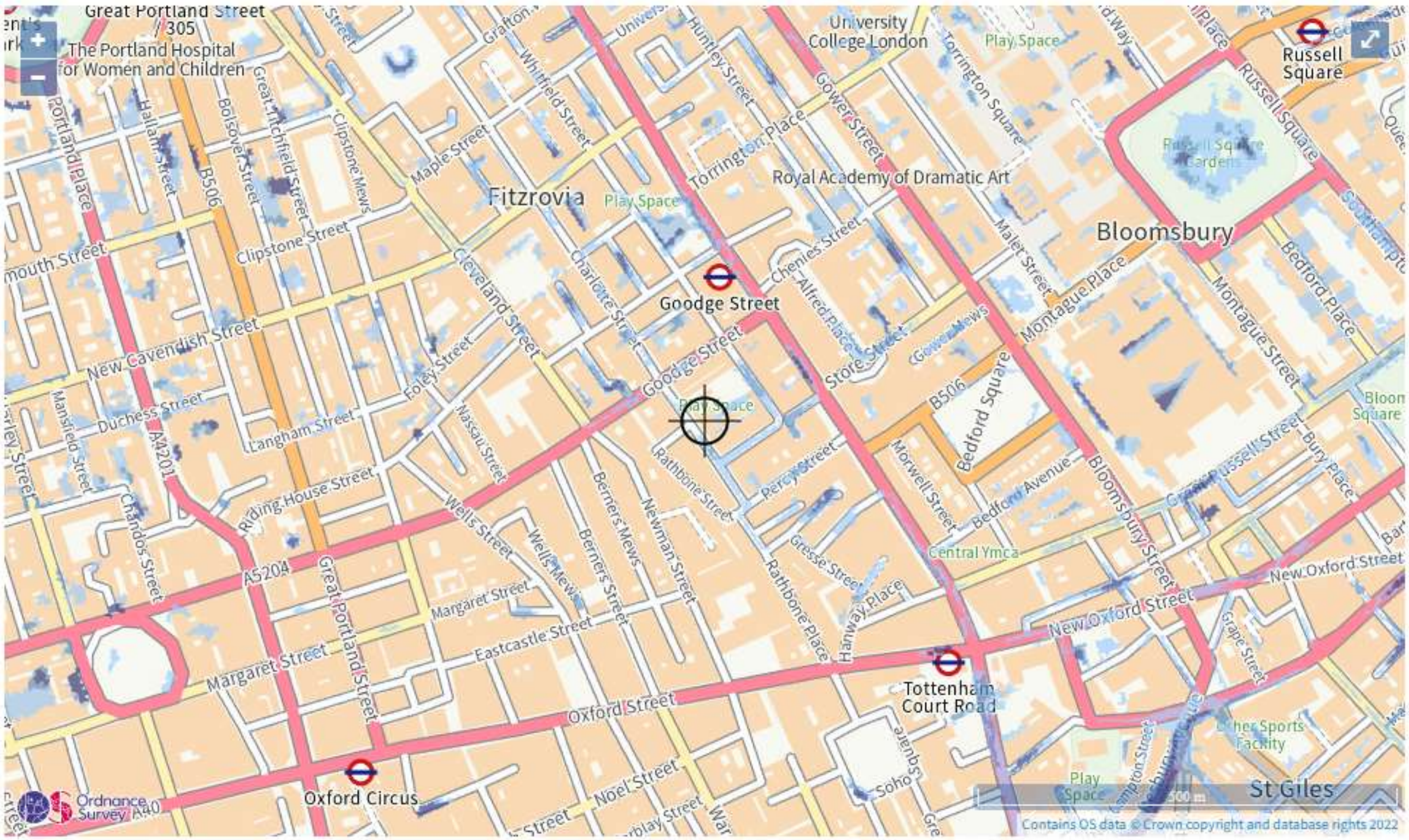
Figure 14 – EA, Flooding from Rivers and Sea

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860



Extent of flooding from surface water

High Medium Low Very low Location you selected

Figure 15 – EA, Flooding from Surface Water

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

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October 2022

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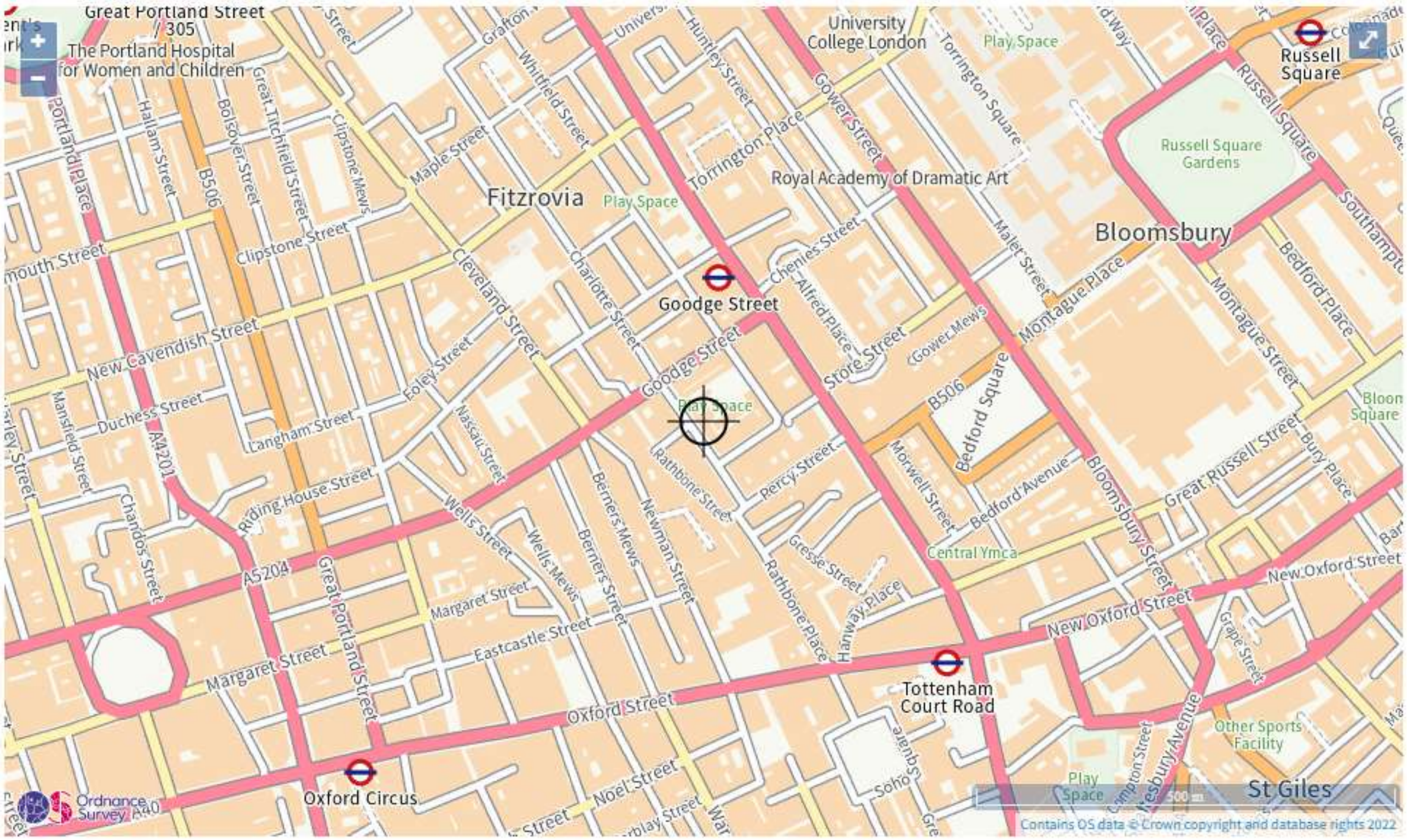
N



Maximum extent of flooding from reservoirs:

when river levels are normal | when there is also flooding from rivers | Location you selected

Figure 16 – EA, Flooding from Reservoirs

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

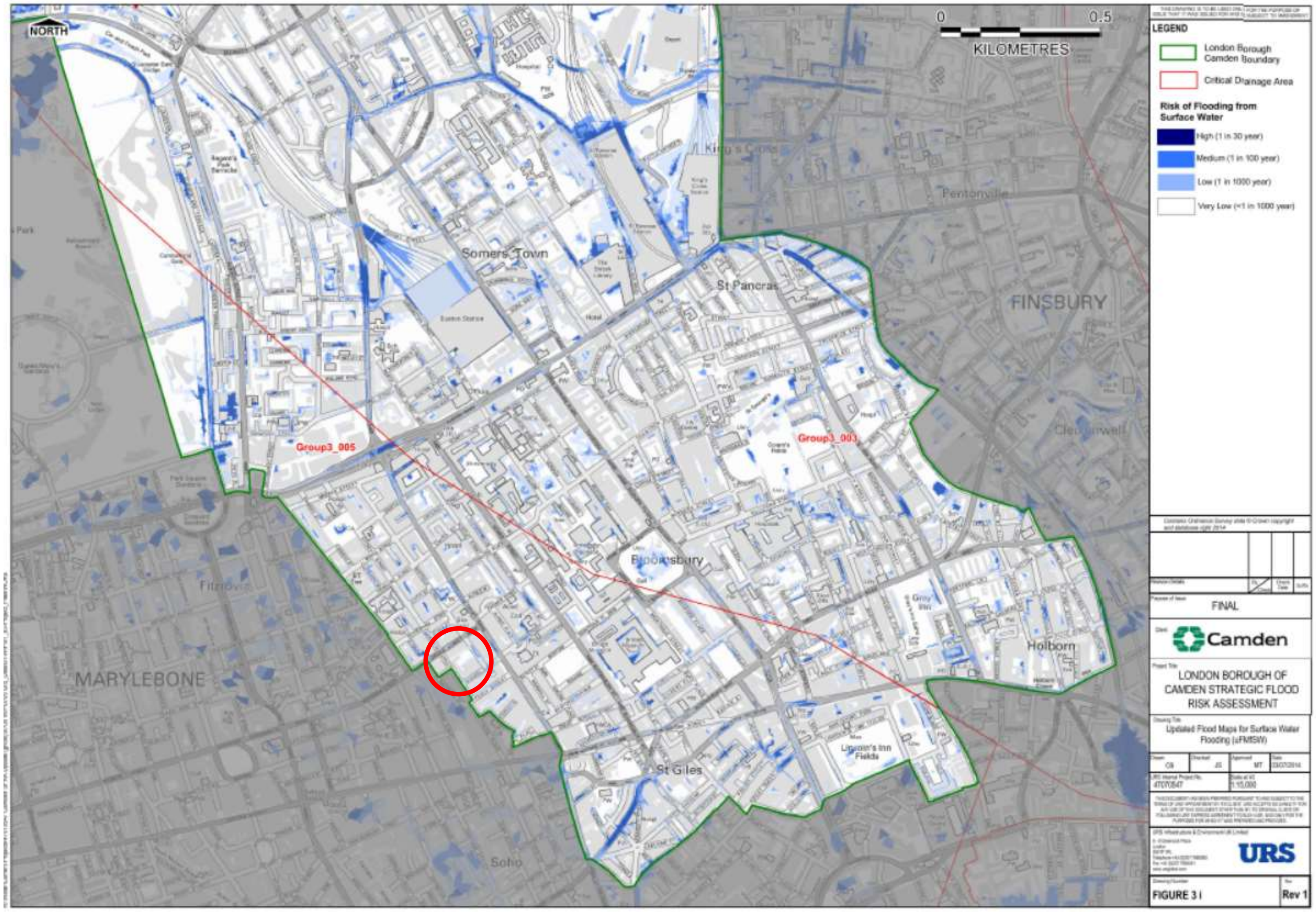


Figure 17 – SFRA, Flooding from Surface Water

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

Approximate site location

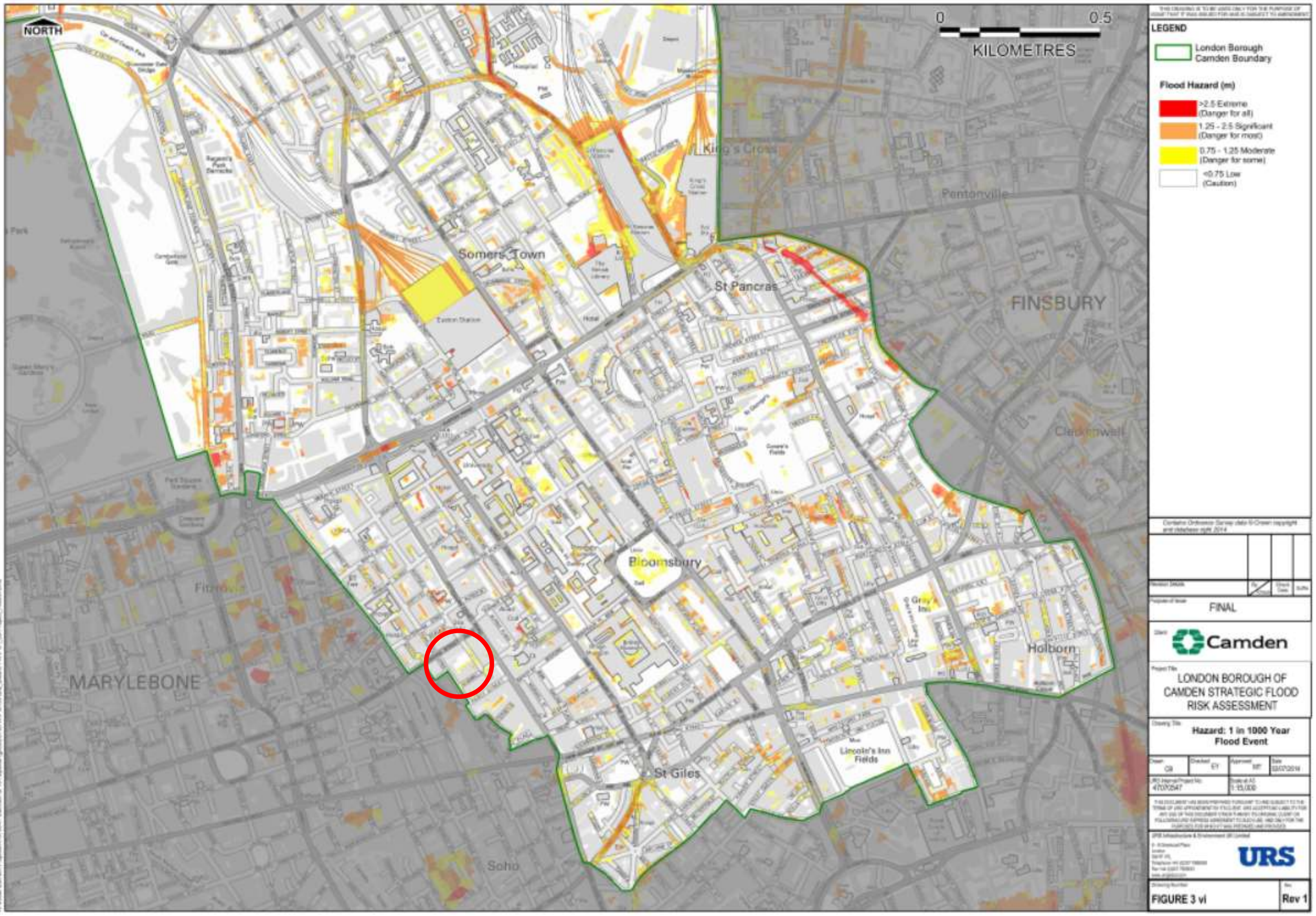


Figure 18 – SFRA, 1 in 1000 year Flood Event

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

Approximate site location

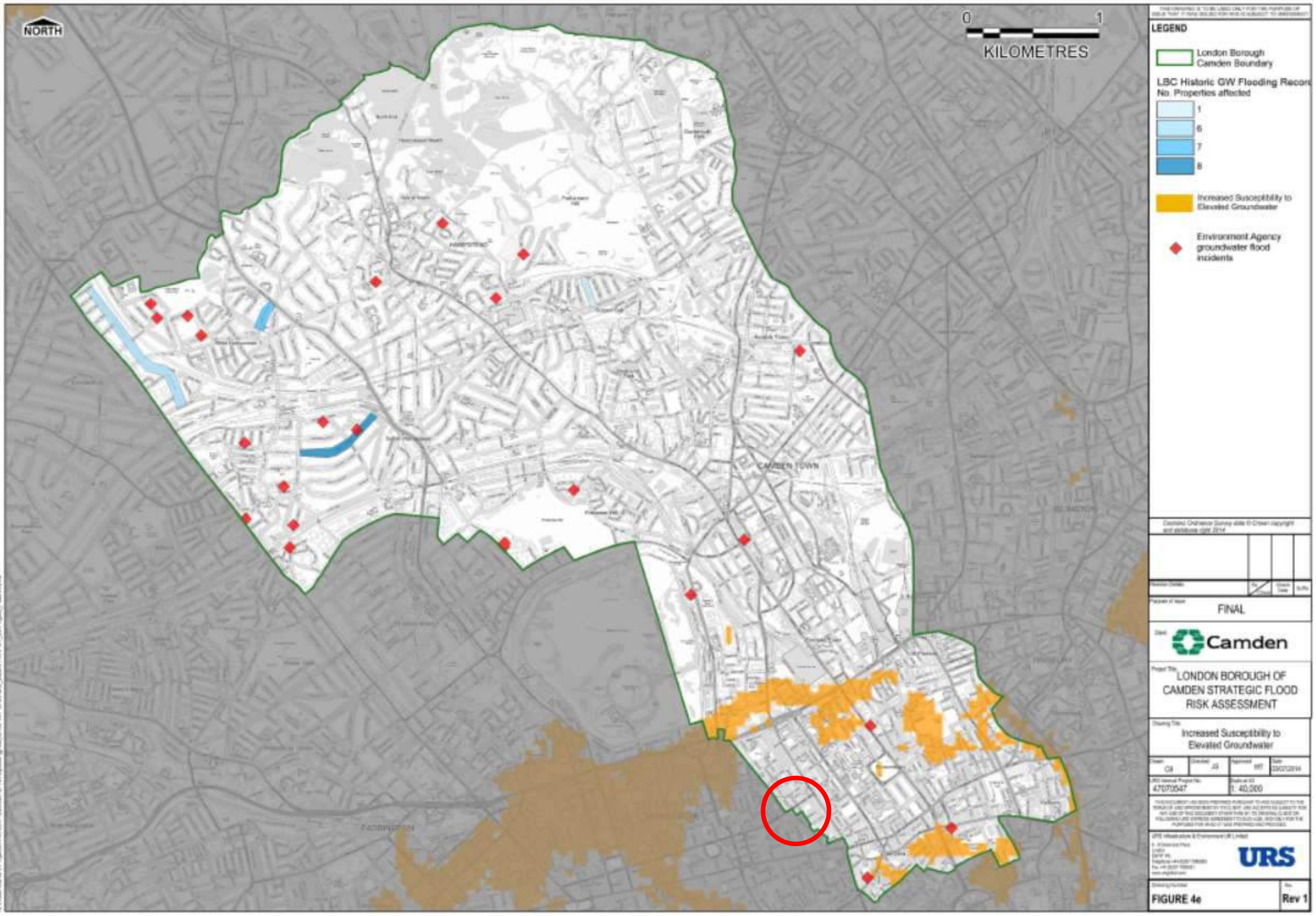


Figure 19 – SFRA, Susceptibility to Elevated Groundwater

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

Approximate site location

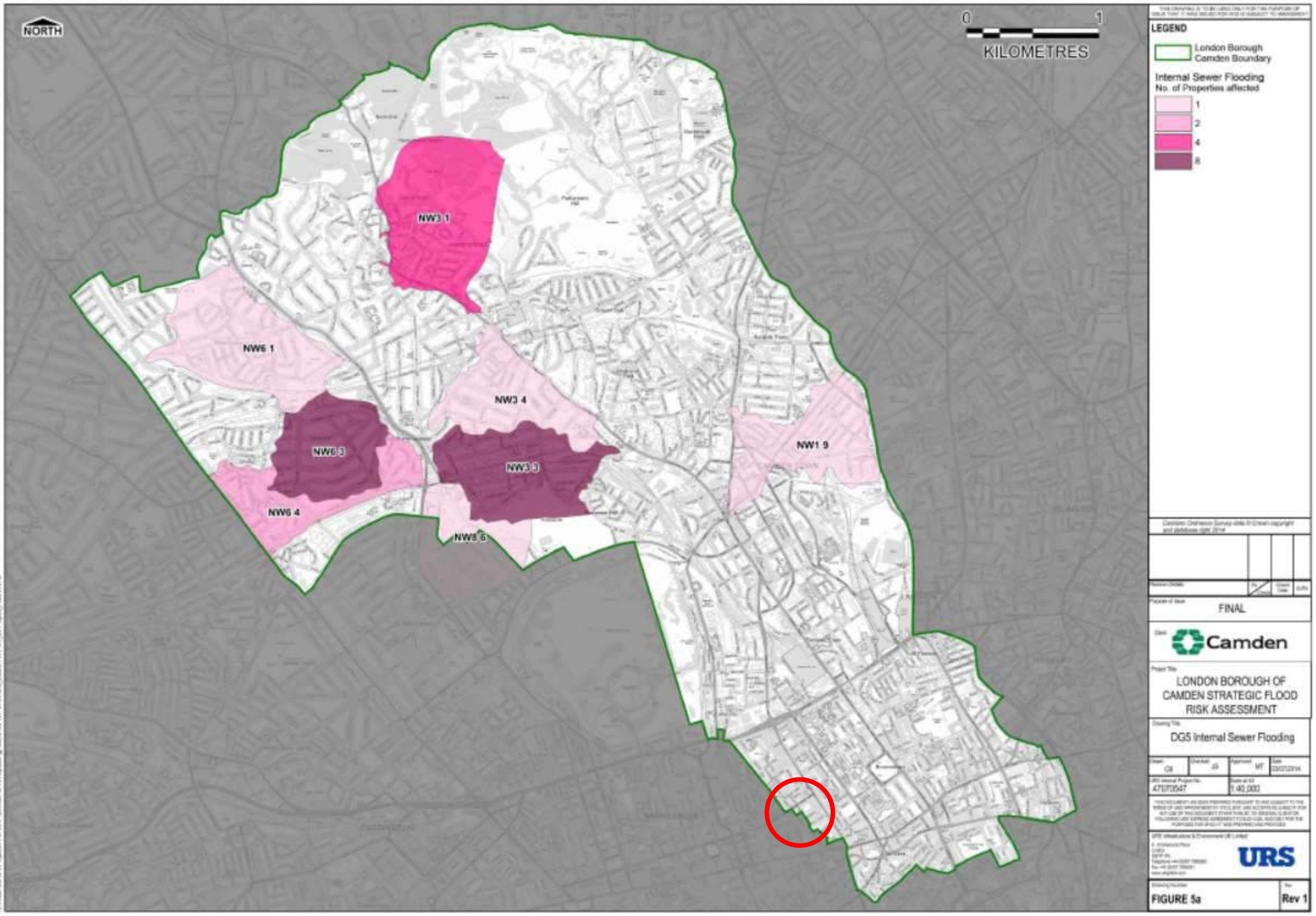


Figure 20 – SFRA, Internal Sewer Flooding

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

Approximate site location

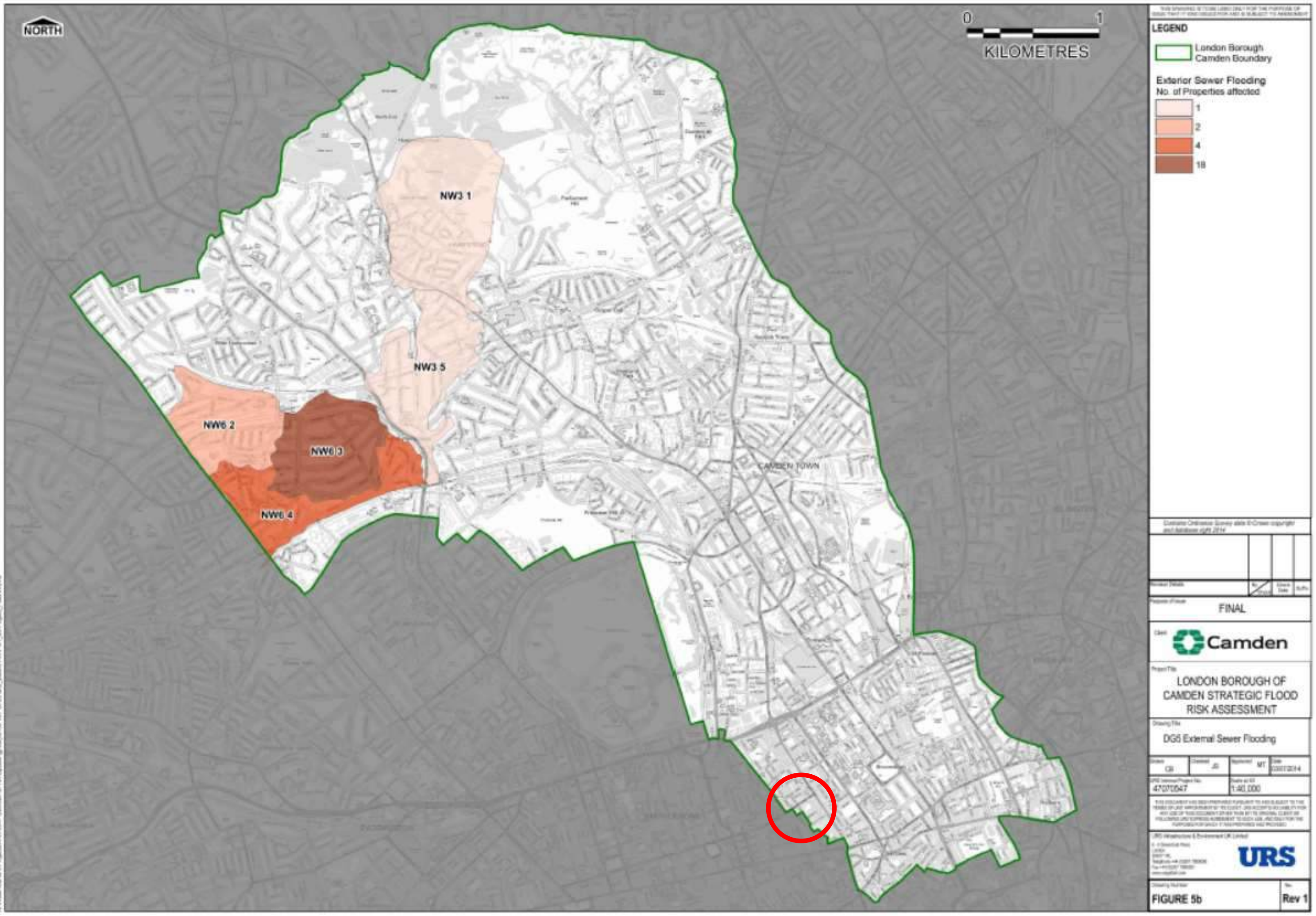


Figure 21 – SFRA, External Sewer Flooding

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

Approximate site location

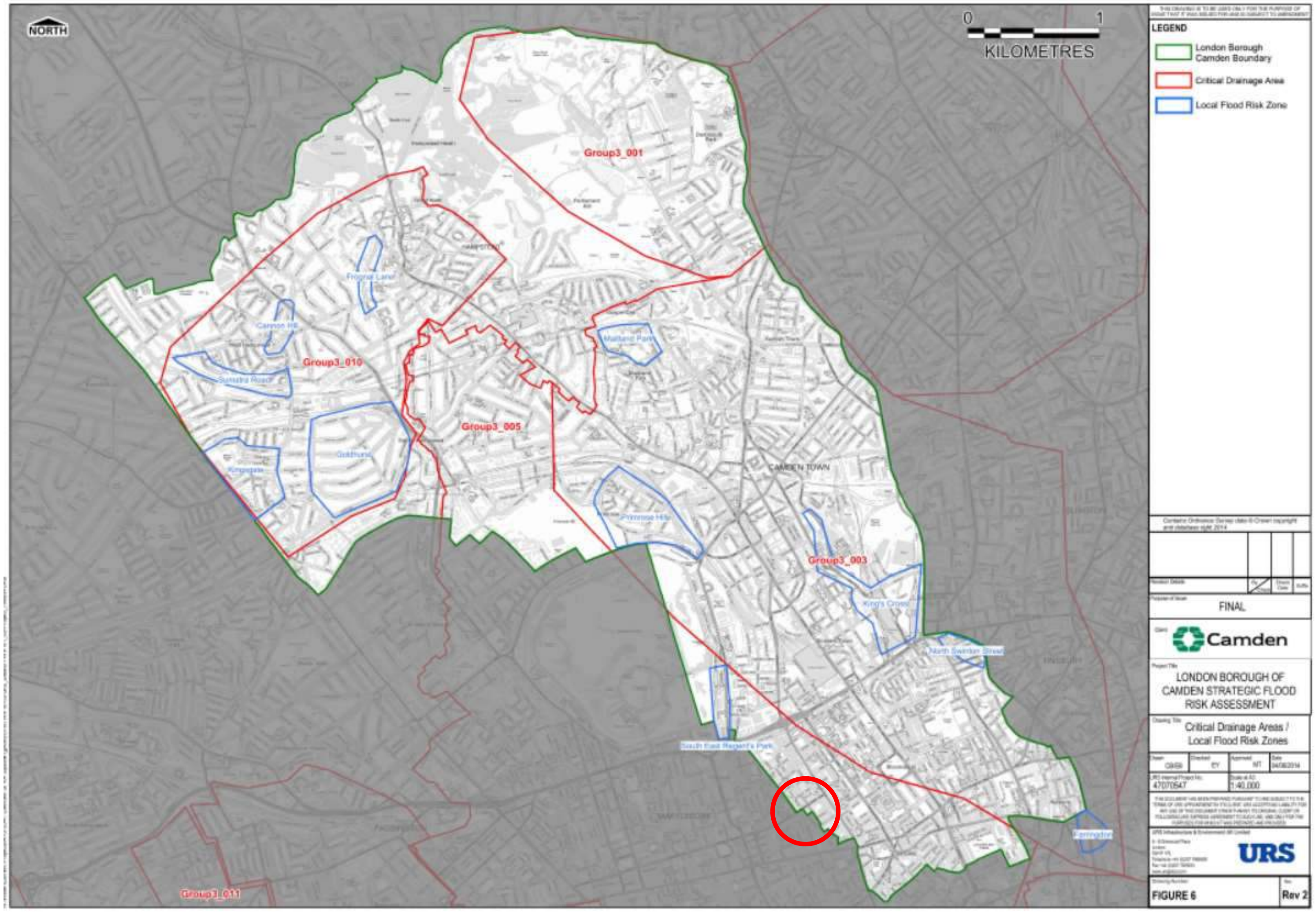


Figure 22 – SFRA, Critical Drainage Areas

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

Approximate site location

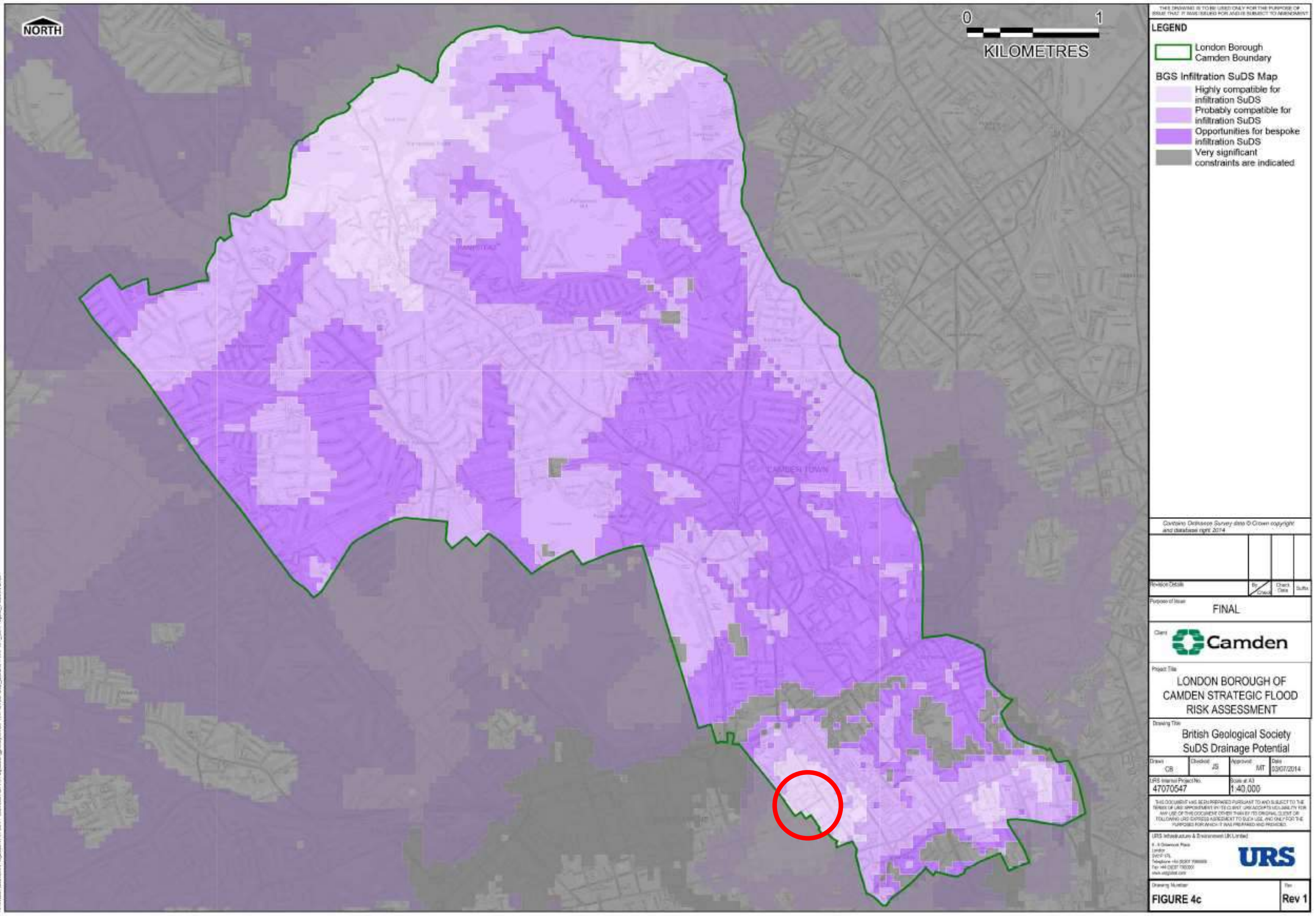


Figure 23 – SFRA, SuDS Drainage Potential

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

Approximate site location

Figure 24 – GHHS, Historic Flooding Events

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

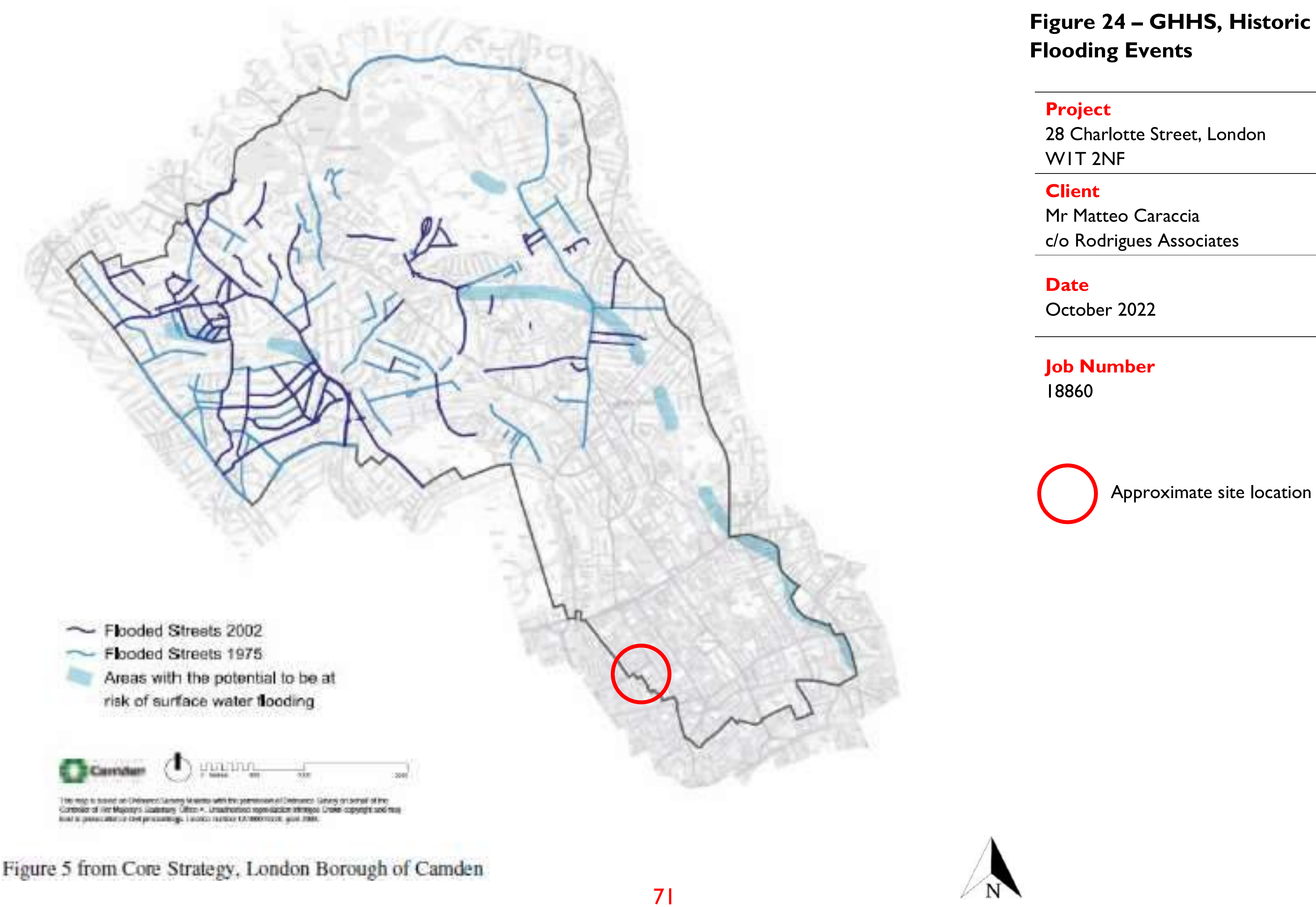


Figure 5 from Core Strategy, London Borough of Camden

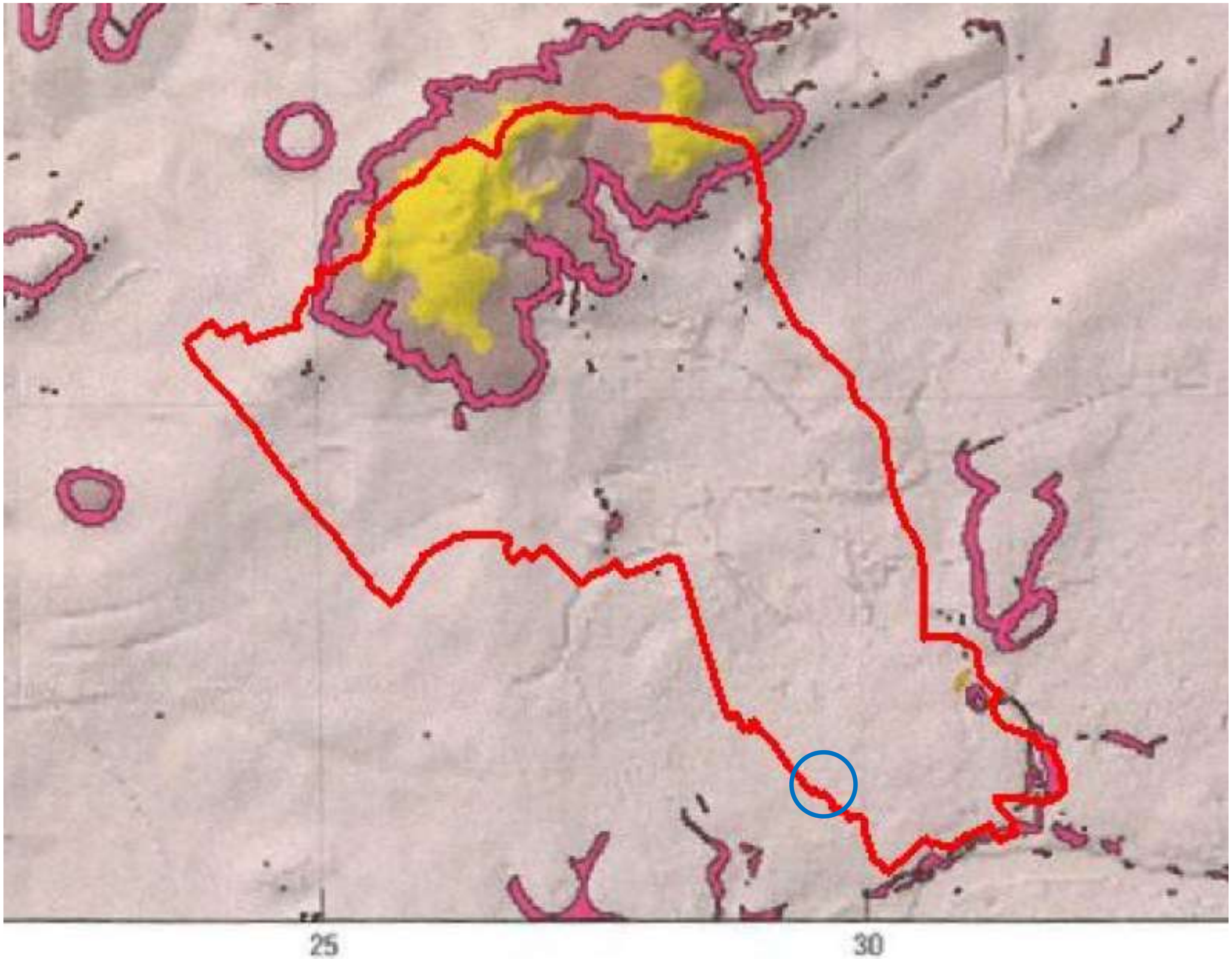


Figure 25 – GHHS, Slope Stability

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

Approximate site location

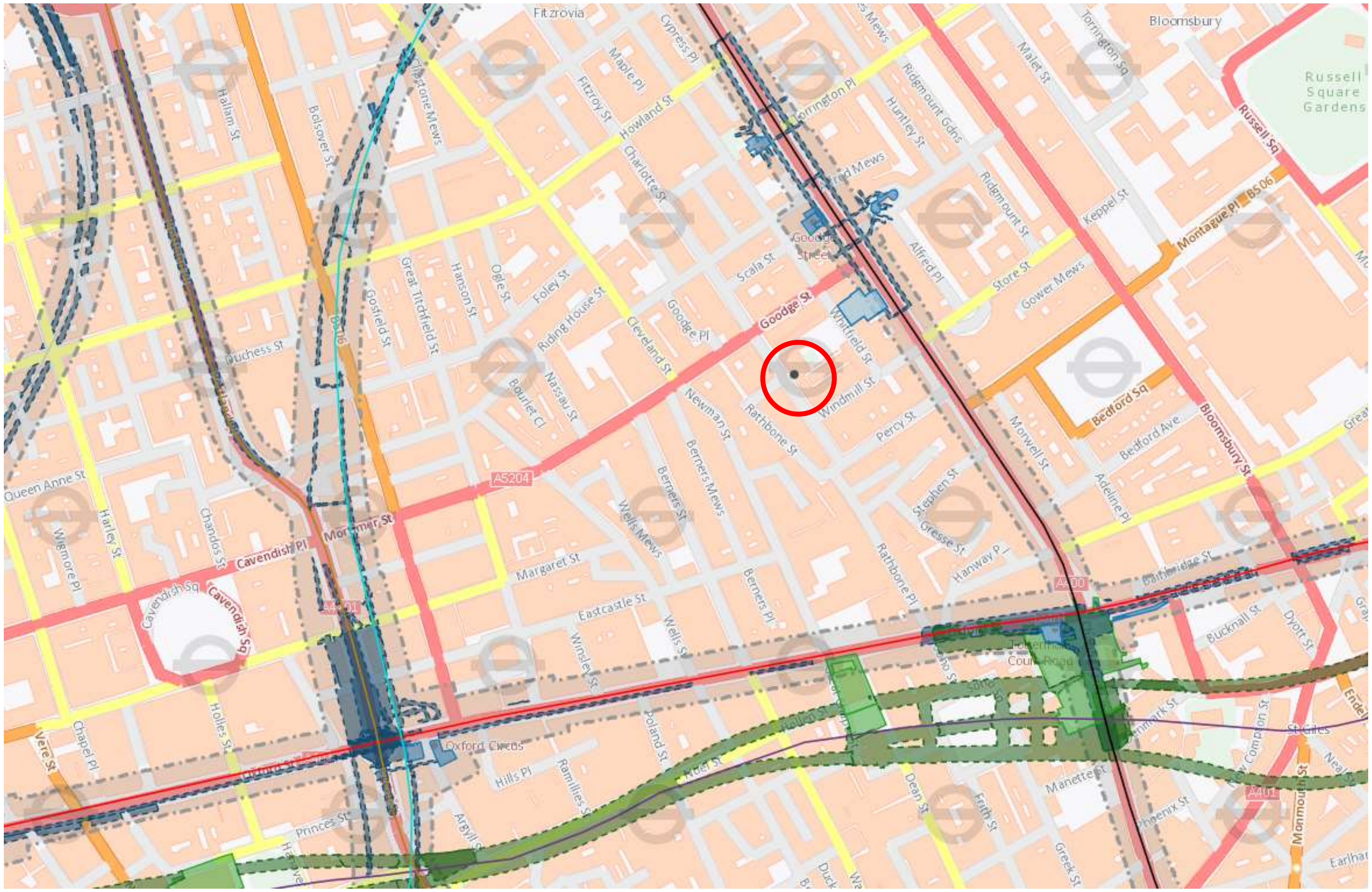


Figure 26 – TFL, Underground Infrastructures

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

Approximate site location

N

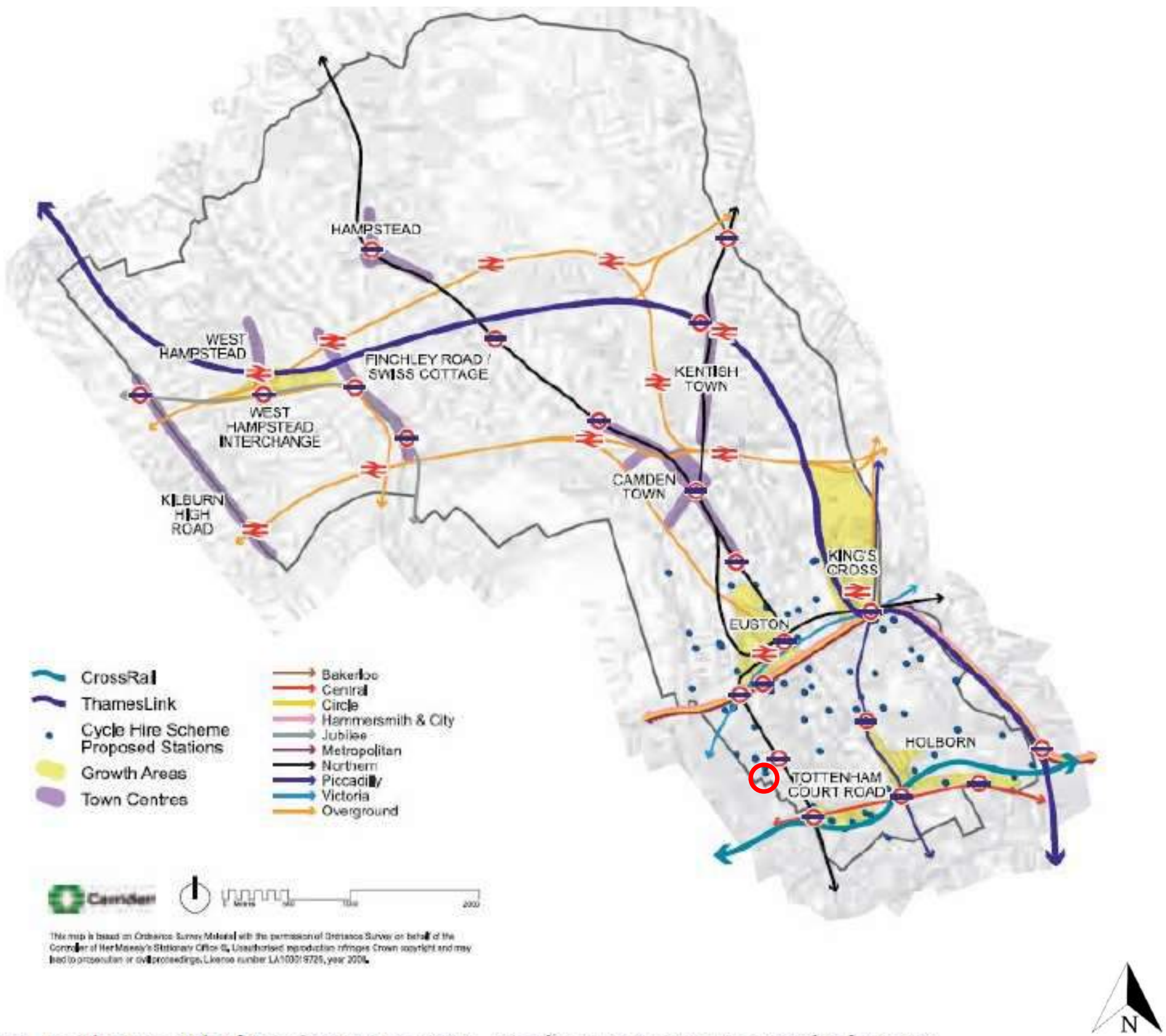
Figure 27 – GHHS, Underground Infrastructures

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860



Source - London Borough of Camden, January 2010. *Camden Core Strategy Proposed Submission.*

SITE LOCATION

Location: W1T 2NF,
Map Centre: 529497,181651

LEGEND

London Bomb Risk

miltary	industry	UXO find	Other
transport	dock	Luftwaffe targets	
utilities	abandoned bombs	Bombing decoy	

Figure 28 – Zetica UXO, UXO Risk Map

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

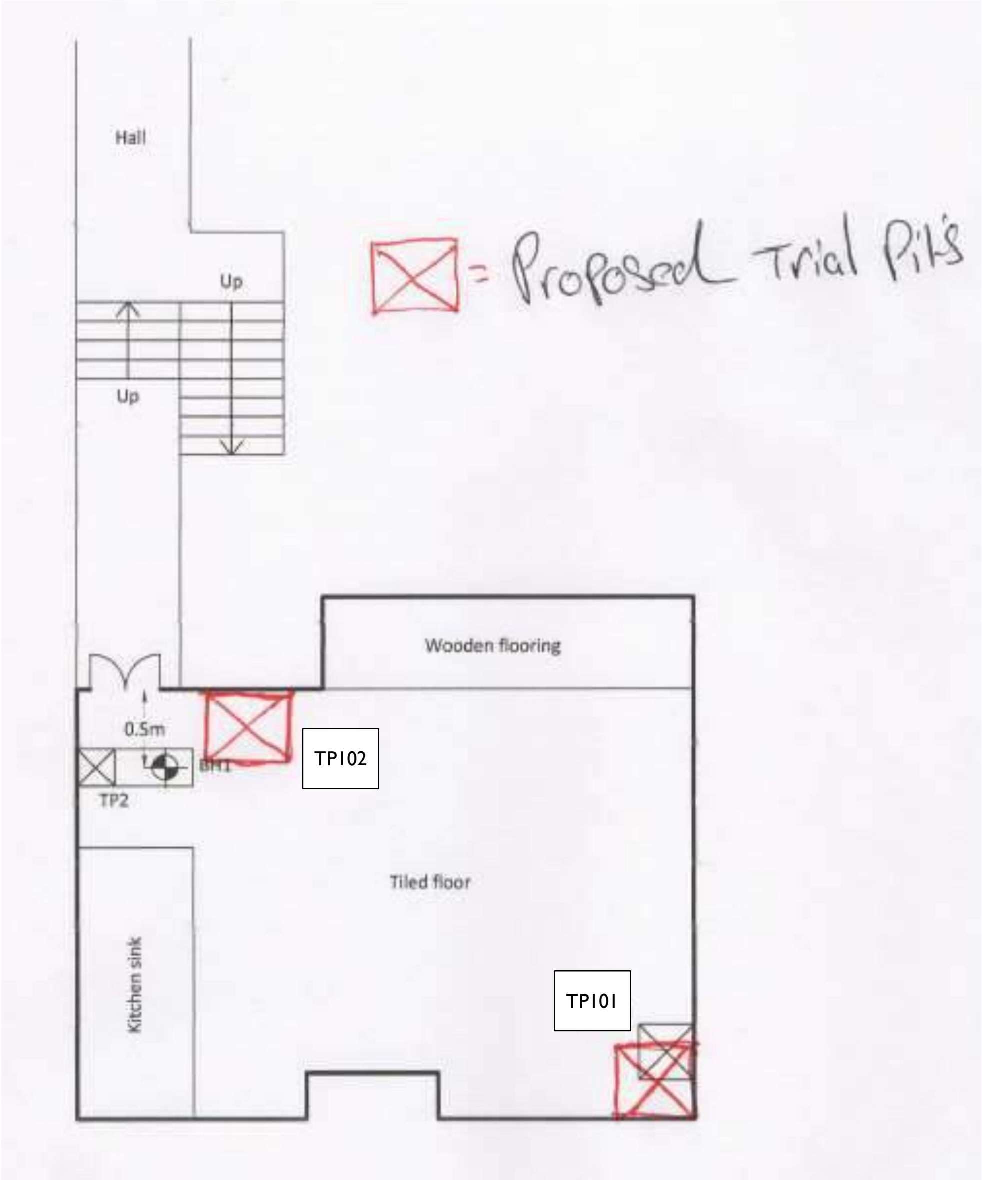


Figure 29 – Trial Hole Plan

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

Figure 30 – GMA, Critical Scenario CS1

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

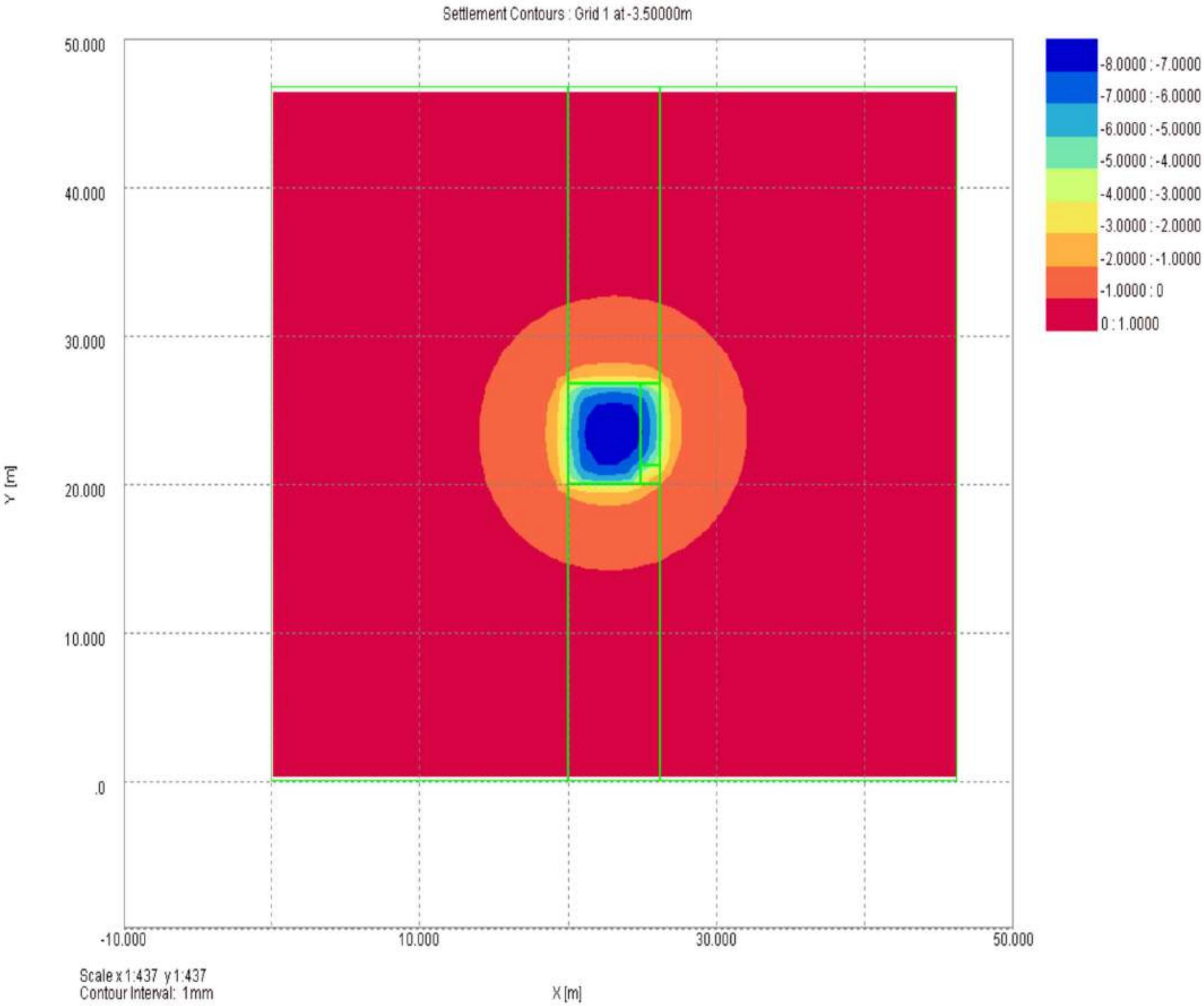


Figure 31 – GMA, Short Term Heave

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

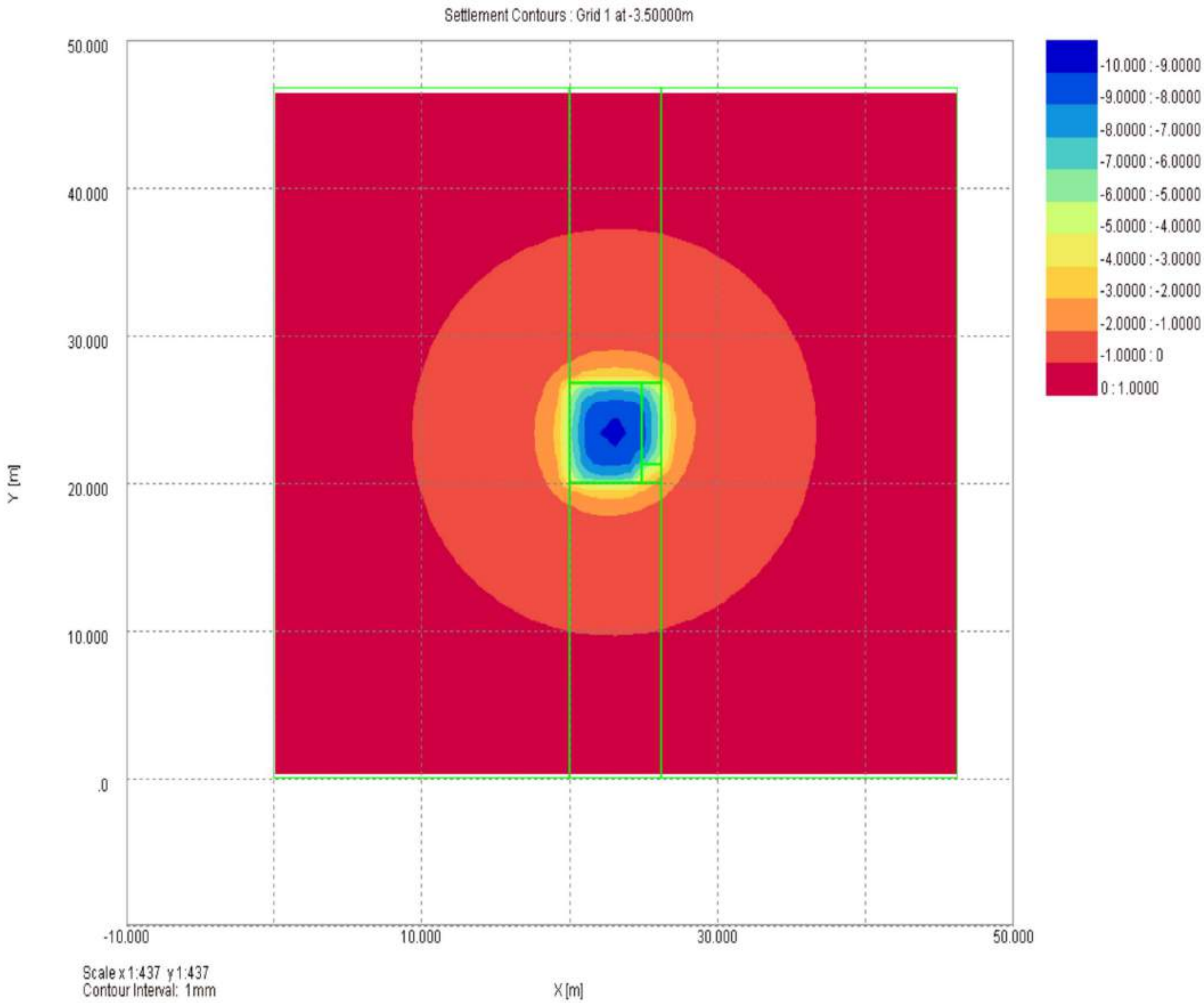


Figure 32 – GMA, Long Term Heave

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

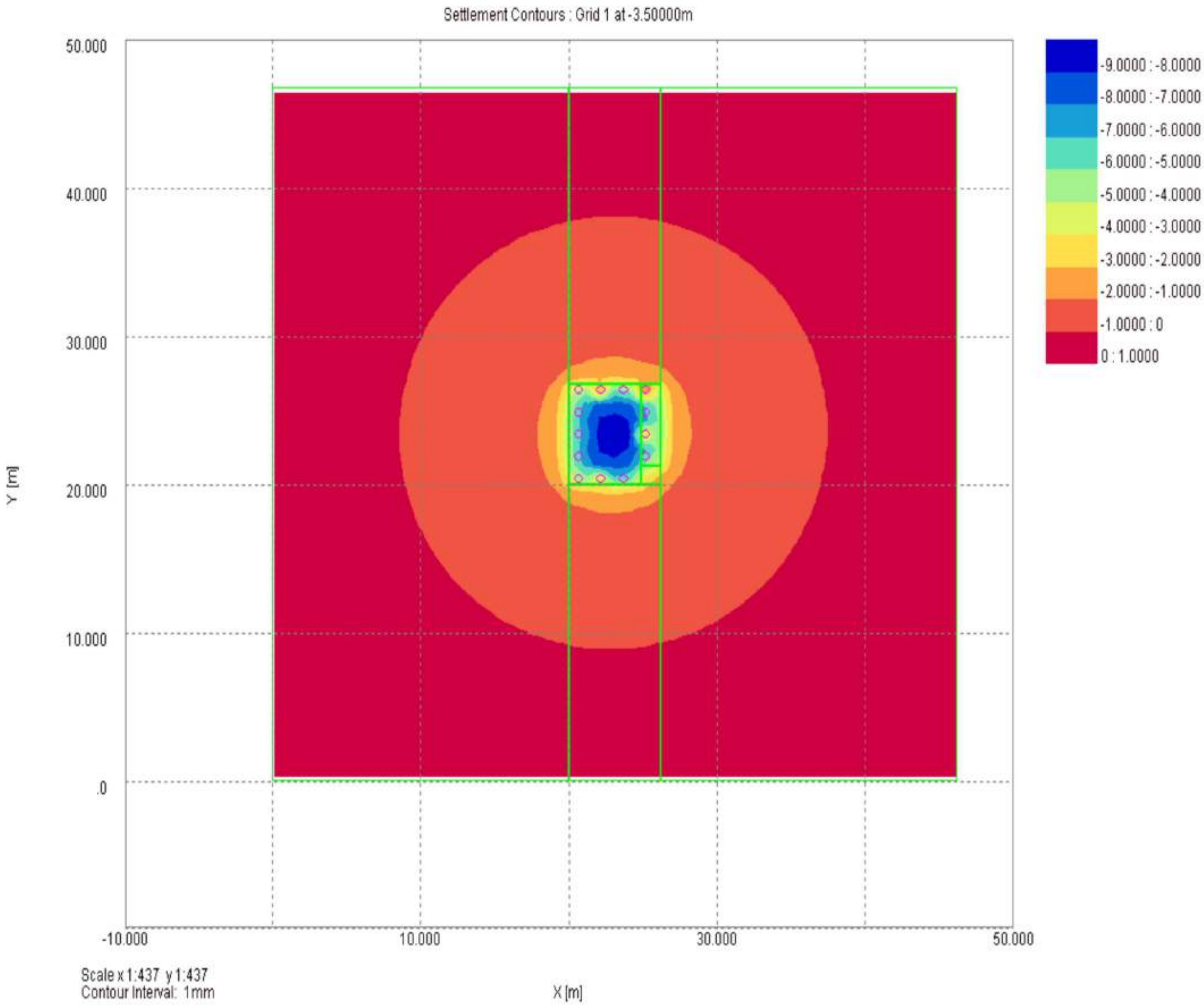


Figure 33 – GMA, Long Term Movements

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

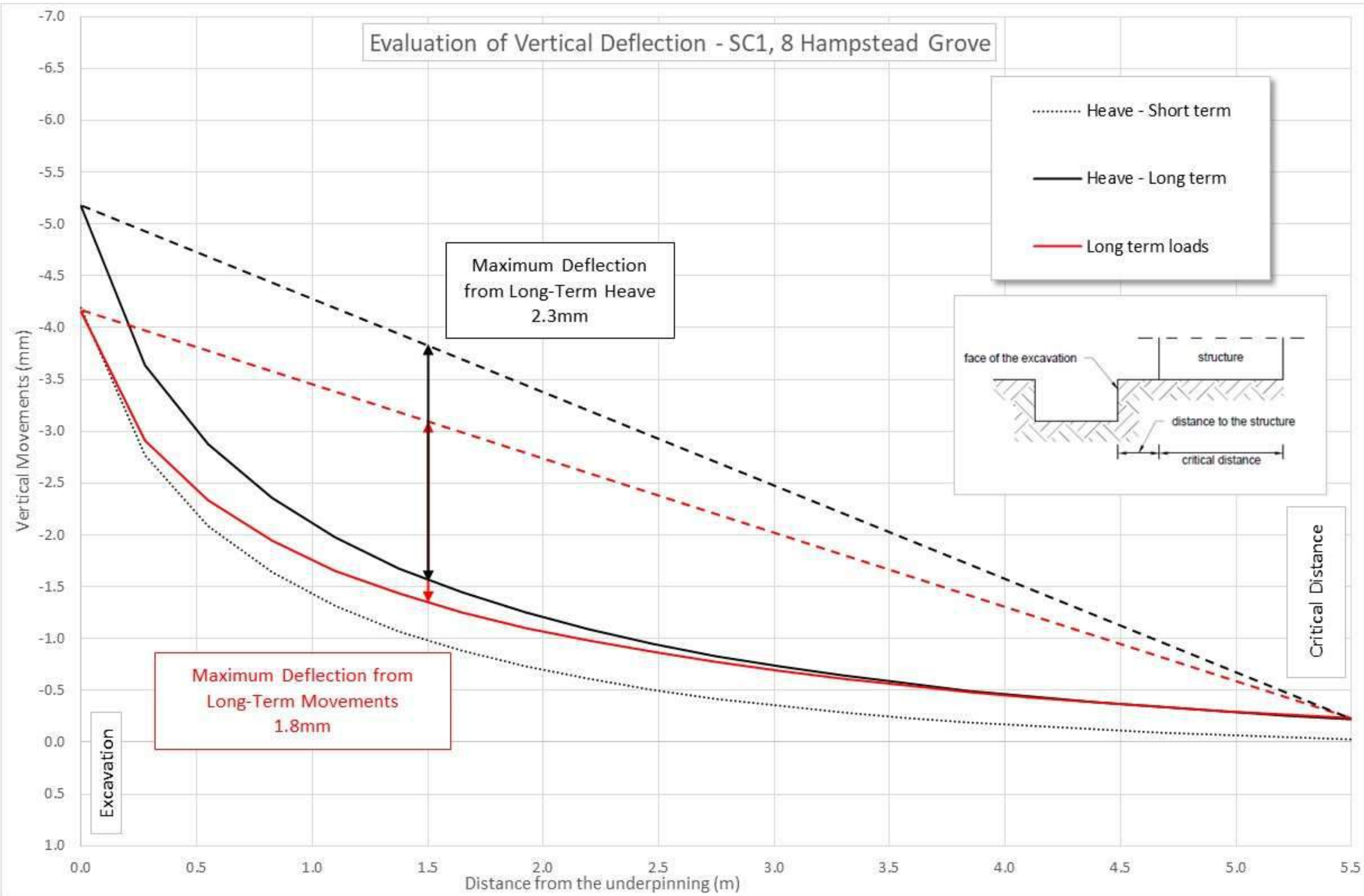


Figure 34 – GMA, Vertical Deflection Scenario CS1

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

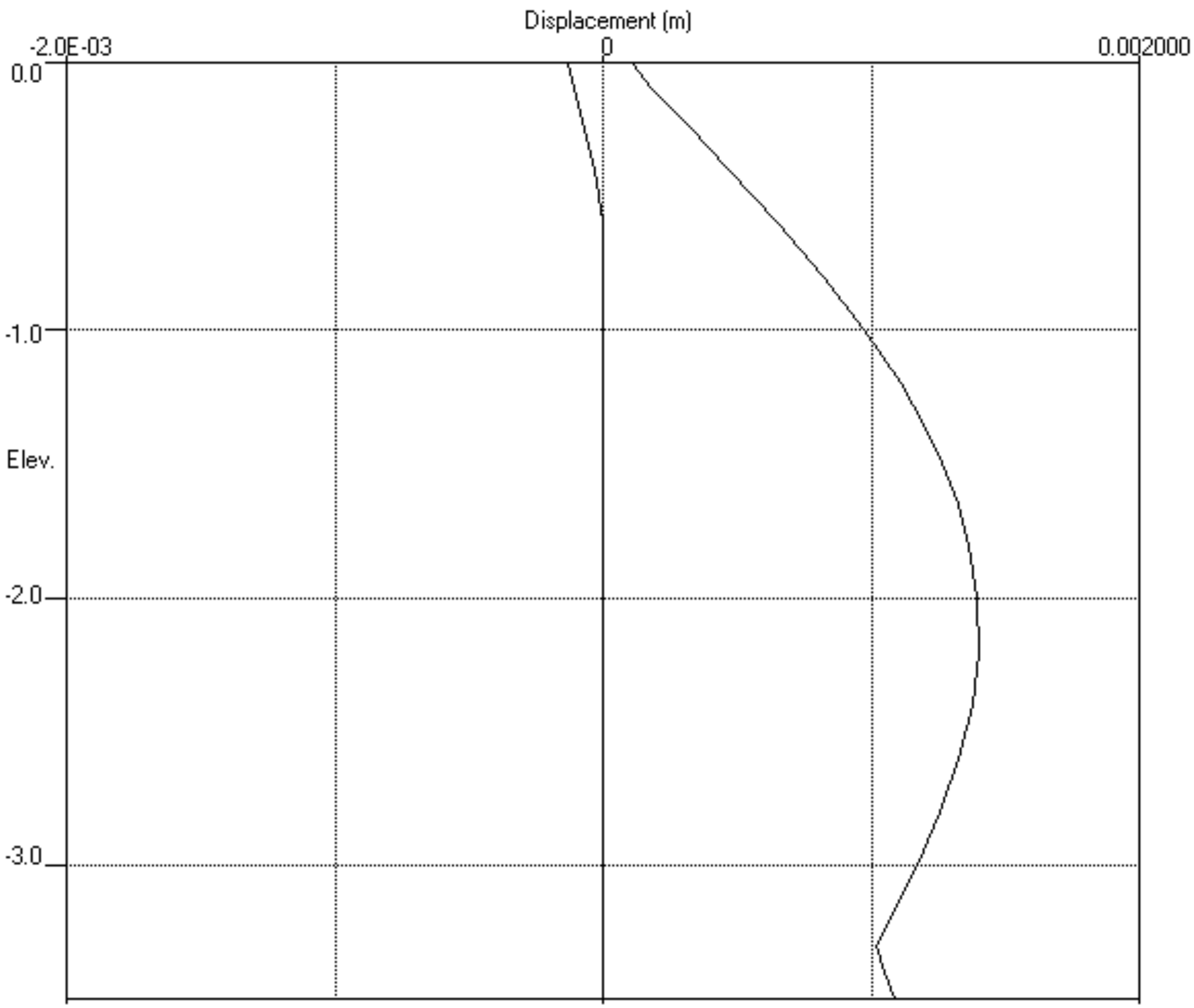


Figure 35 – GMA, Horizontal Deflection Scenario CS1

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

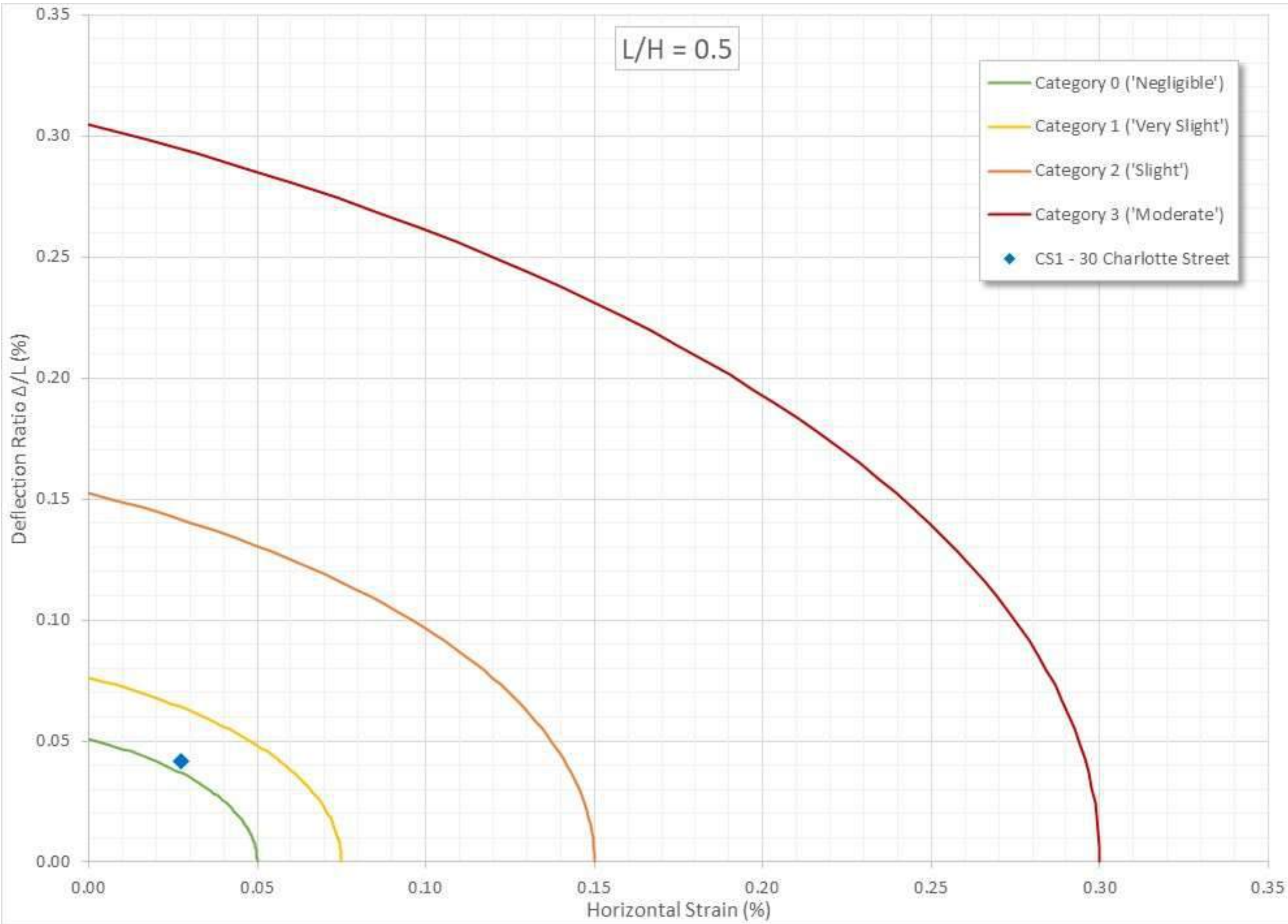


Figure 36 – GMA, Damage Category

Project
28 Charlotte Street, London
W1T 2NF

Client
Mr Matteo Caraccia
c/o Rodrigues Associates

Date
October 2022

Job Number
18860

Appendix A Standards and Resources

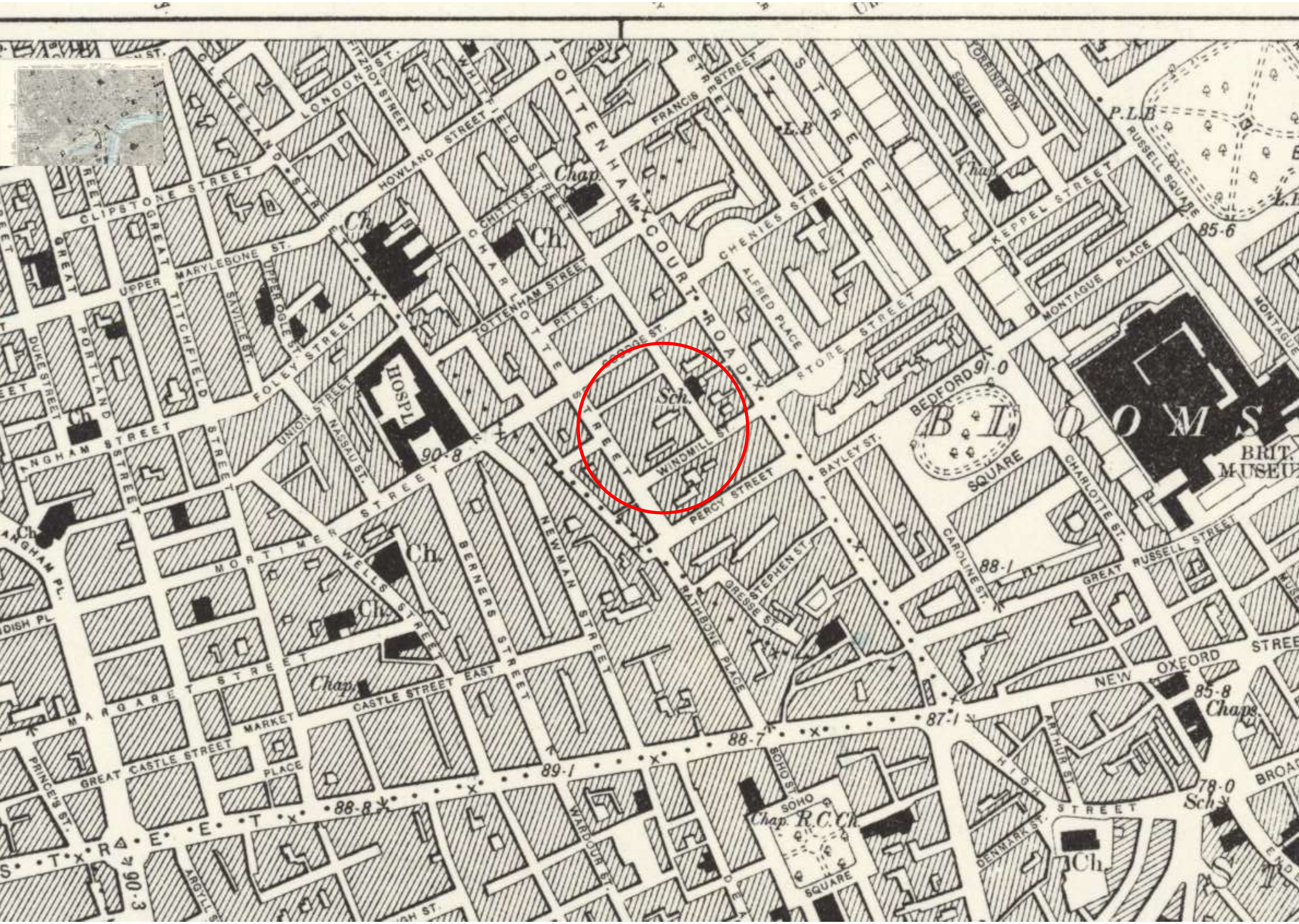
The site works, soil descriptions and geotechnical testing was undertaken in accordance with the following standards were applicable:

- BS 5930:2015 and BS EN ISO 22476-2 2005+A1:2011
- BS 5930:2015 and BS EN ISO 22476-2&3:2005+A1:2011
- BS 5930:2015 and BS EN ISO 22476-3:2005+A1:2011
- BS EN 1997-1:2004+A1:2013 Eurocode 7. Geotechnical design
- BS EN ISO 14688-1:2018 - Geotechnical investigation and testing - Identification and description
- BS EN ISO 14688-2:2018 - Geotechnical investigation and testing - Principles for a classification
- BS 10175:2011+A2:2017 - Investigation of potentially contaminated sites
- BS EN ISO 22476-3:2005+A1:2011 – Geotechnical investigation and testing – Field testing – Part 2: Dynamic probing
- LCRM 2021 Environment Agency
- BS 8004:2015 – Code of practice for foundations
- BS 1377:1990 Parts 1 to 8
- BRE Digest 240 "Low-rise buildings on shrinkable clay soils: Part 1"
- BRE Digest 241 "Low-rise buildings on shrinkable clay soils: Part 2"
- BRE Digest 242 "Low-rise buildings on shrinkable clay soils: Part 3"
- BRE Special Digest 1, 2005, 'Concrete in Aggressive Ground'
- Burland J.B., et al (2001). Building response to tunnelling. Case studies from the Jubilee line Extension, London. CIRIA Special Publication 200.
- Gaba A.R., et al (2003). Embedded retaining walls – guidance for economic design. CIRIA Report C580.
- Robertson, P.K., 1990. Soil classification using the cone penetration test. Canadian Geotechnical Journal, 27, pp. 151 – 158.
- Robertson, P.K., 2010, "Soil Behaviour type from the CPT: an update", 2nd International Symposium on Cone Penetration Testing, Huntington Beach, CA, Vol.2. pp575-583.
- Simons N.E., Menzies B.K., "A Short Course in Foundation Engineering"
- Stroud, M. A. 1974, "The Standard Penetration Test – its application and interpretation", Proc. ICE Conf. on Penetration Testing in the UK, Birmingham. Thomas Telford, London.
- NHBC Standards Chapter 4.2, January 2022.

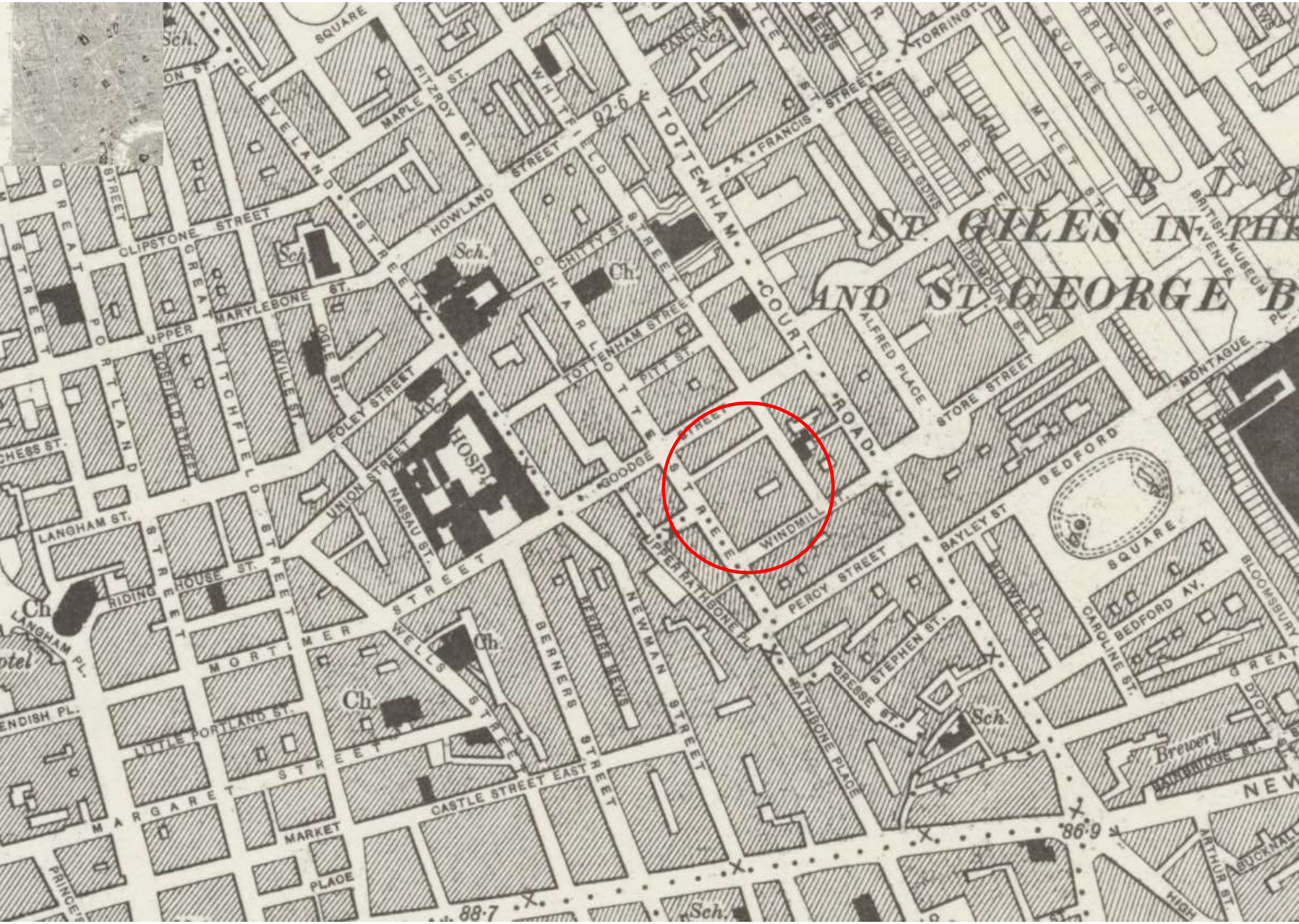
- SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination December 2014
- CIRIA C574, Engineering in Chalk; 2002
- CIRIA C733, Asbestos in soil and made ground: a guide to understanding and managing risks and CAR2012 regulations.
- CIRIA C760 – Guidance on embedded retaining wall design.
- Basement Impact Assessment pro forma 1v0, The London Borough of Camden
- Camden Planning Guidance (CPG): Basements, January 2021
- Basement Impact Assessments: Defining the scope of Engineering input – Guidance note 1v0
- Camden Local Plan, 2017
- Camden Geological, Hydrogeological and Hydrological Study (GHHS), Guidance for subterranean development, Issue01/November 2010
- Environment Agency Water Framework Directive
- London Borough of Camden SFRA – Strategic Flood Risk Assessment, July 2014
- Property Asset Register Public Web Map, Transport for London
- The Lost Rivers of London, Historical Publications Ltd, 1992, N Barton
- The London County Council Bomb Damage Maps 1939-1945, Thames and Hudson, 2018, Laurence Ward.
- Google Earth
- British Geological Survey Website, GeoIndex Website & iGeology App.

Appendix B OS Historic Maps

TOTTENHAM COURT ROAD
GOODGE STREET
CHARLES STREET
WINDMILL ST.
PERCY STR.
RATHBONE PL.
CHARLOTTE STREET
TOTTENHAM ST.
PITT ST.
FRANCIS STR.
CHENIES STREET
STORE STREET
ALFRED PL.
BEDFORD SQUARE
BEDFORD ST.
BRITISH MUSEUM
MONTAGUE PLACE
KEPPEL STR.
TORRINGTON SQUARE
RUSSELL SQUARE
GREAT RUSSELL STREET
NEW OXFORD STREET
OXFORD STREET
HIGH STREET
SOHO SQUARE
BLOOMSBURY STR.
CAROLINE ST.
CHARLOTTE ST.
NEWMAN STREET
BERNERS STREET
CASTLE STREET
CASTLE STREET EAST
WELLS STREET
MARGARET STREET
MORTIMER STREET
LANGHAM STREET
UNION STREET
FOLEY STREET
NASSAU ST.
GREAT TITCHFIELD STREET
UPPER MARYLEBONE STR.
CLIPSTONE STR.
HOWLAND STREET
LONDON STREET
FITZROY SQUARE
GRAFTON STREET
GREAT PORTLAND STREET
DUKE STR.
CAVENDISH PL.
LANGHAM PL.
REGENT STREET
GREAT CASTLE ST.
PRINCES ST.
DEAN STREET
HUNTLEY STR.
TORRINGTON PL.
STEPHEN ST.
GRESSE ST.
BROAD ST.
Hospl.
Chapel



TOTTENHAM COURT ROAD
CLEVELAND STREET
LONDON ST.
FITZROY STREET
WHITFIELD STREET
HOWLAND STREET
FRANCIS STREET
TORRINGTON SQUARE
RUSSELL SQUARE
P.L.B
L.B
Chap.
CLIPSTONE STREET
CHITTY ST.
CHARLOTTE STREET
Ch.
CHENIES STREET
KEPPEL STREET
85·6
UPPER MARYLEBONE ST.
UPPER OGLE ST.
SAVILE ST.
GREAT TITCHFIELD STREET
TOTTENHAM STREET
PITT ST.
ALFRED PLACE
STORE STREET
MONTAGUE PLACE
GEORGE ST.
FOLEY STREET
PORTLAND
DUKE STREET
UNION STREET
NASSAU ST.
HOSPL
Sch.
BEDFORD
91·0
BLOOMSBURY
BRIT. MUSEUM
WINDMILL ST.
BAYLEY ST.
SQUARE
CHARLOTTE ST.
LANGHAM STREET
90·8
PERCY STREET
STREET
MORTIMER STREET
WELLS STREET
BERNERS STREET
NEWMAN STREET
STEPHEN ST.
GRESSE ST.
CAROLINE ST.
88·1
GREAT RUSSELL STREET
LANGHAM PL.
CAVENDISH PL.
RATHBONE PLACE
MARGARET STREET
Chap.
CASTLE STREET EAST
NEW OXFORD STREET
85·8
Chaps.
MARKET PLACE
GREAT CASTLE STREET
87·1
88·7
89·1
SOHO ST.
HIGH STREET
ARTHUR ST.
78·0
Sch.
BROAD
PRINCE'S ST.
88·8
STREET
90·3
WARDOUR ST.
SOHO SQUARE
Chap. R.C.Ch.
DENMARK ST.
Ch.
ARGYLL ST.


SQUARE
Sch.
CLEVELAND STREET
FITZROY ST.
MAPLE STREET
WHITFIELD ST.
92·6
TOTTENHAM COURT ROAD
PANCRAS
MEWS
TORRINGTON
FRANCIS STREET
RIDGMOUNT GDNS
MALET ST.
BRITISH MUSEUM AVENUE
ST. GILES IN THE
AND ST. GEORGE B
GREAT PORTLAND STREET
HOWLAND STREET
CLIPSTONE STREET
GREAT TITCHFIELD STREET
UPPER MARYLEBONE ST.
CHARLOTTE STREET
CHITTY ST.
Ch.
OGLE ST.
SAVILLE ST.
GOSFIELD STREET
TOTTENHAM STREET
PITT ST.
ALFRED PLACE
RIDGMOUNT ST.
MONTAGUE PL.
STORE STREET
FOLEY STREET
HOSP.
UNION STREET
NASSAU ST.
GOODGE STREET
WINDMILL ST.
BEDFORD SQUARE
BAYLEY ST.
LANGHAM ST.
RIDING HOUSE ST.
UPPER RATHBONE PL.
PERCY STREET
MORWELL ST.
CAROLINE ST.
BEDFORD AV.
BLOOMSBURY
LANGHAM PL.
MORTIMER STREET
WELLS STREET
BERNERS STREET
BERNERS MEWS
NEWMAN STREET
RATHBONE PLACE
STEPHEN ST.
GRESSE ST.
Brewery
BAINBRIDGE ST.
DYOTT ST.
LITTLE PORTLAND ST.
MARGARET STREET
CASTLE STREET EAST
MARKET PLACE
88·7
86·9
ARTHUR ST.
HIGH

SQUARE
FITZROY ST
MAPLE ST
WHITFIELD STREET
TOTTENHAM COURT ROAD
FRANCIS ST
TORRINGTON PL
ST. GILES IN THE FI
AND ST. GEORGE BLOO
CLEVELAND STREET
HOWLAND STREET
CLIPSTONE STREET
GREAT TITCHFIELD STREET
PORTLAND
UPPER MARYLEBONE ST
CHARLOTTE STREET
CHITTY ST
TOTTENHAM STREET
STORE STREET
ALFRED PLACE
MONTAGUE PL
BRITISH MUSEUM
BEDFORD SQUARE
BAYLEY ST
GOODGE STREET
WINDMILL ST
PERCY STREET
UPPER RATHBONE PL
NEWMAN STREET
BERNERS STREET
RATHBONE PLACE
STEPHEN ST
GRESSE ST
CAROLINE ST
BEDFORD AV.
BLOOMSBURY STREET
DYOTT ST
STREATHAM ST
NEW OXFORD
Brewery
Sch.
Ch.
HOSP.
FOLEY STREET
UNION STREET
NASSAU ST
RIDING HOUSE ST
MORTIMER
WELLS STREET
LITTLE PORTLAND ST
MARGARET STREET
MARKET PLACE
CASTLE STREET EAST
92.6
86.9

Appendix C Field Work

Appendix C.1 Engineers Logs

Soils Limited
Newton House, Cross Road, Tadworth KT20 5SR
Tel: 01737 814221 Email: admin@soilslimited.co.uk

Trial Pit Log

Trial Pit No. **TP101**
Sheet 1 of 1

Project Name: 28 Charlotte Street	Project No.: 18860	Method:	Hole Type: TP
Location: Camden		Plant:	
		Support:	Scale: 1:25
Client: Rodrigues Associates	Trial Pit Length: m	Trial Pit Width: m	
Dates: 07/12/2020	Level:	Co-ords:	Logged By: TS

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (mAOD)	Legend	Stratum Description
	0.50	D					Light greyish brown clayey gravelly SAND. Gravel is fine to coarse, angular to subrounded, brick, flint, glass, metal. Rare cobbles of brick MADE GROUND
	1.00	D					
	1.50	D					
	2.00	D		2.00			
	2.50	D					Dark greyish brown clayey gravelly SAND. Gravel is fine to coarse, angular to subrounded, brick, flint, glass, metal. Rare cobbles of brick MADE GROUND
	3.00	D					
	4.00	B D		4.00			End of Pit at 4.000m

General Remarks:

Groundwater Remarks:

Sample Type
D: Disturbed
B: Bulk
J: Jar
W: Water

Soils Limited
Newton House, Cross Road, Tadworth KT20 5SR
Tel: 01737 814221 Email: admin@soilslimited.co.uk

Trial Pit Log

Trial Pit No. **TP102**
Sheet 1 of 1

Project Name: 28 Charlotte Street	Project No.: 18860	Method:	Hole Type TP
Location: Camden		Plant:	
		Support:	Scale 1:25
Client: Rodrigues Associates	Trial Pit Length: m	Trial Pit Width: m	
Dates: 07/12/2020	Level:	Co-ords:	Logged By TS

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (mAOD)	Legend	Stratum Description
							Dark greyish brown clayey gravelly SAND. Gravel is fine to coarse, angular to subrounded, brick, flint, glass, metal. Rare cobbles of brick MADE GROUND
	0.50	D					
	1.00	D					
	1.50	D					
	2.00	D					
	2.50	B D		2.50			End of Pit at 2.500m

Depth scale: 1, 2, 3, 4, 5

General Remarks:

Groundwater Remarks:

Sample Type
D: Disturbed
B: Bulk
J: Jar
W: Water

Appendix D Geotechnical In-Situ and Laboratory Testing

Appendix D.1 Classification

Classification based on SPT "N" values:

The inferred undrained strength of the cohesive soils was based on the SPT "N" blow counts, derived from the relationship suggested by Stroud (1974) and classified using Table D.1.1. (Ref: Stroud, M. A. 1974, "The Standard Penetration Test – its application and interpretation", Proc. ICE Conf. on Penetration Testing in the UK, Birmingham. Thomas Telford, London.).

Table D.1.1 SPT "N" Blow Count Cohesive Classification

Classification	Undrained Cohesive Strength C_u (kPa)
Extremely low	<10
Very low	10 – 20
Low	20 – 40
Medium	40 – 75
High	75 – 150
Very high	150 – 300
Extremely high	> 300

Note: (Ref: BS EN ISO 14688-2:2004+A1:2013 Clause 5.3.)

The relative density of granular soils was classified based of the relationship given in Table D.1.2.

The *UK National Annex to Eurocode 7: Geotechnical design – Part 2: Ground investigation and testing, NA 3.7 SPT test, BS EN 1997-2:2007, Annex F* states "Relative density descriptions on borehole records should also be based on uncorrected SPT N values, unless significantly disturbed, using the density classification in BS 5930:2015, Table 7.

Table D.1.2 SPT "N" Blow Count Granular Classification

Classification	SPT "N" blow count (blows/300mm)
Very loose	0 to 4
Loose	4 to 10
Medium dense	10 to 30
Dense	30 to 50
Very dense	Greater than 50

Note: (Ref: The Standard Penetration Test (SPT): Methods and Use, CIRIA Report 143, 1995)

Appendix D.2 Interpretation

Table D.2.1 Interpretation of Atterberg Limit Tests

Stratum	Moisture Content (%)	Plasticity Index (%)	Passing 425µm Sieve (%)	Modified Plasticity Index (%)	Soil Classification	Volume Change Potential	
						BRE	NHBC
MG	21	23	63	63	CI	Low	Low

Note: BRE Volume Change Potential refers to BRE Digest 240 (based on Atterberg results)
NHBC Volume Change Potential refers to NHBC Standards Chapter 4.2
Soils Classification based on British Soil Classification System
The most common use of the term clay is to describe a soil that contains enough clay-sized material or clay minerals to exhibit cohesive properties. The fraction of clay-sized material required varies, but can be as low as 15%. Unless stated otherwise, this is the sense used in Digest 240. The term can be used to denote the clay minerals. These are specific, naturally occurring chemical compounds, predominately silicates. The term is often used as a particle size descriptor. Soil particles that have a nominal diameter of less than 2 µm are normally considered to be of clay size, but they are not necessarily clay minerals. Some clay minerals are larger than 2 µm and some particles, 'rock flour' for example, can be finer than 2 µm but are not clay minerals.
(The Atterberg Limit Tests were undertaken in accordance with BS 1377:Part 2:1990 Clauses 3.2, 4.3 and 5)

Table D.2.2 Interpretation of PSD Tests

Location	Depth (m bgl)	Soil Description	Volume Change Potential		Passing 63µm Sieve (%)
			BRE	NHBC	
TP101	1.00	Grey clayey/silty fine to coarse sandy fine to coarse GRAVEL	No	No	14
TP101	2.00	Grey clayey/silty fine to coarse gravelly fine to coarse SAND	Yes	No	19
TP101	3.00	Brown fine to medium gravelly fine to coarse sandy SILT/CLAY	Yes	Yes	48

Note: BRE 240 states that a soil has a volume change potential when the clay fraction **exceeds 15%**. Only the silt and clay combined fraction are determined by sieving therefore the volume change potential is estimated from the percentage passing the 63µm sieve. NHBC Standards Chapter 4.2 states that a soil is shrinkable if the percentage of silt and clay passing the 63µm sieve is greater than 35% and the Plasticity Index is greater than 10%.
(The Particle Size Distribution Tests were undertaken in accordance with BS 1377: Part 2: 1990 Clause 9)

Appendix D.3 Geotechnical In-Situ and Laboratory Results

Laboratory Report

UKAS TESTING 2788

GSTL
GEO Site & Testing Services Ltd

Contract Number: 51940

Client Ref: **18860**
Client PO:

Report Date: **21-01-2021**

Client **Soils Limited**
Newton House
Cross Road
Tadworth
Surrey
KT20 5SR

Contract Title: **28 Charlotte street, London W1T 2NF**
For the attention of: **Dante Valerio Tedesco**

Date Received: **06-01-2021**
Date Completed: **21-01-2021**

Test Description	Qty
Moisture Content BS 1377:1990 - Part 2 : 3.2 - * UKAS	1
1 Point Liquid & Plastic Limit BS 1377:1990 - Part 2 : 4.4 & 5.3 - * UKAS	1
PSD Wet Sieve method BS 1377:1990 - Part 2 : 9.2 - * UKAS	3
Samples Received - @ Non Accredited Test	4
Disposal of samples for job	1

Notes: **Observations and Interpretations are outside the UKAS Accreditation**
*** - denotes test included in laboratory scope of accreditation**
 # - denotes test carried out by approved contractor
@ - denotes non accredited tests

Approved Signatories:
Emma Sharp (Office Manager/Director) - Paul Evans (Quality/Technical Manager) - Richard John (Advanced Testing Manager)
Shaun Jones (Laboratory manager) - Wayne Honey (Administrative/Quality Assistant)

GSTL

NATURAL MOISTURE, LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
(BS 1377 : Part 2 : 1990 Method 5)

Contract Number	51940	
Site Name	28 Charlotte street, London W1T 2NF	
Date Tested	18/01/2021	
	DESCRIPTIONS	

Sample/Hole Reference	Sample Number	Sample Type	Depth (m)			Descriptions
TP2		D	1.00	-		Dark brown fine to medium gravelly silty sandy CLAY
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		

Operators	Checked	21/01/2021	Wayne Honey (Administrative/Quality Assistant)
Ieuan Williams	Approved	21/01/2021	Paul Evans (Quality/Technical Manager)

UKAS TESTING 2788

NATURAL MOISTURE, LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
(BS 1377 : Part 2 : 1990 Method 5)

Contract Number	51940	
Project Location	28 Charlotte street, London W1T 2NF	
Date Tested	18/01/2021	

Sample/Hole Reference	Sample Number	Sample Type	Depth (m)			Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity index %	Passing 0.425mm %	Remarks
TP2		D	1.00	-		21	42	19	23	63	CI Intermediate Plasticity
				-							
				-							
				-							
				-							
				-							
				-							
				-							
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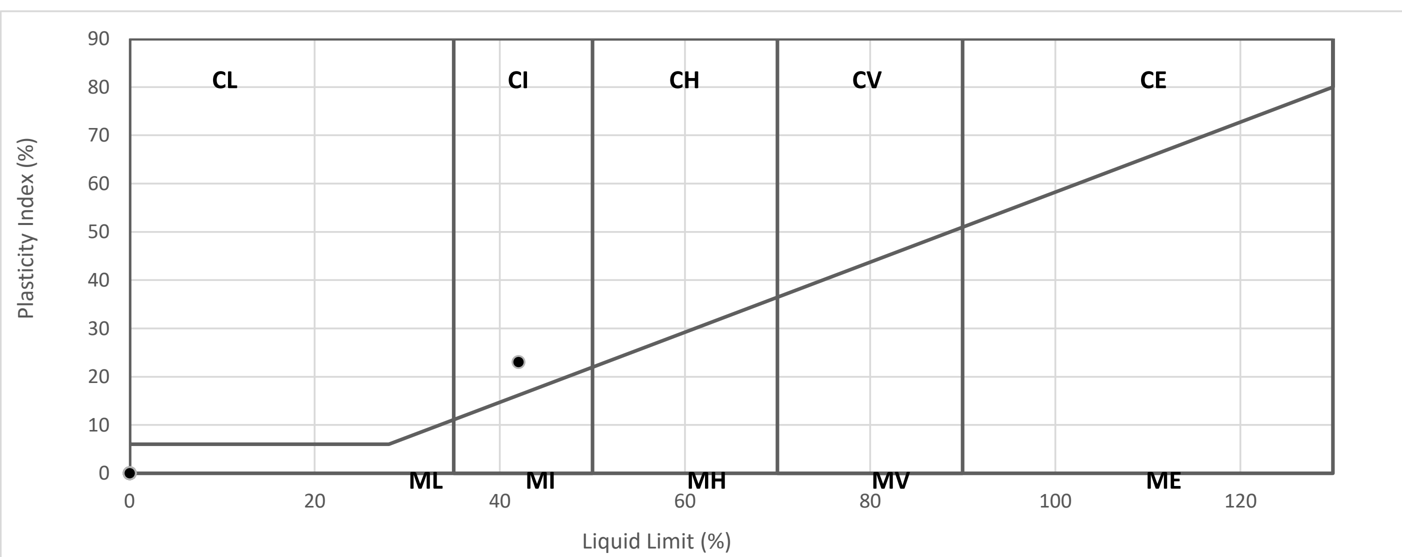
				-							
				-							
				-							
				-							

Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

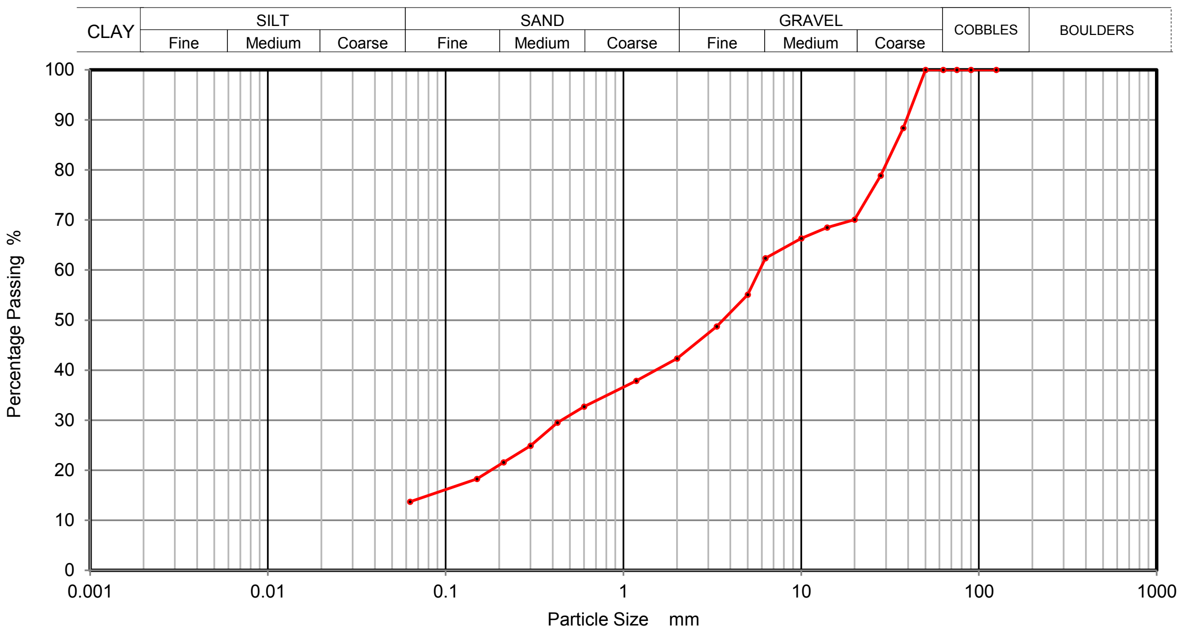
PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION
BS 5930:1999+A2:2010



Operators	Checked	21/01/2021	Wayne Honey (Administrative/Quality Assistant)
Ieuan Williams	Approved	21/01/2021	Paul Evans (Quality/Technical Manager)

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	51940
		Borehole/Pit No.	TP1
Site Name	28 Charlotte street, London W1T 2NF	Sample No.	
Soil Description	Grey clayey/silty fine to coarse sandy fine to coarse GRAVEL	Depth Top	1.00
		Depth Base	
Date Tested	16/01/2021	Sample Type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	88		
28	79		
20	70		
14	69		
10	66		
6.3	62		
5	55		
3.35	49		
2	42		
1.18	38		
0.6	33		
0.425	30		
0.3	25		
0.212	22		
0.15	18		
0.063	14		

Sample Proportions	% dry mass
Cobbles	0
Gravel	58
Sand	28
Silt and Clay	14

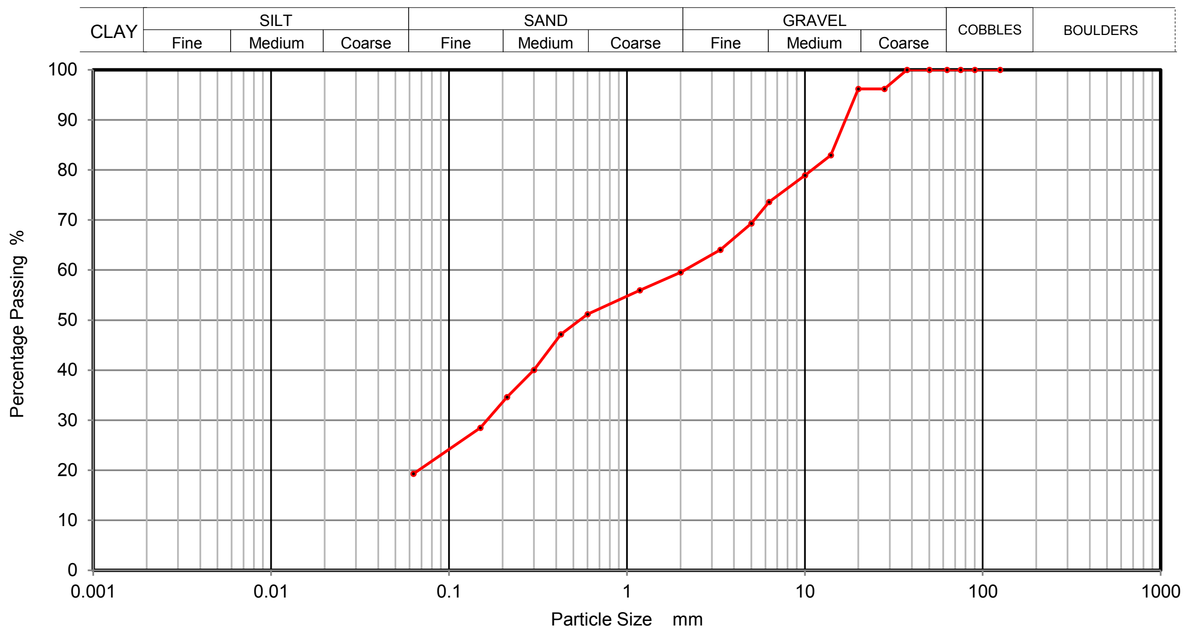
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	20/01/2021	Wayne Honey	W. Honey
RO/MH	Approved	21/01/2021	Paul Evans	P Evans

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	51940
		Borehole/Pit No.	TP1
Site Name	28 Charlotte street, London W1T 2NF	Sample No.	
Soil Description	Grey clayey/silty fine to coarse gravelly fine to coarse SAND	Depth Top	2.00
		Depth Base	
Date Tested	16/01/2021	Sample Type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	96		
20	96		
14	83		
10	79		
6.3	74		
5	69		
3.35	64		
2	60		
1.18	56		
0.6	51		
0.425	47		
0.3	40		
0.212	35		
0.15	28		
0.063	19		

Sample Proportions	% dry mass
Cobbles	0
Gravel	40
Sand	41
Silt and Clay	19

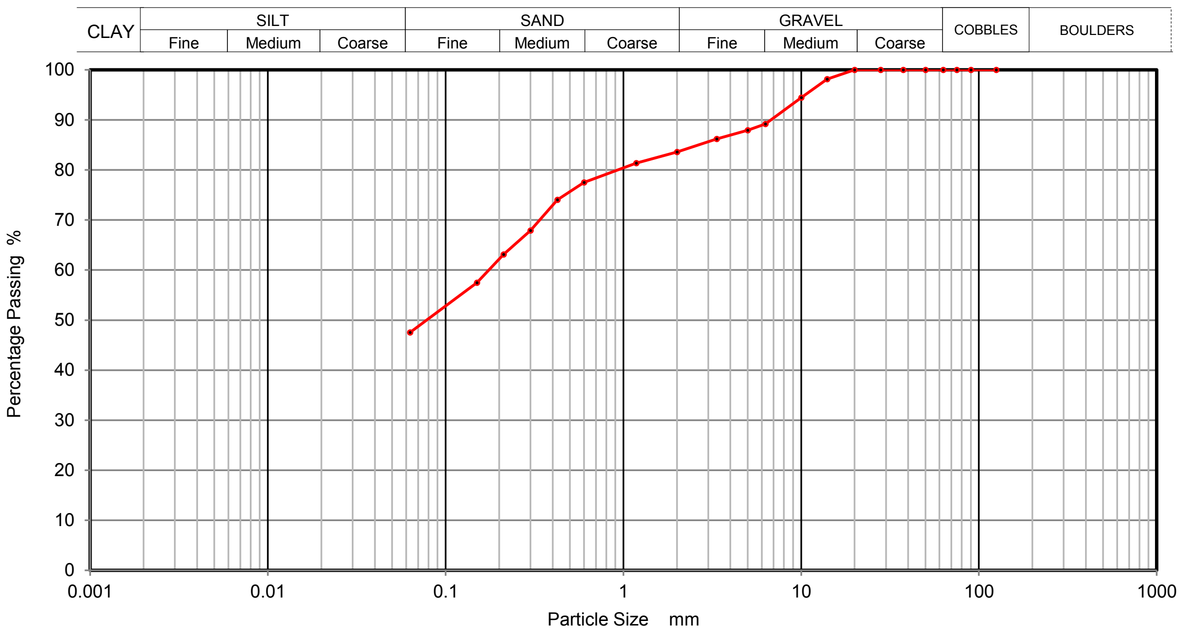
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	20/01/2021	Wayne Honey	W. Honey
RO/MH	Approved	21/01/2021	Paul Evans	P Evans

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	51940
		Borehole/Pit No.	TP1
Site Name	28 Charlotte street, London W1T 2NF	Sample No.	
Soil Description	Brown fine to medium gravelly fine to coarse sandy SILT/CLAY	Depth Top	3.00
		Depth Base	
Date Tested	16/01/2021	Sample Type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	98		
10	94		
6.3	89		
5	88		
3.35	86		
2	84		
1.18	81		
0.6	78		
0.425	74		
0.3	68		
0.212	63		
0.15	57		
0.063	48		

Sample Proportions	% dry mass
Cobbles	0
Gravel	16
Sand	36
Silt and Clay	48

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	20/01/2021	Wayne Honey	W. Honey
RO/MH	Approved	21/01/2021	Paul Evans	D P Evans

UKAS TESTING 2788

Dante Valerio Tedesco
Soils Ltd
Thomas Telford House - Unit 11
Sun Valley Business Park
Winnall Close
Winchester
SO23 0LB

DETS Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410

DETS Report No: 20-15109

Site Reference: 28 Charlotte Street, London, W1T 2NF

Project / Job Ref: 18860

Order No: 18860_B

Sample Receipt Date: 21/12/2020

Sample Scheduled Date: 21/12/2020

Report Issue Number: 1

Reporting Date: 04/01/2021

Authorised by:

Dave Ashworth
Technical Manager

Dates of laboratory activities for each tested analyte are available upon request.

Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate						
DETS Report No: 20-15109	**Date Sampled**	None Supplied	None Supplied			
Soils Ltd	**Time Sampled**	None Supplied	None Supplied			
Site Reference: 28 Charlotte Street, London, W1T 2NF	**TP / BH No**	TP1	TP1			
Project / Job Ref: 18860	**Additional Refs**	None Supplied	None Supplied			
Order No: 18860_B	**Depth (m)**	1.50	2.50			
Reporting Date: 04/01/2021	**DETS Sample No**	517703	517704			

Determinand	**Unit**	**RL**	**Accreditation**					
pH	pH Units	N/a	**MCERTS**	8.0	7.7			
Total Sulphate as SO_4	mg/kg	< 200	**MCERTS**	7978	1759			
Total Sulphate as SO_4	%	< 0.02	**MCERTS**	0.80	0.18			
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	**MCERTS**	1290	461			
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	**MCERTS**	1.28	0.46			
Total Sulphur	%	< 0.02	NONE	0.28	0.08			
Ammonium as NH_4	mg/kg	< 0.5	NONE	< 0.5	0.8			
Ammonium as NH_4	mg/l	< 0.05	NONE	< 0.05	0.08			
W/S Chloride (2:1)	mg/kg	< 1	**MCERTS**	203	75			
W/S Chloride (2:1)	mg/l	< 0.5	**MCERTS**	102	37.6			
Water Soluble Nitrate (2:1) as NO_3	mg/kg	< 3	**MCERTS**	1210	221			
Water Soluble Nitrate (2:1) as NO_3	mg/l	< 1.5	**MCERTS**	604	111			
W/S Magnesium	mg/l	< 0.1	NONE	15	3.5			

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Samples Descriptions page describes if the test is performed on the dried or as-received portion
Subcontracted analysis (S)

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate - Sample Descriptions	
DETS Report No: 20-15109	
Soils Ltd	
Site Reference: 28 Charlotte Street, London, W1T 2NF	
Project / Job Ref: 18860	
Order No: 18860_B	
Reporting Date: 04/01/2021	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
^ 517703	TP1	None Supplied	1.50	13.6	Brown gravelly sand with stones and brick
^ 517704	TP1	None Supplied	2.50	10.6	Brown loamy sand with stones

Moisture content is part of procedure E003 & is not an accredited test
Insufficient Sample I/S
Unsuitable Sample U/S
^ no sampling date provided; unable to confirm if samples are within acceptable holding times

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate - Methodology & Miscellaneous Information
DETS Report No: 20-15109
Soils Ltd
Site Reference: 28 Charlotte Street, London, W1T 2NF
Project / Job Ref: 18860
Order No: 18860_B
Reporting Date: 04/01/2021

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	Fraction Organic Carbon (FOC)	Determination of TOC by combustion analyser.	E027
Soil	D	Organic Matter (SOM)	Determination of TOC by combustion analyser.	E027
Soil	D	TOC (Total Organic Carbon)	Determination of TOC by combustion analyser.	E027
Soil	AR	Exchangeable Ammonium	Determination of ammonium by discrete analyser.	E029
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D **Dried**
AR **As Received**