CampbellReith
consulting engineers

47 Albert Street

London, NW1 7LX

Basement Impact Assessment Audit

For

London Borough of Camden

Project Number: 12466-09
Revision: F2

February 2017

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Appendix

1.0 NON-TECHNICAL SUMMARY

1.1. CampbellReith was instructed by London Borough of Camden, (LBC) to carry out an audit on the Basement Impact Assessment submitted as part of the Planning Submission documentation for 47 Albert Street, London, NW1 7LX (planning reference 2016/4688/P). The basement was considered to fall within Category A as defined by the Terms of Reference. However, a review of the proposals indicates potential impacts on stability. On this basis, the basement is considered to fall within Category B.

1.2. The Audit reviewed the Basement Impact Assessment for potential impact on land stability and local ground and surface water conditions arising from basement development in accordance with LBC's policies and technical procedures.

1.3. The BIA has been carried out by a firm of structural engineering consultants, Symmetrys Limited with supporting documents from LMB Geosolutions. In the original BIA there was no evidence that the assessments had been carried out by individuals with the required qualifications. In the revised submissions, the authors' qualifications are acceptable.

1.4. The property to be developed comprises a 4 storey building, forming part of a Grade II listed terrace and includes an existing basement which is to be extended to the front and rear of the property.

1.5. The BIA has confirmed that the proposed basement will be founded within London Clay. Groundwater was not encountered during the investigation or subsequent monitoring visit.

1.6. The original BIA was carried out assuming proposals fell within Category A as defined by the Terms of Reference. The BIA has been resubmitted including all assessments as required by CPG4 for a Category B Audit.

1.7. In the revised submissions, geotechnical parameters, structural calculations and drawings for retaining wall design have been presented. Temporary works sequencing and propping, and an outline construction method statement and programme are presented. These should be confirmed at detailed design state as satisfactory to limit damage impacts to a maximum of Category 1.

1.8. In the revised submissions, a Ground Movement Assessment (GMA) and a Damage Impact Assessment have been presented, indicating damage Category 2 (Slight) for the property itself and neighbouring properties. The GMA takes account of the soft to firm ground conditions but assumes high stiffness high level propping (at ground floor level) in the permanent case. It is accepted that the Engineer will remodel movements during detailed design and ensure high stiffness ground floor propping as required to limit damage to a maximum of Category 1.

1.9. In the temporary case stiff propping is proposed and structural movement monitoring. The monitoring should be agreed under the Party Wall Act with trigger levels and contingency plans based on the movements predicted in the revised GMA to be undertaken at detailed design stage, to ensure that damage impacts are limited to a maximum of Category 1.

1.10. It is accepted that there are no slope stability concerns regarding the proposed development.

1.11. It is accepted that proposal will have no adverse effect on hydrology or hydrogeology in the area. A Green Roof is proposed and it is stated that attenuation requirements will be agreed with LBC and Thames Water.

1.12. Queries and requests for clarification are discussed in Section 4 and summarised in Appendix 2.

1.13. With the addition of the revised submissions and the requirement to implement control measures that will limit damage impact to Category 1, the criteria of CPG4 have been met.

2.0 INTRODUCTION

2.1. CampbellReith was instructed by London Borough of Camden (LBC) on 27 September 2016 to carry out a Category A Audit on the Basement Impact Assessment (BIA) submitted as part of the Planning Submission documentation for 47 Albert Street, London, NW1 7LX and Planning Reference 2016/4688/P. Upon review, this was updated to a Category B Audit.

2.2. The Audit was carried out in accordance with the Terms of Reference set by LBC. It reviewed the Basement Impact Assessment for potential impact on land stability and local ground and surface water conditions arising from basement development.

2.3. A BIA is required for all planning applications with basements in Camden in general accordance with policies and technical procedures contained within

- Guidance for Subterranean Development (GSD). Issue 01. November 2010. Ove Arup & Partners.
- Camden Planning Guidance (CPG) 4: Basements and Lightwells.
- Camden Development Policy (DP) 27: Basements and Lightwells.
- Camden Development Policy (DP) 23: Water.

2.4. The BIA should demonstrate that schemes:

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

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

c) avoid cumulative impacts upon structural stability or the water environment in the local area, and;

evaluate the impacts of the proposed basement considering the issues of hydrology, hydrogeology and land stability via the process described by the GSD and to make recommendations for the detailed design.

2.5. LBC's Audit Instruction described the planning proposal as *"Various external alterations including: extension of basement level coalholes beneath the front garden; demolition of existing closet wing and erection of new closet wing and rear extension with associated landscaping; installation of 1 x conservation rooflight; and refurbishment or replacement like-for-like, all dilapidated single-glazed timber sash windows."*

The Audit Instruction also confirmed 47 Albert Street involved, or was a neighbour to, listed buildings.

2.6. CampbellReith accessed LBC's Planning Portal on 11 October 2016 and gained access to the following relevant documents for audit purposes:

- Structural Report (BIA included) (ref, 2016044/CC, Rev P1), dated 22/08/2016 issued by Symmetry Limited.
- Heritage Statement dated August 2016, issued by Heritage Collective.
- Planning Application Drawings issued by Insideoutarchitecture:

  Location Plan (P1604_P_001 dated Aug 2016);

  Existing Plans (P1604_P_002 to 009, dated Aug 2016);

  Proposed Plans (Various – dated Aug 2016);

  Proposed Demolition plans (P1604_P_101, Rev A dated Sept 16).
- Design & Access Statement dated August 2016, issued by Insideoutarchitecture.
- Planning Comments and Response.

2.7. CampbellReith were provided the following relevant documents for audit purposes in January 2017:

- Basement Impact Assessment (ref, 2016044/CC, Rev B), dated 18/01/2017 issued by Symmetrys Limited.
- Ground Movement Assessment, Issue 2, Dated 18 January 2017 issued by LMB Geosolutions.
- Email LMB Geosolutions 23 January 2017.
- Email Symmetrys Limited 8 February 2017.

3.0 BASEMENT IMPACT ASSESSMENT AUDIT CHECK LIST

Item	Yes/No/NA	Comment
Are BIA Author(s) credentials satisfactory?	Yes	Updated in the revised submissions.
Is data required by Cl.233 of the GSD presented?	Yes	Updated in the revised submissions.
Does the description of the proposed development include all aspects of temporary and permanent works which might impact upon geology, hydrogeology and hydrology?	Yes	See BIA Section 4.
Are suitable plan/maps included?	Yes	Updated in the revised submissions.
Do the plans/maps show the whole of the relevant area of study and do they show it in sufficient detail?	Yes	Updated in the revised submissions.
Land Stability Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	See BIA Section 11.
Hydrogeology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	See BIA Section 11.
Hydrology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	See BIA Section 11.
Is a conceptual model presented?	No	However, the ground conditions and proposed scheme are adequately described.
Land Stability Scoping Provided? Is scoping consistent with screening outcome?	Yes	Updated in the revised submissions.

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Item	Yes/No/NA	Comment
Hydrogeology Scoping Provided? Is scoping consistent with screening outcome?	Yes	Updated in the revised submissions.
Hydrology Scoping Provided? Is scoping consistent with screening outcome?	Yes	Updated in the revised submissions.
Is factual ground investigation data provided?	Yes	See BIA Appendix C.
Is monitoring data presented?	Yes	See BIA Appendix C.
Is the ground investigation informed by a desk study?	Yes	
Has a site walkover been undertaken?	Yes	
Is the presence/absence of adjacent or nearby basements confirmed?	Yes	Updated in the revised submissions.
Is a geotechnical interpretation presented?	Yes	See BIA Appendix C.
Does the geotechnical interpretation include information on retaining wall design?	Yes	Updated in the revised submissions.
Are reports on other investigations required by screening and scoping presented?	N/A	None identified.
Are the baseline conditions described, based on the GSD?	Yes	Updated in the revised submissions.
Do the base line conditions consider adjacent or nearby basements?	Yes	Updated in the revised submissions.
Is an Impact Assessment provided?	Yes	Updated in the revised submissions.
Are estimates of ground movement and structural impact presented?	Yes	Updated in the revised submissions.

Item	Yes/No/NA	Comment
Is the Impact Assessment appropriate to the matters identified by screen and scoping?	Yes	Updated in the revised submissions.
Has the need for mitigation been considered and are appropriate mitigation methods incorporated in the scheme?	Yes	Updated in the revised submissions.
Has the need for monitoring during construction been considered?	Yes	This should reflect movement prediction to limit all damage impacts to a maximum of Category 1.
Have the residual (after mitigation) impacts been clearly identified?	Yes	Drainage / permanent structure.
Has the scheme demonstrated that the structural stability of the building and neighbouring properties and infrastructure will be maintained?	Yes	Updated in the revised submissions.
Has the scheme avoided adversely affecting drainage and run-off or causing other damage to the water environment?	Yes	However, drainage proposal to be agreed with LBC.
Has the scheme avoided cumulative impacts upon structural stability or the water environment in the local area?	Yes	Updated in the revised submissions.
Does report state that damage to surrounding buildings will be no worse than Burland Category 2?	Yes	Updated in the revised submissions.
Are non-technical summaries provided?	Yes	At the end of the BIA.

4.0 DISCUSSION

4.1. The Basement Impact Assessment (BIA) has been carried out by a firm of structural engineering consultants, Symmetrys Limited with supporting documents from LMB Geosolutions. In the original submission, the author's qualifications were not in accordance with CPG4. However, in the revised submissions the authors' qualifications are acceptable.

4.2. The LBC Instruction to proceed with the audit identified that the basement proposal either involved a listed building or was adjacent to listed buildings but gave no details. The Design & Access Statement (DAS) identified that 47 Albert Street is part of a row of 4/5 storey Grade II listed terraces. The DAS states the listing refers to the external appearance and coherence of the terraces and makes reference to the cast-iron railings of the front gardens.

4.3. The proposed basement involves the extension of the existing lower ground floor and ground floor into the rear garden along with extending the front vaults below the existing front garden. It is also proposed to lower the existing ground floor by up to 260mm in some areas. The front extension is to be formed by underpinning and using L-shaped units. The rear extension is to be formed using L-shaped pins excavated within the garden.

4.4. The BIA includes a drawings and a construction methodology statement in Appendix A. An outline construction programme is included in the revised submissions.

4.5. The original BIA did not extend beyond a Screening review process. In the revised submissions, Screening, Scoping and Impact Assessments have been carried out, in line with CPG4.

4.6. The BIA includes a summary in Section 12 but does not provide non-technical summaries at the end of each section as required by the GSD. In the revised submission, a concluding non-technical summary is presented.

4.7. The BIA confirmed the basement to be founded within London Clay Formation with ground conditions comprising Made Ground over London Clay based on a window sample undertaken at the front of the property along with four trial pits on the property boundary. The LMB Geosolutions Ground Investigations and Assessment Report included as Appendix C, confirms that ground water was not present during drilling or on a subsequent monitoring visit.

4.8. The BIA presents the ground conditions encountered during the site investigation with further discussion being presented in the LMB Geosolutions report. In the revised submissions, appropriate geotechnical parameters are presented.

4.9. The BIA identified that the highway lies within 5m of the proposed development. The ground movement assessment identifies that the highway / pavement will be subject to some ground movement. Appropriate limitations on movement should be agreed with authority responsible for maintaining the highway, and this should be monitored as party of the structural monitoring and survey proposed to control the construction process.

4.10. In the revised submissions, a Ground Movement Assessment (GMA) and a Damage Impact Assessment have been presented, indicating damage Category 2 (Slight) for the property itself and neighbouring properties. The GMA takes account of the soft to firm ground conditions but assumes high stiffness high level propping (at ground floor level) in the permanent case.

4.11. Although the precise methodology adopted for the GMA and damage impact assessment is not fully agreed upon, the results of the assessment are consistent with what is expected and are therefore accepted. However, as stated in the email of 8 February 2017, the Engineer will remodel movements during detailed design and ensure high stiffness ground floor propping as required to limit damage to a maximum of Category 1.

4.12. In the temporary case stiff propping and structural movement monitoring is proposed. The monitoring should be agreed under the Party Wall Act with trigger levels and contingency plans based on the movements predicted in the GMA. The current trigger levels proposed in the BIA are not considered acceptable, but these are superseded by comments in the GMA Issue 2, which confirms trigger values will linked to predicted movements and agreed with Party Wall surveyors, and damage impacts will be limited to a maximum of Category 1. The GMA also states that ASUC methodology will be employed to mitigate against excessive movements. This should include maintaining adequate contingency materials / props on site to ensure swift mitigating actions are employed, if required.

4.13. It is accepted that 47 Albert Street did not flood in either 1975 or the 2002 flood events and surface water flood risk maps show the site to be at no risk of flooding.

4.14. It is accepted that there are no slope stability concerns regarding the proposed development.

4.15. It is accepted that proposal will have no adverse effect on hydrology or hydrogeology in the area. However, it is stated that the Green Roof and drainage plans proposed will be agreed with LBC and Thames Water to ensure sufficient attenuation is allowed for.

5.0 CONCLUSIONS

5.1. The BIA has been carried out by a firm of structural engineering consultants, Symmetrys Limited with supporting documents from LMB Geosolutions. In the revised submissions, the authors' qualifications are acceptable.

5.2. The property to be developed comprises a 4 storey building, forming part of a Grade II listed terrace and includes an existing basement which is to be extended to the front and rear of the property.

5.3. The BIA has confirmed that the proposed basement will be founded within London Clay. Groundwater was not encountered during the investigation or subsequent monitoring visit.

5.4. The original BIA only presented a Screening assessment. The BIA has been resubmitted including all assessments as required by CPG4.

5.5. In the revised submissions, geotechnical parameters, structural calculations and drawings for retaining wall design have been presented. Temporary works sequencing and propping, and an outline construction method statement and programme are presented.

5.6. In the revised submissions, a Ground Movement Assessment (GMA) and a Damage Impact Assessment have been presented, indicating damage Category 2 (Slight) for the property itself and neighbouring properties. It is accepted that the Engineer will remodel movements during detailed design and ensure high stiffness ground floor propping as required to limit damage to a maximum of Category 1.

5.7. The structural monitoring should be agreed under the Party Wall Act with trigger levels and contingency plans based on the movements predicted in the revised GMA, to limit damage impacts to a maximum of Category 1.

5.8. It is accepted that there are no slope stability concerns regarding the proposed development.

5.9. It is accepted that proposal will have no adverse effect on hydrology or hydrogeology in the area. A Green Roof is proposed and it is stated that attenuation requirements will be agreed with LBC and Thames Water.

5.10. Queries and requests for clarification are summarised in Appendix 2.

5.11. With the addition of the revised submissions and the control measures described in the BIA and supporting documents to limit damage impacts to a maximum of Category 1, the criteria of CPG4 have been met.

Appendix 1: Residents' Consultation Comments

None

Appendix 2: Audit Query Tracker

Audit Query Tracker

Query No	Subject	Query	Status	Date closed out
1	BIA	BIA incomplete for Category B proposals	Closed	January 2017
2	BIA	Author's qualifications not in accordance with CPG4 requirements	Closed	January 2017
3	BIA	Construction methodology and programmed not included	Closed	January 2017
4	BIA	Scoping not included within BIA	Closed	January 2017
5	BIA	BIA does not present non-technical summaries	Closed	January 2017
6	BIA	Conceptual model not detailed enough	Closed	January 2017
7	Hydrology	Outline Drainage proposals not included	Open – attenuation via Green Roof to be discussed and agreed with LBC / Thames Water.	N/A - Ongoing
8	Land Stability	Ground Movement Assessment (GMA) not undertaken	Closed – additional modelling to be undertaken based on Engineer's final ground floor propping arrangements at rear to ensure maximum damage impact of Category 1.	February 2017
9	Land Stability	Geotechnical parameters not presented	Closed	January 2017
10	Land Stability	Construction sequencing, mitigation proposals and monitoring not included	Closed – information provided. However, monitoring proposals to be linked to predicted ground movements.	February 2017

Appendix 3: Supplementary Supporting Documents

Basement Impact Assessment (ref, 2016044/CC, Rev B), dated 18/01/2017 issued by Symmetrys Limited

Ground Movement Assessment, Issue 2, Dated 18 January 2017 issued by LMB Geosolutions

Email LMB Geosolutions 23 January 2017

Email Symmetrys Limited 8 February 2017

Basement Impact Assessment

For

47 Albert Street
London
NW1 7LX

Structural Methodology Statement In Support
Of Planning Application

18/01/16 2016044/CC: Rev B
04/01/16 2016044/CC: Rev A
22/12/16 2016044/CC: Rev P2
22/08/16 2016044/CC: Rev P1

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Appendices

1. INTRODUCTION

1.1 Symmetrys Limited has been engaged by Inside Out Architecture to carry out a structural report for the proposed extension of the existing lower ground floor and ground floor of a 4 storeys building at 47 Albert Street, North West London. The proposal is to extend the existing lower ground floor and ground floor in the back garden by demolishing and rebuilding the rear extension. The front vaults will also be extended below the existing front garden. The remaining parts of the house will be refurbished and new structural elements will be introduced in order to reinforce the existing structure.

1.2 Our drawings and this report will be included within our client's planning application. Our documents are not intended for, and should not be relied upon by, any third party for any other purpose. Proposed and existing general arrangement drawings were passed to us from Inside Out Architecture.

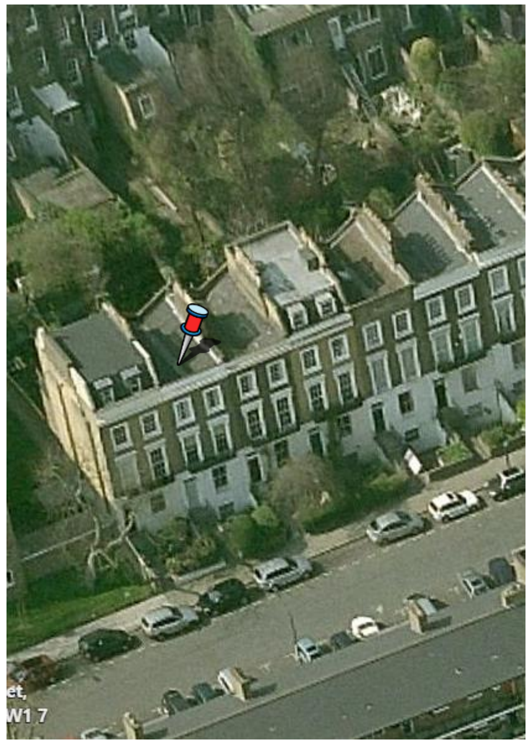


Photo 1 – Birds eye view front elevation

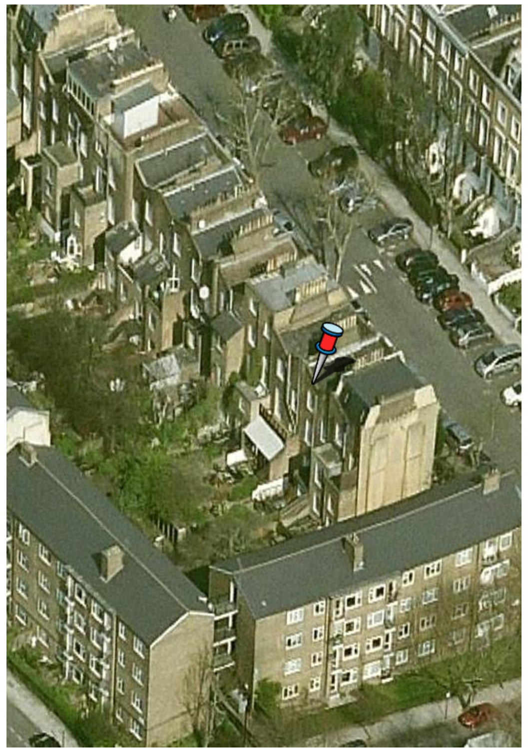


Photo 2 – Birds eye view rear elevation

1.3 Reference documents

The following documents have been used as guidance to complete this Structural Report:
1, Camden Planning guidance: Basements and Lightwells – July 2015
2, Camden's Core Strategy CS14
3, Camden Development Policy DP25
4, National Planning Policy Framework: Section 12.
5, The Lost Rivers of London, Nicholas Barton

2. EXISTING CONDITION

2.1. The existing dwelling is located in Camden.

2.2 The existing structure is 4 storeys high with a two storey outrigger to the rear. The structure is load bearing masonry with timber floor joists spanning front to back and a butterfly roof. The property exhibits no signs of excessive deformation or cracking other than would be expected of a property of this type and age.

2.3 Symmetrys envisage opening up works will be undertaken to further establish the condition of the existing building prior to undertaking detailed design to enable existing defects to be considered.

3.0 DESIGN PROPOSALS

3.1 The proposal is to extend the existing lower ground floor below the front and into the rear garden of the property, see structural drawings in Appendix A. The extended areas will be undertaken by using sequential reinforced concrete underpins which is a well-known and frequently used technique to form basements. The use of temporary propping will ensure that the basement does not cause any local ground movements whilst the construction is taking place.

3.2 Front vault

To form the lower ground floor extension under the front courtyard, the structure of the previously altered coal holes will be demolished. It is proposed to reinstate the historic the shape of the vaults within the new retaining wall. This retaining wall will be formed in an underpinned sequence using reinforced concrete L-shaped pins. This will ensure that the basement slab resists any potential soil pressure due to heave of hydrostatic loads from localised perched water, leaking pipes, etc. The floor level of the vaults will also be lowered using mass concrete underpins under the existing brick wall supporting the new ground bearing slab.

3.3 Rear Extension

The rear extension at lower ground floor will be formed using reinforced concrete L-shaped pins excavated within the rear garden. It is also proposed to lower the existing lower ground floor by 100mm for the courtyard and 260mm for the bathroom by using a concrete ground bearing slab. This will be undertaken by underpinning the existing brick wall using L-shaped reinforced concrete retaining wall as for the front vaults.

To ensure continuity between the RC retaining walls and the masonry walls, dowels will be drilled into the underside of the masonry walls and cast in with the RC walls.

3.4 Rear Garden

The lower ground floor courtyard will extend into the rear garden, by 1.8 meters. The remaining garden will be landscaped as per architect's drawings. Also green roofs are proposed on top of the new rear extension as part of the SuDS strategy for the development.

3.5 Waterproofing

BS8102 sets out guidance for the waterproofing of basement structures according to their use. With this in mind the use of tanked, integral and/or drained methods of waterproofing will have to be considered. These items will be considered once a tanking specialist has been employed.

3.6 Roof

It is proposed to reinstate the roof by carrying out structural repair where necessary. This will involve replacing the existing rotten rafters to avoid any risk of failure and water ingress and strengthen the existing spine wall support.

4. STAGE 1: SCREENING

A screening process has been undertaken based on the flow screening charts of the Camden Planning Guidance CPG4.
The tables below identify any matters that are relevant in the proposed scheme. Each question is answered by "Yes" or "No". "No" answers are justified in the last column of the screening charts. "Yes" answers are discussed further in "Stage 2: Scoping".

Subterranean ground water flow screening chart

1a: Is the site located directly above an aquifer?	No	No Groundwater was recorded during the site investigation and monitoring visit. The London Clay is designated Unproductive Strata.
1b: Will the proposed basement extend beneath the water table surface?	No	No Groundwater was recorded during the site investigation and monitoring visit.
2: Is the site within 100m of a watercourse, well (used/disused) or potential spring line?	No	First watercourse is 1km from the site. The Lost River of London extract in figure 3 shows the river Fleet 500m away from site.
3: Is the site within the catchment of the pond chains on Hampstead Heath?	No	The site is located near Morning Crescent, around 2 km from Hampstead Heath.
4: Will the proposed basement development result in a change in the proportion of hard surfaced/paved areas?	**Yes**	There will be a decrease of hard surfaced area (≈ 3m2) provided by the landscape arrangement of the rear garden and the two green roofs over the rear extension.
5: As part of the site drainage, will more surface water than at present be discharged to the ground?	No	There will be little changes in the surface water discharge.
6: Is the lowest point of the proposed excavation close to, or lower than, the mean water level in any local pond or spring line?	No	There is no local pond or spring line nearby.

Slope stability screening flowchart		
1: Does the existing site include slopes, natural or manmade, greater than 7 degrees?	No	The site is level.
2: Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 7 degrees?	No	There is no proposed change in the slope of the site.
3: Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 degrees?	No	There is a railway track 90 metres from the site, see figure 2. This is considered to be reasonable distance, the basement development will be affect the railway line.
4: Is the site within a wider hillside setting in which the general slope is greater than 7 degrees?	No	The site is not located on a wider hillside.
5: Is the London Clay the shallowest strata at the site?	**Yes**	Please refer to scoping stage.
6: Will any tree(s) 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 scheme will not impact any tree protection zones. No tree is to be fell as part of the proposed basement extension.
7: Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site?	No	Although some small cracks were noticed in the render of walls as described in the Preliminary Risk Assessment, they are not considered to be significant.
8: Is the site within 100m of a watercourse or a potential spring line?	No	The site is not located in proximity of an existing watercourse.

9: Is the site within an area of previously worked ground?	No	The house at 47 Albert Street is a listed building from mid-19th century.
10: Is the site within an aquifer? Is so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?	No	No Groundwater was encountered during the site investigation.
11: Is the site within 50m of the Hampstead Heath ponds?	No	The site is located in Morning Crescent, around 2km from Hampstead Heath.
12: Is the site within 5m of a highway or pedestrian right of way?	**Yes**	Please refer to Scoping stage.
13: Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	**Yes**	Please refer to Scoping stage.
14: Is the site over any tunnels, railway lines?	No	The closest line is the Overground, 90 metres away from the site.
Surface flow and flooding screening flowchart		
1: Is the site within the catchment of the pond chains on Hampstead Heath?	No	The site is located near Morning Crescent, around 2km from Hampstead Heath.
2: As part of the proposed site drainage, will surface water flows be materially changed from the existing route?	No	There will be no changes in the surface water flowing route.
3: Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	**Yes**	There will be a decrease of hard surfaced area (≈ 3m2) provided by the landscape arrangement of the rear garden and the two green roofs over the rear extension.
4: Will the proposed basement result in changes to the profile of the inflows of surface water being received by adjacent properties or downstream watercourses?	No	There will be no material change in the requirements of the local drainage infrastructure.
5: Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No	There is no change in the surface water quality received by the neighbouring properties.
6: Is the site in an area identified to have surface water flood risk according to either the Local Flood Risk Management Strategy or the Strategic Flood Risk Assessment or is it at risk from flooding, for example because the proposed basement is below the static water level of nearby surface water feature ?	No	No ground water was encountered during the site investigation and the site is not located in a flood risk zone, as shown on figure 4. It is also an area considered to have a very low to low risk from surface water flooding.

5. STAGE 2: SCOPING

From the screening process, five relevant matters have been identified and require definition of the scope of investigation to be undertaken.

5.1 Subterranean ground water flow

4: Will the proposed basement development result in a change in the proportion of hard surfaced/paved areas?

Answer: The existing rear garden will be landscaped as part of the refurbishment of the house. There will be a small increase of hard surfaced area which will be counterbalance by the two green roofs proposed for the rear extension providing a 3m2 decrease of the impermeable area of the site. Please refer to architect's drawings for the landscaping proposals.

Scoping: As it is proposed to increase the permeable surface of the site which will provide attenuation to the surface water run-off, no further assessment will be required.

5.2 Slope stability screening flowchart

5: Is the London Clay the shallowest strata at the site?

Answer: Yes. The local geological survey maps indicates that the underlying strata is London Clay.

Scoping: London Clay has a high volume change potential. A Ground Movement Assessment has been undertaken, to predict the potential heave and settlement actions on the proposed structure.

12: Is the site within 5m of a highway or pedestrian right of way?

Answer: Yes. The site is located on Albert Street, the proposed development will be at less than 5 metres from the public highway.

Scoping: The ground movements due to the excavation of the extension of the historic coal holes needs to be considered. A Ground Movement Assessment has been undertaken, to predict the damage category.

13: Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?

Answer: It is proposed to underpin the neighbouring party wall with No. 45 to extend the lower ground floor in the rear garden. It is also proposed to lower the slab in the front vaults and rear extension. This would require to underpin the existing foundations around the perimeters.

Scoping: The effect of the works on the neighbouring building and ground stability will need to be considered. LMB Geosolutions carried out a ground movement assessment which assess the damage category of the proposal.

5.3 Surface flow and flooding screening flowchart

3: Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?

Answer: The existing rear garden will be landscaped as part of the refurbishment of the house. There will be a small increase of hard surfaced area which will be counterbalance by the two green roofs proposed for the rear extension providing a 3m2 decrease of the impermeable area of the site. Please refer to architect's drawings for the landscaping proposals.

Scoping: As it is proposed to increase the permeable surface of the site which will provide attenuation to the surface water run-off, no further assessment will be required.

5.4 Summary of the assessments required

The screening and scoping process three issues all relative to the land stability of the site and the potential ground movements. All three have been assessed in the ground movement report, see appendix D.

6.0 STAGE 3: SITE INVESTIGATION AND STUDY

6.1 Desktop Study

The first stage of a site investigation is to develop an understanding of the site and immediate surroundings. LMB carried a desktop study including a site walkover in their site investigation report, see Appendix C.

6.2 Ground Conditions

The local geographical survey maps, accessible via the British Geological Society website http://mapapps.bgs.ac.uk/geologyofbritain/home.html?mode=boreholes, indicated that the underlying soil strata is London Clay. Having reviewed borehole-s cut in the vicinity of the property on Albert Street, with particular respect to Northeast, with the BGS reference TQ28SE311 (see figure 1), stiff clay was confirmed down to 9m.

Figure 1 - Historical bore hole log map taken from the British Geological Surveys

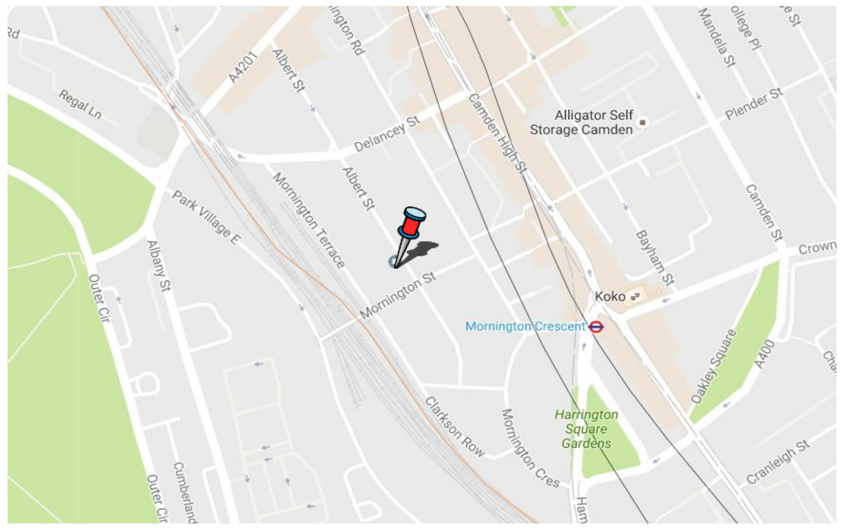


Figure 2: Map showing local transport tunnels

6.3 Ground Investigation / Opening-Up Works Undertaken:

6.3.1 One window sampler was cut in the front light well at lower ground floor level to determine safe bearing loads and cohesion values, traditional foundations. Furthermore the extent of any ground contamination and ground water levels was established. Should planning be granted then additional trial pits will be undertaken.

6.3.2 Four trial pits were excavated along the exterior walls of the house to reveal the existing foundations and to take samples of soil for laboratory testing.

6.4 Existing foundations

Trial pits were dug by LMB Geosolutions Ltd on the 18th of July 2016 to reveal the full profile of the existing foundations. Sections representing the results of the trial pits can be found in the factual report of the basement impact assessment in Appendix C.

6.5 Ground Investigation and Geology

6.5.1 The interpretative report of the site specific investigation has been undertaken by LMB Geosolutions Ltd. The findings and recommendations are described in their report dated August 2016.

6.5.2 The ground conditions are summarised as follows:

Window Sampler 1

G.L to 1.70m	Made Ground
1.1m to 4.0m	Soft becoming firl Brown Clay – London Clay
4.0m to 7.0m	Stiff Brown Clay – London Clay
7.0m to 8.35m	Stiff Dark Grey / Brown Clay – London Clay

6.5.3 Ground Water Monitoring :

No groundwater strikes were recorded during the ground investigation works and groundwater was not recorded during return monitoring visits.

6.5.4 The report confirms that the proposed lower ground flood extension can be founded on London Clay which would allow a safe bearing pressure of 120KN/m^2.

6.6 Hydrology

Referring to the "The Lost Rivers of London" by Nicholas Barton the closest known watercourse is described to be on the east of the site approximately 500m away which is known as the Fleet which runs from Hampstead Heath heading southwards. This is a significant distance away and will not have any impact on the local hydrology, see figure 3 below.

Figure 3 : Extract from the Lost River of London by Nicholas Barton

6.7 Flooding

Referring to the Camden strategic flood risk assessment, the proposed basement does not lie in a Local Flood Risk and therefore having a less than 1 in 1000 annual probability of river or sea flooding any year. Therefore no further assessment is required.

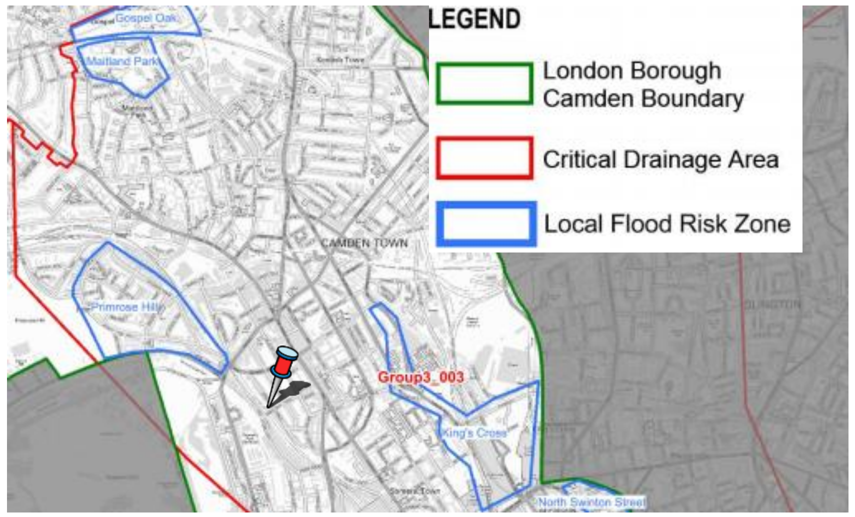


Figure 4 : Extract from Camden Strategic Flood Risk Assessment

7.0 PROPOSED SEQUENCE OF WORKS

7.1 The structural method statement provided, (see Appendix A), is for the purpose of the design team's design development and for the purpose of the client's planning application. The appointed contractor will be responsible for all temporary supports and for the stability of the structure during the works. The method of construction adopted minimises the need for temporary works. However, propping during the underpinning sequencing will be required to minimise the risk of ground movement occurring.

To ensure that the retained engineer's intent is correctly interpreted by the contactor, they will be required to submit all temporary works proposals to review a minimum of 7 working days prior to commencing excavation. The contractor should also submit a dewatering strategy to ensure a strategy is agreed should water be encountered.

7.2 <u>Below Existing Building</u>

Temporary propping to the newly formed retaining walls forming the extensions will be required until the lower ground floor has been formed. For further details please see Appendix A for construction sequence and method statements.

7.3 <u>Dewatering Strategy</u>

As ground water was not recorded during site investigation, a dewatering strategy is not necessary for this planning application.

8.0 CONSTRUCTION METHOD STATEMENTS

Please see Appendix A for construction sequence and method statements.

9.0 CONSTRUCTION MANAGEMENT PLAN

A Construction Traffic Management plan will be undertaken may planning be granted. The works are expected to be completed over a 8-9 months program split in the three phases below:

- 2 months excavation
- 3 months construction
- 3/4 months fit out.

Once appointed, the contractor will be responsible for providing a program with anticipated starting date.

10.0 STAGE 4: IMPACT ASSESSMENT

10.1 Due to the robust engineering principles and construction method applied, the extent of movement is limited in accordance with British and European codes. We can confirm that the proposed structural design and method of construction of the basement has been developed with a view to ensuring structural safety, and that if constructed in accordance with this document the works will be able to be completed without any adverse impact on the structural stability of the neighbouring properties, other adjacent structures, adjoining land and gardens or the adjoining Public Highway.

10.2 The reinforced concrete structure will be designed to accommodate surcharges from the neighbouring property, public highway and ground pressures. The structure will have adequate stiffness to ensure that the lateral deflections do not exceed the appropriate limits recommended by British Standards Codes of Practice in order to ensure that potential ground movements be kept to acceptable limits.

10.3 The structures will be designed to transfer vertical loads into the ground safely. As the basement extension will involve very limited excavation works and will be carried out in an underpinned sequence, it is unlikely to cause any critical damages to the neighbouring structures.

10.4 <u>Ground Movement Assessment</u>

10.4.1 Ground movement assessment report has been undertaken by LMB Geosolutions Ltd and can be found in Appendix D.

10.4.2 *LMB's report confirms that the ground movement model predicts movement to fall between Category 1 (very slight) and Category 2 (slight), which is described in the adjacent table.*

Category of damage	Description of typical damage (Nature of repair in italic type)
0	Hairline cracking which is normally indistinguishable from other causes such as shrinkage and thermal movement. Typical crack widths 0.1mm. *No action required*
1	Fine cracks which can *easily be treated using normal decoration*. Damage generally restricted to internal wall finishes: cracks rarely visible in external brickwork. Typical crack widths up to 1mm.
2	*Cracks easily filled. Recurrent cracks can be masked by suitable linings.* Cracks not necessarily visible externally: *some external repointing may be required to ensure weather tightness.* Doors and windows may stick slightly and *require easing and adjusting*. Typical crack widths up to 5mm.
3	Cracks which *require some opening up and can be patched by a mason. Repointing of external brickwork and possibly a small amount of brickwork to be replaced.* Doors and windows sticking, service pipes may fracture. Weather-tightness often impaired. Typical crack widths are 5 to 15mm, or several of, say 3mm.
4	Extensive damage which *requires breaking-out and replacing sections of walls*, especially over doors and windows. Windows and door frames distorted, floor sloping noticeably*. Walls leaning or bulging noticeably; some loss of bearing in beams. Service pipes disrupted. Typical cracks widths are 15 to 25mm, but also depends on number of cracks.
5	Structural damage which *requires a major repair job, involving partial or complete rebuilding.* Beams loose bearing walls lean badly and require shoring. Windows broken with distortion. Danger of instability. Typical crack widths are greater than 25mm, but depends on the number of cracks.

Important Note. Crack width is one factor in assessing category of damage and should not be used on its own as a direct measure of it. * Local deviation of slope, from the horizontal or vertical, of more than 1/100 will normally be clearly visible. Overall deviations in excess of 1/150 are undesirable.

Figure 5: Building damage categories used by the IStructE and ICE

10.5 Figure 2, shows the position of the Northern Line and Overground relative to the proposed basement. Due to the tunnels being 90m away, which is considered a significant distance, no consultation with the London Underground Asset Protection team will be undertaken.

10.6 Cumulative effects are considered unlikely on this project as there are no record of basement development in the neighbouring properties.

11.0 PARTY WALL MATTERS

11.1 The scope of works falls within the Party Wall Act 1996. Procedures under the Act will be dealt with by the client's Party Wall Surveyor. The Party Wall Surveyor will prepare and serve necessary Notices under the provision of the Acts and agree Party Wall Awards in event of disputes. The Contractor will be required to provide the Party Wall Surveyor with the appropriate drawings, method statements and all other relevant information covering the works notifiable under the Act. The resolution of the matters under the Act and provision of Party Wall Awards will protect the interests of all owners.

11.2 Monitoring

It is proposed that the structural stability of the surrounding/adjacent properties is safeguarded by a system of movement monitoring.

The Contractor shall monitor the position and movements of the elevations of the adjacent properties around the perimeter of the proposed excavation. The monitoring shall be undertaken by a specialist survey company. The monitoring system will have at least the following characteristics:

1) The existing facades of the neighbouring properties as well as the flank wall of the neighbouring building will be monitored near ground level and at roof level, at intervals not exceeding 3m centres.

2) Monitoring points (targets) shall be firmly attached, to allow 3D position measurement, for the duration of the work, to a continuous and uninterrupted accuracy of -/+ 1mm. A suitable remote reference base/datum unaffected by the works will be adopted, one located at least 50m from the site.

3) Points/targets shall be measured for 3D positioning on, at not less than the following intervals:
   - Before any works commence (base reading)
   - Every two weeks during the period of basement excavation/construction.
   - Upon completion of all construction works.

4) All measurements shall be plotted graphically, to clearly indicate the fluctuation of movement with time. The survey company shall submit the monitoring results to the Engineer (Symmetrys Ltd) and to the Adjoining Owners Party Wall Surveyors/Engineer within 24 hour of measurement, graphically and numerically.

5) The following trigger levels for movement are proposed for agreement. In the event of a trigger value being reached the Contractor will immediately stop any work that might cause further movement, assess the situation and propose alternative methods for proceeding, with definitive further movement limits for those later steps.

6) Trigger movement limits are proposed as follows:

A) Existing Buildings Horizontal/Vertical movement

Amber +/-5mm *All parties notified.*
Red +/-10mm *Works reviewed*

B) The garden walls and excavation

Amber +/-5mm *All parties notified.*
Red +/-10mm *Works reviewed*

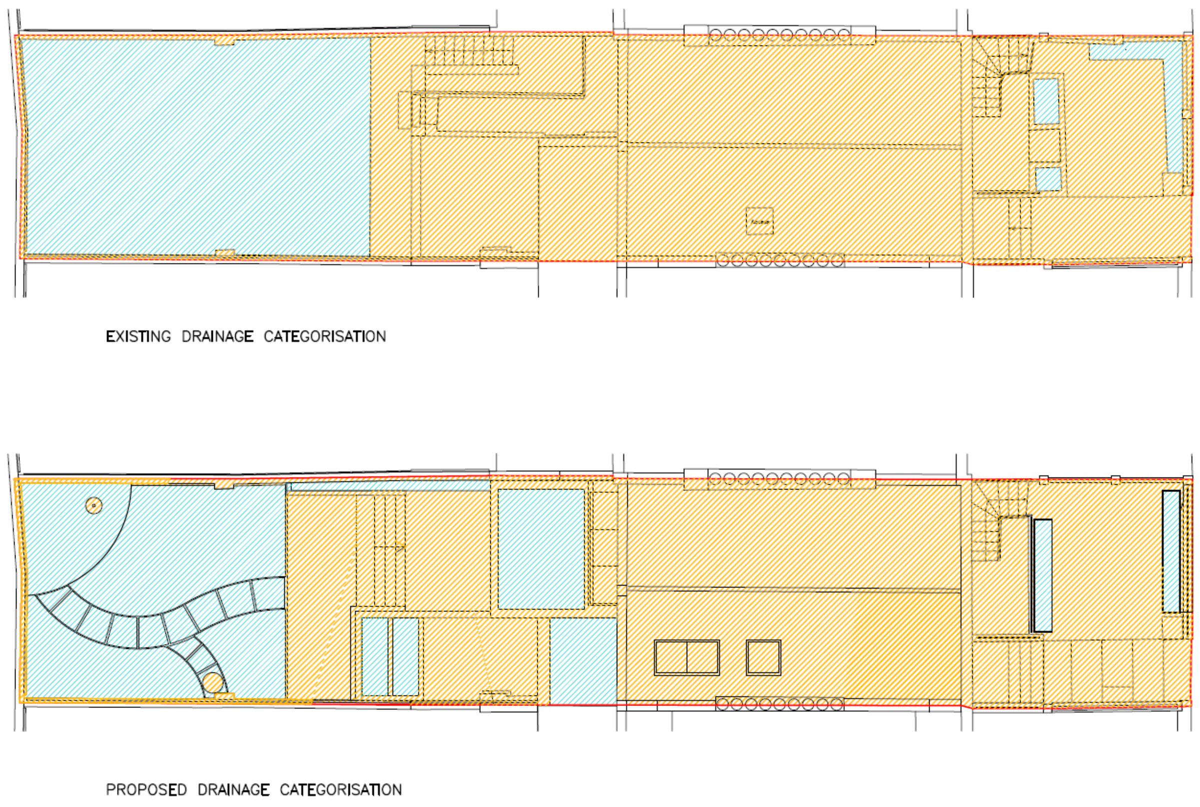
12.0 DRAINAGE

12.1 The development is a subterranean extension of a single family dwelling house. As no additional utilities or units are being created there will be no material change in the requirements of the local drainage infrastructure.

12.2 The above ground drainage will be subject to invert levels, drained by gravity to the existing combined sewage system. The below ground drainage will be drained to a submersible package sewage station situated below the basement slab which will then be pumped via a rising drain to the nearest available inspection chamber on the existing gravity drainage system. This can then flow by gravity into the existing combined sewage system. To mitigate the risk of back flow suitable measures such as non-return valves will be incorporated into the drainage design.

12.3 It is proposed to extend the lower ground floor into the rear garden and to refurbish the rest of the garden. Figure 6 demonstrates that the impermeable areas are not increased and there is an increase of the soft landscaped areas and hence a small reduction in discharge into the Thames water sewer. This will be achieved using permeable paving in the rear garden and using a sedum blanket system on the roofs of the new extension.

The proposed green roof system will be a Bauder Xero Flor XF301 or similar.



LEGEND

SITE BOUNDARY

DRAINAGE CATEGORISATION	EXISTING	PROPOSED	DIFFERENCE
OUTSIDE PROPERTY			
HARD SURFACING RAINFALL IS NOT ATTENUATED AND ENTERS THE SURFACE WATER DRAINAGE SYSTEM	111.2m²	110.6m²	−0.8m²
LANDSCAPE / GARDEN AREAS RAINFALL DOES NOT ENTER THE SURFACE WATER DRAINAGE SYSTEM	47.3m²	47.9m²	+0.8m²

Figure 6: Extract from drainage categorisation drawings

13.0 SUSTAINABILITY

As the proposed extension at lower ground floor will involve significant amounts of concrete, cement replacement alternatives should be considered. Cement replacements can used to replace up to 40% of the cement in concrete mix. These replacements are typically waste products from the energy production industry such as PFA (pulverised fuel ash) and GBFS (granulated blast furnace slag) are recycled and not sent to landfill sites. Furthermore this also reduces the amount of cement that needs to be mined. Concrete should be bought from a local supplier to further reduce the carbon footprint of transport.

There is a significant amount of reinforced concrete on the project for which steel reinforcement bars will be required. By specifying reinforcement from a UK supplier it ensures that the rebar is made from 100% recycled steel. Any structural steelwork should be sourced from a British manufacturer to ensure that rolled sections are made from at least 60% recycled steel. Sourcing the steel from a local supplier will further reduce the transport carbon footprint.

The use of timber as a structural element is to be maximised as timber production actively negates greenhouse gas production. Furthermore all timber is to be FSC certified insuring that the timber is produced from a sustainable source.

14.0 STAGE 5: REVIEW AND MITIGATION MEASURES

The table below summarises the potential impact of the lower ground floor extension on the natural environment and local amenity.

Potential Impact	Mitigation Measures
Land Stability : Impact on neighbouring structures	Monitoring of neighbouring buildings will be undertaken.
	The lower ground floor extension will be constructed following the construction method statement
	The contractor will adopt the practices outlines within the Demolition Protocol and the Considerate Constructors Scheme
Ground Water Flow : Impact on aquifer	The lower ground floor extension will not prevent groundwater flow.
Surface Flow and Flooding : Increase of surface water run off to drainage system	The proposed development will includes green roofs which will provide some attenuation of the surface water run-off to the local drainage system.

15.0 NON TECHNICAL SUMMARY

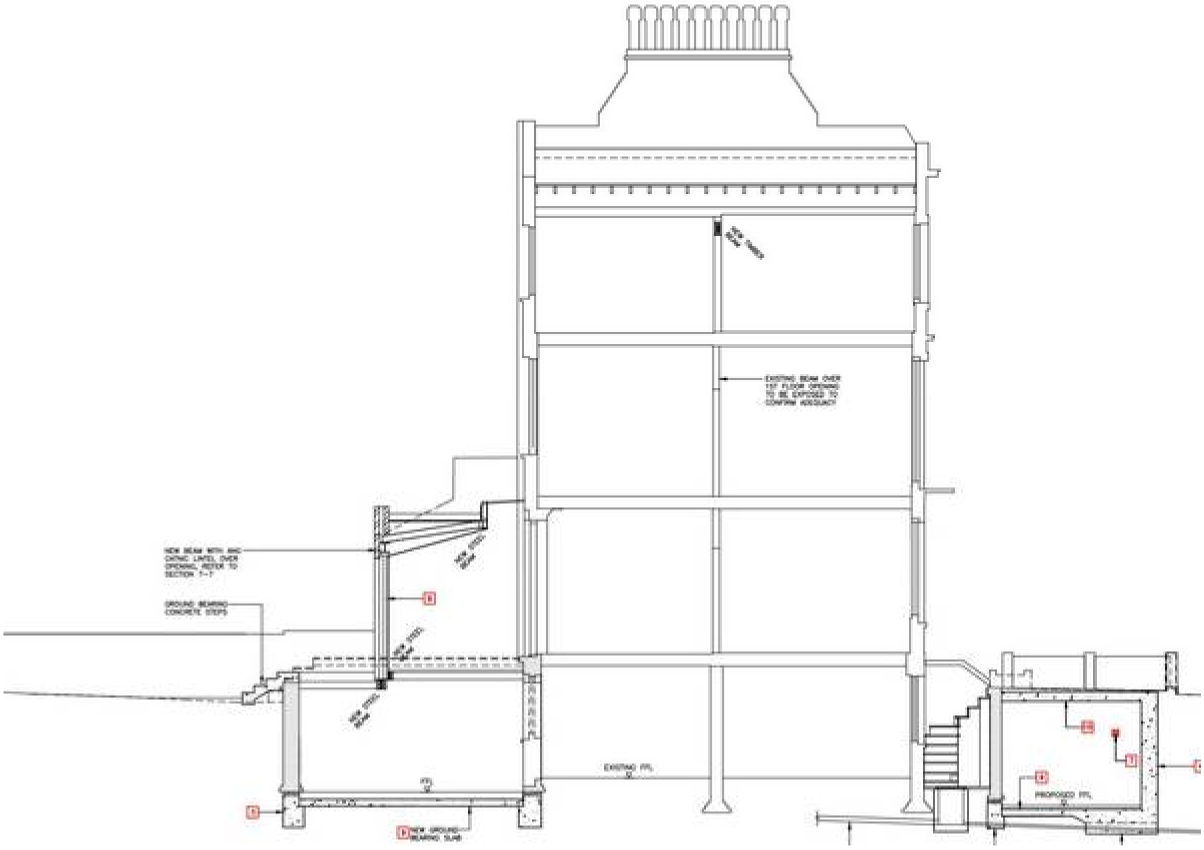
15.1 It is essential that a thorough review of all temporary works, contractors' method statements and calculations for these works is undertaken by a suitable qualified structural engineer prior to works starting. The permanent works will also be submitted to Building Control and the necessary Party Wall Surveyors for approval prior to the works commencing on site.

15.2 The findings of this Basement Impact Assessment can be summarised as per below:

- The lower ground floor extension will be predominantly within London Clay,
- Groundwater is not expected to be encountered,
- The development is expected to have negligible impact on surface water flow and flooding,
- *From the results of the Ground Movement Assessment, the predicted damage category is between Category 1 and Category 2. This is below the limit imposed by Camden Council and will only be a risk of aesthetic damages.*
- Monitoring of adjacent properties will be undertaken
- The proposed development is not expected to provoke any cumulative effect as no existing basement was identified in the adjacent properties.

15.3 The proposed works at 47 Albert Street have been designed with robust structural principles and methods of construction that are widely used and known. This will ensure the integrity of neighbouring structures and roadways are not compromised during its construction.
This assumed Method Statement and Structural report has been completed by Symmetrys Limited.

Report Prepared by:	Report Reviewed by:		
Camille Corvec MEng Structural Engineer	John Strawson MICE	Christopher Atkins CEng MIStructE Managing Director of Symmetrys Limited	Philip Lewis FGS, CGeol Managing Director of LMB Geosolutions Ltd



LMB GEOSOLUTIONS LTD

GROUND MOVEMENT ASSESSMENT

47 ALBERT ST, LONDON NW1

January 2017

DOCUMENT RECORD

Document Title	Ground Movement Assessment
Site	47 Albert Street, London NW1 7LX
Document Date	18th January 2017
Document Version	Issue 2 (Updated following comments from audit)
Document Authorisation	Philip Lewis BSc (Hons), MSc, CGeol, FGS
	THE GEOLOGICAL SOCIETY CGeol CHARTERED GEOLOGIST Fellow No. 1012476

LMB

Ground Investigation
Land Contamination
Hydrogeology
Engineering Geology

Company No. 8303397
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INTRODUCTION

Introduction

AUTHORISATION

LMB Geosolutions Ltd (LMB) was instructed Symmetrys Ltd (Consultant Engineers) on behalf of Mr Neil and Mrs Angela Moran (the Client) in December 2016 to undertake a Ground Movement Assessment in relation to the proposed basement development at 47 Albert Street, London NW1 7LX (the Site).

PROJECT AND SITE DETAILS

Site Address	47 Albert Street, London NW1 7LX. A Site Location Plan is provided as **Figure 1**.
Proposed Development	The site comprises a four storey (including lower ground floor) residential terrace property. It is understood that the Client wishes to construct an extension to the existing lower ground floor of the property.
Existing Reports	LMB has previously produced the following report in relation to the proposed development: • LMB (ref. LMB.16.12.16_RIPPIL_Albert_St_v2.0, dated 16th December 2016). Ground Investigation & Assessment. 47 Albert Street, London NW1. The report includes a Preliminary Risk Assessment (PRA) and the results and findings from ground investigation works completed at the site to aid in development design.

AIMS & OBJECTIVES

This assessment aims to use information from the existing ground investigation and details of the development proposals to undertake a Ground Movement Assessment (GMA) that will estimate the potential impact of the proposed basement development on surrounding buildings / structures.

SCOPE OF WORKS

The following scope of works has been completed:

- Review of available architects plans for the site and surrounding properties to understand the dimensions of neighbouring / adjacent structures and any existing basements. It has been assumed that this information is available and no costs/fees have been allocated to producing such drawings / information;
- Review of the RBKC planning portal to acquire any information in relation to existing / planned neighbouring basements;

INTRODUCTION

- Review of data from the recent ground investigation to appraise ground conditions and potential foundation options;
- Completion of GMA calculations in accordance with the CIRIA publication C580 Embedded Retaining Walls – Guidance for Economic Design;
- Provision of an interpretive report that:
  - Summarises any assumptions and findings;
  - Provides estimates of any predicted damage/impact based upon the Burland scale; and
  - Provides recommendations for additional works and/or mitigation measures.

CONTRIBUTORS

This report has been compiled by Philip Lewis a hydrogeologist and chartered Geologist with over nineteen years experience as a geoscience professional, including over fifteen years experience as a professional adviser (consultant) in hydrogeology, engineering geology and contaminated land.

The Ground Movement Assessment has been completed by Corrado Candian (CEng, MICE).

LIMITATIONS

LMB has prepared this report solely for the use of the named Client and those parties with whom a warranty agreement and/or assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from LMB and the Client.

LMB accepts no responsibility or liability for:

a) the consequences of this document being used for any purpose or project other than for which it was commissioned, and

b) issue of this document to any third party with whom an agreement has not been executed.

The risk assessment and opinions provided, among other things, take in to consideration currently available guidance and best available techniques relating to acceptable contamination concentrations and interpretation of these values. No liability can be accepted for the retrospective effects of any future changes or amendments to these value.

SUMMARY OF GROUND CONDITIONS

Summary of Ground Conditions

INTRODUCTION

The ground investigation works were undertaken on 18th July 2016 and comprised the progression of a dynamic (windowless) sampler borehole to 8.35m bgl and excavation of 4no. hand excavated trial pits with sampling of soil for laboratory testing (see **Figure 2**).

Groundwater monitoring was undertaken following completion of the fieldworks on 28th July 2016.

Details of the ground investigation completed, along with the findings of the investigation, are provided in the Ground Investigation and Assessment report (ref. LMB.16.12.16_RIPPIL_Albert_St_v2.0, dated 16th December 2016).

GROUND & GROUNDWATER CONDITIONS

Ground Conditions

The table below provides a summary of ground conditions encountered with full descriptions provided in the associated exploratory hole logs provided in the Ground Investigation and Assessment report (ref. LMB.16.12.16_RIPPIL_Albert_St_v2.0, dated 16th December 2016).

Strata	Depth Range to Top (m bgl)	Depth Range to (Base (m bgl)	Summary Description
Made Ground	Ground Level	0.45 – 1.70	In the trial pit locations, the ground surface was generally found to comprise concrete. In BH1 (front garden) the ground surface comprised floor pavers over concrete screed. The Made Ground soils were generally found to comprise locally gravelly and sandy clay with varying proportions of brick and concrete.
London Clay Formation	0.45 – 1.70	8.35(1)	The London Clay was found to comprise an upper sequence (c.0.5m) of soft clay overlying firm becoming stiff very closely fissured clay.

(1) Base of the London Clay was not determined.

Groundwater Conditions

No groundwater strikes were recorded during the ground investigation works. During the return monitoring visit completed on 29th July 2016 no groundwater was recorded to the base of the monitoring well at 6.00m bgl.

SUMMARY OF GROUND CONDITIONS

Characteristic Values of Soil Parameters

A summary of the geotechnical properties of the strata based on the field and laboratory testing is provided in the table below.

Soil Property	**Stratum**	
	Made Ground	London Clay
SPT 'N' Value	6	9 – 39
Bulk Density (mg/m^3)	1.70 (2)	1.83 – 2.35 (1)
Moisture Content (%)	18 – 31	29 – 32
Plasticity Index (%)	-	45 – 47
pH	8.1 – 8.3	8.3
Sulphate (g/l)	0.026	0.13

(1) Literature values taken from Forster (1997)
(2) Value based on BS8002

SUMMARY OF FOUNDATION OPTIONS

Summary of Foundation Options

INTRODUCTION

It is understood that the development will comprise an extension to the existing lower ground floor of the property. On this basis, it the following assumptions have been made:

- The formation level for the floor of the extension will be at approximately 3.0m bgl;
- The load from the existing four storey structure will be in the region of 40-60KN/m^2 which is not anticipated to significantly alter following the extension. No additional loads are envisaged;
- For a four storey structure (including the roof) the existing wall load is estimated at approximately 80-100kN/m run, which is not anticipated to significantly alter following basement deepening and extension.
- There will be no significant changes in elevation over the proposed basement development.
- Foundations will not be eccentrically loaded.

FOUNDATION OPTIONS

Spread Foundations

Based on the findings of the ground investigation and the subsequent laboratory testing it has been concluded that for traditional spread foundations (placed on the competent firm London Clay) at the assumed formation level of 3.0m bgl a net safe bearing pressure of 85kN/m^2 should be available.

It is recommended that the undrained shear strength of soils at formation level be confirmed using a hand shear vane and should exceed 40kN/m^2.

Should formation level be extended to 4.0m bgl a net safe bearing pressure of 120kN/m^2 should be available. In this case, it is recommended that the undrained shear strength of soils at formation level be confirmed using a hand shear vane and should exceed 50kN/m^2.

The bearing pressure is based on a factor of safety of 3 to ensure that settlement remains within normally acceptable limits.

The above advice assumes that the proposed basement development and in particular foundations would not be within the influence of any trees or tree routes.

The Consultant Engineers have confirmed that the basement formation level will be approximately 3.0m bgl.

Piled Foundations

Based on the proposed development and the ground conditions encountered it is considered unlikely that a piled foundation would be the most feasible solution. However, it is possible that sheet piling may be considered as part of the temporary works.

GROUND MOVEMENT

Ground Movement

INTRODUCTION

As outline, the site comprises a four storey (including lower ground floor) residential terrace property. It is understood that the Client wishes to construct an extension to the existing lower ground floor of the property.

It is understood that the lower ground floor extension will be constructed using traditional spread foundations, reinforced concrete retaining walls and underpinning. The formation level of the extension is estimated to be at 3.00m bgl.

There is the potential for ground movements due to the proposed development from the wall installation and from the excavation process.

The magnitude and extent of ground movements resulting from installation of a secant/contiguous piled wall and excavation (in front of such a wall) are typically estimated based on the guidance given in the CIRIA publication C580 Embedded Retaining Walls – Guidance for Economic Design. The guidance in the CIRIA publication is based on the behaviour of embedded walls at numerous sites in London, which are predominantly walls embedded in London Clay, though typically with some near surface deposits consisting of River Terrace Deposits and Made Ground.

BUILDING DAMAGE ASSESSMENT

There is the potential for ground movements due to the proposed development from the wall installation and from the excavation process. It has been assumed that the excavation will be undertaken using the traditional method of underpinning up to a depth of approximately 3.0m.

It is envisaged that the excavation to be undertaken in the rear garden is relatively small compared to that at the front of the property. On this basis, a conservative approach has been adopted and the building damage assessment has focused on the underpinning works to be undertaken in the front garden to ensure the worst case is considered.

C580 provides curves estimating horizontal and vertical ground surface movements due to piled wall installation and to excavation in front of wall. Total ground movements resulting from the excavation will be the combination of the installation movements and the excavation movements.

Ground Movements Arising from Wall Installation

It has been assumed that the movements resulting from excavation in front of the underpins also incorporate the movements resulting from the construction (i.e. installation) of the underpins, since, unlike for the piles, the construction process requires an excavation prior to the pins being formed.

GROUND MOVEMENT

Ground Movements Arising from Excavation in front of Wall

The method provided within Box 2.5 in CIRIA C580 has been used to inform the assessment. However, consideration has also been given to recorded firm (and locally soft) nature of the soils over the excavation depth, as outlined in the following section.

The factor of safety against basal heave according to Terzaghi's method (1943) and the system stiffness have been preliminary assessed based on a Cu of 35kPa for soft to firm clay. A Factor of Safety (FoS) of about 7.5 and a system stiffness greater than 3000 have been estimated (see sheet 2, **Appendix A**). However, within the assessment a FoS of 3 has been applied in accordance with the approach by Clough et al (1989), see sheet 2, **Appendix A**).

Fig.2.13 in CIRIA C580 (from Clough 1989) indicates that the ratio between the maximum lateral wall movement and the excavation depth is in the order of 0.2% for such FoS and system stiffness values. According to Peck (1969) and Clough and Davidson (1977) the maximum inward movement of the wall may be in the order of 0.3% of the excavation depth in soft to firm clays.

Furthermore Moormann (2004) carried out extensive empirical studies of retaining wall and ground movements due to excavation in soft soil (cu<75kPa). He found that the ratio between the maximum vertical settlement at the ground surface behind a retaining wall and the maximum horizontal wall displacement varies between 0.5% and 1.0% (see sheet 2, **Appendix A**).

In the absence of underpinning specific guidance, Fig. 2.11a and Fig. 2.11b from CIRIA C580 have been used based on the above implications to reflect the soft to firm nature of the soil excavated.

As such, the ratio between the maximum lateral wall movement and the excavation depth and the ratio between the maximum ground settlement and the excavation depth have been conservatively taken as 0.3% at the wall location.

This is a conservative approach as the underpinned walls will be fully propped in both temporary and permanent cases and as such the 'high stiffness' assumption in C580 would be valid.

Using these predicted movements, estimates of possible damage have been made for the surrounding structures, based on the Damage Classification Scheme proposed by Burland and Wroth (1974).

Summary of Results

Copies of worksheets calculations and graphical representation of the results are presented in **Appendix A** and are summarised in the table below:

Nearby Building / Structure	Estimated Damage Category No.	Category of Damage	Comments
42 to 53 Mornington Terrace	n/a	n/a	Outside zone of influence of ground movement.

GROUND MOVEMENT

Nearby Building / Structure	Estimated Damage Category No.	Category of Damage	Comments
30 to 41 Mornington Street	n/a	n/a	Outside zone of influence of ground movement.
10 to 29 Albert Street	n/a		
Subject Property (47 Albert St)	2	Slight	Cracks easily filled. Redecoration probably required. Crack width <5mm.
49 Albert Street	1	Very Slight	Fine cracks that can easily be treated during normal decoration.
49 Albert Street – Party Wall	2	Slight	Cracks easily filled. Redecoration probably required. Crack width <5mm.
45 Albert Street	1	Very Slight	Fine cracks that can easily be treated during normal decoration.
45 Albert Street – Party Wall	2	Slight	Cracks easily filled. Redecoration probably required. Crack width <5mm.

The ground movement assessment undertaken indicates that damage to the subject property and surrounding properties will be between Burland Categories 1 (Very Slight) and 2 (Slight).

Anticipated vertical movements provide a maximum tilt of about 1 in 1500, which is well within generally tolerable differential movement (see **Appendix A**).

ADDITIONAL CONSIDERATIONS

Potential for Heave, Settlement & Inward Yielding

The removal of the overburden during the excavation of the basement is likely to result in some inward yielding of soils at formation level and possibly a subsequent settlement of the soils outside the excavation. In sandy soils the effects tend to be limited by their relatively low compressibility (as compared to soft clay soils). Inward yielding in firm to stiff clays is typically in the range of 5-40mm (Tomlinson, M.J. (1986).

The estimated depth of excavation is 4.0m below current ground level, assuming an unsaturated unit weight of 18-20kN/m^3, the estimated unload due to the excavation would be in the order of 60-80kN/m^2.

As the lower ground floor extension will be beneath the front garden area, there will be a difference in load at formation inside and outside that could result in differential settlement.

As outlined, groundwater was not encountered at the anticipated formation level of the basement. However, it would be prudent to adopt a conservative approach in relation to the basement design and account for groundwater at a depth of approximately 1m bgl.

GROUND MOVEMENT

Experience suggests that such heave movements tend largely to be restricted to within the site boundary when excavations are created with contiguous/secant piled retaining walls, so it is not anticipated that the changes in loading at basement level will have a significant impact on any surrounding structures. However, based on the information presented above it is recommended that the basement design takes into account the following:

- The potential for short term and longer term heave and inward yielding during construction and following construction.
- The potential for differential heave that will occur in the areas of the basement and areas where the basement doesn't extend (i.e. rear garden).
- The potential for groundwater to cause both lateral and uplift pressure.
- The potential for groundwater ingress into the basement following construction.

Ground Movement & Construction

The predicted building damage during construction is based on a conservative approach and it is recommended that the contractor gives consideration to the Association of Specialist Underpinning Contractors (ASUC) guidelines which should provide some mitigate and reduce the potential movements.

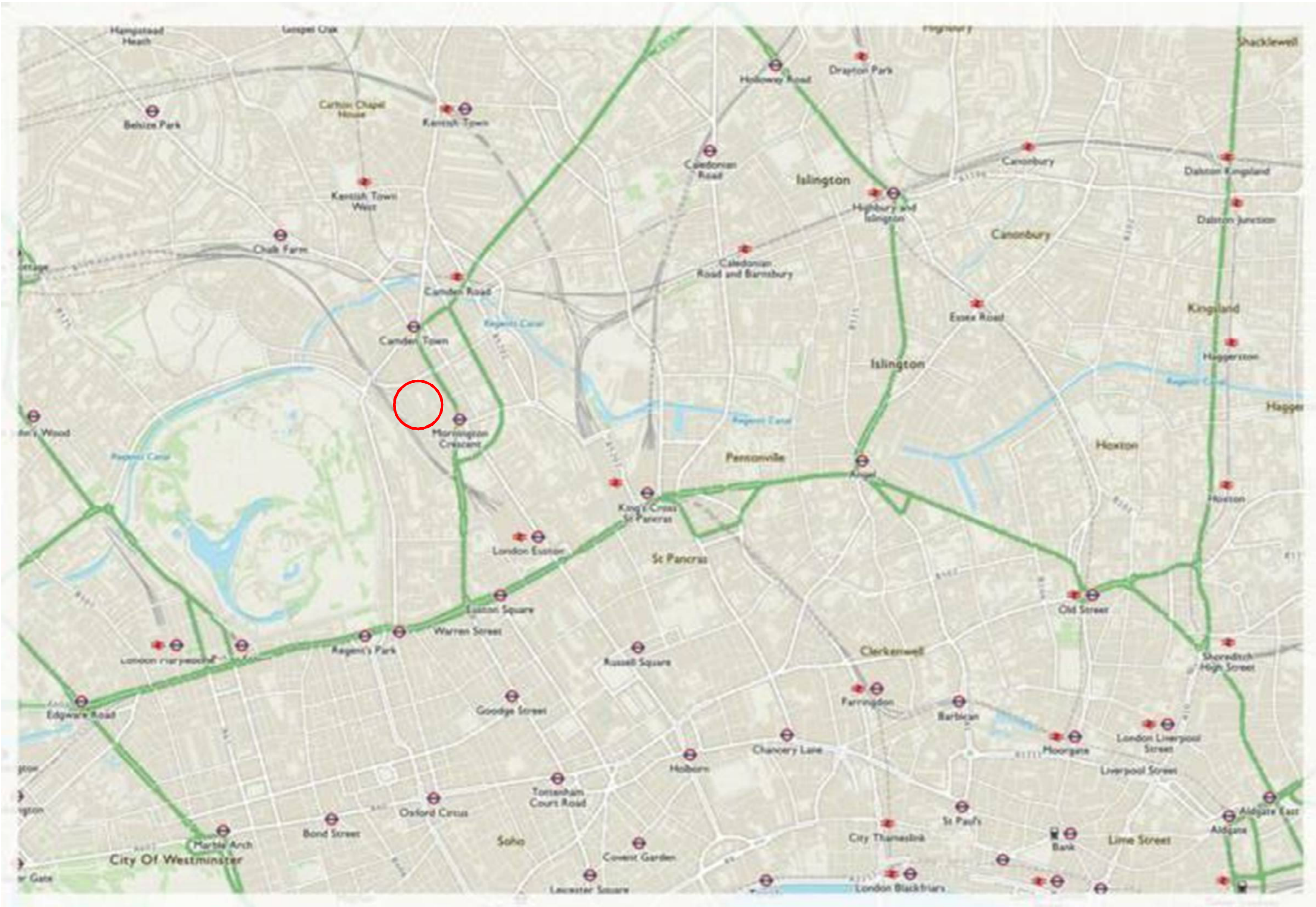
Ground Movements Monitoring

As a minimum, it is recommended that movement monitoring should be undertaken with surveying points set up using a total station prior to commencement of the works and it is recommended that monitoring be undertaken at weekly intervals. It is recommended that trigger values for monitoring are based on the predicted ground movements to ensure conservatism and that they are agreed under the Party Wall Act.

References

1. CIRIA C580 - Embedded Retaining walls: guidance for economic design, London 2003.
2. Moormann, C. Analysis of wall and ground movement due to deep excavation in soft soil based on a new worldwide database. Soils and Foundations, Vol. 44, No. 1, 87-98, 2004.
3. Peck, R.B. Deep excavations and tunnelling in soft ground. Proceedings of the 7th International Conference on Soil Mechanics. Mexico, State of the Art, pp. 225-290, 1969.
4. Clough, G.W. and Davidson, R.R. Effects of construction on geotechnical performance. Proceedings of the 9th International Conference on Soil Mechanics. Tokyo, Specialty Session, p. 3, 1977.
5. Clough, G.W. et al. Movement control of excavation support systems by iterative design procedure. ASCE Foundation Engineering: current principles and practices. Vol 1, pp. 869-884, 1989.

FIGURES



N

Key:

Approximate site location

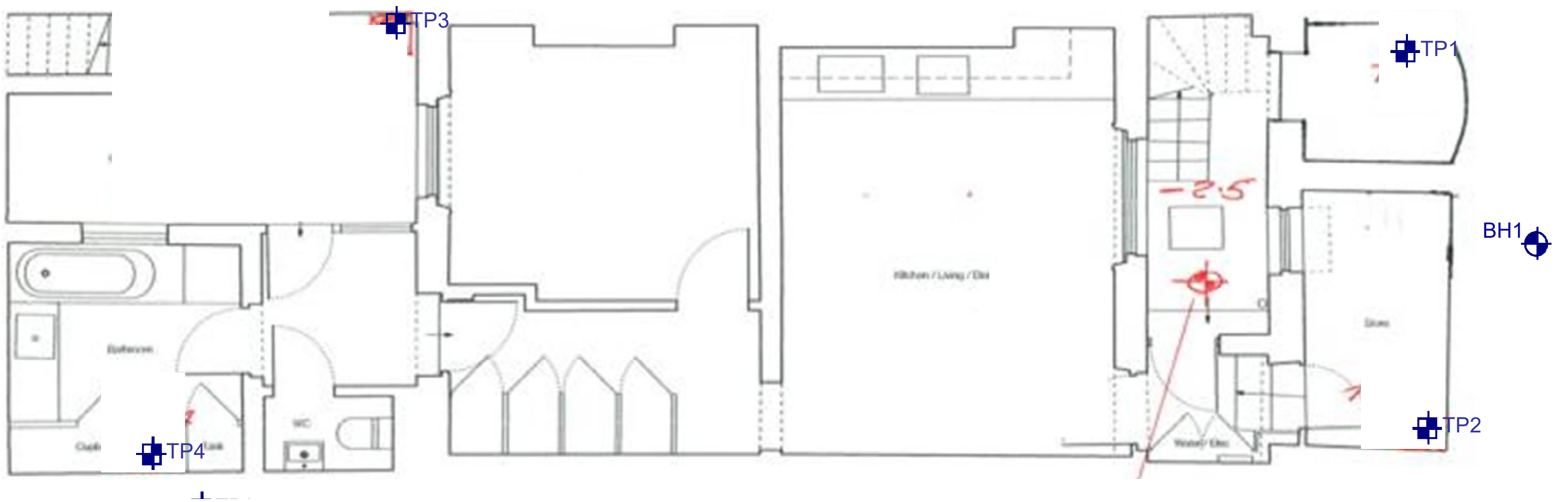
IMPORTANT – Please Read

This drawing is for illustrative purposes only and is for use only in conjunction with associated reports relating to the project details below. LMB accepts no liability for the mis-interpretation or use of this illustration by any other parties.

LMB

Ground Investigation
Land Contamination
Hydrogeology
Engineering Geology

Site: 47 Albert Street, London NW1		
Figure Number: Figure 1		
Title: Site Location Plan		
Project No:	**Created By:** PIL	**Date:** August 2016
Client: Mr Neil & Mrs Angela Moran		



Key:

BH Borehole location

TP Trial Pit location

IMPORTANT – Please Read

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Ground Investigation
Land Contamination
Hydrogeology
Engineering Geology

Site:	47 Albert Street, London NW1
Figure Number:	Figure 2
Title:	Exploratory Hole Location Plan

Project No:	**Created By:**	**Date:**
	PIL	August 2016

Client: Mr Neil & Mrs Angela Moran

APPENDICES

Appendices

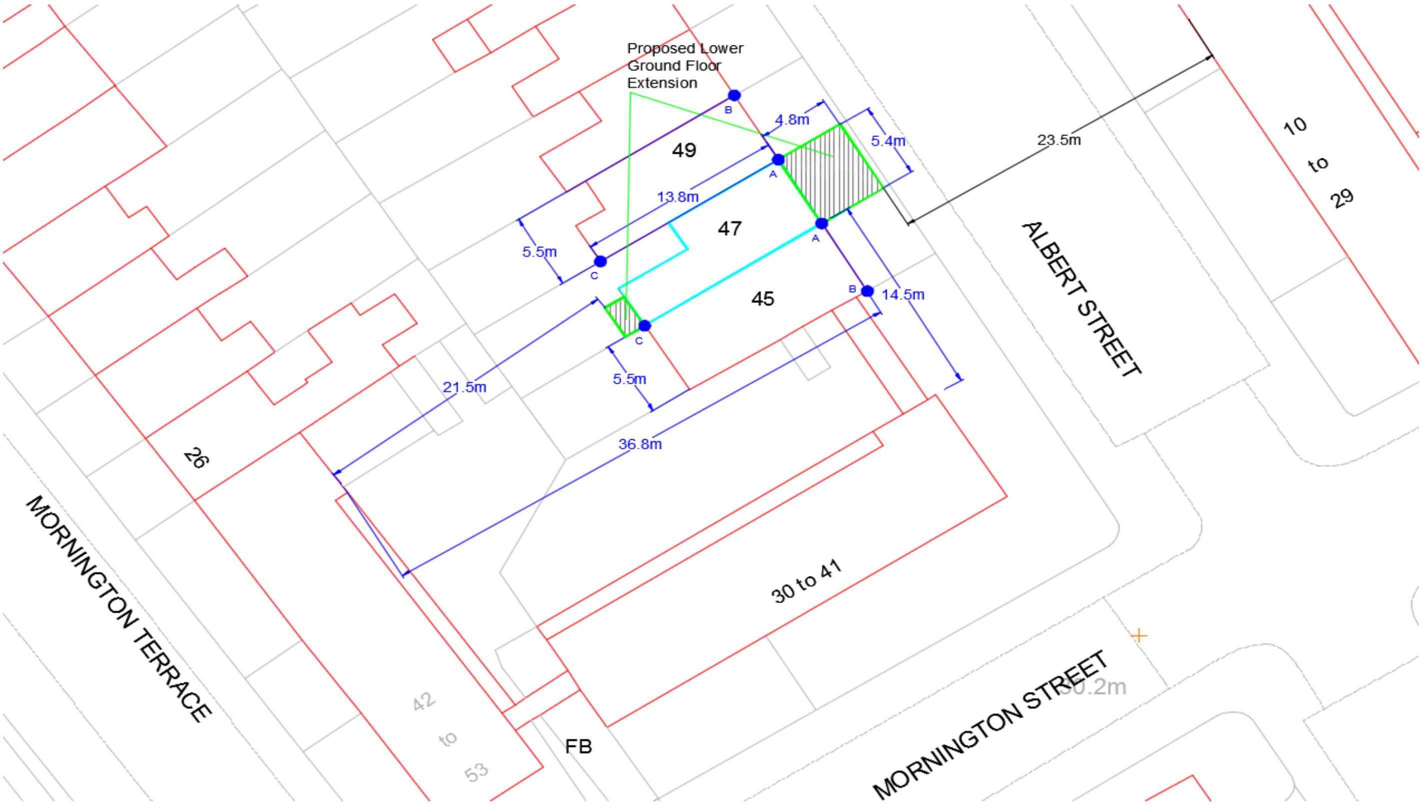
APPENDIX A GMA CALCULATION WORKSHEETS

Ground Investigation
Land Contamination
Hydrogeology
Engineering Geology

Calc No.	Sheet No.	Rev
	1	A

Calculation Sheet

Project	Ground Movement Assessment	Made by	CC
Location	47 Albert Street - London NW1	Date	18.01.17

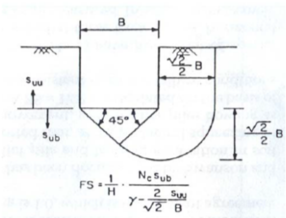


Calc No.	Sheet No.	Rev
	2	A

Ground Investigation
Land Contamination
Hydrogeology
Engineering Geology

Calculation Sheet

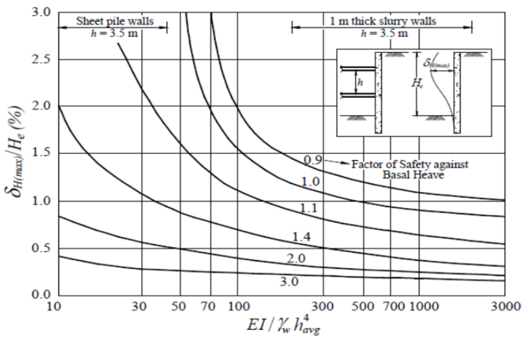
Project	Ground Movement Assessment	Made by	CC
Location	47 Albert Street - London NW1	Date	18.01.17



B	5.4	m	Excavation Width
H	3	m	Excavation Depth
Nc	5.7		
Cu	35	kPa	Undrained Shear Strenght
γ_s	18	kN/m³	Bulk Unit Weight of Soil
FoS	7.5		Factor of Safety against Bottom Heave (after Terzaghi, 1943)

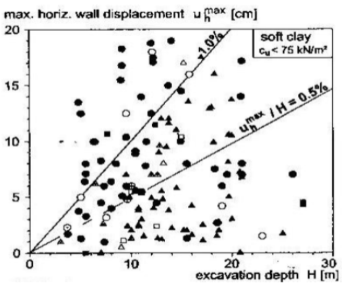
Ground movements arising from excavationin fornt of wall

Terzaghi's Method to assess Factor of Safety against Bottom Heave (1943).



E	3.00E+07	kPa	Wall Stiffness
b	0.4	m	Wall Width
I	0.00533	m^4/m	Moment of Inertia
γ_w	10	kN/m³	Bulk Unit Weigth of Water
h	1.5	m	Props Vertical Spacing
ρ_s	3160		System Stiffness (after Clough et al, 1989)

Lateral wall movements as a percentage of excavation deph versus system stiffness (Clough et al. 1989).



Variation of maximum horizontal displacement with excavation depth following Moormann (2004).

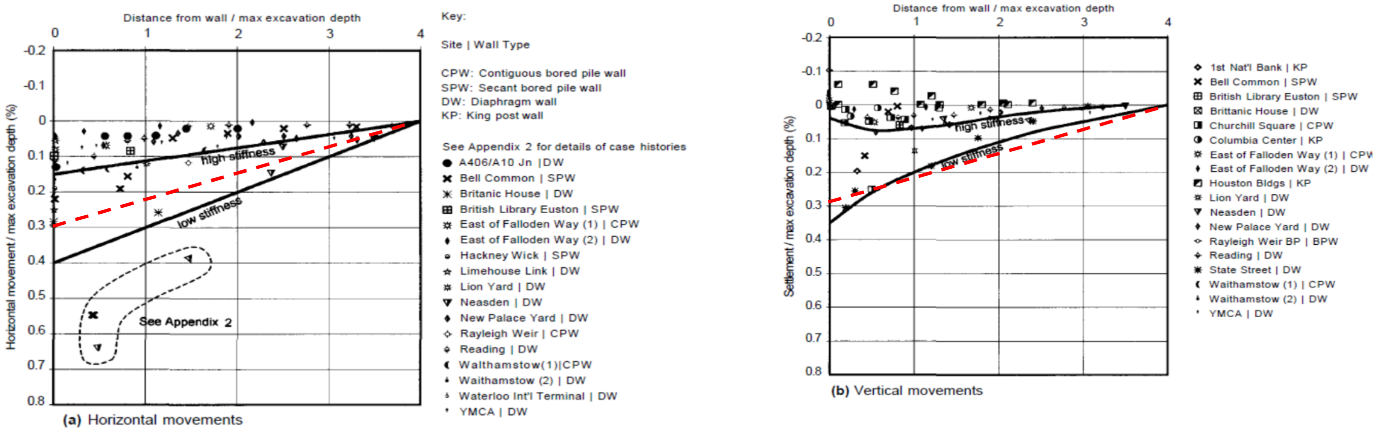


Figure 2.11 *Ground surface movements due to excavation in front of wall in stiff clay*

Ground Investigation
Land Contamination
Hydrogeology
Engineering Geology

Calc No.	Sheet No.	Rev
	3	A

Calculation Sheet

Project	Ground Movement Assessment	Made by	CC
Location	47 Albert Street - London NW1	Date	18.01.17

Assumptions
Excavation depth - 3.0m
Underpinning to -3.0m
Propping System will be utilised

Max Excavation Depth 3.0 m
Wall Depth 3.0 m

Nearby Structure	Note	Point	Distance from wall (m)	Ground movements arising from excavation in front of wall				
				Distance from wall / max excavation depth	Horizontal movement / max excavation depth (%) Fig. 2.11a	Horizontal movement (mm)	Settlement / max excavation depth (%) Fig. 2.11b	Vertical movement (mm)
49 Albert Street		A	0.0	0.0	0.3	9.0	0.3	9.0
		B	5.5	1.8	0.17	5.1	0.13	3.9
49 Albert Street	Party Wall	A	0.0	0.0	0.30	9.0	0.3	9.0
		C	13.8	4.6	0	0.0	0	0.0
45 Albert Street		A	0.0	0.0	0.30	9.0	0.3	9.0
		B	5.5	1.8	0.17	5.1	0.13	3.9
45 Albert Street	Party Wall	A	0.0	0.0	0.3	9.0	0.3	9.0
		C	13.8	4.6	0	0.0	0	0.0

Nearby Structure	Total Movements											
	Corner Effect	Horizontal movement (mm)	Vertical movement (mm)	L (m)	H (m)	L/H	Δ (mm)	Tilt (1/x)	M=Δ/L (%)	δh (mm)	εh=δh/L (%)
49 Albert Street	Y	4.5	4.5	5.5	10.0	0.6	2.6	2157	0.046	2.0	0.035
		2.6	2.0								
49 Albert Street - Party Wall	N	9.0	9.0	13.8	10.0	1.4	9.0	1533	0.065	9.0	0.065
		0.0	0.0								
45 Albert Street	Y	4.5	4.5	5.5	10.0	0.6	2.6	2157	0.046	2.0	0.035
		2.6	2.0								
45 Albert Street - Party Wall	N	9.0	9.0	13.8	10.0	1.4	9.0	1533	0.065	9.0	0.065
		0.0	0.0								

Ground Investigation
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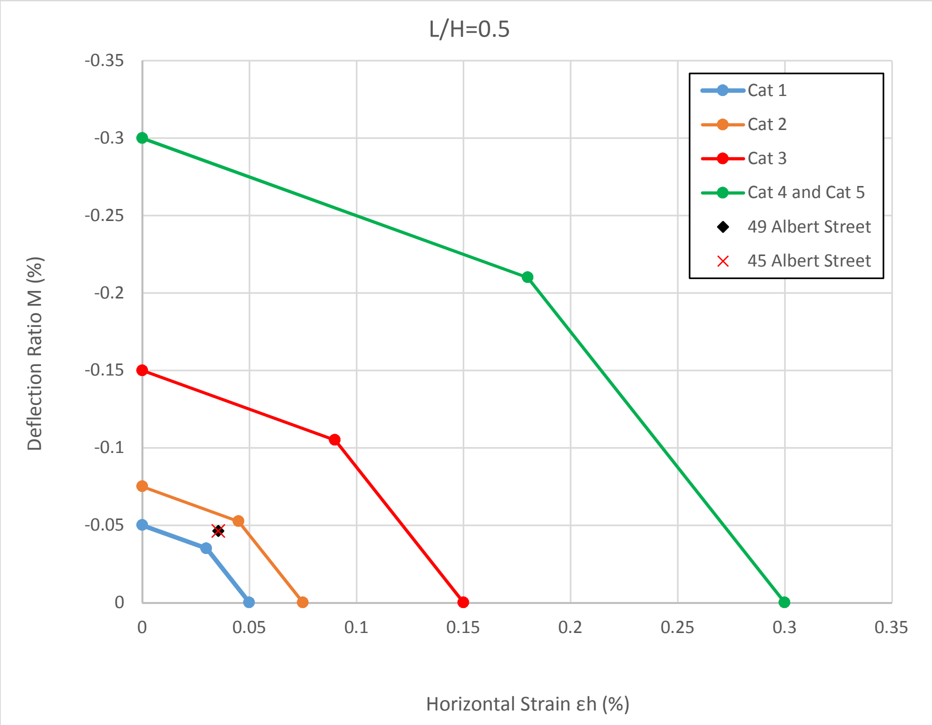
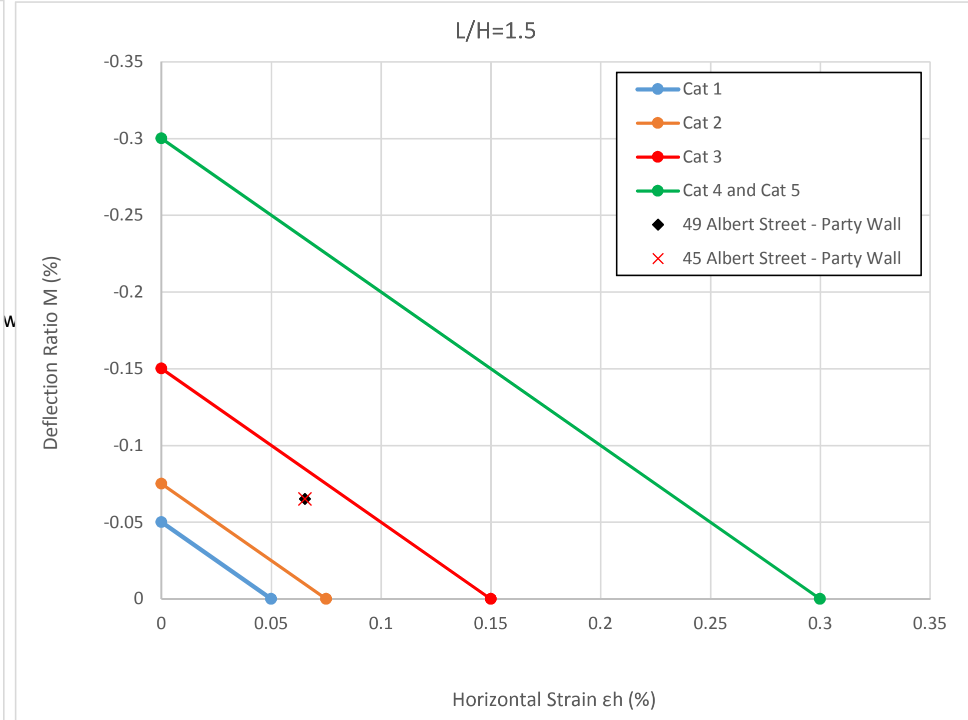
Calc No.	Sheet No.	Rev
	4	A

Calculation Sheet

Project	Ground Movement Assessment	Made by	CC
Location	47 Albert Street - London NW1	Date	18.01.17





RE: Albert St BIA

philip lewis to: grahamkite 23/01/2017 11:35
Cc: "'Camille Corvec'"

Hi Graham
As discussed please find attached drawing that was issued to us from Symmetrys which details the reinforced concrete at the rear extension. This should provide a high stiffness in the permanent case, although as discussed the GMA calculation focused on the front extension as the worst case.

In addition, I have discussed the green roof SuDS with Symmetrys and they have agreed that there will be consultation with LBC and/or Thame Water to confirm the requirements for allowable run-off are met.

Should you have any further queries then please feel free to contact me at your convenience.

Best regards,

Philip Lewis
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Director
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Connect with me on

2016044 01 Rev.P4.pdf

Albert Street - Audit
Camille Corvec
to:
GrahamKite@campbellreith.com
08/02/2017 12:41
Hide Details
From: Camille Corvec <camille.corvec@symmetrys.com>
To: "GrahamKite@campbellreith.com" <GrahamKite@campbellreith.com>

Hi Graham,

Following your phone call we would comment as follows:

-The party wall on gridline 1/A-D will have a high degree of vertical fixity provided by the existing return walls at each end. In addition to this, the beams on grid line B will also offer a prop at the top of the wall midway along its length. Therefore, whilst being a cantilever, we would suggest that the wall will also span horizontally and not require any further propping at its head.

-The wall on gridline 1-3/A-D is 3 metres long and will benefit of the same vertical fixity at both ends as provided on the party wall. It will also receive lateral support from the in situ RC stairs in the garden.

-The full perimeter of the rear extension and the terrace will be tied together and restrained at upper ground floor level by the use of 850mm long galvanised steel straps at 1200mm centres. The timber joists of the terrace will be ply lined to offer further stiffness.

We will ensure that the predicted movements of the building do not excess the damage category 1. We will consider replacing the timber floor with a RC slab if required to increase the stiffness.

Kind regards,

Camille Corvec
Structural Engineer

Symmetrys
Structural Engineers

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