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190 Goldhurst Terrace
London NW6

Basement Impact Assessment Audit

For

London Borough of Camden

Project Number: 12466-45

Revision: F1

January 2018

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Document History and Status

Revision	Date	Purpose/Status	File Ref	Author	Check	Review
D1	February 2017	Comment	AFLemb12466-45-270217-190 Goldhurst Terrace-D1.docx	AFL	GK	GK
D2	June 2017	Comment	AFLgk12466-45-270617-190 Goldhurst Terrace-D2.docx	AFL	GK	EMB
F1	January 2018	Final	AFLgk12466-45-100118-190 Goldhurst Terrace-F1.docx	AFL	EMB	GK

Document Details

Last saved	10/01/2018 09:13
Path	AFLgk12466-45-100118-190 Goldhurst Terrace-F1.docx
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Project Number	12466-45
Project Name	190 Goldhurst Terrace
Planning Reference	2016/2689/P

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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 190 Goldhurst Terrace, London NW6 (planning reference 2016/2689/P). The basement is considered to fall within Category B as defined by the Terms of Reference.

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. CampbellReith was able to access LBC's Planning Portal and gain access to the latest revision of submitted documentation and reviewed it against an agreed audit check list.

1.4. The proposed development involves the excavation of a single storey basement to be constructed beneath almost the full footprint of the house, including the rear projection but not the conservatory, with open lightwells at basement level, alongside both the existing front and rear bays on the west side of the house. Underpinning and contiguous piling is proposed.

1.5. The BIA has been prepared by Chelmer Consultancy Services with supporting documents prepared by S.C. Green Limited and Clague Architects, and the final October version of the BIA by Gabriel GeoConsulting Limited. The combined authors' qualifications are in accordance the requirements of CPG4.

1.6. Information within the BIA is broadly in line with the aspects recommended of a desk study within the LBC guidelines.

1.7. The BIA states that the site lies on Made Ground over Head Deposits and the London Clay. The London Clay is identified as the bearing formation for the proposed foundations. The London Clay is designated unproductive strata.

1.8. Site investigation data and geotechnical design parameters are provided. The Contractor must confirm that insitu shear strength is equal to / greater than the Engineer's design requirements as per section 10.4.5 of the revised BIA report prior to forming retaining walls / foundations.

1.9. The BIA states that Head deposits in the area are known to be highly variable, and locally have been recorded as soft to firm. Whilst the revised BIA report states that no Head Deposits were found on site, it notes that their presence is still possible. Mitigation and contingency measures to demonstrate that weak and water bearing soils will not impact the structural stability of the development were proposed and further detail was requested in the previous audit. This has been supplied in the October 2017 BIA revision.

1.10. Further longer term groundwater monitoring should be undertaken to inform temporary works contingency planning, control measures and waterproofing design. The BIA acknowledges an engineered bypass system may be required. Further detail of this contingency measure including comment on how it will be incorporated into construction was previously requested and is now included in the October 2017 revision of the BIA.

1.11. The BIA states that the site has a very low risk of flooding according to Environment Agency data. This is accepted. However, the site is located within the Goldhurst Local Flood Risk Zone and the flood risk mitigation measures proposed in the BIA should be implemented.

1.12. Attenuation SUDS drainage is discussed. The proposals have been finalised in the revised BIA report and off-site discharge flow rates should be agreed with Thames Water and LBC prior to works commencing on site.

1.13. Outline calculations and construction drawings have been presented including temporary works and propping arrangements, with a method statement. An assessment of ground movements due to piling is presented.. The BIA states that transitional underpinning may be required, which is detailed in the revised October 2017 BIA version and shown on the updated drawings 4013/A1/05E and 4013/A1/02G.

1.14. A ground movement assessment (GMA) for buildings within the zone of influence has been presented. Whilst the GMA predicts potential damage to neighbours of Category 2 (Slight) mitigation is proposed to limit damage to a maximum of Category 1 (Very Slight), by use of sufficiently stiff restraint (capping beam) to the piles and stiff propping of the underpins. Structural monitoring will be used to control the works. Appropriate trigger values are proposed.

1.15. Queries and matters requiring further information or clarification are discussed in Section 4 and summarised in Appendix 2. Considering the revised submissions, the BIA is considered to meet the requirements of CPG4.

2.0 INTRODUCTION

2.1. CampbellReith was instructed by London Borough of Camden (LBC) on 19 January 2017 to carry out a Category B Audit on the Basement Impact Assessment (BIA) submitted as part of the Planning Submission documentation for 190 Goldhurst Terrace, London NW6 3HN, Camden Reference 2016/2689/P.

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.
- Local Plan Policy A5 Basements.

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; and,

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: "Excavation of a basement to form an independent two-bedroom dwelling."

2.6. CampbellReith accessed LBC's Planning Portal on 24 January 2017 and gained access to the following relevant documents for audit purposes:

- Basement Impact Assessment of 190 Goldhurst Terrace, London NW6 3HN (ref BIA/6366) dated April 2016 by Chelmer Consultancy Services.
- Basement Impact Assessment (Redacted) of 190 Goldhurst Terrace, London NW6 3HN (ref BIA/6366a Rev1) dated November 2016 by Chelmer Consultancy Services.
- Geo-environmental Interpretive Report of 190 Goldhurst Terrace, London NW6 3HN (ref GENV/6366) dated May 2016 by Chelmer Consultancy Services.
- Proposed plans, elevations and sections dated August and October 2015 by Clague Architects.
- Proposed Basement Phase 1-4 Drawings and Phase 3 Sections dated March 2016 by S.C. Green Ltd.
- Design and Access statements (ref 222447A) dated May 2016 by Clague Architects.
- Method statement (ref job 4013) by S.C. Green Ltd.
- Comments and responses to the proposed development from local residents.

2.7. Following an initial audit issued in February 2017, CampbellReith was provided with the following additional documents for audit purposes in May 2017:

- 4013 Calculations pages 14A and 20A dated Feb. 2016 by S.C. Green Ltd.;
- 4013 Revised Calculation sheet 14B dated Feb. 2016 by S.C. Green Ltd.;
- 4013 Revised Calculations Aug 2016 dated August 2016 by S.C. Green Ltd.;
- 4013 Revised Calculations dated April 2016 by S.C. Green Ltd.;
- BIA6366a Rev2 Revised Basement Impact dated May 2017 by Chelmer Consultancy Services;
- EMC-2015-176 Letter SWMP Outline strategy dated 25 May 2017 by Tridax Ltd.;
- EMC-2015-176 outline design dated 25 May 2017 by Tridax Ltd.

2.8. Following a second audit issued in June 2017, CampbellReith was provided with the following additional documents for audit purposes in October 2017:

- Basement Impact Assessment of 190 Goldhurst Terrace, London NW6 3HN (ref 16550/R2.1) dated October 2017 on behalf of Chelmer Site Investigation Laboratories Ltd. by Gabriel GeoConsulting Limited;
- Drawing reference 4013/A1/05E dated 11 October 2017 by S.C. Green Ltd.;
- Drawing reference 4013/A1/02G dated 11 October 2017 by S.C. Green Ltd..

3.0 BASEMENT IMPACT ASSESSMENT AUDIT CHECK LIST

Item	Yes/No/NA	Comment
Are BIA Author(s) credentials satisfactory?	Yes	Combined the authors of the 2016 BIAs have the required accreditation.
Is data required by Cl.233 of the GSD presented?	Yes	Information within the BIA is broadly in line with the information required of a desk study in line with the GSD Appendix G1.
Does the description of the proposed development include all aspects of temporary and permanent works which might impact upon geology, hydrogeology and hydrology?	Yes	Section 10 deals with this in detail.
Are suitable plans/maps included?	Yes	
Do the plans/maps show the whole of the relevant area of study and do they show it in sufficient detail?	Yes	
Land Stability Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	Conceptual Ground Model indicates Head deposits being encountered below the Made Ground. Changes to construction / movement assessment acknowledged.
Hydrogeology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	
Hydrology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	

Item	Yes/No/NA	Comment
Is a conceptual model presented?	Yes	Adequately described in text.
Land Stability Scoping Provided? Is scoping consistent with screening outcome?	Yes	
Hydrogeology Scoping Provided? Is scoping consistent with screening outcome?	Yes	
Hydrology Scoping Provided? Is scoping consistent with screening outcome?	Yes	
Is factual ground investigation data provided?	Yes	As appendices to BIA.
Is monitoring data presented?	Yes	Only two rounds of groundwater monitoring presented, both in March 2016 and groundwater not thought to be at equilibrium with water pressures in the clay. Further groundwater monitoring should be undertaken to assess for seasonal fluctuations in groundwater elevations and inform temporary works design. Conservative approach to groundwater control taken assuming groundwater at ground level - accepted.
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	Neither of the adjacent properties are reported to have basements although cellars are likely, as at the property in question.
Is a geotechnical interpretation presented?	Yes	Yes. A factual site investigation report is included in the BIA and an Interpretive Site Investigation report is included with the application documents.

Item	Yes/No/NA	Comment
Does the geotechnical interpretation include information on retaining wall design?	Yes	Indicative information provided and calculations are referenced but not presented in original BIA report. A subsequent version of the BIA includes a geotechnical interpretation and provides calculations.
Are reports on other investigations required by screening and scoping presented?	N/A	
Are baseline conditions described, based on the GSD?	Yes	Groundwater levels should be confirmed by longer term monitoring and / or by the contractor in advance of the works.
Do the base line conditions consider adjacent or nearby basements?	Yes	Cellars are presumed to exist in adjacent properties and a structural condition report is recommended for the adjacent buildings.
Is an Impact Assessment provided?	Yes	
Are estimates of ground movement and structural impact presented?	Yes	Yes, Category 0 to 2 damage predicted. Stated to be limited to Category 1 by monitoring strategy. Mitigation measures should be presented. This is accepted.
Is the Impact Assessment appropriate to the matters identified by screen and scoping?	Yes	
Has the need for mitigation been considered and are appropriate mitigation methods incorporated in the scheme?	Yes	Three types of SuDS are proposed for site specific mitigation. Transition underpinning is recommended both for the single storey rear extension at no. 190 and all adjoining load bearing walls (no.s 188 and 192), described in BIA October 2017 revision.
Has the need for monitoring during construction been considered?	Yes	

Item	Yes/No/NA	Comment
Have the residual (after mitigation) impacts been clearly identified?	Yes	Mitigation measures in relation to shallow groundwater provided in BIA October 2017 revision.
Has the scheme demonstrated that the structural stability of the building and neighbouring properties and infrastructure will be maintained?	Yes	Category 0 to 2 damage predicted stated to be limited to Category 1 by monitoring strategy. Mitigation measures should be presented. Transitional underpin design detailed in BIA October 2017 revision. Ground conditions to be confirmed by contractor.
Has the scheme avoided adversely affecting drainage and run-off or causing other damage to the water environment?	No	SUDS proposals to be clarified and agreed with TW and LBC. However, mitigation measures to avoid impact to wider hydrogeology provided in October 2017 BIA revision.
Has the scheme avoided cumulative impacts upon structural stability or the water environment in the local area?	Yes	
Does report state that damage to surrounding buildings will be no worse than Burland Category 2?	Yes	Mitigation to limit movements provided in October 2017 BIA revision.
Are non-technical summaries provided?	Yes	

4.0 DISCUSSION

4.1. The proposed development involves the excavation of a basement to form an independent two-bedroom dwelling. The basement is to be constructed beneath almost the full footprint of the house, including the rear projection but not the conservatory, with open lightwells at basement level, alongside both the existing front and rear bays on the west side of the house. The proposed rear lightwell is shown as projecting approximately 6.9m beyond the rear wall of the house and the proposed front lightwell is shown as projecting approximately 2.15m from the front wall of the house. A flight of stairs in the front lightwell will provide external access to the basement. Underpinning and contiguous piling is proposed to form the basement.

4.2. The BIA has been prepared by Chelmer Consultancy Services with supporting documents prepared by S.C. Green Limited and Clague Architects. The third revision of the BIA submitted in October 2017 was prepared by Gabriel GeoConsulting Limited for Chelmer Site Investigation Laboratories Limited. The combined authors' qualifications are in accordance the requirements of CPG4.

4.3. Reference information provided within the BIA is broadly in line with the aspects recommended of a desk study within the GSD Appendix G1.

4.4. The BIA states that the site lies on Made Ground over Head Deposits and the London Clay, although the revised BIA identifies the London Clay as the bearing formation for the proposed foundations. The London Clay is designated unproductive strata.

4.5. Site investigation data and geotechnical design parameters are provided, broadly in accordance with the GSD Appendices G2 and G3. However, the BIA states that insitu strength testing is not reliable for design purposes, and therefore the Contractor must confirm insitu shear strength is equal to / greater than the Engineer's design requirements as per section 10.4.5 in the revised BIA, prior to forming retaining walls / foundations.

4.6. The BIA identified a former tributary of the River Westbourne running some 80m to the south of the site, which was diverted to the east of the site by means of a ditch and later culverted in the late nineteenth century. The BIA does not consider this presents a risk to the site, which is accepted.

4.7. The BIA states that Head Deposits in the area are known to be highly variable, and locally have been recorded as soft to firm. Soft to firm and / or water bearing deposits, if present, could impact stability of the proposed basement during construction of the underpins. Mitigation and contingency measures have been provided in the October 2017 BIA revision, to demonstrate that these deposits will not impact the structural stability of the development during construction. A

description of the proposed groundwater control methodology is also provided in this third BIA revision.

4.8. Groundwater has been detected between 0.56 and 5.91m bgl. Further longer term groundwater monitoring should be undertaken to inform temporary works contingency planning, control measures and waterproofing design. The original and revised BIAs acknowledge that if more permeable soils are encountered during basement excavations that allow significant groundwater flow, an engineered bypass system may be required. The revised BIA October 2017 version includes a description of this contingency measure in section 10.2.6, including comment on how it will be incorporated into the construction process.

4.9. Due to the uncertainties stated within the BIA regarding the underlying conditions, the Contractor should confirm the ground and groundwater conditions in advance of the works, and update design and assessments as required to maintain stability and mitigate impacts.

4.10. It is considered unlikely that the proposed development will have an adverse impact on the wider hydrogeological environment. However, mitigation measures are described in the October 2017 BIA revision, which can be incorporated or omitted once the ground and groundwater conditions have been confirmed.

4.11. The BIA states that the site has as having a low risk of flooding, which is confirmed by Environment Agency data. However, the site is located within the Goldhurst Local Flood Risk Zone due to local fluvial flooding events in 1975 and 2002. The BIA has adequately assessed the flood risk from all sources and proposes a number of measures to mitigate against surface water flooding and sewer surcharging. These should be implemented as stated.

4.12. The front and rear lightwells will be formed by contiguous bored pile walls. Indicative pile lengths, diameters and spacing have been provided. The retaining walls beneath the existing property will be formed by underpinning. Outline calculations have been referred to and some are presented for review with the revised BIA report. However, design calculations relating to proposed piling are not presented, although 8m long piles are used as a basis for the ground movement assessment (GMA), which is considered reasonably conservative for assessment purposes. If the final piling design requires deeper piling, the GMA should be updated.

4.13. Temporary works plans and sequencing are presented in the BIAs, and groundwater control is adequately covered in the October 2017 BIA revision. These include groundwater control measures and contingency measures to deal with softer than anticipated deposits, as 4.7, and provision of additional structural support due to predicted movements being exceeded, as 4.14. The BIA states that transitional underpins are likely to be required and these are indicated on the drawings submitted in October 2017, as requested in the previous CampbellReith audit reports.

4.14. The GMA for buildings within the zone of influence has been presented based on CIRIA C580. Whilst the CIRIA approach is intended for embedded retaining walls, we accept that the predicted ground movements are within the range typically anticipated for underpinning techniques carried out with good control of workmanship. Estimates of horizontal movements due to underpinning are not confirmed by calculations, but have been limited to a maximum of a stated 5mm, which is considered reasonable assuming good workmanship. Ground movements due to piling are estimated based upon CIRIA guidance. The BIA notes that for the short length of piled retaining wall proposed, this is likely to be an overestimate. Provided there is good control of workmanship and the piled wall is sufficiently restrained (propping / capping beam) at all times, this is accepted, and horizontal movements will be controlled to not exceed 6mm.

4.15. The BIA proposes a structural monitoring strategy to limit damage impact to a maximum of Very Slight (Category 1) and indicates trigger values in order to do this. Mitigation and contingency actions linked to these trigger values should be determined as part of detailed design.

4.16. Attenuation SUDS drainage solutions are discussed, comprising a combination of intervention storage, rainwater harvesting/control and use of a grey water system. The proposals are finalised in the revised BIA report and off-site discharge flow rates should be agreed with Thames Water and LBC prior to commencement of the works.

4.17. Queries and matters requiring further information or clarification are summarised in Appendix 2.

5.0 CONCLUSIONS

5.1. The proposed development involves underpinning and contiguous piling to form a basement.

5.2. The combined authors' qualifications are in accordance the requirements of CPG4.

5.3. Information within the BIA is broadly in line with the aspects recommended of a desk study within the GSD Appendix G1.

5.4. The original BIA states that the site lies on Made Ground over Head Deposits with the London Clay beneath. This is updated in the revised BIA report to reflect the findings of the site-specific ground investigation, which confirms the London Clay formation will be the bearing stratum.

5.5. Groundwater is present beneath the site and in the absence of further, longer term groundwater monitoring, a conservative approach assuming groundwater is at ground level has been taken to inform temporary and permanent works design in the October 2017 BIA revision.

5.6. Site investigation data and geotechnical design parameters are provided. Mitigation and contingency measures that demonstrate that any soft or waterbearing deposits will not impact the structural stability of the development and wider hydrogeology are provided in the October 2017 BIA revision.

5.7. The Contractor must confirm that insitu shear strength is equal to / greater than the Engineer's design requirements prior to forming retaining walls / foundations, as per section 10.4.5 in the revised BIA report.

5.8. The site is located within the Goldhurst Local Flood Risk Zone and the flood risk mitigation measures proposed in the BIA should be implemented.

5.9. Attenuation SUDS drainage is discussed. The proposals are finalised in the revised BIA and off-site discharge flow rates should be agreed with Thames Water and LBC in advance of the works.

5.10. Outline construction drawings have been presented including temporary works and propping arrangements, with a method statement. The original and revised BIAs state that transitional underpinning may be required, and indicative design is provided in the October 2017 revision.

5.11. The BIA proposes a structural monitoring strategy to limit damage impact to a maximum of Very Slight (Category 1). Assuming good workmanship and appropriate monitoring, this is accepted as being achievable.

5.12. Queries and matters requiring further information or clarification are summarised in Appendix 2. The additional information requested has been provided and the requirements of CPG4 have been met.

Appendix 1: Residents' Consultation Comments

Residents' Consultation Comments

Surname	Address	Date	Issue raised	Response
Gould	188 Goldhurst Terrace	27 June 2016	Concerned about impact of development on the structure of his property. Worried about potential subsidence. Concerned about differential depth of foundations between his property and the development.	4.12 – 4.15
Laniado	Flat 2, 192 Goldhurst Terrace	2016 (no date)	Worried about ongoing issues with neighbouring building foundations.	4.12 – 4.15
Combined Residents Associations of South Hampstead	48 Canfield Gardens, NW6 3EB	28 June 2016	Concerned about impact on drainage and groundwater flow in a road already listed as at risk from flooding.	4.10, 4.16

Appendix 2: Audit Query Tracker

Audit Query Tracker

Query No	Subject	Query	Status/Response	Date closed out
1	Hydrogeology	Groundwater conditions – impact on temporary and permanent works	Ongoing monitoring not provided however adequate details of mitigation provided in October 2017 BIA revision, sections 10.2.6, 10.2.9 and 10.3.2.	December 2017
2	Land Stability	Strength and groundwater conditions in Head Deposits / strength of London Clay	Ground and groundwater conditions described and contingency measures provided in October 2017 BIA revision. To be independently verified, including insitu strength data by contractor.	December 2017
3	Land Stability	Ground Movement Assessment and structural monitoring	Revised GMA provided with monitoring strategy including trigger values and contingency measures to limit damage.	June 2017
4	Land Stability	Retaining wall calculations, transitional underpinning	Outline calculations provided and transitional underpins shown on drawings in October 2017 revisions.	December 2017
5	Hydrology	Attenuation SUDS	Mitigation measures proposed	June 2017

Appendix 3: Supplementary Supporting Documents

Basement Impact Assessment (ref 16550/R2.1) dated October 2017 on behalf of Chelmer Site Investigation Laboratories Ltd. by Gabriel GeoConsulting Limited

Drawing reference 4013/A1/05E dated 11 October 2017 by S.C. Green Ltd.

Drawing reference 4013/A1/02G dated 11 October 2017 by S.C. Green Ltd.

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