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31 Willoughby Road, London, NW3 1RT

Basement Impact Assessment Audit

For

London Borough of Camden

Project Number: 12466-50

Revision: F1

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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 31 Willoughby Road, London NW3 1RT (planning reference 2016/7146/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. Subsequent to the initial audit, discussions between CampbellReith and the BIA authors have taken place.

1.4. The proposed development involves the construction of a basement beneath the existing house which will extend to a depth of approximately 4.1m below existing ground level. The proposed basement will also extend beneath part of the rear garden. The Grade II listed Willow Cottages and a 2.4m high retaining wall are immediately to the rear of the proposed basement.

1.5. The BIA has been prepared by Geotechnical and Environmental Associates. The February 2018 submission includes a hydrogeological assessment by Chord Environmental. The author's qualifications are in accordance with CPG4 guidelines.

1.6. A desk study broadly in accordance with LBC guidance is presented. In the revised submissions, local utility underground infrastructure records and a conceptual site model are presented. An outline construction programme is provided in the February 2018 submission.

1.7. A site investigation has identified a varying thickness of Made Ground underlain by 'Superficial Deposits' and the London Clay Formation. In the revised submissions, interpretative geotechnical information has been updated, including a reduction in bearing capacity at foundation level.

1.8. BGS mapping identifies that the site lies on a designated Secondary 'A' Aquifer, the Claygate Member. The hydrogeological assessment disputes the presence of the aquifer. The revised submissions (September 2017 and February 2018) provide further assessment but this has not demonstrated that the proposed basement will not cause groundwater to impact local structures e.g. Willow Cottages.

1.9. The propensity of local wells, the inferred historic route of a tributary of the River Fleet and the comments from residents of Willow Cottages indicating existing groundwater issues affecting

their properties, plus the monitored water level below the site, have all been considered within the February 2018 hydrogeological study. However, the conclusions are not accepted.

1.10. It is proposed to construct the basement retaining walls by underpinning of the existing foundations. Outline temporary and permanent works are described, which includes two stages of underpinning. Local dewatering via sump pumping is proposed. The February 2018 submission includes proposals for single stage underpinning.

1.11. The revised (February 2018) ground movement assessment (GMA) is considered to suitably address the proposed works. The revised GMA identifies the potential sensitive structural receivers within the zone of impact of the proposed development. Category 0 to 1 (Negligible to Very Slight) damage is predicted.

1.12. In the September 2017 BIA, a structural monitoring strategy is presented. This should be implemented at a suitable frequency to ensure damage impacts are maintained within predicted limits. Given the close proximity, the observed structural issues and Listed nature of the rear retaining wall, a Basement Construction Plan (BCP) is recommended.

1.13. The BIA states that the site is at very low risk of surface water flooding but does identify it as being within a Critical Drainage Area (Group 3-010, as determined by LBC). In the revised submission a SUDS assessment has been undertaken, which discounts the use of an attenuation tank due to limited space within the plot.

1.14. The site is at low to moderate risk of flooding from sewers. It is understood that a non-return valve will be installed to mitigate against sewer flooding.

1.15. In the September 2017 submission, a non-technical summary of evidence has been presented.

1.16. Queries and matters requiring further information or clarification are summarised in Appendix 2. Until the further information required has been presented, the BIA does not meet the criteria of CPG4.

2.0 INTRODUCTION

2.1. CampbellReith was instructed by London Borough of Camden (LBC) on 19 February 2017 to carry out a Category B Audit on the Basement Impact Assessment (BIA) submitted as part of the Planning Submission documentation for 31 Willoughby Road, London NW3 1RT, Camden Reference 2016/7146/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.
- The Local Plan 2017 (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 planning portal describes the proposal as: "*Excavation of basement with rear lightwell below dwelling house (C3); demolition and reconstruction of single storey side extension.*"

2.6. The planning portal also confirmed the site lies within Hampstead Conservation Area but the building is not a listed building. Numbers 33 to 41 Willow Cottages (located adjacent to the north of the property) are Grade II listed, as is the retaining wall to the garden.

2.7. CampbellReith accessed LBC's Planning Portal on 27 February 2017 and gained access to the following relevant documents for audit purposes:

- Basement Impact Assessment (ref J15315) dated December 2016 by Geotechnical & Environmental Associates Ltd (with appendices including the Structural Methodology Statement).
- Design Access and Heritage Statement dated December 2016 by Michael Burroughs Associates.
- Flood Risk Assessment (ref 1542/RE/12-15/01 Revision A) dated January 2016 by Evans Rivers and Coastal Ltd.
- Construction Management Plan dated December 2016 by Areaview Ltd.
- Existing and Proposed Plans and Elevations dated December 2014 by Ungar Architects.
- Comments and objections to the proposed development from local residents.

2.8. Revised and updated submissions were received between May and September 2017:

- Letter Response May 2017 by Geotechnical & Environmental Associates Ltd.
- Revised BIA 05092017 containing a Structural Method Statement by Richard Tant Associates and Basement Impact Assessment by Geotechnical & Environmental Associates Ltd.

2.9. A further revised and updated submission was received in February 2018:

- BIA Audit Response 24 January 2018 by Geotechnical & Environmental Associates Ltd with Appendices by Richard Tant Associates and Chord Environmental.
- Comments and objections to the proposed development from Willow Cottage residents.

3.0 BASEMENT IMPACT ASSESSMENT AUDIT CHECK LIST

Item	Yes/No/NA	Comment
Are BIA Author(s) credentials satisfactory?	Yes	
Is data required by Cl.233 of the GSD presented?	Yes	Outline construction programme received February 2018.
Does the description of the proposed development include all aspects of temporary and permanent works which might impact upon geology, hydrogeology and hydrology?	Yes	
Are suitable plans/maps included?	Yes	BIA Appendix.
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	BIA Section 3.1.2.
Hydrogeology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	BIA Section 3.1.1.
Hydrology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	BIA Section 3.1.3. The Screening has identified that the site is at very low risk of flooding from surface water although the adjacent Willow Cottages are at medium risk (300 to 900mm flood depth and 0.25m/s flood velocity). The site is at low to moderate risk of flooding from sewers.
Is a conceptual model presented?	Yes	Updated in revised submissions.

Item	Yes/No/NA	Comment
Land Stability Scoping Provided? Is scoping consistent with screening outcome?	Yes	Consideration required of settlement due to 2 stage underpinning.
Hydrogeology Scoping Provided? Is scoping consistent with screening outcome?	Yes	However, hydrogeological assessment required – potential impacts to Willow Cottages. Local sump pumping proposed to dewater basement excavation.
Hydrology Scoping Provided? Is scoping consistent with screening outcome?	Yes	Updated in revised submissions. SUDS discounted as impracticable to implement.
Is factual ground investigation data provided?	Yes	Section 4 and 5 of the BIA.
Is monitoring data presented?	Yes	
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?	No	Adjacent shallow foundations identified. Due to level changes the hydrogeological impact to Willow Cottages should be considered. 44 Willoughby Road has basement (consultation response).
Is a geotechnical interpretation presented?	Yes	Updated in revised submissions.
Does the geotechnical interpretation include information on retaining wall design?	Yes	BIA section 8.1.1.
Are reports on other investigations required by screening and scoping presented?	Yes	Flood Risk Assessment provided in BIA Appendices.

Item	Yes/No/NA	Comment
Are baseline conditions described, based on the GSD?	No	Hydrogeological conditions require further assessment.
Do the base line conditions consider adjacent or nearby basements?	No	Hydrogeological assessment not agreed with.
Is an Impact Assessment provided?	Yes	BIA Section 9. However, not all potential impacts considered.
Are estimates of ground movement and structural impact presented?	Yes	Revised in 2018 Submission.
Is the Impact Assessment appropriate to the matters identified by screen and scoping?	No	The Impact Assessment addresses those issues identified by screening and scoping. However, it does not address hydrogeological impacts to Willow Cottages.
Has the need for mitigation been considered and are appropriate mitigation methods incorporated in the scheme?	No	Potential hydrogeological impacts require further assessment.
Has the need for monitoring during construction been considered?	Yes	Updated in September 2017 BIA.
Have the residual (after mitigation) impacts been clearly identified?	No	Potential for hydrogeological impacts.
Has the scheme demonstrated that the structural stability of the building and neighbouring properties and infrastructure will be maintained?	Yes	February 2018 submission. Given the close proximity, the observed structural issues and Listed nature of the rear retaining wall, a Basement Construction Plan (BCP) is recommended.

Item	Yes/No/NA	Comment
Has the scheme avoided adversely affecting drainage and run-off or causing other damage to the water environment?	No	Hydrogeological assessment not accepted.
Has the scheme avoided cumulative impacts upon structural stability or the water environment in the local area?	No	Hydrogeological assessment not accepted.
Does report state that damage to surrounding buildings will be no worse than Burland Category 2?	Yes	Damage Impact limited to Category 1 (Very Slight). Given the close proximity, the observed structural issues and Listed nature of the rear retaining wall, a Basement Construction Plan (BCP) is recommended.
Are non-technical summaries provided?	Yes	Section 14.1 of BIA.

4.0 DISCUSSION

4.1. The proposed development comprises the formation of a single level of basement underneath the entire footprint of the existing building and rear extension, and will extend into the rear garden to form a lightwell. The depth of the basement is proposed to be 4.1m below ground level (bgl).

4.2. The BIA has been prepared by Geotechnical and Environmental Associates. The author's qualifications are in accordance with CPG4 guidelines. In the latest revised submission, a hydrogeological assessment by Chord Environmental is presented.

4.3. The site investigation and BIA have been informed by a desk study broadly in accordance with the GSD Appendix G1. In the revised submissions, local utility underground infrastructure records and a conceptual site model are presented. An outline construction programme is provided in the latest BIA submission.

4.4. The BGS mapping for the area indicates the Claygate Member, designated a Secondary 'A' Aquifer, underlies the site. The BIA interprets the data from the site investigation as a varying thickness of Made Ground underlain by 'Superficial / Head' Deposits overlying the London Clay Formation.

4.5. The hydrogeological assessment presented in the previous BIA submissions disputes the presence of an aquifer, stating that the groundwater is within 'Superficial Deposits', is perched, and is not part of a continuous groundwater body. The assessment considers the authors' interpretation of the ground conditions and permeability testing undertaken in Summer 2017, arguing that differences in recharge rates and water levels recorded within individual boreholes demonstrate that a continuous water body in hydraulic continuity is not present. The latest hydrogeological assessment by Chord Environmental is discussed in detail in paragraphs 4.26 and 4.27.

4.6. The longer term monitoring data, taken over a period of approximately 18 months, suggests that groundwater is present consistently at approximately 82.50m AOD across the site. This corresponds with a level close to, or just below, lower ground floor level in Willow Cottages, the residents of which report anecdotally existing groundwater ingress issues, and a groundwater level within the well at Willow Cottages of (anecdotally) 83.60m AOD.

4.7. The proposed basement development will be at a depth of 4.10m bgl (81.40m AOD) and therefore below standing groundwater level. The previous audit requested that the BIA should assess the impacts to the proposed development itself and impacts to the wider hydrogeological environment.

4.8. In regards to potential impacts / risk to the proposed development from groundwater, the BIA concludes that some form of dewatering may be required but states that since the Made Ground and 'Superficial Deposits' comprise predominantly clay strata they are unlikely to support groundwater flow. The BIA recommends that trial excavations are undertaken at the commencement of construction to assess the ground and groundwater conditions further. It is accepted that the ground conditions are of low permeability and that a dewatering solution to enable construction should be feasible. However, this should be described as part of the temporary works sequence and consideration should also be given to potential stability impacts (see 4.14).

4.9. In regards to potential impacts to the wider hydrogeological environment, the previous Audit report, dated March 2017, commented that the BIA: *"does not further assess potential impacts to the wider hydrogeological environment…The propensity of local wells, the inferred historic route of a tributary of the River Fleet and the comments from residents of Willow Cottages indicating existing groundwater issues affecting their properties, plus the monitored water level below the site, should all be considered within a hydrogeological study. Groundwater flow rate and direction should be ascertained and considered with reference to the proposed structure and the potential impacts on neighbouring structures. Seasonal groundwater levels should be considered and further monitoring undertaken, as required."*

4.10. The permeability testing and assessment presented in the revised September 2017 BIA does not demonstrate that there will be no impact to the wider hydrogeological environment or surrounding structures. The long term consistency of the groundwater levels monitored is considered, in lieu of any local data presented to the contrary, to be representative of a groundwater body. The low permeabilities of the ground conditions indicated within the BIA suggest that, once basement retaining walls are constructed and founded within the very low permeability London Clay, effectively cutting off any groundwater flow beneath the site, there is potential for an increase in groundwater level immediately upstream of the retaining walls. The likelihood of groundwater readily diverting around the basement without any increase in groundwater level immediately upstream of the wall has not been proven. Given the proximity of Willow Cottages, the potential for rising groundwater impact to the Cottages exists. Suitable assessment to either demonstrate there will be no impact, or to mitigate any impacts assessed, is required. Such further assessment should also consider any potential downstream impacts (see paragraphs 4.26 and 4.27).

4.11. The original BIA did not include a geotechnical interpretation and did not explicitly include all the parameters recommended in the GSD Appendix G3 (e.g. in situ shear strength). The D1 Audit report commented that: *"at formation level the underlying soils are observed to be soft to firm, which is inconsistent with the stated allowable bearing capacity of 120kPa. It is also inconsistent with the stiffness values adopted in the ground movement assessment (GMA)".*

4.12. In the September 2017 BIA, it is noted that the bearing capacity of the London Clay has been reduced to 100kPa and that the Structural Engineer has demonstrated that foundation loads will be in the order of 98kPa. The bearing capacity is considered to be at the upper end of the usually accepted range, considering the reliance on engineering description rather than consistent in situ test results. It is noted that where bearing pressure is close to the maximum bearing capacity, settlement of foundations is likely to be at the upper end of the generally accepted range.

4.13. The initial documents describe the intention to construct the basement retaining walls by two stages of underpinning of the existing foundations. Outline temporary and permanent works are described in both the main BIA text and the Structural Methodology Report written by Richard Tant Associates provided within the BIA Appendices. In the D1 Audit it was noted that there were a number of assumptions made and that loads, bearing capacities and bearing pressures were inconsistently referenced between the two and that the site investigation data did not support the range of bearing pressures proposed. As noted in 4.12, these figures have been revised.

4.14. The D1 Audit requested further dewatering information to demonstrate temporary stability. Although not provided in detail, as noted in 4.8, local sump pumping is proposed, to be designed based on pre-construction trials, and this should be adequate considering the low permeability soils. However, this should be confirmed following the trials.

4.15. The D1 Audit noted that: *"the GMA has assumed foundations will be formed within stiff clay, whereas the actual conditions to be underpinned are soft to firm Made Ground and Claygate Member / 'Superficial Deposits', and the foundations will be in soft to firm material. The GMA assumes a maximum of 5mm horizontal movement to be generated by underpinning, which in light of the nature of the soils and the groundwater level should be supported by assessment or evidence. The GMA should be repeated, adopting the actual site conditions and providing evidence for any conclusions drawn".*

4.16. The September 2017 BIA submissions suggested that the final foundations will be formed in "firm to stiff" London Clay. In this scenario, the first stage of underpinning would be formed within the Made Ground and / or 'Superficial Deposits'. The temporary works sequencing indicated that the works will be stiffly propped throughout.

4.17. The original GMA was revised in September 2017 to provide a sensitivity analysis of horizontal movements at 5mm and 10mm, which is considered a sensible approach considering the proposed construction method. However, calculated vertical movements do not seem to have considered the two stages of underpinning, with foundation loads temporarily placed within the Made Ground / 'Superficial Deposits'. Settlements of foundations appear to have been offset by heave, calculated from the bulk excavation. Based on the works sequence, settlement of

underpins is likely to occur as the loads are taken by the pins, with the bulk excavation then taking place. The D2 Audit requested that settlement within the Made Ground / 'Superficial Deposits' should be considered reasonably conservatively, with due regard to the low strength and variabilities observed.

4.18. Further to 4.17, the same observation is applied to the second stage of underpinning, with settlement of the pins considered likely as loads are applied, with any heave effects to be considered subsequently. Comments in 4.12 should be noted.

4.19. In the latest February 2018 submissions, the GMA has been updated to consider the comments raised in the previous Audits, and includes commentary on: construction sequencing, existing and proposed foundations and why existing and proposed bearing pressures are considered to be conservatively assessed; why the methodology adopted is considered is to be conservative; sensitivity analysis considering single stage and two stage underpinning.

4.20. The GMA identifies the potentially sensitive structures within the zone of impact of the proposed development, which includes neighbouring buildings and the Listed boundary retaining wall with Willow Cottages. The GMA also includes Willow Cottages. For the structures assessed, Category 0 to 1 (Negligible to Very Slight) damage is predicted. Considering the revisions and approach noted in 4.19, the GMA is accepted and damage to neighbouring structures should be limited to a maximum of Category 1, assuming good workmanship.

4.21. It was noted in the D1 Audit that the retaining wall between the site and Willow Cottages is reported as structurally unstable by neighbouring. The Listed retaining wall is indicated to be in poor condition with the original structure currently propped by more recently constructed steelwork. In the September 2017 BIA, a structural monitoring strategy has been provided. The monitoring strategy should be applied to the retaining wall, Willow Cottages and the neighbouring structures on Willoughby Road at a suitable frequency to ensure that contingencies can be implemented in sufficient time to minimise structural damage, as applicable. Given the close proximity, the observed structural issues and Listed nature of the rear retaining wall, a Basement Construction Plan (BCP) is recommended.

4.22. The BIA states that the site is at very low risk of surface water flooding but does identify it as being within a Critical Drainage Area (Group 3-010, as determined by LBC). The site area is currently 100% impermeable and there will be no change under the proposed development. In the revised submission a SUDS assessment has been undertaken, which discounts the use of an attenuation tank due to limited space within the plot.

4.23. The site is at low to moderate risk of flooding from sewers. The BIA states that a non-return valve will be installed so that the basement will be protected further from sewer flooding.

4.24. In the revised submissions, a conceptual site model has been presented.

4.25. In the revised submission, a non-technical summary of evidence has been presented.

4.26. In response to the comments raised in previous audits, a hydrogeological assessment has been undertaken by Chord Environmental (CE). In summary, CE provides the following responses:

4.26.1 Aquifer status and monitored water levels below the site: the CE assessment refers to the Claygate Member and London Clay but offers no comment as to the presence or absence of the Claygate Member beneath the site, other than stating that the underlying soils are of low permeability, which is 'consistent with the clays of the Claygate Member and London Clay'.

CE highlight the difference in groundwater levels in monitoring wells BH1 and BH2 (0.75m to 0.80m), which are in close proximity. From review of the monitoring well installation details it is evident that BH1 is installed only in the Made Ground whereas all other wells are installed in both the Made Ground and natural soils. It could be that in BH1 the water encountered is representative of groundwater in the Made Ground, perched above the natural soils. In the other boreholes, water levels could be a composite of perched groundwater and groundwater in the natural soils. The water levels are at similar elevations and could indicate a groundwater flow to the east and north east, as would be anticipated with groundwater contributions to an easterly flowing stream (see also 4.26.3).

4.26.2 Demonstration of no impact: reference is made to the permeability tests (falling / rising head) and the derived average linear velocity. CE concludes this demonstrates that 'the rate of groundwater flow within it is negligible.' On a technical note, the values reported for effective porosity and hydraulic gradient appear very high, although it is acknowledged that lower values would have very little effect on the results.

CE's interpretation of the groundwater flow rate on potential impact is questioned. In the instance of a higher flow rate, stresses on the system would re-establish equilibrium more rapidly i.e. groundwater would flow more quickly around an obstruction and less of an increase in groundwater level would be expected. At the subject site, where there is relatively low permeability, a slower response in terms of the rate of any increase in groundwater level would be expected and there is potential for a localised increase in groundwater level.

4.26.3 Historical tributary of River Fleet: the CE assessment references mapping that suggests an historical tributary of the River Fleet is located approximately 150m north

of the site. The assessment also suggests that a flow conduit from head water springs was directed 'within the valley feature along what is now Willow Road', that most likely 'followed topographic contours within the valley feature along which Willow Road has been built'. No reference to the Arup Sub-Surface Water Features Mapping Summary Report for Redington and Frognal (Figure 7) has been made, that suggests that the historical course of a tributary of the River Fleet runs very close to / directly below the subject site.

4.26.4 Local Wells: the CE assessment suggests that the propensity of wells is due to the location of the site and surrounding area in a topographical low and the water in the wells is surface water, not groundwater. This is not consistent with CE's own assessments (discussed in 4.26.3 and 4.26.5)

4.26.5 Residents Comments: the CE assessment reiterates their views that wells in the area receive surface water and not groundwater and that soils beneath the site cannot support groundwater flow and any underground flows relate to the surface water drainage system.

It has not been demonstrated that the water in the local wells came from 'surface water off-takes.' The location of the wells at the topographical lows may also be because that is where the greatest proportion of groundwater flow would be anticipated. Whilst it is accepted that the main tributaries have been culverted and partial infilling of the local valley is likely to have taken place, it is plausible that groundwater flow paths (of limited extent) related to the old alluvial channel are still present in close proximity to the subject site.

4.27 In conclusion, CE suggest there is no groundwater body or groundwater flow within the superficial deposits and therefore no potential impact resulting from basement development. However, this has not been demonstrated and therefore there is potential for hydrogeological impacts as a result of the proposed development.

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

5.0 CONCLUSIONS

5.1 The qualifications of the authors meet the LBC requirements.

5.2 An outline construction programme has been provided in the February 2018 submission.

5.3 A site investigation is presented. In the revised submissions, interpretative geotechnical information has been updated, including a reduction in bearing capacity at foundation level.

5.4 It is proposed to construct the basement retaining walls by underpinning of the existing foundations. Outline temporary and permanent works are described, which includes options for one stage or two stages of underpinning. Local dewatering via sump pumping is proposed.

5.5 The revised ground movement assessment (GMA) is accepted, assuming good workmanship and close control by use of the monitoring strategy. Damage impacts will be limited to Category 0 (Negligible) to Category 1 (Very Slight). A Basement Construction Plan (BCP) is recommended.

5.6 The revised BIA (February 2018) provides further hydrogeological assessment but this has not demonstrated that the proposed basement will not cause groundwater to impact local structures e.g. Willow Cottages.

5.7 In the revised submission a SUDS assessments has been undertaken, which discounts the use of an attenuation tank due to limited space within the plot.

5.8 The site is at low to moderate risk of flooding from sewers. It is understood that non-return valves will be installed to mitigate against sewer flooding

5.9 In the September 2017 submission, a non-technical summary of evidence has been presented.

5.10 Queries and matters requiring further information or clarification are summarised in Appendix 2. Until the additional information requested has been provided, the requirements of CPG4 have not been met.

Appendix 1: Residents' Consultation Comments

Residents' Consultation Comments

Surname	Address	Date	Issue raised	Response
Fricker	50 Willoughby Road	Not provided	"I strongly object to the planning application because as I live opposite the proposed basement area the reconstruction of number 31 could cause water penetration into our home. We have water seepage into our old coal cellar and patio. We are vulnerable to water flowing from the clay under Willoughby Road. Excavation in Willoughby Road causes unforeseen consequences and likely damage to our property."	5.8
Franklin and Beinhocker	21 Willoughby Road	15th January 2017	"We would like to register our concern relating to the planned basement excavation at this address on the basis of potential disruption to the water table and foundations of surrounding buildings."	5.3 - 5.8
Guibert	32 Willow Road	17th January 2017	"I am quite concerned by all the consequences of the vibrations on a vulnerable soil and I am concerned as well with having 2 basements built at the same time (number 31 and 33)." (Planning application for 33 Willoughby Road has now been withdrawn).	5.3 – 5.7, 5.10
Heath and Hampstead Society		18th January 2017	"The proposal requires considerable engineering work before the basement can be constructed – including excavation, propping support of the existing building and reinforced concrete retaining walls all round. We are very concerned about the sub-soil water movement known to exist in this location and the effect this proposed basement will have on water movement and on the structure of the very near Listed cottages in Willow Road."	5.8, 5.10
Hersov	23 Willoughby Road	20th January 2017	"We want to register our strong objection to the proposed basement excavation at 31 Willoughby Road. We know from our own experience of work carried out on No 21 Willoughby Road several years ago that any digging down and into a property on our street has a significant and wholly negative impact on the adjourning properties. Because of the water table running underneath our side of the street (which is sloping downwards) and its clay based soil structure which swells and contracts, any work underground during a basement development will result in the water having to find a new way out with unpalatable consequences. We witnessed the impact on our own and the next property down the street (No 25) affecting the growth of the garden as well as producing marked problems with damp and mould. We feel Camden ought to insist on a full hydrogeological examination of any proposed work in Hampstead village and its impact because of the particular soil structure and presence of underground springs. The separate Basement application for No 33 Willoughby Road – Application number 2016/6733/P which is on an	5.8

			even larger scale would have a similar and likely even greater negative impact, so we would like the linkage between these 2 applications to be considered by the Planning Department." (Planning application for 33 Willoughby Road has now been withdrawn).	
Manchanda	6 Denning Road	21st January 2017	"Strongly object to basement development as this further increases the likelihood of damage to my property through subsidence and cracking."	5.3 – 5.7
13 residents	33, 34, 35, 37, 38, 39, 40, 41	22nd January 2017	"Strongly object to the proposed basement works as they will: 1. Realign the existing underground water patterns to form a convergence of increased water volumes with higher flow velocities causing increased hydrostatic pressure on an already weakened and unstable listed retaining wall that will in due course if left unchecked, precipitate structural failure to Listed Willow Cottages and the already damaged and unstable lower listed retaining wall along the shared boundary with 31 Willoughby Road. 2. Realign the existing underground water patterns to form a convergence of increased water volumes with higher flow velocities causing increased water to be forced to flow under the lower trench level of Willow Cottages. This will cause the loss and corrosion of fines to the existing soil undermining existing safe bearing capacity and causing structural loading imbalance which will result in very real structural damage to the loadbearing walls of Listed Willow Cottages and the rear listed lower retaining wall. 3. Cause higher water table levels in and around Listed Willow Cottages resulting in rising water ingress to existing loadbearing brickwork which is of poor standard. This will cause structural decay, wood rot and undermine the structural and environmental wellbeing of the existing listed cottages. 4. Cause increased levels of loss of privacy to cottages 39, 40 and 41 due to the close proximity to the new rear ground habitable room. 5. Cause excessive disruption and noise to the residents of Willow Cottages who are in extremely close proximity to 31 Willoughby Road site. 6. Cause major traffic flow and parking problems during the work phase. Furthermore the proposed works submission is seen to have (a) project drawings that do not cover all required areas of the works making any assessment incomplete (e.g. the drawings do not show key relationships to Willow Cottages in either plan or section); and (b) the Desk Study and BIA Document undermines and contradicts any and all desk calculated real impacts and associated damage to both Listed Willow Cottages and the	5.3 – 5.8, 5.10

			fragile rear lower listed retaining wall running the full length of the south boundary to Willow Cottages, by way of utilising oversimplified inputs and assumptions within the document. This makes the BIA incomplete and incorrect."	
Griffis	14 Denning Road	24th January 2017	"On behalf of the Pilgrim's to Willoughby Residents Association, I would like to lodge an objection to this basement proposal for the following reasons: As argued by the residents of Willow Cottages, a basement in this location, built to a depth of 4.1m, would likely change the flow of underground water in ways that could put at risk the Grade II listed Willow Cottages and the listed boundary wall; These changes have been inadequately modelled and therefore have not fully addressed mitigation measures; Insufficient attention has been given to the protection of the 8m chestnut within 5m of the new development and the Construction Management Plan does not adequately address how the root protection zone will be maintained and monitored."	5.3 – 5.8, 5.10
Zarifi	19 Willoughby Road	25th January 2017	"Objection: construction of the basement triggers instability in the area. My house, built on a slope already has water seeping in as a result of basement constructed nearby. Doors and windows have altered angle, swelling is causing cracks. This might increase more rapidly (prior to underground constructions the structure of my house had been stable for 35 years). Noise, vibration dust and traffic affects the neighbourhood and my work and health."	5.3 – 5.8
King	34 Willow Road	28th January 2017	"Willow cottages were built to form a level row sunk into a trench cut out of the hillside so that the lower ground floors sit at a depth ranging from 1.5 to 2.6 metres below street level. This makes them more vulnerable to flooding from below. When number 44 Willoughby Road, directly opposite number 31, was rebuilt some 5 years ago and a basement dug out there was considerable flooding of the newly excavated area. The 1866 ordnance survey map identifies 4 wells following the downward slope of Willow Road suggesting an underground watercourse running close to or along the boundary of Willow Cottages and numbers 31 and 33 Willoughby Road. There is also an 'active' well in the garden on 38 Willow Cottages. Willow Cottages were built with minimum footings and with substandard brickwork, our listed retaining wall sits on slabs of stones and is already damaged by undue pressure from the soil in the garden of numbers 31 and has had to be braced to prevent collapse. I am concerned that this proposed basement excavation so close to our buildings will inevitably cause a substantial and wholly unacceptable level of damage and I ask that this application be rejected."	5.3 – 5.8, 5.10

Hatje	36 Willow Road	29th January 2017	"I am extremely concerned that the proposed basement will have a damming effect and could lead to flooding. The excavation works for this proposal will cause considerable disturbance and inconvenience to residents. I believe that my property is likely to suffer damage if the proposed works go ahead."	5.8, 5.10
Chappell	Flat 2, 5 Denning Road	30th January 2017	"If passed in the short term our tranquil neighbourhood will subjected to months and months of noise, vibration, dust and the inevitable fleet of heavy lorries. Also inevitably even though this will denied by the applicant's parties there will be structural movement and cracking of neighbouring properties. In the long term, the slopes of Hampstead especially on the southern side are fragile with several rivers emanating from this area. The southern slopes of Hampstead are the most vulnerable with Claygate over sand. The Claygate allows water to easily pass through it; however the construction of a basement forms a damming effect, making the clay expand one side of the building more than the drier side on the other. The area we live in being one of the worst hence the water surfaces forming the Hampstead Ponds. A high profile case was that of St Stephen's Church where the Royal Free Hospital caused a damming effect and the major subsidence of the church. Clay swells and contracts by around 7% in volume across the seasons. By changing the hydrogeology from the front to back of the house and potentially across the house (as the land slopes both ways) will cause differing swell characteristics in the clay and therefore problems. The critical angle of stability for this clay is around 7°. Arup' advice is 'the construction of a basement may be the triggering factor which initiates an instability problem in an area which otherwise would have remained stable for the foreseeable future'. They also say that a period building built using lime mortar will move with the clay. As basements have to be built of rigid concrete construction this can have a detrimental effect. By digging down and putting the building onto a different soil stratum than the attached house, this will cause differential movement between the houses. In a survey published by Camden in February last year, they record 'Approximately one quarter of respondents suffered damage to their property. 25% windows and doors sticking; 19% internal fractures; 20% external cracking; etc".	5.3 – 5.8
Johnson	33 Willow Road	3rd February 2017	"The basis of my objection is the scale and depth of the proposed basement which means it is likely to disrupt the water tributaries under the house and houses nearby and cause increased ground water volumes. I am concerned there hasn't been enough due diligence in the BIA to prove otherwise. This disruption of the underground tributaries and the additional loss of a significant amount of soft, permeable landscape will have a negative impact on the ground waters and risks causing major structural failure to a row of listed	5.3 – 5.8, 5.10

			19th century properties close by – Willow Cottages - and the retaining wall behind them. My property is the end property of the row and it already has historic structural issues – a recent survey discovered that in the past there had been remedial work carried out in the form of brick stitching and lateral restraint wall-tie installation. The surveyor found that the side wall of the terrace was experiencing what is known as the 'bookend effect' – a form of structural movement which can occur in long terraces of buildings due to the longitudinal expansion of the brick walls. I am concerned that the creation of an extensive and deep basement nearby that reroutes the underground tributaries can only exacerbate this structural problem which risks affecting the whole row of cottages. I am also extremely concerned about the impact on the listed retaining wall at the back of our cottages. This wall encloses an external shared yard area and recreation space which is used by families with children and I am concerned the basement would do significant damage to the wall making it a serious hazard."	
Homa	Gayton Crescent	14th February 2017	"Disruption caused by the building of basements has become increasingly controversial but it would seem inconceivalbe that such development would be permitted where there is a real risk of damge to the structural integrity of a listed terrace of cottages which contributes enormously to the charm and character of the area. The Willow cottages are built as a level terrace on a sloping site, together with load bearing walls with apparently shallow footings; in veiw of the underground water courses which will surely be disrupted by the above proposed basement, there would appear to be a substantial risk of destabilising this delightful terrace of such individual design."	5.3 – 5.8, 5.10

Ratzer	Gayton Road	14th February 2017	I live just above Willow Cottages in Gayton Road and am well aware of how much they contribute to the street scene in Hampstead. They are justifiably grade II listed, but some of the buildings' structure is fragile, as has been pointed out in the comments by Glen Robinson et al, and in particular the back retaining wall. There is much concern about the movement of underground water in this part of Hampstead. It is complex geologically, having the Bagshot Sands, the Claygate Beds and the London Clay in close proximity to one another. How complex it is is shown by the fact that the BIA report presents a BGS map (eg page 11) showing 31 Willoughby Road lying within the Claygate Beds, but the presence of the Claygate Beds was not firmly identified during the investigations. The BIA report refers to wells in the area but does not mention that at one stage there was a stream running down along Willow Road. *The Victoria History of the County of Middlesex: Volume IX: Hampstead and Paddington Parishes (1989)* states on page 138 "The Fleet tributary ran along the line of Willow Road to the lowest of the Hampstead ponds and fed watercress beds and wells along its length." On page 13 of the BIA a map is reproduced of river flow, which posits that there is an (underground) tributary which flows down from the Whitestone Pond area through Gainsborough Gardens towards the area of the Hampstead ponds. However, looking at this area on the 1:25 000 Ordnance Survey the shape of the contours strongly support the fact that a watercourse had once run in the vicinity of Willow Road (see attached map where the relevant contours for this part of Hampstead village have been emphasised). The underground flow of water will naturally be dependent on the amount of rainfall. A winter of heavy rain will give rise to water flows that may not be picked up by a study of insufficient length. In addition, the BIA report does recognise the fact that at the interface of the Bagshot Sands and the Claygate Beds there will be a spring line. Water from such springs, which may not be active year-round, will naturally affect the flow of underground water in the Claygate Beds area, and more markedly so after heavy rain. (The Claygate Beds are mapped on pp 303 and 304 as a Minor Aquifer (Variably Permeable) or as a Secondary A Aquifer.) There is also the worrying comment on page 13 of the report that "The investigation [presumably at No 44 Willoughby Road] also encountered deposits interpreted as material accumulating at the base of a former pond and there is potential for similar ground conditions beneath number 31 Willoughby Road." Willow Cottages are in a vulnerable position whereby water flows altered by the nearby construction of an extensive basement could quite substantially destabilise them. I urge Camden to turn down this planning application.	5.3 – 5.8

Sherlock	35 Willow Cottages	15th February 2017	Object because "the submitted documents do not correctly define the real possible damage that will be caused to both the listed Willow Cottages and to the rear boundary listed retaining wall which is contiguous to 31 Willoughby Road. Furthermore the BIA document omits including Willow Cottages numbering 40, 39, 38 and 37 within the 5m zone for considering potential damage to surround structures and buildings, the water table calculations are inadequate as they do not cover a suitable longitudinal study period which the report itself acknowledges. Loss of light – we are currently in dispute with applicant based on the damage that their poor construction has caused to our lower listed boundary wall which has made it both unsafe and dangerous, requiring temporary support so that we can use our south facing rear patio space. The submitted scheme shows no intent of resolution nor solution to the rear boundary which currently has a temporary screen at higher level blocking out daylight to our home. Danger to existing safe play area used by the children of Willow Cottages and frequented rear access to most of the listed cottages."	5.3 – 5.8, 5.10
Skipwith	38 Willow Cottages	20th February 2017	"We had extensive modernisation works carried out on our house over 40 years ago and when the floors were up in the basement, we could see the wet mud on which these properties stand. The cottages which were built in the 1840s have basically no foundations and have moved as a unit with the expansion and contraction of the soil. Willow Cottages were here before either Willow or Willoughby Roads were built and when the foundations of the red brick houses opposite and those in adjacent Willoughby Road were dug out the soil was piled up in front to make the existing road level. At this point the cottages were, in effect, partially buried, creating the existing basement areas and the alleyway that connects the cottages at the rear. This alley which is accessed by a flight of steps down from Willoughby Road is supported on the one side by an already bulging brick wall – the retaining wall for Numbers 31 and 33 Willoughby Road – and on the other gives rear door access to each of the properties. The proximity of water to the cottages is exemplified by the fact that I still have in my garden the well that served these properties."	5.3 – 5.8, 5.10
-	Willow Cottage Residents	March 2018	Re-iteration of potential structural and hydrogeological impact concerns.	5.3 – 5.8, 5.10

Appendix 2: Audit Query Tracker

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Audit Query Tracker

Query No	Subject	Query	Status/Response	Date closed out
1	Desk Study	Utility infrastructure information, outline construction programme	Utility Information - Closed Programme to be provided as 5.2 - Closed	September 2017 February 2018
2	BIA	Conceptual site model	Closed	September 2017
3	Stability / Hydrogeology	Geotechnical parameters to be provided as GSD Appendix G3, based on site investigation data and proposed development foundation level	Closed	September 2017
4	Stability	Permanent and temporary works information, including loads, retaining wall design, dewatering to be clarified	Closed	September 2017
5	Stability	GMA and damage impact assessment, to be based on revised geotechnical parameters and actual site proposals	Closed – BCP recommended	February 2018 – BCP recommended
6	Stability	Condition surveys, structural monitoring, to be undertaken in accordance with BIA recommendations plus suitable proposed scheme	Closed – BCP Recommended	September 2017 – BCP recommended
7	Hydrogeology	Groundwater flow rate and direction should be ascertained and considered with reference to the proposed structure and the potential impacts on neighbouring structures. Seasonal groundwater levels should be considered and further monitoring undertaken, as required.	Open – to be provided as 5.8, 5.10	- Open - CE Assessment presented but conclusions not accepted
8	Surface Water Flow	Attenuation SUDS assessment	Closed	September 2017
9	BIA	Non-technical summaries	Closed	September 2017

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Appendix 3: Supplementary Supporting Documents

BIA Audit Response 24 January 2018
by Geotechnical & Environmental Associates Ltd
with Appendices by Richard Tant Associates and Chord Environmental

Comments and objections to the proposed development
from Willow Cottage residents

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