Hardman Structural Engineers

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Basement Impact Assessment

(Revision A)

For

New Basement

To

59 Solent Road, London, NW6 1TY

Ref. 2298

Date. March 2017

Hardman Structural Engineers

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Introduction

This report references and follows the Camden Planning Guidance document entitled "Basements and Lightwells CPG4" issued on July 2015. Reference has also been made to the "Camden Geological, Hydrogeological and Hydrological Study" by Arup.

The level of assessment that has been undertaken is considered to be appropriate for the size of the project.

1. Screening

1.1 *Background information*

The property forms a Victorian three storey terraced residential property with no basement. The roof space has been extended into a loft level rooms circa 2011. A site location plan and photographs are shown in Figures 1 and 2.

A Basement extension construction has been carried out to the adjoining property No. 57 Solent Road circa 2010.

There is no basement construction to No.61 Solent Road.

At the front of the property there is concrete hard-standing. To the rear of the property, there is also a hard-standing with a half-paved garden.

Historical maps show that the property dates back to between 1874 and 1894. The maps show that the site was not developed previous to this.

Geological maps indicate that the soil for the area is London Clay with no superficial deposits.

The National Grid reference for the property is 525108, 185135.

There are two trees (Elderberry and Demsen Tree) next to the rear garden wall within the adjacent Neighbours garden to No.16 Sumatra Road.

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Figure 1. Site location plan

Figure 2. Front elevation

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It is proposed to form a new basement extension to extend the full length of the existing building footprint. It is also proposed to form a new side and rear extension at ground floor level. Refer to Appendix B for existing and proposed structural drawings (Rev A).

The new basement will be constructed by introducing reinforced concrete underpinned foundations to No. 61 Solent Road side and reinforced concrete to the rest of the basement. The excavation is to be carried out in approximately 1m long sections below the main party wall and along all the structural wall.

1.2 Groundwater flow

In relation to Figure 23 of the Camden Geological, Hydrogeological and Hydrological Study by Arup, the proposed basement will form a relatively small isolated obstruction in the ground to any groundwater flow as there is not a high density of basements in the local area. It is more significant that the underlying ground conditions (predicted on the geological maps and encountered in a borehole site investigation) is London Clay.

In relation to Figure 1 of the Camden Planning Guidance for Basements and Lightwells, the following are responses to the questions posed regarding subterranean ground water flow:

There are two responses to the following questions, the original screening done by Hardman Structural Engineers (HSE), and the second response concluded by a Chartered Geologists from Chelmer Site Investigation Laboratories Ltd after the second audit (Refer to Appendix F - Hydrogeology Basement Impact Assessment).

Question 1a:

HSE response:
No. According the Camden Aquifer Designation Map, the site located where London Clay does outcrop at the surface so the site is not directly above aquifer. In addition, from a site investigation carried out the borehole indicates that the site is not located directly above an aquifer.

Chelmer response:
No. The site is located above the "unproductive" aquifer of the London Clay Formation

Question 1b:

HSE response:
No. The borehole extended to 8m depth from ground level with no water table been found.

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Chelmer response:
Yes. The initial Basement Impact Assessment Ref.2298 dated October 2016 by Hardman Structural Engineers answered this question as 'No' due to the boreholes being dry during drilling. However, during subsequent monitoring visits groundwater was recorded at depths of 0.65m and 0.68m bgl in BH1, and 1.83m and 1,.91m bgl in BH2.

The 'dry' borehole recorded during drilling highlights that the movement of groundwater in the London Clay Formation is very slow as no noticeable water could enter the borehole during drilling periods (<1 day). The groundwater investigation (August 2016) and the monitoring visits (February 2017). Due to the anticipated low permeability of the London Clay Formation and the low topographical relief the proposed basement is not anticipated to have any impact on groundwater conditions and will require little or no dewatering.". No further groundwater monitoring visits are currently planned.

Question 2:

HSE response:
No. Hydrological and Geological maps indicate that the site is not within 100 m of a watercourse, well or spring line.

Chelmer response:
No, current surface water bodies were identified within 250m of the site by the Groundsure Report and the nearest well identified by the BGS GeoIndex is almost 1km southwest of the site, to a depth os 85.3m bgl within the Thanet Sand Formation.

Question 3:

HSE response:
No. The site is not within the catchment of the ponds to Hampstead Heath.

Chelmer response:
No. The site is approximately 1.3km from the catchment of the pond chains on Hampstead Heath

Question 4:

HSE response:
No. The new basement is to be located below the footprint of the existing ground floor and extend further into the garden. The existing section of hardstanding area to be replaced by the new extension. So there will not be an increase in hard surfaced paved areas.

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Chelmer response:
No. The proposed basement will be located beneath the footprint of the existing structure and extend into the rear garden area where there is an existing area of hardstanding.

Question 5:

HSE response:
No. There will be no increase in surface water discharge into the ground.

Chelmer response:
No. As detailed by Hardman Structural Engineers, in their Basement Impact Assessment Ref. 2298 dated October 2016, there will be no increase in surface water discharge into the ground. The Flood Risk Assessment (RFA) carried out by ARK Environmental Consultancy in December 2016 indicates that the flood risk will be reduced due to a 10% increase in permeable area. The FRA concludes that the site remains as one dwelling with no change to site operations or sensitivity and minimal SUDS and flood protection measures could still be incorporated as appropriate but no specific SUDS are required due to the impermeable area decreasing.

Question 6:

HSE response:
No. The site is not close to any ponds or springs.

Chelmer response:
No. There are no current surface water bodies or spring lines indicated within 250m of the site

1.3 Land Stability

In relation to Figure 2 of the Camden Planning Guidance for Basements and Light wells, the following are responses to the questions posed regarding slope stability:

Question 1:
No. A site walkover was undertaken. The topography of the site and surrounding area is fairly level with a slope of approximately 100mm from the boundary line to No. 61 Solent Road side to the boundary line to No. 57 Solent Road side, which is approximately 1 in 50.

Question 2:
No. There will be no re-profiling of the existing landscape greater than 7 degrees.

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Question 3:
No. The basement does not neighbour land with a greater slope than 7 degrees, as indicated on the measured survey and ordnance survey of the area.

Question 4:
No. The site is not within a wider hillside setting in which the slope is greater than 7 degrees.

Question 5:
Yes. London Clay is the shallowest strata on site, as indicated on geological maps and site investigation of the site.

Question 6:
No. It is not proposed to fell any trees. The area of the new basement is not within a tree protection area.

Question 7:
No. There is no sign of subsidence at the existing property and we are not aware of there being a history of seasonal shrink–swell subsidence in the local area.

Question 8:
No. Hydrological and Geological maps indicate that the site is not within 100 m of a watercourse, well or spring line.

Question 9:
No. Historical maps indicate that the area was a green field site before the existing property was constructed. The North Camden Geological map indicates worked areas within the borough. The site is not within one of these areas. The reading from a borehole carried out also indicates that the soil below the topsoil is virgin clay.

Question 10:
No. According the Camden Aquifer Designation Map, the site located where London Clay does outcrop at the surface so the site is not directly above aquifer. From a site investigation carried out the borehole indicates that the site is not located directly above an aquifer. The borehole extended to 8m depth from ground level with only London Clay being encountered.

Question 11:
No. The site is not within 50m of the Hampstead Heath ponds.

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Question 12:
Yes. The basement is within 5m of a highway or pedestrian right of way.

Question 13:
Yes. The proposed basement will increase the differential depth of foundations along the party wall line with the neighbouring property at No. 61.

Question 14:
No. According to Transport Infrastructure Map there is no underground tunnels nearby. The only railway line nearby is the Thameslink.

1.4 *Surface flow and flooding*.

A flood risk assessment has been carried out across the borough identifying streets that have previously flooded and are at higher risk of surface water flooding.

In relation to Figure 3 of the Camden Planning Guidance for Basements and Lightwells, the following are responses to the questions posed regarding surface flow and flooding:

Question 1:
No. Hampstead Heath Surface Water Catchments and Drainage Map indicate that the property is not within the catchment of the pond chains on Hampstead Heath.

Question 2:
No. It is proposed for the new surface water flows from the new extension to be similar to the existing.

Question 3:
No. There will be no change in the proportion of hard standing / paved areas from the new rear extension and basement as the existing rear garden is already paved.

Question 4:
No. There will be no change in inflows of surface water being received by the adjacent buildings.

Question 5:
No. There will also be no change in the quality of surface water being received by the adjacent properties or downstream water courses.

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Question 6:
No. The property is not within the areas with the potential to be at risk of surface water flooding. However, the site is close to areas that are at risk of surface water flooding. Therefore, a Flood Risk Assessment will be carried out.

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2 Scoping

Where the answer was yes or unknown in the Groundwater Flow and Land Stability sections of the screening section our response is as follows:

Groundwater Flow:

Question 1b:
HSE response:
No. The borehole extended to 8m depth from ground level with no water table been found.

Chelmer response:
Yes. The initial Basement Impact Assessment Ref.2298 dated October 2016 by Hardman Structural Engineers answered this question as 'No' due to the boreholes being dry during drilling. However, during subsequent monitoring visits groundwater was recorded at depths of 0.65m and 0.68m bgl in BH1, and 1.83m and 1,.91m bgl in BH2.

The 'dry' borehole recorded during drilling highlights that the movement of groundwater in the London Clay Formation is very slow as no noticeable water could enter the borehole during drilling periods (<1 day). The groundwater investigation (August 2016) and the monitoring visits (February 2017). Due to the anticipated low permeability of the London Clay Formation and the low topographical relief the proposed basement is not anticipated to have any impact on groundwater conditions and will require little or no dewatering.". No further groundwater monitoring visits are currently planned.

Land Stability

Question 5:
The basement proposed beneath the property will be cast in London Clay.

Question 12:
Yes. The basement is within 5m of a highway or pedestrian right of way.

Question 13:
The new basement will significantly increase differential depth of foundations relative to neighbouring properties.

To address the above issues, a Ground Movement assessment prepared by Chelmer Site Investigation Laboratories (Appendix I). The assessment analysis the vertical ground movement arise from changes in vertical stresses caused by excavation of the basement. It also includes a damage category assessment which will be interpreted in Burland scale, this is later discussed for monitoring layout including the neighbouring building (Appendix I).

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3 Site Investigation and Study

3.1 Scope and Summary

A site investigation has been carried out by Chelmer Site Investigations Ltd in August 2016 (refer to Appendix A) to determine the following: soil conditions; existing footing details including to the to the party wall area; the presence of any groundwater.

Two 8m deep borehole were drilled at the front and rear of the property and two trial pits were carried out (one to No.61 Solent road side and one to front wall).

A factual report has been prepared by Chelmer Site Investigations Ltd (Appendix A).

Both trial pits and boreholes encountered London Clay beneath the existing footing from approximately 0.7m depth.

The trial pits indicated that the party wall footing to No. 61 is sat on shallow concrete strip footings onto London Clay.

Samples were taken and laboratory tested for moisture content and liquid limit.

Site testing was undertaken to record in-situ shear strength.

No groundwater was encountered in the 8m deep boreholes during drilling in August 2016. However, two return visits in February 2017, have recorded 0.65m and 0.68m bgl in BH1 and 1.83m and 1.91m bgl in BH2.

3.2 Assessment of Site Investigation (to cover aspects of an Interpretative Report)

3.2.1 Discussion

The site has a ground profile of 0.7m deep made ground on top of London Clay with no superficial. The footings to the existing parts of the building and to No.61 Solent Road party wall side are concrete strip footings onto firm London Clay at shallow depths.

It is noted from the boreholes that the clay strata is becoming considerably stiffer at 2m depth below ground level. This highlights the need to consider the effects of differential settlement with part of the property supported on deep foundations (ie. underpinning) and the remainder on shallow foundations as existing.

From the results of the shear vane tests the clay immediately below the existing footings has an allowable bearing capacity of at least 150 kN/m^2.

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The liquid limit test results find that the soils are classified as "high" to "very high" on the plasticity chart. This is not unusual for London Clays.

Although the soils encountered were London Clay with very little made ground above it, precautionary contamination testing should be carried out prior to construction to verify the soils are inert. This will also be required for removal of spoil from site.

Trial pits dug indicate that the existing footings are approximately 500 mm wide bearing onto clay below. The existing bearing pressure below the existing footings to the property is around 150 kN/m^2. This is within the allowable bearing pressure for the underlying soils. There is no sign of subsidence or settlement of the existing foundations.

There is likely to be limited heave associated with a 3m deep excavation for the new basement. A Ground movement assessment had been carried out and consideration of this been taken into account in the design (Appendix I).

Two 8m deep boreholes was drilled in August 2016, it has been recorded to be dry during drilling. However, during subsequent monitoring visits groundwater was recorded at depths of 0.65m and 0.68m bgl in BH1, and 1.83m and 1,.91m bgl in BH2. Referenced to the Hydrogeology Impact Assessment completed by Charted Geologist (Appendix F) indicated that the permeability within the London Clay Formation at the site is expected to be very low due to the high clay content. Groundwater is expected to flow downslope to the south towards the Westborne. However, this is expected to be minimal due to the low permeability and low typographic relief.

A CCTV drainage survey for below ground drainage has been carried out by DrainSmart in October 2016 (Appendix J). It is suggested that the below ground drainage is private.

There are two small trees (Elderberry and Demsen) in the Neighbour's garden at No. 16 Sumatra Road which is approximately 9m from the rear edge of the basement. However, considering that the new basement construction will deepen the foundations to approximately 3m below ground level, the proposed foundations will satisfy the NHBC guidelines on Building near to Trees, Appendix G outlined the tree protection area which showed that our proposed basement is not within the area and should not have an impact on the existing trees.

3.2.2 Design Proposal

The party walls with adjacent properties at No. 61 Solent Road and rear half party wall at No.57 respectively will be underpinned. The underpinning will be formed using reinforced concrete and will also act as a retaining wall. The basement slab forms a ground bearing reinforced concrete slab and the ground floor level joists will be replaced by new timber joists.

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Two void formers (4m x 1.5m x 0.3m deep and 6m x 2m x 0.3m deep) will be included below the basement slab to protect against heave pressures. The dead weight of the concrete will also help to act against heave pressures from the excavations.

Underpinning the party wall with No. 61 creates the potential for differential settlement between adjacent parts of the properties supported on shallow and deep foundations respectively. However, the bearing pressure on the existing party wall footings is below the allowable bearing capacity for the soil conditions. Existing there is no sign of cracking in the property to No. 61 Solent Road.

The wall loading has been applied along this line and onto the underlying soil for around a hundred years. The clay soils beneath the footing will therefore be well consolidated now. The underpinned wall will be founded on stiffer clay at greater depth with a relatively low bearing pressure. Therefore, the scope for differential settlement of the adjacent footings at differing depths is very limited.

With respect to the potential for heave, construction of the basement will be phased to allow some relaxation of the ground (heave) to take place as the excavation proceeds.

Further measures should be taken against heave by initially reducing site levels in the area of the proposed basement extension to a safe level to avoid undermining existing perimeter wall footings. Void formers will also be used beneath parts of the new basement slab.

An internal tanking system will be employed in order to waterproof the basement.

It would be prudent to undertake monitoring of the properties at No. 61 Solent Road respectively during the underpinning works which in outlined in Appendix D.

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4. Impact Assessment

4.1 *Overall assessment*

The party walls with adjacent properties at No. 61 Solent Road and rear half party wall at No.57 respectively will be underpinned. Underpinning the party wall with No. 61 creates the potential for differential settlement between adjacent parts of the properties supported on shallow and deep foundations respectively. However, the underpinned wall will be founded on stiffer clay at greater depth with a relatively low bearing pressure. Therefore, the scope for differential settlement of the adjacent footings at differing depths is very limited. Ground movement assessment has been also carried out by Chelmer Site Investigation Laboratories refer to Appendix I.

Considering that the new basement construction will deepen the foundations to approximately 3m below ground level, the proposed foundations will satisfy the NHBC guidelines on Building near to Trees.

4.2 Sequence of works

Below is a sequence of works to mitigate movement of the property or adjoining property. Sketches are also attached to illustrate this in Appendix C.

The construction sequence will be as follows:

Stage 1

- Underpin the main party walls to No. 61 Solent Road side by casting reinforced concrete retaining wall in sections.
- Create two sections of reinforced concrete retaining wall to form a base for the proposed steel frame between ground and first floor level.

Stage 2

- Install main proposed steel structures at first floor level.

Stage 3

- Carry on the underpinning process to the rest of the perimeter walls to both No. 57 and No. 61 Solent Road sides by casting reinforced concrete retaining wall in sections.

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Stage 4

- Carefully demolish the existing internal walls at ground floor level and carry out excavation for the footprint of the basement area. The excavation work to carry out in stages.

Stage 5

- Install proposed structures at basement floor and ground floor levels.

4.3 *Ground movement assessment*

From the site investigation report, the ground profile includes 0.7m of made ground overlying London Clay formation with no artificial deposit (becoming stiff at 2m depth and very stiff from 6m below ground level).

Excavation of the basement and construction of the underpin will case immediate elastic heave/ settlements in response to the stress changes. From the GMA prepared by Chelmer (Appendix I), all short-term elastic displacements would have occurred before the basement slab is cast. As a long-term movement, the basement slab is predicted to have 0.0 – 4.0mm heave. As a result, a mitigation strategy is to form two void formers (4m x 1.5m x 0.3m deep and 6m x 2m x 0.3m deep) below the bottom of the basement slab to accommodate the soil heave.

4.4 *Monitoring*

During the period of formation of the new basement areas beneath to the existing property, monitoring of the adjacent properties to No. 61 Solent Road, No. 57 Solent Road and No. 16 Sumatra Road will be carried out respectively. This is intended to monitor the impact of the works at No. 59 Solent Road on the adjacent properties to ensure they are not adversely affected by the works.

A damage category assessment has been prepared in adjoining to the GMA, excavating and underpinning will create ground movement at foundation level of the neighbouring building. From the GMA, the worst-case scenario is the front wall of No. 61 Solent Road (without a basement) based on the maximum displacements predicted by PDISP analysis, combined with ground moments alongside the basement in response to lateral stress released.

In this case the front elevation of No. 61 and No. 63 Solent Road are classified to be within Burland Category 1 "very slight". No further assessment has been carried out as other structure are further away and/or in area with less predicted ground movements. Therefore, they are considered to have a lower risk and can be classified as Category 1 "very slight" or Category 0 "negligible".

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Monitoring will be a carried out by forming fixed points as references on the front, rear and side of the property to No. 59 Solent Road in conjunction with targets placed on the walls of No. 61 Solent Road, No. 57 Solent Road and No. 16 Sumatra Road respectively.

Independent reference points will be established in total so that a comparison among the displacements measured at the fixed points and displacements measured at the other points can then be made. The monitoring points will cover elevations to the surrounding properties and the perimeter of No. 59 Solent Road. Refer to the Appendix D for details of these positions.

The points may be summarised as follows:

P1: on front elevation to No.61 Solent Road main building
P2: on front elevation to No.61 Solent Road main building
P3: on front elevation to No.57 Solent Road main building
P4: on front elevation to No.57 Solent Road main building
P5: on rear elevation to No.59 Solent Road rear extension
P6: on rear elevation to No.59 Solent Road main building
P7: on rear elevation to No.59 Solent Road main building
P9: on rear elevation to No.61 Solent Road main building
P10: on rear elevation to No.61 Solent Road main building
P11: on rear elevation to No.61 Solent Road main building
P12: on rear elevation to No.57 Solent Road main building
P13: on rear elevation to No.57 Solent Road main building
P14: on side elevation to No.61 Solent Road rear extension
P15: on side elevation to No.61 Solent Road rear extension
P16: on boundary garden wall with No.57 Solent Road
P17: on boundary garden wall with No.16 Sumatra Road
P18: on rear elevation to No.16 Sumatra Road
P19: on front elevation to No.59 Solent Road main building
P20: on front elevation to No.59 Solent Road main building
P21: on front elevation to No.59 Solent Road main building

Initially, at the start of the basement works, readings will be taken on a weekly basis. Assuming no significant movement is identified, the intervening period will be increased after approximately three months. As the basement works progress further the frequency of the readings will be reviewed.

After each round of readings, a review will take place to compare those taken and to determine whether any significant movement has taken place. A summary report would be prepared each month for issue to the Party Wall Surveyor.

For the purposes of this exercise any movement recorded of between 3-5mm would be immediately declared to the Party Wall Surveyor. Any movement recorded of greater than 5mm would lead to works ceasing immediately whilst an assessment was made of the cause of any such movement.

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4.5 *Flooding*

A flood risk assessment had been carried out by ARK (Appendix H), the design proposal has an overall increase in permeable area on site which reduces overall flood risk. It is suggested from the assessment that it is likely for the development to have no effect on surrounding infrastructure, since there will not be any significant increase in overland flow from the site.

4.6 *Hydrogeology basement impact assessment*

A conceptual site model has been built using desk study evidence with the ground investigation findings. (Refer to Appendix F). It is concluded that the proposed basement is not anticipated to have any measurable impact on groundwater flows/levels. This is justified because:

- Due to the very low permeability of the London Clay Formation and the low topographical relied the quantity of groundwater flow passing through the basement footprint (which is approximately 18.5m wide perpendicular to the expected direction of groundwater flow) will be limited

- The direction of groundwater flow is to the south, approximately parallel to Solent Road.

4.7 *Tree*

Surrounding the site, there are two trees (Elderberry and Demsen) in the neighbour's garden (16 Sumatra Road), a tree root protection area drawing was prepared by Paul Archer Design (Appendix G). This is marked according to the mature height of the existing trees. As shown on the drawing, the proposed basement is not within the tree protection area, and therefore the proposed basement will have minor effect on the neighbour's trees.

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APPENDICES

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A Site investigation report

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B Existing and Outline Proposed Drawings (Rev A)

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C Sequencing drawings (Rev A)

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D Monitoring layout drawings

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E Suggested construction programme

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F Hydrogeology Basement Impact Assessment (Rev A)

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G Tree Protection Area

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H Flood Risk Assessment

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I Ground Movement Assessment (Rev A)

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J CCTV Survey