16th October 2015

Ellis Green
CP Plus Ltd
10 Flask Walk
LONDON
NW3 1HE

Our Ref: 401-04869-00001

Dear Ellis

RE: 66 FITZJOHNS AVENUE – HYDROLOGY REPORT FOR BASEMENT IMPACT ASSESSMENT

SLR Consulting has been appointed to carry out the groundwater and surface water components of a Basement Impact Assessment (BIA) for the basement development at 66 Fitzjohns Avenue, NW3 5LT, as required by Camden Planning Guidance CPG4 'Basements and Lightwells'.

The SLR staff involved in the preparation of this letter includes two hydrogeologists with the Chartered Geologist qualification and one hydrologist who is a Chartered Civil Engineer and holds a Masters Degree in Hydrology, as required by section 3.6 of CPG4.

1.0 PROJECT INFORMATION FOR SCREENING PROCESS

CPG4 states that the BIA should start with a Screening Process, and that where the answers to any of the questions in the flowcharts are 'YES' or 'UNKNOWN', these matters will need further investigation. Paragraph 233 of 'Guidance for Subterranean Development', LBC, 2010, indicates that the following summary information should be included in the BIA Screening Process.

1.1 Brief Description of the Development

The basement development involves the demolition of two existing houses and the construction of two new houses each with a single storey basement with rooflights as shown in Webb Architects Drawing 1169.01.11C. The proposed basements would have a floor level of approximately 15.9m above site datum[1] (ASD), and would extend beneath the whole of the current building footprint and the nearby front cobbled area, however the above ground building footprint would remain similar to the present footprint. The part of the proposed basements outside the above ground footprint would be overlain by a combination of lawns, several covered light-wells and an area of external car parking surface. As shown on the current site survey (Drawing 1169.01.03) there is a slight slope down from north to south with the current ground elevation (19.7mASD) at the northern end of the front cobbled area approximately 0.1m higher than the southern end.

[1] The zero elevation of the site datum is approximately 66mAOD

1.2 Construction Programme

The key phases of basement construction are understood from Michael Chester and Partners structural engineers to be:

- demolition of existing houses and site clearance;
- installation of secant piling;
- casting of capping beam and installation of wellpoint to allow dewatering of water within site boundary;
- lowering of ground and installation of high level props;
- excavation of basement, formation and casting of basement slab and walls; and
- formation and casting of ground floor slab, removal of high level props.

2.0 GROUNDWATER FLOW

2.1 Subterranean (Groundwater) Flow Screening Flowchart Questions

Q1a: Is the site located directly above an aquifer?

SLR Response: **YES.** The available published information[2] indicates that the application site is located on the Claygate Member, which is classified by the EA as a Secondary Aquifer. The southern edge of the outcrop of the Claygate Member is indicated on BGS geological mapping as approximately 70m south of the site, as shown in Drawing 001.

The site geology was confirmed by August – September 2015 site investigation involving drilling and monitoring of two 7m deep boreholes and one 15m deep borehole at the site (locations and logs appended to this letter). The site geology, borehole installation details and groundwater levels are summarised in Table 1 below. Elevations are estimated based on the site topographical survey prior to drilling, but are likely to be accurate to within a few cm.

Table 1 – Site Geology based on Site Investigation

Elevations - m above site datum	WS02	WS01	BH01
Paving	19.2 – 19.75	19.35 – 19.7	19.4 – 19.6
Made Ground	15.95 – 19.2	16.76 – 19.35	18.6 – 19.4
Soft sandy Clay (Claygate)	Not present	Not present	16.1 – 18.6
Firm sandy Clay (Claygate)	14.75 – 15.95	15.2 – 16.76	15.1 – 16.1
Firm to Stiff London Clay	12.75 – 14.75	12.7 – 15.2	4.6 – 15.1
Driller's Comments on Groundwater	No water recorded	Water ingress at 16.2	Encountered at 14.4, level rose to 14.5 after 20 mins
Slotted Installation	14.75 – 17.45	15.4 – 18.7	14.4 – 18.4
Groundwater Levels 11.9.15	16.40	16.41	Not available

Q1b: Will the proposed basement extend beneath the water table surface?

SLR Response: **YES**. As the proposed basement floor level is approximately 15.9mASD and the groundwater level recorded in September 2015 is approximately 16.4mASD, based on current groundwater levels there would be at least 0.5m depth of groundwater above the basement floor level. Furthermore, it is noted that groundwater levels could rise significantly

[2] Based on Figure 8 of 'Guidance for Subterranean Development' showing the areas of aquifer and the 1994 British Geological Survey geological map (Sheet 256 North London, reproduced as Figure 4 of 'Guidance for Subterranean Development', LB Camden, 2010).

in a wet winter. Ongoing monitoring is proposed to assess maximum winter groundwater levels.

Q2: Is the site within 100m of a watercourse, well (used/disused) or potential springline?

SLR Response: **YES.** The nearest potential springline is the southern edge of the outcrop of the Claygate Member which is indicated on BGS geological mapping as approximately 70m south of the site i.e. down-gradient of the site, as shown in Drawing 001. The nearest up-gradient springline is the southern edge of the outcrop of the Bagshot Formation, which is approximately 300m north of the site. Figure 2 of 'Guidance for Subterranean Development' indicates that no wells were present within 100m in 1920, and the British Geological Survey website confirms that this remains the case.

The available information regarding watercourses within 100m, which would only be culverted underground watercourses as no surface watercourses are indicated on current maps, is summarised in Drawing 001, and comprises:

- the approximate historical location of the Shepherds Well Conduit indicated by Figure 11 of 'Guidance for Subterranean Development';
- the approximate location of the Shepherds Well Conduit shown on 1871 historical map;
- location of Thames Water storm relief sewers near the site – the sewer flowing beneath the upper half of Akenside Road is considered likely to be carrying the springflow which originally flowed down the Shepherds Well Conduit, as a short branch sewer starts very near the plaque marking the site of the original Shepherd Well;
- watercourses 'visible' or 'concealed' (i.e. culverted) in 1920 as shown on Figure 2 of 'Guidance for Subterranean Development' – in 1920 no watercourse is shown near the site which may be due to the water being culverted down the sewer beneath Akenside Road; and
- there is no indication from August 2015 drilling at the site of geological horizons potentially associated with the presence of any historic subterranean channels.

Q3: Is the site within the catchment of the pond chains on Hampstead Heath?

SLR Response: **NO,** as indicated in Figure 14 of 'Guidance for Subterranean Development' (LBC, 2010).

Q4: Will the proposed basement development result in a change in the proportion of hard surfaced/paved areas?

SLR Response: **YES.** The proposed development would result in the loss of between approximately 80-100m^2 of external cobbled area which would be replaced by a combination of hard surfaces and lined and under-drained lawn area.

Q5: As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)

SLR Response: **NO.** Due to the extended footprint of the property owing to the basement, there would be less rainfall infiltration into the ground at the rear than at present.

Q6: Is the lowest point of the excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond (not just the pond chains on Hampstead Heath) or springline.

SLR Response: **NO.** As discussed in Q2, based on the local geology the nearest up-gradient springline would be approximately 300m north of the site. Based on the Ordnance Survey 1:25000 map[3] and satellite mapping[4], there are no ponds in close proximity to the site.

2.2 Subterranean (Groundwater) Flow Scoping and Impact Assessment

2.2.1 Introduction

As the responses to Q1, Q2 and Q4 in the Subterranean (Groundwater) Flow Screening were YES, it is necessary to proceed to further stages of the BIA. As detailed in CPG4 and chapter 6 of 'Guidance for Subterranean Development', these further stages involve presentation of a conceptual ground model, additional site investigation (if necessary) and identification of potential impacts. Site investigation carried out by Michael Chester structural engineers in August 2015 (as summarised in section 2.1 above) facilitated the development of the conceptual ground model and impact assessment.

2.2.2 Conceptual Ground Model and Potential Impacts

Geology

The available published information indicates that the application site is located on the Claygate Member, as detailed in Q1a above. Site investigations confirmed that the local near surface geology is indeed sandy clay of the Claygate Member, as detailed in section 2.1 above. Available published information also indicates that the geological boundary with the sands of the Bagshot Formation is approximately 300m north of the site.

Site investigations indicated that the natural geology at the application site is covered by sandy clay Made Ground up to approximately 3.25m thick. This is underlain by up to 4.3m thickness of soft to firm sandy clay Claygate Member overlying firm to stiff London Clay.

It is understood that 62 and 64 Fitzjohns Avenue have lower ground floors with a floor level of approximately 18m above site datum (mASD). The nearest proposed basement at 66 Fitzjohns Avenue would be approximately 4m east of the lower ground floor of 62 Fitzjohns Avenue, but within 1m of the concrete lower ground floor patio of no.62 as shown on Webb Architects Drawing 1169.01.11C. It is noted that the level of the no. 62 lower ground floor patio (approximately 17.7mASD) is approximately 1.8m lower than the current ground level (approximately 19.5mASD) at the front cobbled area of no.66.

Hydrogeology

The groundwater level 10m west of the northern end of the proposed basement as measured in September 2015 was approximately 16.4mASD. Given the steep slope to the south, groundwater is likely to be seeping towards the south beneath the existing building and beneath the rear basement of no.64 Fitzjohns Avenue. Seepage rates would be likely to be low due to the low permeability of the sandy clay of the Claygate Member. It is noted that groundwater levels in winter could be significantly higher than those recorded in September 2015. Even if groundwater rose into the Made Ground, seepage rates would likely remain low due to the clayey nature of the Made Ground.

[3] OS Explorer 173 'London North'
[4] Google Maps accessed September 10th 2015

As discussed in section 2.1 above, there is contradictory information available regarding the proximity of a nearby watercourse. The nearest culverted watercourse is likely to be the Thames Water storm relief sewer flowing beneath the upper half of Akenside Road, which is considered likely to be carrying the springflow which originally flowed down the Shepherds Well Conduit, as a short branch sewer starts very near the plaque marking the site of the original Shepherd Well.

However, based on the approximate watercourse locations indicated by Figure 11 of 'Guidance for Subterranean Development' and by the 1871 Ordnance Survey 1:1000 map, there was originally a watercourse flowing to the south only approximately 15m west of the proposed basement, as shown in Drawing 001. Site investigation indicated Claygate Member sandy clay beneath the front cobbled area (borehole BH01) and the drive to the west (boreholes WS01 and WS02) – there is no indication of any change of lithology which would be expected in the immediate proximity of a watercourse. Hence there are not likely to be any significant underground flows associated with a historic watercourse at or immediately adjacent to the proposed basement development.

With the current site layout, rainfall infiltration in the front cobbled area through gaps in the cobbles and decking, and from localised runoff into the flowerbeds and gravel areas, is likely to seep vertically into the clayey gravel made ground and the underlying sandy clay Claygate Member. Due to the likely relatively low permeability of the sandy clay Claygate Member, some of the rainfall infiltration may find a higher permeability pathway laterally within the clayey gravel made ground downslope to the south towards the subsoil of the rear lawn of 62 Fitzjohns Avenue.

Potential Impacts of Basement on Subterranean (Groundwater) Flow

The potential impacts of the basement related to groundwater flow are as follows (as listed for the relevant screening questions in Appendix F2 of LB Camden's 2010 'Guidance for Subterranean Development'):

- Q1: 'the groundwater flow regime may be altered by the proposed basement. Changes in flow regime could potentially cause the groundwater level within the zone encompassed by the new flow route to increase or decrease locally. For existing nearby structures then the degree of dampness or seepage may potentially increase as a result of changes in groundwater level' – based on the available site information, it is considered very unlikely that any shallow[5] underground water seepage would be significant, owing to the presence of sandy clay Claygate Member below approximately 1m below ground level. Hence, under these conditions it is considered that the proposed basement is unlikely to make a significant difference to underground water seepage to the south. However, if in a very wet winter groundwater levels beneath the no.66 site rise to approximately 17.5 mASD, it is theoretically possible (in the absence of mitigation measures) that the blockage of the groundwater pathway caused by the proposed basement could cause water levels to rise slightly and spill out onto the lower ground floor patio or southern sunken garden of no.62, both of which have elevations of approximately 17.7 mASD. Any such impact is likely to be offset by the loss of rainfall infiltration into the flowerbeds and gravel to the west of the current building.
  However, in order to minimise any such impact it is proposed to construct a drainage corridor, eg French drain or similar, at a suitable depth to protect the nearby lower ground floor patios and sunken garden from any potentially elevated groundwater levels. This drainage corridor would drain groundwater flows for up to approximately 5m west of

[5] Shallow groundwater is distinguished from deep groundwater flow in the Chalk deep beneath the London Clay

the proposed basement development, and lead to a nearby sump from where any excess groundwater could be pumped if/when necessary and used for toilet flushing and plant irrigation;

- Q2: 'the flow in a watercourse may increase or decrease if the groundwater flow regime which supports that water feature is affected by a proposed basement' – as any underground water seepages between the basement at 66 Fitzjohns Avenue and any nearby remnant historic watercourse would be through low permeability sandy clay, such seepages are likely to be negligible, and changes in seepages due to the presence of the basement would also be negligible;
- Q4: 'the sealing of the ground surface by pavements and buildings to rainfall will result in decreased recharge to the underlying ground. In areas of non-aquifer (i.e. on the London Clay) this may mean changes in the degree of wetness which in turn may affect stability' – the proposed loss of infiltration from between approximately 80-100m2 of ground surface in the front cobbled area and adjacent flowerbeds, decking and gravel areas is not likely to significantly affect wetness in the underlying sandy clay Claygate Member or London Clay, as most of the current infiltration is likely to find a higher permeability pathway laterally within the clayey gravel made ground downslope to the south. Any slight change in subsurface moisture due to reduced infiltration into the underlying sandy clay Claygate Member or London Clay is, based on the opinion of Michael Chester and Partners structural engineers, not considered likely to affect the stability of no.66. The nearest wall of neighbouring buildings is approximately 4m away from the area of additional hard surface, hence any local minor reduction in subsurface moisture at no.66 is also not considered likely to affect stability of neighbouring buildings, based on the opinion of Michael Chester and Partners structural engineers.

Mitigation Measures

The following mitigation measure is proposed to address the above noted potential underground water seepage issues:

- construction of a drainage corridor, eg French drain or similar, at a suitable depth to protect the nearby lower ground floor patios and sunken garden from any potentially elevated groundwater levels. This drainage corridor would drain groundwater flows for up to approximately 5m west of the proposed basement development, and lead to a nearby sump from where any excess groundwater could be pumped if/when necessary and used for toilet flushing and plant irrigation.

3.0 SURFACE FLOW AND FLOODING

3.1 Surface Flow and Flooding Screening Flowchart Questions

Q1: Is the site within the catchment of the pond chains on Hampstead Heath?

SLR Response: **NO,** as indicated in Figure 14 of 'Camden Geological, Hydrogeological and Hydrological Study, Guidance for Subterranean Development' (LBC, 2010).

Q2: As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?

SLR Response: **NO.** Currently, surface water drainage from the majority of the site enters Thames Water combined sewers under Fitzjohns Avenue. Whilst some minor amendments may be made to the routing of surface water runoff via the private drainage connections, no material effect would be anticipated at the receiving combined sewer.

As discussed in **Groundwater Flow Q4**, it is proposed to increase the extent of hard surfaced / paved areas. Without mitigation, the potential impact of this increase is evaluated below.

The effective proposed areas of increased hard surfaced would be as are as follows, as shown on Webb Architects Drawing 1169.01.11C:

- the area of car parking hardstanding and entrance ramps located fronting the units. This would form an additional up to 58.8m^2 of hard surfaced area; and
- lined and under-drained area of lawn laid as part of the 'intensive green roof' surface finish above a section of the basement. This would contribute a total area of approximately 44.7m^2 above the existing scenario, however, rain falling on this surface would infiltrate through the substrate (organic and non-organic) and therefore, the corresponding runoff would be heavily reduced and delayed as the majority of the incident rainfall would be 'lost' via absorption and evaporation.

CIRIA SUDS Manual C697 recommends that the Wallingford Modified Rational method (WMRM) is applied to areas of hardstanding to determine the discharge rate, Q in l/sec. The WMRM specified is given as:

$Q = C_v \times C_r \times (2.78 \times i \times A)$

where:

C_v = Volumetric Runoff Coefficient taken as 0.5 (to reflect the runoff coefficient from the different proposed surface types)

C_r = Constant routing factor taken as 1.3

i = rainfall intensity taken as 113.8mm hr^{-1} for a 30 minute rainfall event with an annual probability of occurrence of 1% / 1 in 100 year return period based on the Flood Estimation Handbook CD-ROM Depth Duration Frequency model.

A = Additional total net impermeable area = 0.01035 hectares]

Applying the WMRM, the corresponding potential uplift in surface water peak flow is up to 2.13 ls^{-1}.

However, POL 03 CN19 of the BREEAM guidance states:

'*For the surface water run off credits, where the limiting discharge flow rate would require a flow rate of less than 5 l/s at a discharge point, a flow rate of up to 5 l/s may be used where required to reduce the risk of blockage.'*

However, it is proposed that the following mitigation measures are provided to reduce the rate of runoff post-development from additional areas of hard surface:

- additional external contributing hardstanding and paving areas (up to 58.8m^2) - it is proposed that runoff from these areas would drain to the adjacent areas of lawn and be allowed to percolate through the substrate. Attenuation storage to accommodate the critical storm event and duration could be provided within the intensive green roof 'layers';
- Runoff from covered light-wells, as well as the surface of the lawn areas (total 44.7m^2) would follow the aforementioned strategy and percolate through the

substrate. Discharge of excess flows would mimic the existing 'pre-development' drainage regime and would discharge via infiltration to the underlying ground (located outside of the proposed basement extent). Detailed drainage design such as grassed filter strips would ensure that this infiltration outside the proposed basement extent would be channelled to the south rather than impacting neighbours' sunken patios to the west. Therefore, whilst there would be an increase in the hard surfaced / paved area within the external area of the proposed property, the proposed mitigation measures would ensure that the proposals would have no material impact on the current surface water drainage to combined sewers beneath Fitzjohns Avenue.

Q3: Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?

SLR Response: **YES.** The proposed development would result in the loss of up to approximately 103.5m^2 of existing external cobbled area which would be replaced by a combination of hard surfaces and lined and under-drained lawn area. However, it is proposed in mitigation that additional stormwater runoff would be attenuated within the 'layers' of the proposed intensive greenroof, as described in response to **Surface Flow Q2**. As detailed in the response to **Q2** above, the proposed mitigation measures would ensure that the proposals would have no material impact on the current drainage arrangements.

Q4: Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses?

SLR Response: **NO.** Please refer to the response to **Surface Water Q2** above.

Q5: Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?

SLR Response: **NO.** The temporary storage and subsequent discharge of runoff from external hardstanding and lined and under-drained lawn areas would allow robust surface water treatment as water filtrates through the surface and underlying sub-base layers. Further provision of 'in-parcel' SuDS could also be implemented in the scheme design in order to manage runoff at source and to provide water quality improvements. The informal attenuation credentials of such measures would provide further offset against climate change-induced increases in peak flow, prior to discharge into the receiving sewer network. These measures could take the form of (but not limited to) informal permeable surfaces and paths, grassed filter strips, and / or rainwater harvesting facilities (including water butts).

Therefore, the quality of surface water discharge to existing site drainage connections are not likely to result in changes received by adjacent properties and / or downstream watercourses.

Q6: Is the site in an area identified to have surface water flood risk according to either the Local Flood Risk Management Strategy or Strategic Flood Risk Assessment, or is it at risk from flooding, for example because the proposed basement is below the static water level of nearby surface water feature?

SLR Response: **UNKNOWN.** Mapping provided by the Camden Strategic Flood Risk Assessment (SFRA) indicates that the site is located within an area with a history of external sewer flooding (Area NW3_5), however the SFRA does not provide specific details of the flooded extents. EA mapping indicates the site is located within a *'Very Low'* area of flood risk from surface water flooding.

3.2 Surface Flow and Flooding Scoping

As the response to **Q3** in the Surface Flow and Flooding Screening regarding hard surfaced areas is **YES** and the response to **Q6** regarding surface water flood risk is **UNKNOWN**, it is necessary to proceed to further stages of the BIA.

3.2.1 Potential Impacts related to Change in the Proportion of Hard Surfaced Areas

Appendix F1 of LB Camden's 2010 'Guidance for Subterranean Development' states the following in relation to potential impacts due to changes in the proportion of hard surfaced areas:

'*A change in the proportion of hard surfaced or paved areas of a property will affect the way in which rainfall and surface water are transmitted away from a property. This includes changes to the surface water received by the underlying aquifers, adjacent properties and nearby watercourses. Changes could result in decreased flow, which may affect ecosystems or reduce amenity, or increased flow which may additionally increase the risk of flooding'*.

Calculations presented in the response to **Surface Flow Q2** above indicate that the potential uplift in peak runoff for a 1 in 100 year / 1% AEP rainfall event would be up to 2.13 ls^{-1}.

However, it is proposed that the planned additional external hardstanding areas would be drained to the adjacent lawn areas and underlying substrate, which would attenuate stormwater runoff and ensure that there would be no increase in existing peak discharge rates to public drains or off-site areas.

Therefore, whilst there would be an increase in the hard surfaced / paved area at the property, the proposed mitigation measures would ensure that the proposals would have no material impact on the current surface water drainage to combined sewers beneath Fitzjohns Avenue.

3.3 Flood Risk Assessment

As the response to question **Q6** above was **UNKNOWN**, a Flood Risk Assessment is required.

It is recognised that developments that are designed without regard to flood risk may endanger lives, damage property, cause disruption to the wider community, damage the environment, be difficult to insure and require additional expense on remedial works. Current guidance on development and flood risk[6/7/8] identifies several key aims for a development to ensure that it is sustainable in flood risk terms. These aims are as follows:

[6] CIRIA, 2004, Funders Report CP/102 Development and Flood Risk – Guidance for the Construction Industry

- the development should not be at a significant risk of flooding and should not be susceptible to damage due to flooding;
- the development should not be exposed to flood risk such that the health, safety and welfare of the users of the development, or the population elsewhere, are threatened;
- normal operation of the development should not be susceptible to disruption as a result of flooding;
- safe access to and from the development should be possible during flood events;
- the development should not increase flood risk elsewhere;
- the development should not prevent safe maintenance of watercourses or maintenance and operation of flood defences;
- the development should not be associated with an onerous or difficult operation and maintenance regime to manage flood risk. The responsibility for any operation and maintenance required should be clearly defined;
- future users of the development should be made aware of any flood risk issues relating to the development;
- the development should not lead to degradation of the environment; and
- the development should meet all of the above criteria for its entire lifetime, including consideration of the potential effects of climate change.

To achieve the aims outlined above, a staged approach has been adopted in undertaking this Flood Risk Assessment (FRA), in accordance with current best-practice guidance. A screening study has initially been undertaken to identify whether there are any potential sources of flooding to the site which may warrant further consideration. Any potential flooding issues identified in the screening study have subsequently been considered in a scoping study. The aim of the scoping study is to define the input data requirements and study methodologies required to technically assess each of the flood risks and if appropriate include within the development proposals suitable measures to mitigate these.

The FRA has been completed with due regard to the EA's Flood Risk Standing Advice (FRSA) for use by planning applicants and their agents[9].

3.3.1 Site Location

The site is approximately 0.028 hectares in size and is located in a densely built-up residential area with a slight topographic slope falling north-south across the site. As shown in Drawing 001, the site is bounded to the north, east, south and west by residential dwellings and associated gardens. Fitzjohns Avenue is located beyond the residential dwelling to the west of the site. Fitzjohns Avenue slopes from north to south, with an average gradient in the immediately region of the site of approximately 1 in 15. The property immediately north (Medresco House) is at a slightly higher elevation (approximately 0.2m higher) than the site, while the property immediately to the west (no. 64 Fitzjohns Avenue) and east (no.12 Akenside Road) is at the same elevation. Land and the associated gardens of no. 62 Fitzjohns Avenue to the south of the site are situated at a slightly lower elevation, approximately 0.5m lower.

[7] National Planning Policy Framework, Department for Communities and Local Government (2012)

[8] Planning Practice Guidance to the National Planning Policy Framework : Department for Communities and Local Government (March 2014)

[9] Environment Agency, April 2012, FRSA for use by planning applicants and their agents, http://www.environment-agency.gov.uk/research/planning/82587.aspx accessed 24 April 2013.

3.3.2 Hydrological Features

There are no designated Main Rivers, Ordinary Watercourses, or other significant surface water features on-site.

The River Brent (designated Main River) is located, at its closest, approximately 4km to the north-west of the site, as indicated in Drawing 001.

3.3.3 Flood Zone Designation

The site lies wholly within a *'Zone 1 – low probabilit*y' flood risk area (Flood Zone 1) as defined by *Table 1: Flood Zones* of the Planning Practice Guidance (PPG)[10]. Flood Zone 1 is defined as land where the annual probability of fluvial and / or tidal flooding is less than 0.1% of a flood occurring in any one year / 1 in 1,000 year return period. The site covers an area less than 1 hectare and is located entirely within Flood Zone 1, therefore, with reference to footnote 20 of the National Planning Policy Framework (NPPF)[11], any planning application for the site does not require the support of a FRA. However, Camden Planning Guidance CPG4 'Basements and Lightwells' requires in Section 3.48 that all applications for basement developments within areas identified in the LB Camden Flood Risk Management Strategy or in any future SFRA will be expected to include a Flood Risk Assessment. SFRA mapping indicates that Fitzjohns Avenue is located within an area of historic flooding.

3.3.4 Basement Development

As detailed in section 1.1, the basement development involves the demolition of two existing houses and the construction of two new houses each with a single storey basement as shown in Webb Architects Drawing 1169.01.11C. The proposed basements would extend beneath the whole of the current building footprint and the nearby front cobbled area, however the above ground building footprint would remain similar to the present footprint. The part of the proposed basements outside the above ground footprint would be overlain by lawns, a car parking area and several covered light-wells.

3.3.5 Screening Study of Potential Flood Risk

All potential sources of flooding must be considered for any development. A summary of the potential sources of flooding and a review of the potential risk posed by each source at the application site is presented in Table 2.

[10] Planning Practice Guidance to the National Planning Policy Framework : Department for Communities and Local Government (March 2014)

[11] National Planning Policy Framework, Department for Communities and Local Government (2012)

Table 2 –
Potential Risk Posed by Flooding Sources

Potential Source	Potential Flood Risk at Site?	Justification
Fluvial flooding	No	EA Flood Mapping shows site is located in Flood Zone 1. Distance from nearest significant watercourse >4km
Tidal flooding	No	Site location is 'inland' and topography > 85m AOD
Flooding from rising / high groundwater	Yes	Proposed basement floor level is below groundwater level
Surface water (pluvial) flooding	No	EA mapping indicates the site is located within a *'Very Low'* area of flood risk from surface water flooding.
Flooding from infrastructure failure	Yes	Surcharge, failure or blockage of private drainage and / or public sewers at or near the Site could potentially pose a risk to the site. Drainage of the basement terrace areas may rely on pumping.
Flooding from reservoirs, canals and other artificial sources	No	There are no reservoirs, canals or other artificial sources in the vicinity of the site that could give rise to a flood risk.

3.3.6 Scoping Study

The screening study indicates that the only significant potential flood risks to the new development arise from a failure (principally blockage) of the existing private drainage connections and / or public sewers in the vicinity of the site, and from groundwater flooding. Additional information has therefore been gathered to evaluate the flood risk from these sources, including completion of a site visit by SLR in July 2015.

3.3.7 Groundwater Flooding

As discussed in Q1a of the Groundwater Flow Screening above, the available information indicates that groundwater levels in the Claygate Member sandy clay at the site are approximately 16.4 mASD i.e. at least 0.5m above the proposed basement floor level. As discussed in the Conceptual Ground Model in section 2.2.2 above, if in a very wet winter groundwater levels beneath the no.66 site rise to approximately 17.5 mASD, it is theoretically possible (in the absence of mitigation measures) that the blockage of the groundwater pathway caused by the proposed basement could cause water levels to rise slightly and spill out onto the lower ground floor patio or southern sunken garden of no.62 Fitzjohns Avenue, both of which have elevations of approximately 17.7 mASD.

In order to minimise any such impact it is proposed to construct a drainage corridor, eg French drain or similar, at a suitable depth to protect the nearby lower ground floor patios and sunken garden from any potentially elevated groundwater levels. This drainage corridor would drain groundwater flows for up to approximately 5m west of the proposed basement development as shown on Webb Architects Drawing 1169.01.11C, and lead to a nearby sump from where any excess groundwater could be pumped if/when necessary and used for toilet flushing and plant irrigation.

Based on the opinion of Michael Chester and Partners, it is considered that any significant inflow of groundwater should be stopped at an early stage by the secant piling to be installed around the excavation, and during the long term by the basement reinforced concrete walls

and basement floor slab. In order to avoid the long term potential risk of flotation, depending on the findings of winter groundwater level monitoring it may be necessary to include a basal groundwater drainage layer in the basement design.

It is considered unlikely that groundwater would cause significant flooding at the site and it is considered unlikely that the development would increase the risk of groundwater flooding in the local area.

3.3.8 Flooding from Infrastructure Failure

Public Sewer Failure

The External Sewer Flooding map[12] in the LB Camden Strategic Flood Risk Assessment indicates that the site is located within an area with a history of one external sewer flooding event (Area NW3_5). No specific details of the location or extent of the flooding event are provided by the SFRA.

However, it is considered that in the event that the combined sewer located beneath Fitzjohns Avenue was to fail, or significantly reduce its designed capacity (i.e. blockage) in the future, the flood risk is likely to be very similar to that from the overland flow of surface water flooding[13]and therefore, the following sequence of events would be likely to occur:

- the combined sewer along Fitzjohns Avenue would reach capacity and surcharge;
- excess flow from the combined sewer would start to spill out through gulleys and manholes onto Fitzjohns Avenue in the vicinity of the site; and
- excess flow would largely be contained within the kerbed road network and would be directed away from the entrance to the site, following the topography of Fitzjohns Avenue.
- in the unlikely event that excess flows exceed the crest level of the pedestrian pavement and reach the entrance to the site, flows would be directed towards the site following the topography of the access road. However, flows would fail to reach the main extent of the site due to the topography of the external area of the site and the significantly lower elevation of land immediately to the west and south of the site. This follows the modelled surface water flood risk extent provided by the EA mapping.

It is therefore considered unlikely that floodwaters would accumulate at the site.

3.3.9 Summary of Flood Risk Assessment

In summary, it is considered unlikely that flooding from infrastructure failure is a significant risk to the new basement and the development itself would not increase the risk of flooding elsewhere.

[12] Drawing DG5 External Sewer Flooding in London Borough of Camden Strategic Flood Risk Assessment, July 2014.
[13] Modelling undertaken by the Environment Agency indicates that the site is located in a *'Very Low'* probability area of surface water flooding.

3.4 Mitigation Measures

As detailed in section 3.3.5 above, it is considered that the development would not increase the risk of flooding elsewhere, hence no management of off-site impacts is required.

4.0 SUMMARY AND CONCLUSIONS

This letter report has presented the Basement Impact Assessment screening responses for groundwater flow and for surface flow / flooding.

As the responses to **Q1**, **Q2** and **Q4** of the Subterranean (Groundwater) Flow Screening were **YES**, it was considered necessary to proceed to develop a Subterranean (Groundwater) Flow Scoping and Impact Assessment. As detailed in CPG4 and chapter 6 of 'Guidance for Subterranean Development', these further stages involve presentation of a conceptual ground model, additional site investigation (if necessary) and identification of potential impacts. The groundwater flow impact assessment examined three potential risks revealed by the groundwater flow scoping. The potential risk of significant changes in groundwater flow to the south is considered low, as it is considered very unlikely that any shallow underground water seepage would be significant, due to the presence of sandy clay Claygate Member below approximately 1m mbgl. However, it is considered that in a very wet winter groundwater levels beneath the site could rise and it is theoretically possible (in the absence of mitigation measures) that a blockage of the groundwater pathway caused by the proposed basement could cause water levels to rise slightly and spill out onto neighbouring properties to the west and south (both positioned at a lower elevation). Appropriate mitigation measures are recommended to be incorporated into the development to minimise any such impact. The potential risk of significant changes in seepages to or from the nearest watercourse due to the basement was found to be negligible due to the low permeability sandy clay Claygate Member. The risk of significant decreased recharge to the underlying ground is considered not likely to significantly affect wetness in the underlying sandy clay Claygate Member or London Clay.

As the responses to **Q3** and **Q6** of the Surface Flow and Flooding Screening were **YES** and **UNKNOWN** respectively, it was considered necessary to proceed to develop a Surface Flow and Flooding Scoping.

The risk of increased surface water flows due to an increase in the hard surfaced / paved area was assessed, but the proposed mitigation measures would ensure that the proposals would have no material impact on the current surface water drainage to combined sewers beneath Fitzjohns Avenue.

As the response to **Q6** was **UNKNOWN** due to the location of the site shown within an area of history flooding on mapping provided by the Camden SFRA, it was considered appropriate to undertake a Flood Risk Assessment (FRA). The FRA assessed the risk from all forms of flooding, including river (fluvial) and surface water (pluvial), however, only two forms of flooding were assessed as potential flood risk sources to the site. The potential risk from groundwater was discussed in response to **Q1a** of the Subterranean (Groundwater) Flow Screening previously. It is considered theoretically possible (in the absence of mitigation measures) that a blockage of the groundwater pathway caused by the proposed basement could cause water levels to rise slightly and spill out onto neighbouring properties to the west and south (both positioned at a lower elevation). Appropriate mitigation measures are recommended to be incorporated into the development to minimise any such impact, and also to minimise the risk of flotation of the basement structure due to rising groundwater levels. The potential flooding from the failure and / or blockage of existing drainage systems was found not to be significant. In the unlikely event that the combined

sewer located beneath Fitzjohns Avenue were to fail, or significantly reduce its designed capacity (i.e. blockage) in the future, the flood risk is likely to be very similar to that from the overland flow of surface water flooding and therefore floodwater would be contained within the kerbed road network, or in the unlikely event that water levels increased and spilled over the crest of the pedestrian pavement, surface water would be directed towards the site along the access road, but would be prevent from discharging onto the site due to the topography i.e. the significantly lower ground levels located to the west and south of the site.

The FRA therefore demonstrates that the basement development would be safe for its lifetime and would not increase the risk elsewhere as required by the National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG).

5.0 CLOSURE

This report has been prepared by SLR Consulting Limited with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of CP Plus; no warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.

Yours sincerely
SLR Consulting Limited

P. M. Slater

Phil Slater CGeol
Principal Hydrogeologist

Enc Drawing 1169.01.11C – Proposed Ground Floor Plan showing French Drain
Drawing 1169.01.03 - Existing Site Survey
Drawing 001 – Local Geology and Hydrology
August 2015 Site Investigation Location Plan and Logs

Indicative location of buried French drain to collect any groundwater seepages from the North, as protection for neighbours sunken garden areas

Groundwater collection sump formed with 1.2m diameter concrete manhole rings

T10

London Plane

Bicycles

Hardstanding

Roof Light

Hall

Reception

Roof Light

Lawn

Hall

A1

Lawn

Roof Light

Reception

A

Roof Light

T6

T7

T8

18.75

5m
4m
3m
2m
1m
0m

REV
A- 23.09.15 Hardstanding added, lawn omitted
B- 15.10.15 French drain and sump added
C- 15.10.15 Note revised

N

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66 FITZJOHNS AVENUE

PROPOSED-
SITE PLAN

1:100 / A3

FOR INFORMATION

1169.01.11(C)

rough ground

T10

London Plane

T1

T6

T7

T8

66

No Access to Garden Area

No Access to Garden Area

No1

No 2

tarmac

steel gate

drainage grill

MH CL19.69 conc

steel column brick base

wall 1600 ht

c.770 h.1690

conc

decking

stone kerb

gravel

kerb

svpc

boe

bed

stone coping

stone cobbles

Silver Birch

c.820 h.1670

c.830 h.1665

brick wall

1950 ht

railing 1200 ht

steel balcony

Basemnt Open Area

conc upstand

c.1060

grass

Parking Bays

Parking Bays

trellis fence 910 ht

conc footings

conc footings

conc footings

ledge

conc kerbing

conc kerbing

tarmac

tarmac

grass

5m
4m
3m
2m
1m
0m

REV A-

N

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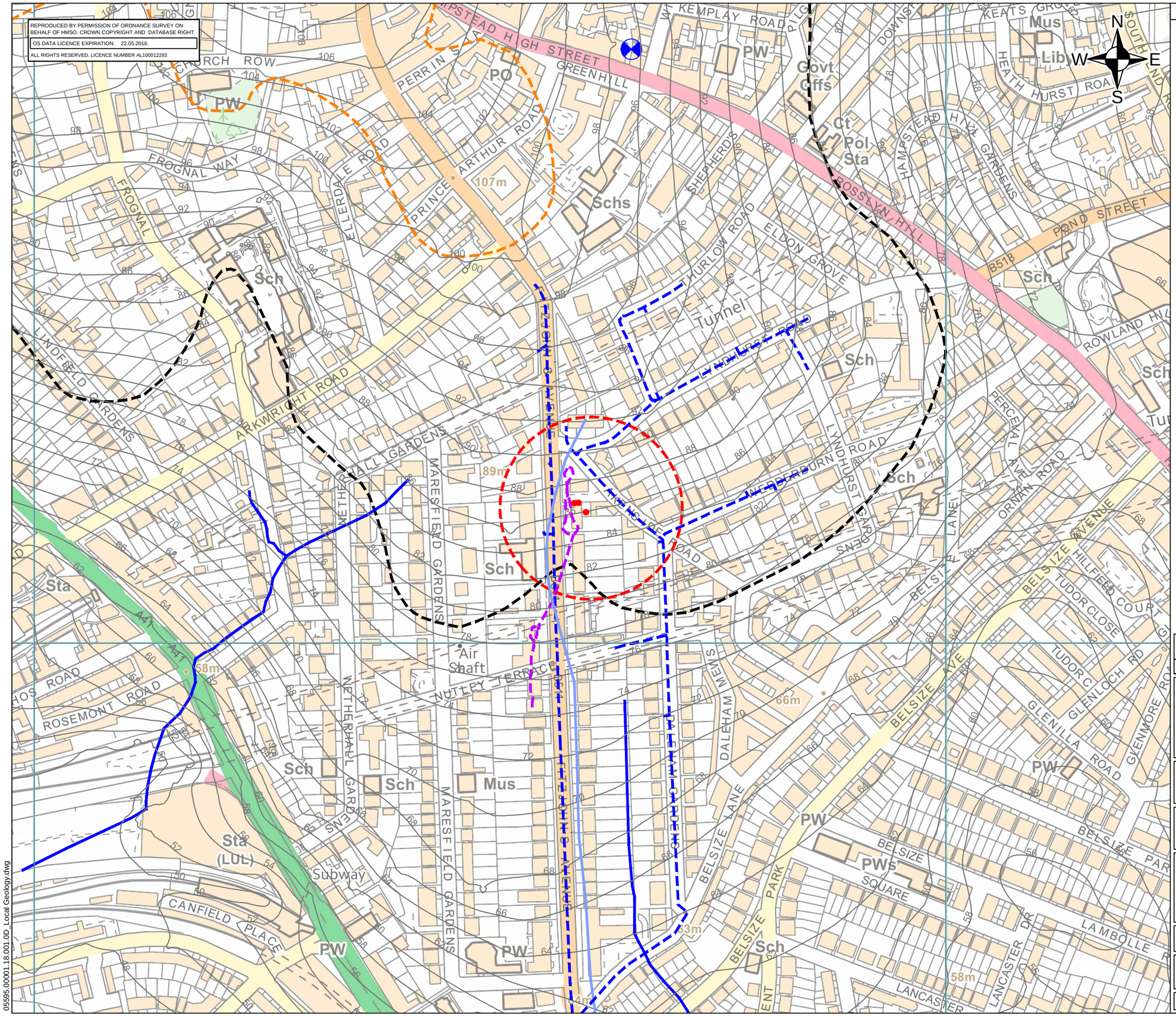
66 FITZJOHNS AVENUE
EXISTING-
SITE PLAN
1:100 / A3

FOR INFORMATION

1169.01.03(-)



LEGEND

- 100m OFFSET BOUNDARY
- 70 — SURROUNDING OS LEVEL CONTOURS (mOAD)
- APPROXIMATE NEARBY WATERCOURSE LOCATION (VISIBLE OR CONCEALED) AS SHOWN 1920 GEOLOGICAL MAP IN RELATION TO ROADS
- APPROXIMATE NEARBY WATERCOURSE LOCATION AS SHOWN 1871 MAP
- NEARBY STORM RELIEF SEWERS (INFORMATION FROM THAMES WATER)
- APPROXIMATE NEARBY WATERCOURSE LOCATION AS PER BARTON - LOST RIVERS OF LONDON (ONLY UNDERGROUND WATERCOURSES FLOWING WITHIN 250m OF SITE SHOWN)
- OLD WATER WELLS (WITHIN 800m OF SITE)
- APPROXIMATE LOCATIONS OF 2015 ON-SITE BOREHOLES
- SOUTHERN BOUNDARY OF BAGSHOT BEDS - AS PER BGS 1994 GEOLOGICAL MAP SHEET 256
- SOUTHERN BOUNDARY OF CLAYGATE MEMBER - AS PER BGS 1994 GEOLOGICAL MAP SHEET 256

Revision	By	Chk'd By	Date	Comments
0	KW	PS	09/15	

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Project
BASEMENT IMPACT ASSESSMENT

Drawing Title
LOCAL GEOLOGY & HYDROLOGY

Scale
1:4000 @ A3

Date
SEPTEMBER 2015

Drawing Number
001

Revision
0

05595.00001.18.001.0D_Local Geology.dwg

INFRASTRUCTURE
Giving our all

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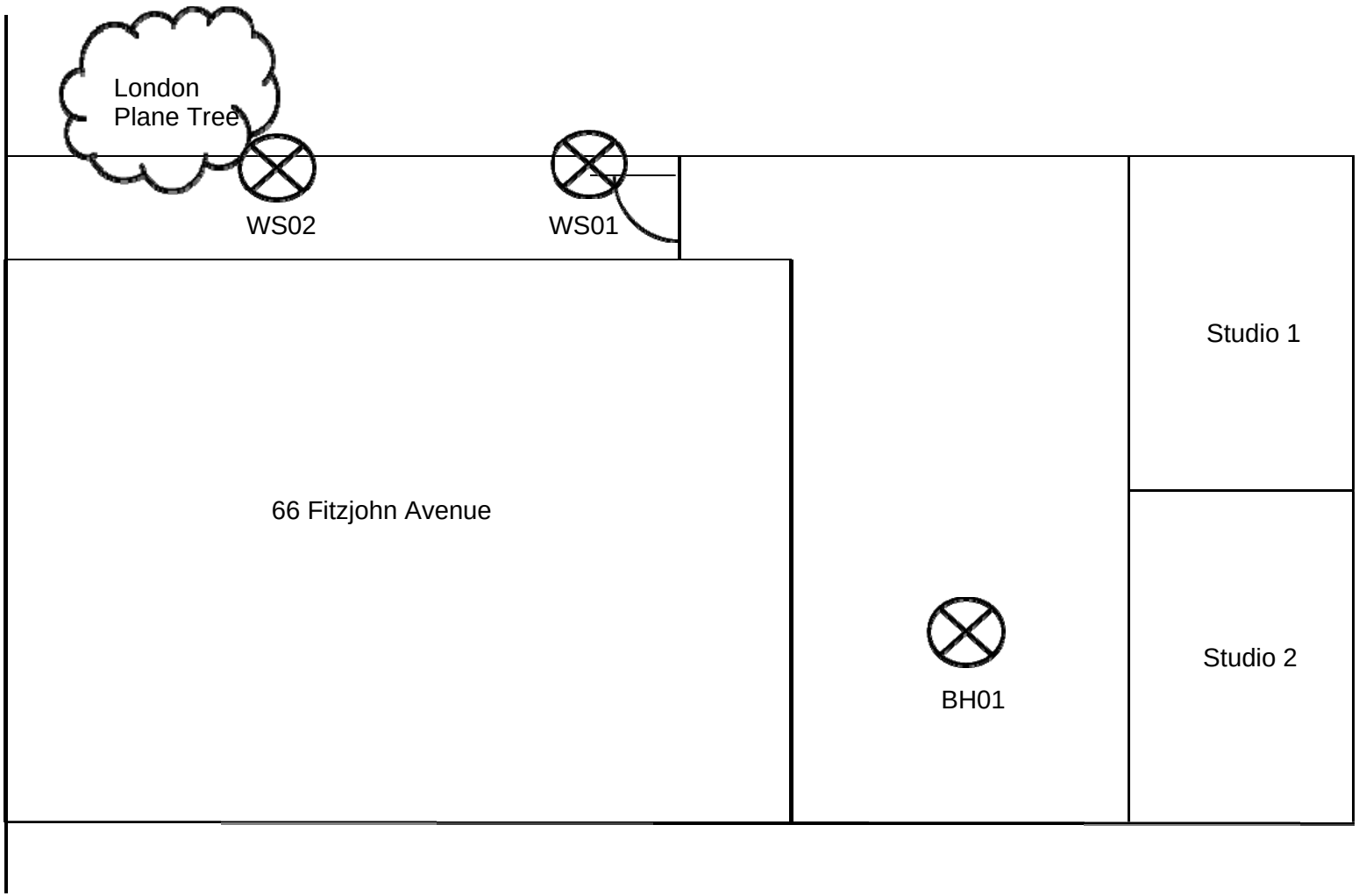
66 Fitzjohn Avenue, Camden			Lead No. **240179**
Created By: **MIW**	Checked:	Approved:	Date: **August 2015**

A



Approximate Borehole Location Plan

Scale: Not to Scale

FIGURE 1

Client: **CP Plus Limited**	Hole Diameter (mm): 90 tapering with depth to 7.00m	**BOREHOLE NUMBER** **WS01** Sheet 1 of 2
Method: Window Sampler		
Date: 27/08/15 Co-ordinates E N	Ground Level (m AOD)	Ref. No: 240179

Backfill/Well Legend (m)	Water Depth (m)	Samples Depth (m)	Samples Type	In Situ Tests Results	Reduced Level (m AOD)	Depth & (Thickness) (m)	Description of Strata	Legend
						(0.10) 0.10	Asphalt.	
0.20						(0.10) 0.20	Concrete.	
		0.25		Vh = 31 pp = 2.0		(0.15) 0.35	Brick Cobbles.	
		0.50	D	Vh = 30 pp = 2.2		(0.45)	Firm, brown, fine to coarse sandy, slightly gravelly CLAY. Gravel is angular to rounded, fine to coarse brick, clinker, concrete and flint. (Made Ground)	
		0.75		Vh = 35		0.80		
1.00		1.00	D				Stiff, brown, fine to coarse sandy CLAY. (Made Ground/Reworked Claygate Member?)	
		1.25				(1.00)		
		1.50	D					
		1.75				1.80		
		2.00	D	Vh = 59 pp = 5.0			Stiff, orange brown and mottled grey, fine sandy, slightly gravelly CLAY. Gravel is angular to well rounded, fine to coarse quartz and brown, black and orange brown flint. (Made Ground/Reworked Claygate Member?)	
		2.00 - 2.40						
		2.25		Vh = 140 pp = 6.0		(1.14)		
		2.50	D	Vh = 99 pp = 4.2				
		2.50 - 3.00						
		2.75		Vh = 60 pp = 2.5				
		3.00	D	Vh = 51 pp = 1.8		2.94		
		3.00 - 3.50					Firm, orange, ochre and mottled grey, fine sandy, possibly very thinly laminated CLAY. (Claygate Member)	
		3.25		Vh = 42 pp = 2.2				
		3.50	D	Vh = 29 pp = 1.8				
		3.50 - 4.00						
		3.75		Vh = 40 pp = 2.7		(1.56)		
		4.00		Vh = 80 pp = 2.8				
		4.25		Vh = 40 pp = 3.8				
4.30								
		4.50	D	Vh = 51 pp = 2.4		4.50	Firm, grey, slightly fine sandy CLAY. Selenite crystals observed. (London Clay Formation)	
		4.50 - 5.00						
		4.75		Vh = 50 pp = 3.0			*Continued on next sheet*	

General Remarks:
1. Service inspection pit hand dug to 1.2m and then furthered to 2.0m below ground level through the use of a hand auger due to service concerns prior to commencement of borehole.
2. Water ingress observed at 3.5m below ground level.
3. Roots and rootlets observed to 2.2m below ground level.

Driller:	CB	BOREHOLE RECORD Scale 1:25 See Key Sheet for explanation of symbols, etc.	CET INFRASTRUCTURE Giving our all
Logged:	MIW		
Chked:		66, Fitzjohns Avenue NW3	**FIG A2**
Appr'd:			

Client: **CP Plus Limited**	Hole Diameter (mm): 90 tapering with depth to 7.00m	**BOREHOLE NUMBER** **WS01** Sheet 2 of 2
Method: Window Sampler		
Date: 27/08/15 Co-ordinates E N	Ground Level (m AOD)	Ref. No: 240179

Backfill/Well		Water	Samples		In Situ Tests	Reduced	Depth &		
(m)	Legend	Depth (m)	Depth (m)	Type	Results	Level (m AOD)	*(Thickness)* (m)	Description of Strata	Legend
			5.00 5.00 - 6.00	D	Vh = 50 pp = 2.5			Firm, grey, slightly fine sandy CLAY. Selenite crystals observed.	
			5.25		Vh = 50 pp = 2.6				
			5.50		Vh = 60 pp = 2.8				
			5.75		Vh = 50 pp = 3.0		*(2.50)*		
			6.00 6.00 - 7.00	D	Vh = 55 pp = 3.0				
			6.25		Vh = 50 pp = 2.6				
			6.50		Vh = 60 pp = 2.8				
			6.75		Vh = 55 pp = 2.6				
7.00			7.00		Vh = 50 pp = 2.8		7.00	*End of Borehole at 7.00 m*	

General Remarks:
1. Service inspection pit hand dug to 1.2m and then furthered to 2.0m below ground level through the use of a hand auger due to service concerns prior to commencement of borehole.
2. Water ingress observed at 3.5m below ground level.
3. Roots and rootlets observed to 2.2m below ground level.

Driller:	CB	BOREHOLE RECORD Scale 1:25 See Key Sheet for explanation of symbols, etc.	CET INFRASTRUCTURE Giving our all
Logged:	MIW		
Chked:		66, Fitzjohns Avenue NW3	**FIG A2**
Appr'd:			

Client: **CP Plus Limited**	Hole Diameter (mm): 90 tapering with depth to 7.00m	**BOREHOLE NUMBER**
Method: Window Sampler		**WS02**
Date: 27/08/15	Co-ordinates E N / Ground Level (m AOD) / Ref. No: 240179	Sheet 1 of 2

Backfill/Well		Water	Samples		In Situ Tests	Reduced	Depth &		
(m)	Legend	Depth (m)	Depth (m)	Type	Results	Level (m AOD)	(Thickness) (m)	Description of Strata	Legend
			0.00				(0.10)	Asphalt.	
							0.10		
0.20							(0.10)	Concrete.	
			0.25				0.20		
							(0.35)	Brick Cobbles.	
			0.50	D			0.55		
			0.75		Vh = 30 pp = 4.5			Light brown, slightly silty, slightly gravelly, fine to coarse SAND. Gravel is angular to well rounded, fine to coarse flint, concrete and brick. (Made Ground)	
			1.00	D	Vh = 59		(1.05)		
			1.25		Vh = 100				
			1.50	D	Vh = 110		1.60		
			1.75		Vh = 120 pp = 6.0			Very stiff, brown, fine to coarse sandy, slightly gravelly CLAY. Gravel is angular to well rounded, fine to coarse flint and clinker. (Made Ground/Reworked Claygate Member?)	
			2.00 2.00 - 2.50	D	Vh = 115 pp = 6.0		(0.70)		
			2.25		Vh = 88 pp = 4.4				
2.30							2.30		
			2.50 2.50 - 3.00	D	Vh = 120 pp = 5.4			Very stiff, orange brown and mottled grey, slightly fine sandy, slightly gravelly, possibly very thinly laminated CLAY. Gravel is angular to rounded, fine to coarse flint (brown, orange and black). (Made Ground/Reworked Claygate Member?)	
			2.75		Vh = 62 pp = 3.2		(1.05)		
			3.00		Vh = 45 pp = 3.0				
			3.25		Vh = 50 pp = 2.0				
			3.35 - 3.80	D			3.35		
			3.50		Vh = 50 pp = 2.5		(0.45)	Firm and locally soft, black, organic CLAY. Organic odour noted. (Made Ground/Reworked Claygate Member?)	
			3.75		Vh = 45 pp = 4.0		3.80		
			4.00 4.00 - 4.50	D	Vh = 50 pp = 2.3			Firm, orange brown and grey, slightly fine sandy CLAY. (Claygate Member)	
			4.25		Vh = 52 pp = 1.5		(1.20)		
			4.50		Vh = 45 pp = 2.4				
			4.75		Vh = 50 pp = 3.9				

Continued on next sheet

General Remarks:
1. Service inspection pit hand dug to 1.2m and then furthered to 2.0m below ground level through the use of a hand auger due to service concerns prior to commencement of borehole.
2. Roots and rootlets observed to 3.0m below ground level.

Driller:	CB	BOREHOLE RECORD Scale 1:25 See Key Sheet for explanation of symbols, etc.	CET INFRASTRUCTURE Giving our all
Logged:	MIW		
Chked:		66, Fitzjohns Avenue NW3	**FIG A3**
Appr'd:			

Client: **CP Plus Limited**	Hole Diameter (mm): 90 tapering with depth to 7.00m	**BOREHOLE NUMBER** **WS02** Sheet 2 of 2
Method: Window Sampler		
Date: 27/08/15	Co-ordinates E N	Ground Level (m AOD)	Ref. No: 240179

Backfill/Well		Water	Samples		In Situ Tests	Reduced	Depth &		
(m)	Legend	Depth (m)	Depth (m)	Type	Results	Level (m AOD)	*(Thickness)* (m)	Description of Strata	Legend
5.00			5.00		Vh = 50 pp = 4.0		5.00	Firm, grey, slightly fine sandy CLAY. (London Clay Formation)	
			5.25		Vh = 50 pp = 4.2				
			5.50 5.50 - 6.30	D	Vh = 50 pp = 2.8				
			5.75		Vh = 45 pp = 3.0				
			6.00		Vh = 50 pp = 3.5		*(2.00)*		
			6.25		Vh = 40 pp = 3.0				
			6.40 - 7.00	D					
			6.50		Vh = 70 pp = 2.8				
			6.75		Vh = 55 pp = 3.5				
7.00			7.00		Vh = 50 pp = 4.2		7.00	*End of Borehole at 7.00 m*	

General Remarks:
1. Service inspection pit hand dug to 1.2m and then furthered to 2.0m below ground level through the use of a hand auger due to service concerns prior to commencement of borehole.
2. Roots and rootlets observed to 3.0m below ground level.

Driller:	CB	BOREHOLE RECORD Scale 1:25 See Key Sheet for explanation of symbols, etc.	CET INFRASTRUCTURE Giving our all
Logged:	MIW		
Chked:		66, Fitzjohns Avenue NW3	**FIG A3**
Appr'd:			

Client: **CP Plus Limited**	Hole Diameter (mm): 150 to 15.00m		BOREHOLE NUMBER **BH01** Sheet 1 of 2
Method: Cable Percussion	Casing Dia. (mm): 150 to 6.00m		
Date Started: 27/08/15	Co-ordinates E N	Ground Level (m AOD)	Ref. No: 240179

Backfill/Well Depth (m)	Backfill/Well Legend	Water Depth (m)	Samples Depth (m)	Samples Type	In Situ Tests Type	In Situ Tests Results	Reduced Level (mAOD)	Depth & (Thickness) (m)	Description of Strata	Legend
0.00								(0.20)	Granite Blocks (Driller's Description).	
0.20			0.20	D				0.20	Dark brown and black, slightly fine sandy, clayey GRAVEL. Gravel is angular and sub-angular, fine to coarse flint, brick, ash and concrete. (Made Ground)	
								(0.80)		
1.00			1.00	D				1.00	Soft, brown, grey and orange brown, slightly fine sandy CLAY. (Claygate Member)	
			1.50 - 1.95	D	S	N = 6				
			2.00	D						
								(2.50)		
			2.50 - 2.95	U						
			3.00	D						
			3.50 - 3.95	D	S	N = 13		3.50	Firm, brown, grey and orange brown, fine sandy CLAY. (Claygate Member)	
			4.00	D				(1.00)		
			4.50 - 4.95	U				4.50	Firm becoming stiff with depth, grey, slightly fine sandy CLAY with occasional selenite crystals and shell fragments. (London Clay Formation)	
5.00		4.90 5.00	5.00	D						
6.00			6.00 - 6.45	D	S	N = 12				
			7.00	D						
			7.00 - 7.45	U						
			7.50	D						
			8.00	D						
			8.50 - 8.95	D	S	N = 15				
			9.00	D						
								(10.50)		

Continued on next sheet

General Remarks:
1. Groundwater encountered at 5.0m, rising to 4.9m below ground level after 20 minutes.
2. Roots and rootlets observed to 2m below ground level.

Driller:	SL	BOREHOLE RECORD Scale1:50 See Key Sheet for explanation of symbols, etc.	CET INFRASTRUCTURE Giving our all
Logged:	MOV		
Checked:		66, Fitzjohns Avenue NW3	**FIG A1**
Appr'd:			

Client: **CP Plus Limited**		Hole Diameter (mm): 150 to 15.00m	BOREHOLE NUMBER **BH01** Sheet 2 of 2
Method: Cable Percussion		Casing Dia. (mm): 150 to 6.00m	
Date Started: 27/08/15	Co-ordinates E N	Ground Level (m AOD)	Ref. No: 240179

Backfill/Well		Water	Samples		In Situ Tests		Reduced	Depth &	Description of Strata	Legend
Depth (m)	Legend	Depth (m)	Depth (m)	Type	Type	Results	Level (mAOD)	*(Thickness)* (m)		
			10.00	D					Firm becoming stiff with depth, grey, slightly fine sandy CLAY with occasional selenite crystals and shell fragments.	
			10.00 - 10.45	U						
			10.50	D						
			11.00	D						
			11.50 - 11.95	D	S	N = 14				
			12.00	D						
			13.00	D						
			13.00 - 13.45	U						
			13.50	D						
			14.00	D						
			14.50 - 14.95	D	S	N = 17				
15.00			15.00	D				15.00	*End of Borehole at 15.00 m*	

General Remarks:

Driller:	SL	BOREHOLE RECORD Scale1:50 See Key Sheet for explanation of symbols, etc.	CET INFRASTRUCTURE Giving our all	
Logged:	MOV			
Checked:		66, Fitzjohns Avenue NW3		**FIG A1**
Appr'd:				