APPENDIX 3: HYDROLOGY & HYDROGEOLOGY REPORT

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53-55 Chalton Street, 60 Churchway and 70 Churchway: Surface Water and Subsurface Flow Basement Impact Assessment screening stage

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The findings do not purport to include any manner of legal advice or opinion. New information or changes in conditions and regulatory requirements may occur in future, which will change the conclusions presented here.

TABLE OF CONTENTS

Figures

Tables

1. Introduction

1.1 Background

This report presents the surface water and subsurface flow (groundwater) component of a basement impact assessment, to be submitted in support of a planning application for the basement development at 53-55 Chalton Street NW1 1HY, 60 Churchway and 70 Churchway, Kings Cross, London NW1 1HY (national grid reference TQ 2977 8283). The local planning authority is Camden Borough Council.

In Figure 1.1 53-55 Chalton Street to 60 Churchway is the block roughly aligned east-west between Chalton Street (in the east) and Churchway (in the west). 70 Churchway is the northward extension of the boundary.

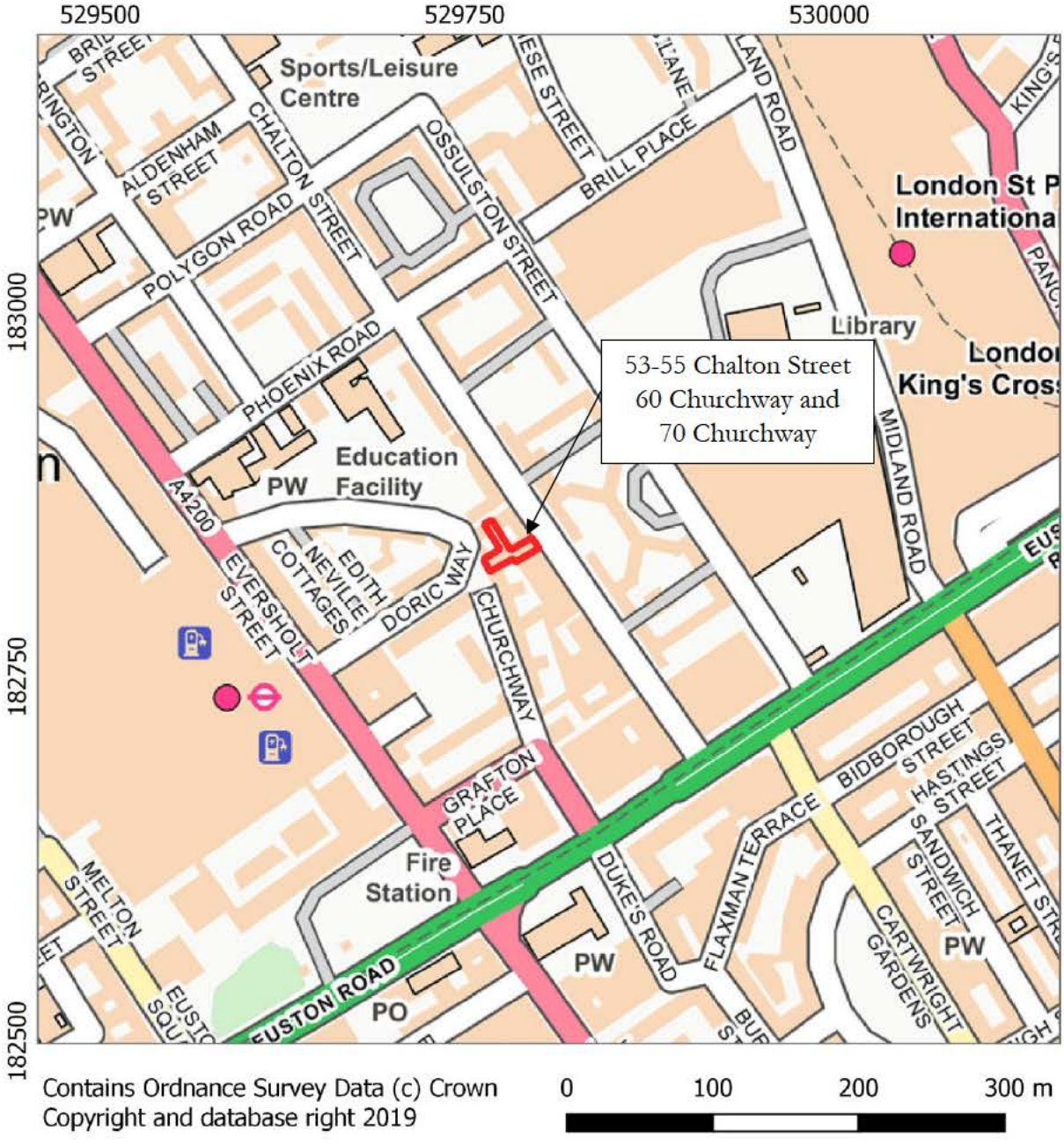

Figure 1.1 Location

1.2 Basement Works

The site comprises two properties, each of which is to have separate a basement extension.

53-55 Chalton Street is currently a four-storey building on the west side of Chalton Street. The property continues westwards with a rear entrance on 60 Churchway. The property has a low-ceilinged storage basement beneath most of its footprint. The plan for the new basement extension at 53-55 Chalton Street involves excavating down from the existing basement, and extending beneath 60 Churchway, out to the extent of the ground floor. The basement extension is to be roughly rectangular, with length c. 6 m and width c. 8 m. The finished floor level (FFL) of the refurbished basement and the basement extension will be 0.23 m deeper than the current floor level.

70 Churchway is currently a two-storey building on the south side of the east-west aligned part of Churchway; it has no basement at present. The plan for 70 Churchway involves demolishing the building and excavating a single-storey basement across the whole plot. The rear (south) of the plot will have a sunken garden.

Figure 1.2 shows a plan view of the proposed basements, from Divine Ideas Architects drawing 1103-A/200/E. Section A-A' in Figure 1.3 shows existing and proposed sections through 53-55 Chalton Street, and Section B in Figure 1.4 shows existing and proposed sections through 70 Churchway.

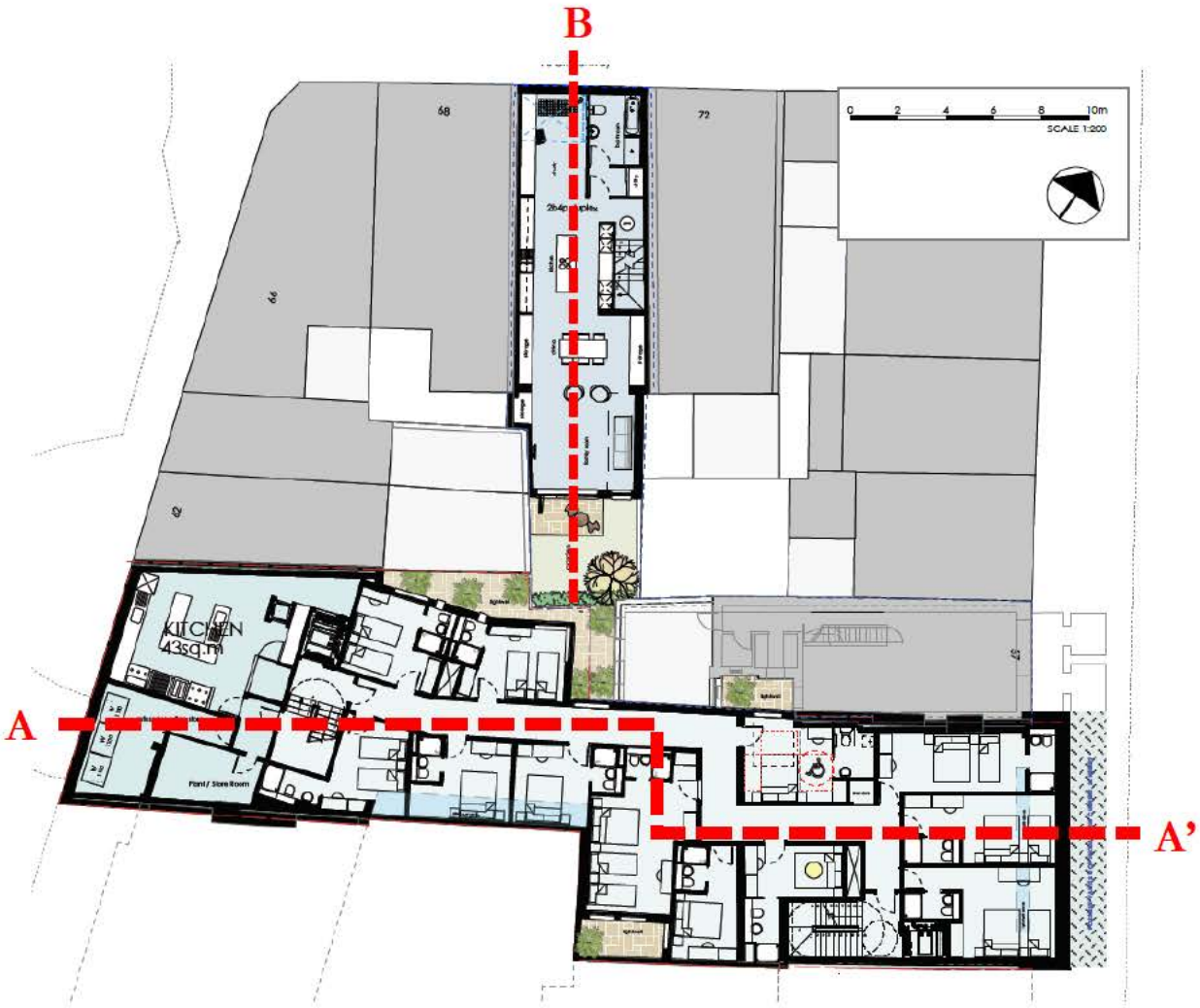

Figure 1.2 Plan of the proposed developments (do not scale).

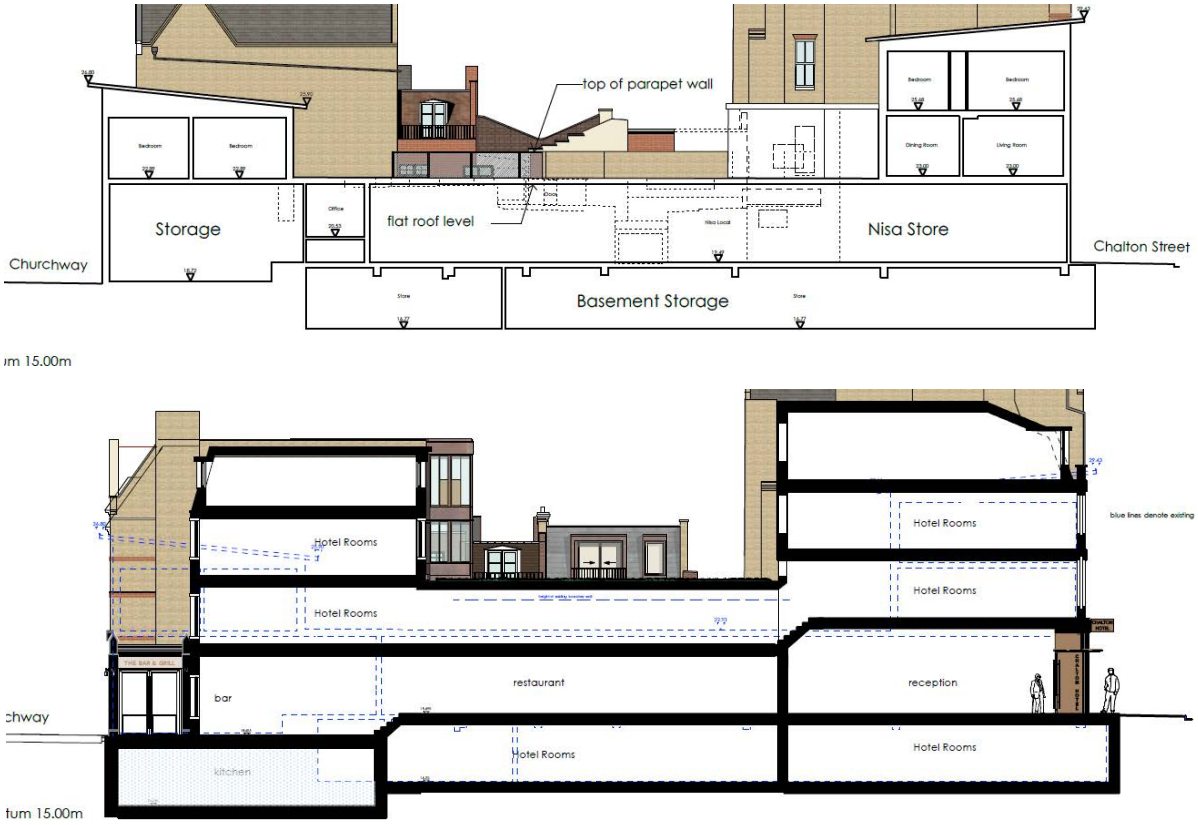

Figure 1.3 Cross section A-A' through 53-55 Chalton Street and 60 Churchway

(existing above, proposed below)

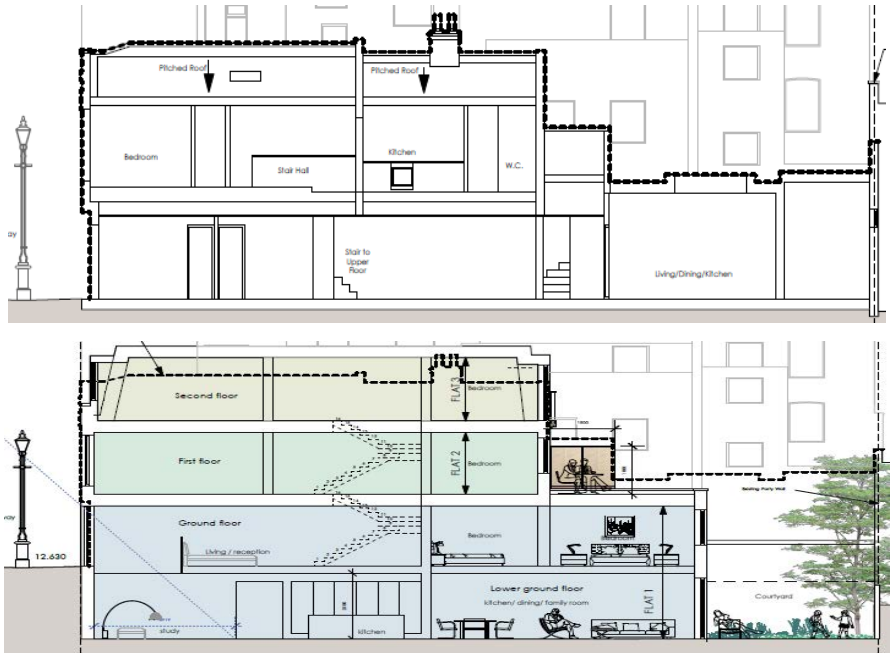

Figure 1.4 Cross section B through 70 Churchway

(existing above, proposed below)

1.3 Scope of Report

This report presents the surface water, and sub-surface water, screening report for a basement development, that complies with CPG4 screening and scoping stages, and makes reference to the basement impact assessment guidance of ARUP (2010)[1].

1.4 Authorship of Report

Stephen Buss Environmental Consulting Ltd was instructed in May 2019 to complete this report.

This report has been prepared by Dr Stephen Buss MA MSc CGeol. Dr Buss is a UK-based independent hydrogeologist with more than 19 years' consulting experience in solving groundwater issues for regulators, water companies and other private sector organisations. **Dr Buss is a Chartered Geologist with the Geological Society of London.** Dr Buss's CV and publications list is available at www.hydro-geology.co.uk.

Hydrology aspects of this report have been prepared by Rupert Evans MSc CEnv C.WEM MCIWEM AIEMA. Mr Evans is a UK-based independent hydrologist with more than 12 years' consultancy experience in flood risk assessment, surface water drainage schemes and hydrology/hydraulic modelling. **Mr Evans is a Chartered Water and Environmental Manager (C.WEM) and a Member of the Chartered Institution of Water and Environmental Management.**

[1] ARUP, 2010. Camden geological, hydrogeological and hydrological study. Guidance for subterranean development.

2. Basement Impact Assessment Screening: Surface Flow

Surface flow screening follows the procedure outlined in Figure 5: Surface flow and flooding screening chart of the Camden Planning Guidance 4 (CPG4) entitled Basements and Lightwells dated July 2015.

1) Is the site within the catchment of the pond chains on Hampstead Heath?

NO. Figure 14 of the Camden geological, hydrogeological and hydrological study – Guidance for subterranean development dated 2010, confirms that the site is not located within this catchment area.

2) 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?

NO. With regards to 53-55 Chalton Street the proposed basement is entirely below the footprint of the existing building and therefore the existing drainage regime will remain the same. At 70 Churchway there is at present a paved rear yard, which is to become part of the sunken garden. The FRA proposes use of porous pavement to improve the balance of runoff and infiltration in this area.

The basement levels are either: under the buildings, or exposed at the rear of 70 Churchway so the 1 m distance between the roof of the basement and ground surface as recommended by the Arup report and para 2.16 of the CPG4 does not apply.

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

NO. There will not be an increase in impermeable area across the ground surface above the basement. For the most part, both basements are to be within the existing building footprints. The sunken garden at 70 Churchway is to replace an impermeable yard area.

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

NO. There are negligible inflows from adjacent properties, and no flows to adjacent properties. For the most part, both basements are to be within the existing building footprints.

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

NO. The proposals are very unlikely to result in any changes to the quality of surface water being received by adjacent properties or downstream watercourses as the surface water drainage regime will be unchanged and it will be unpolluted roof water or low pollution hazard land uses draining into the sewer system.

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

NO and YES. Regarding 53-55 Chalton Street, the findings of this BIA together with the Camden Flood Risk Management Strategy dated 2013 and Figures 3i, 4e, 5a and 5b of the SFRA, dated 2014, in addition to the Environment Agency online flood maps, show that the site has a low flooding risk from sewers, groundwater, reservoirs (and other artificial sources), fluvial/tidal watercourses and surface water.

Regarding 70 Churchway a separate flood risk assessment has been undertaken to deal with the increased risk of surface water flooding at the property.

In accordance with paragraph 5.11 of the CPG a positive pumped device should be installed in the basements in order to further protect the site from sewer flooding.

3. Basement Impact Assessment Screening: Groundwater

Subterranean (groundwater) screening follows the procedure outlined in Figure 3: Subterranean (ground water) flow screening chart of the Camden Planning Guidance 4 (CPG4) entitled Basements and Lightwells dated July 2015.

1a) Is the site located directly above an aquifer?

NO. The geological map and the nearest off-site boreholes and trial pits indicate that a continuous layer of permeable superficial deposits is not present beneath the site. Beneath made ground a significant thickness of London Clay isolates the deeper aquifer units of the London Basin aquifer from the surface.

1b) Will the proposed basement extend beneath the water table surface?

YES. Water was observed in boreholes completed in the London Clay at depths above the FFL of the basements (Section 4.2). This issue is dealt with in more detail in Section 5.2.

2) Is the site within 100m of a watercourse, well (used/disused) or potential spring line?

NO. There are no current surface water bodies within 100 m of the site. The site lies between the 'lost' River Tyburn (c. 2000 m to the west) and the River Fleet (c. 250 m to the south and east). There are no known water wells within 100 m of the site.

Geological conditions indicate that there is no potential for development of a spring line in the vicinity of the property, as the 1:50 000 geology map indicates that it is located upon the outcrop the London Clay, and there are no superficial deposits nearby.

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

YES. Most of the development is beneath the current footprints of the properties, so surface water flows will be mostly unchanged. However at 70 Churchway there is at present a paved rear yard, which is to become part of the sunken garden. The FRA proposes use of porous pavement to improve the balance of runoff and infiltration in this area.

4) As part of the site drainage, will more surface water (e.g. rainfall and runoff) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)?

NO. Discharge to the ground is not proposed.

5) Is the lowest point of the proposed 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 or spring line?

NO. The nearest water body is the Grand Union Canal, about 600 m to the north east. This is too far from the site to be a concern, especially given that there are not permeable superficial deposits beneath the site.

4. Conceptual Site Model

4.1 Drainage and Topography

Elevation of Chalton Street to the east of no.s 53-55 is about 19.4 m above Ordnance Datum (m AOD) according Environment Agency LIDAR data, while Churchway to the west of no. 60 is at c. 18.8 m AOD. Churchway to the north of no. 70 is at an elevation of c. 18.5 m AOD. Ground surface around the site slopes gently eastwards (gradient from Ordnance Survey 10 m contours is about 0.012).

The site location is between two historical rivers, but these have been culverted beneath the city. These were the 'lost' River Tyburn (c. 2000 m to the west as Regent's Park Lake) and the River Fleet (c. 250-300 m to the south and east)[2] (Figure 2.1). The nearest current surface water feature is the Grand Union Canal, about 600 m to the north east of the site.

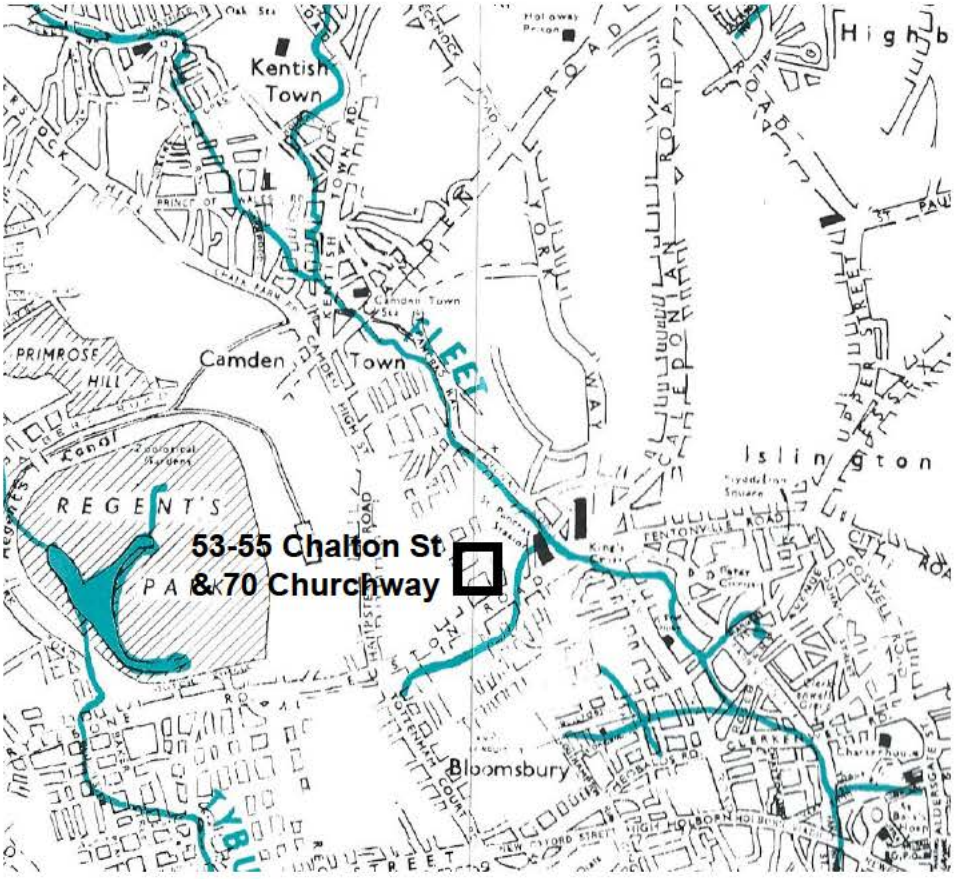

Figure 4.1 Location of tributaries of the River Tyburn (south west) and River Fleet (east)

4.2 Mapped Geology and Hydrogeology

Bedrock at the site comprises London Clay. The base of the London Clay is at about 18.2 m below ground level at the Victoria Tube #14 borehole[3] (about 30 m to the north west of the site) and isolates the main aquifer of the London Basin from the surface.

[2] Barton, N.J., 1993. The Lost Rivers of London 3rd edition.
[3] http://scans.bgs.ac.uk/sobi_scans/boreholes/591872

Nearby shallow borehole records available from the British Geological Survey show the absence of any thickness of permeable superficial deposits in the area:

- Victoria Tube #14 borehole, TQ28SE348, was drilled in December 1958. This shows a 1.5 m layer of 'soft to firm brown clay' over London Clay. This is probably mostly weathered London Clay.
- Four trial pits were dug at locations from about 30 m to 60 m north of the site[4], TQ28SE721, in 1956. All record 'brown clay' below made ground to a depth of 2.4 m. Two more trial pits about 60 – 100 m to the north of the site[5], TQ28SE677, show the presence of 'light clay' and 'yellow clay' to about 2 m depth, above the London Clay. These are probably superficial deposits rather than weathered London Clay.
- Whilst the geology map indicates outcrop of gravels about 200 m to the south of the site, borehole TQ28SE347 indicates[6] clay at the surface and London Clay at 1.5 m depth.

Referring back to the screening, a detailed assessment of the near-surface geology reinforces the view that there is not an aquifer directly beneath the site.

Groundwater levels

None of the boreholes described above refer to groundwater within 4 m of the ground surface (i.e. within the potential depth of influence of the basement). The two deeper boreholes nearest the site (TQ28SE348 and TQ28SE347) detected seepages in the London Clay at c. 13.6 m and 10 m depth respectively.

It is typical of some boreholes in the London Clay to exhibit occasional seepages of water from horizons above low permeability bands; others remain dry to significant depths. These are not instances of intercepting water tables, just pockets of water moving through the upper horizons.

In addition, the London Clay is not an aquifer, so there are not considerable amounts of water available.

4.3 Information from the Ground Investigation

Soil Consultants (2019) undertook a ground investigation to establish conditions at the site. Three auger holes were constructed and installed with standpipes. Locations are indicated on Figure 4.2: BH1 was driven from ground level, while BH2 and BH3 were driven from basement level.

- In BH1, below 1.8 m of mostly gravelly made ground, there was weathered London Clay and then intact London Clay to the base of the hole at 5.0 m. There was a water seepage from sand partings below 4.2 m but on completion the borehole was dry.
- In BH2, below 0.8 m of rubbly made ground, there was London Clay to the base of the hole at 3.0 m. There was a water seepage associated with a claystone at 2.2 m (c. 14.57 m AOD), and on completion the water level was at 2.0 m.

[4] http://scans.bgs.ac.uk/sobi_scans/boreholes/592299
[5] http://scans.bgs.ac.uk/sobi_scans/boreholes/592248
[6] http://scans.bgs.ac.uk/sobi_scans/boreholes/591871

- In BH3, below 0.7 m of rubble and sand made ground, there was London Clay to the base of the hole at 5.0 m. There were no water seepages and on completion the borehole was dry.

Water level monitoring was repeated after construction of the boreholes and the results are shown in Table 4.1 (assumed datums are based on BH1 being at ground level for Churchway outside number 70).

Table 4.1 Water observations

Borehole	Date	Water observations
BH1 (5.0 m deep) (datum = 18.466 m AOD)	On construction 4/4/2019 15/5/2019	Dry 1.32 m (17.15 m AOD)
BH2 (3.0 m deep) (datum = 16.77 m AOD)	On construction 4/4/2019 15/5/2019	2.00 m (14.77 m AOD) 0.53 m (16.24 m AOD)
BH3 (5.0 m deep) (datum = 16.77 m AOD)	On construction 4/4/2019 15/5/2019	Dry 1.32 m (15.45 m AOD)

Figure 4.2 Borehole locations

4.4 Local basements

Details of any other recent basement developments have searched for via the Camden Planning Portal but none have been identified, except changes of use of the existing basements.

- There is evidence that 66 Churchway has a small, single storey, basement beneath the southern end of the property (see planning reference 2013/0575/P).
- Also there is a basement office beneath 57 Chalton Street (2013/1585/P). (Also Figure 1.2 shows the outline of a basement and pavement vaults beneath 57 Chalton Street.)

Other nearby properties on Chalton Street and Churchway likely have single-storey basements: for instance, Google Streetview shows lightwells at the front of 61, 63 and 65 Chalton Street.

5. Impact Assessment

5.1 Baseline Conditions

There is no near-surface aquifer present beneath the site and, beneath made ground, the properties sit directly upon London Clay.

Groundwater was encountered in each of the three boreholes that were installed. After a little more than one month the water levels varied by several metres difference across the site, from 17.15 m AOD to 15.45 m AOD.

This is not considered to be representative of a 'natural' water table gradient from north to south as this is very steep: extrapolation northwards would bring it to ground surface beneath the buildings on the north side of Churchway. Therefore either:

1) There is a consistent natural water table that is not so steep, but the borehole levels had not equilibrated with this at the time of measurement, or
2) It is typical of water in the London Clay to occur in saturated pockets throughout the sequence, that are not spatially or vertically continuous. But in many cases there is enough water in them to fill up a borehole to a certain level.

It is conservative, with regard to assessing risks to adjacent properties, to assume that the former is the case, though the final hydraulic gradient will be much less than that observed to date. Current borehole measurements suggest that, if there is a continuous water table, the hydraulic gradient is roughly southwards.

The measurement of 17.15 m AOD is 0.38 m above the floor level of the existing basement at 60 Churchway, and no groundwater seepage issues are known in this basement.

5.2 Impact Assessment

Finished floor level (FFL) of the lowest basement, at 60 Churchway, is expected to be 15.82 m AOD, which is about 1.0 m beneath the current basement floor. Water levels measured in the site boreholes have been higher than these, and the hydraulic gradient appears to be southwards.

The basement excavations are, therefore, expected to penetrate through the water table. Typically, when impermeable basement structures are constructed within a groundwater flow field, the head of groundwater rises upstream of the basement and drops downstream of the basement. It appears likely that – if there is a continuous water table – this will be the case. From experience of modelling other basements, the typical rise[7] on the upstream edge is likely to be no more than 0.1 m (vertically) within a few metres (horizontally) of the edge of the new basement. Seasonal variation in groundwater level is to be expected but it is likely to be very subdued in this densely urbanised environment: there are no trees on or adjacent to the site so there will be little evapo-transpiration.

Hence if there are basements up-gradient (north) of the proposed basement there might be an increase in groundwater level below or against the sides of these basements.

[7] For example, in the ARUP (2010) guidance for subterranean development for Camden Borough Council (paragraph 172), it is stated that: 'The change in water levels is in proportion to the increase in the length of the flow path. In the case of a site measuring 10 m in the direction of groundwater flow, the natural difference in groundwater level might be one or two centimetres.'

- Some rise is expected, therefore, north of 70 Churchway, where the basement is to be entirely new. While the groundwater level seems to be highest beneath 70 Churchway, north of the building is a street. Hence most of the anticipated increase in groundwater level will be below the street, and not beneath a property.
- North of 60 Churchway some rise in the water table might also be expected. There is no evidence of basements below 62 and 64 Churchway, which are adjacent to the western end of the building, where there is to be a new basement. Hence any rise in groundwater level is not expected to impact structures here.
- There appear to be existing basements north of the eastern end of 53-55 Chalton Street. At this, eastern, end of the building the floor level is to be deepened by only 0.23 m to achieve a FFL of 16.54 m AOD. Measured groundwater levels at the southernmost boreholes were both below this level, though there may be an increase in measured levels as the boreholes equilibrate. The difference in basement depth is very small in comparison to the thickness of London Clay that the water might be moving through.

6. Conclusions

Potential environmental impacts of the basement extension at 53-55 Chalton Street, 60 Churchway and 70 Churchway have been considered. The following summary conclusions are made:

- There will be no increase in man-made impermeable area so the amount, timing and quality of surface water runoff will not be affected by the development.
- The site of 70 Churchway is adjacent to an area mapped as having a high risk of surface water flooding. Basement development is not expected to exacerbate this risk. The risk to residents of the property is dealt with in an accompanying FRA.
- Available geological and hydrogeological information indicates that there is no permeable aquifer beneath the site that is capable of maintaining a significant water table.
- Water has been detected in local boreholes at depths comparable to the excavation depth of the basement. This may or may not be representative of a local water table, the hydrogeology of the London Clay being quite heterogenous.
- If the boreholes are representative of localised pockets of water, and if these pockets are intercepted by construction, there would be no rise in water level anywhere, and would not lead to any significant change in pore pressures over a wider area. This seems the most likely outcome.
- If the water level measurements were to be representative of a local water table, which seems less likely, some change in groundwater level is to be expected as a result of basement construction, but no receptors have been identified that would be affected by that rise in groundwater levels.
- In either case the amount of water available to enter the excavation, on construction, will be very small.

These conclusions are considered to be robust and no further investigations are needed to satisfy the screening criteria for surface water and sub-surface risk (given that a separate FRA has been provided).