2 Proposed Development

The Site occupied by 16 Daleham Gardens slopes gently downward from the front (West) to the rear (East) of the property. The house, which occupies the Eastern part of the Site, is a large unoccupied four-storey detached property with three-stories evident at the front and a part basement or lower ground floor at the rear.

The proposal is to refurbish the upper floors and to lower the existing basement to accommodate a swimming pool and associated plant rooms.

The property's existing basement will be deepened by approximately 2m throughout to accommodate the new lower ground floor level and by approximately 4m to accommodate the swimming pool. An additional basement level will be created below this to accommodate plant rooms. This will occupy approximately 30% of the property footprint and will be deepened by a further 1m. The foundations of the basement will be approximately 6m below the existing external ground level.

It is envisaged that foundations for the basement will be formed through underpinning the existing perimeter walls.

Ground levels in the central part of the garden to the rear of the property will be lowered by approximately 1m. This will involve excavating to a depth of 2m and subsequently backfilling with approximately 1m of topsoil.

3 Site Setting

The Site is located on the east side of Daleham Gardens in the Belsize Park area of London, NW3 5DA.

3.1 Topography

The Site lies at an elevation of approximately 67mAOD on ground sloping at around 3 to 4% south and eastwards towards the Adelaide Road which lies 700m to the south at an elevation of approximately 50mAOD.

Within the Site itself the ground slopes gently downward from the front (West) to the rear (East) of the property. The front garden is at an elevation of approximately 1.3m higher than the rear garden.

3.2 Hydrology and Drainage

The Site lies within the surface water catchment of the culverted River Tyburn. The river historically rose from springs on Hampstead Heath. A small tributary is believed to have flowed southwards along the course of Fitzjohn's Avenue[3] approximately 150m west of the Site. The tributary is now culverted.

There are no other surface water features marked on Ordnance Survey mapping (1:25,000 scale) within 1km of the Site.

3.3 Geology

According to the British Geological Survey (BGS) 1:50,000 sheet for the area (Sheet 256, North London. 2006) and the associated geological memoir, The Geology of London (BGS 2004), the Site lies on the London Clay Formation. Approximately 100m north of the Site the sheet shows that Quaternary head deposits may be present. This is disturbed material which has moved downslope from higher ground in the area of Hampstead Heath.

The London Clay is underlain by the Cretaceous Chalk at a depth of over 100m beneath the Site.

Site specific geological data from the SAS Ltd. site investigation (July 2011)[2], has established the presence of between 0.25m and 1.60m thickness of made ground beneath the Site locally overlying a thin layer of Superficial Head Deposits. Firm silty clay was proved to the investigation depth of 20m below ground. This latter material has been attributed to the London Clay Formation.

3.4 Hydrogeology

The Environment Agency classifies the London Clay as Unproductive Strata (formerly Non Aquifer), i.e. not capable of providing useable quantities of water; however this classification does not take into account local geological variations within the sandier upper London Clay Formation.

The Cretaceous Chalk is classified as a Primary (formerly Major) Aquifer however it is highly confined and not generally used for water supply in the central London area due to its poor water quality.

Groundwater beneath the Site will be dominated by fissure flow through Unit D of the upper London Clay Formation. Due to the nature of the London Clay, any groundwater flow will be at very low rates. Groundwater flow beneath the Site follows general topographic contours toward the south or southeast. This is parallel to the alignment of Daleham Gardens dwellings.

Groundwater was not encountered in any of the exploratory holes during boring and excavation and the material remained essentially dry throughout.

Geological logs show only occasional partings of silty fine sand within the clay. Falling head tests have confirmed the low permeability of the clay at around 3.5 x 10^{-8}m/s.

Groundwater was subsequently observed within monitoring wells installed at the Site (BH1, BH2, BH3 shown on Figure 1 of the SAS Ltd. report) with a rest water level at approximately 4.9m below ground. This is attributed to minor and delayed seepage to the monitoring wells from the London Clay formation.

4 Screening

The London Borough of Camden's "Guidance for subterranean development" suggests that any development proposal which includes a subterranean basement should be screened in order to determine whether there is a requirement for a BIA to be carried out.

4.1 Screening Discussion

Appendix E of the guidance document details the following six questions:

- **Question 1a: Is the site located directly about an aquifer?**

  No. London Clay is at outcrop, and this is not considered to be an aquifer.

- **Question 1b: Will the proposed basement extend beneath the water table surface?**

  The basement will extend into saturated London Clay formation. The proposed basement extends to a depth of approximately 6m below existing ground level. Monitoring standpipes installed during the site investigation showed water at 4.96m, 4.92m and 4.95m below ground approximately three weeks after installation (August 2011). Therefore in summer conditions, the basement can be expected to extend 1m into saturated medium. In winter conditions, the groundwater level can be expected to rise. Refer to Section 3.4.

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

  No. Refer to Section 3.2.

- **Question 3: Is the site within the catchment of the pond chains on Hampstead Heath?**

  No. The Site is approximately 1km south and outside the catchment of Hampstead Heath ponds.

- **Question 4: Will the proposed development result in a change in the proportion of hard surfaced / paved area?**

  Yes. A roof terrace is proposed with a surface area of 55m^2. The drainage from the Site will be directed to public sewer via a storm attenuation tank.

- **Question 5: As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to ground (e.g. via soakaways and/or SUDS)?**

- No. The nature of the London Clay strata is unsuitable for receiving ground discharge.

- **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 (not just the pond chains on Hampstead Heath) or spring line?**

- No. There are no local ponds or spring lines present.

4.2 Screening Conclusions

The screening exercise has identified two potential issues which should be assessed:

1. The basement structure will extend into saturated London Clay formation.
2. An additional 55m^2 of hard surfaced area will be created in the form of a roof terrace which will extend above the basement on the rear ground floor.

5 Scoping and Site Investigation

Scoping is the activity of defining in further detail the matters to be investigated as part of the impact assessment. Potential impacts should be ascertained for each of the matters of concern identified during the screening process.

The investigation of the potential impacts is undertaken through a site investigation. In this instance, a site investigation has been undertaken to establish ground conditions for geotechnical and land contamination assessment purposes. The investigation included the installation of groundwater monitoring points and falling head testing. This groundwater impact assessment relies upon the findings of the site investigation.

5.1 Potential Impacts

The following potential impacts have been identified:

Potential Impact	Relevant Site Investigation conclusions
The basement structure may extend into saturated ground. The groundwater flow regime may be altered by the proposed basement. Changing is 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 the degree of dampness or seepage may potentially increase as a result of changes in groundwater level.	The ground investigation has confirmed the presence of London Clay at outcrop. It has also confirmed saturated water levels within the London Clay formation, and that the basement is likely to extend into this water table. The London Clay is not considered to be an aquifer and will not store or transmit significant quantities of groundwater.
An additional 55m2 of hard surfaced area will be created in the form of a roof terrace which will extend above the basement on the rear ground floor. The sealing off of the ground surface by pavements and buildings to rainfall will result in decreased recharge to the underlying ground. In areas underlain by an aquifer, this may impact upon the groundwater flow or levels. In areas of non-aquifer (i.e. the London Clay), this may mean changes in the degree of wetness which in turn may affect stability.	The ground investigation has confirmed the presence of London Clay beneath the Site, a non-aquifer. Falling head tests have demonstrated that soakaway drainage is not appropriate for the Site.

6 Groundwater Impact Assessment

The screening process identified two potential impacts. The results of the site investigation have been used below to revisit the original concerns and to assess the likelihood of these impacts occurring. These are:

1. Altering of the groundwater flow regime.

It has been established that the basement will extend into saturated soils. The potential impact of this is that the groundwater regime may be altered. However, it is apparent from the site investigation that the geological formation into which the basement will be installed is not an aquifer as defined by the Guidance. The hydrogeological properties of the London Clay are such that groundwater is not present in significant quantities.

Additionally, the basement will extend only a few meters (possibly 2 or 3 depending on winter water levels) into the saturated clay, which is believe to be in excess of 100m thick at this location. When considering the shape of the basement, and the orientation with respect to groundwater flow, the structure will occupy only a minor fraction of the total width of the Site. Damming of any groundwater is therefore unlikely to occur.

It is therefore highly unlikely that the proposed development will result in significant changes to the groundwater regime beneath the Site.

2. Altering of the recharge rate or changes in the degree of wetness through the installation of additional hard surfaces and/or soakaway

As discussed above, the site investigation has demonstrated that the Site is located on a non-aquifer as defined by the Guidance. Recharge to the London Clay is likely to be negligible. In addition, the properties of the London Clay negate the possibility of discharging drainage to ground.

Due to the nature of the soils beneath the site, groundwater recharge is unlikely to be affected by the proposed development. Drainage from the development will be directed to public sewer via a storm attenuation tank, and therefore the degree of wetness of local soils will be unaffected by the development.

16 Daleham Gardens
Groundwater Impact Assessment

7 Review and Decision Making

A groundwater impact assessment of the proposed development has been undertaken. The assessment has been based on information and guidance published by the London Borough of Camden[3] and on site investigation information[1,2].

Potential impacts have been identified and assessed.

It is concluded that the proposed development is unlikely to result in significant changes to the groundwater regime beneath the Site.

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