6.5 Foundation considerations

In a city development there are several key issues that must be considered. Neighbouring and adjoining structures may require permanent or temporary support during the demolition and construction works. Highways and utilities may similarly be sensitive to ground movement arising from demolition and construction activity due to the effect of both short and long term heave or settlement. The level of the existing groundwater will also influence the method of retaining wall construction (see 6.5.4).

The unloading and reloading of the existing sub-soils has the potential to influence a wide area and the amount of heave and settlement needs to be predicted over time to provide assurances that neighbouring properties, highways and utilities will not be impaired. This will require an assessment of the existing and proposed loading.

The presence of a high groundwater table is an important consideration with regard to foundation construction. Construction problems can arise from the ingress of water. The selection of the method of construction must take account of the presence of the existing retaining walls and foundations, the need to limit ground movements and the practical limits on the structural performance of the walls themselves.

Due to the large amount of overburden removed to form the new basement, there is scope to provide a so-called balanced foundation whereby the weight of the building is compensated by the weight of the soil removed limiting the change of stress within the ground in the permanent condition. Given the volume of soil to be removed, the resulting situation may be classified as over-compensated requiring careful consideration of heave effects not just in the temporary but also the permanent condition.

The information provided in the following sections is necessarily preliminary and may be subject to change as a more detailed assessment of potential foundation design is undertaken.

6.5.1 Existing foundations

The record information suggests that existing foundations and services will be present beneath the site at a depth of approximately 3.5-4.0m below ground level. Current record information indicates that the existing masonry building was founded on spread footings. It is not possible to reuse the existing foundations due to the increased depth and size of the proposed new basement. The foundations of adjacent structures may cause obstruction to the new basement wall construction which require exploration with trial holes prior to confirming the foundation design.

Along the Kings Road facade are a series of pavement vaults which stretch out some 3-4m beneath the road. As these lie outside the site boundary they cannot be incorporated into the proposed building design and will require infilling to ensure they remain stable.

6.5.2 Made ground

The structure will not be founded on Made Ground as the proposed basement formation level will likely be in the Kempton Park Terrace Gravel or below the London Clay horizon. If local shallow foundations are required then the made ground will be removed and replaced with a more appropriate formation material.

6.5.3 Groundwater

As the basement will be to be formed through the Terrace Gravels, it is likely be subjected to potential water ingress from perched groundwater. A suitable method of minimising water entry to the excavation and retaining the surrounding soils will be required. Groundwater flows present in particular the risk of washing fines from the adjacent soil matrix which can have a detrimental effect on the integrity and bearing capacity of the adjacent ground. The detailing of the waterproofing will vary depending on the retaining wall construction (see 6.5.4). Further details of the anticipated groundwater at the site are contained in Section 6.3.2. It is recommended that an allowance for de-watering is made within the Preliminary cost plan.

6.5.4 Basement box

It is at present understood that the existing basement will be deepened and extended.

The construction of the proposed basement will present an engineering challenge likely to require the use of embedded retaining walls (sheet piling, secant piling or skin walls) to provide temporary and permanent lateral support to the ground. Existing neighbouring foundations may complicate these issues and therefore careful consideration of the construction sequence will be required to mitigate these risks.

Sheetpiles can be installed by various means including vibratory and jacking (push-pile) techniques through to fully driven installation. It is likely that push-pile techniques would be preferred in order to minimise noise & vibration with the potential to effect adjacent buildings and installations. To achieve sheetpiling through dense gravels ‘water jetting’ is required which can cause heave or settlement issues to the adjacent land if not managed properly. The dense gravels shown from adjacent boreholes may require preaugering to be undertaken. In such ground conditions sheet piled solutions may not be appropriate subject to the detailed findings of the geotechnical site investigation.

Secant piling can provide an enhanced resistance to water ingress compared to other techniques and would also generally provide greater rigidity and stiffness compared to a sheet-piled solution, which may offer better control of potential ground movements. Contiguous piles may also be used where ground water flows are less of a concern.

Skin walls/underpinning can achieve reduced structural zone and maximise basement capacity by using internal plunge columns as propping. The internal wall then can provide greater rigidity and stiffness than a secant piled wall of similar thickness.

It is anticipated that a combination of embedded retaining wall systems such as secant pile or skin wall will be most appropriate. Advice should be sought also from the project cost consultant to help inform the choice of wall construction.
6.5.5 Spread foundations

The principle considerations in the assessment of the viability of spread footings are the magnitude of the applied loads and the sensitivity of the structure to settlement. Spread foundations range from localised pad footings, through to combined footings and on to full raft foundations. Given the ground conditions on site, a raft foundation would be most suitable to a development of this size, allowing stresses to be spread over the largest area possible while maintaining a greater inherent capacity to limit differential settlement.

The raft would be founded at depth within the London Clay (which would need to be confirmed through a site specific ground investigation). Raft foundations require extensive soil and structural analysis, which would be undertaken during subsequent design stages in order to confirm the viability and construction details of such a foundation solution.

6.5.6 Piling

An alternative solution to a raft foundation is the use of piled foundations which generally offer reduced overall settlement and may allow the proposed structure to be isolated from the effects of heave in the clay. Straight shafted augered bored piles are routinely used to mobilise skin friction and end bearing in the London Clay. Arisings from the boring operation can either be re-used on site as fill material (subject to suitable geotechnical assessment) or, more usually, removed from site.

Below ground obstructions may be encountered during the foundation works. Multiple piles are considered to be a more flexible solution and more easily adapted to changes in layout if ground obstructions are encountered. A single large pile strategy is generally a much less flexible solution but can offer an economic solution in the case of heavily loaded piles or where access is restricted.

The safe loading capacity of the piles will be dependent upon the pile type, their founding depth, the method of installation adopted and the immediate ground conditions.

Considerations such as vibration and its effect on nearby structures, the potential need for casing bored piles due to water ingress, the possible need for chiselling due to cobbles or boulders, and potential environmental issues will all define the type of pile to be used.

6.5.7 Contamination and foundation construction

During the site investigation and subsequent construction of the foundations, a visual appraisal of ground contamination is recommended. If any visual or olfactory evidence of contamination is recorded, a geo-environmental consultant should be appointed to guide the foundation works and any additional site investigation works that may become necessary.

Excavations in such a confined environment should be adequately ventilated.

6.5.8 Trees

The proximity of existing trees or planted areas could represent a problem to the proposed development as they can cause both direct and indirect damage to the structure. The site has no trees immediately adjacent to it however there is a large tree outside the bank at 226 Kings Road (approx. 15m) and smaller recently planted trees outside the Waitrose at 196 Kings Road (approx. 7m).

Direct damage would include items such as disruption of underground services, the displacement, lifting or distortion of hard standing areas or structure, the impact of branches on the superstructure or collapse of a tree. Shrinkage and swelling of a clay subsoil can cause indirect damage.

Small diameter piles may offer the possibility to reduce the risk of striking major tree roots. This also reduces the size of the rig required to carry out piling works.

Trench works can damage tree roots and change the local soil hydrology which consequently affects the tree’s health. Particular care is required when trenching close to a tree. Heave can take place in a clay soil when moisture content rises. Swell occurs after the removal of a tree. This can also happen beneath the building if parts of the tree roots are damaged during construction works.

Manufactured products such as void former and compressible material can protect foundations from the effects of heave where suspended structures are utilised.

6.6 Construction within Archaeological remains

The archaeological sensitivity of the site is unknown and the Client requires confirmation by the Local Authority and other relevant bodies, such as Museum Of London Archaeology (MOLA) as to the importance of the site. It should be noted that there is already basement beneath a large portion of the existing structure which is probably founded in the terrace gravels and may have voided any remains previously in situ.

In general, there are engineering principles to reduce the impact of construction on the archaeological heritage:

- Minimise the extent of excavation required for the construction
- Minimise the number of vertical penetrations
- Minimise the extent of excavation required for the foundations

Activities such as level reduction, new basement and foundation construction, new service trenches or demolition works for example will raise archaeological issues. As the new basement is fundamental to the viability of the development, there are limited opportunities to reduce the archaeological impact. If the site is determined to be archaeologically sensitive an advanced period of archaeological investigations might be expected with a continuing watching brief during excavation and piling works.
Environmental assessment

7.1 Introduction

The aim of this part of the report is to provide an initial assessment of the environmental conditions of the site as well as the potential contamination of the site including ground and water sources.

Additionally, the objective is to characterise the contaminants, their pathways and potential receptors for the purpose of a risk assessment. This aims also to provide relevant information to worker health and safety and to the protection of the environment.

Information on the potential contaminants that could be present within the ground can come from many sources; historical maps, Environment Agency, Envirocheck Report, RBKC etc.

Contamination may arise from a wide range of activities on the site or off-site. This may include:

- Heavy industries
- Electric substations, power stations, gas works, etc.
- Chemical plants and facilities utilising aggressive chemicals
- Landfill sites, recycling or disposal sites
- Railway sidings
- Works including finishing processes (plating, painting, etc.)
- Fuel storage facilities, garages, etc.
- Former mining sites
- Ministry of Defence sites
- Timber treatment works
- Sewer farms or sewage treatment plants

During a site walkover, suspect soils may be identified by sight and olfactory observations provided the soils are accessible. Some obvious signs of contamination include, but are not limited to:

- Soil discoloration
- Unusual or different soil texture
- Unusual odour
- Standing water or trench with hydrocarbon sheen
- Abandoned industrial waste such as drums or asbestos sheeting

None of the above was recorded during the site visit, although it is noted that the majority of areas are currently covered by hardstanding.

7.2 Statutory information

AKT II instructed Envirocheck to carry out a search of their records and report on the following aspects:

**Water:**
- Abstractions and discharge consents
- Red-list discharge consents
- Pollution incidents and prosecutions relating to controlled waters
- Groundwater vulnerability and river quality

**Waste:**
- Landfill sites (historical and current)
- Waste water treatment or disposal and transfer sites
- IPC registered waste sites

**Statutory controls:**
- Integrated pollution and air pollution controls
- Prosecutions relating to authorised processes
- Enforcement and probation notices
- Planning hazardous substance consents and enforcements
- COMAH, NIHHS and explosive sites

The following is a factual summary of the information obtained from the Envirocheck search (appendix B) and the RBKC search (appendix G).

**A Discharge Consent was found located 553m South East of the site from sewage discharge storm overflow. Seven other discharge consents were located within 2km of the site. All sites are associated with either dry cleaning or petrol filling stations.**

**The Nearest Surface Water Feature is 512m of the site to the South East which is the River Thames.**

**Fourty two Registered Radioactive Substances were found located between 200m and 500m of the site. This is due to the close proximity of the Royal Brompton and Harefield NHS Trust and The Royal Marsden Hospital.**

**Two Water Abstractions are located within 50m of the site down Chelsea Manor Street. A further 69 Water Abstractions were found located within 2km of the site.**

**The site was found to have Groundwater Vulnerability with soils of high leaching potential. A worst case vulnerability classification (H) assumed, until proved otherwise.**

**There are no current or former landfill sites, within a 500m radius of the site.**

**Two fuel filling station entries were found located within 1km of the site. The closest is located 448m North of the site. There have been two underground storage tanks at Britten Street 18m away and the old Chelsea Fire Station 174m.**

**A number of contemporary trade directory entries were found in close vicinity to the site including dry cleaners, manufacturers, photographic processors, car dealers all located within 400m of the site.**

**The site is not in a radon affected area, as less than 1% of the homes are above the action level. BRE document 211: Radon, Guidance on Protective Measure for New Dwellings 1999.**

**The site does not lie within a nitrate vulnerable zone defined by the Department for Environment, Food and Rural Affairs (DEFRA). Nitrates Vulnerable Zones are designated areas of land draining into waters polluted by nitrates from agriculture.**
7.3 Water quality

The site is not located within an Environment Agency designated source protection zone (SPZ).

7.4 Contamination from unexploded bombs

The London Bomb Damage maps indicate that bombs did fall on and around the site giving an elevated risk that UXO will be found. Common forms of contamination from unexploded bombs include:

- Heavy metal (Copper, Zinc etc) contamination from the bomb’s casing.
- Organic aromatics (Toluene, Nitrosamines, daughter products etc) contamination from the degradation of the explosive charge.
- Heavy metal (Lead, Mercury) contamination from the degradation of the detonator charge.

7.5 Radon

The site is not in a radon affected area, as less than 1% of the homes are above the action level. BRE document 211: Radon, Guidance on Protective Measures for New Dwellings - 1999.

7.6 Land Contamination Assessment

An environmental investigation has not yet been undertaken for the site. There are adjacent sites which could have caused contamination historically including a garage, dry cleaners and a hospital. The land use taken from record information of 202-222 Kings Road has not indicated any industry which is known to be at a high risk for contamination.

7.6.1 Potential contamination sources

Potential contamination sources and their form (solid, liquid, and gas) are presented below:

- There is the potential for ground gas from unknown deposits left by historical land uses on and around the site.
- The presence of ash and clinker may be indicative of potential contamination with arsenic, cadmium, copper, lead, nickel, zinc and PAH.
- Additionally, it is possible that some of the building may contain asbestos as they appear to have been built or refurbished during the period in which asbestos was widely used across the industry. Necessary measures should be taken to deal with this hazard during the design and demolition phase.

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The site is not located within an Environment Agency designated source protection zone (SPZ).

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- Additionally, it is possible that some of the building may contain asbestos as they appear to have been built or refurbished during the period in which asbestos was widely used across the industry. Necessary measures should be taken to deal with this hazard during the design and demolition phase.
7.6.2 Potential contamination migration

If potentially polluting activities have taken place historically at a site, the hazard to human and/or environmental receptors will be increased if significant pathways are, or were historically present on or beneath the site along which contaminants can preferentially migrate. Pathways can be anthropogenic (artificial) or natural.

7.6.2.1 Potential natural pathways

The Envirocheck Aquifer maps in Figures 23 & 24 indicates that the site is underlain by a underproductive bedrock strata. Terrace Gravel deposits, which are classified as a Secondary Superficial Aquifer are located above. The potential for significant contamination migration through the Terrace Gravel is considered to be moderate. The underlying London clay should act as an impermeable barrier below the site to prevent the deeper penetration of contaminants into the ground.

The incorporation of permanent hardstand within the development such as car parking areas, concrete hardstanding and tarmac paths can be used to demonstrate a breakage in pollutant linkage pathway to cause harm to human health. This would break the source, pathway, receptor pollutant linkages. This can limit contact with non-organic pollutant that do not readily volatise such as arsenic, lead, copper, nickel and also some PAH. However, increasing the hardstanding nature of the landscape would seriously increase the surface water runoff from the site and contradict sustainable drainage measures and surface water infiltration.

7.6.2.2 Potential anthropogenic pathways

Anthropogenic pathways for contaminant migration can be present in the form of soakaways, land drains, etc. Leaking surface water or foul drainage pipes and permeable backfill to the trenches containing services could also act as preferential pathways for potential contaminant migration.

Given the anticipated high ground water levels, it is unlikely that soakaways and other ground infiltration systems were historically present at the site. It is probable that surface water and foul water are carried from the site in the public sewage and highway drainage systems. It should be noted that that a survey of on-site drains was not undertaken as part of this investigation.

7.6.3 Potential receptors

The potential receptors identified could be one of the following categories:

**Humans**
- Construction site workers, future site users, visitors and maintenance staff.

**Property**
- Foundations, basement structure and services
- High minor aquifer: Upper Chalk and Thanet Sands
- River Thames 500m to South

7.7 Summary and recommendations

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Potential sources</th>
<th>Pathways</th>
<th>Risk</th>
<th>Justification/Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Health</td>
<td>Contaminated soils</td>
<td>Direct contact, ingestion, inhalation</td>
<td>Moderate</td>
<td>Elevated concentration of contaminants have been identified in the surface made ground during the Envirocheck Consulting Report. No contamination sources identified during site walkover. Made ground to be removed from site as part of development of basement. Due to the hardstanding nature of the proposed development, the risk to future site users is considered to be low.</td>
</tr>
<tr>
<td>Construction workers</td>
<td>Contaminated soils</td>
<td>Direct contact, ingestion, inhalation</td>
<td>Moderate</td>
<td>Elevated concentration of contaminants have been identified in the surface made ground in the Envirocheck Consulting Report. Also potential for contamination around below ground fuel oil tank which requires additional contamination testing. Standard health and safety precautions likely to be implemented during any below ground works.</td>
</tr>
<tr>
<td>Existing and future site users and maintenance staff</td>
<td>Ground gas</td>
<td>Inhalation</td>
<td>Low</td>
<td>The proposed basement should be adequately ventilated to inhibit the build up of ground gases</td>
</tr>
<tr>
<td>Construction workers</td>
<td>Ground gas</td>
<td>Inhalation</td>
<td>Low</td>
<td>Any excavations should be adequately ventilated and appropriate risks assessments completed</td>
</tr>
<tr>
<td>Construction workers</td>
<td>Asbestos</td>
<td>Direct contact, ingestion, inhalation</td>
<td>Medium</td>
<td>Carry out asbestos assessment survey before any demolition works.</td>
</tr>
<tr>
<td>Construction workers</td>
<td>Asbestos</td>
<td>Direct contact, ingestion, inhalation</td>
<td>Medium</td>
<td>Carry out asbestos assessment survey before any demolition works.</td>
</tr>
<tr>
<td>Property</td>
<td>Contaminated soils</td>
<td>Migration through soils</td>
<td>Low</td>
<td>The proposed two storey basement should be adequately ventilated to inhibit the build up of ground gases</td>
</tr>
<tr>
<td>Controlled waters</td>
<td>Contaminated soils and groundwater</td>
<td>Soil leaching and migration of contamination</td>
<td>Low</td>
<td>The nearest watercourse was situated 500m from the site but has now been culverted into a sewer. The River Thames is situated 2km away.</td>
</tr>
<tr>
<td>High Minor Aquifers</td>
<td>Contaminated soils and groundwater</td>
<td>Rainfall infiltration, soil leaching and migration of contamination</td>
<td>Low</td>
<td>The Terrace Gravel is not utilised for groundwater abstraction within 2km of the site.</td>
</tr>
</tbody>
</table>

Table 6: Contamination risk assessment