Short Term Movements

Sensitive Structure	Structure Reference	Category of Damage*
Salvation Army Citadel	A	Category 0 - Negligible
	B	Category 0 - Negligible
	C	Category 1 – Very Slight
	D	Category 0 - Negligible
Haverstock School	E	Category 0 - Negligible
	F	Category 0 - Negligible
	G	Category 0 - Negligible
Chalk Farm station	H	Category 0 - Negligible
	I	Category 0 - Negligible
	J	Category 0 - Negligible
Depot adjacent to Chalk Farm station	K	Category 0 - Negligible

** From Table 6.4 of C760[1]: Classification of visible damage to walls.*

Total Movements

Sensitive Structure	Structure Reference	Category of Damage*
Salvation Army Citadel	A	Category 0 - Negligible
	B	Category 0 - Negligible
	C	Category 0 - Negligible
	D	Category 0 - Negligible
Haverstock School	E	Category 0 - Negligible
	F	Category 0 - Negligible
	G	Category 0 - Negligible
Chalk Farm station	H	Category 0 - Negligible
	I	Category 0 - Negligible
	J	Category 0 - Negligible
Depot adjacent to Chalk Farm station	K	Category 0 - Negligible

**From Table 6.4 of C760[1]: Classification of visible damage to walls.*

The analysis has predicted that the proposed basement construction may result in a building damage category for sensitive structures of between Category 0 (negligible) and

Category 1 (Very Slight). These movements are within the acceptable limits outlined in the draft version of CPG4 and in accordance with the Camden Local Plan.

Movements may be controlled to a wider extent during construction, through control of workmanship during the sequence of wall construction. It is recommended that the foundation depths of nearby structures are confirmed.

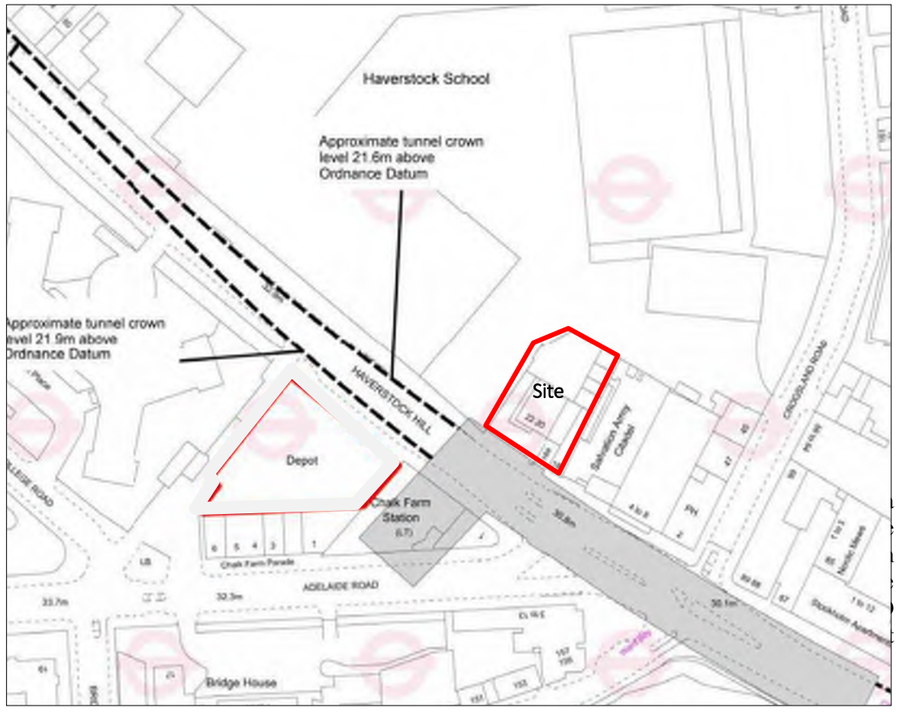
9.3.2 Monitoring of Ground Movements

The predictions of ground movement based on the ground movement analysis should be checked by monitoring of adjacent properties and structures. The structures to be monitored during the construction stages should include all of the sensitive structures included within the assessment. Condition surveys of the existing structures should be carried out before and after the proposed works.

The precise monitoring strategy will be developed at a later stage and it will be subject to discussions and agreements with the owners of the adjacent properties and structures. Contingency measures will be implemented if movements of the adjacent structures exceed predefined trigger levels. Both contingency measures and trigger levels will need to be developed within a future monitoring specification for the works.

10.0 TUNNEL MOVEMENTS

The proposed basement extension will be in close proximity to the southbound tunnel of the Northern line of the London Underground which runs below Haverstock Hill, adjacent to the site. The plan below shows the location of the tunnel in relation to the site.



The analysis has been carried out using the Oasys P-Disp software. The tunnel has been modelled at four discrete reference points; the crown level, invert level, and the widest points along the northern and southern walls. The four points have been modelled at roughly 1.0 m intervals.

The analysis assesses the change in vertical movement of the four reference points in order to determine the differential movement, if any, across the tunnel structure. The analysis also provides an assessment of the vertical stress and strain along the crown level of the tunnel.

Short term movement

Tunnel Reference Point	Maximum Vertical Displacement (mm)	Maximum Vertical Stress (kN/m²)	Maximum Vertical Strain (%)
Crown	1.22	-5.44	7.21×10^{-5}
Invert	1.37	-9.37	3.47×10^{-5}
/Northern side wall	1.81	-11.45	4.85×10^{-5}
Southern side wall	0.96	-5.18	4.73×10^{-5}

Total movements

Tunnel Reference Point	Maximum Vertical Displacement (mm)	Maximum Vertical Stress (kN/m²)	Maximum Vertical Strain (%)
Crown	1.70	-3.72	-3.95×10^{-5}
Invert	1.53	-5.55	-6.10×10^{-5}
Northern side wall	2.10	-6.89	-8.36×10^{-5}
Southern side wall	1.31	-3.29	-3.22×10^{-5}

A total displacement of 2.1 mm is likely to fall within LUL tolerances, although this should be confirmed by LUL.

11.0 CONCLUSIONS

The analysis has predicted that the proposed installation of the retaining walls and excavation of the proposed basement may generally result in building damage for sensitive structures of Category 0 (negligible) and Category 1 (very slight), which fall within acceptable limits according to the Camden Planning Guidance (CPG4).

The separate phases of work, including excavation of the proposed basement, will in practice be separated by a number of weeks during which time construction of permanent supports, basement raft and retaining wall curing will take place. This will provide an opportunity for the ground movements during and immediately after retaining wall construction to be measured and the data acquired can be fed back into the design and compared with the predicted values. Such a comparison will allow the ground model to be reviewed and the predicted wall movements to be reassessed prior to the main excavation taking place so that propping arrangements can be adjusted if required.

Part 4: BASEMENT IMPACT ASSESSMENT

This section of the report evaluates the direct and indirect implications of the proposed project, based on the findings of the previous screening and scoping, site investigation and ground movement assessment.

12.0 INTRODUCTION

The screening identified a number of potential impacts. The desk study and ground investigation information has been used below to review the potential impacts, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

10.1 Potential Impacts

The table below summarises the previously identified potential impacts and the additional information that is now available from the ground investigation in consideration of each impact.

Potential Impact	Site Investigation Conclusions
London Clay is the shallowest stratum at the site. Seasonal shrink-swell can result in foundation movements.	The London Clay is the shallowest stratum at the site. Shrinkable clay is present within a depth that can be affected by tree roots, and desiccation of the clay soils was noted and should be bypassed. New foundations will need to be designed in accordance with NHBC guidelines to protect from future shrinking and swelling associated with tree removal / growth. Subject to inspection of foundation excavations in the normal way.
Damage to trees – heave of clay soils.	Damage to tree roots during construction works may lead to the death of trees, which would result in long term swelling of the clay, this could lead to structural damage of neighbouring properties and the new building on site. An arboriculturist should be consulted for advice, along with the tree officer at the Local Authority, to ensure damage does not occur.
The site is located within 5 m of a highway or pedestrian right of way	The investigation has not indicated any specific problems, such as weak or unstable ground, voids or a high water table that would make working within 5 m of public infrastructure particularly problematic at this site. A retention system will be adopted that maintains the stability of the excavation at all times.
Different founding depths relative to neighbours.	A ground movement assessment will be carried out to confirm movements that may affect neighbouring structures as a result of demolition of the existing building and construction of the new building and the results will be discussed in Section 3 of this report.
The location of the Northern Line Underground tunnel	A ground movement assessment will be carried out to confirm movements that may affect the tunnel as a result of demolition of the existing building and construction of a new building and the results will be discussed in Section 3 of this report. Consultation will be required with LUL prior to commencement.

The results of the site investigation have been used below to review the remaining potential impacts, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

Seasonal Shrink-Swell / the London Clay is the shallowest stratum at the site.
Shrinkable clay of the London Clay is present below the site and damage is noted on site to the existing building and boundary walls. Numerous trees are present to the northwest of the site and desiccation was noted within two boreholes, drilled in close proximity to existing trees. The proposed single level basement is likely to extend below the potential depth of root action, but this should be confirmed once proposals have been finalised. Heave protection measures should form part of the final proposals.

Tree protection orders.
A check should be undertaken by an arboriculturist to ensure that the proposals do not damage tree roots which could lead to death of the trees and long term swelling of clay, which could lead to structural damage on site. Foundations of the proposed basement should extend beyond the zone of tree root activity.

The site is located within 5 m of a highway or pedestrian right of way.
The site is located within 5 m of Haverstock Hill to the southwest of the site. A retention system will need to be adopted that maintains the stability of the excavation at all times to protect the highways. This is however standard construction practice.

Differential founding depths relative to neighbouring properties.
The proposed basement will extend to a significant depth relative to the existing foundations of the neighbouring properties and the proposed retaining walls will need to be designed to ensure the stability of the site and any potentially sensitive structures that are in close proximity to the site. Appropriate propping and temporary works installed during basement construction will limit the effect of ground movements on the surrounding properties.

Location of the Northern Line Underground tunnel.
The proposed building and basement are within the zone of influence of the Northern Line Underground tunnel. The proposed retaining walls and foundation method will need to be designed to ensure the stability of the site and limit the effect on the tunnel. Appropriate propping and temporary works installed during basement construction will limit the effect of ground movements on the tunnel.

12.2 Non-Technical Summary of Evidence

This section provides a short summary of the evidence acquired and used to form the conclusions made within the BIA.

12.2.1 Screening

The following table provides the evidence used to answer the subterranean groundwater screening questions.

Question	Evidence
1a. Is the site located directly above an aquifer?	Aquifer designation maps acquired from the Environment Agency as part of the desk study and Figures 3, 5 and 8 of the Arup report.
1a. Is the site located directly above an aquifer?	Aquifer designation maps acquired from the Environment Agency as part of the desk study and Figures 3, 5 and 8 of the Arup report.
1b. Will the proposed basement extend beneath the water table surface?	Previous nearby GEA investigations.
2. Is the site within 100 m of a watercourse, well (used/ disused) or potential spring line?	Historical maps acquired as part of the desk study and Figures 11 and 12 of the Arup report.

Question	Evidence
3. Is the site within the catchment of the pond chains on Hampstead Heath?	Figures 12 and 14 of the Arup report.
4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	A site walkover and existing plans of the site have confirmed the proportions of hardstanding and soft landscaping, which have been compared to the proposed drawings to determine the changes in the proportions.
5. 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)?	The details of the proposed development do not indicate the use of soakaway drainage.
6. 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?	Topographical maps acquired as part of the desk study and Figures 11 and 12 of the Arup report.

The following table provides the evidence used to answer the surface water flow and flooding screening questions.

Question	Evidence
1. Is the site within the catchment of the pond chains on Hampstead Heath?	Figures 12 and 14 of the ARUP report.
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?	A site walkover and existing plans of the site have confirmed the proportions of hardstanding, which has been compared to the proposals to work out any proposed changes in hardstanding.
3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	
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?	
5. Will the proposed basement result in changes to the quantity of surface water being received by adjacent properties or downstream watercourses?	
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?	Flood risk maps acquired from the Environment Agency as part of the desk study, Figure 15 of the Arup report, the Camden Flood Risk Management Strategy dated 2013 and the North London Strategic Flood Risk Assessment dated 2008.

The following table provides the evidence used to answer the slope stability screening questions.

Question	Evidence
1. Does the existing site include slopes, natural or manmade, greater than 7°?	Site survey drawing and Figures 16 and 17 of the Arup report and confirmed during a site walkover
2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7°?	The details of the proposed development provided do not include the re-profiling of the site to create new slopes.
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	Topographical maps and Figures 16 and 17 of the Arup report and confirmed during a site walkover
4. Is the site within a wider hillside setting in which the general slope is greater than 7°?	