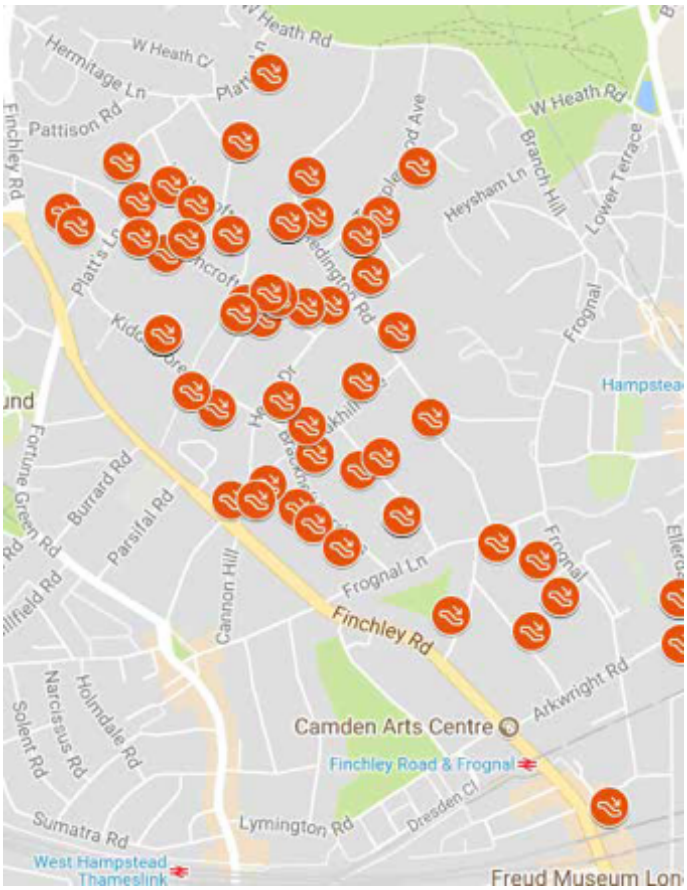
DI Soil Depths

Underground Development and Green Infrastructure Impacts

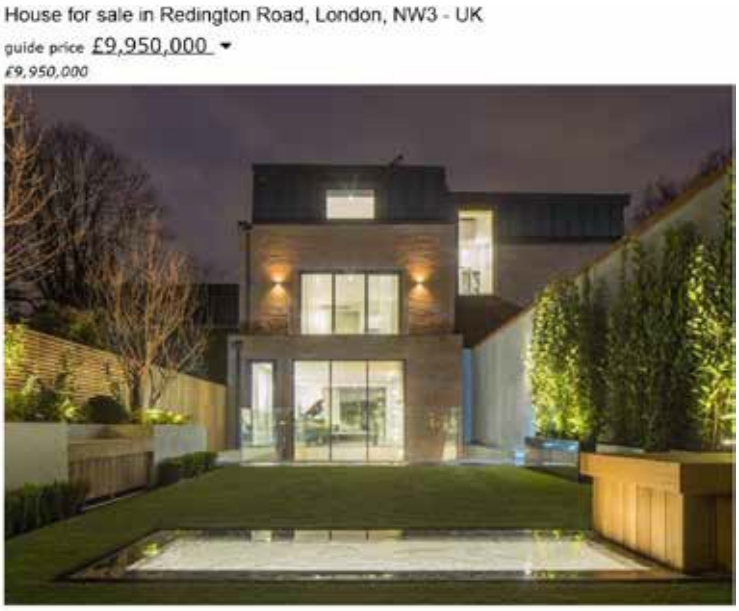
Between 1 January 2010 and 28 October 2017, data from Camden's Socrata website indicate that consents were granted for 123 basement excavations in the Redington Frognal Conservation Area.

Map DI 1 Consented Basement Excavations in the Redington Frognal Conservation Area, 1.1.10 to 28.10.17



Source: Socrata Open Data API

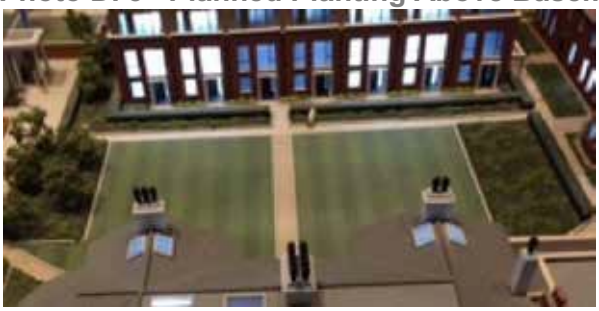
Photo DI 1 Biodiverse-Free Garden with Light Pollution Above Basement at 38 Redington Road



In order to excavate the basement car park at Hampstead Manor (the former Westfield College site), some 38 mature trees were felled. Planned replacement planting is comprised of shrubs and a lawned area, the soil depth of 1 metre being insufficient to sustain large-canopy species.

Photo DI 2 Existing Large Canopy Mature Trees in Deep Soil at Hampstead Manor

Photo DI 3 Planned Planting Above Basement Car Park at Hampstead Manor



During excavation works it is typical for almost the entire garden area, minus the perimeter buffer, to be dug up and removed offsite. This has been observed at the Barratt and Mount Anvil construction sites (the latter designated SINC CaB1109), both in Kidderpore Gardens (2014 to 2018), where almost all the vegetation (except on the far perimeters) has been removed, and the sites left bare for the duration of the works.

The main consequence in the short-term (during construction) will be the removal of habitat for microrganisms, invertebrates, birds, reptiles, amphibians and small mammals. As some animals are territorial, this will create knock-on effects on local populations. If the works occur during breeding or nesting season, the removal of the nesting sites could result in a lost generation and/or severe stress on the breeding animal if they have to reproduce again in the same season. Such disturbance could also result in the breeding pairs abandoning the site never to return. Likewise, in the winter season, the works could disturb hibernating animals (this includes overwintering insects as well as small mammals). The energetic costs of being roused from hibernation are often lethal for the animals, as they generally cannot replenish their reserves in the winter months.

The removal and relocation of the soil also has a more permanent impact on its micro-organisms and invertebrate populations. If the soil is taken away and redistributed to other sites, potentially in other regions, this will impact on the natural distribution of those animals. For example, construction work on the south side of Kidderpore Avenue saw the rehoming of bats in Royston[1].

3.7.2 Soil Depth, Volume and the Potential for Tree Planting

The importance of retaining a soil depth, which is sufficient to support large canopied species to survive to reach maturity (or their full potential) is critical not only to biodiversity, but also to retaining the character and setting of the conservation area, and to facilitate a healthy age structure. Greater leaf canopies generally also afford improved carbon storage and capacity for sequestering carbon and filtering airborne particulates, as well as commanding enhanced CAVAT values.

Dr. Andrew D. Hirons, Senior Lecturer in Arboriculture at University Centre Myerscough advises that tree roots are often found beyond a depth of 1 metre [2]. Soil volume is key to achieving a good quality rooting environment and species such as oak can have a water requirement of 100 litres per day. In the book "Applied Tree Biology"[3], Dr. Hirons and Dr. Peter A. Thomas note that,

> *"to reach their potential for shade, rainfall management, noise reduction and carbon sequestration, trees must have sufficient water available for uptake within the rooted soil volume for growth and for transpiration."*

This necessitates a soil volume of 10 cubic metres or more and, on average 20 to 30 cubic metres of soil per tree, with an open surface to enable oxygenation of the soil[4].

Similarly, studies such as the *Kew Wind Blown Tree Survey* by Gasson and Cutler (1990), show that 56% of trees surveyed had a root plate depth of below 1 metre, while an Arboricultural Advisory and Information Service research note[5] states that "All trees can develop a deep root system (2-3 metres deep) if soil conditions allow". However, this ability will be influenced by the capacity of different species to tolerate varying soil conditions.

Soil volumes and depths are set out by the London Borough of Islington in its Supplementary Planning Guidance (SPG) on Basement Development, in paragraphs 7.4.14 and 7.4.15. This provides for the following soil volumes according to tree size (as defined by *The Benefits of Large Species Trees in Urban Landscapes a Costing, Design and Management Guide,* CIRIA, 2012:

- small trees (ultimate height of 5 - 8m): a minimum of 10 m^3
- medium trees (ultimate height of 8 -15m): a minimum of 20 m^3
- large trees (ultimate height of 15m+): a minimum of 30 m^3

Soil rooting depths are stipulated as follows:

- small trees: a minimum of 1 metre
- medium trees: 2 metres
- large trees: 3 metres, in order to allow for adequate anchorage and hydrology during weather events (heavy rain/ water logging, drought conditions/ soil moisture deficit) to support tree health.

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1 Natural England reference TRM-2014-7164 B

2 Soil depth telephone conversations, 26.2.18 and 6.3.18

3 *Applied Tree Biology* by Andrew D. Hirons and Peter A. Thomas, pub. WILEY Blackwell, 2018

4 *Applied Tree Biology* by Andrew D. Hirons and Peter A. Thomas, pub. WILEY Blackwell, 2018

5 *Tree Root Systems* by Martin Dobson, 1995 https://www.trees.org.uk/Trees.org.uk/files/61/6181f2b7-e35d-4075-832f-5e230d16aa9e.pdf

A 2018 planning consent for a basement development in the City of London[6] required a soil depth of about 2 metres to ensure that the soil "provides sufficient depth (about 2m) over the basements for the growth and longevity of large trees."

The Royal Borough of Kensington and Chelsea notes, in its "Trees and Basements" review (February 2015):

> *"The physical root barriers, such as boundary walls, building foundations etc, typically found in this borough may restrict certain species from utilising soil beyond these constraints, which could greatly affect the health and vigour of many trees"* and
>
> *"when you consider the constraints on a newly planted tree above a basement in a walled garden with potentially limited soil volume available the scenario appears not too dissimilar to the many moribund town centre trees in planters. Providing a suitable growing medium for all species of trees may not always be possible above a basement one metre below ground level, especially where further rooting constraints exist beyond the basement footprint".*

Flooding due to lack of adequate drainage will greatly impact vegetation growth.

Research by the Royal Borough of Kensington and Chelsea[7] found that, "All applications for basements are likely to affect trees either on-site or nearby". Supplementary planning guidance has been drawn up in an attempt to protect trees from development[8].

3.7.3 Basement Size

The significance and value of private gardens to biodiversity and the area's character is formally accepted by the London Borough of Islington. In its Supplementary Planning Guidance (SPG) on Basement Development, adopted January 2016[9], paragraph 7.1.4 states that,

> *"Open space including private residential gardens contribute greatly to Islington's character as well as providing vital green infrastructure functions for the borough such as reducing surface water flood risk, providing important habitat and ecological connectivity, and contributing to the borough's biodiversity, urban cooling and adaptation to climate change. Private open spaces make up a significant proportion of Islington's open space. The piecemeal loss of these spaces due to incremental development such as large outbuildings and extensive basements within gardens has serious potential implications for the borough."*

For residential basement extensions, paragraphs 7.1.7 to 7.1.10 note that,

> *"For extensions to existing residential basements or the creation of new basement areas underneath and/or within the curtilage of an existing dwelling, the majority of original open area of the site should be retained, and the total area of basement beyond the original footprint must be subordinate to the original footprint of the dwelling."*
>
> and
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> *"The maximum extent will be measured separately for each garden/unbuilt upon area within the site, e.g. front, back or side."*

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6 http://democracy.cityoflondon.gov.uk/documents/s102906/Final Seething Lane Garden Outcome rpt.pdf

7 Basements Publication Planning Policy, Partial Review of the Core Strategy, February 2014 https://www.rbkc.gov.uk/pdf/63%20Markham%20Sq%20Res%20Asso-%20D.pdf

8 Royal Borough of Kensington and Chelsea Adopted Trees and Development SPD https://planningconsult.rbkc.gov.uk/consult.ti/trees.2009/viewCompoundDoc?partid=1322100

9 London Borough of Islington Supplementary Planning Document Basement Development, January 2016 https://www.islington.gov.uk/planning/planning-policy/supplementary-planning-documents/basement-development

"The remaining garden area/unbuilt upon area of the site should be designed to maximise garden and amenity functionality, providing useable amenity space and supporting biodiversity enhancement, to protect the garden setting and contribute to local character. In considering the design of a basement that extends into a garden/unbuilt upon area, a proposal should avoid fragmentation of spaces to deliver cohesive, useable and functional private open space."

The location of all basements should take account of leaving the unaffected portion of garden connected to other unaffected gardens and open space immediately adjoining the site, to ensure connectivity of these spaces is protected." "… margins should be left between basements and adjoining sites. This allows for space to enable natural surface water drainage and lateral ground water movement to occur between sites."

Research by the Royal Borough of Kensington and Chelsea also found the size of the basement to be directly correlated with the level of nuisance and disturbance to neighbours. Chapter 34 of the Local Plan, para 34.3.53 notes that,

"Restricting the size of basements will help protect residential living conditions in the Borough by limiting the extent and duration of construction and by reducing the volume of soil to be excavated. Large basement construction in residential neighbourhoods can affect the health and well-being of residents with issues such as noise, vibration and heavy vehicles experienced for a prolonged period. A limit on the size of basements will reduce this impact."

Carbon emissions are another reason for size restrictions, noted in para. 34.3.54.

"The carbon emissions of basements are greater than those of above ground developments per square metre over the building's life cycle [10], [11] … Limiting the size of basements will therefore limit carbon emissions and contribute to mitigating climate change."

Para 34.3.55 notes that [basements],

"can also introduce a degree of artificiality into the garden area and restrict the range of planting[12]. …… and "will enable natural landscape and character to be maintained, give flexibility in future planting (including major trees), support biodiversity[13] and allow water to drain through to the 'Upper Aquifer'[14]. This policy takes into account the London Plan[15] and the Mayor of London's Housing SPG 9[16] both of which emphasise the important role of gardens. The National Planning Policy Framework (NPPF)[17] also supports local policies to resist inappropriate development of residential gardens and excludes private gardens from the definition of previously developed land."

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10 Life Cycle Carbon Analysis of Extensions and Subterranean Development in RBKC, Eight Associates, February 2014 https://www.rbkc.gov.uk/pdf/E642 RBKC FinalReport 1402-10RM lores.pdf

11 Life Cycle Analysis (LCA) is a methodology for assessing the environmental performance of a product (i.e. building) over its life cycle.

12 Trees and Basements, RBKC, February 2014 (BAS 35) https://www.rbkc.gov.uk/pdf/Trees%20and%20basements.pdf ; and Basements Visual Evidence, RBKC, February 2014 (BAS 33) https://www.rbkc.gov.uk/sites/default/files/atoms/files/BAS 33 Basements Visual Evidence, Feb 2014.pdf and Basements Visual Evidence - External Manifestations, Feb 2014 (BAS 34) https://www.rbkc.gov.uk/pdf/Bsmt_Visual%20evidence_external%20man.pdf

13 Impact of Basement Development on Biodiversity, RBKC, February 2014 (BAS 36) https://www.rbkc.gov.uk/pdf/BiodiversityBasementPaper_final.pdf

14 Royal Borough of Kensington and Chelsea Residential Basement Study Report, Alan Baxter and Associates, March 2013 https://www.rbkc.gov.uk/wamdocs/0954-130_RBKC_Residential%20Basement%20Study%20Report_2013-03_low.pdf

15 Policy 3.5 of the London Plan, Spatial Development Strategy, March 2016 https://www.london.gov.uk/sites/default/files/the_london_plan_malp_final_for_web_0606_0.pdf

16 Paras 1.2.44 and 2.2.12 London Plan Housing SPG, March 2016 https://www.london.gov.uk/sites/default/files/housing_spg_revised.pdf

17 Para 53 and Appendix Glossary, NPPF, March 2012 https://www.gov.uk/guidance/national-planning-policy-framework/annex-2-glossary

In para. 34.3.59 it is acknowledged that,

> *"Trees make a much-valued contribution to the character ……., and bring biodiversity and public health benefits. Works to, and in the vicinity of, trees, need to be planned and executed with very close attention to detail. All applications for basements likely to affect trees [18] either on-site or nearby must be accompanied by a full tree survey and tree protection proposal for the construction phase. Core Strategy Policy CR6 Trees and Landscape will also apply."*

18 Works to trees should be carried out in accordance with BS 5837 2012 (with the exception that tunnelling underneath the root protection area should not be undertaken) and The Royal Borough of Kensington and Chelsea's Trees and Development SPD: https://www.rbkc.gov.uk/planning-and-building-control/planning-policy/supplementary-planning/trees-and-development

3.7.5 APPLICATION

Consideration must be given to how the excavation might affect trees at adjoining properties and ensure that trees are not placed at risk. All trees on the development site, and at neighbouring sites, are to be clearly marked and named, and their distance from the perimeter of the proposed basement measured.

Developers should consult the latest version of the Arup Red Frog Sub-Surface Water Features Mapping Report, to check if the development site is located near to an underground water feature.

Areas of landscaping proposed should be designed as deep soil landscaping with natural drainage. A minimum soil depth of 2 to 3 metres above the basement development will be required in order to maintain well-vegetated gardens, with space available for tree planting. A soil depth of less than 2 metres is likely to increase the risk of the soil profile drying out and prevent large canopy trees planted in future to endure to reach their fill maturity or, ideally, veteran stage.

Adequate natural drainage is required in order to ensure the soil above a basement does not become waterlogged in times of high rainfall to prevent any adverse effect on planting within this space. The provision of a drainage layer with a minimum depth of 200mm above any basement that extends beyond the footprint of a building should be provided to ensure surface water drainage is adequately dealt with in conjunction with the unbuilt upon areas/drainage margins/areas of natural drainage.

Root protection areas are to be calculated by multiplying the diameter of a tree at breast height in meters by 12 (but capped at a radius of 15 metres[19]).

The demolition, construction and even the landscaping phase of a development is when damage to trees is most likely to occur. Tree protection arrangements are to be monitored throughout the demolition and construction process to ensure that the following does not occur:

- bark wounds or broken branches caused by machinery;
- compaction of the soil from repeated movement of heavy machinery and the storage of materials within the Root Protection Area (RPA) of a tree;
- root bark damage from site stripping or grading;
- cutting of roots during excavation for foundations and services;
- raising or lowering soil levels beneath the crown spread of a tree;
- raising the water table;
- the spillage of petrol or diesel, mixing of cement and the storage of toxic materials or machinery within the Root Protection Area of a tree or under the canopy of a tree;
- burning waste materials close to the tree;
- removal of branches to create space for scaffolding or access of heavy plant.

Margins are to be left between basements and adjoining sites in order to allow for space to enable natural surface water drainage and lateral ground water movement to occur between sites.

19 This in accordance with BS 5837: 2012 ("Trees in relation to design construction and demolition"