Arboricultural Report

& Impact Assessment

For planning purposes at

Kings College London Hampstead Residence
Kidderpore Avenue
Hampstead
NW3 7ST

Dated
1st July 2015

CROWN Consultants

Tree consultants throughout England and Wales

Contents

1. Introduction

1.1. Instruction

1.1.1. We are instructed by Huw Bramhall of The Ecology Consultancy to undertake an Arboricultural Survey at Kings College London Hampstead Residence and produce our findings in a report. We are also instructed to assess the likely impact of development proposals.

1.2. Scope and Purpose of the Report

1.2.1. This report is designed to accompany a planning application for development proposals at the above site. Its purpose is to assist and inform the planning process. It is produced according to the guidance and recommendations within *BS 5837: 2012 - Trees in Relation to Design, Demolition and Construction.*

1.3. References

1.3.1. We have liaised closely with several members of the design team in order to agree a workable design that will minimise the impact of the proposal on adjacent trees. We have an adequate understanding of the project to enable us to carry out an accurate assessment of the proposals.

1.4. Drawings

1.4.1. We have been supplied with a measured plan of the site with tree positions already plotted. Where applicable, additional trees have been plotted according to measurements taken on site.

1.4.2. The *Tree Constraints Plan* shows the existing layout. For each tree the stem location is indicated and scaled according to its diameter, the canopy is indicated according to measurements taken along the four cardinal points of the compass. Root protection areas (RPAs) are indicated which are calculated according to the guidelines within BS 5837 (2012).

1.4.3. When using the Tree Constraints Plan for design purposes, the RPAs should be amended to reflect actual site conditions. Where the circular RPAs extend beneath roads or existing buildings, that part of the RPA should be ignored and the RPA extended a suitable distance in other directions.

1.4.4. The *Tree Removal Plan* indicates the tree constraints with the proposals overlaid. This plan shows which trees are to be pruned or removed. This plan accompanies the Impact Assessment which is to be found in Section 5.

1.4.5. The *Impact Assessment Plan* indicates the tree constraints with the proposals overlaid but only shows the trees to be retained. Where applicable, this plan shows where works are proposed in Root Protection Areas. This plan also accompanies the Impact Assessment which is to be found in Section 5.

2. Site Overview

2.1. Brief Description (Existing Layout)

2.1.1. The site co-ordinates are 51° 33.448'N 0° 11.545'W and the altitude is approximately 99m above sea level. (Co-ordinates may be pasted or typed into the following site: http://maps.google.co.uk/ where maps, satellite imagery and street views may be accessed).

2.1.2. Our survey covered the area indicated in Figure 1.

Figure 1 Extent of the survey (image is not current).

2.1.3. The survey area encompassed the entire curtilage of Kings College London Hampstead Residence. Within this site are several buildings and distinct landscaped areas. Trees growing beyond the boundary were also included in the survey.

2.1.4. The Tree Constraints Plan and Tree Data Schedule should be referred to for descriptions and locations of all trees.

2.1.5. Photographs of the site are included in Sections 7, 8, 9 and 10.

2.2. Soils

2.2.1. Geological maps (http://mapapps.bgs.ac.uk/geologyofbritain/home.html) indicate that the underlying geology of the area is clay with no recorded superficial deposits. This means that soils throughout the site are likely to be susceptible to compaction and the root systems are likely to be relatively shallow. We have undertaken trial excavations in four places within the site and can confirm the present of clay soils.

3. Tree Survey and Data Schedule

This page is largely generic. Tree officers and other persons familiar with arboricultural reports may go straight to the following section and refer to the tree data in Appendix 6.

3.1. Survey Details

3.1.1. A ground level survey was undertaken on several dates between February and June 2015. The survey was conducted by Ivan Button. No climbed inspections or specialist decay detection were undertaken. Only trees with a stem diameter over 75mm were included, which lie within the site boundary or relatively close to it.

3.1.2. Where applicable, trees with significant defects have been highlighted and appropriate remedial works have been recommended. However, this report should not be seen as a substitute for a full *Safety Survey* or *Management Plan* which are specifically designed to minimise risk and liability associated with responsibility for trees.

3.1.3. Wherever possible, dimensions are obtained using diameter tapes, logger's tapes, distometers and clinometers. Where obstacles prevent accurate measurement, dimensions are estimated. Trees on privately owned third party are surveyed from the best available vantage point and observations relating to the condition of these trees should be treated accordingly. All height measurements should be regarded as approximate.

3.2. Data Schedule

3.2.1. The findings of the survey are presented in The Tree Data Schedule which is provided as a separate document as well as being appended to the end of this document within Appendix 6.

3.2.2. The Schedule includes scaled tree images based on measurements recorded for stem diameter, crown spread, crown height and overall height. Their purpose is to indicate, at a glance, the relative dimensions of each tree.

3.2.3. A definition of the Retention Categories can be found in Appendix 1. All other terms used within the Tree Data Schedule are defined and explained in Appendix 3.

3.3. RPA calculation - Single Stems & Multiple Stems

3.3.1. For single stemmed trees, the RPA is calculated according to the following formula:

RPA radius = 12 x stem diameter (measures at 1.5m above ground level)

3.3.2. Where a tree has more than one stem, the equivalent-single-stem diameter is usually recorded. This is calculated by adding the squares of the stems and then finding the square root of this total. The radius of the Root Protection Area is then calculated by multiplying the equivalent-stem-diameter by 12.

3.3.3. Occasionally this method is not appropriate (e.g. for coppiced specimens where there are numerous stems). In such cases the diameter at ground level may be recorded or a stem diameter which would provide a suitable Root Protection Area calculation. The form of the tree is recorded in the notes section.

4. Vegetation Overview (independent of proposals)

This section summarises all the recommendations within the Tree Data Schedule regardless of whether trees are to be retained, felled or pruned to facilitate the proposed development. It does not specify works that may be required to facilitate the development proposals. The protection status of the trees is also reported in this section.

4.1. Preliminary Management Recommendations

4.1.1. The following recommendations are made in order to maintain the trees in an acceptable condition:

4.1.2. The ash tree, T6, was observed to be in poor condition. This is evidenced by the sparse canopy and significant deadwood throughout its canopy. Pockets of decay were also encountered in two places between the buttress roots. To our knowledge the extent of decay has not been determined. We therefore recommend that specialist decay detection is undertaken (especially since this tree is being considered for retention).

4.1.3. T26 and T60 could not be fully inspected due to the presence of dense ivy. It is recommended that the ivy is removed so that the trees may be re-inspected.

4.1.4. All other trees were deemed to be in an acceptable condition.

4.2. Work Priority and Future Inspections

4.2.1. The table below suggests a schedule for completing the works recommended in the Tree Data Schedule based on the perceived risk:

Work Priority	Definition	Tree Number
Urgent	As soon as possible	None
Very High	Within 1 Month	None
High	Within 3 Months	T6
Moderate	Within 1 year	T26, T60
Low	Within 3 years	None

4.2.2. The table below suggests a schedule of future inspections based on the condition and location of each tree:

Inspection Frequency (years)	Tree Number
0.5	T6
1	T60
1.5	T26
3	T1, T2, T3, T4, T5, G7, T8, T9, T10, T11, T12, T13, T14, T15, T16, T17, T18, G19, T20, T21, G22, T23, T24, T25, T27, T28, T29, T30, T31, G32, T33, T34, T35, T36, T37, T38, T39, T40, T41, T42, T43, T44, T45, T46, T47, T48, T49, T50, T51, T52, T53, T54, T55, T56, T57, T58, T59, T61, T62, T63

4.2.3. The trees should be inspected sooner if there is a noticeable decline in their condition, or following extreme weather events.

4.3. Tree Protection Status – Site Specific

4.3.1. On 26th June 2014, we were informed, by Leela Muthoora of London Borough of Camden that:

- The site is within a conservation area.
- There are tree preservation orders affecting trees within the site.
- There are no TPO's immediately adjacent to the site.

4.4. Tree Protection – General Notes

4.4.1. Heavy fines exist for carrying out unauthorised works to protected trees so we advise that further checks are made before any tree-works are undertaken.

4.4.2. Before undertaking works to trees protected by a tree preservation order, consent needs to be obtained from the local authority which will provide application forms and advice to potential applicants. The removal of dead wood is exempt.

4.4.3. Where the works are proposed for reasons of safety or ill health, a report from a suitably qualified arborist will usually be required. Trees that are dead, dangerous or dying are technically exempt from protection, though it would be prudent to give the local authority 5 days' notice of intention and take photographs before undertaking works without prior consent being granted. Unauthorised works to protected trees may result in a criminal prosecution and a large fine (unlimited).

4.4.4. Where trees are located in a conservation area, works are not permitted without first giving the local authority 6 weeks' notice of intention. During this time the local authority may elect to create a tree preservation order or to inform the applicant that they have no objection to the proposed works. If the local authority does not respond within 6 weeks, then the intended work may be undertaken. Note: the local authority cannot refuse consent for works to trees within a conservation area; they may only create a tree preservation order if they wish to have further control over what works are undertaken.

4.4.5. Where planning permission is granted and tree works have been approved as part of the planning consent, no further application is required in respect of protected trees and no further notice is required in respect of trees within a conservation area.

4.5. Species Present – Additional Information

4.5.1. The table below contains general information about the tree *species* (rather than the actual tree *specimens*) included in the survey. Its purpose is to assist readers who are unfamiliar with the characteristics of the various species.

Species	Typical Height at Maturity (m)	Typical Canopy Spread at Maturity (m)	General Notes
Ash	25	18	Large deciduous tree with a straight bole and a high open domed crown. Native to Britain and commonly found in woodlands and adjacent roadsides. Not suitable for small gardens. Easily identified by its oppositely arranged pinnate leaves and black buds. Branches are relatively brittle resulting in a fairly high incidence of small branch failure in windy conditions. Visit http://www.pfaf.org/user/Plant.aspx?LatinName=Fraxinus+excelsior for more info.
Beech	25	18	Deciduous tree native to W and S Europe. Does not have resilient heartwood, therefore typically lives for 100 - 150 years before decay may cause structural failure if unmanaged. Can be an extremely attractive tree at maturity due to its size and majesty. Young branches may retain their foliage through winter as is evidenced in beech hedges. Visit http://www.pfaf.org/user/Plant.aspx?LatinName=Fagus+sylvatica for more info.
Cherry	8	10	Many cultivars available, bred for their abundance of spring flowers, edible cherries or ornamental bark (e.g. Tibetan Cherry). Usually white or pink flowering, often in very early spring. Usually with a single bole to around 2.5m and multi-stemmed thereafter. Most varieties have excellent autumn colour.
Elder	8	8	Deciduous tree native throughout Europe, N Africa and W Asia. Untidy, shrubby habit. Very fast growing. Covered in dense creamy flowers and deep red berries which are excellent for making wine. Visit http://www.pfaf.org/user/Plant.aspx?LatinName=Sambucus+nigra for more info.
Fig	30	12	Deciduous tree native to western Asia with large leaves. Many varieties available. Edible variety usually planted, though rarely fruits and ripens in the UK.
Goat Willow	10	8	Also called Pussy Willow or Great/Common Sallow. Native and abundant in Britain except on the lightest soils. One of the first pioneer species to colonise an abandoned site due to its light far-blown seeds. Traditionally coppiced and used for basket making. Rarely planted as an ornamental due to its untidy habit. Visit http://www.pfaf.org/user/Plant.aspx?LatinName=Salix+caprea for more info.
Hawthorn	6	6	Arguably Britain's most common tree due to its abundance in field and roadside hedges. Deciduous, prickly and one of our most hardy trees, it will tolerate almost all conditions including drought, pollution and coastal winds. Also known as Mayflower because of its abundance of white flowers in May. Red 'haws' ripen from September to November and have only one pip (unlike Midland hawthorn which contains 2 pips). Visit http://www.pfaf.org/user/Plant.aspx?LatinName=Crataegus+monogyna for more info.
Holly	16	12	Evergreen tree native across Western Europe. Many cultivars available, often with variegated leaves. Females produce bright red berries. Good wildlife value. Visit http://www.pfaf.org/user/Plant.aspx?LatinName=Ilex+aquifolium for more info.
Hornbeam	25	14	Deciduous tree native to Southeast England and across Europe. Bark is smooth and grey on a stem which is often twisted and sinewy. Leaves sharply toothed and deeply veined. Tolerant of heavy clay soils. Formerly coppiced and prized for its durable timber which was used in wheel hubs, piano hammers, mill wheels and chopping blocks. Visit http://www.pfaf.org/user/Plant.aspx?LatinName=Carpinus+betulus for more info.
Indian Bean Tree	16	12	The 'Indian Bean Tree'. Native to S. Catalpa, Florida, Alabama and Mississippi. More frequent in the southern UK as it prefers a warmer climate. Leaves are very large and smell foul when crushed. Flowers in large candles at the branch ends in summer followed by slender hanging seed pods to 40cm long. Visit http://www.pfaf.org/user/Plant.aspx?LatinName=Catalpa+bignonioides for more info.
Laburnum	9	10	Deciduous tree native to Southern and Central Europe. Garden tree prized for its small stature and abundance of hanging yellow flowers in spring. Poisonous. Liable to split at forks. Visit http://www.pfaf.org/user/Plant.aspx?LatinName=Laburnum+anagyroides for more info
Lawson Cypress	40	10	Erect, narrowly conical evergreen tree native to Southwest Oregon and N. W. California. Introduced to Britain in the 1850's and now a common tree in gardens and parks. Makes an excellent dense hedge. Many varieties are available including golden and miniature varieties. Easily distinguished from Leyland cypress by the presence of small cones. Visit http://www.pfaf.org/user/Plant.aspx?LatinName=Chamaecyparis+lawsoniana for more info.

Species	Typical Height at Maturity (m)	Typical Canopy Spread at Maturity (m)	General Notes
Leyland Cypress	40	8	Vigorous evergreen tree, cultivated hybrid between Nootka Cypress and Monterey Cypress. Widely planted and widely hated. Excellent hedging species unless it is undermanaged in which case it forms a giant, dense wall of foliage. Very hardy. Tolerates most conditions. Size may be managed by regular trimming. Golden forms available. (The details of the specific cultivar surveyed are not listed here.) Visit http://www.pfaf.org/user/Plant.aspx?LatinName=Cupressocyparis+leylandii for info.
Lime	25	12	Very common street tree. Several species exist; the one most often found in woods is 'common lime' which produces a mass of suckers at the stem base, making it very cheap to propagate. Limes have non-symmetrical heart shaped leaves which are much loved by aphids (hence the sticky honeydew on cars parked beneath). Limes are tolerant of heavy pruning and are often managed as pollards. Old limes tend to support a lot of small dead branches. Visit http://www.pfaf.org/user/Plant.aspx?LatinName=Tilia+x+europaea for info.
Lombardy Poplar	35	8	Distinctive, narrowly columnar deciduous tree with triangular leaves. Native to Italy. Gnarled bole supports numerous ascending branches that taper towards a narrow pointed crown. Often planted in rows. Tolerates a wide range of soils and climes. Upright habit can lead to weak branch junctions and a tendency for branch failure. Fast growing. Tolerant of heavy pruning.
London Plane	30	20	Deciduous tree arisen in cultivation probably as a cross between the Oriental Plane and the American Buttonwood. Has attractive bark which peels off in small plates leaving a multi-coloured flecked pattern. Very common as a street tree, especially throughout London where it dominates the streetscape. Often managed as a pollard in order to constrain its large size to more manageable proportions, especially where there are clay soils and adjacent buildings. Somewhat susceptible to the decay fungus Innonotus hispidus. Visit http://en.wikipedia.org/wiki/Platanus for more info.
Magnolia	7	8	Small tree or large shrub, favoured for its large, ornamental flowers. About 80 species and numerous cultivars are available, both deciduous and evergreen. Leaves always untoothed and sometimes very large. Large silky flower buds and berries dangling from unusual 'knobbly cucumber' fruits.
Maidenhair Tree	25	12	Deciduous tree native to Eastern China - a living fossil with no known relatives. Slow growing. Angular crown with long erratic branches. Occasionally planted as a street tree. Female trees are to be avoided due to their unpleasant smell. Visit http://www.pfaf.org/user/Plant.aspx?LatinName=Ginkgo+biloba for more info.
Monkey Puzzle	30	16	Evergreen tree native to Chile. Prized for its regular, geometric form. Intolerant of pollution. Very prickly foliage clothes all branches. A nightmare to climb.
Oak	22	18	Deciduous, long lived tree native and common throughout Europe with very durable timber. Excellent habitat tree - provides food and shelter for thousands of native species. Can be very attractive as a mature open grown specimen though not particularly ornamental, having no autumn colour or showy flowers. Responds well to pruning. Visit http://www.pfaf.org/user/Plant.aspx?LatinName=Quercus+robur for more info.
Pissards Plum	6	7	Also called Purple Plum. Small deciduous tree usually with a dense, low canopy containing a multitude of upright epicormic shoots giving it a messy appearance. Adds colour interest and is suitable for a small garden. Pink flowers appear very early in the year and large fruits make good jam. Visit http://en.wikipedia.org/wiki/Cherry_plum for more info.
Rowan	14	12	Deciduous tree native across Europe and N Africa. Also known as mountain ash due to its pinnate leaves and ability to grow at high altitudes. Attractive autumn colour and berries along with spring flowers. Good wildlife tree. Visit http://www.pfaf.org/user/Plant.aspx?LatinName=Sorbus+aucuparia for more info.
Silver Birch	16	10	Deciduous native tree. A pioneer species requiring good lighting levels that will readily colonise open ground. Relatively short lived and surpassed in woodland by dominant species such as oak and beech. Attractive white bark and graceful, delicate form make this a popular garden tree. Visit http://www.pfaf.org/user/Plant.aspx?LatinName=Betula+pendula for more info.
Sycamore	25	16	Deciduous tree native to S. Europe, widely naturalised in the UK. Often regarded as a weed species due to its invasive nature and ability to tolerate most conditions. Responds well to pruning. Not a good tree to park beneath in summer due to the sticky sap secreted by aphids. Visit http://www.pfaf.org/user/Plant.aspx?LatinName=Acer+pseudoplatanus for more info
Turkey Oak	25	20	Deciduous and native across Southern Europe. Long whiskers clothing the buds distinguish this tree from Common Oak in winter. Acorn cups are also rougher and hairier. Visit http://www.pfaf.org/user/Plant.aspx?LatinName=Quercus+cerris for more info

4.5.2. The figures quoted regarding typical height and canopy spread should be treated as approximate. The figures quoted are not the maximum dimensions that the species may attain.

5. Arboricultural Impact Assessment

5.1. Overview

5.1.1. The proposed development involves the retention of the site's five Grade II statutorily listed buildings. Kidderpore Hall, the Maynard Wing, the Chapel and the old Skeel Library will all be sensitively converted to residential use, and the Summerhouse will be restored in a new location on the site close to the Chapel.

5.1.2. Other non-listed buildings will also be retained and sensitively converted to residential use, namely Bay House, Dudin Brown, and Rosalind Franklin.

5.1.3. Three existing buildings will be demolished and replaced with new residential buildings: Lord Cameron Hall, Rosalind Franklin Hall and the Queen Mother's Hall.

5.1.4. Integrated in the Kidderpore Avenue elevation of the replacement for the Queen Mother's Hall will be an access to a basement area where car parking for residents and visitors will be provided. In total 97 spaces are proposed. The majority of cycle parking requirements will also be accommodated in the basement, amount to 312 spaces. Some cycle parking – in particular that intended to be used by visitors, amounting to 16 spaces – will be provided at ground floor level, carefully integrated into the hard and soft landscaping scheme.

5.1.5. New buildings are proposed in two locations on the site. The first is between the Chapel and Queen Mother's Hall where 'pavilion' houses are proposed. A terrace of 'townhouses' is proposed between the Chapel and the Maynard Wing on the site of the previously-consented student accommodation development, planning permission for which remains extant by virtue of the development having been commenced. The proposed development also includes residents' facilities and a concierge.

5.1.6. These proposals are indicated on the accompanying plans in Appendix 6. The existing layout is indicated in blue, the footprint of the proposed layout is indicated in pale green.

5.1.7. The table below summarises the potential impact on trees due to various activities.

Activity	
Tree Removal: Retention Category A	None
Tree Removal: Retention Category B	T14, T15, T17, T18, T56, T60
Tree Removal: Retention Category C	T1, T2, G7, T8, T10, T12, T13, T16, G19, T23, T24, T25, T26, T27, T28, T29, T30, T31, G32, T36, T37, T41, T42, T43, T44, T45, T49, T55
Tree Removal: Retention Category U	None
Tree Pruning	T38, T48, T50, T64
RPA: Foundations	T6, T20, T50, T64
RPA: New Road Surface	None
RPA: Underground Services	None Anticipated (To be confirmed)
RPA: Change of Ground Levels	None
RPA: Soil Compaction	All trees throughout the site (preventable by installing tree protection measures)

5.1.8. Other potentially damaging activities often associated with construction sites include demolition or the careless use of plant machinery, hazardous materials, or fires.

5.1.9. All of the above potential impacts are considered in detail throughout this section.

5.2. Tree Removal

5.2.1. All trees to be removed are indicated on the Tree Removal Plan and are listed below:

5.2.2. **Retention Category A:** It is proposed to retain all Retention Category A trees.

5.2.3. **Retention Category B:** It is proposed to remove the following Retention Category B trees: T14, T15, T17, T18, T56 andT60. T60 is located so close to a proposed residence that retention is not considered practicable. The other trees are all located over areas where deep excavation is required to enable the basement parking to be installed.

5.2.4. T14, T15, T17 and T18 are all birch trees and are either considered to be mature (T14) or early mature (T15, T17 and T18). These are a relatively fast growing and short lived species. They are located internally to the site so are not considered to have a particularly high amenity value. Their removal shall not have a major impact on the wider visual amenity of the locality.

5.2.5. T56 is a small monkey puzzle tree (height 6m) it is also located internally to the site and as such has a low amenity value.

5.2.6. T60 is a mature Lombardy poplar. This tree is in good physiological condition though it was not possible to accurately assess its structural condition as a dense covering of ivy prevented a close inspection of the tree stem and branch junctions.

5.2.7. Poplars are a fast growing species. This means that they sacrifice some structural strength in favour of rapid growth. They are generally regarded as a brittle species and are not very good at preventing the spread of decay (should any decay become established within the stem).

5.2.8. Lombardy poplars are fastigiate in habit. This means that their branch junctions are at an acute angle. Bark often gets trapped between the branches and the stem, thus forming a weak junction. Branch failure is therefore relatively high in this species. They are often regarded as unsuitable for locations where safety is paramount. We have visited this site on several occasions and have observed that the rear gardens of the adjacent church grounds are used as a children's play area.

5.2.9. T60 is considered to be approaching end of its safe useful life expectancy for all of the reasons stated above.

5.2.10. T60 is barely visible from roads or public footways so it is not considered to have a particularly high amenity value. The removal of this tree is therefore considered to be justifiable to enable the site to be developed to a sensible extent. The Root Protection Area of this tree is so large that retaining it would effectively prevent any development of the north-west corner of the site.

5.2.11. **Retention Category C:** It is proposed to remove the following Retention Category C trees: T1, T2, G7, T8, T10, T12, T13, T16, G19, T23, T24, T25, T26, T27, T28, T29, T30, T31, G32, T36, T37, T41, T42, T43, T44, T45, T49, T55. These are all relatively small trees the tallest being the birch, T30 at 14m tall, the other trees are all 11m tall or less. Species include birch, holly, lime, Lawson cypress, laburnum, magnolia, rowan, cherry, hawthorn, goat willow, 2 x young ash, 4 x holly, magnolia, elder, young oak). These trees are all considered to have a low amenity value and are not considered to be a material planning consideration.

5.2.12. **Retention Category U:** Our survey did not identify any Retention Category U trees.

5.2.13. Details specific to each tree can also be found in the Tree Data Schedule.

5.3. Mitigation Planting

5.3.1. There is ample scope for new planting to mitigate against tree loss. I understand that it is proposed to plant several new trees as part of a post development landscaping scheme.

5.4. Impact on Tree Canopies

5.4.1. It is proposed to remove the lower branches of T64 where they overhang the site boundary. This will create a clearance height of circa 6m which shall be sufficient to enable the build to the rear of the existing chapel. T64 is a sycamore so will tolerate such pruning with no detrimental impact.

5.4.2. The canopies of T38 and T50 may require very light trimming of the outer foliage in order to create enough clearance for scaffolding and demolition. No branches in excess of 30mm diameter shall require pruning.

5.4.3. It is also proposed to prune back the branches of T48 that are growing towards the proposal in order to create a clearance distance of circa 4.5m. This may be largely attained by the removal of one significant branch along with minor trimming of other branches. The exact pruning specification shall be agreed with the local authority and the owner of this tree (it is believed to be growing just beyond the site boundary). Some pruning of the canopy of T20 may also be required in order to provide adequate clearance for a piling rig to operate close to the periphery of its canopy. The exact pruning specification shall be agreed with the local authority after discussions with the piling rig operator. We understand that a clearance distance of circa 0.75m shall be required beyond the one where the piles are to be installed

5.4.4. So long as the above pruning works are undertaken sympathetically (working to BS 3998: 2010 guidelines) the trees shall not be significantly harmed or disfigured. These works are specified within the Tree Works Schedule in Section 6.

5.4.5. All other tree canopies shall be unaffected by the proposals.

5.5. Impact on Tree Roots

5.5.1. **Foundations / Basement Parking:**

5.5.2. Trees potentially affected by excavation for foundations or for the basement parking are T6, T20, T50 and T64.

5.5.3. The extension to the rear of the chapel shall extend over the Root Protection Area of **T64.** However a pile and raft foundation is proposed here which shall avoid all excavation within the RPA. The reinforced raft shall be located entirely above the existing ground levels and shall be supported by narrow piles. So long as the piles are located in areas of low rooting activity (pre-determined by trial excavation), there shall be minimal impact on the root system of T64. Any minor loss of roots shall be off-set by the canopy proposed pruning.

5.5.4. Trial excavations have been undertaken to determine the extent of rooting activity where the basement parking is proposed close to T20 and T6. The impact assessment plan shows the location of the trial excavations. Photographs in Sections 8, 9 and 10 illustrate our findings.

5.5.5. The excavations beneath the periphery of the canopy of **T20** (Trench 3 on the Impact Assessment Plan) revealed very low rooting activity (maximum root diameter was 15mm. See Photos 3 to 15 in Section 10). This was to be expected since the excavations took place close to the edge of the Root Protection Area. In order to install the basement without impacting on soils within 6m of the stem of T20, it is proposed to utilise sheet piling (or contiguous piling). This will ensure such a small impact on the root system of

T20, that this tree will be able to tolerate it with no long term detrimental impact. Because excavation is proposed on three sides of this tree, it will be necessary to ensure additional rooting volume of soils are available to enable this tree to mature. In order to do this it is proposed to install 60mm of fertile soil on top of the basement car park.

5.5.6. The trial trench to the southeast of **T6** (Trench 1) also revealed low rooting activity (see Photograph 19 in Section 8). The largest roots unearthed in this trench measured 35mm and 11mm diameter. All other roots were less than 8mm diameter. This indicates that rooting activity is not prolific within the soils in excess of 10.5m from the stem of T6 (in a south-easterly direction). The installation of the pavilions here should therefore be tolerated by this tree if there were to be no other impact on its root system.

5.5.7. However, additional excavation is proposed at a distance of approximately 9m from the stem in a south-westerly direction. A trial trench here (Trench 2) revealed a high frequency of small feeder roots (though no particularly large roots (see Photographs 3 to 8 in Section 9). The largest root measured 35mm, the second largest measured 30mm and the third largest measured 20mm. This indicates that soils in this area are being exploited by the root system of T6. Healthy trees are able to tolerate some disturbance of their root system (up to approximately 20% loss of roots), however, T6 is not a healthy, vigorous tree. On the contrary, this tree is in very poor physiological condition. It has low vigour, a sparse canopy and significant deadwood throughout its canopy.

5.5.8. If this tree is to be retained, we recommend that the soils throughout most of its RPA are ameliorated by terraventing (our trial investigations revealed hard compact clay), along with the application of a nutritious mulch and earthworms. The removal of the existing grass coupled with mulching and aeration shall greatly improve the rooting environment for this tree with a likely improvement in its overall condition. This would mitigate against the negative impact of root loss due to excavation. The proposed landscaping scheme should take allow for significant soil amelioration throughout the Root Protection Area of this tree.

5.5.9. We also observed some decay present at the base of this tree stem. However, the extent of decay has not been determined. Specialist decay detection is recommended in order to determine the extent of decay. Depending on the findings of such an investigation, some additional works may be requires (canopy reduction or possibly even tree removal).

5.5.10. Excavation is proposed in order to install foundations within the Root Protection Area of T50. Only 2.3% of the Root Protection Area shall be affected. In order to ensure no disturbance of the rest of the root system, it is proposed to utilise sheet piling (or contiguous piling). We understand that a separate construction method statement is being compiled by engineers to demonstrate how this will be achieved. So long as there is no disturbance of the soils beyond the footprint of the adjacent proposed building, T50 will be able to tolerate the loss of approximately 2.3% of its root system with no observable impact.

5.5.11. ## New Road Surfaces:

5.5.12. No new road surfaces are proposed within the Root Protection Areas of any trees.

5.5.13. ## Underground Services:

5.5.14. Due to the potentially major impact of excavating trenches within Root Protection Areas, the locations of all underground services should be approved by the local authority after consultation with an appointed arborist to assess the potential impact on trees.

5.5.15. **Changes in Ground Levels:**

5.5.16. The finished ground levels shall approximate the existing ground levels throughout most of the site and there shall be very little impact on tree roots from land regrading. Proposed levels around the rear of the chapel should be clarified and agreed with the local authority. Sectional drawings of proposed levels in this area indicate that some raising of ground levels may be required to enable the elevated raft foundation. If possible, the raised levels should be limited to the footprint of the extension.

5.5.17. **Soil Compaction:**

5.5.18. The majority of tree roots lie within the upper soil horizons. This is because the availability of oxygen decreases with depth and roots need to breathe to stay alive. In addition, nutrients are more readily available in the form of organic matter close to the soil surface.

5.5.19. Healthy soils contain about 25% air space between solid particles. Increased loading of the soils caused by construction activity causes air to be squeezed out as the soil becomes compacted preventing roots from breathing. Even an increase in pedestrian activity may cause some soil compaction.

5.5.20. It is important therefore that ground compaction and soil disturbance over Root Protection Areas should be avoided during the construction phase. This may be done by installing protective fencing and ground protection measures as recommended within BS 5837 (2012). The exact specification of protection measures should be specified in an Arboricultural Method Statement so that it may be agreed and approved by the local authority.

5.6. Demolition Activities

5.6.1. Adequate tree protection methods should be specified in an Arboricultural Method Statement, and approved by the local authority, before demolition takes place. Areas should be designated for the storage of debris.

5.7. Hazardous Materials

5.7.1. All hazardous materials (including cement and petrochemical products) will need to be controlled according to COSHH regulations in order to ensure there is no detrimental impact on tree health. Provision shall need to be made to ensure that cement and cement run-off are contained outside of all Root Protection Areas.

5.8. Cabins and Site Facilities

5.8.1. There is limited room for the siting of cabins and storage of materials / spoil during the construction phase so the logistics of the development shall need to be well organised to ensure that there is adequate space outside of the Tree Protection Zones for construction activity.

5.9. Boundary Treatments

5.9.1. No changes are proposed to the existing boundary features.

5.10. Impact of Retained Trees on the Development

5.10.1. The proposed layout shall result in an improved juxtaposition between the large hornbeam, T50 and the adjacent building.

5.10.2. The new buildings shall extend closer to the canopies of T6 and T48 however so some future pruning may be required. Facilitative pruning has been specified for T48 as it is clear that this shall be required. Because the canopy of T6 is so high, it is anticipated that facilitative pruning may not be required. However, future maintenance pruning is likely to be required to enable adequate lighting levels in adjacent rooms. The canopy of this tree is so sparse (and the life expectancy so low), that excessive pruning is unlikely to be required.

5.11. Summary

5.11.1. In order to facilitate the development, it is proposed to remove thirty seven, Retention Category C trees and six Retention Category B trees. Most of these are located internally to the site and are largely hidden from public vantage points. Consequently the impact of tree removal on the wider local amenity shall be minor.

5.11.2. Three trees require light pruning to create an adequate clearance from the proposal.

5.11.3. No significant hard surfaces are proposed in RPAs.

5.11.4. Excavation is proposed in the Root Protection Areas of three trees. The potential impact and proposed mitigation measures are discussed in Section 5.5.

5.12. Arboricultural Method Statement

5.12.1. BS 5837 recommends that a detailed methodology is agreed in the form of an Arboricultural Method Statement which shall ensure that trees are well protected during the construction phase. This should detail all tree protection measures and limitations on construction activity. All of the issues raised within this Impact Assessment should be covered by the Method Statement.

6. Tree Works Schedule

6.1. Tree Works Specification

6.1.1. The following table specifies the tree works which will be required prior to the commencement of construction activity:

Tree Reference	Action Required	Notes
T1, T2, G7, T8, T10, T12, T13, T14, T15, T16, T17, T18, G19, T23, T24, T25, T26, T27, T28, T29, T30, T31, G32, T36, T37, T41, T42, T43, T44, T45, T49, T55, T56, T60	Remove.	Stumps of trees within the RPAs of retained trees shall be removed with a stump grinder NOT a mechanical excavator.
T64	Prune lowest branches overhanging the boundary to create a clearance height of 6m.	Branches to be pruned back to a secondary branch junction or the branch collar wherever possible. Pruning to be kept to a minimum to achieve the desired clearance bright of 6m.
T38, T59	Light trimming of the foliage to create a clearance distance of 1.8m from the existing buildings (to enable scaffolding and demolition)	Branches to be pruned back to a secondary branch junction or the branch collar wherever possible. Pruning to be kept to a minimum to achieve the desired clearance of 1.8m.
T48	Prune back to create a clearance distance of 4.5m from the proposed new building (clearance distance to be agreed with the local authority and the tree owner).	Only very minor pruning using secateurs (or a small manual pruning saw) is necessary.

6.1.2. **Pruning Standards:** Sympathetic pruning shall be carried out to BS 3998 (2010). Lopping of branches is to be avoided. Instead as system of 'drop crotching' or 'reduction via thinning' is to be used to achieve the desired clearance without spoiling the appearance, or form, of the trees. All pruning cuts shall be made close to the branch collar or a secondary growth point. Cuts to be made with sharp, clean tools. No wound sealants to be used.

6.1.3. **Additional works:** Any recommendations specified in the Tree Data Schedule (but not replicated in the above table) are intended to maintain the tree population in an acceptable condition. They are made for reasons of good arboricultural practice regardless of development proposals. However, they do not form part of this planning application. Where these trees are protected by a tree preservation order or are in a conservation area, consent must be sought from the local authority. Only the works listed in the table above form part of this planning application whereby no additional consent will be required if planning permission is granted.

7. Photographs

Refer to the Tree Constraints Plan for photo locations

Photo 1.

Photo 2.

Photo 3.

Photo 4.

Photo 5.

Photo 6.

Photo 7.

Photo 8.

Photo 9.

Photo 10.

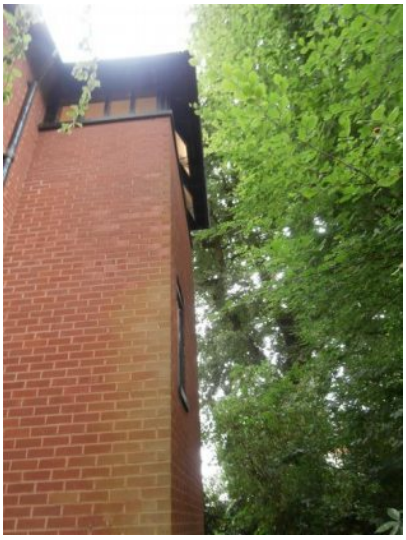


Photo 11.

Photo 12.

Photo 13.

Photo 14.

Photo 15.

Photo 16.

Photo 17.

Photo 18.

Photo 19.

Photo 20.

Photo 21.

Photo 22.

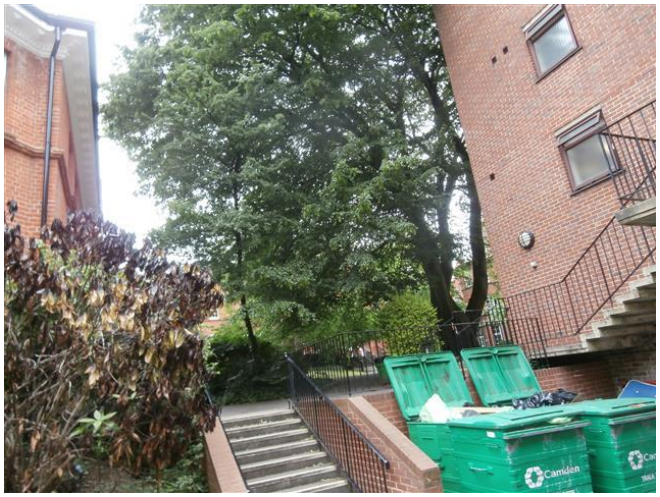


Photo 23.

Photo 24.

Photo 25.

Photo 26.

Photo 27.

8. Photographs of Trench 1

Photo 1. Commencing excavation of trench 1 in relation to the ash tree, T6

Photo 2. Trenches 1 and 2 in relation to the ash tree.

Photo 3. Trenches 1 and 2 in relation to the ash tree.

Photo 4. Trench 1 in relation to the ash tree.

Photo 5. Tape measure is set up from the rear wall of Queen Mother Hall

Photo 6. Tape measures runs alongside trench 1 to enable roots to be plotted.

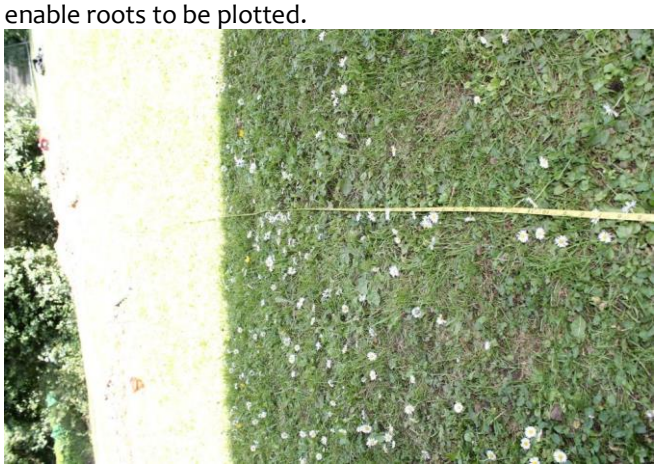


Photo 7. Between 6 and 7m from QMH very little rooting activity.

Photo 8. Between 9 and 10m from QMH the largest root is 8mm dia. one other roots are 8 and 7mm.

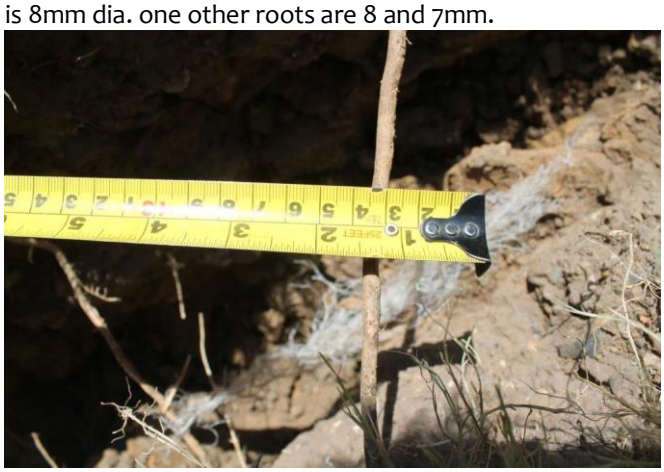


Photo 9. Between 7 and 8m from QMH only one root dia 8mm.

Photo 10. See photo 9

Photo 11. Between 8 and 9m form QMH no roots were found.

Photo 12. Between 9 and 10m from QMH three roots were found.

Photo 13. Between 10 and 11m from QMH is one 35mm root, one 11m root and 3xN° 5mm to 8mm roots.

Photo 14. See photo 13

Photo 15. See photo 13

Photo 16. See photo 13, the 35mm root is 27cm deep

Photo 17. Maximum depth of trench is 67cm. Minimal rooting activity below 40cm deep

Photo 18. Shallowest part of trench is 42cm deep. this was distant from the ash where there was no rooting activity even in the upper soil bhorizons.

Photograph 19. View along the length of Trench 1, facing east

9. Photographs of Trench 2

Photo 1. Trench 2 in relation to the ash

Photo 2. Monitoring point at 0.9m from the end of QMH dictated the max extent of the trenching. Smaller tape is to allow the roots to be plotted.

Photo 3. Between 1m and 2m from the monitoring point were roots of 35mm, 20mm and 20 roots of 2mm to 8mm

Photo 3a. See photo 3

Photo 5b. See photo 3

Photo 3c. See photo 3

Photo 3d. See photo 3

Photo 4. Between 2m and 3m were 14 roots between 2mm and 10mm plus severaal fibrous roots.

Photo 5. Between 3m and 4m were one 30mm root, one 10mm root and 11 2mm - 9mm roots

Photo 5a. See photo 5

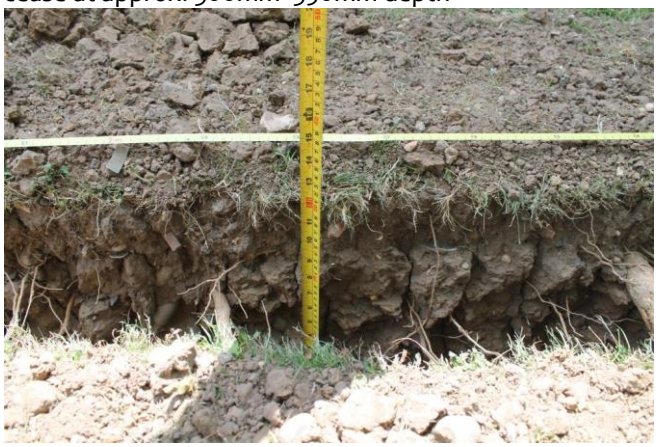
Photo 5b.

Photo 6. Between 4 and 5m was one 11mm root.

Photo 6a. See photo 6

Photo 7. beyond 5mm there were no significant roots

Photo 8. Ground was very hard clay. Even after terraventing to break up the soil the excavation had to cease at approx. 300mm -350mm depth



10. Photographs of Trench 3

Photo 1. Location of Trench 3.

Photo 2. Starting measurement for Trench 3.

Photo 3. Trench 3 between 0m and 0.5m from the monitoring point.

Photo 4. Trench 3 between 0.5m and 1.5m of the start from the trench.

Photo 5. Trench 3 between 1.5m and 2.5m of the start from the trench.

Photo 6. Trench 3 between 2.5m and 3.5m of the start from the trench.

Photo 7. Trench 3 between 3.5m and 4.5m of the start from the trench.

Photo 8. Trench 3 between 4.5m and 5.5m of the start from the trench.

Photo 9. Trench 3 between 5.1m and 5.8m from the start of the trench.

Photo 10. Start of the change in direction of Trench 3 between 0m and 1m.

Photo 11. Trench 3 between 1.5m and 2.5m from the start of the trench direction change.

Photo 12. Trench 3 between 2.5m and 3.5m from the start of the trench direction change.

Photo 13. Trench 3 between 3.5m and 4.5m from the start of the trench direction change.

Photo 14. Trench 3 between 4.5m and 5.5m from the start of the trench direction change.

Photo 15. Trench 3 between 5.5m and 6.5m from the start of the trench direction change.

Photo 16. See Photo 11.

Photo 17. See Photo 6 and 7.

Photo 18. See Photo 8.

11. Signature

This report represents a true and factual account of the trees and potential impact of development at

Kings College London Hampstead Residence
Kidderpore Avenue
Hampstead
NW3 7ST

Signed

.....

Ivan Button N.C.H. (Arb), FDSc (Arb), BSc (Hons), P.G.C.E., M. Arbor. A.

on behalf of

Crown Consultants Ltd

Dated

1st July 2015

CROWN Consultants
Tree consultants throughout England and Wales

Appendix 1: BS 5837: 2012 – Guidance Notes

This Standard prescribes the principles to be applied to achieve a satisfactory juxtaposition of trees and structures. It sets out to assist those concerned with trees in relation to design, demolition and construction to form balanced judgements.

It acknowledges the positive contribution trees may offer to a site, as well as the negative aspects of retaining inappropriate trees. It addresses the negative impacts that construction activity may have upon trees and offers mitigation strategies to minimise these impacts.

The Standard suggests a three stage approach to ensure best practice is followed when developing close to trees:

A1.1 Stage 1: Survey of Existing Trees

This identifies the existing trees on and adjacent to the site. Data is recorded for each tree and is presented in a Tree Data Schedule. Each tree is allocated a ***Retention Category*** according to its size, amenity value, condition and safe useful life expectancy. The categories are allocated independently of development proposals. Our interpretation of the Retention Categories is explained below:

A1.1.1 Retention Categories

A Category: Trees of high quality and amenity value. Usually, mature trees with a significant life expectancy which would enhance any development. Retention of these trees is strongly encouraged.

B Category: Trees of moderate quality and amenity value. Usually these are maturing trees or younger trees with exceptional form. Retention of these trees is desirable though the removal of occasional specimens may be acceptable.

C Category: Trees of low quality or small specimens with a relatively low amenity value. These trees are not considered to be a material planning constraint and their removal will generally be seen as acceptable in order to facilitate development.

U Category: Trees of such low quality that their removal is recommended regardless of development proposals.

A1.1.2 Occasionally trees are borderline and do not fall neatly into one of the categories A, B or C. In such cases we apply a superscript (**+/-**) such that:

C^{+} Indicates borderline C/B, though Category C is deemed to be most appropriate.

B^{-} Indicates borderline C/B, though Category B is deemed to be most appropriate.

A1.1.3 The British Standard suggests that each of the A, B and C categories may be further subdivided (A1, A2, A3, B1, B2, B3 etc) such that subcategory 1 denotes mainly arboricultural values, subcategory 2 denotes mainly landscape values and subcategory 3 denotes mainly cultural values (including conservation). Multiple subcategories may be used.

Our experience suggests that these subdivisions lack clarity and can be confusing. Within this report subcategories are **not** denoted. Where appropriate, the use of phrases such as '*Part of a formal group*', or '*Has a high ecological value*', or '*Offers good screening to the site*' are incorporated into the observation section of the Tree Data Schedule. We believe this conveys all relevant landscape and cultural information without any confusion.

A1.1.4 **Tree Constraints Plan (TCP).** This indicates the position, crown spread, Retention Category and Root Protection Area of each tree. It is used to inform where development may proceed without causing damage to trees.

A1.1.5 **Root Protection Area (RPA).** This is the area around each tree likely to contain the majority of roots. It should ideally remain undisturbed to avoid a detrimental impact on tree health. For single stemmed trees It is calculated according to the formula "radius of RPA" = "12 x stem diameter". For multiple-stemmed trees a more complex formula is used which may occasionally produce an RPA which seems inappropriately large relative to the trees canopy. This shape can then be modified to take into account site factors which influence rooting activity, e.g. foundations, soil type or impermeable surfaces. Where development works are proposed within the RPA they should be undertaken in a sympathetic manner to minimise root disturbance.

A1.1.5 **Shade Constraints.** The previous Standard (BS 5837 2005) suggested that shade constraints should be indicated on the TCP. This are denoted as a circle-segment drawn northwest to due east with a radius equal to the height of the tree. These do not represent the actual shade pattern which varies through the seasons. Rather, they indicate the area most shaded by the tree throughout the course of the year. Ideally habitable room windows should be located outside of these shade constraints. Where we consider it appropriate, we will include shade constraints information on our Impact Assessment Plan or Proposed Layout Plan.

A1.2 Stage 2: Arboricultural Impact Assessment

After the initial survey and the production of the Tree Constraints Plan, arborists and designers are encouraged to work together to establish a design proposal with minimal impact on the high quality trees. An assessment should be made of all possible impacts including the impact that the trees may have upon the proposal. The arborist may recommend mitigation strategies to minimise these impacts and help achieve a more harmonious juxtaposition between buildings and trees.

A1.3 Stage 3: Arboricultural Method Statement

This type of report specifies the measures necessary to protect trees against damage from construction activity. The Method Statement should be written in a manner that it may be conditioned and enforced by the local authority upon granting of planning permission. The site manager should be familiar with all aspects of the Method Statement and should ensure that all persons working on the site are aware of those aspects which appertain to their work. This includes service installation engineers and operators of plant machinery.

Appendix 2: Explanation of Tree Data & Glossary

This section explains the terms used in the **Tree Data Schedule** (see Section 3 and Appendix 6).

A4.1 General Observations

A4.1.1	**Numbering System:**	Each item of vegetation has its own unique number prefixed by a letter such that T1=Tree 1, G2=Group 2, H3=Hedge 3 and W4=Woodland 4, S5=Shrub 5.
A4.1.2	**Age Categories:**	
	Young	Usually less than 10 years old.
	Semi-Mature	Significant future growth to be expected, both in height and crown spread (typically below 30% of life expectancy).
	Early-Mature	Full height almost attained. Significant growth may be expected in terms of crown spread (typically 30-60% of life expectancy).
	Mature	Full height attained. Crown spread will increase but growth increments will be slight (typically 60% or more of life expectancy).
	Veteran	A level of maturity whereby significant management may be required in order to keep the tree in a safe condition.
	Over Mature	As for veteran except management is not considered worthwhile.
A4.1.3	**Species:**	Common names and Latin names are given.
A4.1.4	**Height:**	Measured from ground level to the top of the crown.
A4.1.5	**Stem Diameter:**	Taken at 1.5m above ground level where possible. On multi-stemmed trees this measurement may be taken at ground level, though usually an indication of the number of stems and average diameter is given, e.g. 3 x 30cm.
A4.1.6	**Crown Height:**	Measured from ground level to the height at which the main crown begins. Where the crown is unbalanced it is measured on the side deemed to be most relevant. This is usually the side facing the area of anticipated development.
A4.1.7	**Tree Diagram:**	This scaled drawing is computer generated based on measurements taken for stem diameter, crown height and spread, and overall height. It is designed to help the reader rapidly assess the data. It is not an accurate representation of the form of the tree.
A4.1.8	**Crown Spread:**	Measured N, E, S & W, taken from the centre of the stem and usually rounded up to the nearest metre.
A4.1.9	**Observations:**	If a tree's position is considered to be relevant it will be commented upon (e.g. overhanging a children's play area). Tree form and pruning history are also recorded along with an account of any significant defects. Defects and descriptive terms are dealt with in more detail at the end of this section.
A4.1.10	**Recommendations:**	Usually based on any defects observed and intended to ensure that the tree is in an acceptable condition.
A4.1.11	**Priority Scale:**	Depending upon the threat posed by the tree, and the likelihood of failure, recommendations should be carried out according to the following priority scale:
	Urgent	To be carried out as soon as possible.
	Very High	To be carried out within 1 month.
	High	To be carried out within 3 months.
	Moderate	To be carried out within 1 year.
	Low	To be carried out within 3 years.
A4.1.12	**Inspection Frequency:**	An interval of 6 months, 1 year, 1.5 years or 3 years is allocated before the next inspection is due. Wherever practical, consideration should be given to seasonal changes so that deciduous trees are not always surveyed in winter when they have no leaves, or in summer when leaves may obscure branches within the upper crown.
A4.1.13	**Vigour:**	An indication of growth rate and the tree's ability to cope with stresses:
	High	Having above average vigour.
	Moderate	Having average vigour.
	Low	Having below average vigour.
	Very Low	Tree is struggling to survive and may be dying.
A4.1.14	**Physiological Condition:**	
	Good	Healthy and with no symptoms of significant disease.
	Fair	Disease present or vigour is impaired.
	Poor	Significant disease present or vigour is extremely low.
	Very Poor	Tree is dying.
A4.1.15	**Structural Condition:**	
	Good	Having no significant structural defects.
	Fair	Some defects observed though no high priority works are required.
	Poor	Significant defects found. Tree requires monitoring or remedial works.
	Very Poor	Major defects which will usually require significant remedial works or tree removal.
A4.1.16	**Amenity Value:**	
	Very High	Exceptional specimen, observable by a large number of people.
	High	Attractive specimen, observable by a significant number of people.
	Moderate	One of the above factors is not applicable.
	Low	Unattractive specimen or largely hidden from view.
A4.1.17	**Life Expectancy:**	The estimated number of years before the tree may require removal. Classified as (<10), (10 – 20), (20 – 40), or (40+).
A4.1.18	**Retention Category:**	These are explained in detail in Appendix 1.

A4.2 Evaluation of Defects

A4.2.1 Cavities, wounds, deadwood etc are all evaluated as follows:

Major	Such that structural integrity is, or will become, compromised and the tree is, or will inevitably become, hazardous.
Significant	A defect that may over time become a major defect, though not necessarily so. This will depend on the vigour of the tree and its ability to deal with decay etc.
Minor	A defect that is not likely to compromise the tree's structural integrity.

General Glossary

Adaptive growth	In tree biomechanics, the process whereby wood formation is influenced both in quantity and quality by the action of gravitational forces and mechanical stresses on the cambial zone.
Aerobic	Conditions in which oxygen is freely available, or to biomechanical processes that depend on the presence of oxygen.
Anaerobic	A condition marked by the absence of oxygen; Generally such areas are unsuitable for normal life and growth of plant tissues. These sites tend to be populated by bacteria capable of surviving low oxygen conditions often associated with Slime Flux.
Arboriculture	The culture and management of trees as groups and individuals primarily for amenity and other non-forestry purposes.
Arborist	A person possessing the technical competence through experience and related training to provide management of trees or other woody plants in a landscape setting. Generally involved with the development or management of trees for visual amenity or land management rather than the growth of trees for product or profit.
Barrier zone	A layer within an annual increment of wood which contains abnormal xylem cells, laid down by the cambium in response to wounding or other trauma.
Body language	In trees, the outward display of growth responses and or deformation in response to mechanical stress.
Bole	Or Trunk, the main stem of a tree below its first major branch.
Bracket	A type of fruiting body produced by various fungal species, plate like to hoof like in shape and often a one sided attachment to the wood or bark.
Branch bark ridge	A ridged area located at the union of a branch to a trunk or stem.
Branch Collar	Trunk tissue that forms around the base of a branch between the main stem and the branch, or between a main branch and a lateral branch. As a branch decreases in vigour or begins to die, the collar usually becomes more pronounced and completely encircles the branch.
Brown Rot	Form of decay where cellulose is degraded, while lignin is only modified.
Buttress Root	Roots that emerge from the base of the tree stem, normally large and well developed that rapidly reduce in diameter to create the Root Plate this offers structural support for the tree. Buttress roots divide rapidly forming the connection between the stem and the transport roots.
Cabling Bracing	Installing cables within the crown of a tree to prevent collapse.
Callus	Undifferentiated cells often formed at the edges of recent injuries. This tissue quickly becomes differentiated, forming cells of the type characteristic of that position on the tree (e.g. forming wood, bark, roots, etc.) see wound response tissue.
Cambium	A thin layer of actively growing and dividing cells, located between the xylem (sapwood) and bark of a plant; the part responsible for radial growth of a tree stem or branch.
Canopy	The topmost layer of twigs and foliage in a woodland, tree or group of trees.
Canker	A localised area of dead bark and cambium on a stem or branch, caused by fungal or bacterial organisms, characterised by woundwood development on the periphery. This may be annual or perennial.
Cavity	An open and exposed area of wood, where the bark is missing and internal wood has been decayed and dissolved.
Chlorotic	Also Chlorosis. A condition of the plant marked by yellowing of normally green foliage, often indicating nutrient deficiency or plant dysfunction.
Clinometer	Devices that measures vertical angles, and provides direct height measurements of objects by triangulation.
Co-dominant stems/trunk	Are forked branches or trunks of nearly the same size in diameter and lacking a normal branch union.
Compacted soils	Soils in which the air-space (oxygen space) has been reduced or eliminated, reducing water infiltration and percolation, reducing root presence and inhibiting new root development.
Compartmentalisation	The physiological process that creates the chemical and mechanical boundaries that act to limit the spread of disease and decay organisms.
Compression Failure	Localized buckling of fibres and other longitudinal elements produced by compression of wood along the grain; compression failures sometimes develop in standing trees.
Compression Strength	The ability of a material or structure to resist failure when subjected to compressive loading; measurable in trees using special drilling devices
Compression Wood	Abnormal wood formed on the lower side of branches and curved stems, with physical properties different from normal wood.
Conservation Area	In Great Britain, designated areas of architectural or historical interest, in which there are special procedures for planning applications. Additionally tree works cannot generally be undertaken without prior notification (Currently 6 weeks) to the relevant local planning authority. See also Tree Preservation Orders.
Core Sample	A sample of wood extracted from a trunk or branch, using an increment borer tool. The resulting core can be analysed for characteristics of growth, wood strength, structure, decay, and for species identification.
Crotch	The union of two or more branches; the auxiliary zone between branches.
Crown	The upper canopy of a tree, including upper trunk, scaffold branches, secondary branches, stems and leaves.
Crown lifting / raising	Crown Lift The removal of the lowest branches, usually to a given height. It allows more residual light and greater clearance underneath for vehicles etc.
Crown reduction	The reduction of a tree's height or spread while preserving its natural shape.
Crown thinning	The removal of some of the density of a tree's crown, usually 5-25% allowing more light through its canopy and reducing wind resistance.
Deadwood (noun)	Deadwood is often present within the crown or on the stems of trees. It may be an indication of ill health, however, it may also indicate natural growth processes. If a target is present beneath the tree, deadwood may fall and cause injury or damage and should be removed, otherwise deadwood can remain intact for conservation purposes (insects, fungi, birds etc.).
Deadwood (verb)	The removal of dead branches from a tree's canopy, usually of a specified size (in diameter).
Decay	Progressive deterioration of organic tissues, usually caused by fungal or bacterial organisms, resulting in loss of cell structure, strength, and function. In wood, the loss of structural strength.
Decay Detection	The assessment of decay within a tree has been traditionally difficult, but recent advances have made it possible to achieve accurate representations of the internal section of a tree in both 2D and 3D, removing doubt over the condition of the tree and allowing accurate management decisions.
Defect	In relation to tree hazards, any feature of a tree which detracts from the uniform distribution of mechanical stress, or which makes the tree mechanically unsuited to its environment.
Defoliation	The losing of plants foliage.
Dieback	Progressive death of buds, twigs and branch tissues, on individual limbs resulting in Deadwood, or throughout the canopy,

	extreme cases can result in Stag Heading.
Dripline	A projected line on the ground that corresponds to the spread of branches in the canopy; the farthest spread of branches.
Epicormic shoots	Fast growing, weakly attached shoots/branches that often grow as a response to stress factors upon a tree or branch removal.
Failure	In connection with tree hazards, a partial or total fracture within the wood tissue or loss of cohesion between roots and soil. (In total failure affected parts will snap or tear away completely, Partial failure there is a crack or deformation, which results in an altered distribution of mechanical stress.
Feeder Roots	Fine fibrous Water and nutrient absorbing roots located in the outer root system.
Flush-Cut	In trees and shrubs, a pruning cut close to the parent stem, which removes the branch bark ridge.
Foliage	The live leaves or needles of the tree; the plant part primarily responsible for photosynthesis.
Formative pruning	The trimming of a tree to remove weaknesses and irregularities which may lead to problems. The formative pruning operation is aimed at reducing the potential for future weaknesses or problems within the tree's crown.
Gall	An abnormal, disorganized growth of plant tissues, caused by parasitic or infectious organisms such as insects, fungi, bacteria, or viruses.
Girdling	In woody plants, any form of damage that destroys the bark and / or the Cambium all the way around the stem, branch or root, normally resulting in death of the damaged section.
Girdling Root	In woody plants, a root that grows across the buttress, or across other roots, eventually causing constriction of the radial growth.
Growth Increment	The incremental growth added as new annual ring develops each season over existing wood. This is seen as (growth) rings in cross-sections of wood.
Hazard beam	An upwardly curved branch in which strong internal stresses may occur without the compensatory formation of extra wood (longitudinal splitting may occur in some cases).
Heartwood	Inner non functioning tissues that provide structural support to trunk.
Heave	In relation to shrinkable clay soils, expansion due to rewetting of a volume of soil previously subjected to the removal or water by plant / trees following felling or root severance. Also in relation to root growth, the lifting of pavements and other structures by radial expansion. Also in relation to tree stability, the lifting of one side of a wind rocked root plate.
Herbicide	A chemical compound that causes the death of a plant.
Included Bark	Bark that becomes embedded in a crotch between branch and trunk or between co-dominant stems, usually found in narrow or tight crotches, and causes a weak structure.
Increment Borer	A tool that cuts and extracts a narrow cylinder of wood from a tree for analysis of the wood tissue and growth increments.
Leader	The primary terminal shoot or trunk of a tree.
Limb	A large lateral branch growing from the main trunk or from another larger branch.
Lion Tailing	Often the result of poor pruning practices; the main leader or branches are largely devoid of side branches, growth is restricted to the end of branches and is likely to suffer damage through end loading.
Lopping	In trees, a general term that related to the removal of branches from a tree.
Monitoring	Due to the relative life span of trees in relation to our own, long-term monitoring provides a valuable insight to the health of trees, identifying decline and or stabilisation and or improvement.
Mulch	A material laid over the root system of a tree to help conserve moisture within the soil. Additionally it may help control the development of weeds close to the tree.
Mycelium	A mass of growing filaments (hyphae) formed by fungi.
Mycorrhizae	The symbiotic relationship between roots and certain beneficial fungi. Mycorrhizae are the combined root / fungal growth.
Occluding tissue	The general tern of wood, cambium and bark that develop around the site of a wound on a woody plant
Pathogen	A microorganism that causes diseases within another organism.
Phloem	The principle conductive tissue that the products of Photosynthesis are transported around the plant
Photosynthesis	The process were light energy is used to create energy (Carbohydrate) for use within the plant.
Pollard	A term for a pollarded tree.
Pollard head	The swollen section of branch / stem that forms behind the pollarding cut.
Pollarding	The complete or partial removal of the crown of a young tree so as to encourage the development of numerous branches either for amenity or historically as fodder, repeated management is required cyclically to maintain the feature
Prune or Pruning	Selective removal of woody plant parts of any size, using saws, Loppers, Secateurs, or other pruning tools.
Reaction Wood	Wood with distinctive anatomical characteristics, formed in parts of leaning or crooked stems and in branches to provide additional strength / support. In hardwoods, tension wood usually forms. In conifers, compression wood is usually found.
Reaction Zone	A zone normally darker than surrounding wood that denoted the boundary often a defensive one between functional sapwood and dysfunctional or decaying wood.
Re-grading	The raising or lowering of a soil profile from its original grade.
Remedial pruning	The removal of old stubs, deadwood, epicormic growth, rubbing or crossing branches and other unwanted items from the tree's crown.
Resistograph	Invasive decay detection technique whereby the resistance offered by the timber to a spinning probe is measured and plotted.
Rib	In tree body language, a long narrow, axial protuberance which often over lays a crack.
Ring Barking	Artificial Girdling of the stem, to result in the death of a tree. May be used in habitat creation were the retention of dead standing trees is required.
Rod Bracing / Bolting	Traditionally, this has relied upon the Installation of steel rods or bolts through the stems or limbs, to reduce twisting or splitting of the wood. The installation of such features does require legal interpretation.
Root Barriers	Both Buildings and services can benefit from the installation of root barriers to protect a soil volume from the ingress of roots.
Root Collar	The basal area of the tree; transition zone from trunk to root. Also sometimes called trunk flare.
Root Plate	The primary support area for the tree; an area of the root system close to the base that structurally anchors the tree to the soil.
Root Rot	Either a general term for decay within the wood of the lower stem / buttress roots, or a disease in which the fine roots are killed.
Root System	The portion of the tree containing the root organs, including buttress roots, transport roots, and fine absorbing roots; all underground parts of the tree.
Root Zone	The area and volume of soil around the tree in which roots are expected. May extend to three or more times the branch spread of the tree, or several times the height of the tree.
Sail Area	That area or the tree subjected to wind load.

Sapwood	**Xylem wood tissue, usually light in colour, representing the outer growth rings of the wood. Usually living, reactive wood tissue, in a healthy tree. See heartwood**
Scaffold limbs / scaffold Branches	**The branches that from the main network framework of the crown of a tree.**
Senescent	**A decline in growth and vigour due to age or stress factors.**
Shrub	**A woody plat that branches at or close to the ground level and so does not have a single stem.**
Slime Flux	**Relating to a toxic condition from the spreading of bacteria or their products from a source of infection; characterized by malodorous gases, or salt deposits upon the bark. If these products enter the sap stream, localised vessel necrosis can result, usually associated with anaerobic conditions.**
Soft Rot	**A kind of wood decay, were a fungi degrades cellulose within the cell wall, without causing overall degradation.**
Soil Compaction	**The compression of soil, causing a reduction of pore space and an increase in the density of the soil. Air is squeezed out and nutrients become locked. Tree roots cannot grow in compacted soil.**
Sonic Decay Detection	**Non invasive method whereby sound waves are passed through the tree and the speed is measured. Slow speeds indicate decay and a tomography picture representing the inner stem is produced.**
Stag Heading	**In a tree, a state of dieback were dead branches protrude beyond the current living crown.**
Stress	**In plant physiology, conditions were one or more physiological functions Are not working within normal parameters.**
Stump Grinding	**The removal of a tree stump using a specialist grinding machine.**
Subsidence	**In relation to vegetation, the removal of water by plant growth resulting in localised shrinkage in the soil volume.**
Sucker	**Same as sprout.**
Suppressed	**Trees which are dominated by surrounding vegetation and whose crown development is restricted from above.**
Systemic	**Affecting the whole plant or organism. A systemic compound is carried throughout the entire plant to all parts through the vascular system.**
Target	**Any person or object within reach of a falling tree or part of a tree that may be injured or damaged.**
Target Pruning	**The pruning of a branch were the wound affects only branch material, often result in a target shaped wound.**
Tension Wood	**Reaction wood typically formed on the upper side of limbs or curved stems; characterized by lack of cell wall lignifications (higher ratios of cellulose to lignin).**
Tight Union / Tight Crotch	**Also, narrow crotch. A crotch with a narrow angle between branches, often having included bark.**
Tomography	**The comparison of sound or stress waves through the tree allows the creation of a 2D or 3D representation of the internal structure of a stem or branch section and highlights areas of damage. Virtually non-injurious.**
Topography	**The configuration of surface features, including the vertical and horizontal relationships of the ground and other features.**
Topping	**Cutting large limbs back severely, without regard to form or habit of the tree. Cuts are usually made between lateral branch nodes. This practice is extremely injurious to trees, and promotes decay and structural weakness within the crown.**
Tree	**A woody plant that typically has a single stem, at maturity has a height of a least 4 metres and a stem diameter at breast height of at least 75mm.**
Tree Preservation Order	**In Great Britain, an order made by the local planning authority, were consent must be gained before undertaking all but exempt works to a tree.**
Trunk Flare	**The basal area of the trunk that flares or widens, and merges with the main roots. See root collar**
Veteran Tree	**Veteran trees are often found in large parks or estates and commonly affected by extensive decay or have been subject to extensive works. These trees are retained for historical importance and often pose greater risk than normal, which is generally justified. They need careful management and often propping or bracing to support them, some require fencing to limit access.**
Vigour	**Active, healthy growth of plants: ability to respond to stress factors.**
Visual Tree Assessment (VTA)	**An assessment of the mechanical condition of trees based upon their 'body language'. Trees are dynamic and respond to faults / decay / environmental factors in various ways, these responses can be indicative of structural integrity.**
Wetwood	**An infection caused by bacteria living inside the plant tissues. The bacteria ferment the plant fluids, resulting in death of nearby cells, and often causing exudations of fluid from the bark, often referred to as a Slime Flux.**
White Rot	**A kind if wood decay were a fungi attacks the lignin within the wood matrix**
Wind loading	**Forces placed upon tree canopy, branches, trunk and roots of a tree under windy conditions.**
Wind Throw	**The failure of a tree due to wind loading.**
Witches Broom	**A deformed or unusual growth of twigs from adventitious buds, caused by insects, disease, or dieback of twigs and buds.**
Wood	**Secondary Xylem; the main structural support and water conducting tissue of trees and shrubs.**
Wound Response Tissue	**Also Occluding Tissue, Wound Wood or Callus. Differentiated wood tissue that grows around the margins of a wound or injury.**
Wound Wood	**Wood with atypical features, formed in the vicinity of a wound and a term to describe the occluding tissues around a wound**
Xylem	**Plant tissues with special function of translocation of water and dissolved nutrients.**

Appendix 3: Survey Methodology

A2.1 Ground level visual surveys are carried out using the *Visual Tree Assessment* technique described by Mattheck and Broeler (1994) and endorsed by the Arboricultural Association (LANTRA Professional Tree Inspection course, 2007).

A2.2 Structural condition is assessed by inspecting the stem and scaffold branches from all angles looking for weak branch junctions or symptoms of decay. Particular attention is paid to the stem-base. Cavities are explored using a metal probe in order to assess the extent of any decay. If this is not possible further inspection is recommended in the form of a climbed inspection or using specialist decay detection equipment.

A2.3 The physiological condition is assessed by inspecting the stem, branches and foliage for symptoms of disease. The overall vigour of the tree is also taken into account.

A2.4 Where significant defects are observed, recommendations are made according to a scale of priority in order to reduce the likelihood of structural failure. The position of the tree and its potential targets are taken into account.

A2.5 Measurements are obtained using a diameter tape, clinometer, distometer and loggers tape. Where this is not practical measurements are estimated.

A2.6 Some trees are surveyed as groups, though this is usually avoided close to areas likely to be developed.

A2.7 Finally, a *Retention Category* is allocated as described in Appendix 1.1.1.

Appendix 4: Author's Qualifications

Qualifications & Experience of Ivan Button N.C.H. (Arb), FDSc (Arb), BSc (Hons), P.G.C.E., M. Arbor. A.

Construction

Between 1983 and 1995 Ivan worked primarily within the construction industry and received training in a broad range of practical building skills and general construction principles. During this time he obtained a BSc (Hons) at Leeds University followed by a P.G.C.E at The University of Wales.

Arboriculture

He obtained a NCH (Arboriculture) at the University of Lincoln and became a member of the Arboricultural Association. He then worked for an Arboricultural Consultancy for one year before establishing a tree surgery and landscaping business in 1998. In 2005 Ivan commenced full time employment with a leading Arboricultural Association approved consultancy and soon adopted a senior role responsible for five consultants.

He obtained a FDSc in arboriculture at the University of Lancashire, which he passed with distinction and is now a Director and Principal Consultant of Crown Consultants Ltd. He is accredited as a LANTRA *Professional Tree Inspector*. A qualification produced in association with the Arboricultural Association and generally recognised as appropriate for all levels of tree inspection.

He is a member of the Consulting Arborist Society and is listed within their areas of professional expertise for QTRA and as an expert witness.

Ivan is a professional member of the Arboricultural Association and the International Society of Arboriculture.

He is a licensed Quantified Tree Risk Assessment user.

Ivan has undertaken professional expert witness training and has been registered as a Sweet and Maxwell Checked Expert Witness since 2008.

Throughout 2009 acted as the principal Tree Officer for Barnsley Metropolitan Borough Council.

Ivan has produced several hundred Arboricultural Reports for the purposes of Development, Safety, Management, Mortgage, Subsidence, Mitigation and Litigation.

Appendix 5: Further Information

Building Near Trees – General

National Joint Utilities Group publication # 10 (1995), *Guidelines for the Planning, Installation and Maintenance of Utility Services in Proximity to Trees. Downloadable at www.njug.demon.co.uk/pdf/NJUG%20Publication10.pdf*

NHBC Standards Chapter 4.2., *Trees and Buildings.*

Horticulture LINK project 212. (*University of Cambridge,* 2004), *Controlling Water Use of Trees to Alleviate Subsidence Risk.*

Tree Planting and aftercare

See www.trees.org.uk/leaflets.php# for downloadable leaflets on selecting a garden tree, planting, aftercare and veteran tree management.

British Standards

BS 5837: 2012. Trees in Relation to Design, Demolition and Construction – Recommendations.
Bs 3998: 2010. Recommendations for Tree Work.
BS 3936: 1992. Nursery Stock. Part 1: Specification for Trees and Shrubs.
BS 3936: 1992. Nursery Stock. Part 10: Specification for Groundcover Plants.
BS 4043: 1989. Transplanting Root-balled Trees.
BS 8004: 1986. Foundations.
BS 8103: 1995. Structural design of Low-Rise Buildings.
BS 8206: 1992. Lighting for Buildings.
BS 8545:2014. Trees: From nursery to independence in the landscape – Recommendations
BS 3882: 2007. Topsoil.
BS 4428: 1989. General Landscaping Operations (excluding hard surfaces).

Permission to do Works to Protected Trees / Tree Law

Forestry Commission (Edinburgh, 2003), *Tree Felling – Getting Permission*. Country Services Division - Forestry Commission. Downloadable at www.forestry.gov.uk/website/pdf.nsf/pdf/wgsfell.pdf/$FILE/wgsfell.pdf

Transport and the Regions (Department of the Environment, 2000), *Tree Preservation Orders, A Guide to the Law and Good Practice*. Downloadable at www.communities.gov.uk/publications/planningandbuilding/tposguide

C. Mynors, *The Law of Trees, Forests and Hedgerows* (Sweet and Maxwell, London, 2002)

Communities and Local Government website with numerous downloadable documents, from: http://www.communities.gov.uk/planningandbuilding/planning/treeshighhedges/

Lighting Levels

P.J. Littlefair, *B.R.E. 209: Site layout planning for daylight and sunlight A guide to good practice.* B.R.E. Bookshop, London.

British Standards Institution. Code of practice for day lighting. *British Standard* BS 8206: Part 2 (1992).

Chartered Institution of Building Services Engineers. *Applications manual: Window Design* (London, 1987).

NBA Tectonics. A study of passive solar housing estate layout. *ETSU Report* S-1126. Harwell, Energy Technology Support Unit (1988).

I.P. Duncan; D. Hawkes, Passive solar design in non-domestic buildings. *ETSU Report* S-1110. Harwell, Energy Technology.

P. J. Littlefair, Measuring Daylight, *BRE Information Paper 23/93 f3.50.* (Advises on measuring daylight under the real sky or an artificial sky, allowing for the changing nature of sky light).

High Hedges

Communities and Local Government website with numerous downloadable documents, from: http://www.communities.gov.uk/planningandbuilding/planning/treeshighhedges/

Tree Specific Websites

www.crowntrees.co.uk	Crown Consultants site containing useful information
www.trees.org.uk	Arboricultural Association
www.rfs.co.uk	Royal Forestry Society of England, Wales and N. Ireland
www.treehelp.Info	The Tree Advice Trust
www.woodland-trust.org.uk	The Woodland Trust
www.treecouncil.org.uk	The Tree Council

Appendix 6: Tree Data Schedule and Site Plan(s)

The Tree Data Schedule and all plans accompanying this report follow this page. They are also provided as separate documents for ease of printing and referring between when viewing on a screen.