



# AVArboriculture

**Arboricultural Survey**  
To British Standard 5837 (2012)

**Client:** Harry Wood  
**Location:** Scottish Opera, 40 Edington Street,  
Glasgow G4 9RD

**Date of Survey:** 19th & 29th December 2023

**Survey Location:**

Scottish Opera  
40 Edington Street  
Glasgow G4 9RD

**Survey commissioned by:**

Harry Wood

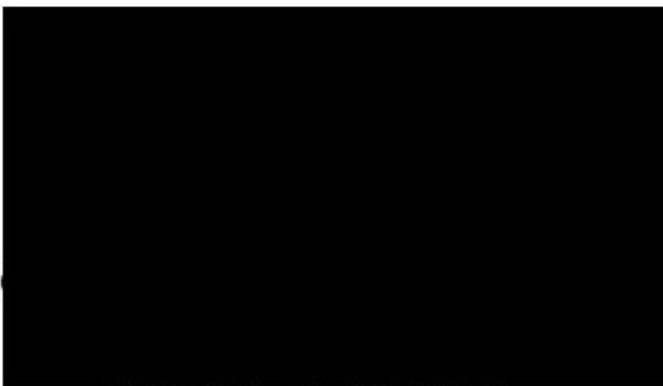
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Signe



Michael J Charkow

Date: 3rd January 2024

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## 1 Client Brief and Overview

- 1.1 Mike Charkow of Arbor Vitae Arboriculture Ltd was instructed by Harry Wood to carry out an arboricultural survey of trees at Scottish Opera, 40 Edington Street, Glasgow G4 9RD.
- 1.2 The trees are not within a conservation area. No details regarding tree preservation orders were found.
- 1.4 The survey was carried out on the 19th & 29th December 2023. Visibility was moderate to good.
- 1.5 Decisions regarding risk from trees are made on the principle of what is reasonably practicable (Health and Safety Executive, 2001). In essence, this is the process of balancing the costs (i.e. money, time, effort and so on) of implementing risk-control measures against the benefits that would be gained. If a risk is present but is deemed to be “as low as reasonably practicable” (ALARP) then the management decision may be ‘no work required’. For instance, it would be deemed unreasonable to spend 1 million pounds on removing all small dead branches from a public park in order to prevent 1 incident of a minor bump on the head. The risk from trees cannot be removed, however the tree owner’s duty of care is being met if this risk has been competently assessed as being as low as reasonably practicable.

Work recommendations have been made according to the surveyors’s assessment of occupancy. The tree owner should assess the work recommendations according to their own knowledge of site usage; any proposed amendments to the tree management recommendations should be discussed with the tree assessor.

- 1.6 The tree survey forms part of the development design process, recording the trees in their current context. The aims of the tree survey are:
- to categorise the trees as to their suitability for retention in terms of their quality and value. Quality is based on the tree’s condition, and importance in terms of cultural, species, aesthetic or ecological significance.
  - to minimise unnecessary impact to the retained tree population and demonstrate the constraints and opportunities available in the positioning of building and other work activity.



2 Tree Constraints Plan





### 3 Survey Findings

- 3.1 213 individual trees and 6 groups were recorded.
- 3.2 No trees (including groups) were categorised as 'A'; 173 as 'B', 3 as 'C' and 8 as 'U'.
- 3.3 See [appendix 8](#) for retention category definitions. Category A and B trees should be retained where possible. Category C trees could be removed, transplanted or replaced elsewhere on site, if this is necessary and feasible. Category U trees are not considered to be suitable for retention.
- 3.4 No trees (including groups) were classed as mature, 77 as early-mature, 105 as young and 2 as dead.
- 3.5 170 trees (including groups) were rated as being in good condition, 6 as moderate, 6 as poor and 2 as dead.
- 3.6 Full tree survey data can be found in the accompanying document 'Scottish Opera tree schedules'.
- 3.7 Root protection areas (RPAs) are estimates based on calculations and recommendations within British Standard 5837 (British Standards Institute, 2012) and some may have been adjusted to accommodate for assumed ground conditions. Actual rooting areas are often biased towards the prevailing wind, or uphill on a slope.

#### **Condition and recommendations**

- 3.8 6 trees were recommended for removal due to their condition (tags 95, 100, 101, 129, 150, 157, NT1 & NT2).
- 3.9 An early-mature Goat Willow (139) was recommended for the removal of one decaying stem, which could fail onto a footpath.

#### **Conflicts with trees**

- 3.10 The proposed development would conflict with many of the trees. A full analysis should be carried out once the design has been finalised; this should be presented as an Arboricultural Method Statement (AMS) and Tree Protection Plan (TPP).

## Appendix 1: **Bibliography**

British Standards Institute (2010), *BS 3998 'Recommendations for Tree Work'*, BSI, London.

British Standards Institute (2012), *BS 5837 'Trees in Relation to Design, Demolition and Construction - Recommendations'*, BSI, London.

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The National Tree Safety Group (NTSG), *Common sense risk management of trees*, Forestry Commission (December 2011).

Roberts, J., Jackson, N. & Smith, M. (2006), *Tree Roots in the Built Environment*, TSO, London.

Slater, D. *The structure and risk of junctions in trees*, at The Arboricultural Associations' 46<sup>th</sup> Annual Amenity Arboriculture Conference, (4<sup>th</sup> September 2012), Reading.

Strouts, R.G. & Winter, T.G. (1994), *Diagnosis of Ill-Health in Trees*, TSO, London, UK.

### Legislation

Countryside Rights of Way Act (2000).

Nature Conservation (Scotland) Act (2004).

Town and Country Planning Act (Scotland) (1997).

Appendix 2: **The Author's Qualifications and Experience**

Mike Charkow holds the Level 4 Certificate in Arboriculture, and also the LANTRA Professional Tree Inspection Certificate. He has been working in the industry since 2004 as both a contracting and consulting arborist.

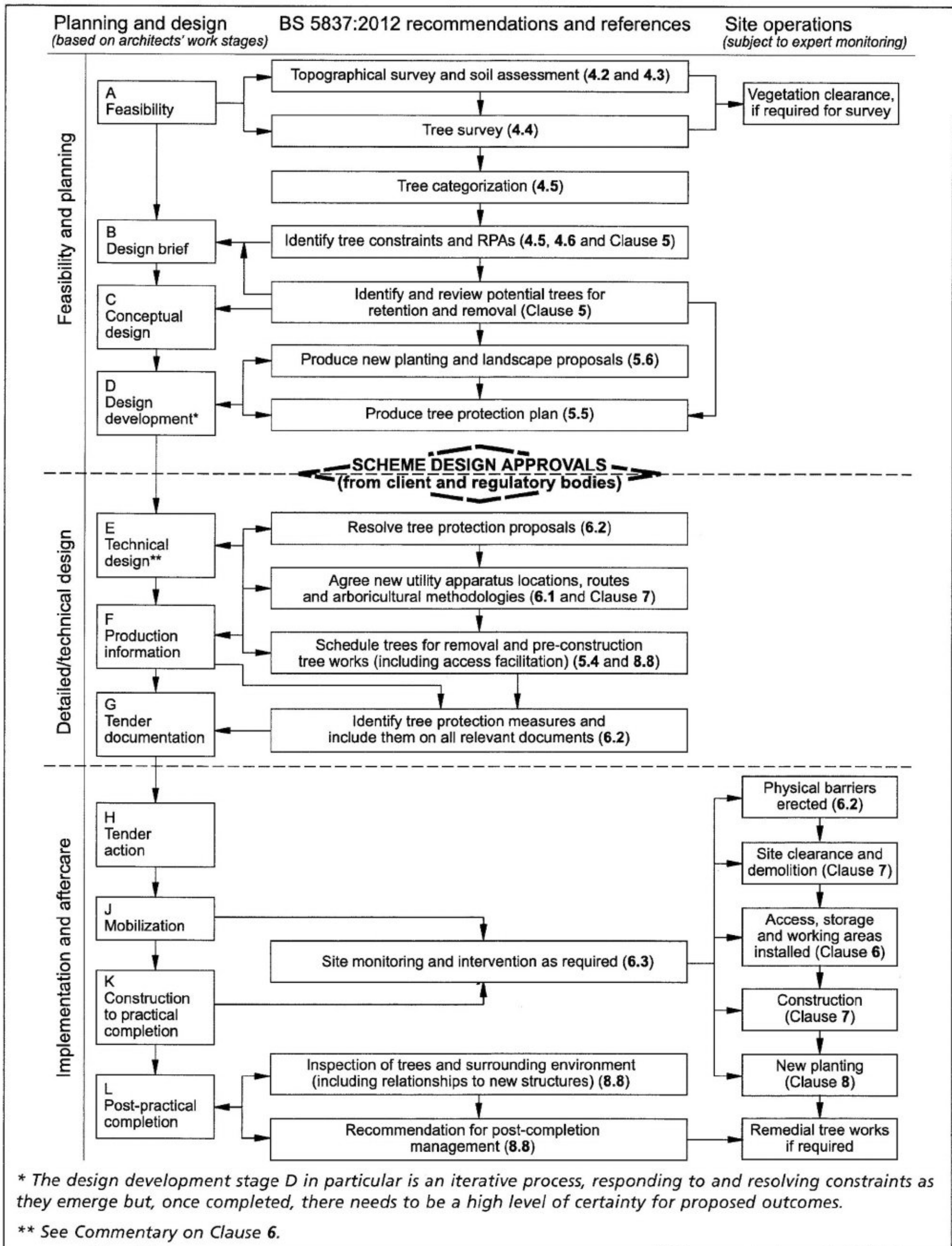
As part of a continual professional development program, Mike regularly attends professional seminars, conferences, training days and meetings.

He has been accredited by 'Echoes Ecology Ltd' as a competent person to inspect trees for bats and their roosts.

He is a member of the Arboricultural Association and the Consulting Arborist Society.




Appendix 3: **BS5837 Figure 1: Trees in the Planning Process**





## Appendix 4: Tree Survey Methodology

- A4.1 The criteria for selecting trees for surveying are specified in BS5837 (2012), i.e. they: have a minimum diameter of 75mm at 1.5m above ground level; have part of their crown extending into the site; or their root protection area extends into the site. Only trees plotted on the supplied topographical survey were surveyed.
- A4.2 Only information relevant to the development plans have been recorded, i.e.:
- Trees within the area marked for a tree survey (i.e. the proposed extent of development) have been located and the following details recorded: species, height, diameter, condition, observations, bat habitat potential, retention category, work recommendations, crown spreads.
  - Trees outwith the tree survey area but with root protection areas or crown spreads falling within the area have been located and tagged if possible. The same details have been recorded, with the addition of relevant crown dimensions.
- A4.3 A topographical drawing with the trees located was supplied.
- A4.4 Individually numbered plastic tags were attached to the trees with a nail, except where the trees were located outwith the site, access was restricted or the tree was too small to attach a tag.
- 
- A4.5 A 'Haglof' electronic clinometer was used for measuring tree heights to within 0.5 metres. A diameter tape was used to measure tree diameters to within 10 millimetres.
- A4.6 The tree genus and species have been recorded using their common English name and botanical name.
- A4.7 Recommendations for management of the trees refer mainly to follow-up inspections and tree surgery for remedial work, or for the removal of hazardous trees. These works are recommended where there is a perceived hazard to people or property in the tree's predicted context of a proposed development (see BS5837:2012, clause 4.4.2.1). Any works will require a detailed work specification: this is out-with the scope of this report.
- A4.8 Some retained trees may require facilitative pruning of branches prior to development work. This pruning work protects trees from possible damage caused by contact with machinery during construction. This work can only be specified once the development has been approved and final plans drafted. A suitably qualified arboriculturist should be approached for recommendations for facilitative pruning before the development site is worked on.
- A4.9 Trees were inspected - where possible - using the Visual Tree Assessment method (VTA) as developed by Claus Mattheck and Helge Breloer (1994). This is a widely accepted methodology that takes into account structural and physiological symptoms from which judgements can be made regarding the risk from the tree.



A4.10 The root protection area (RPA) was calculated in accordance with BS5837 (2012). RPAs and root protection radii (RPR) for retained trees are listed in appendix 12. As per the British Standard, it is capped at 707 square metres.

Root protection areas (RPAs) are estimates based on calculations and recommendations within British Standard 5837 (British Standards Institute, 2012) and some have been adjusted to accommodate for assumed ground conditions. RPAs may be quite different to those shown on the tree constraints plan and it is recommended that where there are potential conflicts between trees and a proposed development, that further investigations are made to determine actual tree rooting areas.

A4.11 **Tree condition criteria** are based approximately on the following requirements:

**Good** = Full healthy canopy. Free from major cavities, wounds, pests or diseases.

**Moderate** = Slightly reduced leaf cover, minor deadwood or isolated major deadwood. Early stages of decay/disease. Structural faults.

**Poor** = Overall sparse leafing or extensive deadwood. Well established decay organisms. Structurally unsound cavities and or large wounds. Structural features prone to failure.

**Very Poor** = Large areas of dead crown. Advanced decay. Structurally unsound.

A4.12 Target-Ratings for Trees (Adapted from Forbes-Laird (2006), Table 5).

Value	Static target examples	Target occupancy examples
Very high (VH)	Building 24 hour use, railway	Constant vehicular traffic/busy playground
High (H)	Building 12 hour use, ≥11Kv power lines	Frequent vehicular traffic/constant pedestrian use
Medium (M)	Building/structure occasional use, <11Kv lines	Peak times traffic/intermittent use, eg commuter run
Low (L)	Garage, Summer house, Listed wall	Occasional traffic/sporadic use, eg slow country road
Very low (VL)	Unlisted wall, paving, garden features	Infrequently used access/public right of way/bridleway
None (N)	Grass	Hardly ever used, eg remote path

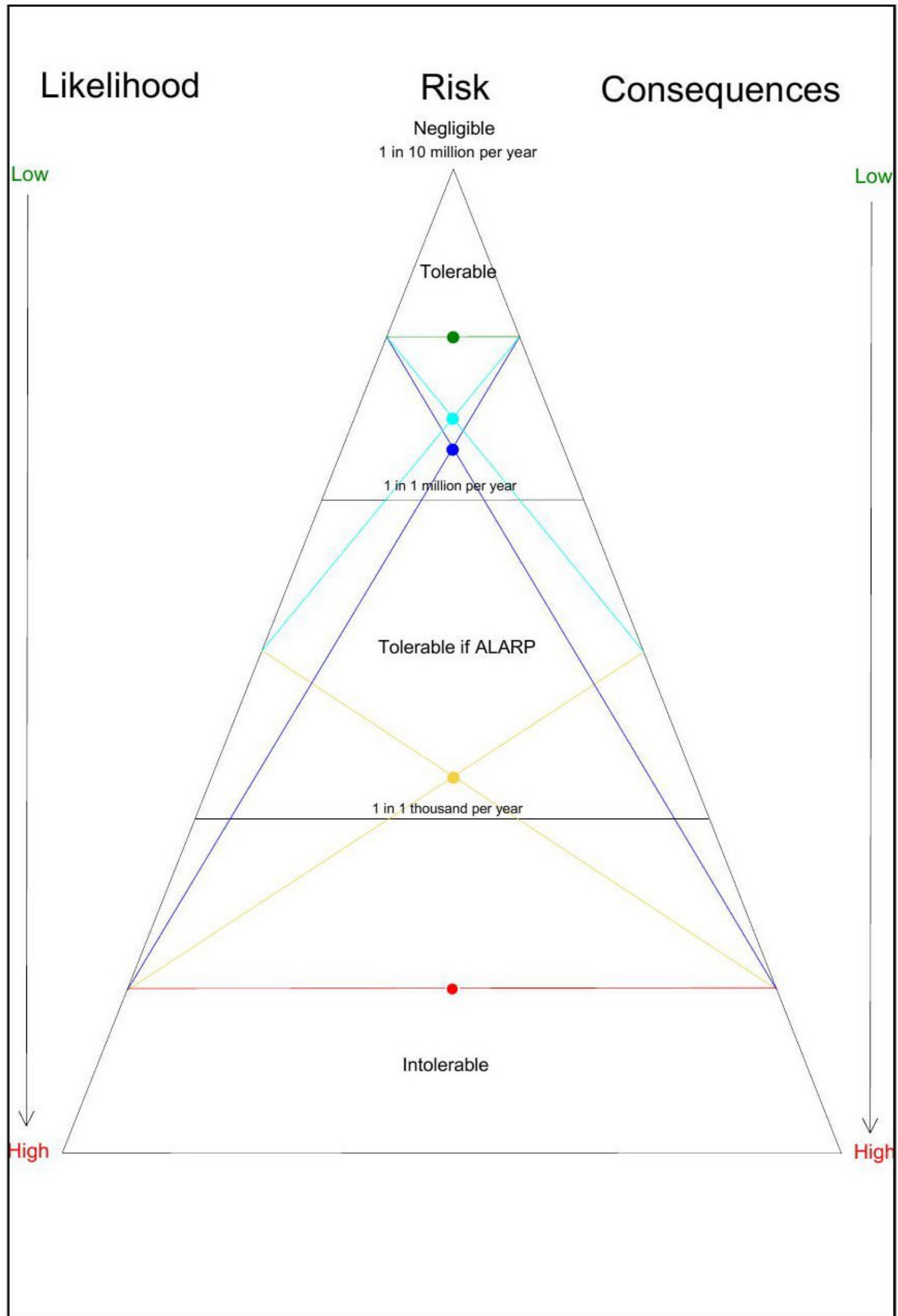
A4.13 Groups of trees have been recorded using two different methods. In both cases, one or more trees representative of the group have been fully surveyed and recorded.

The first method involves duplicating the representative tree.

The second method involves expanding the representative tree's dimensions to form a cohesive RPA and crown spread. In both methods, any trees differing significantly from the representative tree have been individually recorded.



A4.8 As low as reasonably practicable (ALARP) model:



A4.9 Mature tree falling distances are based on information in National House Building Council (September 1999) and Roberts *et al* (2006).

**Appendix 5: Caveats and Limitations**

- A5.1 This survey was conducted according to the VTA type 1 method (Mattheck & Breloer, 1994; Mattheck 2007) meaning survey work was carried out from ground level only.
- A5.2 Root protection areas (RPAs) are calculated with a standard formula; it is a best estimate. Tree roots are opportunistic and rely on favourable rooting conditions. RPAs have been amended to avoid any unfavourable rooting conditions, such as certain built structures. The RPAs shown may not represent the true rooting area of an individual tree.
- A5.3 No soil, foliage, wood, fungus or root samples were taken for analysis. Should any further investigation be required, this will be highlighted in the report.
- A5.4 No internal decay measurements were taken. Should any further investigation be required, this will be highlighted in the report.
- A5.5 Even apparently healthy, structurally sound trees can be adversely affected by extreme climatic conditions. Trees should be reinspected after such events.
- A5.6 Trees are living organisms and can decline in health rapidly due to biotic and abiotic influences. Therefore, due to the unpredictability of nature, the unforeseen failure of intact trees can never be ruled out. The findings of this report are based on observations made at one visit, and best judgement has been made to ensure that any remedial work has been recommended; however no guarantee can be given as to the safety of any individual tree. For this reason, findings and recommendations in this report are valid only for a period of 12 months from the survey date, or until any extreme weather event, whichever is soonest.
- A5.7 Only visible pathogens were recorded at the time of the survey. This does not confirm the absence of other pathogens but merely states that no annual fruiting bodies or other indications were observed at the time of the survey.
- A5.8 A Type 1 VTA cannot eliminate the possibility that any of the trees are used as a habitat for protected flora and fauna (e.g. bat roost). Reference to the legal documents 'Countryside Rights of Way Act' (2000) and 'Nature Conservation Act' (2004) (Scotland) is advised. The trees have been assessed for potential bat habitat, as well as bird nesting. Due to the difficulty of assessing the upper stems and crowns of larger trees from the ground (especially evergreen trees), some habitat features may not have been observed.
- A5.9 British Standard 5837 (2012) is not a specification document; as such it is acknowledged that deviance from the recommendations is permitted, so long as it is justified (British Standards Institute 2012, p.iii).
- A5.10 Due to physical constraints inherent on the site, some measurements have been estimated.

Appendix 6: **Tree Management Proposal**

- A6.1 The tree management proposals within this document should be carried out and the timescales for prioritised works respected.
- A6.2 All recommended arboricultural remedial work should be completed to the standards defined in BS3998 (2010) 'Recommendations for Tree Work', and be carried out by professional arborists with the relevant qualifications and insurance.
- A6.3 Standing deadwood is often created or maintained due to its habitat value. However, the deteriorating structural condition of dead trees is often impractical to monitor. Consequently, standing deadwood should not be retained if it is within falling distance of significant targets.
- A6.4 A qualified ecological worker should be consulted prior to any tree work in order to advise on the likely impact of tree work on any protected flora and fauna.
- A6.5 Trees that are potential bat habitats must be inspected by a suitably qualified person no more than 24 hours prior to tree surgery (April-September) or 48 hours (October -March).
- A6.6 Any proposed disturbance to trees containing bird nests should be carried out with mitigation, and only between October and February.
- A6.7 During periods of extreme weather, especially high wind or gusts (i.e. Beaufort Scale 7, above 30 miles per hour), it is advisable to warn residents, visitors and other site users of the potential risks, given the failure rate of trees under such conditions.



Appendix 7: **Generic Arboricultural Method Statement**

- A7.1 This is a non-specific arboricultural method statement only.
- A7.2 Trees are at risk of harm on any development site, and measures must be taken to protect trees from such harm.
- A7.3 The root protection area (RPA) is intended to protect the roots of retained trees from harm as a result of soil-compaction, changes of soil level, trenching, loss of gaseous exchange, chemical damage and fire. The root protection area should be enclosed using a scaffold framework fixed with vertical tubes at 3 metre intervals, and weld-mesh panels (e.g. 'Heras' fencing) secured with wire or scaffold clamps (see BS5837:2012 Figures 2 and 3). The root protection area is designed to exclude people, machinery, materials and equipment, and must not be entered or altered without first consulting an arboriculturist. Root protection areas for retained trees have been listed in appendix 12, and are shown on the tree constraints plan.
- A7.4 Trees are easily damaged by fire. No fire should be allowed where it might damage any part of a tree.
- A7.5 Tree roots are easily damaged by chemicals. No harmful materials (including cement) should be stored, mixed or dumped anywhere on a level above any root protection area, as spillages and run-off may be absorbed by tree roots.
- A7.6 Any new service-runs within the root protection areas should be excavated using compressed air and an air-lance or, as per National Joint Utilities Group guidelines (NJUG vol. 4 (2), 2007) so as to avoid damage to tree roots.
- A7.7 A properly accredited ecologist should be consulted before any tree operations are carried out, in order to assess the trees for protected species. It is a criminal offence to disturb any protected species.
- A7.8 Aerial parts of a tree can be damaged by construction vehicles or cranes. This damage can be avoided by facilitative pruning: branches that are expected to come into contact with machinery or vehicles can be correctly pruned by a tree surgeon before any damage is caused. An arboriculturist should be consulted prior to work starting on site.
- A7.9 All tree surgery operations are governed by the British Standard 3998, 2010: "Recommendations for Tree Works". Any contractor employed must comply with this standard to ensure the pruning work is as damage-limiting as possible.

Table 1 Cascade chart for tree quality assessment

Category and definition	Criteria (including subcategories where appropriate)			Identification on plan
<b>Trees unsuitable for retention</b> (see Note)				
<b>Category U</b> Those in such a condition that they cannot realistically be retained as living trees in the context of the current land use for longer than 10 years	<ul style="list-style-type: none"> <li>Trees that have a serious, irremediable, structural defect, such that their early loss is expected due to collapse, including those that will become unviable after removal of other category U trees (e.g. where, for whatever reason, the loss of companion shelter cannot be mitigated by pruning)</li> <li>Trees that are dead or are showing signs of significant, immediate, and irreversible overall decline</li> <li>Trees infected with pathogens of significance to the health and/or safety of other trees nearby, or very low quality trees suppressing adjacent trees of better quality</li> </ul> <p><i>NOTE</i> Category U trees can have existing or potential conservation value which it might be desirable to preserve; see 4.5.7.</p>			Trees identified by tree number and coloured circle referring to retention category.
	<b>1 Mainly arboricultural qualities</b>	<b>2 Mainly landscape qualities</b>	<b>3 Mainly cultural values, including conservation</b>	
<b>Trees to be considered for retention</b>				
<b>Category A</b> <b>Trees of high quality</b> with an estimated remaining life expectancy of at least 40 years	Trees that are particularly good examples of their species, especially if rare or unusual; or those that are essential components of groups or formal or semi-formal arboricultural features (e.g. the dominant and/or principal trees within an avenue)	Trees, groups or woodlands of particular visual importance as arboricultural and/or landscape features	Trees, groups or woodlands of significant conservation, historical, commemorative or other value (e.g. veteran trees or wood-pasture)	<b>Colour</b> Dark Red <b>RGB Code</b> 127-000-000
<b>Category B</b> <b>Trees of moderate quality</b> with an estimated remaining life expectancy of at least 20 years	Trees that might be included in category A, but are downgraded because of impaired condition (e.g. presence of significant though remediable defects, including unsympathetic past management and storm damage), such that they are unlikely to be suitable for retention for beyond 40 years; or trees lacking the special quality necessary to merit the category A designation	Trees present in numbers, usually growing as groups or woodlands, such that they attract a higher collective rating than they might as individuals; or trees occurring as collectives but situated so as to make little visual contribution to the wider locality	Trees with material conservation or other cultural value	<b>Colour</b> Light Green <b>RGB Code</b> 000-255-000
<b>Category C</b> <b>Trees of low quality</b> with an estimated remaining life expectancy of at least 10 years, or young trees with a stem diameter below 150 mm	Unremarkable trees of very limited merit or such impaired condition that they do not qualify in higher categories	Trees present in groups or woodlands, but without this conferring on them significantly greater collective landscape value; and/or trees offering low or only temporary/transient landscape benefits	Trees with no material conservation or other cultural value	<b>Colour</b> Mid Blue <b>RGB Code</b> 000-000-255



Appendix 9: **Glossary of Arboricultural Terms**

**Adaptive growth.** In tree biomechanics, the process whereby the rate of wood formation in the cambial zone, as well as wood quality, responds to gravity and other forces acting on the cambium. This helps to maintain a uniform distribution of mechanical stress.

**Adaptive roots.** The adaptive growth of existing roots; or the production of new roots in response to damage, decay or altered mechanical loading.

**Adventitious shoots.** Shoots that develop other than from apical, axillary or dormant buds; see also 'epicormic'.

**Anchorage.** The system whereby a tree is fixed within the soil, involving cohesion between roots and soil and the development of a branched system of roots which withstands wind and gravitational forces transmitted from the aerial parts of the tree.

**Architecture.** In a tree, a term describing the pattern of branching of the crown or root system.

**Bacteria.** Microscopic single-celled organisms, many species of which break down dead organic matter, and some of which cause diseases in other organisms.

**Bark.** A term usually applied to all the tissues of a woody plant lying outside the vascular cambium, thus including the phloem, cortex and periderm; occasionally applied only to the periderm or the phellem.

**Bottle-butt.** A broadening of the stem base and buttresses of a tree, in excess of normal and sometimes denoting a growth response to weakening in that region, especially due to decay by selective de-lignification.

**Branch:**

- Primary.** A first order branch arising from a stem

- Lateral.** A second order branch, subordinate to a primary branch or stem and bearing sub-lateral branches.

- Sub-lateral.** A third order branch, subordinate to a lateral or primary branch, or stem and usually bearing only twigs.

**Branch bark ridge.** The raised arc of bark tissues that forms within the acute angle between a branch and its parent stem.

**Branch collar.** A visible swelling formed at the base of a branch whose diameter growth has been disproportionately slow compared to that of the parent stem; a term sometimes applied also to the pattern of growth of the cells of the parent stem around the branch base.

**Brown-rot.** A type of wood decay in which cellulose is degraded, while lignin is only modified.

**Buckling.** An irreversible deformation of a structure subjected to a bending load.

**Buttress zone.** The region at the base of a tree where the major lateral roots join the stem, with buttress-like formations on the upper side of the junctions.

**Cambium.** Layer of dividing cells producing xylem (woody) tissue internally and phloem (bark) tissue externally.

**Canker.** A persistent lesion formed by the death of bark and cambium due to colonisation by fungi or bacteria.

**Crown clean.** The removal of dead, crossing, weak, and damaged branches, where this will not damage or spoil the overall stability or appearance of the tree.

**Compartmentalisation.** The confinement of disease, decay or other disfunction within an anatomically discrete region of plant tissue, due to passive and/or active defences operating at the boundaries of the affected region.

**Condition.** An indication of the physiological vitality and/or structural stability of the tree.

**Crown/Canopy.** The main foliage bearing section of the tree.



**Crown lifting.** The removal of limbs and small branches to a specified height above ground level.

**Crown thinning.** The removal of a proportion of secondary branch growth throughout the crown to produce an even density of foliage around a well-balanced branch structure.

**Crown reduction/shaping.** A specified reduction in crown size whilst preserving, as far as possible, the optimal tree shape.

**Deadwood.** Branch or stem wood bearing no live tissues. Retention of deadwood provides valuable habitat for a wide range of species and seldom represents a threat to the health of the tree. Removal of deadwood can result in the ingress of decay to otherwise sound tissues and climbing operations to access deadwood can cause significant damage to a tree. Removal of deadwood is generally recommended only where it represents an unacceptable level of hazard. Deadwood sizes: small (<25mm), moderate (<50mm), major (>50mm); the deadwood may be up- or down-rated depending on its overall volume.

**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.

**Dieback.** The death of parts of a woody plant, starting at shoot-tips or root-tips.

**Disease.** A malfunction in or destruction of tissues within a living organism, usually excluding mechanical damage; in trees, usually caused by pathogenic micro-organisms.

**Disfunction.** In woody tissues, the loss of physiological function, especially water conduction, in sapwood.

**Epicormic shoot.** A shoot having developed from a dormant or adventitious bud and not having developed from a first year shoot.

**Girdling root.** A root that circles and constricts the stem or roots possibly causing death of phloem and/or cambial tissue.

**Hazard beam.** An upwardly curved part of a tree in which strong internal stresses may occur without being reduced by adaptive growth; prone to longitudinal splitting.

**Heartwood/false-heartwood/ripewood.** Sapwood that has become disfunctional as part of the natural ageing processes

**Incipient failure.** In woody tissues, a mechanical failure which results only in deformation or cracking, and not in the fall or detachment of the affected part.

**Included bark.** Bark of adjacent parts of a tree (usually forks, acutely joined branches or basal flutes) which is in face-to-face contact.

**Internode.** The part of a stem between two nodes; not to be confused with a length of stem which bear nodes but no branches.

**Lever arm.** A mechanical term denoting the length of the lever represented by a structure that is free to move at one end, such as a tree or an individual branch.

**Lignin.** The hard, cement-like constituent of wood cells; deposition of lignin within the matrix of cellulose microfibrils in the cell wall is termed lignification.

**Loading.** A mechanical term describing the force acting on a structure from a particular source; e.g. the weight of the structure itself or wind pressure.

**Longitudinal.** Along the length (of a stem, root or branch).

**Minor (small) deadwood.** Deadwood of a diameter less than 25mm and or unlikely to cause significant harm or damage upon impact with a target beneath the tree.

**Occluding tissues.** A general term for the roll of wood, cambium and bark that forms around a wound on a woody plant (cf. woundwood)

**Occlusion.** The process whereby a wound is progressively closed by the formation of new wood and bark around it.

**Pathogen.** A microorganism which causes disease in another organism.

**Photosynthesis.** The process whereby plants use light energy to split hydrogen from water molecules, and combine it with carbon dioxide to form the molecular building blocks for synthesising carbohydrates and other biochemical products.

**Phototropism:** The growth of a tree or branch towards the light. Phototropic branches can become exposed and therefore prone to breakage.

**Pollarding:** A pruning system in which the upper branches of a young tree are removed, promoting a dense head of foliage and branches. Historically this was done to keep young shoots above grazing level; now used to keep trees at a manageable level. Not to be confused with topping.

**Reactive Growth/Reaction Wood.** Production of woody tissue in response to altered mechanical loading; often in response to internal defect or decay and associated strength loss (cf. adaptive growth).

**Removal of dead wood.** Unless otherwise specified, this refers to the removal of all accessible dead, dying and diseased branch-wood and broken snags.

**Re-spacing.** Selective removal of trees from a group or woodland to provide space and resources for the development of retained trees.

**Residual wall.** The wall of non-decayed wood remaining following decay of internal stem, branch or root tissues.

**Sapwood.** Living xylem tissues

**Shedding.** In woody plants, the normal abscission, rotting off or sloughing of leaves, floral parts, twigs, fine roots and bark scales.

**Sprouts.** Adventitious shoot growth erupting from beneath the bark

**Stem/s.** The main supporting structure/s, from ground level up to the first major division into branches. The stem (or stems if two or more co-dominant stems are present) may extend to the uppermost part of the tree.

**Stress (plant physiology):** A condition under which one or more physiological functions are not operating within their optimum range, for example due to lack of water, inadequate nutrition or extremes of temperature.

**Stress (mechanics):** The application of a force to an object.

**Structural roots.** Roots, generally having a diameter greater than ten millimetres, and contributing significantly to the structural support and stability of the tree; also containing water conducting vessels.

**Taper.** In stems and branches, the degree of change in girth along a given length.

**Targets.** In tree risk assessment (with slight misuse of normal meaning) persons or property or other things of value which might be harmed by mechanical failure of the tree or by objects falling from it

**Topping.** In arboriculture, the removal of the crown of an older tree, or of a major proportion of it. This is not generally advised as it can allow decay into the upper parts of the tree. Not to be confused with pollarding.

**Torsional stress.** Mechanical stress applied by a twisting force.

**Understorey.** A layer of vegetation beneath the main canopy of woodland or forest or plants forming this

**Wind exposure.** The degree to which a tree or other object is exposed to wind, both in terms of duration and velocity.

**Wind-throw.** The blowing over of a tree at its roots.

**Woundwood.** Wood with a typical anatomical features, formed in the vicinity of a wound.