The 6Cs Design Guide

Appendix F: Preserving trees when carrying out roadworks and building new developments

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Section RT1: General principles

1.1 Trees are an important feature in our urban and rural landscapes and make a significant contribution to the character and quality of our roads. They play an important role in providing screening, filtering traffic noise and absorbing dust and other pollutants. Trees on or next to the highway can be severely damaged by construction and maintenance work to roads and footways. However, damage can be limited, and in many cases prevented, by following the guidelines contained in this appendix. The guidelines cover design principles and site practices, which, if followed, protect existing trees within new projects.

1.2 Wherever possible, our policy is to retain, preserve and protect existing healthy trees when carrying out road construction and maintenance work. A large number of trees are lost each year due to many types of land development and so it is important that trees with significant value and potential are retained.

1.3 It is better to retain healthy, semi-mature and mature specimens with significant life potential rather than retain over-mature specimens with limited life expectancy. Protection measures must always be thorough. You should put them in place before the works begin and maintain them until the works are finished. Inadequate or half-hearted protection measures are a waste of money and can lead to significant damage, which may only become apparent months or years after the works are completed. A damaged or deteriorating tree can present a significant danger to users of the highway.

Figure RT1 Retained mature tree showing signs of stress and damage because it is too close to new dwellings and could lead to incompatibility problems in the future



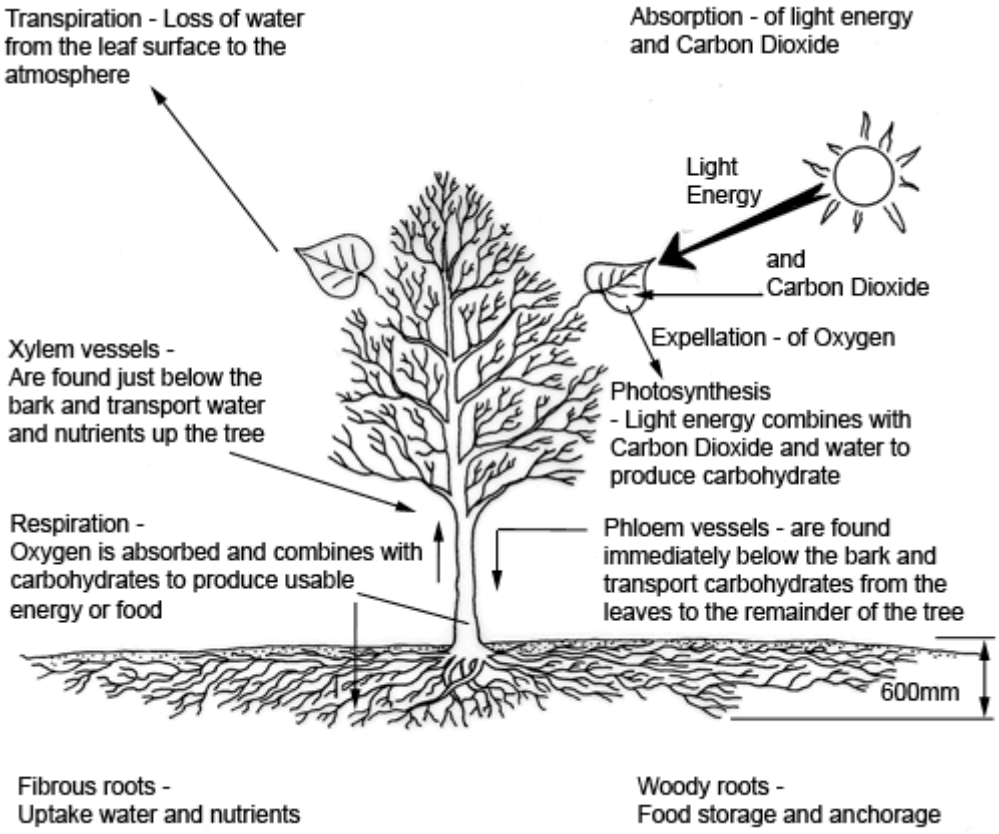
Section RT2: Tree form and function

1.4 Trees are complex living organisms which can be badly affected by direct or indirect damage caused during construction works. Even minor changes to their living environment can affect growth. As the tree forms a trunk and crown above the ground it also produces a root system below ground which supports the crown. Tree roots need to absorb oxygen to survive, so most of a tree's root system is found in the aerobic (oxygen-rich) soil within the 600mm immediately below the surface. The tree's roots absorb nutrients and moisture from the soil and can extend well beyond the area taken up by its crown.

1.5 Water and nutrients are transported from the roots, up the trunk and into the crown of the tree through tissues called xylem vessels which lie just below the tree's bark. Similarly, carbohydrate produced by the tree's leaves is transported through phloem vessels down the tree to its trunk and roots. Here it combines with absorbed oxygen to produce food energy which, in turn, supports future growth. And, water lost through the tree's leaves is replaced by moisture absorbed through its root system and transported through the tree.

1.6 Consequently the tree's roots and its trunk and crown above ground are interdependent and even minor damage to one can badly affect the other.

Figure RT2 Tree form and function



Section RT3: Planning and design

- Site survey
- Tree survey

1.7 Highway construction and maintenance design should allow for all healthy existing trees and where appropriate, planting of new trees. You should involve our forestry officer or your consultant arboriculturalist who should advise at the planning and design stage on retaining existing trees and planting new specimens. You should consider the potential growth of retained trees, their future compatibility with new and existing highway features and how near new and existing service runs will be. You should identify an appropriate protection zone around the trees you are retaining and, wherever possible, you should exclude this area from the construction site. All necessary tree maintenance work, both before and after construction, should be carried out by trained operatives in consultation with our forestry officer.

1.8 When planting new trees, you should consider their future growth and habit and the development should include design features which allow for their growth.

1.9 You should carry out a survey of the construction site at the planning stage before you design the development or improvement works. The survey should include details of both the site and individual trees and should provide the following information.

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Site survey

- The location and identification of all trees shrubs and hedges.
- Other relevant site features such as watercourses, service runs, hard surfaces and so on.
- Details of ground levels as a basis for avoiding changes to soil levels around retained trees.
- Locations of trees on adjoining land which might be affected by the works.
- Details of site drainage which may be altered or interrupted by the proposed works and
- which may, as a result, affect retained trees.
- Site features with a high nature-conservation value .

Tree survey

- The general health, vigour and condition of each tree including details of structural defects.
- An assessment of life expectancy of each tree.
- The size and form of each tree including accurate details of the position and shape of its crown in relation to the proposed new site layout.
- Details of other site features such as service runs and how close they are to the trees.
- How suitable each tree is for retention within the completed development or works.
- Any tree surgery or other maintenance work required.
- Any existing tree-preservation orders or conservation-area status.

1.10 Detailed information on the species, health, condition and status of each tree should be collected and assessed by an appropriately qualified and experienced arboriculturalist.

Section RT4: Retaining existing trees

- Trees to be retained high category
- Trees where retention is desirable - moderate category
- Trees which could be retained low category
- Trees which should be removed fell category

1.11 When designing a new development or road, you should, wherever it is safe and practical, incorporate existing trees worth retaining into the overall layout to provide a mature and established appearance.

1.12 Trees within the development site should be assessed in accordance with the recommendations included in section 5.2 of British Standard (BS) 5837 ‘Trees in relation to construction’. The assessment should cover their condition, significance and landscape and environmental value and potential. The tree survey should classify each tree into one of the retention categories below.

1.13 Where there is a conflict between retaining a category A or B tree and ensuring road safety, the first option should be to amend the proposed design to avoid the conflict and retain the tree. We will consider situations where it is not reasonable or practical to do this on a site-by-site basis.

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A)Trees to be retained – high category

Trees in this category:

- are prominent, healthy trees of good form and habit;
- have high historical and commemorative value;
- are botanically valuable (because of their species) or rare; or
- are. older trees with high nature-conservation value and long life potential which pose little or no danger to users of the highway and the surrounding locality.

B)Trees where retention is desirable moderate category

Trees in this category are:

- healthy young trees of good form with substantial life potential; or
- healthy mature trees of reasonable form with moderate life potential.

C)Trees which could be retained – low category

Trees in this category are:

- mature trees in reasonable condition with some life potential; or
- less prominent young trees in reasonable condition.

D)Trees which should be removed – fell category

Trees in this category are:

- dangerous or unstable;
- dead;
- likely to become unstable after others are removed; or
- less prominent, over-mature trees with limited life potential.

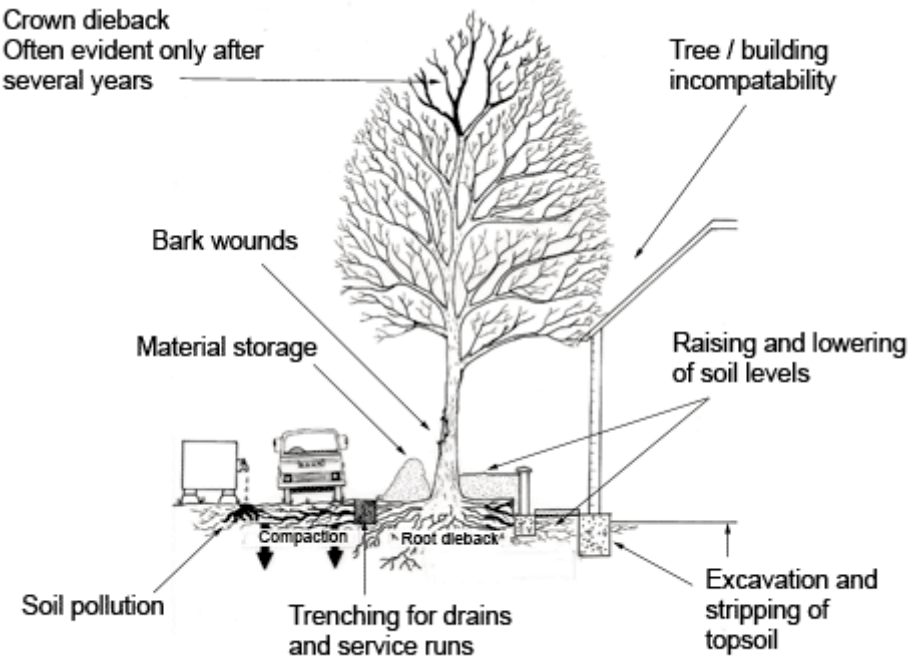
1.14 You should plan or design the roadworks or new development to ensure all category A and B trees are retained and, where possible, category C trees. However, you should not impair road safety or access to the development.

Section RT5: Causes of damage to trees during construction works

1.15 The following activities are common causes of damage to trees when construction is carried out within the trees' natural rooting area.

Activity		Damage caused
Excavating trenches	-	To install and maintain services, for foundations, kerbing and so on.
Alterations in soil level	-	Raising or lowering the soil level.
Installing non-porous surfaces	-	Affects soil aeration and drainage.
Compacting the surface	-	By plant, vehicles and storing material.
Soil pollution	-	Storing toxic material (for example, diesel oil and road salt).
Physical damage	-	By plant and machinery to a tree's roots, trunk and branches.
Changes to soil hydrology	-	Caused by changes to drainage which accelerates water run-off or compacts the soil which causes waterlogging.
Fires	-	Burning unwanted material within the tree's root spread can cause significant damage to the tree's roots, trunk and branches.
Exposure	-	Damage caused by increased levels of sunlight and wind when neighbouring trees are removed.

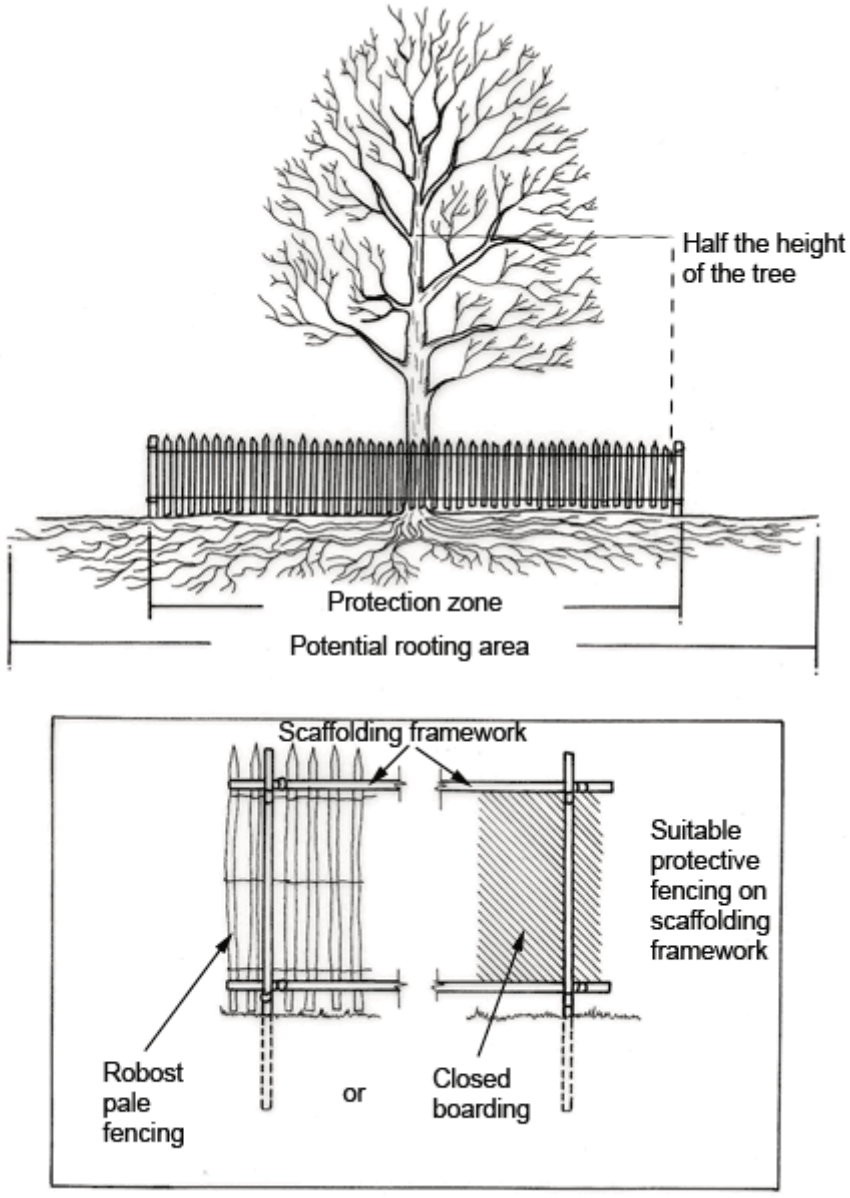
Figure RT3 Damage to trees during construction works



1.16 A tree's root system can extend radially (outwards) to a distance much greater than the tree's height. Ideally the whole of this area should be protected and remain undisturbed during construction work. If works are necessary within the tree's potential rooting area, you should identify a protection zone from the base of the tree's trunk. This should equal the full extent of the branch spread or be equivalent to half the tree's height, whichever is greater. This area should be protected with substantial fencing (see below) and be excluded from the construction site. If the works are necessary within the protection zone, you must consult our Forestry and Arboricultural Group at the design and implementation stages to

identify specific measures to minimise damage. At this stage you should also consider the potential effects of the works on privately-owned trees next to the site.

Figure RT4 Avoiding damage to trees



1.17 On larger schemes where you are retaining trees within the site area, you should erect protective fencing, as specified in Figure RT4, before the works begin. This fencing should stay up until the work is finished. It is essential that the protection zone is excluded from the construction site and all associated activities including excavations and changes of soil level. Areas where machinery, materials, chemicals and waste material are stored should also be excluded from the protection zone.

1.18 However, due to the linear nature of many highway maintenance operations (for example, kerbing) and the fact that most highway corridors are narrow, it is not always

possible to exclude a tree's protection zone from the work area. In such cases you should adopt the following specific measures to minimise the affects of the works.

- Before starting the work a survey team should identify the protection zone with marker paint or pegs. This will ensure that the construction gang know the precise area where special precautions are required to avoid or minimise damage.
- You should protect the trunk of each tree with substantial hoarding, supported on scaffolding, to a height of at least two metres, to protect its bark from mechanical damage. This protection should be reusable so that as work progresses, it can be transferred from tree to tree.
- If the work needs surfaces to be removed or excavated, this should be carried out as follows.
    - Footways –Slabs or paving should be removed manually, but initial layers of concrete or tarmacadam should be removed using a hand-held breaker. All sub-base material should then be removed using hand tools only.
    - Carriageways –Tree roots are not likely to penetrate the road base, base course or wearing course and may only be present in the sub-base material below the carriageway. This means the oad base, base course and wearing course can be removed by machine. The compacted sub-base material below may initially be broken using a hand-held breaker but all material, once broken, should be excavated carefully using hand tools only.
- All excavations using hand tools need to be carried out with great care to avoid damage to as many roots as possible. There needs to be close supervision during hand-digging operations and all site staff should understand what is required. All tree roots over 25mm in diameter should ideally be worked round and retained. If, however, it is necessary to remove these roots, you should first ask the forestry officer for advice. Any root cutting should be done with a sharp handsaw or secateurs and the size of the wound should be kept to a minimum. Individual roots of less than 25mm may be severed, but mats of smaller roots (including fibrous roots) should be retained. Smaller roots can easily desiccate (dry out) and die when exposed, particularly in warm or windy conditions. These should be covered and protected with damp hessian until the excavation is back filled.
- Where kerbs are being installed or refitted through a tree's protection zone and roots with a diameter of more than 25mm obstruct the work, you should consult the forestry officer before severing the roots. If the root cannot be severed without putting the stability of the tree in danger, you should consider:
    - reducing the section of kerb;
    - creating a gap in the kerb to allow for the root;
    - bridging the kerb over the root; or
    - constructing a kerbside build-out.
- You should take particular care when backfilling excavations within a tree protection zone. Tree roots are particularly affected when soil is compacted and they can also be damaged by the mechanical action of tamping down. Backfill material around exposed roots should consist of a fine granular material which provides a high proportion of air space. You should not use builders' sand as it is toxic to tree roots. The material should be compacted using hand-tamping methods which maintain a degree of aeration and enable tree roots to survive. This method will allow the backfill material to be compacted to the required level for footway construction. Compacting a road base close to tree roots is more complicated due to the load-bearing requirements of a road. If a road carriageway is to be constructed within a

tree's protection zone and tree roots more than 25mm are present, you should consult the forestry officer to identify special measures to protect tree roots. Non-paved areas should be backfilled using the previously excavated soil which should be only lightly firmed and left proud to allow for natural settlement.

1.19 To survive, tree roots needs water and oxygen within the soil. Surface material should also be flexible to allow for soil movement and future root activity. Granular surfacing, such as chippings or other permeable materials, laid on to a geo-textile membrane would be appropriate in this case.

1.20 You should install any service runs or street furniture within a tree's protection area using hand-digging methods to ensure that all roots with a diameter of more than 25mm are retained. You should follow the recommendations contained in NJUG 10. You should contact the forestry officer if you need more advice.

1.21 Do not include residual chemical herbicides in construction materials within a tree's protection zone as these may be absorbed by the tree's roots and have a serious toxic effect.

Section RT6: Tree surgery and site aftercare

1.22 In some instances, it may be necessary to carry out tree surgery before work begins to accommodate access to the site and prevent physical damage occurring to nearby trees.

1.23 Tree surgery may also be necessary after the work has finished to repair any minor damage which has occurred. Tree surgery should always be carried out in accordance with British Standard (BS) 3998 : 1989 'Recommendations for tree work'. You should use a qualified tree-work contractor who is skilled in modern arboricultural techniques. If damage has occurred to the site during the works, techniques such as soil aeration and surface mulching with an organic material (for example, pulverised bark) may be beneficial to improve the soil and allow the tree to recover from any disturbance. Cultivating the soil, fertilizing, importing topsoil and raising levels are common site re-instatement techniques which are all potentially harmful to retained trees.

Figure RT5 If you put in place protection measures and maintain them during the course of the works, important trees can be retained which contribute significantly to the newly-developed area.



Section RT7: Installing highway equipment

1.24 When designing and planning highway equipment, you should consider the location of nearby trees, whether they are on the highway or on nearby property. You should take care to avoid installing this equipment within a tree's potential rooting area and within its crown or potential growing space. You should site equipment such as road signs, street lights and so on to avoid damage to trees during installation and to avoid the need for regular pruning to maintain visibility.

Section RT8: Carrying out the works

1.25 When carrying out development work or highway improvement works near to trees, it is essential that everyone working on the site adopts all the measures identified to retain trees and minimise damage. It is also essential that all site operatives (that is site managers, clerks of works, all contractors' operatives including subcontractors and so on) understand what is needed. You should arrange a meeting before work begins between everyone involved to establish good communication and identify all the initial requirements for retaining trees. Regular meetings should then take place while the works are ongoing to identify additional requirements and potential problem areas. It is important that all appropriate practices and protection methods are written into contracts, along with penalty clauses which provide an incentive to adopt good practice.

Section RT9: Adopting trees

1.26 We will adopt trees that have been successfully retained on verges and other highway-related land providing you pay a commuted sum to cover their long-term maintenance. (Please see Part 4, Section MC18 for further details on commuted sums). We will not adopt any tree retained within a development if we know that it has been damaged by poor practices during construction and the appropriate protection measures have not been adopted.

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Section RT10: Checklist

- Arrange for an arboriculturalist to carry out a tree survey before the design stage.
- Design your scheme so you can retain high-category and moderate-category trees and, where possible, low-category trees.
- Exclude protection zones from the worksite using appropriate protective fencing.
- Do not carry out any excavations or alter soil levels within a tree's protection zone.
- Consult with a forestry officer if works need to take place in a protection zone before works begin.
- Arrange for an approved arboricultural contractor to carry out recommended tree surgery before work begins.
- Follow all appropriate codes of practice and specific recommendations when working within protection zones.
- Carry out appropriate measures after work has finished to reinstate and improve the site (for example, soil aeration and mulching) and avoid practices such as cultivation and fertilising.
- Do not store any construction materials or toxic substances (including road salt) or light fires within a tree's potential root area.
- Do not operate any vehicles or plant within a tree's protection zone.
- Install permeable surfaces over disturbed ground within a tree's protection zone.
- Avoid building houses close to retained trees, particularly where there is little possibility of them existing together.

Figure RT6 Building so close to retained trees leads to problems with shade and leaf litter.
This can result in trees being mutilated and high future maintenance costs.



Section RT11: References

- BS 3998 : 1989 – Recommendations for tree work
- BS 5837:1991 – Trees in relation to construction

- National Joint Utilities Group – NJUG 10 – Guidelines for the planning, installation and maintenance of utility services in proximity to trees
- Arboricultural Practice Note 1 – Driveways close to trees
- Arboricultural Association Guide – Trenching and trees

Section RT12: Contacts

- Leicestershire County Council
- Forestry and Arboricultural Group:0116 305 6922
- Leicestershire County Council Landscape Officer:0116 305 7061
- Arboricultural Association: 01794 368717
- Nottinghamshire County Council, Gareth Broome: 01623 821313