# Canopy Consultancy

## 4 and 4a, Oaklands Road, Bromley

## Tree Survey Report

12th November 2014

# Canopy Consultancy

| | |
|---|---|
| **Client** | South East Living Group |
| **Job name** | 4 and 4a, Oaklands Road, Bromley |
| **Report title** | Tree Survey Report |
| **File reference** | 13-171-Report-Rev-A |

| | **Name** | **Position** | **Date** |
|---|---|---|---|
| **Author** | Neil Taylor | Consultant Arborist | 12th November 2014 |

## Report Contents

# 1 Introduction

## 1.1 Site Description

4 and 4a, Oaklands Road, Bromley (the "site") is situated approximately half a mile northwest of the centre of Bromley. The site currently comprises a building divided into two apartments and a detached garage set within a large garden. The site is suburban in character and is bounded by residential dwellings to the north, east south and west and by Oaklands Road to the south, beyond which are further residential dwellings.

The trees on site are protected by TPO; No. 9 1960. The trees are within an area TPO which means that all trees that were present on site when the order was created are protected. Any trees that were planted or self-sown after 1960 are not protected.

## 1.2 Proposed Works

The demolition of the existing building and the construction of an apartment building with associated car parking and access drive are proposed. Works that are likely to affect retained trees include the movement of demolition and construction machinery and the construction of an access drive.

## 1.3 Aims of Study

To inform a planning application, Canopy Consultancy has been commissioned by South East Living Group to undertake a tree survey of the site, in accordance with British Standard (BS) 5837:2012 "Trees in Relation to Design, Demolition and Construction - Recommendations".

The aim of this report is to present the results of the survey, including a Tree Survey Schedule (TSS), an Arboricultural Implications Assessment (AIA), and an Arboricultural Method Statement (AMS). A Tree Protection Plan (TPP) has also been produced and accompanies this report as a separate drawing.

This report in no way constitutes a health and safety survey report. Where concerns for tree health and safety exist, the necessary and appropriate tree inspections should be carried out.

## 2 Methodology

The trees were inspected from ground level by consultant arboriculturist Neil Taylor on 11th October 2014 and measurements taken in accordance with the recommendations set out in the BS 5837:2012. Canopy spreads were measured and plotted to the four compass points. Where direct access was not possible measurements have been estimated. The surveyed trees are colour coded on the accompanying tree survey drawing according to their relevant BS category.

The tree data collected is used to enable the current canopy spread of the surveyed trees and the Root Protection Area (RPA) to be plotted on the accompanying TPP. The RPA is defined by the formula in paragraph 4.6 from the BS 5837:2012 and may be refined by taking into account current on-site constraints to root activity such as buildings, earthworks and hard paving. This forms part of the design process for the proposed development.

# 3 Assessment

## 3.1 Tree Character Groups

The detailed results of the tree survey are provided in the TSS, in Appendix 1. In summary, the trees on the site vary considerably in terms of condition and the amenity value that they provide to the wider landscape. The trees can be divided into three distinct character groups as follows:

1. The first character group includes the large, mature trees found growing across the site. In the main the trees in this character group are in a good condition and bring sense of maturity to the site.

2. The second character group includes the medium sized, middle aged trees found growing across the site. Due to their location, the trees in this character group contribute little to the amenity value of the local area.

3. The third character group includes the small garden scale trees found growing across the site. Due to their size and location, the trees in this character group contribute little to the amenity value of the local area.

# 4 Arboricultural Implications Assessment (AIA)

## 4.1 Methodology

The AIA uses the information obtained in the tree survey to identify areas where the proposed construction may be at odds with accepted standards, in terms of a tree's requirements for space in which to maintain existing roots and shoots, and space for future growth.

The quality and relative importance of each tree is illustrated as a coloured polygon. The colour used relates to the BS categories as follows: A - green, B - blue, C - grey and R - red (see accompanying drawing reference 13-171-TPP). In general the design process will try to retain A and B category trees. Proposed construction will therefore normally be excluded from the RPA of A and B category trees. Red trees are discounted as they are recommended for removal.

Details of the trees surveyed are given in the TSS (Appendix 1). The juxtaposition of the proposed development in relation to existing tree locations are shown on the accompanying TPP drawing, reference 13-171-TPP.

The AIA considers existing site conditions and the effect that they may have on the development of the surveyed trees root systems. Hard structures such as building and paved roads and paths can influence the root activity of trees by reducing the availability of both moisture and nutrients.

## 4.2 Assessment

Refer to the accompanying TPP, drawing, reference 13-171-TPP, for the relationship between the proposed development and the trees on and adjacent to the site.

The following tree within the site boundary should be removed for arboricultural reasons:

T9

The following trees will be removed to enable the proposed development:

| | |
|---|---|
| T4 | to enable the construction of an access drive |
| T7 | to enable the construction of an access drive |
| T8 | to enable the construction of a car park |
| T13 | to enable the construction of an access drive |
| T14 | to enable the construction of an apartment building |

| | |
|---|---|
| T16 | to enable the construction of a car park |
| T21 | to enable the construction of an apartment building |
| T22 | to enable the construction of an apartment building |
| T23 | to enable the construction of an apartment building |
| T24 | to enable the construction of an apartment building |

The following tree will be pruned prior to demolition and construction:

T1 Crown lift to clear 5 metres, secondary branches only

Reduce western laterals by 1.5m to suitable growth points

The following trees will be affected by the demolition of the existing buildings, space on site is limited so the existing buildings will be demolished in accordance with the methodology described in section 5.2 below:

T1 and T3

The following trees will be affected by the construction of hard surfaces across the site. The hard surfaces will be constructed in accordance with the 'no dig' principles outlined in APN12 (Appendix 2) and utilise a cellular confinement system such as Cell Web as a sub base. Refer to Section 5.3 below for details:

T1, T2, T3, T5, T6, T18 and T25

The following tree will be affected by the construction of a bin store. Excavations will be carried out in accordance with the methodology outlined in section 5.3 below:

T1

# 5 Arboricultural Method Statement (AMS)

## 5.1 Methodology

The AMS provides the means by which retained trees and hedges can be protected throughout the development.

The movement of demolition and construction machinery in close proximity to trees may cause compaction of the soil which affects the tree's ability to absorb moisture and nutrients. The RPAs of retained trees will be protected by a tree protection barrier as described in paragraph 5.5 below and shown on the accompanying TPP, drawing number 13-171-TPP.

## 5.2 Demolition within the RPA of Retained Trees

Where the existing dwelling is to be demolished, works will be carried out under the supervision of a suitably qualified arboriculturist. Any machinery used will be stood within the building footprint and will pull the walls down inwards so as to avoid damage to the tree. Where possible, the foundations closest to the tree will remain in situ. If this is not possible, the foundations will be broken up with a hydraulic pecker and removed from the trench with a toothless bucket so as to minimise damage to any roots that may be present.

Where the existing garage is to be demolished, the walls and roof are to be pulled down inwards so as to avoid damage to the nearby tree. The concrete will be broken up with an air or hydraulic pecker and removed with a toothless bucket. The sub base will remain in situ and will be utilised for the new hard surface.

## 5.3 Construction within the RPA of Retained Trees

Construction of all hard surfacing within the RPA of retained trees will incorporate the principles set out in Arboricultural Advisory and Information Service guidance note APN12 (refer to Appendix 2). Guidance on the form of construction necessary to avoid root damage and loss is provided in the form of an extract of the Cell Web Product brochure for their cellular confinement system at Appendix 3. The extent and nature of hard paved surfaces within the RPA of retained trees will determine the level of construction required. The finished sub base and hard surface will be edged with sleepers, pinned into place or minor increases in level using topsoil may be permitted to blend the new hard surface into the existing landscape.

Where the above method of construction is proposed across the site, the cell web will be installed prior to demolition of the existing dwelling taking place so as to act as ground protection throughout the demolition and construction process.

Excavations for the foundations for the bin store will be carried out by hand under the supervision of a suitably qualified Arboriculturist to a depth of 600mm or until no more roots are found. Any roots encountered will be pruned in accordance with current best working practice.

No materials or spoil is to be stored within the RPA of a retained tree.

In order to avoid damage to the retained trees the tree surgery and felling work identified in the accompanying tree survey schedule will be carried out prior to the occupation of the site by the building contractor. The work will be carried out in accordance with BS 3998:2010.

## 5.4 Services

The proposed locations of service runs is not known at this stage but are likely to be located outside the RPA of the trees on and adjacent to the site. Where it is not possible to achieve this, the section of service run which passes within the RPA of a tree will be hand dug in accordance with 'broken trenches' described in NJUG 4 Section 4, an extract of which can be found in Appendix 4. This will ensure that tree roots are not damaged during the installation of the service. All root pruning will be agreed before hand with the named Arboriculturist in consultation with the local authority Arboricultural officer. All root pruning will be in accordance with current best working practice. All routes for overhead services will aim to avoid the trees. Where this is unavoidable any tree work will be agreed prior to commencement with the Council's Arboricultural Officer.

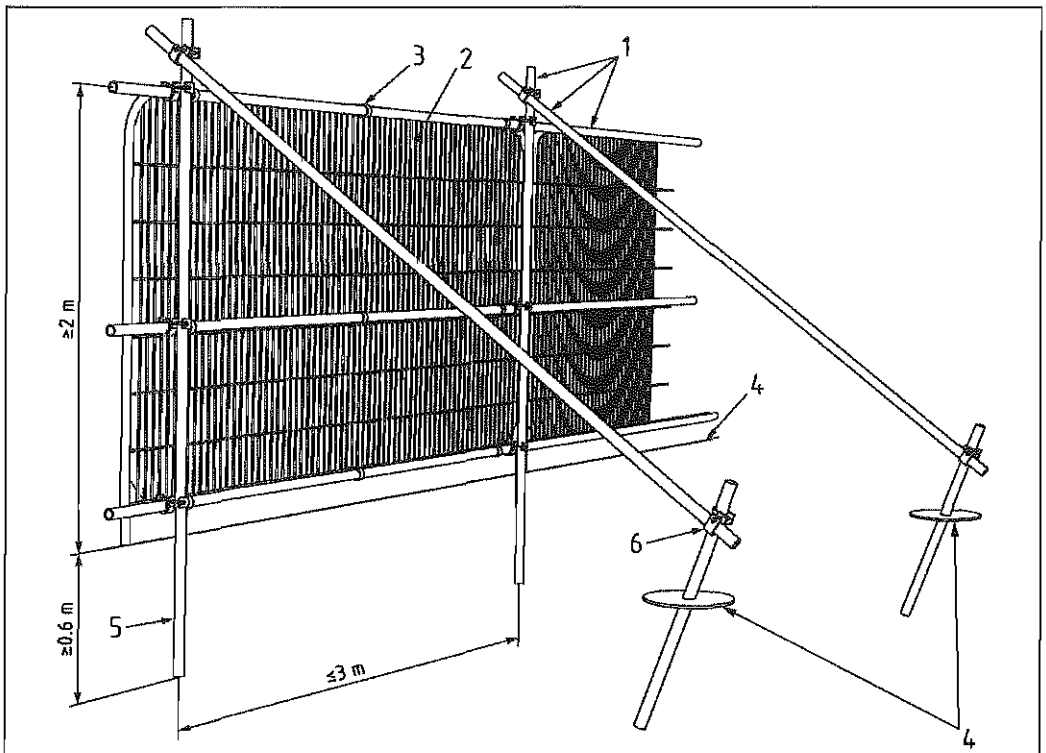
If the conditions are suitable on site and there is sufficient space, underground services may cross the RPA if a low impact method is used. Such low impact methods include: moleing, directional drilling and thrust boring. It is important that all entry and exit pits remain outside of the RPA and the services are installed at a sufficient depth (at least 600mm) so as to avoid the tree rooting system.

## 5.5 Tree Protection

All trees that are to be retained on the site will be protected by the use of a tree protection barrier erected in the location shown on the accompanying TPP, drawing number 13-171-TPP. The fence will consist of "Heras" type panels or similar braced at appropriate intervals and secured to keep in place. The tree protection barrier will be erected prior to the occupation of

the site by the building contractor and will only be removed once the construction phase is complete.

Where specified on the accompanying TPP, drawing number 13-171-TPP, the ground between the cell web and the building will be protected by geotextile fabric and side butting scaffold boards or thick plywood fit for purpose on a compressible layer (e.g. 100mm layer of woodchip over a geotextile membrane). A single thickness of boarding laid on the soil surface will provide sufficient protection for pedestrian load. The boarding will be left in place until the building works are complete.




**Key**

1 Standard scaffold poles
2 Heavy gauge 2 m tall galvanized tube and welded mesh infill panels
3 Panels secured to uprights and cross-members with wire ties
4 Ground level
5 Uprights driven into the ground until secure (minimum depth 0.6 m)
6 Standard scaffold clamps

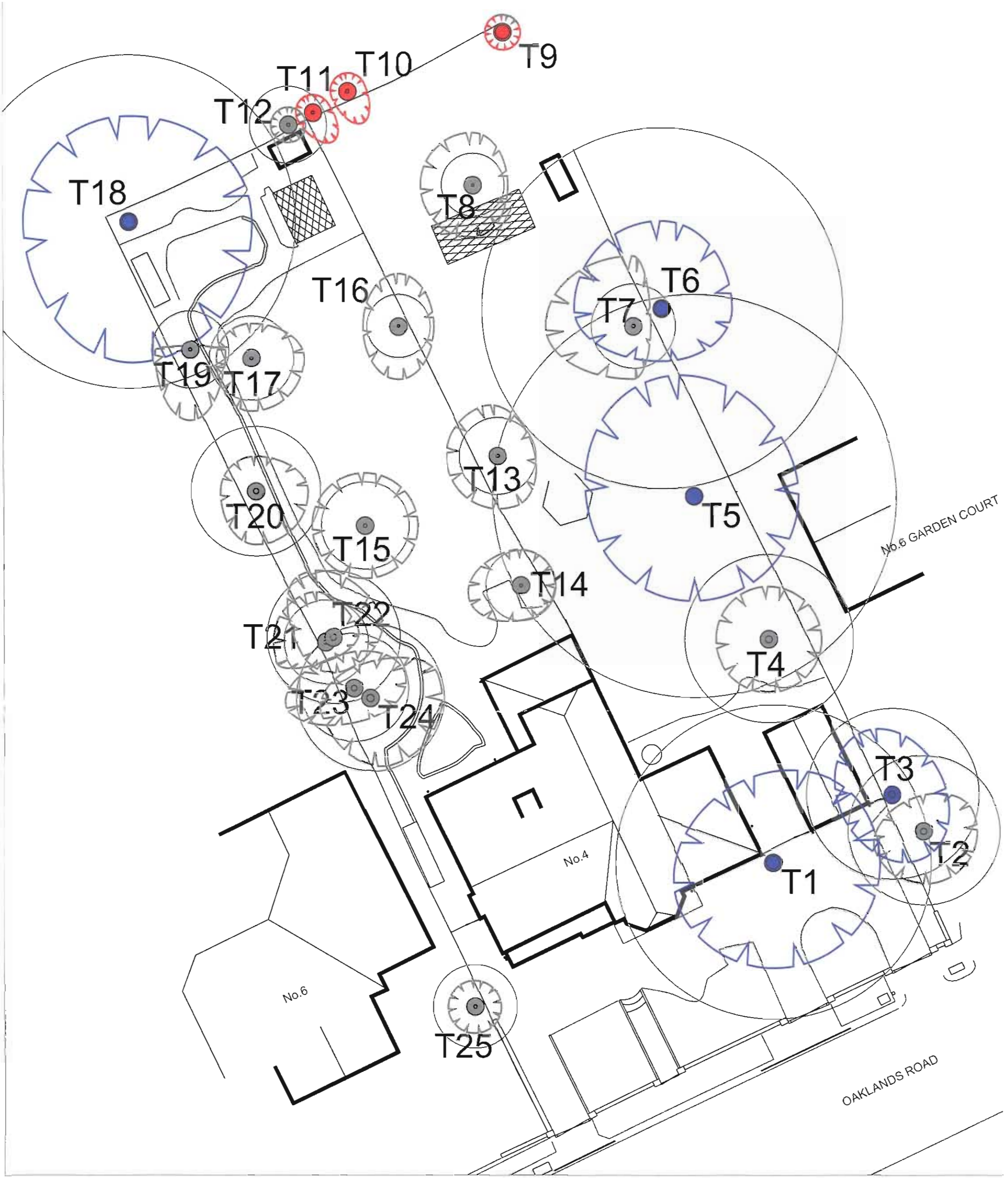
# 6 Conclusion

Canopy Consultancy was commissioned by South East Living Group to carry out a tree survey at 4 and 4a, Oaklands Road, Bromley. The results of the survey indicate that the trees within the survey area vary considerably in terms of quality and contribution to the amenity value within the local area. Although a small number of trees will be removed to enable the proposed development, the larger trees will be retained which will help assimilate the new building into the existing streetscape.

Nine individual trees will be removed to enable the proposed development. However it will be possible to incorporate a number of new specimen trees within the proposed site layout, increasing the species diversity and age range of the site's tree population.

Through the specified tree protection measures and construction methodologies, it will be possible to minimise the impact of the proposed development on the retained trees.

Overall, there are no known overriding arboricultural constraints which would prevent the proposed development from going ahead, subject to the protection measures and construction methodologies specified within this report being correctly implemented.




## Legend

Root protection area (RPA)
Diameter of trunk
Tree number as recorded on Survey Schedule
Tree canopy
Coloured symbol indicating BS category as shown below

Category A tree
BS5837 2012

Category B tree
BS5837 2012

Category C tree
BS5837 2012

Category U tree
BS5837 2012

The above BS categories are judgements of quality and value based on the contribution each tree would be expected to make over a given period of time, categories A, B and C being high, moderate and low respectively. Category U represents trees that, in their current context, should be removed for sound arboricultural reasons. For exact definition of BS categories refer to notes accompanying schedule.

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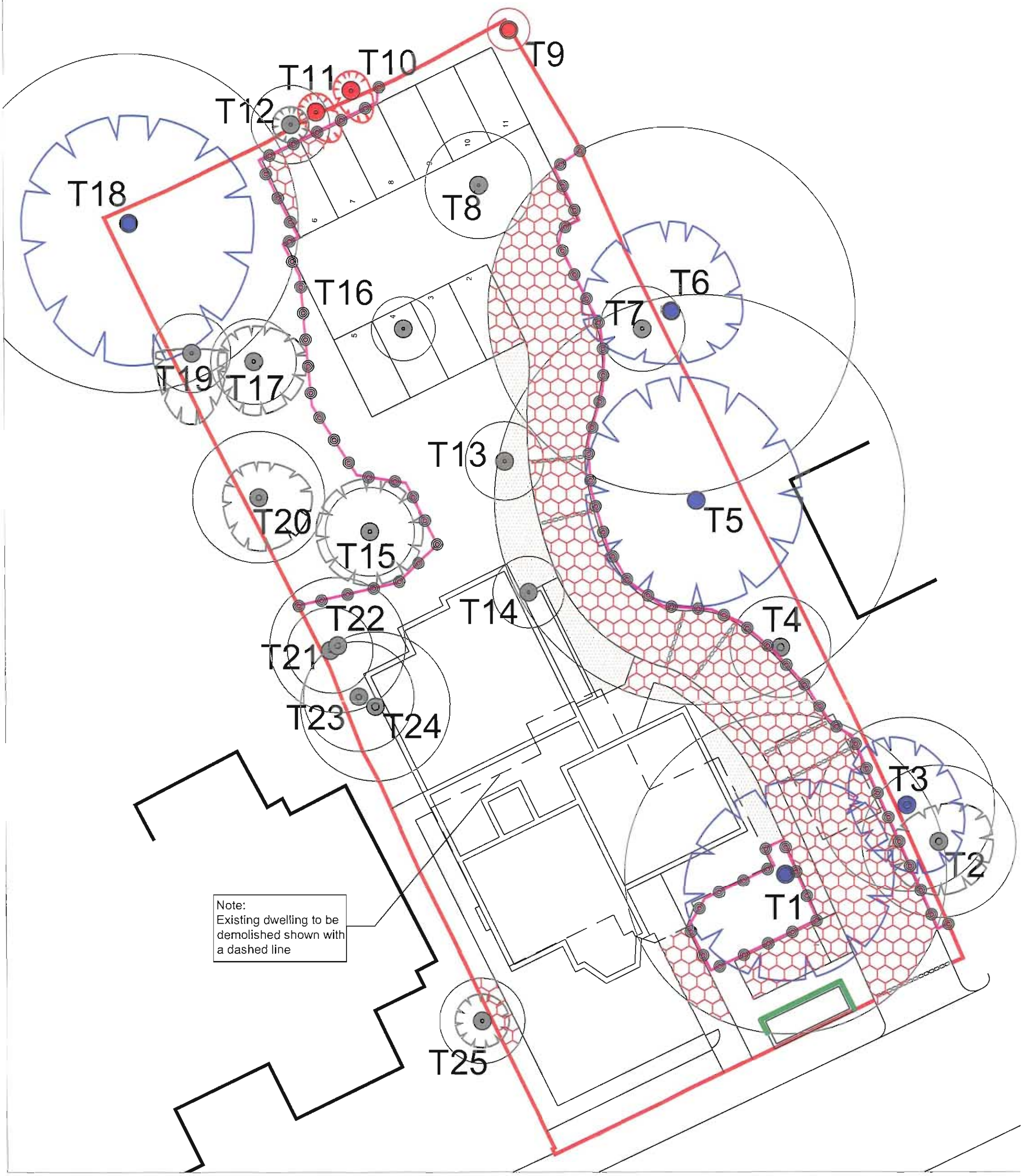
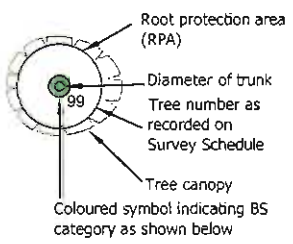
| | |
|---|---|
| Project | 4 Oaklands Road |
| Drawing | Tree Constraints Plan |
| Date | 14.10.14 |
| Ref | 13-171-TCP-REV-A |
| Drawn | NT |
| Checked | DR |
| Client | South East Living Group |
| Scale | 1:200@A3 |

Address: Butlers Dene Cottage, Butlers Dene Road, Woldingham, Surrey CR3 7HD Tel: 07775 686588 Email: admin@canopyconsultancy.com Web: www.canopyconsultancy.com



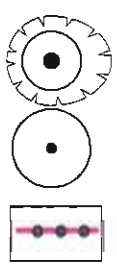

# Legend




Underlined tree tags denote tree located by eye

## Tree categories


## Tree Protection Measures



Tree to be retained
Colour reference in accordance with the categories defined by BS:5837

Tree to be removed
Colour reference in accordance with the categories defined by BS:5837

Line along which Tree Protection Barrier should be installed. Refer to accompanying tree survey report for specification

Area where additional ground protection will be required. Refer to section 5.5 of the accompanying tree survey report for details.

Area of supervised excavations. Refer to accompanying tree survey report for details

Area of hard surface to utilise a cellular confinement system such as cell web as a sub base

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| | |
|---|---|
| Project | 4 Oaklands Road |
| Drawing | Tree Protection Plan |
| Date | 10.11.14 |
| Ref | 13-171-TPP |
| Drawn | NT |
| Checked | DR |
| Client | South East Living Group |
| Scale | 1:200@A3 |

Address: Butlers Dene Cottage, Butlers Dene Rd, Woldingham, Surrey CR3 7HD Tel: 07775 686588 Email: admin@canopyconsultancy.com Web: www.canopyconsultancy.com

# 7 Appendices

Appendix 1: Tree Survey Schedule

| Project: | 4 Oaklands Road, Bromley | BS 5837 2012 Trees In relation to design, construction and demolition- recommendations | Surveyed by | NAT |
|---|---|---|---|---|
| Ref: | 13-171-TSS | | Weather | Clear and Bright |
| Date: | 11.10.14 | | Tagged | No |
| Client: | South East Living | | | |

| Tree No. | Species | Height (m) | DBH (mm) | Canopy Spread N | E | S | W | Stems | Height of crown clearance | Age class | Physiological condition problems/comments | Structural condition | Preliminary management recommendations | Estimated remaining contribution years | BS category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T1 | beech (Fagus sylvatica) | 18 | 750 | 5 | 6 | 6 | 6 | 1 | 2 | M | Good | Fair - signs of decay at first branch union | None | 20-40 | B2 |
| T2 | false acacia (Robinia pseudoacacia) | 10 | 360 | 2 | 3 | 3 | 3 | 1 | 3 | MA | Fair - minor die back | Good | None | 10-20 | C1 |
| T3 | false acacia (Robinia pseudoacacia) | 11 | 410 | 4 | 3 | 4 | 3 | 1 | 3 | MA | Good | Good | None | 20-40 | B2 |
| T4 | leyland cypress (xcupressocyparis leylandii) | 6 | 400 | 3 | 3 | 3 | 3 | 1 | 1 | MA | Good | Good | None | 20-40 | C1 |
| T5 | oak (Quercus robur) | 16 | 957 | 7 | 6 | 6 | 6 | 1 | 2 | M | Good | Fair - twin stem. Decay at base of western stem which leans west | None | 20-40 | B2 |
| T6 | sweet chestnut (Castanea sativa) | 14 | 860 | 5 | 4 | 3 | 5 | 1 | 4 | M | Good | Fair - possible basal decay | None | 20-40 | B2 |
| T7 | cherry (Prunus sp.) | 5 | 200 | 4 | 1 | 3 | 5 | 1 | 2 | MA | Good | Good | None | 10-20 | C1 |
| T8 | apple (Malus sp.) | 3 | 150 | 3 | 2 | 3 | 3 | 1 | 1.5 | MA | Good | Good | None | 20-40 | C1 |
| T9 | horse chestnut (Aesculus hippocastanum) | 6 | 800 | 1 | 1 | 1 | 1 | 1 | 1 | M | Fair - monolith | Fair - large tear out wound | Remove | 0-10 | U |

| Project: | 4 Oaklands Road, Bromley | BS 5837 2012 Trees In relation to design, construction and demolition- recommendations | Surveyed by | NAT |
|---|---|---|---|---|
| Ref: | 13-171-TSS | | Weather | Clear and Bright |
| Date: | 11.10.14 | | Tagged | No |
| Client: | South East Living | | | |

CANOPYCONSULTANCY

| | | | | Canopy Spread | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tree No. | Species | Height (m) | DBH (mm) | N | E | S | W | Stems | Height of crown clearance | Age class | Physiological condition problems/comments | Structural condition | Preliminary management recommendations | Estimated remaining contribution years | BS category |
| T10 | Lawson's cypress (Chamaecyparis lawsoniana) | 7 | 200 | 1 | 1 | 2 | 1 | 1 | 2 | MA | Moribund | Fair | N/A off site | 0-10 | U |
| T11 | Lawson's cypress (Chamaecyparis lawsoniana) | 7 | 180 | 1 | 1 | 2 | 1 | 1 | 2 | MA | Die back | Fair | N/A off site | 0-10 | U |
| T12 | Lawson's cypress (Chamaecyparis lawsoniana) | 7 | 180 | 1 | 1 | 1 | 1 | 1 | 2 | MA | Fair - sparse canopy | Fair | N/A off site | 10-20 | C1 |
| T13 | silver birch (Betula pendula) | 11 | 180 | 3 | 2 | 3 | 3 | 1 | 2 | MA | Good | Good | None | 20-40 | C1 |
| T14 | silver birch (Betula pendula) | 10 | 170 | 2 | 2 | 2 | 3 | 1 | 1 | MA | Good | Good | None | 20-40 | C1 |
| T15 | Lawson's cypress (Chamaecyparis lawsoniana) | 8 | 210 | 3 | 3 | 3 | 3 | 1 | 1 | MA | Good | Good | None | 20-40 | C1 |
| T16 | yew (taxus baccata) | 4 | 150 | 3 | 2 | 3 | 2 | 1 | 1.5 | Y | Good | Good | None | 20-40 | C1 |
| T17 | Japanese maple (Acer palmatum) | 4 | 200 | 2 | 3 | 3 | 2 | 1 | 1.5 | MA | Good | Good | None | 20-40 | C1 |
| T18 | horse chestnut (Aesculus hippocastanum) | 10 | 790 | 6 | 7 | 8 | 6 | 1 | 2 | M | Fair | Fair - girdled roots | None | 20-40 | B2 |
| T19 | lilac (Syringa vulgaris) | 4 | 180 | 0 | 2 | 4 | 2 | 1 | 2 | MA | Fair - ivy | Fair - leans south | None | 10-20 | C1 |
| T20 | Lawson's cypress (Chamaecyparis lawsoniana) | 10 | 310 | 2 | 3 | 3 | 2 | 1 | 2 | MA | Good | Good | None | 10-20 | C1 |

| Project: | 4 Oaklands Road, Bromley | BS 5837 2012 Trees in relation to design, construction and demolition- recommendations | Surveyed by | NAT |
|---|---|---|---|---|
| Ref: | 13-171-TSS | | Weather | Clear and Bright |
| Date: | 11.10.14 | | Tagged | No |
| Client: | South East Living | | | |

CANOPYCONSULTANCY

| | | | | Canopy Spread | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tree No. | Species | Height (m) | DBH (mm) | N | E | S | W | Stems | Height of crown clearance | Age class | Physiological condition problems/comments | Structural condition | Preliminary management recommendations | Estimated remaining contribution years | BS category |
| T21 | holly (Ilex aquifolium) | 7 | 241 | 3 | 2 | 1 | 3 | 2 | 2 | MA | Good | Good | None | 10-20 | C1 |
| T22 | yew (taxus baccata) | 4 | 320 | 4 | 3 | 2 | 2 | 1 | 2 | MA | Good | Good | None | 10-20 | C1 |
| T23 | laurel (Prunus laurocerasus) | 5 | 313 | 2 | 3 | 2 | 4 | 3 | 0 | MA | Good | Good | None | 10-20 | C1 |
| T24 | holly (Ilex aquifolium) | 5 | 425 | 2 | 4 | 4 | 3 | 2 | 1 | MA | Good | Good | None | 10-20 | C1 |
| T25 | Lawson's cypress (Chamaecyparis lawsoniana) | 8 | 200 | 1.5 | 2 | 2 | 2 | 1 | 2 | MA | Good | Good | None | 10-20 | C1 |

Appendix 2: Arboricultural Advisory and Information Service guidance note APN12

Trees in focus

APN 12

Arboricultural Practice Notes

# Through the Trees to Development

Derek Patch and Ben Holding

*Arboricultural Advisory and Information Service*

## Summary

The majority of tree roots grow in the upper metre of soil and they may spread outwards in any direction a distance equal to the tree's height. Any disturbance of the ground within the root spread of a tree can damage its roots and may severely injure the tree. Damage to roots will interrupt the supply of water necessary to keep the tree alive and may cause decline in vigour, dieback or even death of the tree.The tree may also be made unstable and so pose an unacceptable threat to the safety of people and property. Development of a site, including construction of access routes, driveways and parking areas can result in substantial root severance of trees. Techniques for the construction of access drives, which may avoid or lessen the damage caused to trees, are described.

This note embraces the principles first published by The Tree Advice Trust as "Driveways Close to Trees" (Aboricutural Practice Note No. 1[1]) and reviews where the principles may be applied in practice.

## Trees: A Cause of Conflict

Development of a site is sometimes hampered or prevented because of the presence of trees. Local authorities and residents may wish to see trees 'preserved' whilst developers seek permission to build close to them - often ignorant about the damage this may cause to trees. Even developments such as access drives and parking areas can threaten existing nearby trees.

Traditional driveway construction (excavation and backfilling with a compactable load-bearing sub-base material) can seriously damage tree roots. Such damage occurs because of a lack of understanding that roots mainly grow outwards from a tree's trunk, near to the soil surface, rather than downwards (Dobson 1995). Where there is a significant risk of damage to trees by root severance, or changes in soil conditions during construction, local planning authorities may sometimes refuse permission for installation of an access driveway or parking area close to trees - especially if the trees are subjects of Tree Preservation Orders.

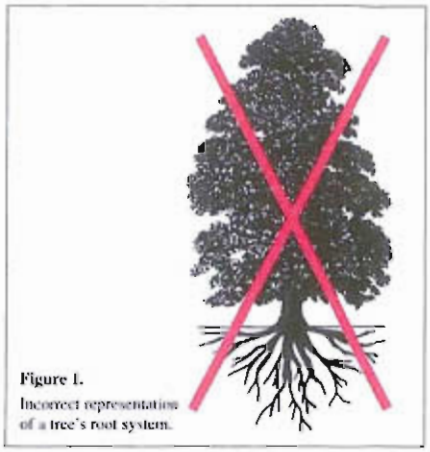


**Figure 1.**
Incorrect representation of a tree's root system.

However, if the potential for damage to the tree's root system (e.g. by severance or soil compaction) can be avoided during construction, development may be more easily accepted. A technique is described below which should reduce the risk of significant damage to tree roots while enabling access and parking for light vehicles to be constructed close to trees.

## Where Do Tree Roots Grow?

Survival of a tree depends on its roots being able to absorb enough water from the soil to sustain the foliage (an estimated 1,000 litres per day in summer for a fully grown forest tree in a rural area) and on developing a strong root system capable of keeping the tree upright through autumn and winter gales. To achieve this the tree's roots must exploit a very large volume of soil. However, the assumption that these requirements are met by a system of roots growing predominantly downwards (Figure 1), and that anchoring roots are very thick and descend into the soil for many metres (like the base of a lamp post) is incorrect. In reality tree roots:

AAIS

[1] Driveways Close to Trees, Arboricultural Practice Note No. 1 is withdrawn and superceded by this wider text.

1

- grow in any direction more or less parallel with the soil surface rather than vertically (Figure 2). This is also true for trees growing on sloping land.
- are usually relatively shallow - most of a tree's roots are in the upper metre of soil.
- usually radiate outwards from a tree for a distance equivalent to at least the tree's height (which for a mature tree may be 20 m or more).
- can be 30 cm or more in diameter at the base of the trunk.
- sub-divide and taper rapidly as they extend out from the trunk.
- are only 2-3 cm in diameter, and often much less at 3-4 m distance from the trunk.

The small woody roots (those less than 3 cm diameter) taper very little but they may spread out for long distances. Smaller, non-woody roots (sometimes described as white, feeder, fibrous, fragile or absorbing roots) grow outwards and usually upwards from the woody roots and subdivide to exploit the better aerated surface soil. Although generally short lived they (and the fungi associated with them - called mycorrizas) are the principal absorbers of moisture and nutrients.

Most roots (both thick and fine) are situated close to the soil surface, forming a thin layer less than 1m deep, but some small roots (usually only a few mm in diameter) may reach 2 m or more deep.

## Roots and the Soil

Roots are living and, like all plants and animals, must have oxygen if they are to survive. Without oxygen roots are unable to function properly or grow, and when they are starved of oxygen for prolonged periods, they die.

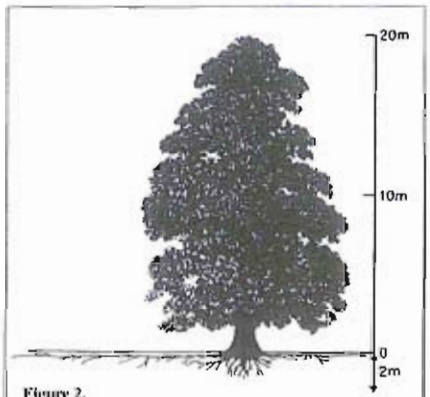



**Figure 2.**
Trees have a relatively shallow but wide spreading root system.

Both oxygen and water are held in the pores between the soil particles. Where the pores are large (e.g. in coarse or sandy soils) the soil will generally be freely draining and well-aerated, but where the pores are small (e.g. in heavy clays or soils which have been compacted) they may be full of water and have a poor supply of oxygen.

Most trees that have been growing undisturbed on a site for many years will have developed an extensive root system with the roots growing where the soil conditions are most favourable. There will be a balance between the development of the crown (which demands water) and the roots (which supply it). Any sudden alteration of the soil conditions within the tree's rooting area (a circle of radius equal to the tree's height) will therefore upset this balance. For example, the single passage of a machine will 'squeeze' the soil closing up the pores (causing compaction - especially in the upper levels) and so reduce the amount of oxygen available to roots which prevents them from growing through the soil. With each additional machinery movement the compaction increases and so do the problems for the tree and its roots.

Placing soil or other materials over the root system of a tree will impede air movement into and out of the soil around the roots and consequently reduce the availability of oxygen to the roots. The effect on the tree is usually progressive shoot and branch dieback until a new balance has been reached between the reduced capacity of the damaged root system to absorb water and the demands of the leaves. If damage is progressive or so severe that such a balance cannot be achieved, the tree will ultimately die.

Excavations - **even stripping the topsoil** - within the rooting area will sever roots. The closer the excavation is to the trunk of the tree the larger will be the roots lost and the greater the significance for the health and stability of the tree. Once the excavation is a metre deep virtually all of the roots growing into the excavated area will have been severed. The tree may then either be unable to absorb sufficient water to sustain the foliage and dieback will occur, or anchorage will be so reduced that the tree is unsafe and has to be severely pruned or even felled for safety.

Soil compaction, excavations and soil level increases will all damage roots and the closer to the trunk they occur the greater the damage inflicted on the tree. Nevertheless, healthy trees are generally able to withstand the loss of some roots (a maximum of about 20% of the rooting area, Helliwell and Fordham (1992)) without noticeable adverse effects.

## Development Near Trees

British Standard BS 5837:2005 *Trees in Relation to Construction – Recommendations* recommends that on construction sites an area around a tree should be left undisturbed (the Root Protection Area) so that unacceptable damage to the root system is avoided. In the British Standard the Root Protection Area is calculated as

the equivalent of a circle about 12x the diameter of the tree's trunk (measured at 1.5m above ground level). The distance from the trunk extending to the branch spread, or half the tree's height, whichever is the greater (Figure 3) is a useful indicator of the typical Root Protection Area for a given tree.

**The Root Protection Area** is an area of protected ground around a tree within which any activity that could damage roots should be prohibited without the prior agreement of an aboriculturist.

However, if the principles and guidelines set out below are followed, installation of access driveways and parking for light vehicles within the Root Protection Area may, in many situations, be possible without causing significant, permanent damage to trees. Nevertheless, expert arboricultural advice should be sought to determine whether the tree and the site conditions lend themselves to the principles described in this Note. Any assessment of a site should include consideration of the health and overall condition of the tree(s). That is because old and declining trees may be vulnerable to sudden changes in the site conditions and so they may warrant a larger area than the minimum recommended in the British Standard.

## Engineering Needs

Driveways, footpaths and car parking areas must be built on a firm, stable base. Engineers usually achieve this by excavating the soil to a depth of about 0.5 m, compacting the base if necessary, and backfilling with an inert material that can be compacted to form a stable platform. This usually involves progressive placement of layers of inert material with each being compacted by repeated passes of a powered roller or whacker plate. Each pass of a machine creates increasing compaction at depth in the soil. The edges of the excavation act as the supporting formation and kerbs or other edgings may be used to retain the surface material.

Any such excavations or soil stripping will sever roots and should be avoided within the Root Protection Area.

Compacting the base of an excavation can change the bulk density of the subsoil creating conditions unsuitable for the survival of any roots, particularly the water absorbing fine roots, contained in that volume. Placement and particularly compaction of load bearing construction materials will contribute to this creation of conditions unsuitable for root survival.

On many sites it is possible to construct an adequately supported access driveway suitable for limited usage by light vehicles while retaining healthy, stable trees, by adoption of three principals particularly when construction is within the Root Protection Area as determined in consultation with an arboriculturist.

Where the finished structure will be adopted by the Highway Authority a more robust specification may be required. Provided the same principles are embraced construction across the root systems of trees should still be feasible.

## Protection *and* Construction

For tree roots to be retained undamaged there must be *no excavation, no soil stripping* and *no grading of the site within the Root Protection Area* - in other words, **NO DIGGING**. This means that construction will have to be above the existing ground level.

Passage of vehicles across an unprotected soil surface must also be avoided, particularly where the soil is wet, as this will cause breakage of surface roots, soil compaction and consequently reduced soil aeration. These problems are heightened on clay soils. Most vulnerable to soil compaction are the fine white roots (those roots that are generally difficult to find when soil is examined) essential for water absorption. Surviving roots may not be able to grow through the compacted soil.

To reiterate there must be **NO COMPACTION** of the soil.

Where trees are to be retained on a site it is essential, therefore, that all but the immediate area of the development is protected from access and construction operations by fencing as recommended in BS 5837.

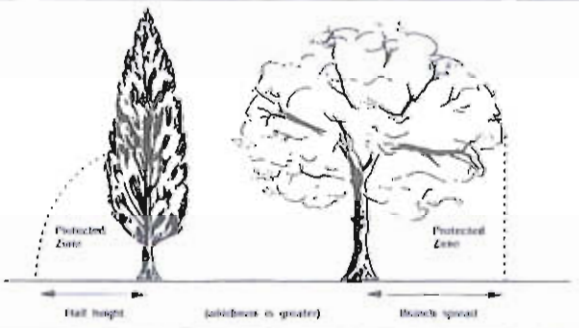



**Figure 3.**
Distance from a tree which constitutes the zone in which roots should be protected - i.e. no digging.

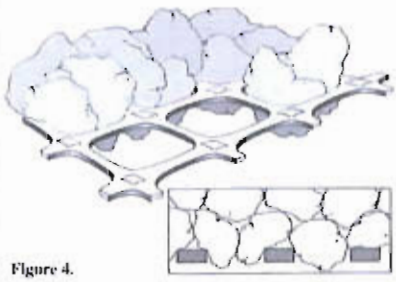


**Figure 4.**
The mechanism of interlock between aggregate and geogrid.

## No-Dig Construction

Successful retention of trees, even when adopting a no-dig method, depends upon the condition (health and vigour) of the tree(s), which should be assessed by a qualified arboriculturist, and on adherence to three simple rules within the Root Protection Area:

- roots must not be severed, cut or broken – **no digging**
- ground levels must not be changed – **no digging, no soil level raising**
- **soil must not be compacted – no tracking of vehicles**
- oxygen must be able to diffuse into the soil beneath the engineered surface – **no tracking of vehicles**

## Meeting the Engineering Needs

Damage to trees can be avoided only if the construction embraces the above simple principles and, within the fenced Root Protection Area, is no more than 5m wide.

Construction should incorporate two main components:

- a synthetic load spreading material
- a no-fines aggregate sub-base

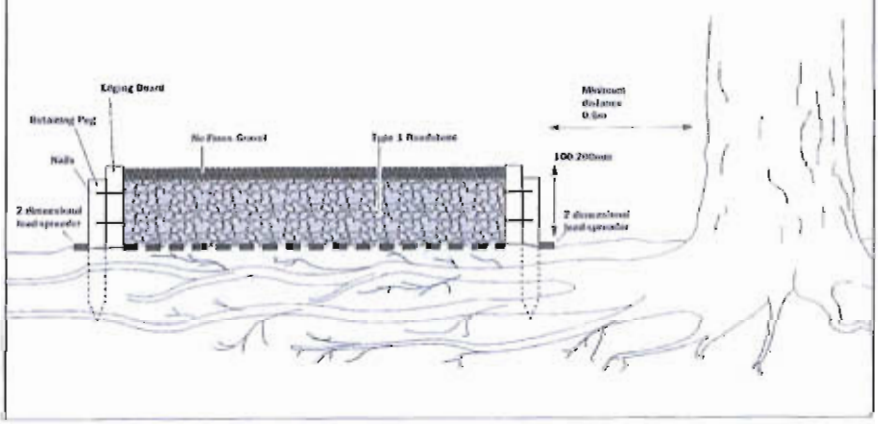
**Note:** a geotextile, which is usually used to prevent layers of different mineral materials mixing while allowing water to pass through, is not designed to be load bearing.

'Load spreading' materials, are synthetic grids/webs designed to support roads on soft ground by distributing the load of a wheel over a larger area than would normally occur. They may be 2- or 3-dimensional.

When placed on a 2-dimensional grid, appropriate, no-fines granular sub-base material penetrates the mesh, but is unable to pass through it, forming a positive interlock (Figure 4). This interlock between aggregate and grid provides a reinforced platform and efficient load spread into the underlying ground over a wider area than the footprint of the wheel on the surface. A suitable geogrid/aggregate combination constructed with the grid under tension should prevent rutting of the ground beneath the construction (Figure 5).

The 3-dimensional load spreading products (Cellular Confinement System) create cells into which the sub-base material is placed (Figure 6). Such a construction does not support the sub-base material, it confines the material in discrete cells. Manufacturers recommended, therefore, that a geotextile (see note above) is placed between the ground

**Figure 5.** Diagram of a 'no-dig' method for constructing access drives and parking near to trees in order to minimise damage to tree roots. *(Not to scale)*



and the load spreader to prevent the cell-contained mineral material being pressed down into the underlying soil.

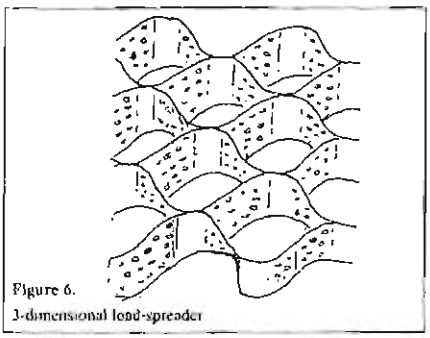


Figure 6.
3-dimensional load-spreader

A no-dig construction, that is a construction above ground level, will need to be contained to prevent outward creep under the weight of vehicles. This may be achieved with an edging support provided its construction does not involve excavation. A suitable material may be long-life timbers pinned through the load-spreader into the underlying soil. This could add strength to the structure because the pressure of vehicles forcing the sub-base downwards and outwards will tend to increase the tension on the grid and any tendency to rutting.

Note: some manufacturers specify that their product should be placed in a 100mm or greater depth of formation (i.e. excavation). It is important that before such a construction is adopted the agreement of an arboriculturist who has considered the circumstances of the tree's health and evaluated the site conditions, should be obtained. Failure to do so could result in breach of a Tree Preservation Order and Conservation Area legislation because roots will inevitably be damaged by an excavation of as little as 100mm.

The granular sub-base material should have a no 'fines' content which means that even when it is compacted it should be freely draining and will allow oxygen to diffuse into, and damaging gases (e.g. carbon dioxide and methane) out of the soil.

For site-specific prescriptions and materials specifications advice should be sought from a qualified geotechnical or civil engineer who should work in consultation with an arboriculturist.

## Putting the Principles into Practice

Is the site suitable for a no-dig construction? (see next section)

Construction should ideally be undertaken in dry weather between May and October when the ground is likely to be driest and least prone to damaging compaction.

There must be a method of working that does not require movement of machinery or heavy plant within the branch spread of the tree before the ground is protected by a load spreader and the sub-base. Then the movements must be only along the construction.

For example when making a new access into a site construction should commence at the entrance to the site and 'roll out' the driveway in front of the machinery which always remains over the sub-base.

Ground vegetation should be killed using a translocated herbicide such as glyphosate[1]. (This may be most appropriately done in consultation with an experienced arboriculturist to ensure that the chemical and application method do not result in damage to retained trees.) After allowing time for the chemical to be absorbed and kill the plants, including their roots, gather up the dead organic material - this will prevent the build up of anaerobic conditions beneath the construction which might otherwise occur as dead vegetation decomposes.

Carefully remove major protrusions such as rocks.

Remove tree or shrub stumps (stumps should be ground out rather than excavated to minimise soil disturbance).

Fill major hollows with clean sharp sand – DO NOT GRADE-OFF HIGH SPOTS.

If necessary, for example when using a three dimensional cellular confinement product as a load spreader, a geotextile should be spread over the area of the driveway or car park.

With a two dimensional load spreading product into which the no-fines sub-base stone forms a lock a geotextile may be used but it is not essential.

Lay the synthetic load spreader directly onto the levelled ground or the geotextile as appropriate.

Secure the synthetic load spreader under tension using long pins driven into the ground through the grid.

Note: Before driving pins into the ground check for underground services that could be damaged.

Construct an edging which is secured through the load spreader so that pressure on the running surface will force the edging outwards and so increase the tension on the load spreader.

Cover the load spreader with a minimum of 100 mm of no-fines aggregate. This should not be tipped straight onto the synthetic material, but should be placed at one end and then pushed onto the load spreader between the retaining edges so that machinery is supported by the spread sub-base material rather than directly on the load-spreader and not on the ground either side of it.

Compact the sub-base to ensure binding with the load spreader and to minimise future rutting.

[1] When selecting a herbicide care must be taken to select a product which does not damage the roots of desirable vegetation that may extend into the treated area. Always read the product label before use.

A further geotextile may be placed over the sub-base to prevent dry bedding materials or surfacings merging with the sub-base.

Place the final surface. In the main it is likely that this will consist of gravel or tarmacadam, although paving slabs and brick pavours may be acceptable provided they are dry bedded on the sub-base and the joints are not sealed with grout, to allow for infiltration of water and gaseous diffusion[1].

Where a mass concrete, or impervious surface material is required the specification for an adoptable road (see below) should be used.

## Sites are not all the Same!

The principles detailed above, if applied sensibly, should permit access to be constructed across the root system of a healthy tree. That is where the construction passes through the Root Protected Area retained around a tree as recommended by British Standard BS 5837:2005 *Trees in relation to construction - Recommendations*.

Why the 'sensibly'? No two sites are the same, in fact some are totally unsuitable for a no-dig construction and it may be necessary to admit that access to the site cannot be achieved if certain trees are so important/valuable that their retention is essential. For example, where trees grow on an old hedge bank excavation to cut through the bank may be unavoidable and so an unacceptable proportion of the root system would be severed. In contrast ditches that can be filled/piped/bridged (Figure 7) should be less problematic.

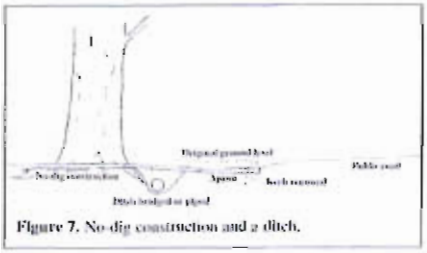



**Figure 7.** No-dig construction and a ditch.

When planning a driveway it is important to consider the ground levels on site and to relate them to the fixed level on the public thoroughfare into which the drive must connect and be tied. Where a roadside verge within the root protection area around a tree cannot be crossed without excavations then a different access point may be needed if the tree is deemed to be of very significant value to the amenities of the area.

Highway Authorities generally seek an 'apron' (upto 4m long), with a shallow or no gradient and a sealed surface at the entrance to a site where the drive joins the highway. This is to reduce the risk of loose material migrating onto the footpath and road where it could become a hazard. Such an apron may involve excavation thus reducing the scope for a drive constructed using the no-dig principles.

The simplest site on which a no-dig construction can be used is where the ground falls into the site from the edge of the road. Level sites should not pose significant problems provided there is an adequately wide verge/pavement to accommodate the 'apron' without severing roots.

It is also important to remember that the no-dig construction needs to tie onto the road and also the levels of the garage or damp proof course of a building.

The roots of a tree will generally grow parallel with the ground surface - they do not grow preferentially up, down or across the slope! As such trees growing on a slope do not present any problems different from those of trees growing on a flat site – it is the engineering requirements that differ! Where the drive crosses the contours at a gentle angle, there is no reason why the depth of a no dig construction should be constant across its width of a drive. The engineering problem may be how to retain the structure. The scope for increasing the lift on one side of a drive is not unlimited – probably 1:3 should be a maximum (Figure 8).

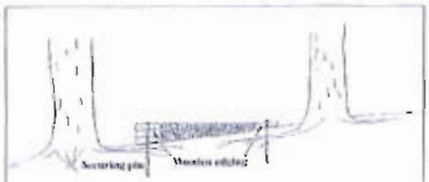



**Figure 8.** No-dig construction across a slope.

Permanently wet areas of ground should normally be drained, or they may be filled with no-fines stone, or if the water is flowing, they may be partially piped. In contrast, seasonally wet areas may benefit from drainage and building up the ground with coarse stone with a low fines component over which the drive is constructed.

The depth of each layer in the construction of a no-dig drive will be influenced by the bearing capacity of the ground over which the drive will pass. Also there must be consideration of the weight of traffic that will use the drive. The final design should, therefore, be achieved in discussion between a civil engineer and an arboriculturist.

## A Potential Benefit

Inclusion of a load spreader in a construction should offer resistance to direct damage often caused to drives and car parks by diameter growth of roots under the structure.

[1] For drives less than 5m wide the finished surface may be constructed with a less permeable material such as asphalted reinforced mass concrete.

## Adoptable Highways

The above construction is generally unacceptable where the finished structure is to be adopted by a Highway Authority – a more robust specification will be required for example pre-rutting, that is compaction of the ground under the driveway before construction commences, will be required. Such an engineering requirement will usually involve a vibrating roller or repeated tracking of heavy machinery, which is totally unacceptable for the welfare of the tree. The repeated tracking needed to deliver and consolidate layers of aggregate is likely to severely compact the underlying soil at increasing depth. A single pass of a vehicle can cause significant changes in the pore structure in the soil. Repeated passes will further compact the soil which will favour the needs of the engineer, but will eventually create conditions in the soil that are totally unsuitable for root activity and root death will result.

In such circumstances consideration must be given to designing and constructing a running surface which does not require either excavation, or direct compaction of the material under the construction and which does not place a dynamic force on the soil around tree roots. Further, an adopted road is likely to have a width greater than the 5m driveway considered above. The wider the construction the greater the impedance to gaseous exchange between the atmosphere and the soil around roots.

Where a load spreader is acceptable to the Highway Authority there will be need for a greater thickness of no-fines sub-base to support the loads carried by the finished structure[4]. It is then practical to include a system of perforated pipes laid in the sub-base material with venting either at the road surface or in the verges at the edge of the road. The finished surface over the sub-base may then be impermeable to gases (e.g. hot rolled asphalt, or concrete). Inclusion of a 'clay board', or similar over the sub-base may be appropriate to aid casting of the surface.

In the more extreme circumstances a construction to bridge the root system of a very high value tree could be based on an elevated 'board walk' or causeway. That is a series of pads sunk into the ground (causing only localised damage to the root system) supporting beams across which reinforced concrete beams are placed (c.f. a suspended floor in a building). Such a construction would not apply pressure to the ground and so there would not be any threat to underlying tree roots. This removes the need for a load spreader and specialized anchors and edgings.

## Final Remarks

Adoption of the no-dig principles for creating access and parking for light vehicles near to trees, which avoids root severance, should help to overcome concerns about possible adverse effects on trees. Nevertheless, successful retention of a tree will depend upon the site in relation to the adjacent highway and strict adherence to the above principles, and upon the tree's condition – indicative of its ability to withstand changes in its rooting environment. This should be assessed by a qualified arboriculturist.

On completion a no-dig construction will be at least 300m above the original ground level.

## Acknowledgement

The authors acknowledge the valuable comments and suggestions made by colleagues and members of the Arboricultural Association.

## References and Further Reading

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[4] Type 1, as specified by the Highways Agency (2004) is not a recommended aggregate for use around tree roots because it contains a significant proportion of 'fines'.

Appendix 3: Extract from the Cell Web product brochure

# CellWeb

Tree Root Protection System

CellWeb Tree Root Protection System provides a flexible and permeable solution for protecting tree roots while creating a strong stable surface for traffic

With increased urbanisation and more redevelopments of existing properties, the need to be mindful of the impact on the surrounding environment is more important than ever.

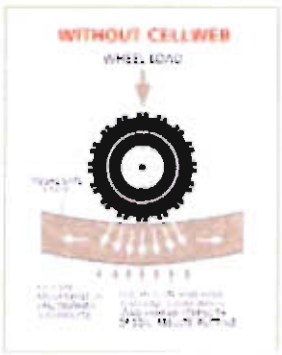
The demand for building site access, driveways and parking around existing trees can have a potentially fatal impact on the tree if carried out incorrectly. Tree preservation orders (TPO's) ensure that trees are not wilfully damaged. However the need for vehicle access over and around tree roots can still cause the following problems:

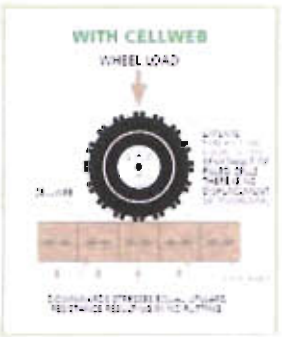
**Problems:**

- Compaction of subsoils (especially by construction traffic) causing oxygen and nutrient depletion
- Creating an impermeable surface that prevents water reaching the roots
- Changes in ground level and water table
- Damage caused during excavation
- Contamination of the subsoil

By using CellWeb Tree Root Protection System you can avoid these problems and ensure the tree's long-term future. BS 5837:1991 (revised 2005) and APN 1 provide information for the protection of trees during the construction process, and CellWeb is a well-established solution that conforms to these guidelines.

# Product features

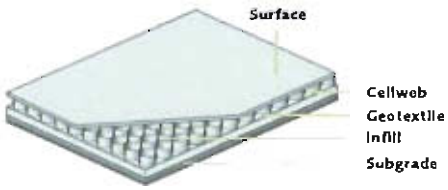



Cellweb's patented design with its unique cellular structure and perforated cell walls reduces the vertical load pressure on tree roots and prevents damage. With clean granular materials as infill, air and moisture can reach the roots to encourage healthy growth.

With no-dig solutions being the preferred option of most Arboricultural Consultants and Tree Officers, CellWeb is ideal as only the surface vegetation need be removed. As well as avoiding disruption to the roots this reduces installation time and saves money.

What's more CellWeb also cuts down the depth required for the sub base – in most cases by 50% for further cost savings. CellWeb also significantly reduces surface rutting, increasing the long-term performance of the finished surface.




Using CellWeb for tree root protection gives you these benefits:

- Reduced depth of excavation required
- Preventing the compaction of subsoils
- Preventing oxygen and nutrient depletion
- Environmentally sound
- Quick, easy and cost-effective installation
- Free technical support available

CellWeb gives you the cost-effectiveness you need at the same time as helping to preserve trees.

Access road for the National Lake District Park Authority

Site before construction pictured above

CellWeb during installation

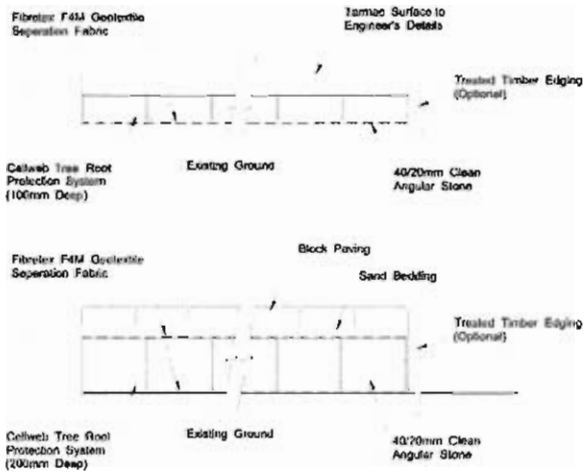
Final surfacing

## Final surfacing

The CellWeb Tree Root Protection is totally confined within the clean stone sub base, therefore you can choose whichever surface materials are most appropriate for your installation. Some materials are more suitable than others and serious consideration should be given to the porosity of the surface for continued healthy growth of the tree. An ideal surfacing are DuoBlocks: a grass reinforcement and gravel retention system. Geosynthetics can supply these systems for a visually attractive surface that also has the advantage of being fully porous.

Loose or bonded gravels can be used as an alternative hard landscaping and CellWeb can also be used with block pavors whose porous joints will permit moisture and air transfer to the roots. Where planning allows, porous asphalt is yet another possible surfacing treatment.

Call our sales office on 01455 617 139 for more information.



Appendix 4: Section 4, extracted from NJUG 4

## 4. HOW TO AVOID DAMAGE TO TREES

This section gives general guidance on methods of work to minimise damage to trees. The local authority (or for privately owned trees, the owner or their agent), should be consulted at an early stage prior to the commencement of any works. This will reduce the potential for future conflict between trees and apparatus.

### 4.1 Below Ground

Wherever trees are present, precautions should be taken to minimise damage to their root systems. As the shape of the root system is unpredictable, there should be control and supervision of any works, particularly if this involves excavating through the surface 600mm, where the majority of roots develop.

#### 4.1.1 Fine Roots

Fine roots are vulnerable to desiccation once they are exposed to the air. Larger roots have a bark layer which provides some protection against desiccation and temperature change. The greatest risk to these roots occurs when there are rapid fluctuations in air temperature around them e.g. frost and extremes of heat. It is therefore important to protect exposed roots where a trench is to be left open overnight where there is a risk of frost. In winter, before leaving the site at the end of the day, the exposed roots should be wrapped with dry sacking. This sacking must be removed before the trench is backfilled.

#### 4.1.2 Precautions

The precautions referred to in this section are applicable to any excavations or other works occurring within the Prohibited or Precautionary Zones as illustrated in Figure 1 – 'Tree Protection Zone'.

#### 4.1.3 Realignment

Whenever possible apparatus should always be diverted or re-aligned outside the Prohibited or Precautionary Zones. Under no circumstances can machinery be used to excavate open trenches within the Prohibited Zone.

The appropriate method of working within the Precautionary Zone should be determined in consultation with the local authority (or for privately owned trees the owner or their agent) and may depend on the following circumstances;

- the scope of the works (e.g. one-off repair or part of an extensive operation)
- degree of urgency (e.g. for restoration of supplies)
- knowledge of location of other apparatus
- soil conditions
- age, condition, quality and life expectancy of the tree

Where works are required for the laying or maintenance of any apparatus within the Prohibited or Precautionary Zones there are various techniques available to minimise damage.

Acceptable techniques in order of preference are;

#### a ) Trenchless

Wherever possible trenchless techniques should be used. The launch and reception pits should be located outside the Prohibited or Precautionary Zones.
In order to avoid damage to roots by percussive boring techniques it is recommended that the depth of run should be below 600mm. Techniques involving external lubrication of the equipment with materials other than water (e.g. oil, bentonite, etc.) must not be used when working within the Prohibited Zone. Lubricating materials other than water may be used within the Precautionary Zone following consultation and by agreement.

**b) Broken Trench - Hand-dug**
This technique combines hand dug trench sections with trenchless techniques if excavation is unavoidable. Excavation should be limited to where there is clear access around and below the roots. The trench is excavated by hand with precautions taken as for continuous trenching as in (c) below. Open sections of the trench should only be long enough to allow access for linking to the next section. The length of sections will be determined by local conditions, especially soil texture and cohesiveness, as well as the practical needs for access. In all cases the open sections should be kept as short as possible and outside of the Prohibited Zone.

**c) Continuous Trench - Hand-dug**
The use of this method must be considered only as a last resort if works are to be undertaken by agreement within the Prohibited Zone. The objective being to retain as many undamaged roots as possible.

Hand digging within the Prohibited or Precautionary zones must be undertaken with great care requiring closer supervision than normal operations.

After careful removal of the hard surface material digging must proceed with hand tools. Clumps of roots less than 25mm in diameter (including fibrous roots) should be retained in situ without damage. Throughout the excavation works great care should be taken to protect the bark around the roots.

All roots greater than 25mm diameter should be preserved and worked around. These roots must not be severed without first consulting the owner of the tree or the local authority tree officer / arboriculturist. If after consultation severance is unavoidable, roots must be cut back using a sharp tool to leave the smallest wound.

### 4.1.5 **Backfilling**

- Any reinstatement of street works in the United Kingdom must comply with the relevant national legislation (see: **Volume 6 – 'Legislation and Bibliography'**). In England this relates to the requirements of the code of practice – 'Specification for the Reinstatement of Openings in Highways' approved under the New Roads and Street Works Act 1991. Without prejudice to the requirements relating to the specification of materials and the standards of workmanship, backfilling should be carefully carried out to avoid direct damage to roots and excessive compaction of the soil around them.

- The backfill should, where possible, include the placement of an inert granular material mixed with top soil or sharp sand (not builder's sand) around the roots. This should allow the soil to be compacted for resurfacing without damage to the roots securing a local aerated zone enabling the root to survive in the longer term.

- Backfilling outside the constructed highway limits should be carried out using the excavated soil. This should not be compacted but lightly "tamped" and usually left slightly proud of the surrounding surface to allow natural settlement. Other materials should not be incorporated into the backfill.

### 4.1.6 **Additional Precautions near Trees**

- Movement of heavy mechanical plant (excavators etc.) must not be undertaken within the Prohibited Zone and should be avoided within the Precautionary Zone, except on existing hard surfaces, in order to prevent unnecessary compaction of the soil. This is particularly important on soils with a high proportion of clay. Spoil or material must not be stored within the Prohibited Zone and should be avoided within the Precautionary Zone.

- Where it is absolutely necessary to use mechanical plant within the Precautionary Zone care should be taken to avoid impact damage to the trunk and branches. A tree must not be used as an end-stop for paving slabs or other materials nor for security chaining of mechanical plant. If the trunk or branches of a tree are damaged in any way advice should be sought from the local authority tree officer / arboriculturist.

See TABLE 1 –'Prevention of Damage to Trees Below Ground' below for summary details regarding causes and types of damage to trees and the implications of the damage and the necessary precautions to be taken to avoid damage.

**TABLE 1 - Prevention of Damage to Trees Below Ground**

| Causes of Damage | Type of Damage | Implications to Tree | Precautions |
|---|---|---|---|
| Trenching, mechanical digging etc. | Root severance | • The tree may fall over<br>• Death of the root beyond the point of damage<br>• Potential risk of infection of the tree<br>The larger the root the greater the impact on the tree. | Hand excavate only within the Precautionary Zone. Work carefully around roots. Do not cut roots over 25mm in diameter without referring to the local authority tree officer. For roots less than 25mm in diameter use a sharp tool and make a clean cut leaving as small a wound as possible. |
| Trenching, mechanical digging, top soil surface removal etc. | Root bark damage | • The tree may fall over<br>• If the damage circles the root it will cause the death of the root beyond that point<br>• Potential risk of infection of the tree<br>The larger the root the greater the impact on the tree. | Do not use mechanical machinery to strip the top soil within the Precautionary Zone.<br>Hand excavate only within the Precautionary Zone. Work carefully around roots. Do not cut roots over 25mm in diameter without referring to the local authority tree officer. For roots less than 25mm use a sharp tool and make a clean cut leaving as small a wound as possible. |
| Vehicle movement and plant use. Material storage within the precautionary area. | Soil compaction & water saturation | Restricts or prevents passage of gaseous diffusion through soil, the roots are asphyxiated and killed affecting the whole tree. | Prevent all vehicle movement, plant use or material storage within the Precautionary Zone. |
| Top-soil scouring, excavation or banking up. | Alterations in soil level causing compaction or exposure of roots. | Lowering levels strips out the mass of roots over a wide area. Raising soil levels asphyxiates roots and has the same effect as soil compaction. | Avoid altering or disturbing soil levels within the Precautionary Zone. |
| Use of herbicides. | Poisoning of the tree via root absorption | • Death of the whole tree<br>• Death of individual branches<br>Damage to leaves and shoots. | The selection and application of herbicides must be undertaken by a competent person in accordance with COSHH regulations. |
| Spillage of oils or other materials. | Contamination of soil | Toxic and asphyxiation effects of chemicals, oils, building materials (cement, plaster, additives etc.) on the root system can kill the tree. | Never store oils, chemicals or building materials within the Precautionary Zone or within the branch spread of a tree, which ever is the greater. |
| Placement or replacement of underground apparatus. | Various | Death of all or part of the tree. | Effective planning and liaison with local authority tree officer, taking into consideration the position of trees, and their future growth potential and management |

### 4.2 Above Ground

#### 4.2.1 Damage by Pruning

Trees (including shrubs and hedges) can be damaged by inappropriate or excessive pruning. Reference should be made to the Energy Networks Association (ENA) document "Engineering Technical Report 136 Vegetation Management near Electricity Equipment – Principles of Good Practice" (see section 8 – 'Other Useful Publications') or appropriate company specific documentation for guidance on pruning.

See TABLE 2 – 'Prevention of Damage to Trees Above Ground' below for summary details regarding causes and types of damage to trees and the implications of the damage and the necessary precautions to be taken to avoid damage.

**TABLE 2 - Prevention of Damage to Trees Above Ground**

| Causes of Damage | Type of Damage | Implications for the Tree | Precautions |
|---|---|---|---|
| Impact by vehicle or plant<br><br>Physical attachment of signs or hoardings to the trunk<br><br>Storage of materials at base of tree<br><br>Rubbing by winch or pulling cables | Bark bruising, bark removal, damage to the wood, damage to buttress roots, abrasion to trunk | Wounding with the potential for infection ultimately resulting in death of all or part of the tree.<br><br>Structural failure of the tree | Surround the trunk with protective free-standing barrier. Exclude vehicles, plant or material storage from the Precautionary Zone. Ensure sufficient clearance of cables or ropes. |
| Impact by vehicle or plant<br><br>Rubbing by overhead cables | Bark damage to branches, breakage and splitting of branches, abrasion to branches | Structural failure of the branch.<br><br>Wounding or loss of a branch with the potential for infection ultimately resulting in death of all or part of the branch or tree. | Exclude vehicles, plant or material storage from the Precautionary Zone. Ensure sufficient clearance of cables or ropes.<br>All pruning should be carried out in accordance with BS3998 *(prune affected branches to give appropriate clearance from cables)* |
| Inappropriate siting of overhead apparatus, such as CCTV, lighting fixtures and communications masts and dishes. | Inappropriate pruning, unnecessary tree removal | Severely pruning tree to acquire line of sight signal for communications dish etc. | Effective planning and liaison with local authority tree officer / arboriculturist, taking into consideration the position of trees, and their future growth potential and management. |
| Lack of forethought in design and location of apparatus and services entries on new developments | Complete tree removal | The tree is removed unnecessarily | Agree the location and installation of services at the design stage. Consideration should be given to the creation of dedicated service routes wherever possible. |
| Use of herbicides | Poisoning of the tree via absorption through bark, leaves and shoots | Death of the whole tree, death of individual branches, damage to leaves and shoots | The selection and application of herbicides must be undertaken by a competent person in accordance with COSHH regulations. |