Appendix 3: Protecting retained trees

Introduction

1. Purpose and use of this guidance

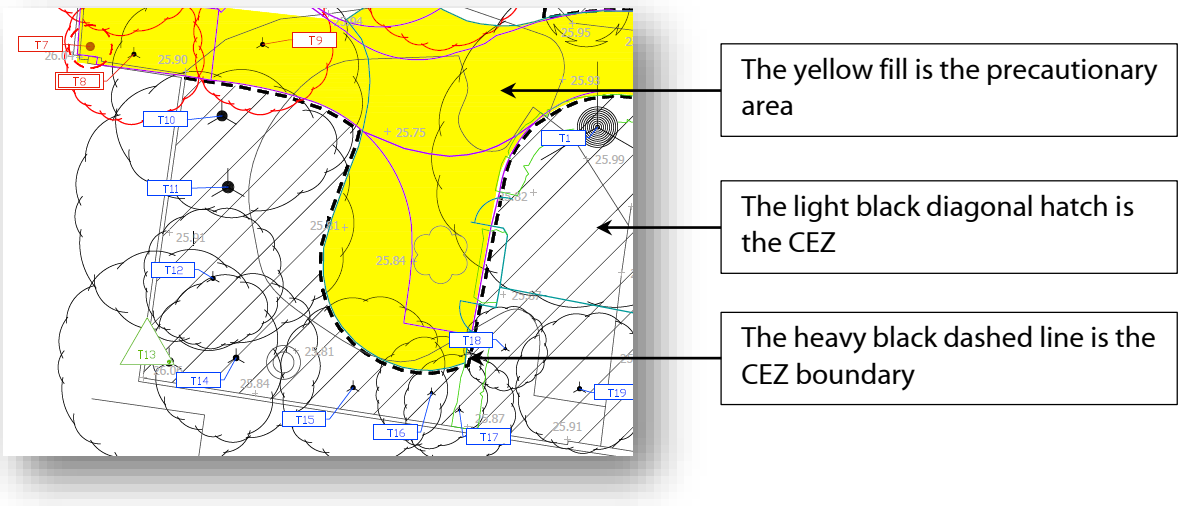
This general guidance is for construction site management to help protect trees that have been agreed for retention. It must be read in conjunction with the site-specific proposals shown on the tree protection plan and explained in the body text of this report. It supplements and expands upon the principles set out in the British Standards Institution (2012) BS 5837: *Trees in relation to design, demolition and construction – Recommendations* (www.bsigroup.com) and the National Joint Utilities Group (NJUG) (2007) Volume 4, Issue 2: *Guidelines for the planning, installation and maintenance of utility apparatus in proximity to trees* (www.njug.org.uk). More specifically, it describes useful practical precautions that can be taken when working close to retained trees and provides sources of further information. Important terms include:

- **Root protection areas (RPAs):** RPAs are the areas surrounding retained trees where disturbance must be minimised.

- **Construction exclusion zone (CEZ):** This is the RPA where no construction activity should occur and damage is prevented by either installing fencing to restrict access or installing ground protection that allows limited access above the ground, while protecting the rooting environment below.

- **Precautionary area:** This is RPA outside the CEZ where limited works are proposed, but must be carried out with care to minimise any impact on the tree rooting environment.

These areas are illustrated on our plans and annotated as follows:



At the planning stage, this guidance describes practical methods and examples of how trees can be protected to assist the local planning authority (LPA) in deciding whether the proposal is feasible. If the LPA issues consent, this guidance, in conjunction with the report and tree protection

plan, will act as a written record for reference during the construction process. Once work starts on site, this guidance is designed to help the site personnel implement effective tree protection. All personnel working in RPAs must be familiar with this document and be properly briefed about their responsibilities to protect important trees.

2. Arboricultural supervision

All work within RPAs requires a high level of care. Qualified arboricultural supervision is essential to minimise the risk of misunderstanding and misinterpretation. Site personnel must be properly briefed about protecting retained trees before any work starts. Ongoing work near trees must be inspected regularly by an arboriculturist and, on completion, the work must be signed off to confirm compliance by the contractor. This supervision arrangement will normally include a pre-commencement meeting, regular inspection visits and sufficient flexibility to allow for visits as necessary to deal with emerging tree protection issues.

Primary tree protection

3. Primary tree protection

The CEZ is the RPA surrounding retained trees that must be protected from any disturbance by the construction activity. In practice, this can be done by any combination of fencing and ground protection, to be finalised and agreed at the pre-commencement meeting. Whether the CEZ is protected by fencing or ground protection, all the protective measures must be installed before the start of any site works that could affect trees. No protective measures should be removed or temporarily dismantled without consulting the supervising arboriculturist. Furthermore, the condition of all the protective measures should be regularly monitored to ensure they remain fit for purpose. The main means of preventing damage to trees and their RPAs in the CEZ are fencing, barriers and ground protection.

4. Protective fencing

Various fencing options are illustrated in figure 1 and photos 2–4 below. The minimum specification for the fencing must be as described in figure 2 of BS 5837 (figure 1 below) or an equivalent design that effectively restricts access to the RPA it protects.

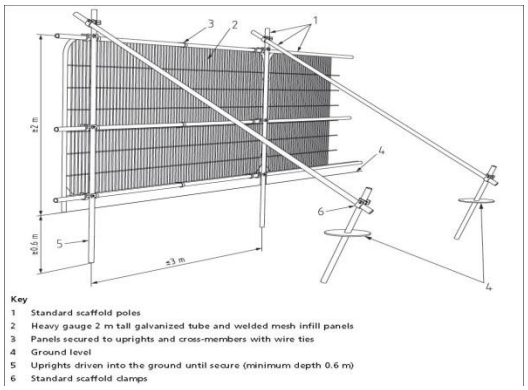


Figure 1: Recommendations taken from figure 2 of BS 5837.

Photo 2: Heras fencing wired to scaffold braced posts is a robust and effective interpretation of the BS specification.

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Photo 3: Close up of bracing detail, essential for increasing the stability of the vertical framework.

Photo 4: Board specification on secure wooden posts is a suitable alternative to the standard braced scaffold design.

The precise form of the fencing can vary, provided it is fit for purpose in that it effectively restricts access and damaging activities within the RPA that it encloses. More specifically, behind the fencing, there must be no vehicular access; no fires; no storage of excavated debris, building materials or fuels; no mixing of cement; no service installation or excavation; no raising or lowering of soil levels; and no excessive cultivation for landscape planting. Any variations to these restrictions must be agreed by the supervising arboriculturist.

5. Trunk protection

Where individual trunks or branches are vulnerable to impact damage, a framework of scaffold or wood can be constructed to provide protection (photos 5 and 6).

Photo 5: A scaffold braced framework surrounding the trunk reduces the risk of accidental impact.

Photo 6: Board secured to scaffold framework adds another layer of protection for vulnerable trunks and branches.

6. Ground protection

Where it is not practical to protect the CEZ by the use of fencing alone, BS 5837 (6.2.3) allows for the fencing to be set back and the soil protected by ground protection. This allows improved access during construction, with the ground protection preventing damage to the CEZ outside the protection of the fencing. A range of methods can be used, including retaining existing hard surfacing or structures that already protect the soil, installing new materials, or a combination of both. Whatever the choice of method, the end result must be that the underlying soil (rooting

environment) remains undisturbed and retains the capacity to support existing and new roots. Photos 7–14 illustrate a range of practical solutions that can effectively protect CEZs of retained trees.

Photo 7: Heavy-duty plywood set onto a compressible woodchip layer and pinned into position is suitable to spread the loading from pedestrian access.

Photo 8: Spreading soil excavated from footings is an effective way of buffering the plywood surface from the wear of light vehicles.

Photo 9: Plywood fixed to a wood frame is another effective method of protecting soil from pedestrian compaction.

Photo 10: A scaffold framework attached to the main scaffold fencing can be used to support either scaffold planks or plywood to create an elevated platform with a gap beneath.

Photo 11: Cellular products are a very effective means of providing ground protection where heavy vehicle use is expected. Here, it is being used to temporarily widen an existing road, to be removed once the construction is finished.

Photo 12: Custom designed sectional tracks can be joined to support very heavy traffic use through sensitive areas.

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Photo 13: A combination of retaining existing surfacing and using temporary construction cabin accommodation can be a very effective means of preventing damage to sensitive areas.

Photo 14: Steel plates can be an effective way of temporarily reinforcing weak surfacing over a construction access during the development activity.

Guidance for working in precautionary areas

7. Excavation and dealing with roots

Precautionary areas are RPAs outside the CEZ, i.e. they are areas where construction activity can take place, but it must be carried out with care to avoid damaging the sensitive rooting environment. BS 5837 (7.2) makes provision for excavating in RPAs, explaining that all excavation must be carried out carefully using hand-held tools and preferably by compressed air soil displacement, taking care not to damage the bark and wood of any roots (photo 15, 16 and 17).

All soil removal must be done with care to minimise the disturbance of roots beyond the immediate area of excavation. Where possible, flexible clumps of smaller fibrous roots should be retained if they can be displaced temporarily or permanently beyond the excavation without damage. If digging by hand, a fork should be used to loosen the soil and help locate any substantial roots. Once roots have been located, the trowel should be used to clear the soil away from them without damaging the bark. Exposed roots to be removed should be cut cleanly with a sharp saw or secateurs 10–20cm behind the final face of the excavation. Roots temporarily exposed must be protected from direct sunlight, drying out and extremes of temperature by appropriate covering such as dampened hessian sacking (photo 18). If necessary, roots less than 2.5cm in diameter can be cut cleanly without consultation with the supervising arboriculturist. Roots greater than 2.5cm in diameter should be retained where possible and only cut after consultation with the supervising arboriculturist.

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Photo 15: Careful hand-digging using conventional tools is acceptable for exposing roots in RPAs.

Photo 16: Air spades are very effective at exposing roots and services with minimal damage.

Photo 17: Air spades are particularly useful where roots are very dense.

Photo 18: Exposed roots must be protected from light, drying out and extremes of temperature by covering with hessian sacking and boards until they can be covered back with soil.

8. Removing hard surfacing and structures in precautionary areas

For the purposes of this guidance, the following broad definitions apply:

- **Hard surfacing:** Any hard surfacing used as a vehicular road, parking or pedestrian path including tarmac, solid stone, crushed stone, compacted aggregate, concrete and timber decking. This does not include compacted soil with no hard covering.
- **Structures:** Any man-made structure above or below ground including service pipes, walls, gate piers, buildings and foundations. Typically, this would include drainage structures, car-ports, bin stores and concrete slabs that support buildings.

9. Access

Roots frequently grow adjacent to and beneath existing surfacing and structures, so great care is needed during access and demolition. Damage can occur through physical disturbance of roots and/or the compaction of soil around them from the weight of machinery or repeated pedestrian passage. This is not generally a problem whilst surfacing and structures remain in place because they spread the load on the soil beneath and further protective measures are not normally necessary. However, once that protection is removed and the soil below is newly-exposed, the potential for damage to roots becomes an issue.

In summary, there should be no vehicular or repeated pedestrian access unless existing ground protection is retained or new protective measures are installed (photo 19). All exposed RPAs must be protected until there is no risk of damage from the development activity.

Photo 19: Ground protection must be used where repeated foot or vehicle traffic could cause compaction in sensitive RPAs. It can be as simple as plywood for pedestrians, but must be more robust for vehicles.

Photo 20: Machines with a long reach can be used to lift out heavy surfacing and structures as long as the machine sits outside the RPA and the exposed surface is protected before there is any further access.

10. Removal of material

Removing existing surfacing and structures is a high-risk activity for any adjacent roots and the following guidance must be observed:

1. Appropriate tools for manually removing debris may include a pneumatic breaker, crow bar, sledgehammer, pick, mattock, shovel, spade, trowel, fork and wheelbarrow (photos 21 and 22). Secateurs and a handsaw must also be available to deal with any exposed roots that have to be cut.
2. Machines with a long reach may be used if they can work from outside RPAs or from protected areas within RPAs (photo 20), but they must not encroach onto unprotected soil in RPAs.
3. Debris to be removed from RPAs manually must be moved across existing hard surfacing or temporary ground protection in a way that prevents compaction of soil. Alternatively, it can be lifted out by machines, provided this does not disturb RPAs (photo 20).
4. Great care must be taken throughout these operations not to damage roots as set out in paragraph 7 above.
5. If appropriate, leaving below ground structures in place should be considered if their removal may cause excessive root disturbance.

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Photo 21: Careful lifting of cemented-in sets round this tree allowed them to be re-laid on a permeable sand base, improving the water input into the soil around the trunk.

Photo 22: These trees had impermeable surfacing right up to their trunks, which had to be removed by hand before installing new structures.

11. Installation of new surfacing in precautionary areas

BS 5837 (7.4) confirms that new surfacing can be installed within RPAs, but it has to be carried out with care. These operations are potentially damaging to trees because they may require changes to existing ground levels, resulting in localised soil structure degradation and/or disrupt the efficient exchange of water and gases in and out of the soil. Older trees are much more prone to suffer from such changes than young and maturing trees. Adverse impact on trees can be reduced by minimising the extent of these changes in RPAs. Generally, the most suitable surfacing will be relatively permeable to allow water and gas movement, load spreading to avoid localised compaction and require little or no excavation to limit direct damage. The actual specification of the design is an engineering issue that needs to be considered in the context of the bearing capacity of the soil, the intended loading and the frequency of loading. The detail of product and specification are engineering issues and must be provided by appropriate specialists.

12. Cellular confinement systems

BS 5837 (7.4.2.) sets out that no-dig, three dimensional cellular confinement systems can be used as the basis for extending hard surfacing into RPAs. It is our experience (www.barrelltreecare.co.uk/case-studies/SurfacingNearTrees.pdf) that this type of surfacing can be installed in the majority of situations without any significant adverse impact on adjacent trees, provided that proper consideration is given to all the circumstances. Most of our experience is with the CellWeb system supplied by Geosynthetics Ltd (www.geosyn.co.uk) and because of its sustained good performance over time, this is our preferred choice of product. The product is made from heavy-duty plastic that can be pulled apart to open into cells. These are then filled with washed stone, after the product is spread over the ground and pinned in place. This forms a base layer that acts as a floating raft, spreading the load across the whole construction width. The base layer can be topped with a variety of finishes as illustrated in figure 23. Photos 24 and 25 show the product spread over the ground and then filled with stone to produce the base layer.

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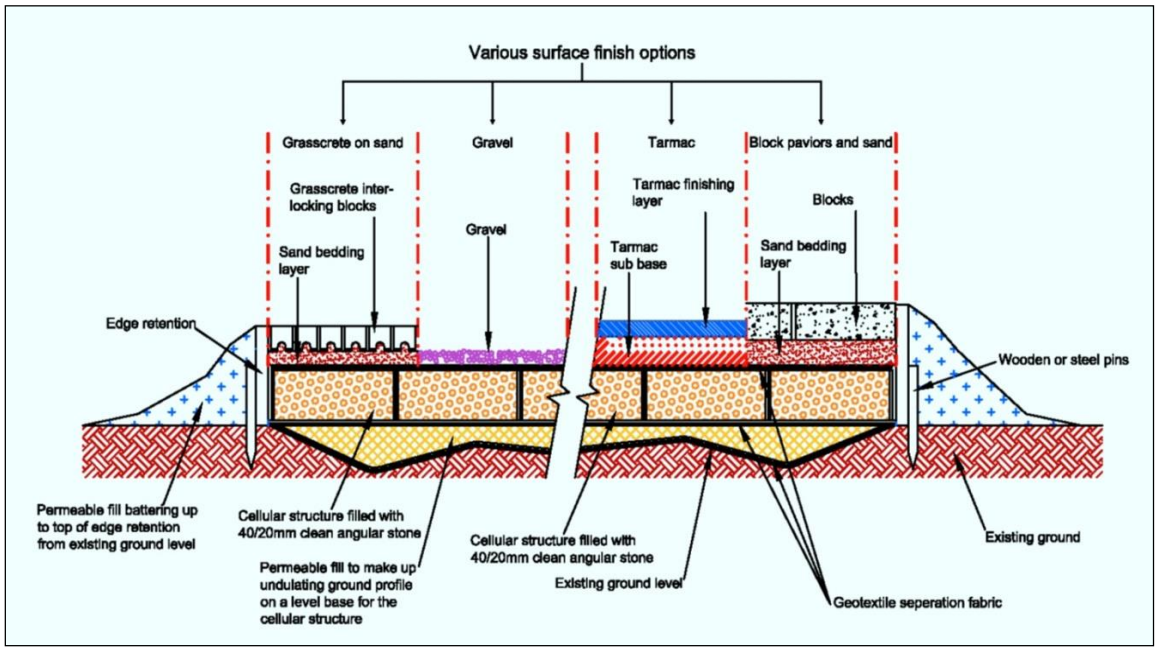

Figure 23: This conceptual cross-section illustrates the structural elements of the system and the multiple surfacing options that can be used with it.

Photo 24: The three-dimensional cells are opened up, spread across the area to be surfaced and pinned in place ready for the stone filling.

Photo 25: The stone-filled cells spreads the load of traffic and the geotextile membrane on the ground prevents migration of the stone into the soil profile.

13. Dealing with undulating surfaces and establishing a tolerable level of excavation

The precise location and depth of roots within the soil is unpredictable and will often only be known when careful digging starts on site. Ideally, all new surfacing in RPAs should be no-dig, i.e. requiring no excavation whatsoever, but this is rarely possible on undulating surfaces. New surfacing normally requires an evenly graded sub-base layer, which can be made up to any high points with granular, permeable fills such as crushed stone or sharp sand. This sub-base must not be compacted as would happen in conventional surface installation. Some limited excavation is usually necessary to achieve this and need not be damaging to trees if carried out carefully and large roots are not cut. Tree roots and grass roots rarely occupy the same soil volume at the top of the soil profile, so the removal of an established turf layer up to 5cm is unlikely to be damaging to

trees. However, this may not be possible where there is no grass because tree roots may grow right up to the soil surface. In some situations, it may be possible to dig to a greater depth depending on local conditions, but this would need to be assessed by an arboriculturist if excavation deeper than 5cm is anticipated.

On undulating surfaces, finished gradients and levels must be planned with sufficient flexibility to allow on-site adjustment if excavation of any high points reveals large unexpected roots near the surface. If the roots are less than 2.5cm in diameter, it would normally be acceptable to cut them and the gradient formed with the preferred minimal excavation of up to 5cm. However, if roots over 2.5cm in diameter are exposed, cutting them may be too damaging and further excavation may not be possible. If that is the case, the surrounding levels must be adjusted to take account of these high points by filling with suitable material. If this is not practical and large roots have to be cut, the situation should be discussed with the supervising arboriculturist before a final decision is made.

14. Sub-base and finishing layers

Once the sub-base has been formed, the load spreading construction is installed on top without compaction. In principle, the load spreading formation will normally be cellular and filled with crushed stone, although the detail may vary with different products. Suitable surface finishes include washed gravel, permeable tarmac or block paviours set on a sand base (figure 23). However, for lightly loaded surfacing of limited widths (<3m) such as pedestrian paths, pre-formed concrete slabs may be appropriate if the sub-base preparation is as set out above.

15. Edge retention

Conventional kerb edge retention set in concrete-filled excavated trenches is likely to result in damage to roots and should be avoided. Edge retention in RPAs must be designed to avoid any significant excavation into existing soil levels (BS 5837, 7.4.3) and there are a number of approaches that are fit for this purpose. For block paviours, the use of pre-formed edging secured by metal pins is effective and can be reinforced by concrete supports as long as there is no excavation into the soil (photo 26). Railway sleepers (photo 27) pinned in place or wooden boards (photo 28) are two options, depending on the expected loading of the surfacing. A permeable soil fill can then be used to batter the grade back down to the existing soil level.

Photo 26: A conventional concrete haunching can be used to retain new surfacing as long as it is not dug into a trench - here is it placed on top of the CellWeb layer.

Photo 27: Although this is only a temporary surface, railway sleepers pinned into the ground can be used to retain the edges of new surfacing.

Photo 28: Wooden board pinned in place or held in position with backfilled topsoil can provide more informal and rustic surface edging.

Photo 29: In some situations, it may be appropriate to cast a free floating concrete surface directly onto the soil surface provided provision is made to prevent soil contamination while the concrete is being poured, i.e. an impermeable membrane separating the concrete from the soil.

16. Footpaths and surfacing without a load-spreading base layer

In some situations, limited-width floating concrete rafts constructed directly onto the soil surface may be acceptable for both pedestrian (photo 29) and vehicular access (photo 30), but the design must not include any strip-dug supports. If concrete is poured directly, precautions must be taken to ensure that no toxic fluids can contaminate the adjacent soil. Alternatively, elevated paths supported on low impact frames or post supports allow a decking surface to cross sensitive areas (photos 31 and 32). Where paths are installed very close to trunks, provision must be made for distortion from future root growth by selecting flexible components for the supporting frame and surfacing (photo 33).

Photo 30: This temporary access for heavy construction traffic on the outer edge of a RPA is a concrete slab cast above ground level and will be removed when the project is completed.

Photo 31: Board walks supported on posts or a light frame are another way of providing pedestrian access across sensitive RPAs.

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Photo 32: New surfacing can be supported above the ground on posts leaving the soil surface beneath undisturbed.

Photo 33: Where surfacing is needed close to rapidly growing buttress roots, a light metal frame with rubberised surfacing will allow the path to distort without cracking as the roots grow.

17. Installing new surfacing on top of existing surfacing

In some instances, existing surfacing can be retained and used as a base for new surfacing. Normally, this will not result in significant excavation that could expose roots and so special precautions are not necessary. However, if large roots already protrude above the proposed sub-base level, then the precautions and procedures set out above must be observed. If the retained surfacing is impermeable, it may improve conditions for tree roots if it is punctured before the new surfacing is laid, but this is detail that should be agreed with the supervising arboriculturist.

18. Installation of new structures in precautionary areas

New structures in RPAs are potentially damaging to trees because they may disturb the soil and disrupt the existing exchange of water and gases in and out of it. Mature and over-mature trees are much more prone to suffer because of these changes than young and maturing trees. Adverse impact on trees can be reduced by minimising the extent of these changes in RPAs. This can be done by constructing the main structures above ground level on piled supports and redirecting water to where it is needed. The detailed design and specification of such structures is an engineering issue that should be informed and guided by tree expertise.

19. Small sheds, carports and bin stores

Light structures do not normally require substantial foundations and can have permeable bases. Ideally, their bases should be of a no-dig, load-spreading construction set directly on to the soil surface. They require a flat base and so an undulating site will need levelling to provide a suitable surface. Excavation of any high points by up to 5cm and filling depressions with permeable fill to provide a flat base will normally be acceptable provided no roots greater than 2.5cm in diameter need to be cut. If large roots are found, the preferred course of action would be to raise the base level of the structure by filling rather than cutting roots. However, if this is not practical and large roots have to be cut, the situation should be discussed with the supervising arboriculturist before a final decision is made. Light covering structures can be fixed onto a frame that can rise directly from the base or be fixed to supports either banged into the ground or set in carefully dug holes (photo 34). Provided the supports are well spaced, i.e. greater than 1.5m apart, and of a relatively

narrow diameter, i.e. not in excess of 15cm, it is unlikely they will cause any significant disturbance to RPAs (photo 35).

Photo 34: These carports are formed by wooden posts above a three dimensional cellular no-dig and load-spreading surface of permeable crushed stone.

Photo 35: This deck supported above the ground on small posts provides a low-impact alternative to conventional stone patio surfacing in RPAs.

20. New foundations for free-standing walls, gate piers, buildings and bridges

Conventional strip foundations in RPAs for any significant structure may cause excessive root loss and are unlikely to be acceptable. However, BS 5837 (7.5) confirms special engineered foundations can be used in RPAs. Damaging disturbance can be significantly reduced by supporting the above ground part of the structures on small diameter piles and beams or cast floor slabs set above ground level (photos 36 and 37). The design should be sufficiently flexible to allow the piles to be relocated if significant roots are encountered in the preferred locations (photos 38 and 39). Before the actual installation of the new structure starts, any vulnerable RPA should be protected by temporary ground protection as set out in paragraph 6 above (one option shown in photo 39). At expected pile or gate pier locations, gaps in the ground protection should be left to allow access to the soil beneath. The preferred pile locations should be carefully excavated to a depth of 60cm to establish if there are any significant roots over 2.5cm in diameter that could be damaged. If significant roots are found, they should be dealt with as set out in paragraph 7 above or the pile location may have to be moved slightly (photo 38).

Once the piles have been installed, the ground protection is usually removed ready for the installation of the slab supporting the structure (photos 40 and 41). It is important to note that the lowest points of the new structure, i.e. the underside of the main slab and any pile-capping beam must be above the ground level between the piles and there should not be any further excavation. The supported structure base can be pre-cast and imported to the site ready to fix or can be cast in position using shuttering for the sides and a biodegradable void-former for the base (photo 42). BS 5837 (7.5.4) recommends that where impermeable structures cover significant proportions of RPAs, it may be necessary to provide water input through redirecting roof drainage beneath the supporting slab (photo 43).

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Photo 36: Small diameter piles (less than 150mm) are an effective means of supporting structures in RPAs with minimal disturbance.

Photo 37: It is possible to support very large structures on piles within sensitive RPAs without any significant adverse impact on tree roots.

Photo 38: Where piles are proposed close to trunks, it is essential to excavate 50–75cm deep to see if there are any significant roots in the way, with provision to move the pile location if roots are found (note the pile was finally installed to avoid this root).

Photo 39: Ground protection must be used to spread the load of the piling rig once excavation has confirmed that no substantial roots are in the preferred pile location.

Photo 40: Once the piles have been installed (yellow tops), the ground protection to support the piling rig is removed ready to fix the void-former onto the bare soil, in advance of pouring the building slab.

Photo 41: Piles can also be used to support bridges across sensitive RPAs, but the temporary ground protection has to be removed before the main structure is either imported in or cast on site.

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Photo 42: Where a slab is cast on site, a biodegradable void-former (red arrow) temporarily supports the weight of the liquid concrete until it sets. The void-former can then be wetted and washed away to leave a void or left to degrade naturally, both of which allow movement of air beneath the slab.

Photo 43: This reinforced base slab for a double garage has drainage provision (red arrow) beneath the structure to redirect roof runoff to supply roots with water.

Gate piers generally require larger holes and have less flexibility for relocation if large roots are found. Localised loss of roots may be unavoidable, so each situation should be assessed on its own merits by the supervising arboriculturist once the careful excavations have been completed. When installing any of these structures, the ground protection must remain in place until the construction is completed and there is no risk of damage to RPAs.

21. Walls on existing foundations and retaining walls

A free-standing wall on an existing foundation is unlikely to require any additional excavation and so its construction should have no adverse impact on RPAs if the appropriate ground protection is in place while the new wall is being built. However, replacing existing walls or constructing new walls that retain the soil of RPAs normally requires some limited excavation back into the exposed soil face to provide a working space of at least 10–20cm behind the inside wall face. This should be done carefully and limited to no more than required to construct the new wall. Any roots found should be dealt with as set out in paragraph 7 above. Once the wall is completed, any voids behind it should be filled with good quality top soil and firmed into place, but not over compacted. Specific difficulties with large roots that are found during the course of the construction should be referred to the supervising arboriculturist.

22. Services

Excavation to upgrade existing services or install new services in RPAs may damage retained trees. Where possible, all services should be outside RPAs and installation in RPAs should only be chosen as a last resort. If installation within RPAs is being considered, as advised in 4.1.3 of the NJUG guidance, the decision should be made in consultation with the LPA or the supervising arboriculturist before any work is carried out. If service installation is agreed within RPAs, the NJUG protocol as set out in 4.1.3 of its guidance should be used to decide the most appropriate method. In summary, this sets out that "*Acceptable techniques in order of preference are; a) trenchless, … b) Broken trench – hand-dug … c) Continuous trench – hand-dug*". If trenchless methods are to be used, there is normally a starting pit and a finishing pit that have to be dug at each end of the service run and these must be outside RPAs (photo 44). Where a hand-digging option is agreed (photo 45), any roots discovered during the excavations should be dealt with as set out in

paragraph 7 above. Where possible, backfilled material around excavated services must not be heavily compacted, with specific advice provided in 4.1.5 of the NJUG guidance.

Photo 44: If possible, thrust boring is the preferred option for installing service routes through the RPAs of important trees, but there has to be space at the start and finish to dig substantial working pits.

Photo 45: Continuous trenches dug by hand so that important roots can be retained (with the service ducting threaded beneath) is an effective means of minimising damage (note the ground protection boards with soil piled on top on the left).

23. Fuel and chemical storage

Spilt chemicals that can soak into RPAs will kill existing roots and may prevent new roots growing, so provision must be made to minimise the risk of contamination to soil within the normal risk management protocols for the site. This would normally include means of containing spillages and procedures for clearing them up if they occur (photo 46).

Photo 46: Where fuel or other chemical are stored on site, it is now standard practice to have emergency spillage kits available to restrict the environmental impact of accidents.

Photo 47: Soil bunding or a supporting framework covered in heavy-duty plastic sheeting is essential where there is a risk of spillages contaminating RPAs. This specifically applies to cement mixing areas and vehicle washing facilities.

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24. Cement mixing and vehicle washing points

All cement mixing and vehicle washing points must be located outside RPAs, with provision to contain any spillages. Where the contours of the site create a risk of polluted water or toxic liquids running into RPAs, a precautionary measure of bunding or a frame, sealed with heavy-duty plastic sheeting sufficient to prevent contamination (photo 47), must be used to contain accidental spillages.

Soft landscaping and new tree planting

25. Upgrading existing soft landscaping or replacing existing surfacing or structures with new soft landscaping

For the purposes of this guidance, soft landscaping includes the re-profiling of existing soil levels and covering the soil surface with new plants or an organic covering (mulch). It does not include the installation of new structures or compacted surfacing, which are considered as substantial works and covered in the preceding sections of this document.

Soft landscaping activity after construction can be extremely damaging to trees. No significant excavation or cultivation, especially by rotovators, should occur within RPAs. Where new designs require levels to be increased to tie in with new structures or the removal of an existing structure has left a void below the surrounding ground level, good quality and relatively permeable top soil should be used for the fill. It should be firmed into place, but not over compacted, in preparation for turfing or careful shrub planting. Ideally, all areas within 1m of tree trunks should be kept at the original ground level and have a mulched finish rather than grass to reduce the risk of mowing damage (photos 48 and 49).

Photo 48: The RPA of this tree was not effectively protected during construction and excessive compaction of the soil meant it died soon after this turf covered up the damage.

Photo 49: This tree had tarmac parking within its RPA that was removed and replaced with an organic mulch near the trunk and limited no-dig surfacing on the outer edges of its RPA.

26. New tree planting

Where new trees are proposed, the species, location and size will be explained within the text of the report and illustrated on the accompanying plan. Essential considerations on a tree-by-tree basis for the successful establishment and sustainability of new trees include:

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1 **Planting locations:** Illustrative locations are shown on the appropriate plans. The final location for each tree must be agreed with the supervising officer after consideration of the prevailing site conditions in the immediate vicinity.

2 **Site preparation:** All competing weed vegetation within 1m of the stem must be mechanically removed or chemically killed to leave a weed-free planting area.

3 **Tree quality:** New trees must be specifically checked before planting to confirm that they are healthy and free of structural defects.

4 **Planting pits:** All planting must be into good topsoil and the pits excavated to a size of at least 10cm beyond the maximum dimensions of the loose roots or root-ball. The bottoms and sides of pits should be forked and broken up for a distance of at least 10cm beyond the pit boundaries before planting. The larger the tree, the greater this broken-up area needs to be, which can be up to 50cm and more for the larger semi-mature trees.

5 **Drainage:** Planting pits must be free-draining to avoid prolonged waterlogging. This specifically applies to poorly draining soils such as clay, where breaking up the pit bottom and sides is essential for the new tree to survive.

6 **Planting depth:** Planting the roots too deeply can seriously damage and kill trees. They should be planted no deeper than the depth that they were growing in the nursery, i.e. the base of the stem where it meets the roots at the root collar, should be no deeper than the final ground level around the planting pit.

7 **Stabilising by staking and guying:** Most trees taller than 1.5m at planting are likely to need stabilising until new supporting roots have grown. For all trees up to semi-mature size, this should be in the form of short staking so that the tree is held 0.5–0.75m above ground level and no higher. For the larger semi-mature trees, either above ground guying of the stem with cables or securing the root-ball below ground is essential to allow new anchoring roots to develop.

8 **Protection:** Where there is a risk of browsing damage from animals, stems must be protected with individual guards or more substantial fenced protection, if appropriate.

9 **Mulching:** The area surrounding each new tree up to at least 1m from the stem must be covered with a 50mm depth of composted woodchip mulch. Cut grass must not be allowed to grow right up to the stem as it competes for water and nutrients, and predisposes the stem to mowing damage during maintenance.

10 **Watering:** All new trees must be watered in periods of dry and hot weather until they are established to be independent in the landscape. This must be for at least one year for smaller trees and could extend for up to four years for larger trees. All standard and larger trees must have a suitable means of ensuring that water reaches the deeper roots, usually in the form of a perforated pipe installed around the rootball at the time of planting.

Appendix 3: Protecting retained trees

11 **Annual maintenance:** All newly planted trees must be inspected on an annual basis until they are successfully established. All failures must be replaced. Annual maintenance must include keeping the planting area weed-free and topping up the woodchip mulch.

12 **Tree size:** Nurseries can supply most species of tree at a variety of sizes, ranging from small whips less than a metre in height up to large semi-mature specimens up to 12m height and more from some specialist growers. Figure 50 provides a simple guide on the commonest forms and sizes, and photos 51 and 52 indicate the variety of trees available.

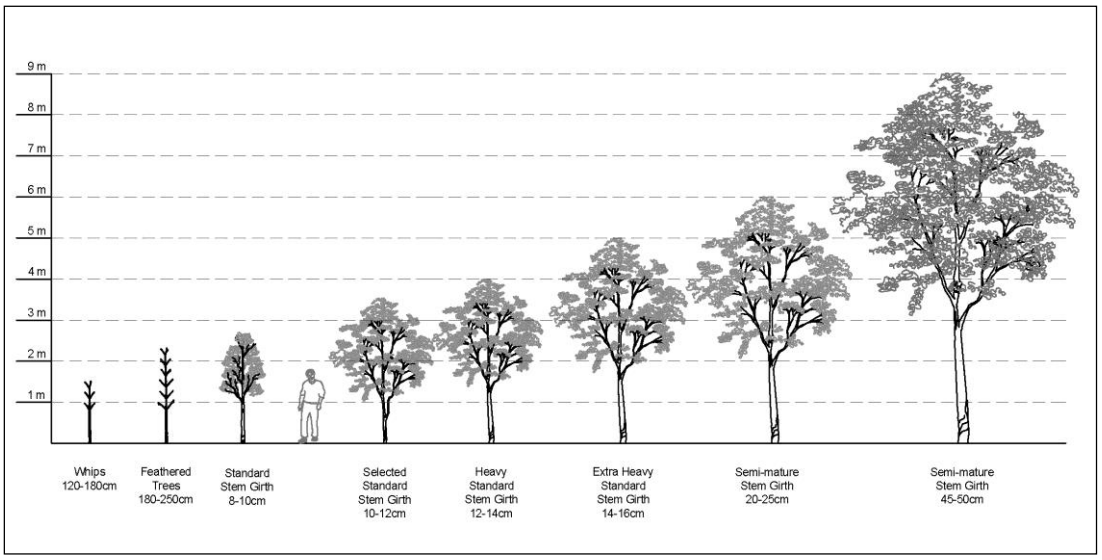

Figure 50: Summary of common conventions used by nurseries to describe tree types and sizes.

13 **Tree form:** Selecting the most appropriate tree for the location so that it does not out-grow the space available is important to avoid future inconvenience to occupiers. Specialist nurseries are able to supply a wide range of different forms (shape, size and proportion) and varieties with different aesthetic characteristics such as leaf shape, branching habit and foliage colour.

Photo 51: Hillier nurseries in Hampshire have a wide range of tree forms and species to provide instant effect in formal landscapes.

Photo 52: Barcham nurseries in Cambridgeshire specialise in supplying large trees for urban planting.

Appendix 3: Protecting retained trees

The larger semi-mature trees over 4–5m in height and the more unusual forms and varieties can be supplied by specialist nurseries (try www.barcham.co.uk, www.hilliertrees.co.uk and www.civictrees.co.uk). Such trees must be planted by experienced landscape contractors for the best results.

27. Structural tree soil

Structural tree soil is a man-made growing medium for trees with a high proportion of angular stone, which provides support for surfacing above while still maintaining voids that roots can grow in. It allows surfacing to be installed close to trees and for roots to establish beneath, making it suitable for growing trees in parking areas (photos 53 and 54). It is generally installed to a depth of about 1m, and filled in layers of about 300mm that can be progressively compacted to provide sufficient bearing for the new surfacing, without compromising future root growth. It is sometimes call tree sand or Amsterdam tree soil, and an internet search on either of these names will identify local suppliers. Three commercial suppliers can be found at www.landtechsoils.co.uk, www.treesand.co.uk and www.woodlandhp.co.uk.

Photo 53: Structural tree soil retains sufficient structure for tree roots to grow, even when compacted.

Photo 54: It allows trees to be successfully established in areas of extensive hard surfacing, with very little, if any, loss of parking space

28. Silva Cells and root deflectors

It is possible to establish trees in fully paved areas using structural supports that protect the soil beneath the surface from being compacted. These are effectively large containers made of concrete or combinations of metal and plastic, which support the surface above and any loads it has to carry. They are filled with soil to provide a viable rooting environment for trees, allowing large trees to provide sustainable amenity in highly urbanised settings. Such systems also have the added advantage that they allow storage of rainwater, significantly reducing the rate of flow of water from paved areas during peak periods. One of the most widely used systems is the DeepRoot Silva Cell (www.deeproot.com) (photos 55–57), but other products are available.

Appendix 3: Protecting retained trees

Photo 55: The individual Silva Cells can be assembled in layers and service ducting threaded through before filling with soil and fitting the reinforced tops.

Photo 56: Drainage from adjacent buildings can be directed into Silva Cells, significantly buffering rainwater runoff from urbanised areas.

New trees planted near surfacing can cause distortion damage from root growth if the appropriate precautions are not taken. Problems of this nature can be significantly reduced by installing root deflectors around the rootballs of new trees at the time of planting (photo 58). New roots growing out from the rootball meet the plastic profiled surface, deflecting them downwards, where they grow outwards at a lower level. Although they do eventually grow back near the surface, the onset of any damage is significantly delayed and it is usually far enough away from the trunk for remedial works to be carried out without seriously affecting the stability of the tree. However, these products are not suitable for all situations, especially on shallow soils, and so their use should always be considered very carefully in the context of individual site conditions. Try www.deeproot.com and www.greenleaftrees.co.uk, or internet search on 'root deflectors' for more information on products.

Photo 57: The finished surfacing is profiled to leave the tree pit open, ready to be filled with good quality topsoil and the new tree.

Photo 58: This excavated tree shows the root deflectors that were installed when it was planted seven years previously. The product has deflected roots downwards and prevented damage to the adjacent surfacing. Note that this is a permeable sandy soil and the roots were able to grow beneath the bottom of the deflectors.