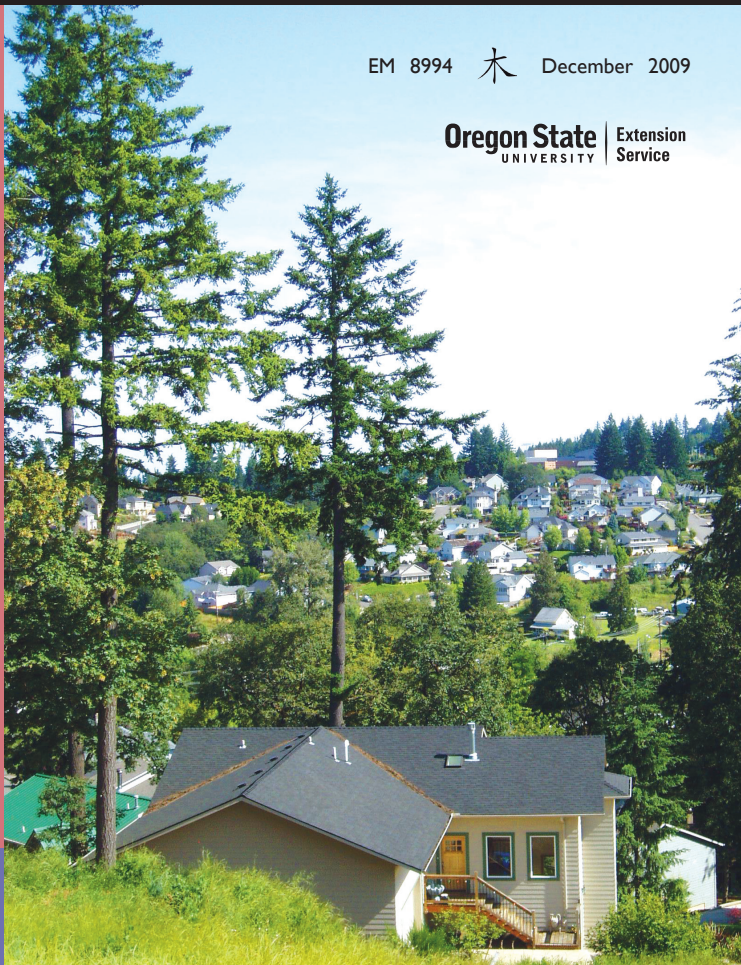


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Tree Protection on Construction and Development Sites

A Best Management Practices Guidebook for the Pacific Northwest

INTRODUCTION
..... 1

What's at Stake

Purpose of
Guidebook

Who Should Use
This Guidebook

**PROTECT
FOREST
REMNANT
STANDS 2**

Excellent Stand
Protection Zone

Poor Stand
Protection Zone

BMPs for
Protecting Native
Forest Remnants

**PROTECT
INDIVIDUAL
TREES 3**

Why Protect Trees

Tree Protection
Techniques

Critical Root Zone
Protection

BMPs for Tree
Protection

**CHANGING
GRADE AROUND
TREES 8**

Raising the Existing
Grade

Lowering the
Existing Grade

Trenching

**MAINTAIN
TREES
PROPERLY ... 10**

Don't Top Trees!
Tree Maintenance

BMPs for Tree
Pruning

Proper Tree
Removal and
Replacement

BMPs for Tree
Removal and
Replacement

**PLANTING &
ESTABLISHING
NEW TREES.. 14**

Proper Tree
Planting

BMPs for Tree
Establishment

INTRODUCTION

What's at Stake

Urban forests consist of the native forest remnants and the planted forested landscapes in our cities.

The urban forest is a valuable resource that provides economic, environmental, and social benefits. Quality of life in cities is enhanced when we have a canopy of trees shading our homes and streets, mitigating stormwater effects, providing energy savings, and improving property values. Research by the USDA Forest Service indicates that, for every \$1 spent on urban trees, \$2.70 in benefits is returned.

As forests in the Pacific Northwest become more fragmented through urbanization and development, we lose a significant amount of the ecosystem services that forests provide, such as stormwater and flood control, and mitigation of greenhouse gases.

This guidebook is designed to help the user retain healthy trees that contribute these services and benefits.

Purpose of Guidebook

This publication is a guide for protecting, conserving, selecting, maintaining, removing, and replacing trees on development sites in the Pacific Northwest. The guidebook is designed to assist people who work with trees during the development and construction phases of both new and existing projects to keep healthy trees a part of the urban environment through the use of accepted tree care standards and practices.

This publication provides best management practices (BMPs) developed and recommended by professional arborists, urban and community foresters, and landscape architects. BMPs are widely accepted practices and standards used by industry professionals and based on the best available research. The guidebook provides basic and practical information about methods to give trees planted or retained on development sites the best chance to survive and thrive during and after the construction process. Please note that while the BMPs in this guidebook are widely accepted practices and standards, they don't guarantee 100% successful tree survival.

While these practices are presented here as voluntary guidelines, some local jurisdictions have tree protection regulations that *must* be followed.

Contact your local planning department for specific regulations for your area.

Who Should Use This Guidebook

This guidebook is intended to support the building, development, and construction industries. If you are a **construction contractor or employee, builder or land developer, heavy equipment operator, landscape maintenance contractor or employee, tree care service contractor or employee, or utility employee**, this guidebook is for you. You are an important part of successful tree protection efforts!

This publication will also be helpful to engineers, landscape architects, and planners that are involved in planning and designing construction projects. It can be used as a project planning and implementation tool, as well as a resource for community education.

The guidelines in this publication could make a significant difference to your construction site for years to come. Trees that are treated as assets rather than liabilities may save thousands of dollars on a project through reduced stormwater infrastructure needs and increased property values.

PROTECT FOREST REMNANT STANDS

Stands, groves, or patches of native Pacific Northwest trees, such as Oregon white oak, Western red cedar, red alder, bigleaf maple, and Douglas-fir, are often found in urban or urbanizing areas. These ecosystems are remnants of the larger forests that previously covered the area. They may range from less than a quarter acre to several acres in size. Conservation of existing groves of native trees often provides greater economic and environmental benefit than preserving individual trees in the developing landscape.

Excellent Stand Protection Zone

High tree densities with an undisturbed understory are characteristics of a high-quality forest remnant worth preserving. An excellent stand protection zone has the following characteristics:

- Trees structurally support one another.
- Soil remains undisturbed.
- Wildlife uses are relatively unimpaired.
- Shady microclimate encourages natural woodland plants.
- Natural forest succession continues and forest regeneration is ongoing.
- The stand is visually attractive.
- Ecological functions are relatively unimpaired.

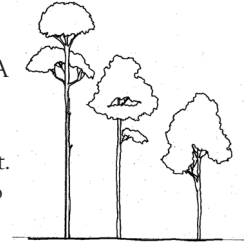


A stand to protect. Reproduced with permission by the City of Chattanooga.

Poor Stand Protection Zone

Scattered trees with a highly disturbed or missing understory may not be worth saving. A poor stand protection zone has the following characteristics:

- Trees blow over easily due to lack of support.
- Soil dries out and soil erosion occurs due to disturbed soils and lack of understory.
- Forest microclimate is disturbed.
- Sunlight and temperature increase.
- Weeds and invasive species take over.
- Forest succession is interrupted and little regeneration occurs.
- The stand is visually unattractive.
- Ecological functions are severely interrupted.



A stand that may not be worth saving. Reproduced with permission by the City of Chattanooga.

BMPs for Protecting Native Forest Remnants

- Fence the entire stand, grove, or patch to protect understory vegetation and soil as well as trees. Healthy soils require little if any fertilization, pesticides, or irrigation to support tree health.
- Avoid removing vigorous, healthy trees and vegetation from the stand.
- Do not retain isolated single, tall, spindly trees; such trees are more likely to become structurally unstable, bend or blow over in storms, or become diseased and/or infested with insects.
- Avoid creating new forest edges that may not be wind-firm; retain large trees that are on the windward side of a stand to provide support and protection to the interior of the stand.

PROTECT INDIVIDUAL TREES

Why Protect Trees

Trees should be protected throughout their lives from damage to maximize their health, safety, functionality, and benefits. Young, newly planted trees need protection as much as large, mature trees.

Protecting trees in new and existing developments

- reduces long-term tree maintenance and replacement costs;
- reduces site preparation and grading costs;
- provides immediate aesthetic and economic benefits because properties with more mature trees and greater tree canopy cover sell faster and accrue property value faster in comparison to properties without these assets;
- generates positive response from neighbors and the surrounding community;
- generates good public relations; and
- provides healthier trees, forest ecosystem, and environment for a healthier, safer, more vital community.

Tree Protection Techniques

Tree protection involves activities designed to preserve and protect tree health by avoiding damage to tree roots, trunk, or crown. Site development planning prior to site disturbance should include identifying tree protection zones (TPZs) for all trees designated for retention.

Tree protection may be passive or active. Passive tree protection, most commonly used during the planning or post-development stages, simply means avoiding any disturbance or harmful activity near the tree. Active tree protection, by contrast, involves physical protective barriers and is generally required during any site disturbance that may impact retained trees, such as grading, building construction and maintenance, infrastructure and utility installation and maintenance, and other landscape changes that may affect the structural integrity and stability of retained trees.

Critical Root Zone Protection

A critical step in retaining healthy trees during construction and development is the protection of tree roots from disturbance. Each tree has a critical root zone (CRZ) that varies by species and site conditions. The International Society of Arboriculture (ISA) defines CRZ as an area equal to 1-foot radius from the base of the tree's trunk for each 1 inch of the tree's diameter at 4.5 feet above grade (referred to as diameter at breast height).

Critical root zone radius distances calculated by tree diameter at breast height.

Tree diameter	Critical root zone radius	Total protection zone diameter, including trunk
2 inches	2 feet	4+ feet
6 inches	6 feet	13.5 feet
20 inches	20 feet	42 feet
46 inches	46 feet	96 feet

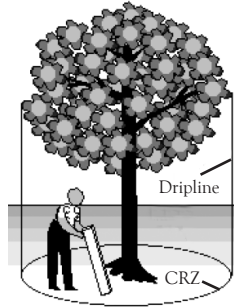
Another common rule of thumb is to use a tree's dripline to estimate the CRZ (see figure). We recommend you evaluate both of these and choose whichever provides the larger CRZ.

Under certain circumstances, disturbing or cutting roots in a CRZ may be unavoidable. In such cases, the work should be done only under the onsite supervision of an ISA certified arborist.

Cutting or disturbing a large percentage of a tree's roots increases the likelihood of the tree's failure or death. Most tree roots over 4 inches in diameter are likely to be structural roots; cutting these roots may impact the structural stability of the tree, creating the potential for catastrophic failure (the tree may fall over).

The BMPs listed below retain good air and water supply to the critical roots of protected trees, as well as protect them from mechanical damage, to help trees remain as healthy and stable as possible during the construction process and beyond:

- Establish a CRZ for both large and small trees.
- Install strong fencing around the CRZ and require the fence to remain in place for the life of the development project to ensure protection.



Using dripline to estimate critical root zone (CRZ). Adapted with permission by the City of Chattanooga.

- Post appropriate signage to help convey the importance of the CRZ to workers.
- Avoid cutting tree roots over 4 inches in diameter.
- Make all necessary cuts to tree roots cleanly with sharp tools; never tear with a backhoe. A clean cut encourages good wound closure and confines the spread of decay.

To protect trees and tree roots within the fenced CRZ, **do not** do the following:

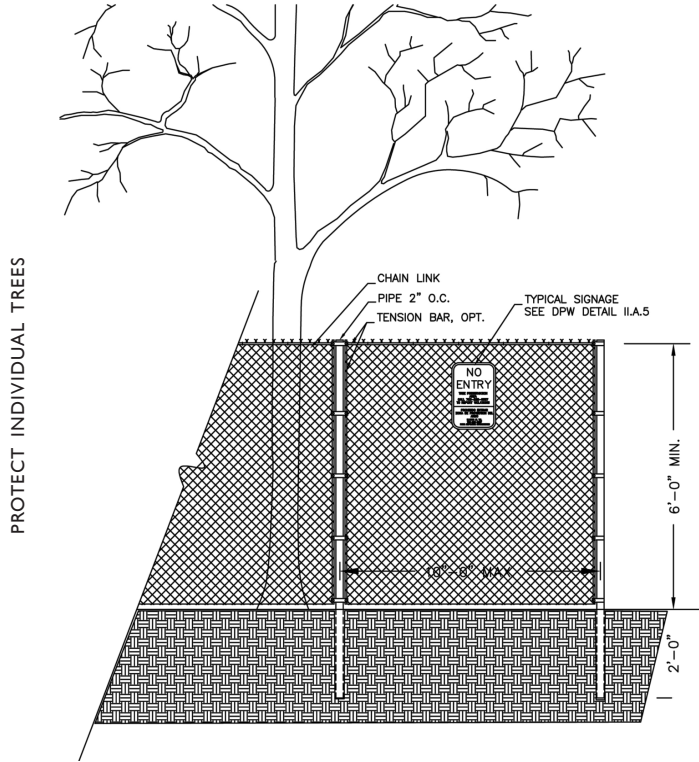
- Stockpile construction materials or demolition debris.
- Park vehicle or equipment.
- Pile soil and/or mulch.
- Trench for utilities installation or repair, or for irrigation system installation.
- Change soil grade by cutting or filling.
- Damage roots by grading, tearing, or grubbing.
- Compact soil with equipment, vehicles, material storage, and/or foot traffic.
- Contaminate soil from washing out equipment (especially concrete) and vehicle maintenance.
- Install impervious parking lots, driveways, and walkways.
- Attach anything to trees using nails, screws, and/or spikes.
- Wound or break tree trunks or branches through contact with vehicles and heavy equipment.
- Wound trunks with string weed trimmers and lawn mowers.
- Cause injury by fire or excessive heat.

Some tree species are more tolerant of damage and disturbance in the CRZ than others. A tree's tolerance depends not only upon the species but also upon conditions present prior to and at the time of the damage. Tree health, age of the tree, soil aeration and moisture, the time of year the damage occurs, its severity, and the weather conditions prior to, during, and after the damage all contribute to the tree's response. An experienced ISA certified arborist can analyze these variables and make specific recommendations to retain or recover a tree's health and safety during and after the construction process.

BMPs for Tree Protection

Planning

- Plan and budget for tree conservation and protection as part of the development process.
- Plan for tree protection at least one growing season prior to the beginning of construction activities, where possible.
- Employ an ISA certified arborist or an urban forester whenever possible to assist in tree protection planning, implementation, monitoring, and follow-up maintenance.
- Plan to protect trees located on adjacent property, including those portions of the roots, trunk, and crown growing into or over the developing property.
- Evaluate soil health and past site damage; incorporate that information into tree protection measures.
- Evaluate existing trees on the site. Locate buildings, other structures and infrastructure through evaluation of the opportunities and constraints of existing trees. Select trees to be conserved and protected based upon their location, species, quality, health, and benefits such as energy savings by shade or wind protection.
- Remove trees within 10 feet of the proposed building or structure.
- Remove trees that cannot be adequately protected.
- Remove trees that have less than one-quarter of their total height composed of tree crown (tall and spindly), or those with more than one-third of the trunk wounded.
- Do not remove the best trees.
- Conserve and protect trees in stands or groups where possible to facilitate their protection and maintenance, and to keep the forest structure intact.
- Establish substantial penalties for tree damage and noncompliance with tree protection requirements.
- Complete preconstruction tree maintenance, including mulch, fertilization, supplemental irrigation as necessary, and pruning to remove dead, structurally weak, and low-hanging branches.
- Engage maintenance staff in early decision-making and education about care of retained trees.



Fencing for tree protection. Reproduced with permission by the City of Arlington, Virginia.

Implementation & Monitoring during Construction

- Educate all workers on site about tree protection techniques and requirements during preconstruction meetings and by sharing this guidebook with them.
- Establish a TPZ based on a tree's CRZ (discussed above).
- Establish TPZs early, during site planning prior to construction.
- Erect barriers or sturdy fencing around individual trees or groups of trees to define and protect CRZs (see figure).
- Protect high-value trees with stem, branch, and root padding or wraps in addition to CRZ barriers.
- Clearly identify the perimeter of TPZs with highly visible signs.
- Establish one access route into the site and one exit route out of the site.
- Confine construction offices, vehicular parking, worker break sites, and material storage to locations outside TPZs.
- Avoid trenching through the CRZ of protected trees. Alter routes of underground infrastructure or use alternate methods such as pipe boring.
- Do not trench or excavate the soil within CRZs. Tunnel or bore at least 18 inches beneath CRZs to install utility lines.
- Where tree roots must be cut, make only sharp, clean cuts to promote root callusing and regeneration.
- Remove badly damaged trees that may attract insects and disease.
- Evaluate the potential of dead, damaged, or dying trees for wildlife habitat either as standing dead or woody debris if left onsite.
- Monitor tree health and compliance with tree protection requirements regularly during construction.

Follow-up Maintenance

- Complete postconstruction tree maintenance, including mulch, fertilization, irrigation, soil aeration, and pruning where necessary.
- In the absence of adequate rainfall, apply at least 1 inch of water per week by deep soaking methods.
- Fertilize trees with phosphorus, potassium, calcium, magnesium, and other macro- and micro-nutrients as indicated by a soil test, but wait at least 1 year to apply any nitrogen.
- Fertilize lightly with nitrogen after 1 year. If recommended by an arborist, light annual applications of nitrogen may be made for the next 3 to 5 years.
- Inspect trees annually for at least 3 to 5 years after construction to look for changes in condition and signs of insects or disease, and to determine maintenance needs.
- Remove trees that are badly damaged or are in irreversible decline if unsuitable for wildlife habitat.
- Continue to protect not only the large, established trees on the site but also those newly planted in the landscape.
- Mulch trees on a regular schedule, ensuring that mulch does not rest against tree trunk.
- Develop a regular maintenance program that incorporates fertilization BMPs and integrated pest management techniques to get best results at lowest cost.

Ongoing Protection Strategies for Property Owners

- Maintain an “invisible” passive TPZ around all important “keeper” trees throughout their lives.
- Avoid damage to tree trunks and bark from mowers and string weed trimmers by maintaining a mulched, grass-free area around the tree.
- Avoid trenching in the CRZ for utility line and irrigation system installation.
- Avoid damage to tree limbs and trunks during home maintenance and repair projects.
- Avoid soil contamination from oil, gasoline, paint, paint thinner, or other chemicals.
- Do not attach wires, cables, conduit, mailboxes, or other objects to trees.
- Do not park or drive cars, trucks, or heavy equipment within the CRZ.
- Avoid placing paved walkways and driveways within the CRZ of valuable, large, and mature trees.
- Protect trees from domestic pets and livestock. Root damage due to soil compaction, as well as trunk and bark damage, is common on sites used by horses, cattle, and other livestock.
- Increase a tree’s CRZ and TPZ as the tree gets older and larger.

CHANGING GRADE AROUND TREES

Changing the grade around the base of a tree by adding or removing soil may seriously disturb the delicate and vital relationship between roots and soil, affecting the tree's health, soundness, and structural strength. Grade changes should be avoided in order to prevent serious damage or death to a tree.

Raising the Existing Grade

When fill is added over existing soils, air and water that are essential for normal root functioning may be blocked. As a result, roots smother and die. This effect is compounded when the added soil is compacted for construction purposes.

Soil piled around the trunk may lead to conditions at the base of the trunk that invite rot, disease, and pests into the tree, compromising its health and safety. Even temporary fills such as stockpiling mulch or soil in the CRZ of a tree for as little as several days during the construction process can have severe, long-term negative effects.

Visual symptoms include small yellow leaves, presence of numerous suckers along the main trunk and branches, many dead twigs and in some instances large dead branches (may appear within a month or may not appear for several years).

The extent of injury from adding soil around a tree varies with the kind, age, and condition of the tree; the depth and type of fill; drainage; and several other factors. Maple, oak and evergreens are most susceptible, while elm, ash, willow, sycamore, and locust are least affected.

Little can be done to save trees that have been suffering from soil added over an extended period of time. It is prudent to consider possible damage that may occur to a tree and take alternative action **before** the fill is made; prevention is less expensive and more effective than attempting to correct the situation after damage has been done.

BMPs for fill operations include the following:

- Never place any fill or organic materials directly against the tree.
- Never compact the soil within the CRZ.
- If no more than 2 to 4 inches of fill is used around existing trees, significant damage may be avoided if the fill has a coarser texture than the existing soil.

Lowering the Existing Grade

Less damage to a tree's roots is likely when the grade is lowered than when it is raised, unless a great deal of the root mass is exposed or removed. Removing 1 to 2 inches of soil normally will not affect a tree adversely, especially if steps are taken to ensure that drought damage does not result from loss of roots or root cover. A general rule-of-thumb used by landscape architects is to remove no more than 6 inches of soil from the existing grade in the CRZ; however, this is dependent on the soils in which the tree is growing. A tree's roots may all exist in the top foot of a shallow soil; removing the top 6 inches would have tremendous negative impact in that case.

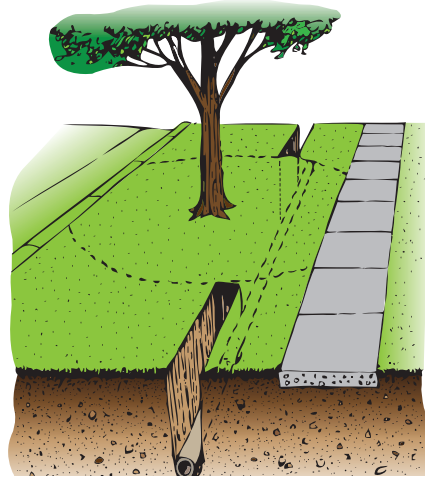
BMPs for removing soil include the following:

- Consider removal and replacement if the tree is young, in poor condition, an undesirable species, or very susceptible to insects and disease.

- Plan grade changes well in advance of construction using the appropriate method to prevent injury to desirable trees.
- Use retaining walls or terraces to avoid excessive soil loss in the area of greatest root growth.
- Spread mulch over the exposed root area when possible to help prevent soil erosion, reduce moisture loss, and keep soil temperatures lower.
- Provide supplementary water when rainfall is less than 1 inch per week.
- Prune roots to prepare the tree for root loss due to grade lowering. Root pruning is best left to an experienced professional who can take into account the variables necessary to reduce the stress of the pruning to the tree.

Trenching

Trenching is a standard way to install utilities. **It is best to entirely avoid trenching through the CRZ** (see figure); such practice could severely destabilize a tree, as well as adversely affect its health through loss of roots. Workers performing such operations should understand that 85% of the mass of a tree's root system is located within the CRZ and that most of a



Proposed trench through a critical root zone. Adapted with permission by the City of Chattanooga.

tree's roots are within the top 18 inches of soil. Tunneling beneath the root zone will prevent loss of critical root mass if underground utilities must unavoidably be placed within the CRZ.

A decision must be made as to where best to locate utility trenches. Planners and designers must be made aware that trenches may not cross a CRZ and design alternate alignments accord-

ingly; such realignments are not the responsibility of the construction crew.

BMPs for trenching include the following:

- Protect the trunks of high-value trees from scraping and gouging to a height of at least 8 feet.
- Keep equipment and excavated backfill on the side furthest from the tree, not against the trunk.
- Place excavated backfill on a plastic or canvas tarp outside the CRZ.
- Prune away jagged roots back to the trench wall closest to the tree. Use a handheld pruner or pruning saw to make sharp, clean cuts.
- Replace the backfill on the same day if at all possible. Cover exposed roots with wet burlap to prevent them from drying out; in hot dry conditions, small roots may be injured in as little as 30 minutes.
- Do not allow chemicals, trash, or other foreign debris to become mixed with the backfill.
- If earthwork specifications allow it, firm the backfill to the same compaction as the surrounding soil and no more.
- Water the backfill to prevent excessive root drying.

MAINTAIN TREES PROPERLY

Don't Top Trees!

Some people “top” trees because they interfere with views or sunlight, or simply grow so large that the homeowner becomes concerned about personal and property safety. Topping to control a tree's size, however, is usually self-defeating. Ugly, bushy, weakly attached branches typically grow back even taller than the original limbs and may break or fall with little or no cause.

Here are some important facts about tree topping:

- Topping violates all accepted pruning practices. Proper tree selection and pruning practices may prevent or remove excessive growth without the problems that topping creates.
- Topping will not make trees safe; in fact, it makes them more hazardous.
- Topping starves the tree by drastically reducing its ability to feed itself through photosynthesis.
- The open wounds of topping make a tree more susceptible to internal rot, insects, and disease.
- Topping makes a tree more susceptible to storm damage.
- Topping is an assault on the health and beauty of your tree.
- Topping is a waste of your money. Topping increases future maintenance costs and the likelihood of removal as a hazardous tree in the near future.
- Topping may inhibit the value and sale of your property.

Tree Maintenance

The amount of maintenance a tree requires depends on the species, the tree's location in the landscape, its age, and the care (or abuse) it has been given throughout its lifetime. Basic tree maintenance begins with regular inspections to determine a tree's needs, which may include pruning, mulching, fertilization, irrigation, and pest management. This guidebook focuses on pruning.

Pruning is the deliberate removal of tree branches and limbs to achieve a specific objective in the alteration of a tree's health and form. Regular inspections to determine a tree's pruning needs should be a part of every tree maintenance program. Always determine the objective for pruning before beginning the work.

The benefits of regular, correct tree pruning include the following:

- better tree form, health, and structural integrity
- removal of decaying and diseased wood that threaten the health and structural stability of a tree
- increased structural strength, stability and resistance to wind damage
- decrease in overall risk of limb failure due to dead or diseased limbs

Some common mistakes made in tree pruning include the following:

- the use of detrimental techniques such as topping, stub cuts, flush cuts, and bark tears at pruning cuts
- using spikes to climb trees for pruning

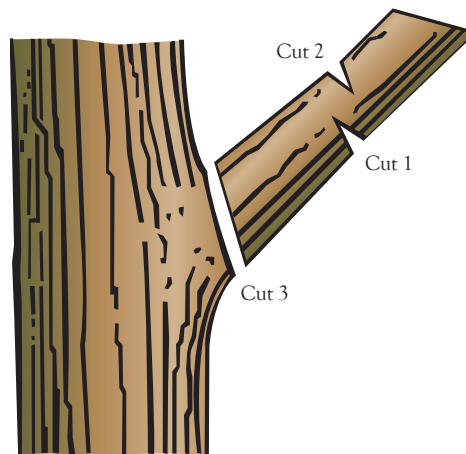
- deferring pruning until limbs get large (large limbs equal large wounds, which are more difficult for a tree to compartmentalize and leave the tree open to disease, insects, and rot)
- pruning trees on a crisis-only basis
- attempting to reduce tree size as a substitute for proper tree selection and placement

The American National Standards Institute (ANSI) publishes tree pruning and safety standards, known as ANSI A300 (Part 1): Tree, Shrub, and Other Woody Plant Maintenance – Standard Practices (Pruning). The ISA has developed BMPs for pruning in relationship to the ANSI standards; these guidance documents are available for sale through the ISA Web site (<http://secure.isa-arbor.com/webstore/>).

BMPs for Tree Pruning

- Hire experienced, qualified professionals to prune trees. Arborists certified by the ISA are required to pass a written test of basic arboricultural knowledge and to maintain their certification through continuing education.

- Never top a tree.
- Never use climbing spikes or spurs while pruning trees.
- Trees should be inspected before climbing to determine the amount and extent of hazards, and the tree's owner should be notified of potentially hazardous or harmful conditions.
- Keep pruning equipment sharp, clean, and in good operating condition.
- When pruning trees that show evidence of disease, disinfect pruning equipment between trees. During extreme infestations, disinfect equipment between cuts.
- Always prune trees back to the parent branch or a lateral branch (see figure) that is at least one-third the diameter of the branch being pruned.
- Prune just outside the branch collar (see figure).
- Prune young or newly planted trees to remove dead, broken, crossed, or rubbing branches.
- Train young trees to develop strong branch structure, strength, and form through proper pruning.



The three-cut pruning method. Cut 1 is a shallow undercut to break the continuity of the bark to prevent tears from occurring should you lose control of the branch. Cut 2 is made just beyond cut 1 to remove the bulk of the branch. Cut 3 is made just outside the branch collar, the swelling at the base of the branch, to finish the pruning cut properly. Adapted with permission by Alex Shigo, Modern Arboriculture.

- Maintain a single leader by removing all but one leader on trees with forked stems.
- Prune trees regularly throughout their life to maintain vehicular, pedestrian, and sight clearance; and to remove dead, diseased, and broken branches.
- Make proper pruning cuts using the three-cut method (see figure).
- Avoid stub cuts, flush cuts, and wounds to other limbs and the trunk.
- Do not remove more than one-quarter of the foliage of a mature tree in any one growing season.
- Do not remove more than one-third of the foliage of a young tree in any one growing season.
- Do not remove more than one-quarter of the foliage from a branch unless you are removing the entire branch.
- Always wear personal protective safety equipment while pruning, including safety glasses.
- Never prune or remove trees located near electrical or other utility lines; contact the local utility service provider to have a tree growing beneath utility lines pruned or removed.
- Talk to your local utility provider about the need for line clearance and the pruning techniques designed to maintain that clearance.

Proper Tree Removal and Replacement

Trees may need to be removed for a number of reasons. They may be a poor selection for the location, lack adequate growing space, or conflict with hardscape such as driveways and sidewalks or other infrastructure such as buildings, roadways, or utility services. Trees, like other living creatures, have a finite lifespan. Trees that are dead or in poor or hazardous condition may require removal to protect the safety and wellbeing of the owner or the public in general. Some species of trees may be invasive, crowding out native plants and thus reducing higher quality habitat for native wildlife. Whatever the reason for removal, the site should be evaluated to determine whether another tree can be planted in the same location or nearby to maintain tree canopy cover in the area.

Everyone needs to understand that some tree removal must occur and that it is not necessarily a bad thing. The goals may be to prepare a site for development, maintain public safety, or maintain community forest health while also preserving as much tree canopy cover as possible.

Trees should not be removed merely because it is more convenient to work on a site without trees. This wastes thousands of dollars in ecosystem benefits and services.

Benefits of timely tree removal and replacement include the following:

- reduced risk of failure through prudent removal of trees in poor or hazardous condition
- reduced risk of epidemic infestations that may damage adjacent trees
- space opened for new, vigorously growing trees

- opportunities created to develop a dynamic, diverse community forest
- healthy tree stocking levels maintained through scheduled removal and replacement

Common tree management mistakes that may cause high levels of tree removals include the following:

- lack of good design and planning that provides inadequate space for trees to grow properly to maturity
- planting the wrong trees in unsuitable locations, such as tall trees beneath overhead utility lines
- lack of proper routine care and maintenance
- undertaking tree preservation activities only when a tree is already in poor condition
- leaving trees in poor condition to fail instead of proactively removing and replacing them where appropriate

BMPs for Tree Removal and Replacement

- Have an experienced, knowledgeable ISA certified arborist evaluate tree health and risk of failure before removing old, large, landmark, or historic trees, or trees damaged in a storm.
- Hire experienced professionals to remove trees (visit www.pnwisa.org for details).
- Select, plant, protect and maintain trees to greatly reduce the number and frequency of necessary tree removals.
- Evaluate trees at risk for failure using standardized methods that include assessing the probability of failure, size of part that may fail, and property or structures affected should the tree fail.

- Hire a wildlife consultant help evaluate trees for their potential as wildlife habitat.
- Remove trees in irreversible health decline and poor condition.
- Remove trees that create hazardous situations that cannot be remedied with pruning, cabling, and bracing, or removal of the target.
- Remove trees that are inappropriate to the site if there is no mitigation possible.
- Remove trees where growing space is inadequate.
- Replace trees wherever and whenever possible, planting large canopy trees if space permits.
- Request the local utility company to remove trees located near or beneath utility lines; do not attempt to remove these trees yourself due to the possibility of death or severe injury by accidental contact with utility lines.
- Consider restricting public access or moving valuable structures in order to preserve desirable trees such as those that have heritage or historic value but may have a high risk of partial or whole tree failure.
- Positively identify ownership of the tree before authorizing a removal. If the tree is in a public right-of-way, contact the local jurisdiction for guidance before work begins. Some jurisdictions require a permit, some allow only ISA certified arborists to work on such trees, and others allow only city crews to work on trees on publicly owned properties including rights-of-way.

PLANTING & ESTABLISHING NEW TREES

Proper Tree Planting

Proper tree planting is essential to long-term tree survival, health, and safety. Planting trees seems like a simple task, but if a tree is to thrive and not just survive, it is best to begin with the development of a planting plan designed to meet the objectives of the property owner or the requirements of local development regulations. The establishment process begins with the selection of good planting sites and appropriate tree species and varieties. Sites are prepared, trees are purchased and planted, and regular maintenance is scheduled for at least 3 years or until trees are established and growing well on their own.

A plan and schedule to plant new trees on a regular basis is useful to replace trees that are removed, to add to an existing group of trees, and to ensure that the community's urban forest remains diverse, dynamic, and stable.

Benefits of a planned planting program and protocol are as follows:

- stable tree population with a diversity of ages, sizes, and species
- tree canopy cover maintenance and development for future generations
- opportunities for community involvement in tree planting and maintenance activities
- better survival of young trees and lower tree establishment costs

Common mistakes made in tree planting and establishment include the following:

- inadequate growing space (the tree grows too large for the available space)
- inadequate soil volume, restricting root growth and potentially decreasing tree stability
- selected species or variety not appropriate for the site conditions (available growing space, soil moisture and pH, sunlight, temperature, or general climate)
- poor quality planting stock
- tree planted in a hole that is too small
- inappropriate soil amendments or mixtures added to the transplanting hole
- roots of transplant stock not protected from heat and wind damage during transportation and pre-planting storage
- tree planted too deep (root collar must be above soil level)
- regular after-planting care, especially supplemental water, not provided during the 3-year establishment period
- trees staked unnecessarily and/or incorrectly
- stakes and guy wires are left on the tree too long

BMPs for Tree Establishment

Tree Selection

- Select a tree of appropriate mature size for the site.
- Select native tree species for planting when appropriate for the location and if good quality stock is available.

- Use nonnative species and varieties if necessary where native soils may be severely impacted by long-term development, such as those found in many urban locations, and cannot support healthy native tree species. Choose noninvasive species and varieties appropriate to the development soils.
- Select trees compatible with special site conditions, such as extremely wet (poor draining) or dry (excessive draining) soils.
- Select only good quality planting stock.
- Select nursery stock that meets the minimum standards for root ball size and quality as defined in ANSI A300 (Standards for Nursery Stock).
- Protect trees from wind damage during transport by wrapping the whole tree including roots with a tarp or landscape fabric.
- Protect the root ball of transplant stock with mulch or other protective measures during storage and planting activities.
- Plan for a diversity of tree species and varieties to protect the urban forest from massive failure due to pest or disease infestation and to add visual interest.

Site Selection

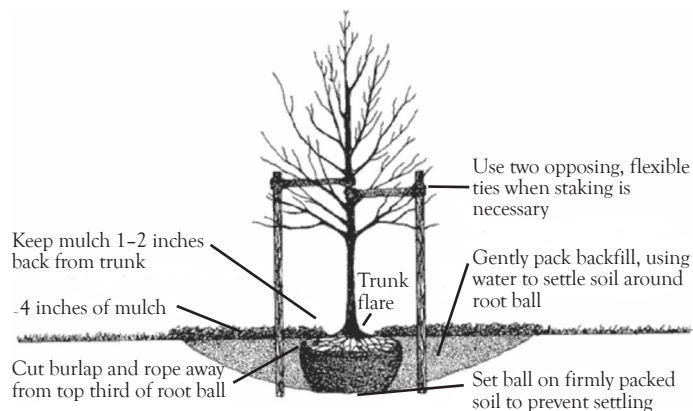
- Plant trees where they have plenty of room to grow to maturity without compromised health or form due to conflicts with adjacent infrastructure.
- Provide trees with an adequate amount of soil volume for tree growth and stability. Adequate volumes range from 400 to 1,000 cubic feet depending on the mature canopy spread. To find the width and length of soil needed, assume a depth of 3 feet. A good

rule of thumb is to assume 1.5 cubic feet of soil volume for each square foot of mature canopy.

- Make sure there is now and will be at tree maturity adequate clearance from overhead utility lines, pedestrian and vehicular traffic, buildings, signs, and street lights. Local jurisdictions may have preferred guidelines for such setbacks.
- Consult with local utilities for planting specifications to maintain adequate utility clearance.
- Plant the right tree in the right place (for example, don't plant large trees that require constant pruning to maintain safety under overhead power lines).

Site Preparation

- **Call your local utility locate service before you dig.** Always have utilities located prior to installing trees on any site.
- Break up compacted soils in an area 5 to 10 times the width of the new tree's root ball or container.
- Dig a planting hole that is at least twice the width of the new tree's root ball or container; more is even better.
- Dig the planting hole no deeper than the height of the root ball from its base to the bottom of the root collar.
- Do not add soil amendments such as peat moss or fertilizer to the planting hole; studies have shown no benefit from these expensive practices.



Recommended tree planting method. Adapted with permission by the International Society of Arboriculture.

Tree Planting (see figure)

- Move the tree using only the root ball or container (using the tree trunk as a “handle” to move trees can break tree roots or even the trunk).
- Plant the root collar at or slightly above ground level, never below.
- Remove all tags, wires, string, straps, burlap, and wire baskets from the root ball.
- Backfill the planting hole with the original soil.
- Do not add fertilizer or other soil amendments to the planting hole.
- Water thoroughly when the planting hole has been filled halfway and again when completely backfilled to lightly compress soil around roots and eliminate air pockets.

- Build a bermed watering ring with leftover backfill soil around the tree a few feet from the trunk unless soil conditions are very wet; remove the ring after one year.
- Add coarse organic mulch in the watering ring to a depth of 4 to 6 inches to conserve water and keep the root zone cool. Do not let mulch touch the tree trunk.
- Do not stake the tree unless it is unable to stand upright on its own or is in a high traffic area. Always remove stakes and guying materials after 1 year.
- Wire should not be used as a guying material; even enclosed in tubing, it tears the thin bark of young trees and may girdle the tree as it grows. Use soft rubber links or other stretchy materials that are not abrasive.

New Tree Care after Planting

- Prune only dead, broken, crossed, or rubbing branches; inspect for pruning needs annually.
- Water 5 gallons per tree per week in the absence of adequate rainfall.
- Establish TPZs around new trees during construction activities.
- Inspect newly planted trees regularly to evaluate condition and maintenance needs.
- Remove tree watering rings after one year.
- Remove stakes and guying materials after one year.
- Develop an integrated maintenance and care program using fertilization BMPs and integrated pest management practices to reduce costs as well as negative impacts on the environment.

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ESTABLISHING NEW TREES
PLANTING AND

MAINTAIN TREES
PROPERLY

CHANGING GRADE
AROUND TREES

PROTECT
INDIVIDUAL TREES

PROTECT FOREST
REMANANT STANDS

INTRODUCTION