Preserving Trees in Construction Sites

Trees add lasting value to the places we live, work, and relax. They provide shade, enhance curb appeal, improve air and soil quality, and create a sense of place in both residential and commercial developments. However, these benefits are often compromised during construction. Whether you are building a home, installing a sidewalk, or upgrading utilities, construction activities can significantly impact tree health. Excavation, trenching, soil compaction, and grading may damage roots and alter critical soil conditions. Even post-construction landscaping, such as laying sod, installing irrigation, or planting ornamental beds, can further disturb sensitive root zones.

When trees are damaged during construction, the effects are often not immediately visible and may take years to fully appear. Injury to roots or compacted soil may seem minor at first, but these changes can trigger a slow decline called the "mortality spiral" (Figure 1). This process starts when one stressor, like root damage from trenching, weakens the tree. Once compromised, the tree becomes more susceptible to other threats such as drought, insects, or disease. As these stresses accumulate, a tree's ability to recover diminishes. Eventually, visible signs like dead branches and canopy thinning appear, but by this time, it is often too late. Emergency interventions from a tree care specialist are costly and usually ineffective. Very few trees recover once they are in decline, and many ultimately die due to structural failure, infestations, or infections.

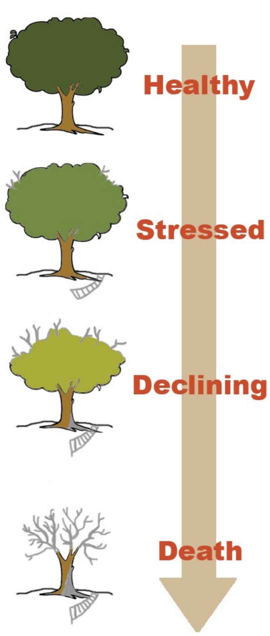

Figure 1. Trees typically die from construction related stress slowly over 1 to 10 years in a "mortality spiral." Once health decline is visible, a tree is already close to the spiral's end, which is death (Matheny & Clark 1998).

Prevention Is the Best Protection

The most effective way to protect trees is to plan and keep construction activity away from root zones whenever possible. With thoughtful preparation, most trees can survive and even thrive through construction. Tree protection must be integrated at every stage of the process:

1. Planning and mapping: Identify and prioritize trees worth preserving. Consult with an arborist to map root zones and define protection areas.
2. Preconditioning: Improve tree resilience before construction begins through pruning, mulching, or deep watering.
3. On-site supervision: Use fencing and signage to mark protected zones. Monitor activity to ensure contractors stay within designated work areas.

By incorporating tree protection into the project timeline from the start, homeowners and contractors can avoid costly losses and preserve the natural beauty and long-term value of their properties. For detailed guidance on tree protection during each construction phase, refer to the steps outlined in the appendix of this publication.

Construction sites are high-risk environments for trees, and often, it takes only one careless act to cause permanent damage. Whether you are a homeowner or a contractor, care and vigilance are essential throughout the entire project. If damage does occur, it is critical to act quickly with the right treatments to provide the best chance for recovery. However, the best strategy is prevention, not reaction. Trees should receive consistent care and protection before, during, and after construction to reduce stress and improve their chances of survival in the long term.

Why Evaluate Trees Before You Build?

Evaluating trees before construction begins is one of the most cost-effective steps you can take. It helps determine:

- which trees are worth preserving.
- which trees are unlikely to survive.
- where to prioritize protection efforts.

Preserving a valuable tree only to damage it later can be just as costly as spending time and resources trying to save a tree that was never viable. A good assessment looks at each tree's health, structure, species, location, and ability to adapt to post-construction conditions.

For trees that cannot be fully separated from the work zone, weigh the long-term value of the tree against the cost of modifying construction plans. Only trees with a reasonable likelihood of survival, at a justifiable cost, should be saved. Trees with extensive preexisting damage, poor health, or high protection costs may be better candidates for removal.

Understanding Tree Roots: Damage Is Often Invisible

While trees are the largest living organisms on the planet, aboveground portions are only part of the story. The biggest vulnerability lies belowground, where most damage goes unnoticed until it is too late.

- Most tree roots are within the top 12–18 inches of soil.
- These roots can extend two to three times the width of the canopy—far beyond what most people expect.
- Roots are responsible for water and nutrient absorption, and even light equipment, trenching, or minor grading can crush or sever them.

Damage to roots is not just about severing them, it also occurs with soil compaction, changes in drainage, and exposure to heat or chemicals, all of which can compromise a tree's health.

Tree Structure: More than Meets the Eye

To truly protect a tree during construction, it helps to understand how it is built both above- and belowground. A helpful way to visualize this is to imagine a wine glass sitting on a large dinner plate (Figure 2):

- The cup represents branches and leaves, where the tree captures sunlight and produces energy.
- The stem of the glass is like the trunk, supporting the tree and transporting water and nutrients.
- The base of the glass mirrors the root plate, which contains large, structural roots that anchor the tree and help it stand upright. This zone is critical, even in trees with a deep taproot.

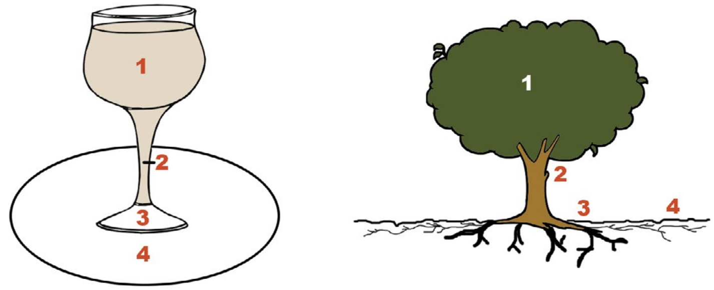

Figure 2. A tree looks like a wine glass on a dinner plate. A wine glass represents (1) leaves and branches, (2) tree stem, (3) the root plate with structural roots. A dinner plate (4) represents the transport and feeder root system.

- The dinner plate symbolizes the vast network of transport and feeder roots. These roots spread well beyond the canopy and are essential for absorbing water and nutrients.

This Matters During Construction

During construction, it is usually easy to avoid hitting the trunk or branches, but the most vital parts of the tree are underground and unseen. Damage to feeder roots or compacting the soil above them can have long-term consequences for a tree's health and stability. Without visible signs of injury, contractors and homeowners might not realize harm has occurred until the tree starts to decline months or even years later.

Bottom Line for Contractors and Homeowners

If you are working near a tree, protect the entire "dinner plate" zone—not just the trunk. This is where most damage happens, and it is also where the tree is most vulnerable. Protecting the root system is essential. With proper planning, trees can survive and thrive even in developed landscapes. Without it, even mature, healthy trees may fail.

Roots Matter: Protecting Trees from the Ground Up

When it comes to tree health, what happens underground is just as important as what is visible above. Most of a tree's life-support system—its transport and feeder roots—is hidden just beneath the surface. These roots are responsible for:

- absorbing water and nutrients.
- producing essential compounds like amino acids and proteins that support growth and healing.
- forming symbiotic relationships with beneficial fungi (mycorrhizae) that boost nutrient uptake.

Roots Are Closer to the Surface Than You Think

- About 85 percent of a tree's roots are located within the top 18 inches of soil.

- Roots commonly extend one to two times the height of the tree, and in some cases, up to three times beyond the canopy (drip line).
- These shallow, widespread roots rely on oxygen, rainfall, and microbial activity that are most available in the upper soil layers.

Roots are extremely vulnerable to construction damage because they grow so close to the surface and spread so far. Even light equipment or minor grading can crush root hairs, compact soil, and disrupt critical relationships with fungi.

Roots and Soil: A Delicate Balance

Healthy trees need healthy soil. That includes not just minerals, but also the right mix of air, water, and organic matter. For strong root systems and long-term tree health, ideal soil should contain 5 percent organic matter, 50 percent mineral particles, and 45 percent pore space (Figure 3), and the best soil for tree growth is loam (i.e., a soil comprised of 40 percent sand, 40 percent silt, and 20 percent clay) (Figure 4). Most urban and residential soils do not meet these standards. Construction often reduces pore space, crushes soil structure, and strips away organic matter, making it harder for trees to survive, even if visible parts seem unaffected at first.

The Problem with Construction: Soil Compaction

Construction can destroy soil structure in a matter of hours. Heavy equipment, vibrations, and foot traffic compact the soil by:

- crushing pedons (naturally formed, small soil blocks).
- squeezing out pore space.
- suffocating feeder roots and killing beneficial fungi.

What Happens when Soil Gets Compacted

- Air and water availability drop: Pore space falls below 12 percent.
- Soil becomes denser: Bulk density increases to 1.4–1.8 grams per cubic centimeter (g/cm^3), depending on soil type.
- Roots stop growing: Penetration resistance over 3 megapascals (MPa; 435 psi) stops root growth.
- Low oxygen and water infiltration: Leads to root death, even if no mechanical damage occurs.

Once compacted, soil cannot support healthy root growth. Water cannot soak in, roots cannot breathe, and nutrients cannot be absorbed. This is often the beginning of tree decline, even if the damage goes unnoticed for months or years.

What Homeowners and Contractors Should Do

- Plan: Identify trees worth saving and map their root zones.
- Stay back: Keep heavy equipment and materials off the root zone (ideally one and a half times tree height).
- Protect soil: Use fencing, mulch, and ground protection mats to preserve structure.
- Avoid over-digging: Do not trench or grade in the root zone unless absolutely necessary.
- Post-construction care: Aerate compacted soil, add organic matter, and water deeply to help recovery.

Roots are highly adaptable and will grow where conditions are favorable, specifically in locations with adequate water, warm temperatures, and sufficient oxygen. However, there are clear limits to what roots can tolerate. Root growth slows and can stop entirely when soil becomes compacted.

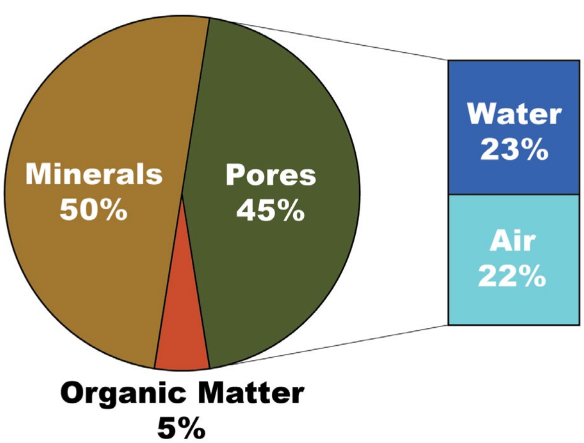

Figure 3. The ideal soil for tree root growth should have 45 percent pore space, 5 percent organic matter, and only 50 percent minerals. Half of the pore space should be filled with water and the other half with air (Neely & Watson 1998).

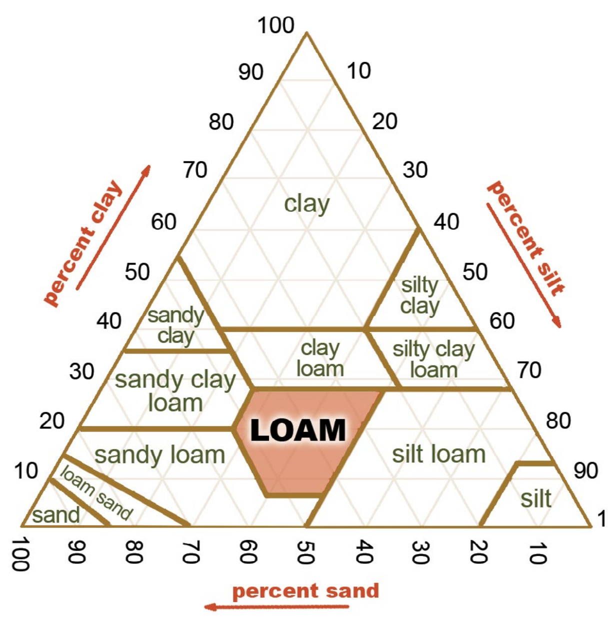

Figure 4. The best soil texture for root growth is a loam with 20 percent clay, 40 percent sand, and 40 percent silt (Fazio 2000).

Compacted soils typically have less than 12 percent pore space and a bulk density greater than 1.4–1.8 g/cm^3, depending on soil texture (Table 1). Bulk density increases as compaction increases, as it reflects the ratio of a soil's dry weight to its volume. In addition, root growth ceases when soil penetration resistance reaches 3 MPa (435 psi). Even without mechanical damage, roots can die from lack of oxygen or moisture if soil conditions fall outside tolerable limits. When construction activities alter soil structure to this extent, root function declines and, with it, tree health.

Table 1. Important soil characteristics and tolerable limits for tree roots. Limits can vary with species and overall tree health (Neely & Watson 1998).

Soil Characteristics Important to Roots	Tolerable Minimum	Tolerable Maximum
Air pore space	12 percent	–
Bulk density clay	–	1.4g/cc
Sand	–	1.8g/cc
Penetration resistance[1]	0.01kPa	3,000kPa
Oxygen in soil air for root survival	2.5%	21%
Oxygen in soil air for root growth	5%	21%
Oxygen in soil air for root initiation	12%	21%
Oxygen in soil air for efficient element absorption	15%	21%
Water content	12%	40%
Temperature for root growth	40°F	94°F
pH (wet soil)	3.5	8.2

[1]Resistance level kPa = 1,000 pascals of force; 1,000 kPa = 1 MPa or 1 million pascals of force = 10 bars = 145 psi or pounds per square inch.

How to Detect Early Compaction: Use a Soil Penetrometer

One of the easiest and most effective tools for detecting soil compaction is a soil penetrometer. This simple device measures the force needed to push a probe into the soil.

- In compacted soil, resistance increases—and root growth slows or stops.
- Even slight compaction can reduce root growth by 90 percent.
- Penetrometers start around $80 and offer a quick way to monitor surface soil, especially the top 2 inches, where compaction usually begins.

Soil Cannot Do Two Jobs: Structure versus Tree Roots

Soil in a construction zone must be treated as a single-use resource. It can be used either for structure support (compacted and stable soil for foundations) or for tree roots (requiring loose, porous, organic-rich soil), but not both.

During construction:

- roots and organic matter are often removed to strengthen the foundation soil.
- vibrations and pressure compact soil, squeezing out pore space and suffocating roots.
- permanent root loss under structures is normal and expected.

Solution: Separate trees and structures. Locate buildings, roads, and hardscape features away from critical root zones, so each has the soil conditions it needs.

Which Trees Should Be Saved?

Not all trees are worth the effort or cost to save. A professional tree evaluation should guide the decision. Here is what to consider:

Good Candidates for Preservation

- Located 20 or more feet away from new buildings, sidewalks, or driveways.
- In good structural and health condition (no dieback, rot, or decay fungi) (Figure 5).
- Desirable species (e.g., oak, hickory, etc.).
- Fit within the owner's goals and budget.

Poor Candidates for Preservation

- Located within 20 feet of the structure footprint.
- Show dieback, rot, fungal growth, or trunk damage (Figure 5).
- Rate as being in poor condition (near end of mortality spiral).
- Weak, short-lived, or pest-prone species.
- Require extensive construction modifications to protect, beyond reasonable cost.

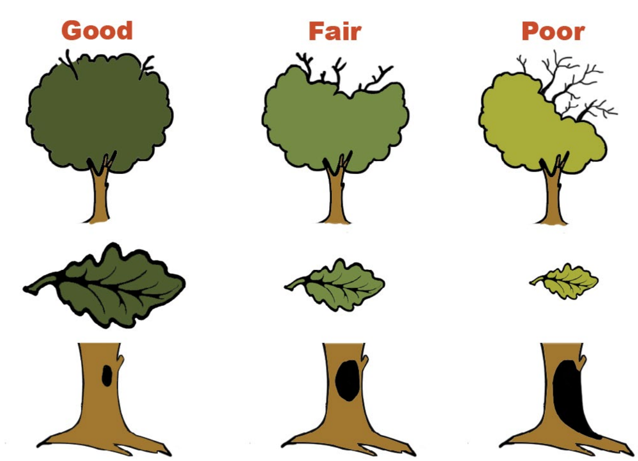

Figure 5. Good, fair, and poor tree condition.

Other characteristics of poor-condition trees:

- Dead top and/or dieback in the larger top branches.
- Narrow branch angles and/or co-dominant stems.
- History of damage from lightning, insects, and/or equipment.
- Lean and/or soil heaving around the base.
- Cracks, cavities, rotten wood, fungal conks, termites, carpenter ants, and cankers.

Size, Species, and Budget All Matter

- Large trees have larger root systems that are harder and costlier to protect.
- Small trees are easier and cheaper to save, even if their value is lower.
- Some species are more tolerant of construction impacts than others.

Preferred species have strong wood, long lifespans, fewer pest issues, and better resistance to soil disturbance. Susceptible species need special care or may not survive even moderate disruption.

Species Resistance to Construction Damage

Resistant

- Ash – green
- Bald cypress
- Birch – river
- Elm – most species
- Gum – black, Tupelo
- Hickory – water, pecan
- Holly – American, dahoon, gallberry, yaupon
- Maple – red, boxelder
- White Oaks – white, swamp chestnut, overcup, bur
- Red Oaks – water, willow, Shumard, Nuttall, northern pin
- Pines – loblolly, longleaf, slash
- Willow

Moderate

- Ash – white
- Dogwood – flowering
- Hickory – pignut, shagbark, mockernut
- Hophornbeam – eastern
- Hornbeam – American
- Magnolia – most species
- Maple – Florida
- Pine – shortleaf
- Sweetgum
- Sycamore – American

Susceptible

- Basswood
- Beech
- Chinkapin – Allegheny
- Maple – silver
- Sourwood
- Sugarberry (hackberry)
- Walnut – black
- Poplar – yellow

Advice for Homeowners and Contractors

- Include tree evaluations in early site planning.
- Do not assume a tree will "bounce back" after construction.
- Use a certified arborist to assess value, location, and viability.
- Protect trees you intend to save before any equipment enters the site.
- Accept that some trees must be removed and plan accordingly.

Tree Protection Guidelines for Construction Sites

Protecting trees during construction is not just good landscaping practice; it is essential for keeping valuable trees alive. Once roots are damaged, recovery is difficult or impossible. Whether you are a homeowner planning a new build or a contractor managing site work, the following guidelines can help you avoid costly tree loss and keep your project on track.

Protect Trees from Injury

The best way to protect a tree during construction is to create a tree protection zone (TPZ) using sturdy fencing and clear signage (Figure 6):

- Erect a physical fence: Place it around the root zone of each protected tree.
- Post "keep out" signs: Make it clear that no activity is allowed inside the TPZ.
- Enforce the rules: Assign a crew member or supervisor to monitor the fence daily.
- Add a penalty clause to contracts: This helps hold subcontractors accountable if they damage fencing or enter restricted zones.
- Zero tolerance: No digging, trenching, parking, storage, or foot traffic should be allowed inside the tree protection zone—not even "just for a moment."
- Mulch: Apply a 1-foot-thick layer of mulch over critical root zones outside the fence. This helps reduce soil compaction from foot traffic or equipment nearby.

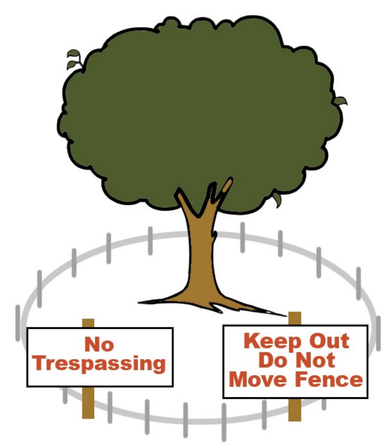

Figure 6. Illustration of a protective fence that separates a tree from construction activity.

Tree Protection Zone Size

The size of the protection zone depends on the diameter of the tree, measured 4.5 feet above ground level (known as diameter at breast height, or DBH) (Table 2).

The standard rule is to provide 1.25 feet of protection radius for every 1 inch of stem diameter.

Example: A tree with a 10-inch diameter needs a TPZ with a 12.5-foot radius (1.25 × 10). That is a 25-foot-wide circle fenced off around the tree. This radius is called the critical root radius, and the total area inside the circle is the critical root area (CRA), the zone most vital to tree survival.

Use larger zones for sensitive trees.

- Trees in poor health or species sensitive to damage need more space.
- Use 1.5 feet per inch of stem diameter, or the dripline, whichever is greater.

For groups of trees:

- Calculate the critical root radius for each tree.
- Fence around the outer boundary of all critical zones to form one larger TPZ (rather than fencing each tree individually) (Figure 7).

Table 2. Critical root radius and critical root area based on stem diameter (Coder 1996).

Tree Stem Diameter (in)	Critical Root Radius (ft)	Critical Root Area (ft^2)
2	2.5	19
4	5	78
6	7.5	176
8	10	314
10	12.5	490
12	15	706
14	17.5	962
16	20	1,256
18	22.5	1,590
20	25	1,963
22	27.5	2,375
24	30	2,827
26	32.5	3,318
28	35	3,818
30	37.5	4,417
32	40	5,026
34	42.5	5,674
36	45	6,361
38	47.5	7,088
40	50	7,853

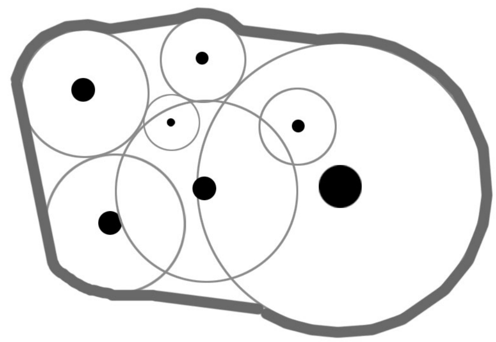

Figure 7. Overhead view of a tree protection zone (outer border line) for a group of trees. Dots represent tree stems and light circles are each tree's critical root area.

Can You Protect Only Part of the Root Area?

Yes, but the more root area you protect, the higher the chance the tree will survive. If 70 percent or more of the critical root area (CRA) is protected, the tree should be saved as it has a high chance of survival. If 50–60 percent of the CRA is protected, you must decide whether to protect the tree or not as it has a 50/50 chance of survival. The likelihood of a tree with 40 percent or less CRA protection surviving is low, indicating that the tree should be removed.

Use this simple formula to determine how much of the critical root area is protected:

% protected CRA = (TPZ area ÷ CRA) × 100

Example: Is a 15 ft × 15 ft TPZ enough for a 10-inch diameter tree?

Step 1: Calculate the critical root radius (CRR):

CRR = 1.25 × 10 = 12.5 feet

Step 2: Calculate the CRA:

CRA = $\pi \times (12.5)^2 = 490.9$ ft^2

Step 3: Calculate the TPZ area:

TPZ area = 15 × 15 = 225 ft^2

Step 4: Compare with CRA:

Protected CRA (%) = (225 ÷ 490.9) × 100 = ~45.8%

Result: The tree is not a good candidate for saving unless construction plans change. You are protecting less than 50 percent of the root system, so survival would be unlikely.

Tree Protection Tips for Contractors and Homeowners

- Measure tree diameter early, during site planning.
- Mark TPZs on site plans and on the ground before work begins.
- Fence first, before grading, equipment staging, or trenching begins.

- Communicate with all crews. Missteps often happen when plans change mid-project.
- Work with a certified arborist for high-value trees or complex sites.
- A single misstep can lead to tree death months or even years later. Protect early and consistently.

Tree Protection During Trenching and Grade Changes

Construction often involves trenching for utilities and changing soil levels (adding fill or cutting soil). If these activities occur too close to trees, they can cause permanent root damage, leading to instability, decline, or death.

Trenching

Trenching (digging linear paths for utilities, sidewalks, or foundations) can severely damage tree roots, especially if done near the structural root plate, which anchors the tree and keeps it upright during storms. This leads to the golden rule of trenching near trees: **never** trench through a tree's root plate.

- Trenching through this zone removes the roots most responsible for structural support.
- A tree with root plate damage can fail suddenly and dangerously, especially in wind.

How Far Is Safe?

The minimum trench distance depends on the size of the tree. Use the following:

- Root plate radius maxes out at 10 feet for large trees (about 24" diameter).
- Always trench outside the root plate.
- For critical root health, stay outside the CRR = 1.25 ft × tree diameter (inches)

How to Calculate Root Loss from a Trench

Use this formula to estimate how much root damage will result:

Distance from trench to tree (%) = [Distance to trench (ft) ÷ CRR (ft)] × 100

Then, refer to a root loss guide (Figure 8) to estimate percent of root system affected.

Limit root loss to 40 percent or less. If greater, do one of the following:

- move the trench.
- drill under the roots.
- remove the tree.

Example: Will a 20-inch tree survive a trench 15 feet away?

Tree diameter = 20 inches

CRR = 1.25 × 20 = 25 feet

Distance from tree to trench = 15 feet

Percentage = (15 ÷ 25) × 100 = 60% of critical root radius

Expected root loss = ~30%

Result: Tree is likely to survive. No root plate damage, and over 70 percent of critical roots remain.

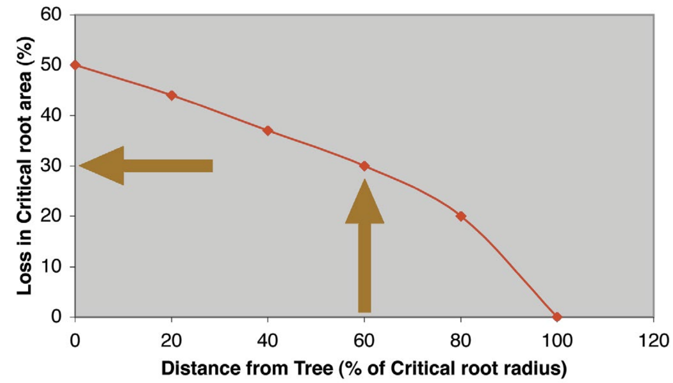

Figure 8. Trenching at a distance of 60 percent of the critical root radius will cause the loss of 30 percent of the critical root area (Coder 1996).

Trenching Tips

- If trenching must occur near trees, use:
  - air spade or hydro-vac excavation.
  - hand tools near roots.
  - tunneling or boring under root systems.
- If roots are cut, prune them cleanly; do not rip or tear.
- Keep roots in open trenches moist and shaded (wet burlap or plastic).

Soil Grade Changes

Changing soil elevation by either adding fill or removing soil (cutting) can smother roots, strip topsoil, or disrupt water flow.

Fills (Raising Soil)

The maximum safe depth for sand is up to 8 inches; for loam, about 4-6 inches; and for clay, 1 inch or less) (Figure 9).

- Can suffocate roots by blocking oxygen.
- Disrupt natural drainage.
- Cause waterlogging if not managed properly.

Never pile soil or mulch against the trunk! Keep stems exposed.

For deep fills:

- use engineered fill mixtures.
- build retaining walls to protect root zones (Figure 10).

Cuts (Lowering Soil)

Deeper roots in sandy soils permit larger cuts, while shallow roots in clay soils do not (Figure 11).

- Remove topsoil and feeder roots.
- Can alter or reduce water availability.
- Should never be done in the structural root plate.

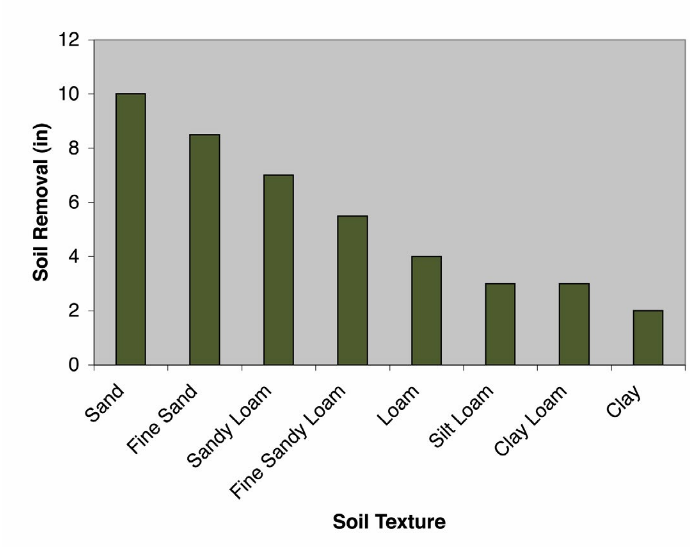

Figure 9. Texture of fill material and maximum depth of fill that can be placed over the critical root area before root damage occurs (Coder 1996).

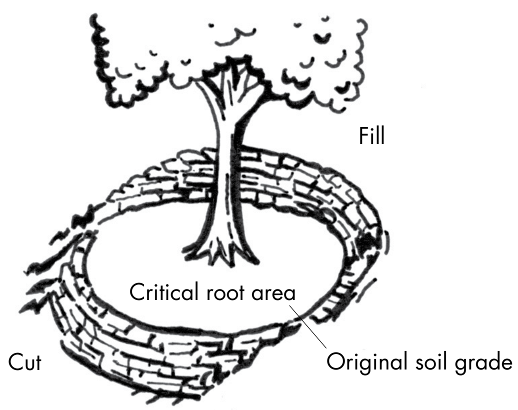

Figure 10. Retaining walls can keep original soil grade within the critical root area and allow deep cuts and/or fills to achieve the grade changes needed for construction.

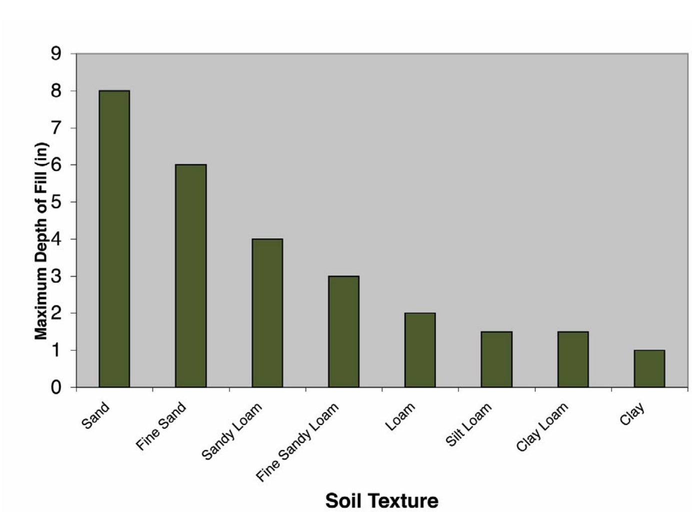

Figure 11. Original soil texture and the maximum depth of cut allowable in the critical root area before serious root damage occurs (Coder 1996).

If cuts are needed:

- excavate carefully by hand.
- prune roots cleanly.
- add mulch immediately.
- supplement irrigation if drainage is altered.

Tips for Grade Changes

- Limit any grade change in the critical root area.
- Mulch exposed roots.
- Use cribbing or retaining walls for significant changes.
- Plan for supplemental irrigation if water tables shift.

Trenching and Grading Checklist for Homeowners and Contractors

- Use protective fencing for 100 percent of critical root area where possible.
- Never trench through root plates.
- Use a penetrometer to detect compaction.
- Plan for mulching, irrigation, and soil protection.
- Work with an ISA-certified arborist to evaluate trees before and after site work.
- Use retaining walls to manage large grade changes.

Ameliorate Compaction

Soil compaction is one of the most common and damaging disturbances that occurs during construction. It limits root growth, reduces oxygen availability, and can lead to tree decline. To counteract compaction and restore soil aeration, the following four treatments are recommended:

1. Fracture the soil to add air space: Use high-pressure air injectors or augers to create holes and fractures in the soil, improving aeration (Figure 12).
2. Dig radial trenches: Excavate 1–2-foot-deep trenches radiating outward from the tree like spokes on a wagon wheel.
   a. Hydroexcavation is highly effective for this task.
   b. Backfill trenches with porous material to promote root growth.
3. Apply organic mulch: Spread 4–6 inches of organic mulch over the tree's critical root area to improve soil structure, retain moisture, and support microbial activity.
4. Use tree growth regulators: Apply paclobutrazol or a similar growth regulator immediately after damage occurs. This treatment helps redirect energy from canopy growth to root regeneration.

Act quickly! Do not wait for symptoms of decline. Prompt treatment is essential to prevent compaction from pushing a tree into the mortality spiral. These treatments can be used individually or combined for maximum effectiveness, depending on the severity of soil compaction.


Figure 12. Reducing soil compaction using a high-pressure air injector. Cracking of soil indicates some relief from compaction.

Summary

The key to preserving trees on construction sites is protection combined with high-quality care. Most tree decline and death after construction is caused by damage to the root system. Common construction activities such as soil compaction, trenching, and grading can severely harm roots and should never be allowed within the tree's critical root area.

The critical root area is a circular zone around the tree, with a radius of at least 1.25 feet for every inch of tree trunk diameter. Installing protective fencing at this distance is an effective way to keep construction equipment and activity away from sensitive roots. Inside this fenced area, encourage new root growth by maintaining ideal soil conditions: apply 4–6 inches of organic mulch, along with fertilizer and irrigation.

When deciding which trees to preserve, evaluate their condition, size, species, and location. Trees selected for preservation should have a good chance of surviving construction, adapting well to their new environment, and enhancing the landscape. If construction must take place within the critical root zone, assess potential root damage and the tree's chance of survival. Only trees with more than a 50 percent chance of survival should be protected; others should be removed.

While several treatments can help alleviate soil compaction, they must be applied immediately after damage to be effective.

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Appendix: Protecting Trees from Construction Damage

Step 1. Mapping and Prescription

- **Identify client priorities:** Understand the client's goals and how important tree preservation is to them.
- **Site inventory and mapping:** Survey the construction site and create a detailed map showing soil types, trees, vegetation, and other natural resources. Assess which trees are healthy, structurally sound, and located safely away from planned construction.
- **Incorporate protection into the construction plan:**
    - Provide a map indicating the locations of protective fencing, and clearly mark areas where construction activities are prohibited.
    - List any necessary changes to the construction plan to safeguard important trees.

Step 2. Preconditioning

- **Build access roads and staging areas:** Plan these as part of the final site design whenever possible. Ensure that trees near these areas are protected from soil sterilant.
- **Coordinate with utility personnel:** Review the locations of proposed utility lines, trenching, and tunneling to minimize impact on trees.
- **Remove unwanted vegetation carefully:** Cut and remove unwanted trees and plants in protected zones—do not pull them out to avoid root disturbance. Fertilize and mulch the protected root zones of trees that will be preserved.
- **Install protective measures:** Set up protective fencing around trees, as well as drainage and irrigation systems if needed.
- **Manage soil and spoil:** Identify designated areas to store topsoil and where construction spoil will be piled, keeping these away from tree root zones.

Step 3. Supervision

- Meet with the general contractor:
    - Define and agree on construction limits, material storage areas, worker parking, and locations for trailers and portable toilets.
    - Establish proper procedures for material disposal, including cement, paint, and plastic waste.
    - Develop a water management plan to address erosion control, stormwater runoff, and cement truck cleaning.
- Designate someone to monitor and protect fencing from encroachment throughout the project.
- Sequence construction activities for tree safety by installing utility lines first; followed by driveways, walkways, and parking; and buildings last to reduce root zone disturbance.
- Review all last-minute plan changes to ensure they do not compromise tree protection.
- Inspect the site twice daily to catch and correct any issues early.
- Provide supplemental water, fertilizer, and pest/disease management as needed.
- Prune and repair any tree injuries promptly.
- Restore soil health where disturbance or compaction has occurred.
- Maintain mulch to conserve moisture and protect roots.

Step 4. After-Care

- Remove temporary fences and irrigation systems.
- Rehabilitate any compacted or eroded soil areas to restore healthy growing conditions.
- Provide additional care for protected trees, including extra watering, fertilizing, and pest and disease control as needed.
- Maintain mulch layers around trees to help conserve moisture and improve soil health.

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