

CITY OF PALO ALTO
TREE TECHNICAL MANUAL
STANDARDS AND SPECIFICATIONS

notes:

SECTION 2.00 - PROTECTION OF TREES DURING CONSTRUCTION

INTRODUCTION

The objective of this section is to reduce the negative impacts of construction on trees to a less than significant level. Trees vary in their ability to adapt to altered growing conditions. Mature trees have established stable biological systems in the preexisting physical environment. Disruption of this environment by construction activities interrupts the tree's physiological processes causing depletion of energy reserves and a decline in vigor, often resulting in the tree's death. Typically, this reaction may develop from one to twelve years or more after disruption. The tree protection regulations are intended to guide a construction project to insure that appropriate practices will be implemented in the field to eliminate undesirable consequences that may result from uninformed or careless acts, and preserve both trees and property values.

Typical negative impacts that may occur during construction include:

- ▶ mechanical *injury* to roots, trunk or branches
- ▶ *compaction* of soil, which degrades the functioning roots and inhibits the development of new ones and restricts drainage, which desiccates roots and enables water mold fungi to develop
- ▶ changes in existing grade which can cut or suffocate roots
- ▶ alteration of the water table - either raising or lowering
- ▶ microclimate change, exposing sheltered trees to sun or wind
- ▶ sterile soil conditions, associated with stripping off topsoil.

Construction projects within the *tree protection zone* (TPZ) of *Regulated Trees* are required to implement the protective practices described in Section 2.00.

2.10 TREE PROTECTION AND PRESERVATION PLAN

Prior to commencement of a development project, a property owner shall have prepared a *Tree Protection and Preservation Plan* if any activity is within the dripline of a *Protected* or *Designated Tree*, (see *Tree Reports, Section 6.30 and Section 1.35*). The Tree Protection Plan will be prepared by a *certified arborist* to assess impacts to trees; recommend mitigation to reduce impacts to a less than significant level and identify construction guidelines to be followed through all phases of a construction project. Projects protecting only *street trees* with fencing (see *Protective Tree Fencing, Section 2.15.D*) are exempt from preparing a Tree Protection and Preservation Plan.

Required Practices

2.15 PRE-CONSTRUCTION REQUIREMENTS

The following six steps shall be incorporated within the Tree Protection and Preservation Plan prior to building permit issuance.

A. Site Plan

On all improvement plans for the project, plot accurate trunk locations and the 'dripline areas' of all trees or groups of trees to be preserved within the development area. (see *Site Plan, Section 1.00*). In addition, for *Protected* and *Street Trees* (oaks, redwoods, heritage or *street trees*) the plans shall accurately show the trunk diameter, dripline and clearly indicate the *tree protection zone* to be enclosed with the specified tree fencing as a bold dashed line.

B. Verification of tree protection

The *project arborist* or contractor shall verify, in writing, that all preconstruction conditions have been met (tree fencing, erosion control, pruning, etc.) and is in place. Written verification must be submitted to and approved by the Planning Department prior to demolition, grading or building permit issuance (see *Inspections, Section 2.30*).

C. Pre-construction meeting

The demolition, grading and underground contractors, construction superintendent and other pertinent personnel are required to meet with the *Project Arborist* at the site prior to beginning work to review procedures, tree protection measures and to establish haul routes, staging areas, contacts, watering, etc.

D. Protective Tree Fencing for Protected Trees, Street Trees or Designated Trees

Fenced enclosures shall be erected around trees to be protected to achieve three primary goals, (1) to keep the foliage crowns and branching structure clear from contact by equipment, materials and activities; (2) to preserve roots and soil conditions in an intact and non-compacted state and; (3) to identify the *tree protection zone* (TPZ) in which no soil *disturbance* is permitted and activities are restricted, unless otherwise approved (see *Tree Protection Zone, Section 1.00 and 2.15.E*).

▶ Size and type of fence

All trees to be preserved shall be protected with five or six (5' - 6') foot high chain link fences. Fences are to be mounted on two inch diameter galvanized iron posts, driven into the ground to a depth of at least 2-feet at no more than 10-foot spacing (see *Public Works Department Detail #505, Appendix K*). This detail shall appear on grading, demolition and improvement plans.

▶ Area to be fenced.



IMAGE 2.15-1
Tree Protection Fence at the Dripline



IMAGE 2.15-2
Tree Protection Fence at the Dripline



IMAGE 2.15-3
Tree Protection within a Planter Strip



IMAGE 2.15-4
Trunk Wrap Protection

• **Type I Tree Protection**

The fences shall enclose the entire area under the **canopy dripline or TPZ** of the tree(s) to be saved throughout the life of the project, or until final improvement work within the area is required, typically near the end of the project (see *Images 2.15-1 and 2.15-2*). Parking Areas: If the fencing must be located on paving or sidewalk that will not be demolished, the posts may be supported by an appropriate grade level concrete base.

• **Type II Tree Protection**

For trees situated within a **narrow planting strip**, only the planting strip shall be enclosed with the required chain link protective fencing in order to keep the sidewalk and street open for public use.(see *Image 2.15-3*)

• **Type III Tree Protection**

Trees situated in a small tree well or **sidewalk planter pit**, shall be wrapped with 2-inches of orange plastic fencing as padding from the ground to the first branch with 2-inch thick wooden slats bound securely on the outside. During installation of the wood slats, caution shall be used to avoid damaging any bark or branches. Major scaffold limbs may also require plastic fencing as directed by the *City Arborist*. (see *Image 2.15-4*)

notes:

- ▶ Duration
Tree fencing shall be erected before demolition, grading or construction begins and remain in place until final inspection of the project permit, except for work specifically required in the approved plans in which case the *project arborist* or *City Arborist* (in the case of *streettrees*) must be consulted.
- ▶ 'Warning' Sign
A warning sign shall be prominently displayed on each fence. The sign shall be a minimum of 8.5 x 11-inches and clearly state: **WARNING - Tree Protection Zone** - This fence shall not be removed and is subject to a penalty according to PAMC Section 8.10.110.9. (see *Image 2.15-5*).



IMAGE 2.15-5
'Warning' Sign

Required Practices

E. Tree Protection Zone or (TPZ)

Each tree to be retained shall have a designated TPZ identifying the area sufficiently large enough to protect the tree and roots from *disturbance*. The recommended TPZ area can be determined by the formula outlined (see *Definitions, Tree Protection Zone, Section 1.36*). The TPZ shall be shown on all site plans (see *Definitions, Site Plan, Section 1.28*) for the project. Improvements or activities such as paving, utility and irrigation *trenching* and other ancillary activities shall occur outside the TPZ, unless authorized by the *City Arborist*, or by project approval. Unless otherwise specified, the protective fencing shall serve as the TPZ.

1. Activities prohibited within the TPZ include:

- ▶ Storage or parking vehicles, building materials, refuse, excavated spoils or dumping of poisonous materials on or around trees and roots. Poisonous materials include, but are not limited to, paint, petroleum products, concrete or stucco mix, dirty water or any other material which may be deleterious to tree health.
- ▶ The use of tree trunks as a winch support, anchorage, as a temporary power pole, sign posts or other similar function.
- ▶ Cutting of tree roots by utility *trenching*, foundation digging, placement of curbs and trenches and other miscellaneous excavation without prior approval of the *City Arborist*.
- ▶ Soil *disturbance* or grade change (see *Grade Changes and Trenching, Section 2.20*).
- ▶ Drainage changes.

2. Activities permitted or required within the TPZ include:

- ▶ Mulching. During construction, wood chips may be spread within the TPZ to a 4-to 6-inch depth, leaving the trunk clear of mulch to help inadvertent *compaction* and moisture loss from occurring. The mulch may be removed if improvements or other landscaping is required. Mulch material shall be 2-inch unpainted, untreated wood chip mulch or approved equal.
- ▶ *Root Buffer*. When areas under the tree canopy cannot be fenced, a temporary buffer is required and shall cover the root zone and remain in place at the specified thickness until final grading stage (see *Definitions, Section 1.27, and Heavy Equipment, Section 2.20 C*).
- ▶ Irrigation, aeration, fertilizing or other beneficial practices that have been specifically approved for use within the TPZ.

3. Erosion Control. If a tree is adjacent to or in the immediate proximity to a grade slope of 8% (23 degrees) or more, then approved erosion control or silt barriers shall be installed outside the TPZ to prevent siltation and/or erosion within the TPZ.

F. Tree Pruning, Surgery and Removal

Prior to construction, various trees may require that branches be pruned clear from structures, activities, building encroachment or may need to be strengthened by means of mechanical support or surgery. The most compelling reason to prune is to develop a strong, safe framework and tree structure. Such pruning, surgery or the *removal* of trees shall adhere to the following standards:

1. Pruning limitations:

- ▶ Minimum Pruning: If the *project arborist* recommends that trees be pruned, and the type of pruning is left unspecified, the standard pruning shall consist of 'crown cleaning' as defined by ISA Pruning Guidelines (see *Pruning, Section 5.15, and Appendix E*). Trees shall be pruned to reduce hazards and develop a strong, safe framework.
- ▶ Maximum Pruning: Maximum pruning should only occur in the rarest situation approved by the *City Arborist*. No more than one-fourth (25 percent) of the functioning leaf and stem area may be removed within one calendar year of any *protected* or *designated tree*, or *removal* of foliage so as to cause the unbalancing of the tree. It must be recognized that trees are individual in form and structure, and that pruning needs may not always fit strict rules. The *project arborist* shall assume all responsibility for special pruning practices that vary from the standards outlined in this *manual* (see *Excessive Pruning, Section 1.15*).
- ▶ Tree Workers. Pruning shall not be attempted by construction or contractor personnel, but shall be performed by a qualified tree care specialist or certified tree worker, according to specifications contained within this *Manual* (see *Pruning Mature Trees, Section 5.20*).

notes:

Required Practices

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2. Surgery. Prior to construction, if it is necessary to promote health and prolong useful life or the structural characteristics, then trees shall be provided the appropriate treatments (e.g. cavity screening, bark tracing, wound treatment, cables, rods or pole supports) as specified by the *project arborist* (see *ANSI A-300, Appendix G*).
3. Tree *Removal Procedure*. When *Regulated Trees* are removed and adjacent trees that are to be preserved (as shown on the approved *site plans*) must be protected, then the following tree *removal practices* apply:
 - ▶ Tree Removal
Removal of trees that extend into the branches or roots of *Regulated Trees* shall not be attempted by demolition or construction personnel, grading or other heavy equipment. A *certified arborist* or tree worker shall remove the tree carefully in a manner that causes no damage above or below ground to trees that remain.
 - ▶ Stump Removal
Before performing stump extraction, the developer shall first consider whether or not roots may be entangled with trees that are to remain. If so, these stumps shall have their roots severed before extracting the stump. *Removal* shall include the grinding of stump and roots to a minimum depth of 24-inches but expose soil beneath stump to provide drainage. In sidewalk or small planter areas to be replanted with a new tree, the entire stump shall be removed and the planting pit dug to a depth of 30-inches. If dug below 30-inches, compact the backfill to prevent settling. Large surface roots three feet from the outside circumference shall be removed, including the spoils and backfilled with City approved topsoil to grade, and the area tamped to settle the soil.

Required Practices

2.20 ACTIVITIES DURING CONSTRUCTION & DEMOLITION NEAR TREES

Soil *disturbance* or other injurious and detrimental activity within the *Tree Protection Zone* (TPZ) is prohibited unless approved by the City based on a *tree report*. If an injurious event inadvertently occurs, or soil *disturbance* has been specifically conditioned for project approval, then the following mitigation is required:

A. Soil Compaction

If *compaction* of the soil occurs, it shall be mitigated as outlined in Soil Compaction Damage, Section 2.20, E and/or Soil Improvement, Section 5.50.

B. Grading Limitations within the Tree Protection Zone

- ▶ Grade changes outside of the TPZ shall not significantly alter drainage to the tree.
- ▶ Grade changes within the TPZ are not permitted.
- ▶ Grade changes under specifically approved circumstances shall not allow more than 6-inches of fill soil added or allow more than 4-inches of existing soil to be removed from natural grade unless mitigated.

- ▶ Grade fills over 6-inches or impervious overlay shall incorporate an approved permanent aeration system, permeable material or other approved mitigation.
- ▶ Grade cuts exceeding 4-inches shall incorporate retaining walls or an appropriate transition equivalent.

notes:

C. Trenching, Excavation and Equipment Use

Trenching, excavation or boring activity within the TPZ is restricted to the following activities, conditions and requirements if approved by the *City Arborist*. (See *Restriction Zones for Excavation, Trenching or Boring Near Regulated Trees, Image 2.20-1 through 2.20-3*). Mitigating measures shall include prior notification to and direct supervision by the *project arborist*.

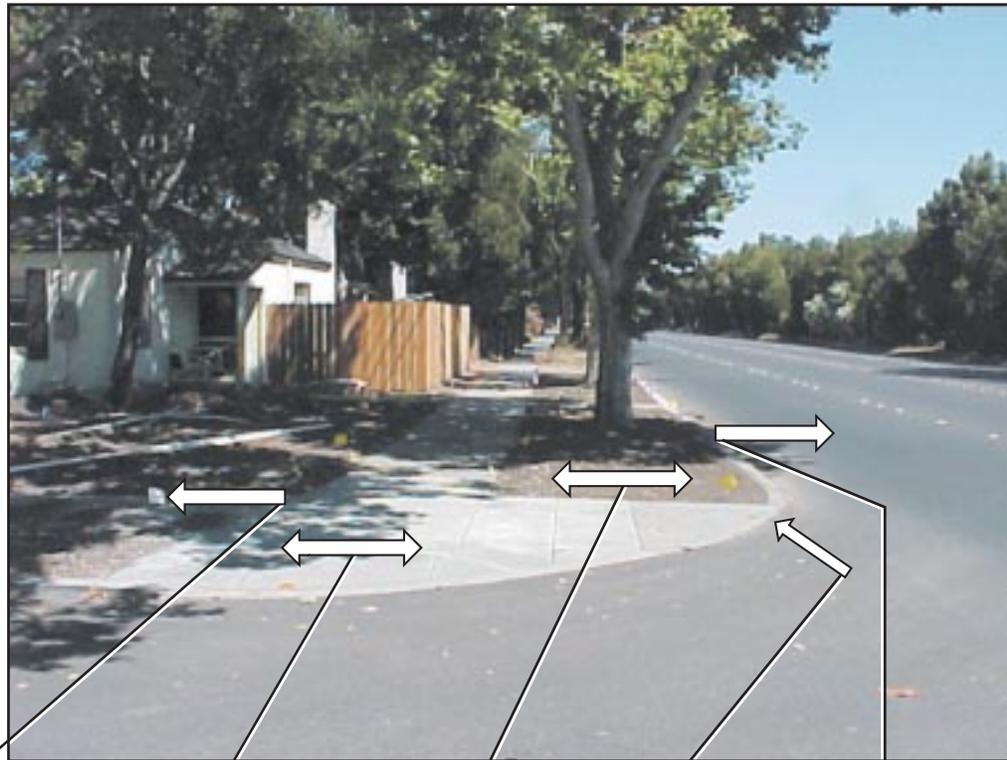
Required Practices

1. Notification. Contractor shall notify the *project arborist* a minimum of 24 hours in advance of the activity in the TPZ.
2. Root Severance. Roots that are encountered shall be cut to sound wood and repaired (see *Root Injury, Section 2.25 A-1*). Roots 2-inches and greater must remain injury free.
3. Excavation. Any approved excavation, demolition or extraction of material shall be performed with equipment sitting outside the TPZ. Methods permitted are by hand digging, hydraulic or pneumatic air excavation technology. Avoid excavation within the TPZ during hot, dry weather.
 - ▶ If excavation or *trenching* for drainage, utilities, irrigation lines, etc., it is the duty of the contractor to tunnel under any roots 2-inches in diameter and greater.
 - ▶ Prior to excavation for foundation/footings/walls, grading or *trenching* within the TPZ, roots shall first be severed cleanly 1-foot outside the TPZ and to the depth of the future excavation. The trench must then be hand dug and roots pruned with a saw, sawzall, narrow trencher with sharp blades or other approved root pruning equipment.
4. Heavy Equipment. Use of backhoes, steel tread tractors or any heavy vehicles within the TPZ is prohibited unless approved by the *City Arborist*. If allowed, a protective *root buffer* (see *Root Buffer and Damage to Trees, Section 2.25.A-1*) is required. The protective buffer shall consist of a base course of tree chips spread over the root area to a minimum of 6-inch depth, layered by 3/4-inch quarry gravel to stabilize 3/4-inch plywood on top. This buffer within the TPZ shall be maintained throughout the entire construction process.
 - ▶ Structural design. If injurious activity or interference with roots greater than 2-inches will occur within the TPZ, plans shall specify a design of special foundation, footing, walls, concrete slab or pavement designs subject to *City Arborist* approval. Discontinuous foundations such as concrete pier and structural grade beam must maintain natural grade (not to exceed a 4-inch cut), to minimize root loss and allow the tree to use the existing soil.

notes:

IMAGE 2.20-1

Restriction Zones For Excavation, Trenching Or Boring
Within A Tree Dripline In A Planter Strip



Zone 1
Private Property

Severing roots greater than 1" needs approval by property owner arborist.

Zone 2
Sidewalk

Severing roots greater than 2" needs approval by Public Works Arborist.

Zone 3
Planter Strip

No mechanical digging.
Severing roots greater than 2" needs approval by Public Works Arborist.

Zone 4
Curb & Gutter

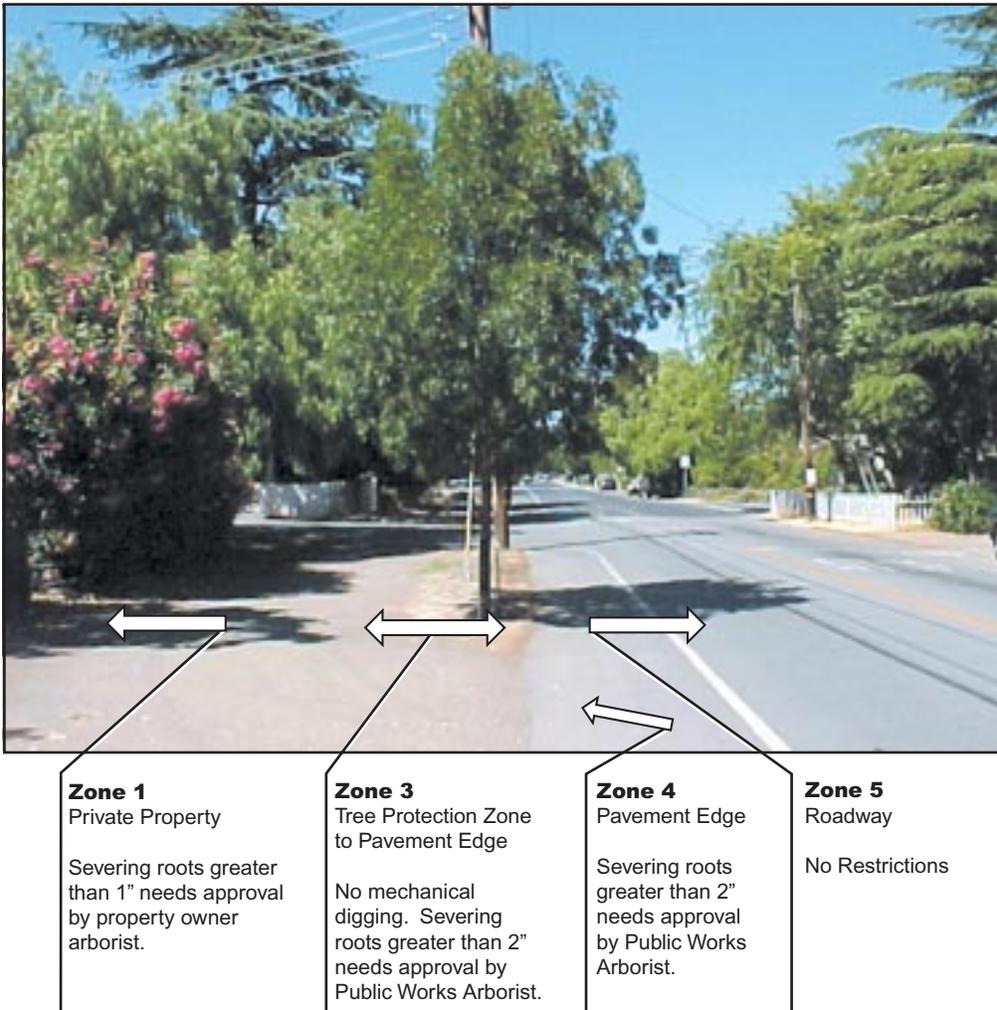
Severing roots greater than 2" needs approval by Public Works Arborist.

Zone 5
Roadway

No Restrictions

notes:

IMAGE 2.20-2
Restriction Zones For Excavation, Trenching Or Boring
within A Tree Dripline And No Curb Or Sidewalk



notes:

IMAGE 2.20-3

Restriction Zones for Excavation, Trenching or Boring within a Tree Dripline behind Sidewalk and Rolled Curb



Zone 5
Roadway
No Restrictions

Zone 2
Sidewalk
Severing roots greater than 2" needs approval by Public Works Arborist.

Zone 1
City Owned Tree
City owned tree is usually within 5' back of sidewalk. Severing roots greater than 1" needs approval by Public Works Arborist.

- ▶ Basement excavations shall be designed outside the TPZ of all *protected and designated trees* (see *Excavation, Section 2.20-3*) and shall not be harmful to other mature or neighboring property trees.

notes:

D. Tunneling & Directional Drilling

If *trenching* or pipe installation has been approved within the TPZ, then the trench shall be either cut by hand, air-spade, hydraulic vac-on excavation or, by mechanically boring the tunnel under the roots with a horizontal directional drill and hydraulic or pneumatic air excavation technology. In all cases, install the utility pipe immediately, backfill with soil and soak within the same day. Installation of private utility improvements shall be tunnel bored beneath the tree and roots per *Trenching Tunneling & Distance Matrix* in Table 2-1.

Required Practices

TABLE 2-1
Trenching & Tunneling Distance

TRENCHING DISTANCE	
	
When the Tree Diameter At 4.5 Ft Is:	Trenching will be Replaced with Boring at this Minimum Distance (10x tree dia.) from the Face of the Tree in any Direction:
6-9" Measured At 6" à	6-9'
10-14" Measured At 54" à	10-14'
15-19" Measured At 54" à	15-19'
Over 19" Measured At 54" à	20' +
DEPTH OF TUNNELING	
	
Tree Diameter	Depth of Tunneling
9" Or Less Measured At 6" à	2.5'
10-14" Measured At 54" à	3.0'
15-19" Measured At 54" à	3.5'
More Than 19" Measured At 54" Depth of Tunnel	4.0'

Bore Pits Shall Be Located At A Minimum Distance As Specified By The Trenching Distance Table Above.

1. Public Utilities

Underground public utility improvements or repairs shall be performed in accordance with the *Utility Standards for Excavation, Trenching or Boring, Section 02200.309*; and per *Restriction Zones Near Regulated Trees* (see *Images 2.20-1 through 2.20-3*).

2. Street Trees

Exclusions for *street trees* in the publicly owned right-of-way (ROW).

- ▶ *Street Trees* that are in conflict with utility infrastructure where the conflict cannot be resolved may be removed if approved by Public Works Operations (e.g., a tree planted directly on top of a damaged sewer lateral.)

notes:

- ▶ Emergency utility repairs shall be exempt from the above restriction zones within the TPZ. The *City Arborist* shall be contacted after any such repairs that may result in significant tree damage or *removal*.

Required Practices

E. Injury Mitigation

A mitigation program is required if the approved development will cause drought stress, dust accumulation or soil *compaction* to trees that are to be saved. To help reduce impact *injury*, one or more of the following mitigation measures shall be implemented and supervised by the project arborist as follows:

1. Irrigation Program. Irrigate to wet the soil within the TPZ to a depth of 24-inches to 30-inches. Or, apply sub-surface irrigation at regular specified intervals by injecting on approximate 3-foot centers, 10-gallons of water per inch trunk diameter within the TPZ. Duration shall be until project completion or monthly until seasonal rainfall totals at least 8-inches of rain, unless specified otherwise by the *project arborist*.
2. Dust Control Program. During periods of extended drought, wind or grading, spray wash trunk, limbs and foliage to remove accumulated construction dust.
3. Soil Compaction Damage. *Compaction* of the soil is the largest killer of trees on construction sites due to suffocation of roots and ensuing decline of tree health. If a *compaction* event to the upper 12-inch soil horizon within the tree protection zone has or will occur by any means, then one or more of the of the following mitigation measures shall be implemented (*see Compaction and Grade Change, Section 2.20 A&B and Soil Improvement, Section 5.50*).
 - ▶ Type I Mitigation. If an approved paving, hardscape or other compromising material encroaches within the TPZ, an aeration system shall be designed by the *project arborist* and used within this area (subject to approval by the *City Arborist*).
 - ▶ Type II Mitigation. If inadvertent *compaction* of the soil has occurred within the TPZ, the soil shall be loosened by one or more of the following methods to promote favorable root conditions: *vertical mulching, soil fracturing, core-venting, radial trenching* or other method approved by the *City Arborist* (*see Soil Improvement, Section 5.50*).
 - ▶ Type III Mitigation. For City-owned improvements in the right-of-way, areas within the TPZ that will be improved (e.g., asphalt, concrete or pavement) soil shall be compacted to 95% proctor density. Unimproved areas (e.g., grass, open landscape strip, etc.) soil in the TPZ shall not exceed 85% by water jet *compaction*.

Required Practices

2.25 DAMAGE TO TREES

A. Reporting

Any damage or injury to trees shall be reported within 6-hours to the *project arborist* and job superintendent or *City Arborist* so that mitigation can take place. All mechanical or chemical *injury* to branches, trunk or to

roots over 2-inches in diameter shall be reported in the *monthly inspection report*. In the event of *injury*, the following mitigation and damage control measures shall apply:

1. Root injury: If trenches are cut and tree roots 2-inches or larger are encountered they must be cleanly cut back to a sound wood lateral root. The end of the root shall be covered with either a plastic bag and secured with tape or rubber band, or be coated with latex paint. All exposed root areas within the TPZ shall be backfilled or covered within one hour. Exposed roots may be kept from drying out by temporarily covering the roots and draping layered burlap or carpeting over the upper 3-feet of trench walls. The materials must be kept wet until backfilled to reduce evaporation from the trench walls.
2. Bark or trunk wounding: Current bark tracing and treatment methods shall be performed by a qualified tree care specialist within two days.
3. Scaffold branch or leaf canopy *injury*: Remove broken or torn branches back to an appropriate branch capable of resuming terminal growth within five days. If leaves are heat scorched from equipment exhaust pipes, consult the *project arborist* within 6 hours.

B. Penalty for damage to street trees

In the event that *street trees* or their roots have been damaged, the contractor or property owner shall be subject to the penalty rate of \$100.00 per inch of damage (City of Palo Alto, Current FY Fee Schedule - subject to change). Measurement of the damage shall be the width of the wound measured across the grain at the widest point. Penalty fee shall be paid to the City and deposited to the general fund as required.

notes:

Required Practices
PAMC 8.04.070

2.30 INSPECTION SCHEDULE

The *project arborist* or Landscape Architect retained by the applicant shall conduct the following required inspections of construction sites containing *protected* and *designated trees*. Inspections shall verify that the type of tree protection and/or plantings are consistent with the standards outlined within this *Manual* and Conditions of Approval for discretionary projects. For each required inspection or meeting, a written summary of the changing tree related conditions, actions taken, and condition of trees shall be provided to the City of Palo Alto. *Monthly Inspection Reports* shall be faxed to the Planning Arborist at (650) 329-2154.

TABLE 2-2
Inspection Schedule

INSPECTION SCHEDULE	
	
A.	<u>Inspection of Protective Tree Fencing.</u> The <i>City Arborist</i> shall be in receipt of a written statement from the applicant or <i>project arborist</i> verifying that he has conducted a field inspection of the trees and that the protective tree fencing is in place prior to issuance of a demolition, grading, or building permit, unless otherwise approved (see <i>Verification of Tree Protection, Section 1.39</i>).
B.	<u>Pre-Construction Meeting.</u> Prior to commencement of construction, the applicant or contractor shall conduct a pre-construction meeting to discuss tree protection with the job site superintendent, grading equipment operators, <i>project arborist</i> , <i>City Arborist</i> , and, if a city maintained irrigation system exists, the Parks Manager (Contact 650-496-6962).
C.	<u>Inspection of Rough Grading.</u> The <i>project arborist</i> shall perform an inspection during the course of rough grading adjacent to the TPZ to ensure trees will not be injured by compaction, cut or fill, drainage and trenching, and if required, inspect aeration systems, tree wells, drains and special paving. The contractor shall provide the <i>project arborist</i> at least 48 hours advance notice of such activity.
D.	<u>Monthly Inspections.</u> The <i>project arborist</i> shall perform monthly inspections to monitor changing conditions and tree health. The <i>City Arborist</i> shall be in receipt of an inspection summary during the first week of each calendar month or, immediately if there are any changes to the approved plans or protection measures (see <i>Monthly Inspection Report, Section 1.17</i>).
E.	<u>Special activity within the Tree Protection Zone.</u> Work in this area (TPZ) requires the direct onsite supervision of the <i>project arborist</i> (see <i>Trenching, Excavation and Equipment, Section 2.20 C</i>).
F.	<u>Landscape Architect Inspection.</u> For <i>discretionary development projects</i> , prior to temporary or final occupancy the applicant or contractor shall call for the Landscape Architect to perform an on site inspection of all plant stock, quality of the materials and planting (see <i>Quality, Section 5.20.1 A</i>) and that the irrigation is functioning consistent with the approved construction plans. The City shall be in receipt of written verification of Landscape Architect approval prior to scheduling the final inspection, unless otherwise approved.

2.40 PAVEMENT AND HARDSCAPE CONFLICTS WITH TREE ROOTS

Conflicts may occur when tree roots grow adjacent to paving, foundations, sidewalks or curbs (hardscape). Improper or careless extraction of these elements can cause severe *injury* to the roots and instability or even death of the trees. The following alternatives must first be considered before root pruning within the TPZ of a *Regulated Tree*.

A. Removal and Replacement of Pavement or Sidewalk:

- ▶ Removal of existing pavement over tree roots shall include the following precautions: Break hardscape into manageable pieces with a jackhammer or pick and hand load the pieces onto a loader. The loader must remain on undisturbed pavement or off exposed roots. Do not remove base rock that has been exploited by established absorbing roots. Apply untreated wood chips over the exposed area within one hour, then wet the chips and base rock and keep moist until overlay surface is applied.
- ▶ Replacement of pavement or sidewalk: An alternative to the severance of roots greater than 2- inches in diameter should be considered before cutting roots. If an alternative is not feasible remove the sidewalk, grind roots only as approved by the Public Works Arborist and replace sidewalk using #3 dowels at the expansion joint if within 10-feet of a street tree. Use a wire mesh reinforcement within if within 10-feet of the trunk of a *protected* or *street tree*.

Note: Any work in the right-of-way requires a street work permit from Public Works Department.

B. Alternative methods to prevent root cutting:

The following remedies should be considered before cutting tree roots that may result in tree instability or decline:

- ▶ Grinding a raised sidewalk edge.
- ▶ Ramping the walking surface over the roots or lifted slab with pliable paving.
- ▶ Routing the sidewalk around the tree roots.
- ▶ Install flexible paving or rubberized sections.
- ▶ On private property, new sidewalk or driveway design should consider alternatives to conventional pavement and sidewalk materials. Substitute permeable materials for typical asphalt or concrete overlay, sub-base or footings to consider are: permeable paving materials (such as ECO-Stone or RIMA pavers), interlocking pavers, flexible paving, wooden walkways, porches elevated on posts and brick or flagstone walkways on sand foundations.

C. Avoiding Conflict

Conflicts and associated costs can be avoided or reduced by the following planting practices:

- ▶ Plant deep rooted trees that are proven to be non-invasive.
- ▶ Over soil that shrinks and swells, install a sidewalk with higher strength that has wire mesh and/or expansion slip joint dowel reinforcement.
- ▶ Follow soil loosening planting techniques to promote deep rooting.

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Required Practices

Recommended Practices

Recommended Practices

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- ▶ Install root barrier only along the hardscape area of the tree (but allow roots to use open lawn or planter strip areas).
- ▶ Dedicate at least 10-linear feet of planting space for the growth of each tree.

Recommended
Practices

D. Alternative Base Course Materials

When designing hardscape areas near trees, the project architect or engineer should consider the use of recommended base course material such as an engineered structural soil mix. The Palo Alto approved structural soil mix will allow a long term cost effective tree and infrastructure compatibility that is particularly suited for the following types development projects: repair or replacement of sidewalk greater than 40-feet in length; subdivisions with new street tree plantings; planting areas that are designed over structures or parking garages; confined parking lot medians and islands or other specialized conditions as warranted. (see *City of Palo Alto Public Works Improvement Specifications Standards and; www.amereq.com/cuintro*).



END OF SECTION