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Littleton Colorado

CITY OF LITTLETON TREE MANUAL

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INTRODUCTION

Trees of Littleton's urban forest – which include trees growing along streets, in parks and other public spaces, and on private property – deliver the city's residents with a multitude of environmental, economic, and societal benefits. As a significant part of Littleton's urban infrastructure, it is critical to maintain and protect these trees to preserve and grow the collective benefits they provide.

The City of Littleton's Tree Manual intends to guide the community in the best practices for planting, maintaining, and protecting trees of the urban forest. The following standards were used to develop the requirements and recommendations set forth in this Tree Manual:

- American National Standards Institute (ANSI) A300 Part 5: *Standards of Management of Trees and Shrubs During Site Planning, Site Development, and Construction*
- ANSI A300 Part 6: *Planting and Transplanting*
- ANSI z133: *The Arboricultural Operations – Safety Requirements Standards*
- ANSI Z60.1-2004: *American Standard for Nursery Stock*
- International Society of Arboriculture's Best Management Practices Manual for Tree Planting
- International Society of Arboriculture's Best Management Practices Manual for Managing Trees During Construction

The following specifications are requirements for those contracted to conduct tree work or construction on City of Littleton property. All tree work must be performed by an arborist, who is licensed in accordance with Title 3, Chapter 16 of the Littleton City Code.

"Director, or authorized designee" shall mean the Director of Public Works & Utilities or a person designated by the Director.

This manual is organized into six sections:

- **Section I: Tree Planting Requirements.** Defines the required planning, preparation, and installation requirements for planting.

- **Section II. Tree Maintenance.** Summarizes industry standard guidelines for properly maintaining newly installed trees.

- **Section III. Tree Warranty**

- **Section IV. Irrigation Standards.** Outlines the approved options for irrigating newly installed trees.

- **Section V. Tree Preservation & Protection.** Generally, guides the community and contractors performing construction on City property on best practices for preserving and protecting trees from damage.

- **Section VI. Mitigation, Tree Removal and Damages.** Presents the City of Littleton's tree removal permit process, mitigation requirements and exceptions, and the consequences of violation.

SECTION I: TREE PLANTING REQUIREMENTS

Trees planted in the urban forest face a wide variety of challenges, and proper planting practices can significantly increase a young tree's chances of survival. Proper planting practices can also minimize potential public safety hazards caused by improperly planted trees.

Tree planting within the City of Littleton shall be performed and specified according to the following standards.

Property owners and Contractors planting trees on private property are not required to follow these specifications, but are encouraged to consider these industry standard guidelines to increase the longevity and health of their tree. Notwithstanding, property owners and Contractors shall obtain a permit, in accordance with Title 8, *Public Ways and Property*, prior to encroachment of any tree or plant materials into the public-right-of-way.

1. Planning for Tree Planting

1.1 Planting Season

Trees should be planted in their dormant season before bud break or after leaf drop. Early spring and late fall are recommended due to cool temperatures and ample moisture. Trees planted during the active growing season may require additional care to become established.

Landscaping that is required by City Code shall be installed between March 15 and October 15. If compliance with this timeframe is impractical due to the time of year that work is completed, a financial guarantee may be provided in the form of a cash bond, irrevocable letter of credit, certified check, or similar instrument acceptable to the City Attorney in an amount equal to 125% of the estimated cost of purchase and installation of required landscaping.

1.2 Species Selection

Selecting the right tree for the right place is critical to ensure tree health and limit future conflicts with infrastructure. Appendix A lists approved species suited to Littleton's current and future climate. Species on Littleton's prohibited species list may not be planted on City property are described in Appendix B. Other site factors must also be considered when choosing a tree for different location types, such as within the City's Right-of-Way (Figure 1) or in an open space

such as a park or yard. Considerations include site-specific environmental conditions, exposure, surrounding utilities and other possible obstructions to root, stem, or crown growth, maintenance requirements, and availability at local nurseries.

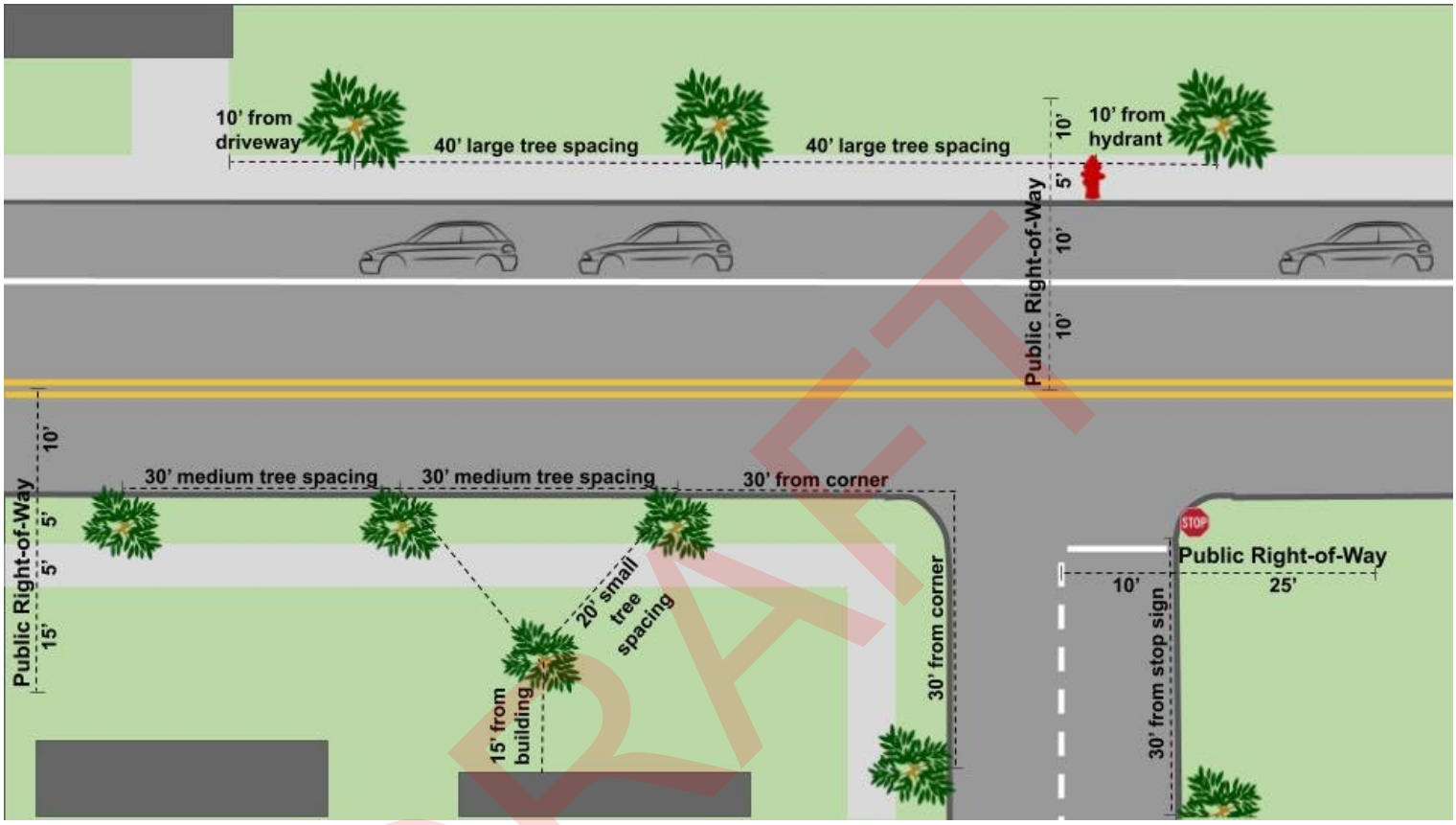
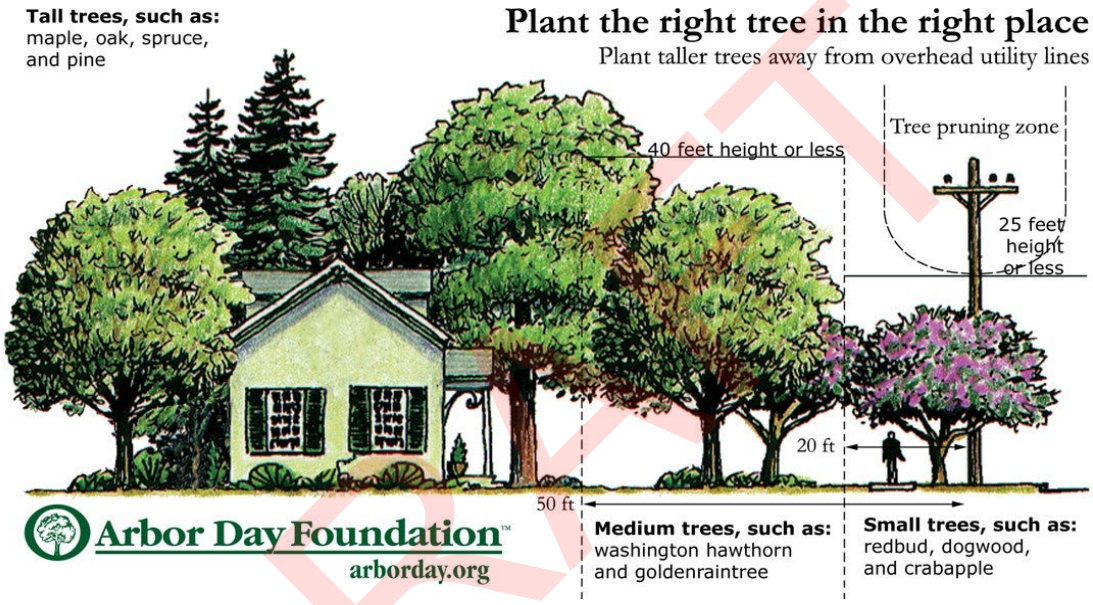


Figure 1. *Street layout depicting the typical ROW size and several minimum spacing requirement examples (see Table 2 for full list).*

The existing tree species growing in the area must be considered to support high levels of biodiversity in the urban forest. A diverse array of tree species ensures that no one threat can cause significant canopy loss of a street, in a neighborhood, or throughout the city. Different tree species also provide distinct benefits to the community and the ecosystem. An industry guideline recognized as ideal is to maintain tree species diversity at levels of no more than 5% of one tree species, 10% of one genus, and 15% of one family to promote a resilient urban forest (Table 1).

Table 1. Example family, genus, and species.			
FAMILY (15%)	Sapindaceae		
GENUS (10%)	*Acer*		*Koelreuteria*
SPECIES (5%)	*saccharinum*	*rubrum*	*paniculata*
COMMON NAME:	Silver maple	Red maple	Golden rain tree



1.3 Substitutions

The following substitution of tree planting requirements may be made:

- **a.** *Large Deciduous Tree.* No substitution options available.
- **b.** *Ornamental Deciduous Tree.* One tree shall be substituted in place of five required shrubs.
- **c.** *Coniferous (Evergreen) Tree*. One tree shall be substituted in place of one required large deciduous tree.
- **d.** *Ornamental Grasses*. Three ornamental grasses shall be substituted for one required shrub.

1.4 Tree Stock

Trees planted shall meet or exceed ANSI Z60.1-2004: *American Standard for Nursery Stock* at the time of planting. All trees are required to have been grown for a minimum of two growing seasons within 150 miles of Littleton. City staff may inspect tree stock selected for planting on City property to approve or reject prior to installation.

The following must be considered when selecting quality stock:

- Caliper – tree shall have a minimum 2-inch caliper, as measured 6 inches above grade
- Root ball size and quality – tree shall be centered in the root ball
- Trunk flare condition and location
- Crown shape and branching structure – shall be fully representative of its species in shape and form
- Branching form
- Damage to trunk or branches
- Foliage color and density, signs of significant stress, insects, or disease

Trees shall be protected from crown and root damage and wind during transport. The root ball must remain moist until the date of planting.

2. Location Selection

2.1 Location Standards

Public Right of Way. For encroachments within the Public Right-of-Way, a permit or approval shall be obtained prior to planting any street tree or landscape material, including required streetscape plantings. All plantings shall comply with Title 8, Public Ways and Property, and this Tree Manual.

Sight Triangle. No landscaping may be planted in violation of the city's sight triangle requirements, as set out in Subsection 10-1-3.9.C, Vision Obstruction or in areas where there is a substantial likelihood that the mature form of the tree would have to be materially compromised in order to maintain sight triangles.

Easements. Trees shall not be placed within any public utility easement.

2.2. Soil Volume and Type

The following **minimum** soil volumes, by mature tree size, are recommended:

- Small Trees: 300 cubic feet
- Medium Trees: 600 cubic feet
- Large Trees: 1,000 cubic feet

These are **minimum** soil volumes – the amount of uncompacted soil for trees to grow should be as large as possible.

Streetscape redesign and infrastructure replacement projects provide an ideal opportunity to incorporate trees and adequate soil volume into the planning and design phases. There are also technologies to assist in maximizing rooting space available for trees.

Soil pH, structure, texture, density, nutrients, and percolation should be assessed prior to planting. Drainage must be adequate for the species being planted. Solving drainage issues is essential for long-term tree health, as saturated soil restricts the tree root's ability to access oxygen necessary for growth and survival. Methods for addressing drainage issues include:

- If a well-drained layer of soil exists beneath a poorly drained layer, drill a vertical hole through the poorly drained layer and fill it with gravel or coarse sand to provide a path for water to flow to the well-drained layer.
- Use a perforated pipe or other product designed to create drainage channels. This approach works well for trees on a slope – a 3-inch fall per 100 feet of pipe is the minimum slope needed for adequate water flow.
- If excess water cannot be drained away, it is best to choose a species tolerant of poorly drained soil or to forgo planting at the site.

2.3 Locate Underground Utilities

The location of utilities and other below and above ground obstructions must be assessed prior to planting. Prior to any digging, 811 is required to be contacted to locate any underground utilities in the area of planting. Contact Colorado 811 by calling 811 or visiting their website at Colorado811.org. If planting on City property, irrigation location is required per City protocol. Representatives or Contractors of the utility companies will visit the site and mark the location of underground utilities to highlight any conflicts that may exist. Adjust planting location based on minimum distance recommendations (Table 2).

2.4 Assess Planting Space

Table 2 lists the minimum distances required for trees to be planted away from varying infrastructure. It is critical to also assess distance from nearby road signage to avoid future obstruction.

Table 2. Required minimum distances from tree trunk.

Object	Min. distance from center of trunk
Stop sign/red light	30 feet
Traffic signs (speed, yield)	20 feet
Street signs (parking, sweeping)	10 feet
Streetlight or utility pole	20 feet
Existing wall, fences, signs[1]	10 feet
Alley, driveway, or other vehicular entrance	10 feet
Crosswalk	10 feet
Corner of street intersection	30 feet
Fire hydrant	10 feet
Building	15 feet

Underground utilities	10 feet
Storm Drain	15 feet
Small Cell Technology	30 feet

Footnote [1] – Not applicable to those existing walls, fences, and signs within the DNR, DTA, DMS, and DMU zoning districts.

2.5 Distance from Utilities

Trees that mature to a height greater than or equal to 25 feet shall not be planted underneath or within 20 feet of any overhead utility to avoid future conflict. Further, no trees, except those approved by the city, may be planted over or within ten (10) lateral feet of any underground utility line (i.e. water, sewer, transmission etc), as required by the owner of the utility, or as required by any specific easement over the proposed planting area.

2.6 Tree spacing

Distance between existing and planned trees must be assessed before planting (Table 3). When choosing planting locations of public trees, trees growing on private property must be considered to avoid crowding and future conflicts.

Table 3. Minimum distance required between trees.

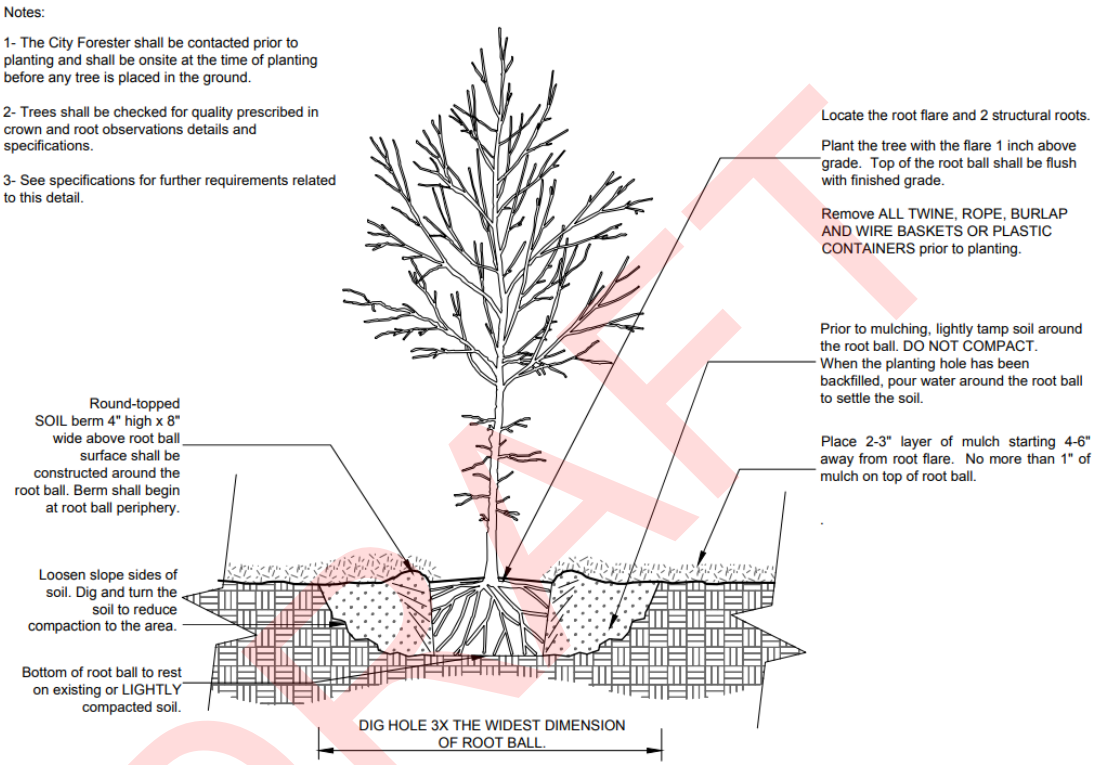
Tree size (height at maturity)	Minimum spacing distance
Large (>45 feet)	40
Medium (31-45 feet)	30
Small (≤30 feet)	20

2.7 Tree Delivery and Storage

All trees must be tarped during transport to the planting site. Trees shall be offloaded using appropriate machinery or by hand. Trees shall NOT be dropped any distance from the truck or trailer to the ground. Trees may not be delivered to the planting site more than 48 hours prior to planting. All trees delivered must be planted within 48 hours of delivery. Trees stored on site during this time must be located so as not to endanger the public and be separated physically from other nearby construction activities. Trees will be watered as needed while awaiting planting.

3. Tree Planting

The Contractor shall provide all trees and all necessary hardware, materials, labor, tools, and equipment required to properly complete the work. The Contractor shall ensure at least one licensed arborist is present at all times during the tree planting and who shall be thoroughly familiar and knowledgeable with the best practices for proper delivery, handling and installation of the type of trees being planted.



3.1 Identify Trunk Flare

The trunk flare is where the tree's trunk expands to form roots. The flare's location determines the depth of the planting hole, making its identification a critical first step. It can be found by identifying the highest non-fibrous root, which can often be found buried underneath soil. If this is the case, the soil above the trunk flare shall be removed.

3.2 Prepare Hole

The depth of the hole shall be from the bottom of the trunk flare to the bottom of the ball and shall not exceed the depth of the root ball. Planting too deeply deprives the tree of oxygen, causing stress and the potential for the growth of unsupportive adventitious roots. The soil directly beneath the root ball should be undisturbed or compacted to prevent settling. The width of the hole should be at least 1.5 times the width of the root ball, and wider in poor-quality soils. The sides of the planting hole should be loose soil, which can be achieved using a shovel. If holes are dug with an auger, hand tools must be used to break up glazing on the sides of the hole.

3.3 Prepare Tree for Planting

The tree shall not be removed from its container by pulling its trunk, but rather by bending, wiggling, or cutting the container. Fabric and burlap should be cut away after being placed in the hole.

Inspect the tree’s roots. Prune any girdling roots growing around the trunk flare, fibrous roots above the trunk flare, or circling roots that cannot be straightened, removing no more than 20% of the roots. To avoid moisture loss, do not leave the exposed root ball out for an extended period of time, especially in direct sunlight. Inspect the crown, pruning any dead or damaged branches.

3.4 Place the Tree

Place the tree in the hole, ensuring that it is centered, then check that the bottom of the trunk flare is at or just above grade. Add or remove soil beneath the root ball as needed to align the bottom of the root flare with grade. Always move the tree by its root ball to avoid damage to its roots.

3.5 Fill Hole

Stabilize the root ball by tamping soil firmly around its base. Add the remaining backfill soil in layers, about 6 inches at a time. Lightly tamp or thoroughly water each layer to limit future settling and prevent air pockets. If the soil is dry, apply water after each layer is tamped. Backfill shall not be compacted to a density that inhibits root growth. Backfill soil should be similar to the soil at the planting site or amended if needed. Organic amendment incorporated should not exceed 10% by volume.

3.6 Build Berm

Build a berm circling the outside edge of the root ball with the remaining soil. The berm must be a minimum 3 inches high and 3 inches wide. This structure will encourage water to stay close to the root ball and will act as a barrier from lawnmowers and foot traffic. Berms should be monitored routinely and weeded or rebuilt as needed.

3.7 Stake Tree as Necessary

Trees establish more quickly and develop stronger root systems and trunks without stakes. If the site is windy or vandalism is a concern, stake tree with two wooden stakes placed on opposite sides of the tree outside of the root ball, or as agreed upon with the Director prior to the tree planting date. Attach jute webbing to the stake and around the tree. Ties should be loose enough so the tree crown moves up to three times the trunk diameter in the wind, in order to develop a strong taper, and taut enough that the trunk cannot rub the stakes. Stakes and straps should be consistently adjusted as needed and removed after 1-year or one full growing season. Straps that are tied around the trunk too tightly or are left on the tree too long may girdle fast-growing young trees. Damage caused by improper placement or use of stakes/straps may require replacement of the tree.

3.8 Water

Using low water pressure, apply water until the root ball is thoroughly moist immediately following installation. Lawn sprinklers are not an acceptable method of irrigation for newly planted trees; hose, soaker hose, or bucket are recommended to ensure deep-root watering. Stationary watering methods, such as gator bags or Tree Diapers®, may be considered as a long-term watering method, following the initial hand-watering immediately after planting.

Providing adequate water to young trees is the single most beneficial action that can be taken to ensure establishment. Trees require consistent, thorough watering for at least three years after planting. Underwatering or overwatering trees often causes irreversible damage, so it is recommended to test the soil's water holding capacity in order to establish an effective irrigation plan. However, the amount and frequency of watering will change with species, soil type, seasons, and stage of establishment, making it important to check moisture levels continually. In hot summer months, up to 10 gallons of water per caliper inch may be needed, while that amount can typically be reduced by 50% in cooler months.

3.9 Mulch

Apply organic mulch 2-4 inches deep over the filled hole and berm, leaving 5 inches around the trunk clear from mulch to avoid excess moisture against the trunk. Mulch shall be free of any extraneous material such as soil, stones, plastic, construction debris, or any other deleterious matter. Replenish mulch as needed to keep soil moist, nutrient-rich, and temperature regulated. Do not exceed 4-inch depth of the mulch.

4. Post-Planting

Upon completing the tree installation, the entire area must be cleaned up to leave a neat and orderly appearance free from debris and other materials. Post-planting care should consist of watering, mulching, integrated pest management, soil management, and adjustment and removal of stakes. Formal written acceptance from the Director is required within 30 days of tree installation, stating that tree(s) were properly planted in accordance with the specifications.

SECTION II: TREE MAINTENANCE

Providing newly planted trees with proper tree care and maintenance is crucial for their long-term health and survival. Contractors providing tree maintenance work for the City of Littleton are required to follow the specifications outlined below, as well as conform to the safety specifications of the ANSI Z-133.1 *Safety Requirement for Pruning, Trimming, Repairing, Maintaining, Removing Trees, and for Cutting Brush*. All maintenance performed on City property must be recorded in the City's maintenance log (Appendix C) to be submitted to the Director.

1. Monitoring

Each tree under a Contractor's purview shall be consistently monitored (weekly during growing season and monthly during dormant season) during its two-year establishment period for declining health and signs of pests and diseases. Monitoring a tree's condition allows for proactive care to address the identified issues, such as adjusting water levels for drought-stressed trees, pruning a damaged branch before it peels off the trunk's bark, or providing Integrated Pest Management for trees affected by a pest.

If treatment for pests or diseases is required, the Contractor shall use least invasive methods, and must have the City approve any chemical pesticide application in advance. If an issue is identified which suggests that a tree should be removed, the Contractor must notify the Director of the problem and wait for their decision before resuming work on that tree.

2. Irrigation

See *Section IV* for tree watering specifications.

3. Berm and Mulch

Berms should be monitored routinely and rebuilt as needed to retain water close to the tree's critical root zone and act as a barrier to foot traffic and lawn mowers. Berms should be a minimum of 3 inches high and 3 inches wide and must be kept clear of unwanted vegetation and other debris. Unwanted vegetation must be removed by hand; chemical weed control is not permitted for use on or around City-owned trees. The use of chemical weed control is subject to a fine, as outlined within the Littleton City Code.

Mulch is very important for retaining moisture in the soil, improving the soil biology, regulating soil temperature, and reducing weeds. Mulch should be replenished within the berm as needed to maintain a layer 2-4 inches deep, leaving 5 inches around the trunk clear from mulch to avoid conditions favorable to decay, disease, and insects.

4. Pruning

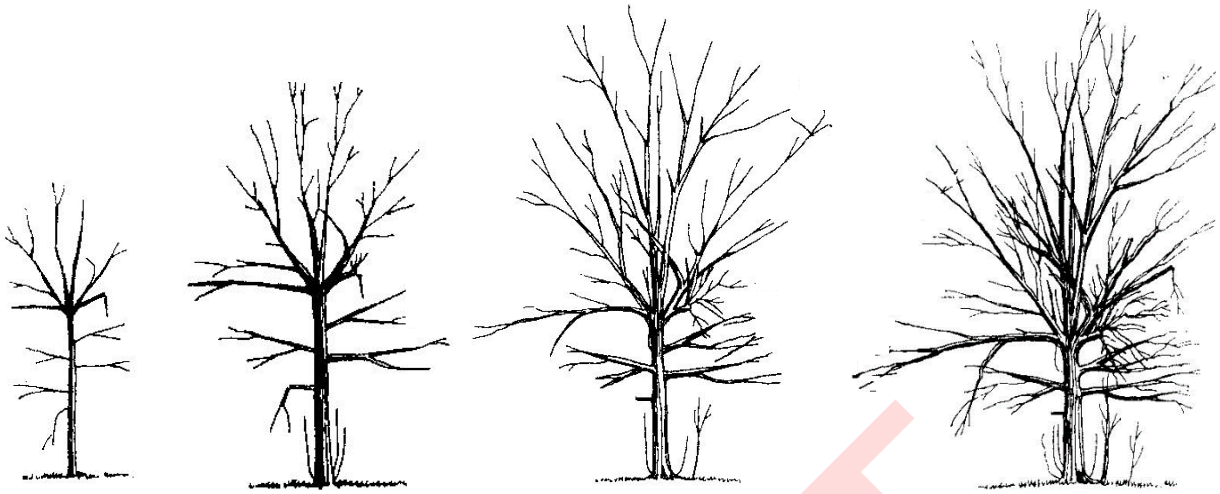
Young trees need periodic pruning to develop good form and branching structure – reducing future public safety risks and increasing the tree's longevity (Figure 2). All pruning of the City's trees must be performed by a licensed arborist and shall be in accordance with the latest revision of ANSI A300 *Standard Practices for Trees, Shrubs, and Other Woody Plant Maintenance.*

Pruning should be kept to a minimum for the first year after tree installation to allow the tree to use its existing foliage to manufacture carbohydrates for growth. In order to structurally prune a young tree, the first step is to identify the stem that will make the best dominant leader. Although there may be several options, the selected leader should be centered and upright, and free of damage or other defects that could compromise its strength. The leader's identification steers the following pruning decisions, as branches and stems in competition should be removed or subordinated. Competition includes stems similar in height, and stems and branches that are larger than half the diameter of the trunk.

Scaffolding must be considered, making sure to remove branches that are clustered together and growing from the same point on the trunk, or are crossing. The ideal spacing between branches on young trees is 4-6 inches. Temporary branches may be retained along the trunk of young trees to encourage taper and protect trees from vandalism and sun scald. They should be pruned annually to slow their growth and should be removed eventually.

Trees should be pruned of all dead, diseased, and dying branches in addition to their structural pruning. No more than 20% of the living crown of an individual tree shall be removed. A sharp handsaw or pruners shall be used, and must be cleaned thoroughly with alcohol, hydrogen peroxide, or chlorine bleach before pruning. In the case of trees known to be infected with diseases such as ceratocystis, hypoxylon canker, oak wilt, or verticillium wilt, the tool must be cleaned after each cut. Treatment of cuts and wounds with wound dressing or paints has not been shown to be effective in preventing or reducing decay and shall not be used.

All cut limbs shall be removed from the crown upon completion of the pruning. Clean-up of branches, logs, or any other debris resulting from any tree pruning shall be promptly and properly accomplished. The work area shall be kept safe and under total control of the Contractor at all times until the clean-up operation is completed. Under no condition shall the accumulation of brush, branches, logs, or other debris be allowed upon a public property in such a manner as to result in a public hazard.



At Planting **After 3-4 Years** **After 5-7 Years** **After 15 Years**

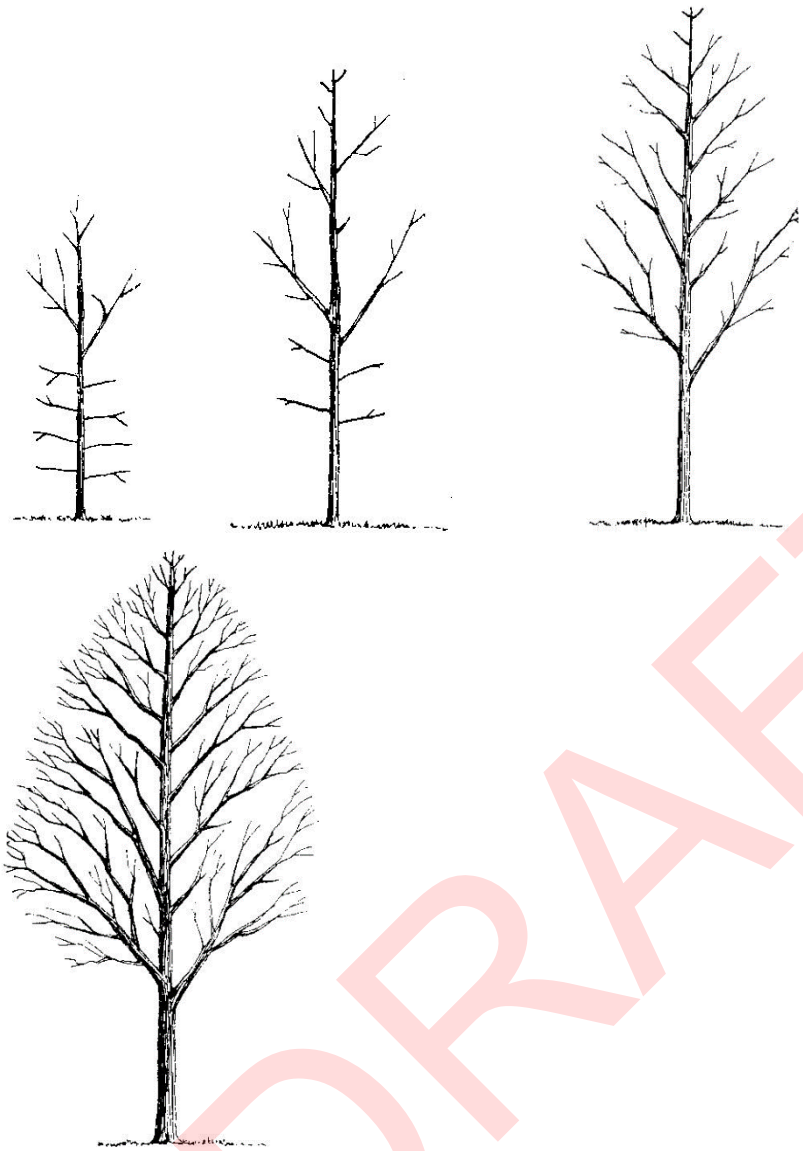


Figure 2. The benefit of structurally pruning a tree from a young age. Image Source: Tree City USA Bulletin.

5. Fertilization

Although fertilization is not required during establishment, it may be beneficial to a tree's condition, appearance, and ability to withstand drought, minor insect and disease issues, and other stresses. Newly planted trees are encouraged to develop a healthy root system when fertilized, allowing them to retain water. However, fertilizer may not be applied directly to newly planted trees for the first year of establishment. All fertilizer used on City-owned trees must be organic.

6. Stakes

Stakes should provide support for young trees while not inhibiting them from moving in the wind and developing trunk taper and a stable root system. The Contractor shall monitor the efficiency of installed stakes and guying material, adjusting and removing as needed. Typically, stakes may be removed after 1-year or one full growing season once they are capable of supporting themselves.

SECTION III. TREE WARRANTY

Formal written acceptance from the Director is required both:

- Within 30 days of tree installation, stating that tree(s) were properly planted in accordance with the specifications of the Tree Manual.
- At the end of the two-year establishment period, stating that tree care and maintenance has been completed by the Contractor in accordance with the tree specifications outlined in this manual and in the contract specifications.

The Contractor must provide a financial guarantee (cash bond, letter of credit, certified check, or similar instrument) to the City prior to the start of establishment care in an amount equal to 125% of the estimated cost of purchase and installation. Within this two-year establishment period, the Contractor will be responsible for any tree failure, except that caused by vandalism. A tree may be determined to be failing if it is showing less than 75% healthy growth, does not have the natural character of its species, or has a dead leader. This guarantee will require the Contractor to remove and replace any trees that die or are failing within the first two years after installation per the Director's judgment, at no additional cost to the City, as well as forfeit their performance bond. The City should be notified as soon as a tree dies, and replacement should occur immediately, or at the start of the next planting season if the tree dies out of planting season.

The City has the right to inspect trees during this period and request additional maintenance or an altered maintenance schedule. The Contractor must notify the City in writing if maintenance appears to not be sufficient in caring for the trees and needs adjustment.

At the end of the warranty period, the Contractor and the City will meet to inspect the plants to determine if they are acceptable. The City will prepare a list of any necessary maintenance actions for the Contractor to complete, continuing the maintenance period at no additional expense to the City. When the deficiencies are corrected to the City's satisfaction, or if there are no actions needed, the City will issue a written notice that the warranty period has ended and release any financial guarantee . In the event that deficiencies have not been corrected, the city will retain financial guarantee for each tree not replaced during this warranty period.

Once the trees' condition has been deemed acceptable, the Contractor must meet with the City to formally transfer the responsibilities of maintenance. The Contractor must provide all information on past maintenance activities and provide a list of critical tasks that will be needed over the next 12 months.

SECTION IV: IRRIGATION STANDARDS

Properly watering trees, turf, and other vegetation is essential to their survival. Contractors conducting irrigation for the City of Littleton shall be fully responsible to provide adequate water to all vegetation from the point of installation until the date of final acceptance and shall furnish all labor, equipment, materials, water, tools and supervision to perform tree watering as described herein.

1. Safety

Contractors providing tree maintenance work for the City of Littleton are required to follow the specifications outlined below, as well as conform to the safety specifications of the ANSI Z-133.1 *Safety Requirement for Pruning, Trimming, Repairing, Maintaining, Removing Trees, and for Cutting Brush*.

Hoses and other watering equipment must not block walking paths or be placed in a manner that may create tripping hazards. The Contractor must use standard safety warning barriers and other procedures as necessary to ensure the site is safe at all times for any vehicle or pedestrian passersby.

2. Acceptable Methods of Irrigation

There are several methods of irrigation considered acceptable by the City. Irrigation plans must be approved by the Director or their designee prior to a project start date. Watering services are to be performed according to the following specifications for each acceptable method of irrigation:

- Irrigation bags (preferred)
    - Irrigation bags wrap around the bottom half of a tree's trunk or sit on top of tree's basin in a doughnut shape.
    - Bags must have a capacity of at least 15 gallons and no more than 20 gallons of water and be made of durable PVC tarpaulin material. Bags must be approved by the Director.
    - At the end of the watering period the Contractor shall remove all watering bags for winter storage. Bags must be removed upon termination of the contract.
    - At the time of watering, both the drip irrigation bag and the tree basin shall be filled to capacity.
- Hand-watering
    - Consists of a simple hose and manual shut-off valve. Water can be directly placed where needed and shut-off to prevent over-watering and run-off.
- Drip irrigation pipes
    - Perforated flexible pipes or hoses laid directly around the root zone soaks soil from the ground-level. Water pressure is controlled by emitters; the number of emitters used for each plant and the flow rate for each emitter will depend on the size of the tree.

- Bubblers
  - *Subsurface bubblers*. A 12 - 36-inch perforated mesh tube delivers water below-ground while allowing water, air, and nutrients to bypass compacted soil and directly reach tree root systems. An added benefit is that it provides excellent aeration, which helps release trapped gases that may increase plant stress.
  - *Above-grade bubblers.* Similar to subsurface bubblers but without the aeration tubes. They are often used with existing trees to avoid damage to an established root zone during installation. Because they are placed above grade, they can be easier to maintain than below-ground bubblers.
- Sprinkler systems
  - The use of sprinkler systems is only allowable for turf or groundcover irrigation.

Automatic irrigation systems are the only options acceptable for trees, turf, or other vegetation planted as a part of new development construction.

3. Irrigation Requirements

In general, the watering season is from May 1 through October 31, or at the discretion of the City, and during long periods without precipitation in the winter months upon request of the Director. It is the responsibility of the Contractor to make adjustments in watering frequency and duration depending on plant species, soil type, and weather as approved by the Director. All installed plants that are injured or damaged due to the lack of water, or the use of too much water, shall be the Contractor's responsibility to correct.

3.1 Trees

Newly planted trees shall receive 10 gallons of water per inch of trunk diameter once weekly during the watering season. The tree watering basin must be maintained to a height of 3-4 inches high along the perimeter of the planting hole and kept free of weeds and debris.

3.2 Turf

Develop a suitable watering schedule for each zone and program the irrigation clock to accommodate each zone’s specific needs. The system shall be zoned to allow for efficient watering of turf areas with different slopes, orientations, and exposure. A typical range of irrigation suitable for turf in Littleton is ¾ to 1 inch of water weekly, although Kentucky bluegrass lawns may require 2.5 inches of water or more per week during the heat of summer.

During the growing season, after each lawn mowing, inspect irrigation heads and systems to ensure that all components remain accurately aligned and no damages have occurred during the mowing operations. Keep grass cut shorter directly around irrigation heads to prevent spray blockage.

3.3 Other Vegetation

Other vegetation, such as annual or perennial flowers, shrubs, and landcover, highly vary in their required irrigation. Each plant species' water requirements must be identified and irrigated to the following guidelines:

- *Xeric perennials:* 1 gallon per week after installation, extending the time between watering once established.
- *Moderate water use perennials and annuals:* 2 gallons per week.
- *5-gallon shrub:* 4 to 6 gallons weekly.
- *Larger shrubs*: 10 to 12 gallons weekly.

4. Water Conservation

The following water conservation methods must be adhered to by all Contractors performing irrigation for the City of Littleton:

- All irrigation methods shall be designed to provide only the water required to sustain the plants and vegetation.
- A rain and/or moisture sensor and shut-off equipment shall be required on automatic irrigation systems.
- Non-potable or reclaimed water shall be used in an irrigation system when available.
- Do not spray on concrete and asphalt or allow water to collect in gutters, streets, and alleys.

5. Watering Log

The Contractor shall provide the Director with a schedule of planned watering before each watering season for approval. The watering schedule shall include details on the order in which the trees will be watered, the volume of water that will be provided to each tree during each visit, and the irrigation methods to be used.

The City will provide a template for a weekly log for the Contractor to record all irrigation activities throughout the watering season (Appendix D). The log shall be updated daily and list the plants watered by Maintenance Zones designated by the City. A copy of the log, which shall be maintained in digital format, must accompany invoicing for tree watering services by the Contractor and submitted during the first week of the month.

6. Annual Maintenance

6.1 Watering season start

Inspect and test all system components to verify they are in appropriate working condition. Check the automatic timers, sensors, gauges, heads, valves, filters, mainlines and tubing if applicable.

6.2 Watering season

All irrigation systems must be monitored throughout the watering season to identify any damage, inefficiencies, or adjustments needed to increase the survivability of the trees, turf, or other vegetation. The Contractor is responsible for notifying the Director of any issues regarding the irrigation system that may cause decline of the plants' health.

6.3 Watering season close

All irrigation systems and equipment must be expelled of water at the end of each watering season. The systems should be manually blown out with pressurized air.

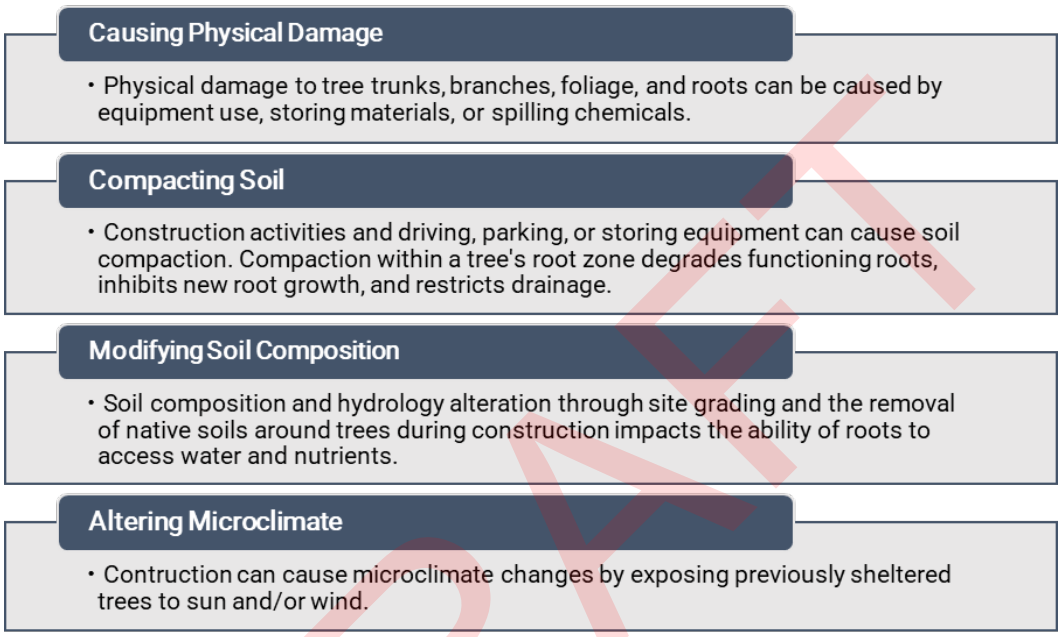
7. Repairs

The Contractor will verify that all installed irrigation systems are in good working condition and will be responsible for making repairs in a timely manner. The Contractor must provide continued and consistent watering with their own equipment as the irrigation system is repaired. If a repair is identified outside of the watering season, the repair must be completed before the start of the watering season.

All irrigation repairs must be made by a licensed irrigation contractor; completed repairs must be viewed by City staff before burial. A separate invoice must be submitted to the City outlining a detailed description of the repair work performed. However, the Contractor is responsible for the cost of repair and/or replacement of all irrigation system materials (e.g., equipment, irrigation bags) and trees that are damaged during tree watering.

SECTION V: TREE PRESERVATION & PROTECTION

The standards detailed in this document are intended to preserve, protect, and maintain Littleton's existing trees to enhance local ecology through the filtering effect of trees on air pollutants, provide noise reduction, prevent topsoil erosion, provide habitat for birds and other wildlife, provide windbreaks and shaded areas, and increase property values by adding to the aesthetic quality of land.



All new development, redevelopment, and substantial improvement, including construction activities within the City of Littleton, must adhere to the standards set forth in this Tree Manual, and state and local laws and regulations as they apply. The following information aims to guide development activities within the City of Littleton in properly protecting trees according to industry standards and City regulations. The Tree Manual also provides for the retention of existing tree canopy and the replacement of damaged or removed trees for existing developments.

1. Planning and Design Requirements

The entity conducting construction work (henceforth referred to as the Contractor) shall be solely responsible for judging the full extent of the work requirements, including, but not limited to any equipment and materials necessary for providing tree protection. Every effort must be made to include existing, healthy, mature trees and shrubs in the landscape design, unless otherwise approved by the Director if it is proven that the site development demands it. The following steps must be taken prior to construction. Development sites shall be configured to meet the tree canopy and landscape requirements outlined herein.

Existing Landscaping. Every effort shall be made to incorporate existing, healthy, mature trees and shrubs into the landscape design. Existing trees and other plants in reasonably healthy condition may be removed only if the owner or developer has satisfactorily demonstrated to the Director that site development constraints necessitate their removal. New development shall follow the requirements outlined in Tree Protection Zone below. Private open spaces, detention ponds and drainage channels not designated as natural areas shall be designed and landscaped in such a manner to complement on-site and adjacent landscapes.

1.1. Plant Material Size

All required plants shall meet the size and type requirements in Table 4 below, *Minimum Plant Sizes and Types*.

Table 4 Minimum Plant Sizes and Types	
Plant Type	**Minimum Size**
Large Deciduous Trees	2.0-inch caliper[1]
Ornamental Deciduous Trees	1.5-inch caliper[1]
Coniferous (Evergreen) Tree	6-feet in height (dwarf pines such as Mugo - 24' branch spread)
Shrubs (Evergreen and Deciduous)	5-gallon container
Ornamental Grasses	1-gallon container
Organic Materials	
Rock or Stone	3/4-inch, minimum 3.0-inch depth[2]
Mulch or Compost[3]	organic and shredded
Table Notes: 1. Measured six inches above the soil line. 2. Requires water-permeable landscape fabric except where horizontally spreading shrubs or ground covers are planted. A nonpermeable landscape fabric shall be permitted if the building foundation design requires soil moisture protection at the perimeter. 3. Mulch or compost shall be fibrous so that they bind together to prevent erosion. 4. Rockscaping shall remain a minimum of ten (10) inches away from any tree stem.	

2. Tree Canopy

2.1 Minimum Standards.

Generally, tree canopy coverage shall include all areas on a lot that are within the CRZ of existing trees and the dripline of newly planted trees at a maturity of twenty (20) years. Notwithstanding the foregoing, the tree canopy coverage requirements for the MFR, NC, CM, and BC districts are set forth in Subsection 10-1-3.6.E of the Unified Land Use Code.

An exemption from tree canopy coverage requirements may be granted by the Director if the following standards are met. A request for exemption shall be accompanied by written, graphic, or photographic explanation to enable proper evaluation, review, and decision.

1) Topography, lot limitations, or other lot conditions are such that compliance with the requirements is impossible or impractical;
2) The tree canopy coverage requirement cannot reasonably be met because of a lack of rooting space or soil volume to accommodate healthy tree growth;
3) The planting of additional trees will require removal of existing pavement used to meet other Code requirements; and
4) The exemption is the minimum necessary to meet these standards.

2.2 Retention of Existing Tree Canopy.

For Multi-Family, Non-Residential, and Mixed-Use Development, where not otherwise specified in Table 5, all lots subject to these standards shall retain existing tree canopy as follows:

i) To the maximum practicable extent, specimen trees should be retained; and
ii) Existing trees retained shall be designated within a fenced tree protection zone established prior to construction or work activities.

For Single-Family Detached and Attached Development, where not otherwise specified in Table 5, all lots shall retain existing tree canopy as follows:

i. At least one tree per lot and for every 40 linear feet of lot frontage;
ii. Retained trees shall be located within a front or corner side yard; and
iii. Each retained tree shall have a minimum DBH of two and one-half inches.

Developments, as referenced above, shall retain a portion of existing specimen trees as outlined in Table 5 below. On lots without the required percentage of existing tree canopy coverage, the applicant shall plant trees in order to achieve the required tree canopy coverage prior to the issuance of a certificate of occupancy.

Table 5: Retention of Specimen Trees	
Specimen Trees Per Acre	**Existing Specimen Trees to be Preserved**
less than 3	80%
3 to 5	65%
6 to 8	50%
9 or more	4 per acre
Table Note: In the case of calculation resulting in a fraction, the required number of specimen trees to be preserved shall be rounded up to the nearest whole number.	

Details of all specimen trees shall be provided within any required landscape plan.

2.3 Tree Canopy Coverage Credit

The preservation and protection of existing trees on a lot may be counted toward the canopy coverage requirements provided the tree is healthy and undamaged. Credit shall be calculated using the dripline of existing, preserved trees, as measured and included on the landscape plan.

i. Historic and specimen trees may be credited two times the area of the critical root zone as determined by a licensed landscape architect or arborist.

ii. Existing trees to be preserved may require a form of security prior to permit issuance. If security is required, the amount shall be equal to 125% of the estimated replacement cost of the existing, preserved trees used to meet the tree canopy coverage requirement. If an existing tree shown on the landscape plan as a preserved tree does not survive within the first year following issuance of a certificate of occupancy, mitigation is as set out in Section 5 herein.

3. Coordination

Engineering and design project teams shall work with the property owner or Contractor at the project's initial design stage. Review for compliance with the Tree Manual shall take place during review of the following applications: a) site plan or master development plan; b) major modification of a site plan or master development plan; c) grading permit; d) final plat; or e) building permit.

The following tree removal activities are exempt from review:

1) Removal of “for sale” trees at a plant nursey or botanical gardens;
2) Removal of trees that post a risk of immediate danger to life and property due to an accident, fire, storm, or other act of nature;
3) Removal of diseased or dying trees as determined by a certified arborist, with written notice to be sent to the Director, or assigned designee, with at least ten (10) days in advance of removal;
4) Selective and limited removal or pruning of trees or vegetation necessary to obtain clear visibility within sight triangles as outlined in Subsection 10-1-3.9.C, Vision Obstruction; and
5) Removal of exotic, invasive, or prohibited tree species.

No land clearance, site grading, removal or stockpiling of soil, or tree removal may be performed on a lot or parcel within the city until a Building Permit, Grading Permit, Site Plan, Master Development Plan, or Subdivision Plat is approved in accordance with Title 10, ULUC, and in accordance with Title 7, *Health and Sanitation*; Chapter 7, *Littleton Storm Drainage Ordinance*. Any land clearing or grading required by the Storm Drainage Manual or excavations for utilities with an approved sewer/utility permit is permissible.

The Contractor shall retain the services of a City Licensed Arborist, Irrigation Specialist, and Restoration Specialist, all with demonstrated experience in construction protection. Prior to start of work, the Contractor shall submit the names and certification numbers of the licensed arborist, Irrigation Specialist, and Restoration Specialist to the Director for approval.

3.1 Initial Site Visit

The Contractor and Arborist shall walk the site with the City Engineer and Director, or their assigned designees, to identify potential tree impacts, trees of special concern for preservation, and trees that are in poor/dead condition that will require removal.

3.2 Tree Survey & Site Assessment

A plan sheet with existing tree conditions shall be provided to the Director prior to any tree clearing, development or land-disturbing activity. The following shall be included in the existing tree conditions plan sheet:

- Limits of project disturbance
- All trees in the construction area shall be inventoried, with the exception of wooded areas, where trees 4-inches or greater diameter at standard height (DSH - 4.5-feet from the ground) shall be inventoried.
- For each tree the following information shall be collected: tree tag number or tree inventory number, location (GPS, map reference, coordinates), species (common and botanical names), size (DSH) and condition (Table 6), and suitability for preservation.
    - Each tree shall be given a numerical value ($) by the Director prior to the start of work based on its size, species, condition, and significance. If a tree is killed during the construction process, the Contractor must pay this value into the City's Tree Fund that shall be used for increasing Tree Equity in the City.
    - Each tree shall be numbered and tagged with one of the following:
        - Small, metal numbered tag affixed to tree trunk with an aluminum nail for any project that may take longer than one-year to complete from the date of tree inventory.
        - Flagging tape with the tree number written on it with permanent/non-fading marker for projects that will take less than one year to complete.
- Tree survey data shall be provided in a chart on the site assessment sheet. For example:

Tree Tag #/ Tree Inventory #	Species (Botanical)	Species (Common)	Size (DSH)	Condition	Suitability for Preservation
35464	*Gleditsia triacanthos* f. *inermis*	Thornless Honeylocust	4"	Fair	Moderate
35359	*Quercus palustris*	Pin oak	13"	Fair	High
17230	*Acer campestre*	Hedge maple	3"	Poor	Low

- Tree surveys will be valid for 3 years.

Table 6. Example specifications of tree condition classifications. Condition = health and structure.	
Condition	**Description**
Good	Tree shows no major problems. There may be some dead twigs or small branches, minor scuffs in the bark that don't penetrate to the wood, or a slight disease/insect issue that are primarily cosmetic.
Fair	Tree may have some issues which are likely to improve with time or maintenance (e.g., dead branches >2" diameter that can be removed during pruning, minor trunk wounds that the tree can heal over time).
Poor	Tree shows no signs of life or has major issues that cannot be corrected with time or maintenance (e.g., large sections of dead canopy, decay cavities in the stem or roots).

3.3 Tree Protection Plan

All trees are to be protected unless otherwise approved for removal. The following requirements shall be included in the Tree Protection Plan. For detailed specifications to assist with tree protection plan development see Section 2 (Tree Protection Details, Specifications, and Requirements):

- Tree inventory data table
- Map identifying:
  - Trees proposed for preservation and location(s) of their tree protection zones (TPZ).
  - Identification of trees proposed for removal.
  - Location and description of protection measures required for reduced tree protection zones, if approved.
- Tree care and maintenance plan prepared by the Licensed Arborist with proposed activities to improve conditions before, during, or after construction (e.g., pruning to provide clearance, root pruning, mulching, irrigation)
- Required mitigation for trees to be removed, if applicable
- Language that addresses responsibility for tree damage mitigation, tree valuation, and tree replacement
- Location of the following:
  - Utility and drainage corridors
  - Grading and excavation
  - Material, soil storage and debris piles
  - Limits of disturbance/ equipment routes on site
  - Construction area access (exit and entry points)
  - Parking for construction and personal vehicles

    - Fueling, mixing, and concrete washout areas
    - Sediment control barriers (silt fence)
- Consequences for non-compliance

3.4 Permit Required

All city-managed projects will require a permit from the Director. To obtain a permit, the existing conditions plan and tree protection plan (1.3 and 1.4) shall be submitted to the Director for review. The Director shall review the plan to ensure that public shade trees are protected to the full extent feasible from damage during construction, street and sidewalk repair, utilities work above and below ground, and other similar activities.

4. Tree Protection Details, Specifications, and Requirements

All tree protection measures shall be installed prior to any construction activities beginning, including, but not limited to, site preparation, grading, grubbing, clearing, and staging activities. Tree protection measures shall be in place and inspected by the City of Littleton before any tree removal, stump removal, clearing, grading, excavation, demolition, or any other construction-related activities begins.

4.1 Tree Protection Zone (TPZ)- *Based on ANSI Standard 55.1*

A TPZ is an area established to prevent injury to a tree's critical root zone (CRZ), or the area extending from the trunk that encompasses the roots most vital to the tree's health (Figure 3). To determine the CRZ: the area under the dripline of the tree; OR the radius of the CRZ, measured from the outside of the tree trunk, shall be calculated as at least 1.5 feet for every 1 inch in trunk diameter measured 4.5' above ground (DSH), whichever is larger.

A TPZ shall be established and specified around all trees being retained and protected prior to any development, construction, or land-disturbing activities (other than survey work). The TPZ should be site-specific, defined based on species tolerance, expected impact of construction activities, tree size, age, and health, and the site's soil conditions (moisture, texture, density), however it is typically defined as the outline of a tree's CRZ (Figure 4), or a combined set of CRZ areas. TPZ shall be demarcated on a site plan, master development plan, construction plan, or building plan.

TPZs shall be located proximate to lot lines or site boundaries to ensure that retained trees will assist in limiting visual and auditory impacts from one form of development to another. TPZs associated with a single-family detached or attached development shall be located within an open space set aside or other unbuildable area.

In the case of street trees with limited space, the outline of a tree well or planter strip in a paved area may be the TPZ (Figures 5 & 6). The Director retains the discretion to extend or modify the TPZ at any time. When the minimum TPZ radius cannot be achieved, appropriate mitigation shall be recommended. TPZ barriers shall be installed in the specified locations with signs to alert contractors about the protected status of the TPZ.

The following activities are prohibited within the TPZ unless approved by the Director:

- Trenching, grading, excavation or digging;
- Root cutting;
- Storage of vehicles, construction equipment, debris, or soil;
- Exhaust or excessive heat directed towards trees' foliage, branches, or trunks;
- Foot or vehicular traffic;No impervious paving;
- Disposal of wash water, fuels, chemicals, or other harmful substances; and,
- Attaching signs to or wrapping materials around trees.

Figure 3. A proportionally accurate depiction of a root span of a tree, which extends well beyond the dripline of its canopy. Image source: Wroclaw University of Environmental and Life Sciences.

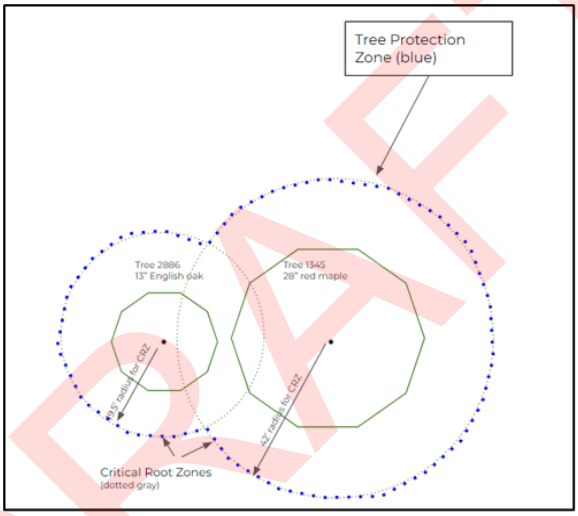


Figure 4. Standard CRZ and TPZ areas.

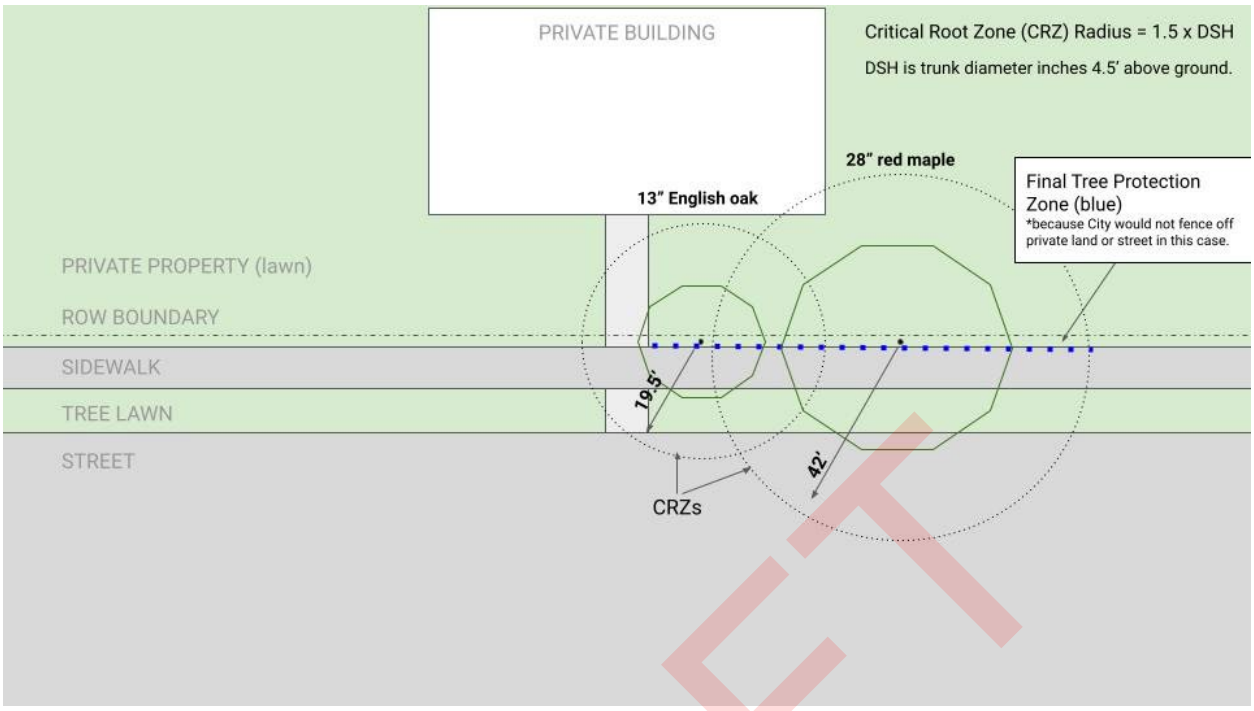


Figure 5. Scenario 1- CRZ and modified TPZ of a tree located in a Right-of-Way site abutting private property.

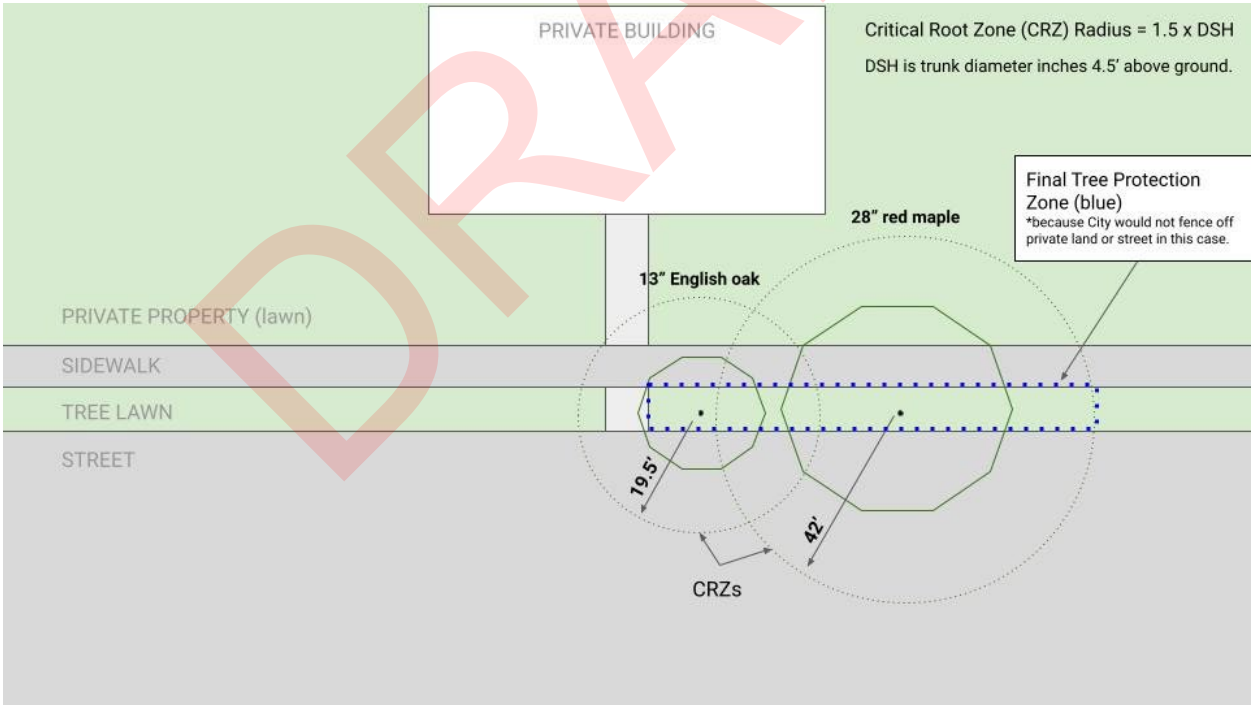


Figure 6. Scenario 2 - CRZ and modified TPZ of a tree located in a tree lawn within the Right-of-Way site.

4.2 Tree Protection Fencing

Tree fencing shall be erected before construction begins and remain in place until final inspection of the project. For street trees, fencing should be installed along the edge of the tree lawn or Right-of-Way that is unpaved.

- Plastic Fencing: A minimum 4-feet high, plastic, heavy duty snow/warning barrier fencing in high-visibility orange color. Fences shall be attached to posts with a zip tie at the top and bottom and shall have a minimum of three ties for a 4-foot-high fence or four ties for a 6-foot high fence.
- Posts: Safety fence posts not more than 8 feet apart, set or driven 1-1.5 feet deep into the ground without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to the City.
- Entrances: Access entrances/gates that are clearly marked with signage and are a different color than the tree protection fencing for visibility.
- Signage: Prominent signage displayed on each fence stating that entrance and removal of fence are prohibited without authorization. Signs shall be posted along the tree protection fence at regular intervals every 30-feet, or centered if the fence is less than 50-feet. DO NOT affix signs to trees themselves.

4.3 Protection of Historic Trees.

All historic trees shall be protected during construction activities with a fenced tree protection zone. If a historic tree is in healthy condition, it may only be removed if approved by the Director if the following standards are met: i) the historic tree prevents development in a way that limits the building area to less than otherwise allowed, or hinders compliance with the zoning district and development standards of this Code; and ii) mitigation is provided as set forth herein.

4.4 Protection of Credited Trees.

Existing trees being used for credit toward the landscaping requirements shall be fenced before grading or other development activity begins.

4.5 Erosion and Siltation Control

If a tree is in the immediate proximity to a grade slope of 8% (23º) or more, then approved erosion control or silt barriers shall be installed outside the TPZ to prevent siltation and/or erosion within the TPZ. The Contractor shall provide all labor, tools, equipment, and material required to install, maintain, and remove all siltation control measures shown on the approved plans, or at the direction of the contract officer.

4.6 Temporary Irrigation

Protected trees shall be cared for regularly during any construction related activities. The Contractor shall provide water for maintaining plants in the construction area that will have exposed root systems for any period during construction. Water each tree within the construction area where work is in progress to the depth of its roots, generally within the upper 6-18 inches of

the original soil surface. A temporary irrigation system with a specified operating schedule may be installed within the TPZ if included in the Tree Protection Plan.

Acceptable irrigation methods include above ground sprinklers, gator bags, bubblers, soaker hoses, injection of water into the soil, or flood irrigation with the creation of a berm. Irrigation should be continued until sufficient root growth has been shown. Trees should be monitored for signs of drought including leaf curling, wilting, leaf drop, early fall color, and dieback of branches or leader and mitigated with supplemental irrigation as recommended by the Arborist.

4.7 Tree Pruning

Prior to construction, it is recommended to remove dead, diseased, or dying branches to reduce the risks of limb failure. Crown raising may be necessary for construction equipment to gain access to an area; other options include lifting lower branches with ropes, cables or straps, or supporting with props. All approved pruning must adhere to the following standards:

- The Contractor shall retain the services of an licensed arborist to perform any cutting of limbs.
- All cuts shall be clean and executed with an approved tool.
- Wounds shall not be painted.
- If the type of pruning is left unspecified in the Tree Protection Plan, the standard pruning shall be 'crown cleaning' as defined by ISA Pruning Guidelines.
- Maximum Pruning: No more than 25% of the functioning leaf and stem area may be removed within one calendar year of any protected tree, or removal of foliage so as to cause the unbalancing of the tree. Maximum pruning should only occur in the rarest situation approved by the Director.

4.8 Root Pruning

Root pruning may be necessary prior to mechanical excavation in order to minimize damage to a tree's root system. Any root >1 inch in diameter should be pruned rather than torn or crushed. The two allowable methods of root pruning are:

- Using air excavation tools, pressurized water, or hand tools to excavate soil, followed by selectively cutting roots. This method allows the arborist to examine the roots and determine the best places to cut.
- Using a tool designed to cut roots, cut through the soil along a predetermined line on the surface.

For most tree species, a significant reduction in stability and long-term health can occur when roots are cut within their CRZ – the farther a root is cut away from the tree's trunk, the better. Root pinning or stapling and directional changes should be considered to minimize root damage.

All approved root pruning shall be performed according to the following standards:

- The Contractor shall retain the services of a licensed arborist to perform any cutting of roots.
- Under no circumstances shall excavation in a TPZ be made with mechanical equipment that might damage the existing root systems. The Contractor shall use equipment and

methods that shall minimize damage to the tree roots, per recommendations of the Arborist. Such methods may require root pruning prior to, as well as during, any excavation activities.

- Exposed tree roots shall be protected by dampened burlap at all times until they can be covered with soil.
- Backfill the areas where root pruning has occurred and immediately water the area with 10 gallons of water per inch of tree diameter.

Branches shall not be removed from a tree to compensate for root pruning – it is best to wait for the tree to respond and act accordingly.

4.9 Death or Removal of Protected Tree(s) or Plant(s).

Should any protected tree die or be removed at any time, the owner shall, within 90 days, replace the tree. The owner shall replace the tree with a minimum of three new trees. The diameter inch of the replacement trees shall be two times the removed or dead tree's diameter at standard height. The replacement trees shall be of a similar approved species that will achieve the same height, spread, and growth characteristics. If spacing is unavailable for any replacement tree, the owner shall pay a fee-in-lieu amount, as outlined in Section V, subsection 2.2. herein. Said fee shall be established by City Council by resolution during annual fee adoptions or at such time as may be determined by City Council.

4.10 Tree & Stump Removal

Removal of identified trees shall be done by a licensed arborist in a skillful manner to avoid above- or below-ground damage to the trees that remain. Before performing stump extraction, the roots that may be entangled with trees that are to remain should be considered – these stumps shall have their roots severed before extracting the stump. Removal shall include the grinding of the stump and roots to a minimum depth of 12 inches below sidewalk grade and hauling away excess material. Any root material within the sidewalk shall be considered part of the stump and therefore removed.

5. Protection Measures and Grading Specifications for Approved Changes in TPZ

All changes to the size of a TPZ or any construction activities within a TPZ must be approved by the Director. Where grading or other disturbance is permitted within a TPZ, extra protection measures must be implemented to protect the CRZ of the tree(s).

5.1 Tree Protection Fence

Required fencing specifications as detailed above. See Figures 5 and 6 for fence placement on sites without space for full TPZ to be fenced.

5.2 Trunk Protection

Trunk protection is necessary when construction activities are close enough to cause mechanical damage to the tree's trunk or buttress roots. Trunk protection shall be 2'x4' cladding, at least 8 feet in length from the tree's base, clad together with wire (alternative materials shall be at the

approval of the Director). No fasteners shall be driven into the tree. Burlap shall be used to separate trunk cladding from bark. The barrier can be installed at an angle to protect the trunk, trunk flare, and buttress roots. Adjustments may be needed if protection is needed during periods of trunk growth.

5.3 Surface Protection

If construction activities cannot be kept outside a TPZ, surface protection measures shall be established to reduce soil compaction and prevent root damage. Measures may vary depending on equipment type and frequency of use and must be approved by the Director. Measures may include, but are not limited to:

- Applying 6-12 inches of wood chip mulch to the area.
- Laying >¾ inch thickness plywood, beams, commercial logging, or road mats over a >4 inch thick layer of wood chip mulch.
- Applying 4-6 inches of gravel over a taut, staked, geotextile fabric.
- Any of the above actions shall be performed manually. Any mulch, plywood, or other material used that exceeds 4 inches must be removed from the TPZ immediately after the potentially hazardous activity has concluded.

Table 7. Minimum distances for offset and length of boring hole relative to tree's DSH.

Tree Diameter (DSH)	Minimum Offset Distance from Trunk	Minimum Length of Bore Hole
2”	1 ft	2 ft
3”	2 ft	3 ft
5”	5 ft	5 ft
10”	8 ft	10 ft
15”	12 ft	15 ft
20”	15 ft	20 ft

5.4 Excavation

Where excavation within the TPZ is unavoidable, the Contractor shall use equipment and methods that shall minimize damage to the tree roots, per recommendations of the Arborist.

Excavation methods permitted inside the TPZ are limited to hand digging, hydraulic or pneumatic air excavation. Roots >2-inches in diameter must be tunneled under. Boring machines that can tunnel under root systems are the preferred alternative to trenching when installing pipes or wires. If possible, these machines should be set up outside the drip line of the tree because they often require a hole to be dug for operation. Prior to soil excavation near trees, roots should be pruned or cleanly cut at the excavation limit, outside the TPZ.

If boring from one side of a tree to the other, the boring hole needs to be offset from the trunk's center to avoid damaging its tap or oblique roots. The distance of offset and the length of the boring hole are based on the tree's diameter (Table 7). The length of the bored hole should be at least 12 times the trunk diameter, with the midpoint based on the location of the trunk. Excavation should then be performed below root depth at 2-3 feet.

If boring cannot be used and trenching is required, the following specifications must be met:

- All trenching shall be located outside TPZs. If a reduction in a TPZ's size has been approved, a minimum distance will be determined.
- The City reserves the right to evaluate the cutting of any roots prior to them being cut.
- Excavation within the TPZ should be avoided during hot, dry weather. Utilities that cannot be routed outside the TPZ should be installed by tunneling under or other methods to avoid root damage. Utilities should be installed far enough from existing trees to avoid future tree damage during utility repair and should be routed in a common trench or conduit or grouped as closely as permitted.

5.5 Grading

Grade changes, even if slight, have the potential to greatly impact a tree's health. Grading within the TPZ is prohibited unless approved by the Director. Grade changes outside of the TPZ shall not significantly alter drainage to the tree. For circumstances where grade changes have been approved within a TPZ, the following specifications shall be followed for each activity:

- Soil Fill: method of placing native soil where existing grade is <2 inches below elevation of finish grade.
    - Place soil in a single un-compacted layer and hand grade to the required finish elevation. It is important to keep fill soil as far from the trunk and in as thin a layer as possible.
    - Coarse-textured soil is best for water and air movement. Soil moisture should be monitored and remain hydrated.
    - No more than 6 inches fill is allowed unless mitigated. Mitigation can include a retaining wall 3x the diameter of the tree, permanent aeration systems or other approved alternatives.
- Soil Cut: method of building a retaining wall around (or on the one side being graded) the tree to maintain the grade within TPZ.
    - Refer to Table 7 for minimum radius of distance from trunk to retaining wall.
    - Walls that encircle a tree may eliminate soil volume available to roots outside, therefore trees may need supplemental irrigation.

- No more than 4 inches of existing soil shall be removed from natural grade (cut) unless mitigated by retaining wall or an equivalent technique.

5.6 Soil Compaction Mitigation

Soil that is damaged or compacted shall be loosened or aerated to promote root growth and enhance tree vitality. One of the following aeration methods shall be specified an in effort to correct compacted soil conditions, as specified by the Arborist:

- Vertical mulching, by auguring holes (2-4 inches wide and 12-18 inches deep, 1-3 feet apart starting approximately 2-3 feet from the trunk and extending to the dripline) and backfilling with porous material such as gravel, sand, perlite, or peat moss.
- Radial trenching using an air excavator to excavate a soil trench (3-6 inches wide and >12 inches deep starting approximately 3 feet from the trunk and extending to the dripline) and add a 2-3 inches application of organic mulch. Trenches shall radiate out from one foot apart at the closest point.
- Soil-fracturing and subsurface injections with a pneumatic air-driven device to increase pore space in the soil.

5.7 Trunk Injury Mitigation

In most cases of trunk or branch damage, it is best to remove loose bark, cutting jagged edges with a sharp knife or chisel and being careful to leave as much firmly attached bark intact as possible. This can be performed during the post-construction phase.

6. Construction and Post-Construction Inspections and Oversight

Failure to comply with the standards, restrictions, conditions, and mitigation measures of this Tree Manual will result in the issuance of a stop work order and may result in the imposition of fines and/or penalties as outlined within the Littleton City Code.

All fencing, trunk protection, branch protection, and woodchips shall be maintained throughout the duration of the contract. The Contractor shall be held responsible for the health and survival of the existing trees in the immediate vicinity of the construction area. Damage that can be remedied by corrective measures shall be repaired immediately per the Director's sole discretion.

6.1 Tree Health Monitoring During Construction

Monitoring the site on a specified schedule is necessary during the construction phase to ensure compliance with tree protection measures. Monitoring tree health, soil moisture, and/or tree damage should be a priority during these site visits so damage can be documented and mitigated, and work plans can be adjusted as needed.

- **Mulch.** Organic mulch, such as wood chips, is an effective way to protect tree health by conserving soil moisture, moderating soil temperature, eliminating turf competition, promoting soil nutrients, and reducing soil compaction. If mulch is used it should be

maintained at 2-4 inches deep within the TPZ throughout the duration of construction activities and NOT piled on the trunk.

- **Foliage.** If leaves begin to yellow, wilt, or die, collecting foliar samples should be done to determine causes. If nutrient deficiencies are found, consultation with the Director shall be done to determine mitigation activities (i.e., fertilization).
- **Pests and Diseases.** The stress induced by construction has been shown to increase the susceptibility of certain tree species to pests. Integrated Pest Management strategies should be employed where a non-lethal pest population exists to minimize damage to trees left vulnerable from the stressors of construction. Tree species that are known to be susceptible to mortality should be monitored during construction.

6.2 Post-Construction Monitoring

After all other construction activities are complete, all materials shall be removed and disposed of off-site by the Contractor. The Director, or their designee, shall conduct a site inspection at project completion to ensure all preserved trees are in good condition. The health and condition of preserved trees on site shall continue to be monitored by the contractor's Arborist after construction activities during the 2-year establishment period. Treatments such as fertilization or pruning may be required at the direction of the Director. If tree removal is necessary, the Director's office shall recommend replacement species suited to the site. The City may require development of a long-term tree maintenance plan for preserved and newly planted trees.

SECTION V: MITIGATION, TREE REMOVAL AND DAMAGES

1. Tree Removal Process

Section V does not apply to single-family residences.

Removal requirements apply to trees, defined as single- or multi-stem woody plants that attain a minimum mature height of fifteen feet (15') with a minimum mature trunk diameter of four inches (4") as measured 4.5' above the ground, Diameter at Standard Height (DSH). It shall be unlawful for any person or entity on any public or private property within the city, excluding lots which contain single-family residences, to remove a tree whose trunk is greater than 4" in diameter without first having obtained a written permit from the city to do so (see permit in Appendix E). For purposes of this section, "removal" means the destruction or displacement of a tree by cutting, bulldozing or other mechanical or chemical means, which results in the physical transportation of the tree from its site and/or death of the tree. "Removal" shall also mean the pruning down of any tree more than 33% of its size in any 365 day period.

In reviewing the application for a permit, the Director, or their designee, shall review and take into consideration approved land uses, landscaping or other approved city plans. Permits for the removal of trees shall be granted by the city under the following conditions:

- The tree is diseased and the applicant has considered possible alternatives;
- The tree is dead;

- The tree is in a location or in such condition as to endanger the public or an adjoining property owner and the applicant has considered possible alternatives;
- The removal of the tree is necessary due to construction activities and the applicant has considered possible alternatives;
- The overcrowding of trees at a specific location threatens their health and makes the requested removal appropriate; or
- The tree significantly impedes the normal water flow of a carrier ditch, canal, storm sewer or the floodway of a natural watercourse.
- Removal of the tree is necessary to mitigate fire risk.
- Removal of the tree is necessary due to green energy efforts.
- The tree is an undesirable or invasive species, as designated by the Director.

2. Tree Removal Mitigation

Mitigation measures are not intended to supplant tree preservation; planning and design of a site must consider all existing trees and ecological features. Mitigation for tree removals will be required if damage or removal of trees within a TPZ, or removal of trees required herein have occurred. Otherwise, mitigation will be considered only after all feasible design alternatives to preserve trees have been exhausted.

If protected trees are damaged or removed without a permit or otherwise, in violation of the requirements herein, the Director shall follow procedures outlined in _____, to notify the responsible party to stop work and provide a timeline for submission of a restoration plan. The restoration plan shall include a narrative describing the reforestation proposed and a schedule for efforts, to be completed prior to final site inspection.

The following tree removal activities are exempt from mitigation requirements upon approval from the Director:

- Removal of "for sale" trees from a plant nursery or botanical garden;
- Removal of trees that pose a risk of immediate danger to life and property due to an accident, fire, storm, or other act of nature;
- Removal of diseased or dying trees as determined by an arborist, with written notice to be shared with the City;
- Selective and limited removal or pruning of trees or vegetation necessary to obtain clear visibility within sight triangles; and
- Removal of exotic, invasive, or prohibited tree species.

2.1 Tree Replacement Requirements

Excluding single-family unit residents, permits granted for removal shall require, to the extent possible, replacement plantings on the site of a similar quantity to those removed. Should any protected tree die or be removed at any time, the owner shall, within 90 days, replace the tree. The owner shall replace the tree with a minimum of three new trees. The replacement trees should be of a similar approved species that will achieve the same height, spread, and growth characteristics.

- For commercial property owners, new building construction, and construction on City property: every DSH inch of tree that is removed or damaged, two diameter inch of replacement trees are required.
    - In cases where the total diameter of trees removed in violation cannot be determined, eight replacement trees shall be provided per acre of disturbed area.
- For multi-family units or development property owners: every DSH inch of tree that is removed or damaged, two diameter inches of replacement trees are required.

2.2 Fee-In-Lieu Alternative

Where existing conditions make it impractical to comply with the replacement standards, a fee-in-lieu of meeting the requirements herein may be made. The fee-in-lieu shall be calculated using the Canopy Loss Formula outlined below.

The 2024 canopy loss fee rate = $250/inch for shade trees

Canopy loss fee ($) = (DSH removed - DSH replanted) x (canopy loss fee rate)

Example:

Trees to be removed: 10" oak, 6" maple, and 5" ginkgo
Total DSH inches of trees removed = 21"
Replacement trees: Three, 2" caliper trees
Total Caliper inches of replacement trees = 6"
Canopy Loss Fee Calculation: (21" - 6") x $250/inch = $3,750

In-lieu fees shall be deposited in a Tree Equity Fund to be used towards increasing tree canopy within Littleton. Tree Equity refers to the fair distribution of trees and their associated benefits, aiming to provide access to these benefits regardless of socioeconomic status or other demographic factors. Although tree planting is the most common tool used to address inequities in the urban forest, providing other urban forestry services on both public and private properties is essential to maintaining an equitable urban forest. For instance, a homeowner may be burdened with costs of pruning a mature tree - if they aren't able to prune, the tree may die or cause damage to property or the public, both creating more costs and eliminating the benefits the tree once provided to the homeowner. Resources from the Public Tree Fund are to be allocated at the discretion of the Forestry division.

Affordable housing developments qualify for a reduction to an amount of $75.00 total. Further, no mitigation payment shall be applied to property owners that may receive verified, established forms of financial assistance.

2.3 Tree Preservation Credit.

Development sites that preserve mature trees may be given credit towards the fulfillment of the requirements set out herein. Credit may only be granted for mature trees located on the same lot and only those detailed on a site plan or master development plans, signed by a licensed

landscape architect and/or certified arborist. The licensed landscape architect or certified arborist must verify the species, caliper, and health of any identified mature trees.

Table 8: Rate of Tree Preservation Credit	
Combined Caliper Size of Preserved Trees	**Landscape Credit Per Tree**
6 to12 inches	3 shade/evergreen or 4 ornamental trees
13 to 24 inches	4 shade/evergreen or 5 ornamental trees
25 to 36 inches	5 shade/evergreen or 6 ornamental trees
Greater than 37 inches	6 shade/evergreen or 7 ornamental trees

APPENDIX A: APPROVED TREE SPECIES LIST

Tree species approved for planting on City of Littleton property (subject to change). Only species indicated as 'ROW Approved' may be planted in the city's Right-of-Way; species not approved for planting in the ROW are suitable for parks or other city properties.

Common name	Botanical name	Acceptable cultivars	ROW Approved?
Hedge maple	*Acer campestre*	Queen Elizabeth	Y
Rocky Mountain maple	*Acer glabrum*		Y
Bigtooth maple	*Acer grandidentatum*	Rocky Mountain Glow	Y
Paperbark maple	*Acer griseum*		Y
Miyabe maple	*Acer miyabe*	State Street	Y
Sugar maple	*Acer saccharum*	Fall Fiesta, Legacy, Caddo	N
Yellow buckeye	*Aesculus flava*		Y
Common horsechestnut	*Aesculus hipposcastanum*		Y
Red horsechestnut	*Aesculus x carnea*	Briotti, Fort McNair	Y
Downy serviceberry	*Amelanchier arborea*		Y
Shadblow serviceberry	*Amelanchier canadensis*		Y
Allegheny serviceberry	*Amelanchier laevis*	Spring Flurry	Y
Apple serviceberry	*Amelanchier x grandiflora*	Autumn Brilliance	Y
European hornbeam	*Carpinus betulus*	Fastigiata, Frans Fontaine	Y
American hornbeam	*Carpinus caroliniana*		Y
Pecan	*Carya illinoinensis*		N
Shagback hickory	*Carya ovata*		N
Chinese catalpa	*Catalpa ovata*		Y
Common name	**Botanical name**	**Acceptable cultivars**	**ROW Approved?**

Western catalpa	*Catalpa speciosa*		Y
Purple catalpa	*Catalpa x erubescens*		Y
Atlas blue cedar	*Cedrus atlantica*		N
Sugar hackberry	*Celtis laevigata*	All Seasons, Magnifica	Y
Common hackberry	*Celtis occidentalis*		Y
Netleaf hackberry	*Celtis reticulata*		Y
Eastern redbud	*Cercis canadensis*		Y
Yellowwood	*Cladrastis kentukea*		Y
Turkish filbert	*Corylus colurna*		Y
Russian hawthorn	*Crataegus ambigua*		Y
Lavalle hawthorn	*Crataegus lavellei*		Y
Downy hawthorn	*Crataegus mollis*		Y
Green Hawthorn	*Crataegus viridis*	Winter King	Y
European beech	*Fagus sylvatica*	Purpurea, Tricolor	N
Ginkgo	*Ginkgo biloba*	Autumn Gold, Golden colonnade, Magyar, Princeton Sentry, Presidential Gold, Shangri-la	Y
Kentucky coffeetree	*Gymnocladus dioicus*	Espresso, Stately Manor	Y
Rocky Mountain juniper	*Juniperus scopulorum*		N
Eastern redcedar	*Juniperus virginiana*		N
Goldenrain tree	*Koelreuteria paniculata*		Y
Sweetgum	*Liquidambar styraciflua*		N
Tuliptree	*Liriodendron tulipfera*		Y
Amur maackia	*Maackia amurensis*		Y
Osage orange	*Maclura pomifera*	White Shield	Y

Common name	Botanical name	Acceptable cultivars	ROW Approved?
Cucumbertree magnolia	*Magnolia acuminata*		Y
Galaxy magnolia	*Magnolia 'Galaxy'*		Y
Magnolia x soulangiana	*Magnolia x soulangiana*		Y
Crabapple	*Malus sylvestris*	Golden Raindrops, Indian Magic, Prairefire, Royal Raindrops, Spring Snow, Thunderchild	Y
Dawn redwood	*Metasequoia glyptostroboides*		N
White mulberry	*Morus alba*		N
American hophornbeam	*Ostrya virginiana*		Y
White spruce	*Picea glauca*		N
Blue spruce	*Picea pungens*		N
London planetree	*Platanus x acerifolia*	Bloodgood, Exclamation	Y
Amur chokecherry	*Prunus maackii*	Sucker Punch, Canada Red	Y
Chokecherry	*Prunus virginiana*		Y
Common hoptree	*Ptelea trifoliata*		N
White oak	*Quercus alba*		Y
Swamp white oak	*Quercus bicolor*		Y
Gambel oak	*Quercus gambelii*		N
Shingle oak	*Quercus imbricaria*		Y
Bur oak	*Quercus macrocarpa*	Bulletproof	Y
Chinkapin oak	*Quercus muehlenbergii*		Y
Chestnut oak	*Quercus prinus*		Y
Wavy-leaf oak	*Quercus undulata*		Y
Whitebeam tree	*Sorbus aria*		Y
Common name	**Botanical name**	**Acceptable cultivars**	**ROW Approved?**

Oakleaf mountain-ash	*Sorbus hybrida*		Y
Japanese pagoda tree	*Styphnolobium japonicum*		Y
Chinese tree lilac	*Syringa pekinensis*	China Snow	Y
Japanese tree lilac	*Syringa reticulata*	Ivory Silk	Y
American linden	*Tilia americana*	Valley Forge, Princeton, Jefferson	Y
Silver linden	*Tilia tomentosa*	Sterling	Y
American elm	*Ulmus americana*	Boulevard, DTR 123, MckSentry, Redmond	Y
David elm	*Ulmus davidiana*	Discovery	Y
Accolade elm	*Ulmus davidiana var. japonica*	Morton	Y
Golden yellowhorn	*Xanthoceras sorbifolium*	Clear Creek	Y

APPENDIX B: PROHIBITED ROW TREE SPECIES LIST

Tree species prohibited from planting in the City of Littleton's Right-of-Way (ROW), parks, or other city properties (subject to change).

Common name	Botanical name	CAUSE
Boxelder (female)	*Acer negundo (female)*	Poor suitability
Silver maple	*Acer saccharinum*	Poor suitability
Tree of heaven	*Ailanthus altissima*	Invasive
Russian olive	*Elaeagnus angustifolia*	Invasive
Ash spp.	*Fraxinus spp.*	Insect/disease concern
Sunburst' honeylocust	*Gleditsia triacanthos var. inermis 'Sunburst'*	Poor suitability
Populus spp., including hybrid poplars, cottonwoods, and aspens	*Populus spp.*	Poor suitability
Bradford flowering pear	*Pyrus calleryana 'Bradford'*	Poor suitability
Willow spp.	*Salix spp.*	Poor suitability
Tamarisk	*Tamarix ramosissima or Tamarix parviflora*	Poor suitability
Siberian elm	*Ulmus pumila*	Poor suitability
Multi-stemmed trees		Poor suitability
Weeping or pendulous trees		Poor suitability
Any large conifers	Picea spp., Pinus spp., Abies spp.	Visibility concerns
Fruit producing trees		Fruit may pose public risk

The following tree species trees are currently over-planted in Littleton. In order to enhance biodiversity in the urban forest, these species are currently not allowed for planting in the ROW and are recommended to avoid planting in other locations. This list is subject to change as levels of species diversity shift.

Common name	**Botanical name**	**ROW Approved?**
Norway maple	*Acer platanoides*	No
Autumn blaze/freeman maple	*Acer x freemanii*	No
Hot wings maple	*Acer tartaricum 'garann'*	No
Austrian pine	*Pinus nigra*	No
Thornless honeylocust	*Gleditsia triacanthos var. inermis*	No

APPENDIX C: MAINTENANCE LOG FOR CONTRACTORS

MONTHLY MAINTENANCE LOG

To be completed and returned to the Director during the first week of the month.

Tree Maintenance Zone	Date	Maintenance performed	Notes	Initials
Zone 1				
Zone 2				
Zone 3				
Zone 4				

Authorized Signature: _____

Date: _____

APPENDIX D: IRRIGATION LOG FOR CONTRACTORS

WEEKLY IRRIGATION LOG

To be completed and returned to the Director during the first week of the month.

Tree Maintenance Zone	Date	Irrigation Method	Gallons per tree	Notes	Initials
Zone 1					
Zone 2					
Zone 3					
Zone 4					

Authorized Signature: _____

Date: _____

APPENDIX E: TREE REMOVAL PERMIT

Littleton

Mail or fax to: Littleton City Forester
1800 W. Belleview Ave.
Littleton, CO 80120
F: (303) 797-2138

TREE REMOVAL PERMIT APPLICATION

A tree removal permit approved by the City Forester is required for the removal of trees ≥4" caliper (diameter measured 6" above grade) on any property, other than outside the Right-of-Way on single-family residential lots.

Location of tree: _____ Date: _____
(Address or legal description)

Property Owner

Name: _____

Phone: _____

Email: _____

Applicant (if someone other than the Property Owner)

Name: _____

Phone: _____

Email: _____

Mark the boxes of any reasons for tree removal that apply:

☐ Tree is dead

☐ Tree is diseased and no reasonable alternative exists

☐ Tree location or condition endangers the public and no reasonable alternative exists

☐ Tree removal is necessary due to construction activities and no reasonable alternative exists

☐ Tree health is threatened due to overcrowding

☐ Tree impedes normal water flow

☐ Tree removal is necessary to mitigate fire risk

☐ Tree is an undesirable or invasive species, as designated by the City Forester

If # 2, 3 or 4 is checked, describe alternatives considered and reasons not selected. Attach supporting materials if necessary. If #4 is checked, list replacement tree size and species (2" caliper minimum) for each tree removed. See the City of Littleton's list of tree removal activities exempt from mitigation requirements, upon approval from the City Forester.

Any person who is denied a permit may, within ten (10) days of the date that written notice of the denial is mailed by the city, appeal the decision of the City Forester to the city's Board of Adjustment. The appeal shall be de novo and the burden of proof shall be on the applicant to show that the criteria specified herein for the issuance of a permit to remove a tree has been met. The Board of Adjustment's decision shall be final and shall be subject to judicial review.

This Section is for City Use Only

Permit is hereby granted to _____
(Applicant)

Permit issued on the _____ day of _____, 20___
(Day) *(Month)* *(Year)*

by _____ at the Department of Public Works.
(City Forester or their designee)

This permit is non-transferable and expires on _____
(Expiration Date)

Tree Site ID _____

Questions: (303) 795-3766 -- mdanser@littletongov.org