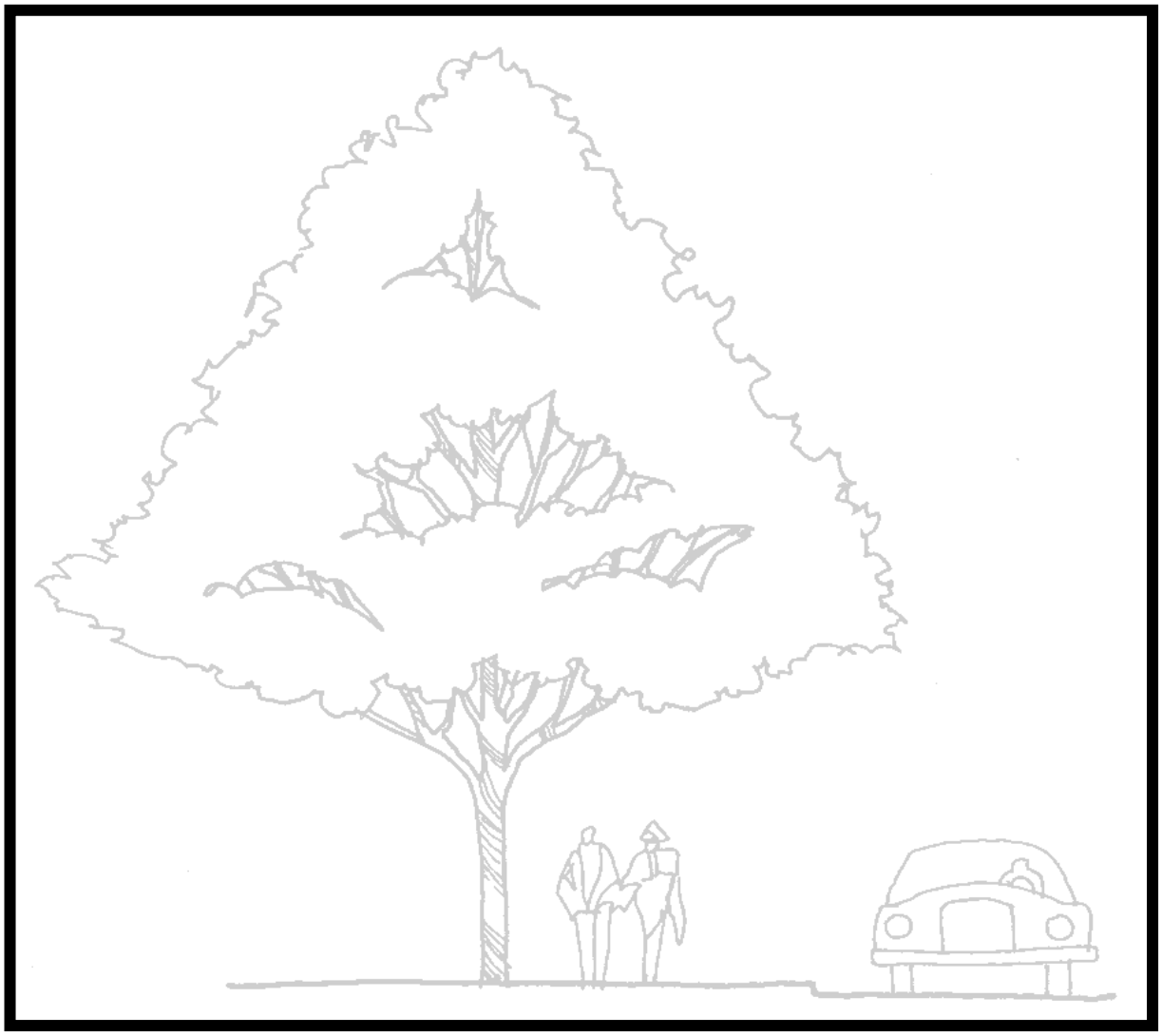
Best Management Practices for Community Trees

A Technical Guide to Tree Conservation in Athens-Clarke County, Georgia

The Unified Government of Athens-Clarke County, Georgia, believes that we all have a responsibility to manage our community trees wisely and to conserve valuable community resources. To contribute to this mission, Athens-Clarke County has developed this Technical Guide to Tree Conservation in Athens-Clarke County…



A Technical Guide to Tree Conservation in Athens-Clarke County, Georgia

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To obtain additional copies of this document or to find out more about the Athens-Clarke County Community Tree Program, visit the Landscape Management Division Office at 350 Pound Street, Athens, GA 30601.

Best Management Practices for Community Trees

Table of Contents

Introduction

Best Management Practices for Community Trees is a Technical Guide to selecting, placing, conserving, protecting, maintaining, establishing, removing, and replacing trees in Athens-Clarke County (ACC), Georgia.

Community trees include all trees within ACC, regardless of where they are located. They may be found growing on public or on private property. They are located in residential yards, along street right-of-ways, around commercial and industrial buildings, in parking lots, in parks, and on the grounds of government and institutional facilities. A healthy, functional, and attractive tree growing in any one of these locations provides benefits not only to the property owner, but to the surrounding community as well.

The Best Management Practices (referred to throughout the Guide as "BMPs") are technically correct and widely accepted *practices* and *standards* used by professional arborists, urban and community foresters, landscape architects and other tree care and landscape professionals. The goal of the BMPs is to provide you with basic and practical information on how to best accomplish the most important tree management activities. The goal of tree management is to maintain tree, forest, environmental, and community health.

Who Should Use This Guide

If you are a—

- **Athens-Clarke County Resident**
- **Athens-Clarke County Unified Government Official or Staff Member**
- **Construction Contractor or Employee**
- **Engineer**
- **Heavy Equipment Operator**
- **Land Developer**
- **Landscape Architect**
- **Landscape Maintenance Contractor or Employee**
- **Neighborhood Association**
- **Planner**
- **Tree Care Service Contractor or Employee**

--then this Guide is for you! *Your* implementation of the BMPs is an important component of our overall community tree management program. This Guide is also intended to support the ACC Development Code, and should be used as a project planning and implementation tool, a community education tool, and standards for community tree care.

How To Use This Guide

This Guide is organized into four (4) sections that follow this **Introduction.** They are—

Section 1 Tree Basics
Section 2 Best Management Practices for Tree Selection and Placement
Section 3 Best Management Practices for Tree Care
Section 4 Best Management Practices for Tree Species Selection

The Guide also includes an **Appendix** containing a list of **References** and a sample **Tree Management Cost Worksheet,** a tool for tree conservation and management planning.

Within each section a number of topics—basic subjects, site situations, and tree care activities—are addressed. BMPs are listed for each site situation and tree care activity. The BMPs are preceded by a list of the **benefits** and **common mistakes** made in tree management.

It is suggested that you read through the entire Guide to gain the greatest understanding of the BMPs. *However,* the Guide is arranged so that you can easily find information on a specific topic by using the **Table of Contents**. The following summary of the contents may also help you to find the information you need.

Tree Basics are included in **Section 1** and are provided to increase your understanding of: *Our Community Trees*, *The Benefits of Trees*, *The Cost of Trees*, *Tree Structure*, *Tree Growth*, and *The Critical Root Zone and Tree Protection Zone*. This basic information is essential for anyone who impacts trees in our community. Many of the terms used throughout the Guide are defined in this section.

Best Management Practices for Tree Selection and Placement are provided in **Section 2.** These BMPs address the *conservation of existing trees* and the *establishment of new trees* in a variety of common *site situations* found in Athens-Clarke County. The site situations addressed are: *Large Landscape Areas, Road Frontage Areas, Parking Lots, Plazas and Downtown Settings, Buffers, Riparian Zones and Drainage Areas,* and *Utility Corridors*. BMPs are included for all site situations and design standards are included for most situations.

Best Management Practices for Tree Care are provided in **Section 3**. These BMPs focus on how to *maintain and preserve* trees throughout their lives. They address basic tree management activities: *Tree Conservation, Tree Protection, Soil Health Maintenance, Tree Establishment, Tree Maintenance,* and *Tree Removal and Replacement*.

Best Management Practices for Tree Species Selection are provided in **Section 4**.

These BMPs will help you select the best trees to *conserve and plant* on your site. This section also contains the **Athens-Clarke County Tree Species List** that includes detailed information on 166 important tree species.

If you'd like more information than the Guide provides, a list of helpful publications is provided at the end of each topic in a text box entitled "**For more information….**" The publications listed here and others used in the development of the Guide are all listed in the **References** section of the **Appendix**. After the list of publications, a place to make personal notes is provided for each topic.

The Athens-Clarke County Community Tree Program

This Technical Guide to **Best Management Practices for Community Trees** is just one part of the Unified Government's pro-active *Community Tree Program*. This Program includes an ongoing *tree inventory*, a comprehensive *tree planting and maintenance program*, and a *community tree care education and outreach program*. The Community Forester, working within the Landscape Management Division of the Central Services Department, administers the Program. The Community Forester is available to work with individuals, neighborhood associations, businesses, non-profit groups, or civic organizations to plan and implement tree management projects in their area.

The types of community assistance available to Athens-Clarke County citizens include residential and commercial neighborhood tree inventories, tree management plans, tree protection plans, tree planting plans, and tree care education. Interested persons or groups can apply for assistance or get a current schedule of upcoming educational opportunities from the Athens-Clarke County Landscape Management Division at 350 Pound Street. Contact can also be made by phone at (706)613-3561, by fax at (706)613-3566, or by e-mail at *forester@co.clarke.ga.us*.

If you are engaged in a land development or building construction project, Athens-Clarke County reminds you that the latest Comprehensive Plan, Future Land Use Plan, and Development Regulations include provisions for the conservation of trees and replacement plantings on new or expanded residential, commercial, and industrial developments. Visit or call the ACC Planning Department at 120 W. Dougherty Street, (706)613-3515, for information on current regulations.

Athens-Clarke County also recommends that you hire a professional arborist, urban forester, or landscape architect to help you implement County regulations and these BMPs. Contact the Landscape Management Division, the Georgia Forestry Commission at (706)542-6880, or the Cooperative Extension Service at (706)613-3640 for a list of qualified arborists, urban foresters, and landscape architects in the area.

Notes:

Section 1: Tree Basics

Our Community Trees

Our community trees are part of our *infrastructure* and are a valuable asset. Trees perform many essential biological functions that benefit all of us and our environment in substantial, measurable ways. But unlike other assets, trees are living entities and have basic biological requirements for survival and growth. As such, this unique asset must be actively managed and protected to maintain its health, function, safety, beauty, and value.

There is a shared community responsibility for tree management that results in considerable costs and risks associated with owning trees. To maximize the benefits we gain from our trees and minimize the costs and risks associated with them, we must have a good understanding of their benefits, costs, structure, and growth requirements, and we must be pro-active in their management.

The Benefits of Trees

Trees provide you, and our community, with many environmental, social, and economic benefits. Many of these benefits are tangible and measurable. Some of the more important benefits are highlighted below:

Trees improve air quality. Their leaves absorb carbon dioxide during the process of photosynthesis, and produce as a by-product the oxygen we need to breathe. Tree leaves also absorb other pollutants and particulate matter from the air.

- ☆ A large, healthy tree can produce enough oxygen each day for 18 people. Trees reduce pollution and absorb carbon monoxide, sulfur dioxide, nitrogen dioxide, and particulates. Deciduous trees remove up to 9% of particulates and evergreen trees can remove up to 13% of particulates in the air.
- ☆ Trees can absorb and store a yearly average of 13 pounds of carbon each. A community forest can store as much as 2.6 tons of carbon per acre per year. Community trees across the United States store 6.5 million tons per year, resulting in a savings of $22 billion in control costs. The value associated with the removal of each pound of carbon is $1.70. Therefore, each tree creates a savings through carbon storage of $22 per year.
- ☆ To grow a pound of wood, a tree uses 1.47 pounds of carbon dioxide and gives off 1.07 pounds of oxygen. An acre of trees might grow 4,000 pounds of wood in a year, using 5,880 pounds of carbon dioxide and giving off 4,280 pounds of oxygen in the process. For every pound of wood that decays (or is burned), the process is reversed: 1.07 pounds of oxygen are used, and 1.47 pounds of carbon dioxide are released.
- ☆ By providing a cool, shady spot for us to park our cars, trees also reduce the amount of volatile organic compounds (VOC's) that are released from them. In the sun and heat, parked cars continue to release VOC's from the gas tank, so tree canopy can significantly reduces the level of emissions.

Trees save energy. They shade our homes and offices, and the streets, parking lots, and other pavement that surrounds them. They cool the air as their leaves evaporate water.

- ☆ Leafy green tree crowns create a canopy of shade, reducing the amount of sunlight reaching our streets, lawns, and parking areas, resulting in lower summer temperatures. If properly placed for optimal shading of buildings (south and west sides) and air conditioners, trees can provide a 17% to 75% decrease in summer cooling costs. The presence of a thick evergreen canopy can *increase* winter heating costs in some areas, but in Athens-Clarke County trees generally *decrease* winter heating costs if properly placed to buffer a home against cold winter winds (north and west sides).
- ☆ The 200,000 leaves on a healthy 100-foot tree can take 11,000 gallons of water from the soil and breathe it into the air in a single growing season. The cooling effect of all that water going into the air is the equivalent of air conditioning for 12 rooms.

Trees reduce stormwater runoff. Their leaves and branches intercept rainfall and release it slowly, thereby reducing runoff and helping to maintain water quality.

- ☆ The many leaves, branches, and stems of trees intercept rainwater, hold it, and then release it slowly so that it can be absorbed by the soil. Tree roots also actively remove water from the soil. The amount of overland flow of water and non-point source pollution that occurs during and after heavy rains is decreased by trees.
- ☆ The value of trees can be measured as the reduction in construction and material costs for storm water control structures and systems because trees intercept 7% to 22% of precipitation. One study has shown that for every tree 2 cents in water control costs are saved for every gallon of water intercepted during a twelve-hour storm. In a medium sized city, this equates to a 17% reduction of 11.3 million gallons, and a savings of $226,000!

Trees improve water quality and reduce soil erosion. Their roots hold the soil, reduce erosion, and decrease the amount of sediment that enters our creeks, streams, rivers, and lakes.

- ☆ Riparian, or “streamside” forests are important to the stream environment. They control fluctuations in water temperature and maintain varied, but stable light levels. Light levels control the type and amount of algae present in a stream, a major food source for many macro-invertebrate animals. Litterfall contributes food energy to stream inhabitants. Aquatic habitat depends in large part on the woody debris available to streams, and the decay of woody debris as it releases nutrients into the aquatic system.
- ☆ Without a streamside forest stream channels become unnaturally wide as stream banks erode. When the dimension, pattern, and profile of a channel are fundamentally changed habitat loss results. Riparian forests remove, hold, or transform nutrients from fertilizers, sediments, and other pollutants. Even before water reaches the riparian forest, trees can reduce sediment movement off a site by 95%. This keeps our lakes, rivers, and streams cleaner and healthier. In a medium sized city, the amount of soil saved annually can be as much as 10,886 tons!

Trees provide wildlife food and habitat. Their flowers, fruits, leaves, buds, and woody parts are important to the survival of birds, mammals, insects, and other wildlife. The decay of these tree parts caused by bacteria and fungi also increases the fertility and structure of the soil.

- ☆ Many birds, mammals, reptiles, amphibians, insects, and microorganisms depend upon trees and the forest for food and shelter. Songbirds eat the fruit of black cherry and sumac; deer, turkey, and squirrels eat acorns of white oak, northern red oak, water oak, and willow oak. Cavities and

branches in many trees, such as oak, sycamore, river birch, American holly, and black willow, are used for cover and nesting sites.

☆ Trees growing along streams contribute to the health of aquatic ecosystems, providing shade and reducing water temperatures. Woody debris that falls into the stream provides habitat for turtles, otters, beavers, and fish.

Trees enhance recreational opportunities and attract visitors and residents to our community. They create an aesthetically pleasing and comfortable place in which to live, work and shop. Trees also create a natural setting for recreational activities such as walking, jogging, bicycling, golfing, and bird watching. The value of community trees is also reflected in increased property values.

☆ For a single home, trees can provide an owner with a 4% to 27% increase in property value. A single tree can add up to 9% to the value of a residential property. One study has shown that each hardwood tree on a site adds $333 to the property value and each pine adds $257. Trees also attract more residents and visitors to a community, adding value by increasing the community's tax and economic base.

The Cost of Trees

While trees provide us with many benefits and are a valuable community asset, there are costs associated with their conservation, establishment, and maintenance. And if neglected, unprotected, abused, or poorly maintained tree health suffers and trees can have an increased risk for failure and additional liability for the tree owner. To assist you in planning for the costs associated with the conservation and management of Trees, a **Tree Management Cost Worksheet** is provided in the Appendix. Some of the ways in which trees directly or indirectly cost money are described below.

Trees cost money to establish, maintain, and protect.

✗ Planning for trees and conducting tree evaluations and surveys requires extra time and costs during project planning and design. However, good design can result in a more successful and valuable project with high income.

✗ Good quality planting stock is expensive, but by purchasing good quality trees, future replacement and maintenance costs can be reduced.

✗ Tree maintenance, especially pruning, must be done regularly to insure tree health, safety, and longevity.

✗ Trees must be constantly monitored and protected from damage that may result from construction activities, utility line installation or repair, and pest problems.

✗ When trees decline beyond the point of improvement or when they die they require removal which can be expensive for large trees.

Trees can grow larger than expected and may outgrow the space available.

✗ When tree branches grow into clear zones for utility lines, pedestrian walkways, buildings, streets, and vehicle and equipment travel lanes they reduce clearance and sight distance and cause increased costs to maintain public safety.

✗ Without adequate growing space, trees will not achieve their potential for size, health, and longevity and will require more maintenance and will need to be replaced more often.

Trees can be hazardous.

✗ Many trees, either today or in the future, tower over our property and us. When whole trees or their parts fail and fall, they can cause utility service outages, damage to vehicles, homes, fences, and pavement, and personal injury.

✗ Tree roots that surface above ground can be a tripping hazard, and can cause damage to lawn mower blades. Trees left unpruned over walkways can cause personal injury.

Tree roots can cause damage to infrastructure.

✗ Tree roots, attracted to favorable soil moisture conditions, will penetrate underground water and sewer lines through small cracks or pipe joints where they proliferate and cause problems.

✗ Tree roots can cause cracking and heaving of sidewalks, curbs, and street pavement.

While there are many costs associated with trees, in most cases the benefits far outweigh the costs. The ratio of benefits to costs can be much improved with the implementation of the BMPs.

Tree Structure

A **tree** is defined as a woody plant that grows to 15 or more feet in height, usually with a single trunk, growing to more than 3 inches in diameter at maturity, and possessing an upright arrangement of branches and leaves. Trees are commonly referred to by their size, specifically their *mature* height. In this Guide, tree heights are divided into **small**, **medium**, or **large** height classes and are defined as follows:

Small Trees:	**Less than 25 feet tall at maturity**
Medium Trees:	**25 to 40 feet tall at maturity**
Large Trees:	**40 to 100 feet tall or more at maturity**

Trees, like people, are complex living organisms made up of many types of cells arranged into tissues and organs. Unlike people, they are only generating systems, and cannot regenerate new cells in the place of damaged or destroyed cells. Because trees generate new wood each year during the growing season, they can get to be very large and achieve a huge volume (size) and mass (weight).

The three main parts of a tree are its **crown**, **trunk**, and **roots**.

The **crown** is the woody and leafy component of the tree. It is composed of large, scaffold limbs that support smaller branches, twigs, leaves, and buds. The leaves absorb carbon dioxide and in the presence of sunlight produce food—carbohydrates—in a process called photosynthesis. As a by-product, the trees leaves produce and

release oxygen. Tree growth occurs at the tips of the branches, which can extend a few inches to several feet a year, depending upon the species and growing conditions. Tree crown size is measured as diameter in feet of the width of the branches at their greatest extent.

The horizontal projection of the tree crown onto the ground or the square foot area the crown covers, is defined as the tree **canopy**. Tree canopy cover is calculated by multiplying the width of the crown in the north-south direction by the width of the crown in the east-west direction. For example, a tree with a crown width of 40 feet in the N-S direction and a width of 30 feet in the E-W direction has a canopy cover area of 1200 square feet. Estimates of mature crown canopy size categories for trees growing in urban areas are listed in the ACC Tree Species List as follows:

Very Small Canopy:	**150 square feet (approximately 12 x 12 feet)**
Small Canopy:	**400 square feet (20 x 20 feet)**
Medium Canopy:	**900 square feet (30 x 30 feet)**
Large Canopy:	**1600 square feet (40 x 40 feet)**

The **trunk** is the main woody stem of the tree and supports the crown. While most trees normally have one stem or trunk, other trees are characteristically multi-stemmed. Carbohydrates and other substances necessary for tree growth are stored in the trunk, roots, and other woody portions of the tree. Water is transported up through the trunk to other parts of the tree. Tree size is often measured as **dbh** or "*d*iameter at *b*reast *h*eight" which is the diameter of the trunk at 4.5 feet above ground. For a tree forked at or below 4.5 feet, diameter is measured at the narrowest point below the fork.

You can calculate trunk diameter by measuring trunk circumference at 4.5 feet above the ground with a standard tape measure and dividing by pi or 3.14, a constant.

Diameter = Circumference ÷ 3.14

Knowing the **cross sectional area** of the trunk may also be useful; the cross sectional area of the trunk at 4.5 feet above the ground is also referred to as a tree's **basal area**. Basal area is often used to describe the stocking of trees (number and size) per acre of land. *Cross sectional area is calculated by first dividing the tree diameter in half to get the radius, and then multiplying the radius times itself and then by 3.14.*

Area = Radius^2 x 3.14

Beneath the **bark**—the outer protective layer that covers the trunk, limbs, branches, and roots—there is a very thin layer of specialized cells known as the **cambium layer**. The cambium layer is where growth in trunk and root diameter takes place each year when

both a layer of wood (xylem) is produced to the inside, and a layer of inner bark (phloem) and bark are produced to the outside. The cambium layer functions as the food transport system for the tree.

The **roots** are the underground structures that anchor the tree and absorb water and nutrients essential for tree survival and growth. The anchoring roots are large, rope-like, and woody and usually number from 4 to 11. ***Tree roots grow out from the trunk for a distance of at least 2 to 3 times the radius of the tree's crown, or at least 2 times the height of the tree.*** However, they taper rapidly as they move away from the tree trunk.

While the large roots grow out from the tree trunk, many small, fibrous absorbing roots arise from the woody roots and generally grow *up* and into the top layers of soil and leaf litter—layers rich in organic material. Attached to the fine root hairs on fibrous roots are beneficial fungi that combine with the root hairs to form **mycorrhizae**, structures of benefit to both the fungus and the tree. These structures increase the surface area that absorbs water and nutrients***. Whether woody or fibrous, 85% of tree roots are located in the top 18 inches of soil.***

Tree Growth

The 205 tree species native to Georgia are nearly 1/3 of all of the 685 tree species native to the United States and Canada. There are 5 distinct geographical regions in Georgia, encompassing a wide diversity of climate, soils, topography, and as a result--trees. In extreme northwestern Georgia lies the *Cumberland Plateau*, which is bordered by the *Ridge and Valley* and the *Blue Ridge Mountains*. The *Piedmont* area lies south of the Blue Ridge Mountains and north of the "fall line" which extends from Columbus to Macon to Augusta. Here the land drops off rather abruptly in elevation and the *Coastal Plain* begins and extends to the Atlantic Ocean. Athens-Clarke County is located in the Piedmont geographical region in USDA Hardiness Zone 7b.

Trees require a certain amount of basic substances and a specific combination of environmental conditions to function, survive and grow. Each individual tree species, like all plant species, has a *range* of soil moisture, soil volume, soil nutrient and acidity levels, air temperature, humidity, and sunlight in which it will grow.

Under optimal conditions, trees will achieve their genetic potential for size, age, and form characteristic of their species. Under less than optimal conditions, trees will grow slower, be smaller at maturity, become easily stressed, have more deadwood, and will be more vulnerable to attacks by insects and disease organisms. The growth requirements of many tree species growing in Athens-Clarke County are included in the ACC Tree Species List.

As stated earlier, trees cannot regenerate or replace cells damaged or destroyed with new cells in the same location. ***Because trees can only "seal" their wounds and cannot "heal" their wounds, any physical damage done to a tree's roots, trunk, or crown affects it for the rest of its life***. This is important to understand before we cut or damage a tree's roots, wound its trunk, break its limbs, or prune it incorrectly.

The amount of energy that a tree is able to store has an effect on its ability to withstand unfavorable conditions and resist attacks by insects, fungi, bacteria, and other harmful organisms. This energy storage capacity is an important factor to consider when working around trees. Trees most affected by injury or stresses are those that store little energy, are fast growing, have inadequate soil volume and growing space, have been adversely affected by weather conditions, have been repeatedly wounded, or are at a critical point in their seasonal or life stage development.

The Critical Root Zone and Tree Protection Zone

Because trees contribute so much to our quality of life and because they can be a potential liability, they must be actively conserved, wisely selected, well placed, well planted, routinely maintained, and constantly protected. One of the most critical steps in planning for trees and cost effective ways of managing trees is to maintain adequate growing space for each tree's roots, trunk, and crown *throughout the tree's life*. ***Remember that as a tree gets older it gets larger and the growing space it requires increases accordingly.***

For existing trees, there is a minimum amount of area, above (for the trunk and crown) and below ground (for soil health and the root system) that is required to protect trees and preserve tree health. This area has been identified as the **critical root zone (CRZ)** or **tree protection zone (TPZ)** by various experts and is generally agreed to be equivalent to the *soil area below ground and the space above ground defined by the tree's dripline*, or the greatest extent of the branches. This is depicted in Figure 1.

However, for small trees, newly planted trees, and trees with narrow crowns, the dripline defines an area that is too small for proper protection. ***So it is best to define both the critical root and tree protection zones as the circular area above and below ground with a radius equivalent to the greater of 6 feet or 1.5 feet for every inch in trunk diameter at 4.5 feet above the ground.*** For example, a tree with a trunk diameter (dbh) of 20 inches has a CRZ and TPZ of 30 feet (20 inches x 1.5) around the tree. While the *radius* of the CRZ (and TPZ) is 30 feet, the *diameter* of the entire CRZ (and TPZ) is 60 feet.

Both concepts--critical root zone and tree protection zone--are used throughout the remainder of this Guide. TPZ is more often used when talking about tree protection.

A generalized requirement for the minimum amount of open soil surface area by tree canopy size category is included in the ACC Tree Species List. Athens-Clarke County established these minimums for the purpose of providing tree canopy cover credits under the Development Regulations. Larger areas are recommended wherever possible. The minimum requirements are listed below:

Very Small Canopy:	**25 square feet (5 x 5 feet)**
Small Canopy:	**100 square feet (10 x 10 feet)**
Medium Canopy:	**225 square feet (15 x 15 feet)**
Large Canopy:	**400 square feet (20 x 20 feet)**

The minimum depth of soil required for adequate root growth is 2 feet, or 24 inches and the maximum required is 3 feet or 36 inches. The minimum soil volume (in cubic feet) required for each tree canopy size listed above can be calculated by multiplying the minimum open soil surface area by 2.0 feet. For example, the *minimum* soil volume required for a tree with a large canopy is 400 square feet x 2 feet, or 800 cubic feet.

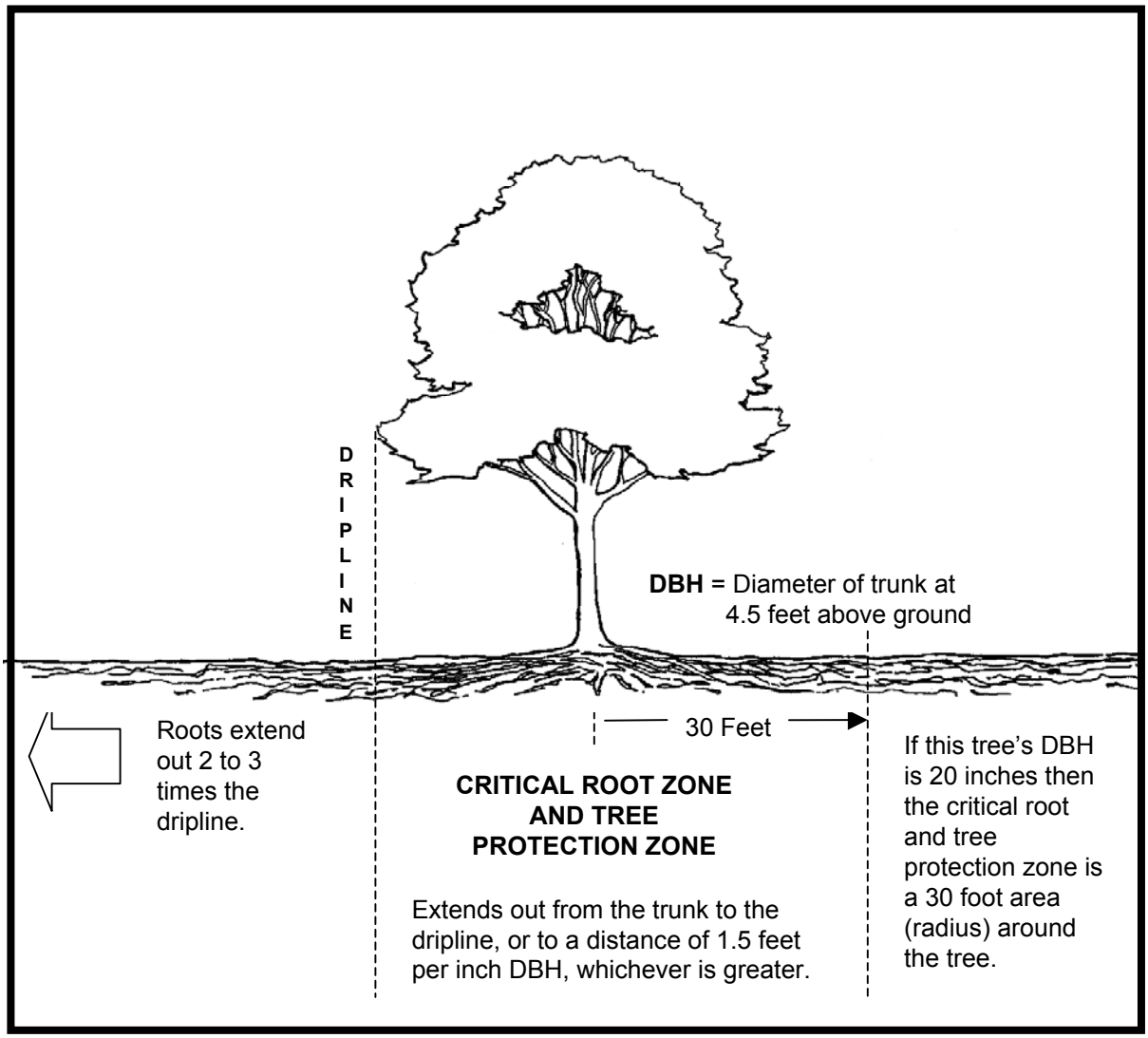


Figure 1. Location of the Critical Root Zone and Tree Protection Zone

For more information on Tree Basics. . .

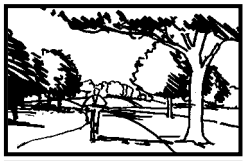
refer to the following publications listed in the Reference section of the Appendix.

- *Arborists' Certification Study Guide*
- *Benefits of Urban Trees*
- *Carbon Dioxide Reduction Through Urban Forestry*
- *Growing Greener Cities: A Tree-Planting Handbook*
- *Guide for Plant Appraisal, 9th Edition*
- *Identified Benefits of Community Trees and Forests*
- *Think Trees*
- *Tree Anatomy*
- *Tree City USA Bulletin No. 5: Living With Urban Soils*
- *Tree City USA Bulletin No. 14: How to Kill a Tree*
- *Tree City USA Bulletin No. 21: How Trees Can Save Energy*
- *Tree City USA Bulletin No. 28: Placing a Value on Trees*
- *Tree City USA Bulletin No. 30: Ten Tree Myths to Thnk About*
- *Tree City USA Bulletin No. 38: The Way Trees Work—How to Help*
- *Tree Growth Rings: Formation and Form*
- *Urban Forestry: A Manual for the State Forestry Agencies in the Southern Region*

Notes:

Section 2: Best Management Practices for Tree Selection and Placement

Throughout Athens-Clarke County there are a number of site situations that have unique characteristics important to the conservation and establishment of trees. In each situation, if trees are well selected and placed, they will provide recognizable, tangible benefits to the property owner and community.



Large Landscape Areas **Page 17**

open and wooded areas, parks, golf courses, large institutional grounds, office and industrial parks, rural lands

Road Frontage Areas **Page 21**

public street right-of-ways, residential front yards, commercial, institutional, industrial, and agricultural frontages

Parking Lots **Page 27**

Urban and suburban, commercial and industrial, paved and unpaved

Plazas and Downtown Settings **Page 35**

sidewalks, paved walkways, tree wells, building plazas, pocket parks

Buffers **Page 39**

environmental buffers, privacy screens, noise barriers, wind breaks

Riparian Zones and Drainage Areas **Page 43**

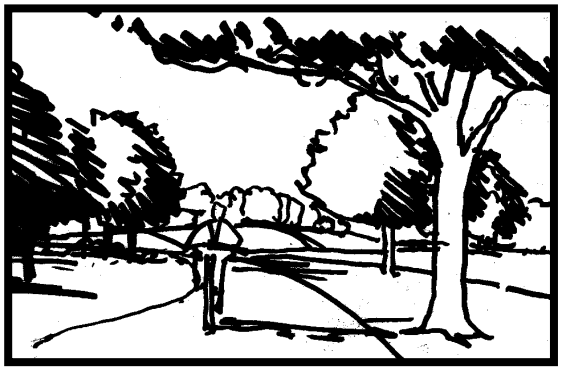
lakes, streams and rivers, wetlands, retention and detention ponds

Utility Corridors **Page 47**

linear landscape corridors for electrical power, gas, water, sewer service easements, and both underground and overhead utility corridors

Notes:

Large Landscape Areas



are open and wooded areas associated with parks, golf courses, large institutions, office and industrial parks, and rural land.

Trees occur singularly, in small groups, and in forest stands within large landscape areas. They usually have abundant growing space for their trunk, crown, and roots. Most of the trees are native and naturally occurring.

While some large landscape areas and the trees within them are intensively managed, such as on a golf course, most are unmaintained or considered "self-maintaining".

Trees growing in large landscape areas are an important part of the regional ecology and contribute the following ***benefits***:

- ☆ **promote environmental quality**
  - ✓ conserve soil and water
  - ✓ reduce stormwater runoff and water pollution
  - ✓ improve air quality and reduce air pollution
  - ✓ cool our communities and reduce energy usage
  - ✓ enhance wildlife habitat
- ☆ **provide a natural setting for outdoor recreation**
- ☆ **beautify the regional landscape**

Some of the ***common mistakes*** made in conserving and planting large landscape areas are:

- ✗ **removal of understory in existing stands**
- ✗ **damage to roots from site development activities**
- ✗ **trees are under-planted with grass**
- ✗ **too much thinning of woodland stands**
- ✗ **woodland clumps conserved or planted are too small**
- ✗ **not enough "tree save" areas**
- ✗ **saving one or two trees out of a woodland to be lawn specimens**
- ✗ **not enough variety of tree species**
- ✗ **trees of poor quality or in poor condition are conserved**
- ✗ **wrong species of trees are planted for the site conditions**
- ✗ **introduction of exotic tree species that become invasive and take over native vegetation**
- ✗ **too much planting in rows**

Best Management Practices for Large Landscape Areas

1. **Conserve and plant trees in mixed groups and stands, as well as singularly where appropriate.**
2. **Save groups of trees whenever possible; trees in existing woodlands protect one another from strong winds, especially in saturated soils.**
3. **Save strips of woodland to connect to other natural areas as corridors for wildlife movement.**
4. **Preserve riparian buffers along streams.**
5. **Conserve and plant trees of different ages.**
6. **Save areas of existing woodlands with understory trees and shrubs intact to preserve microclimate and soil conditions that are beneficial for tree growth.**
7. **Plant primarily native trees that will blend into the broader landscape and ecology of the region.**
8. **Select trees for their suitability to the existing topography, soils, and vegetation.**
9. **Manage areas containing young trees to create valuable mature tree areas over time.**
10. **Work with natural plant succession to achieve landscape goals.**
11. **Create tree islands with understory to enhance wildlife habitats.**

The Best Trees for Large Landscape Areas

Upland Areas

- ☆ Blackgum (M)
- ☆ Dogwood (S)
- ☆ Elm, Winged (M)
- ☆ Hornbeam, Am. (M)
- ☆ Magnolia, So. (L)
- ☆ Maple, Red (M)
- ☆ Maple, So. Sugar (M)
- ☆ Maple, Sugar (L)
- ☆ Oak, Northern Red (L)
- ☆ Oak, Overcup (L)
- ☆ Oak, Scarlet (L)
- ☆ Oak, Shumard (L)
- ☆ Oak, Southern Red (L)
- ☆ Oak, White (L)
- ☆ Pine, Loblolly (L)
- ☆ Pine, Shortleaf (L)
- ☆ Redbud, Eastern (S)
- ☆ Serviceberry, Downy (S)
- ☆ Sourwood (M)

Lowland Areas

- ☆ Alder, Hazel (S)
- ☆ Ash, Green (L)
- ☆ Ash, White (L)
- ☆ Beech, American (L)
- ☆ Birch, River (M)
- ☆ Magnolia, Sweetbay (M)
- ☆ Maple, Red (M)
- ☆ Oak, Overcup (L)
- ☆ Oak, Water (L)
- ☆ Oak, Willow (L)
- ☆ Poplar, Yellow (L)

S = Small 15-25'
M = Medium 25-40'
L = Large >40'

For additional information on appropriate tree species for **Large Landscape Areas** refer to the **Athens-Clarke County Tree Species List** located in **Section 4.**

Trees to Avoid

- ✗ Elm, Chinese
- ✗ Maple, Japanese
- ✗ Maple, Silver
- ✗ Maple, Trident
- ✗ Oak, Pin
- ✗ Oak, Sawtooth

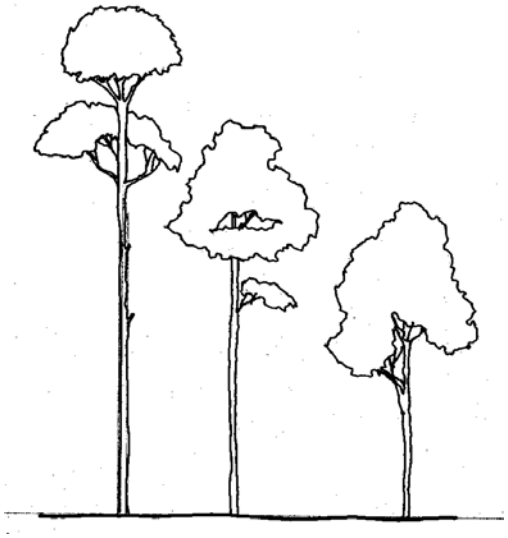
Design Standards for Large Landscape Areas – Saving Trees in Existing Woodlands

GOOD TREE SAVE AREA – High Tree Density with an Undisturbed Understory

- ☆ **trees structurally support one another**
- ☆ **soil remains undisturbed**
- ☆ **shady microclimate encourages natural woodland plants**
- ☆ **natural forest succession continues and forest regeneration in ongoing**
- ☆ **visually attractive**

POOR TREE SAVE AREA – Scattered Trees with the Understory Removed

- ✗ **trees blow over easily**
- ✗ **soil dries out**
- ✗ **soil erosion occurs**
- ✗ **forest microclimate is disturbed and sunlight and temperature increases**
- ✗ **weeds take over**
- ✗ **forest succession is interrupted and regeneration stops**
- ✗ **visually unattractive**



For more information on Large Landscape Areas. . .

refer to the following publications listed in the Reference section of the Appendix.

- *Athens-Clarke County Development Regulations*
- *Conservation Designs for Subdivisions: A Practical Guide to Creating Open Space Networks*
- *Growing Greener Cities: A Tree-Planting Handbook*
- *Landscape Ecology: Principles in Landscape Architecture and Land-Use Planning*
- *Tree City USA Bulletin No. 13: Trees for Wildlife*
- *Tree City USA Bulletin No. 20: A Systematic Approach to Building With Trees*
- *Tree City USA Bulletin No. 27: How to Manage Community Natural Areas*
- *Trees and Development: A Technical Guide to Preservation of Trees During Land Development*
- *Urban Forestry: Planning and Managing Urban Greenspaces*

Notes:

Road Frontage Areas

exist along streets and roads. They are made up of the public road right-of-ways (including medians) and the adjacent property behind them. They include residential front yards and commercial, institutional, industrial, and agricultural frontages.

Frontage areas include both ***street trees*** and ***yard trees*** that are part of a property's landscape design and function. These trees may have been planted, or may have been saved from pre-existing vegetation such as a natural, wooded area. Street trees are found growing both singularly or in groups.

The level of human activity that occurs around these trees, although variable, is usually high and requires a higher level of tree maintenance. Overhead and underground utility corridors, streets, buildings, sidewalks, driveways, mail boxes, signs, street lighting, utility poles, and drainage structures and ditches are common components of these landscapes.

Trees in frontage areas contribute the following ***benefits***:

- ☆ **shade street pavement increasing its useful life**
- ☆ **shade and cool homes and neighborhoods**
- ☆ **create a pleasant and comfortable sidewalk environment**
- ☆ **create an attractive presentation of property and buildings**
- ☆ **screen the view of parking lots and utility areas from public streets**
- ☆ **buffer noise, dust, fumes, and light**
- ☆ **enhance the beauty of public thoroughfares**

Some of the ***common mistakes*** made when planting or conserving trees in frontage areas include:

- ✗ **planting in tree lawns too narrow to support tree growth**
- ✗ **planting too close to buildings and structures**
- ✗ **planting medium or large trees under utility lines**
- ✗ **planting too many of one species of tree along a street or within a neighborhood**
- ✗ **removing trees from a stand and leaving a single specimen with disturbed roots, a small crown, and a tendency to blow over**
- ✗ **over-thinning the canopy or removing the understory in tree save areas**
- ✗ **grading and filling soil within tree-save areas**
- ✗ **severing tree roots and increasing their risk for failure**
- ✗ **leaving trees with root and trunk damage from construction activities that will decline and die**

Best Management Practices for Road Frontage Areas

1. **Plant trees only where there is adequate room both overhead and underground for the mature size of the tree you are planting.**
2. **Vary the spacing of trees along road right-of-ways to add interest and diversity to roadway plantings.**
3. **Maintain sight lines so drivers can see pedestrians and vehicles when pulling out of driveways.**
4. **Provide clearance for large vehicles such as buses and delivery along tree lined streets and drives.**
5. **Provide at least 8 feet of clearance for pedestrians and bicyclists to avoid hazards created by low branches or trees too close to sidewalks and drives.**
6. **Consider the impact of utility line maintenance along roadways.**
7. **Avoid over-thinning a natural stand to reduce susceptibility to wind damage and uprooting.**
8. **Remember that the closer you plant a tree to the street in a frontage area, the more difficult the situation for healthy tree growth.**
9. **Tunnel or bore instead of trenching during utility line installation to avoid damaging tree roots.**
10. **Plant trees a minimum of 15 feet from driveways and 35 feet from road intersections for minor collectors, 50 feet for major collectors, and 100 feet for arterials.**
11. **Avoid planting trees directly over property lines or corners.**
12. **Tree lawns—the planting area between the sidewalk and curb—should be a minimum of 4 feet wide.**
13. **Consider the installation of root barriers along sidewalks and curbs to prevent tree roots from heaving and breaking pavers, sidewalks, curbs, and road pavement.**
14. **Plant trees behind the sidewalk utilizing private property and tree planting easements, to increase above and below ground growing space and vehicular and pedestrian clearance.**

The Best Trees for Road Frontage Areas

Street Trees

- ☆ Crapemyrtle, Common (S)*
- ☆ Dogwood, Flowering (S)*
- ☆ Elm, Chinese (M)
- ☆ Gingko (M)
- ☆ Hornbeam, American (M)
- ☆ Hornbeam, European (M)
- ☆ Maple, Red (M)
- ☆ Maple, Sugar (L)
- ☆ Maple, Trident (M)
- ☆ Oak, Darlington (L)
- ☆ Oak, Overcup (L)
- ☆ Oak, Scarlet (L)
- ☆ Oak, Shumard (L)
- ☆ Oak, Willow (L)
- ☆ Planetree, London (L)
- ☆ Redbud, Eastern (S)*
- ☆ Serviceberry (S)*

Yard Trees

- ☆ All of the Street Trees
- ☆ Ash, Green (L)
- ☆ Ash, White (L)
- ☆ Baldcypress (L)
- ☆ Birch, River (M)
- ☆ Blackgum (M)
- ☆ Cherry, Yoshino (S)
- ☆ Crapemyrtle (S)
- ☆ Elm, Winged (L)
- ☆ Holly, American (M)
- ☆ Magnolia, So. (L)
- ☆ Maple, So. Sugar (M)
- ☆ Oak, Northern Red (L)
- ☆ Oak, Overcup (L)
- ☆ Oak, Post (L)
- ☆ Oak, Southern Red (L)
- ☆ Oak, Water (L)
- ☆ Oak, White (L)
- ☆ Pistache, Chinese (M)
- ☆ Redcedar, Eastern (M)
- ☆ Redwood, Dawn (L)

S = Small 15-25'
M = Medium 25-40'
L = Large >40'

*suitable for planting beneath utility lines

For additional information on appropriate tree species for **Road Frontage Areas** refer to the **Athens-Clarke County Tree Species List** located in **Section 4.**

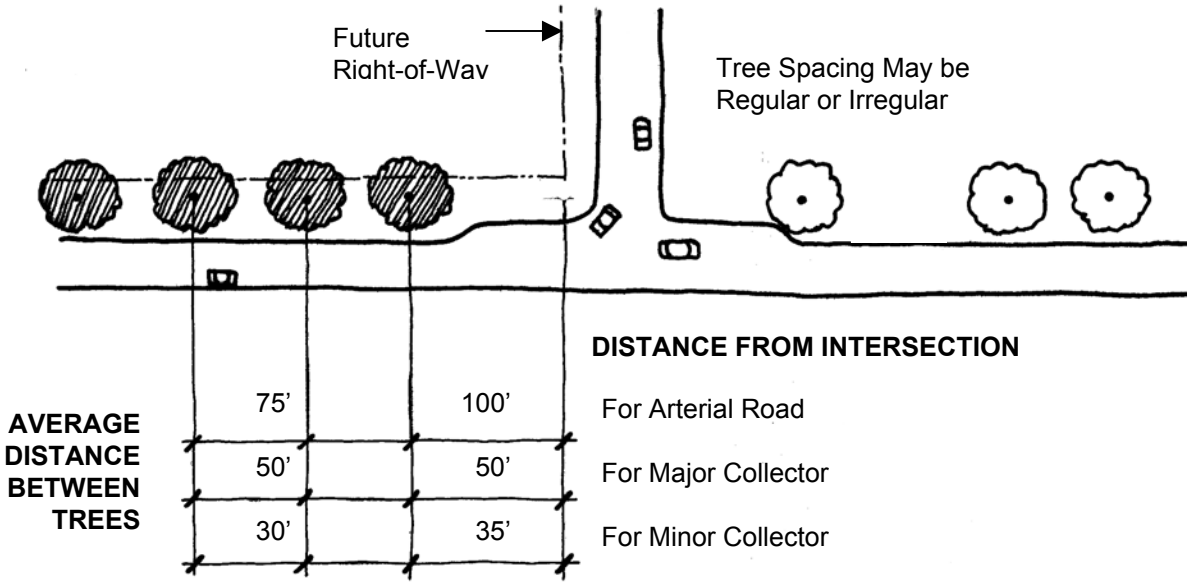
Trees to Avoid

Street Trees

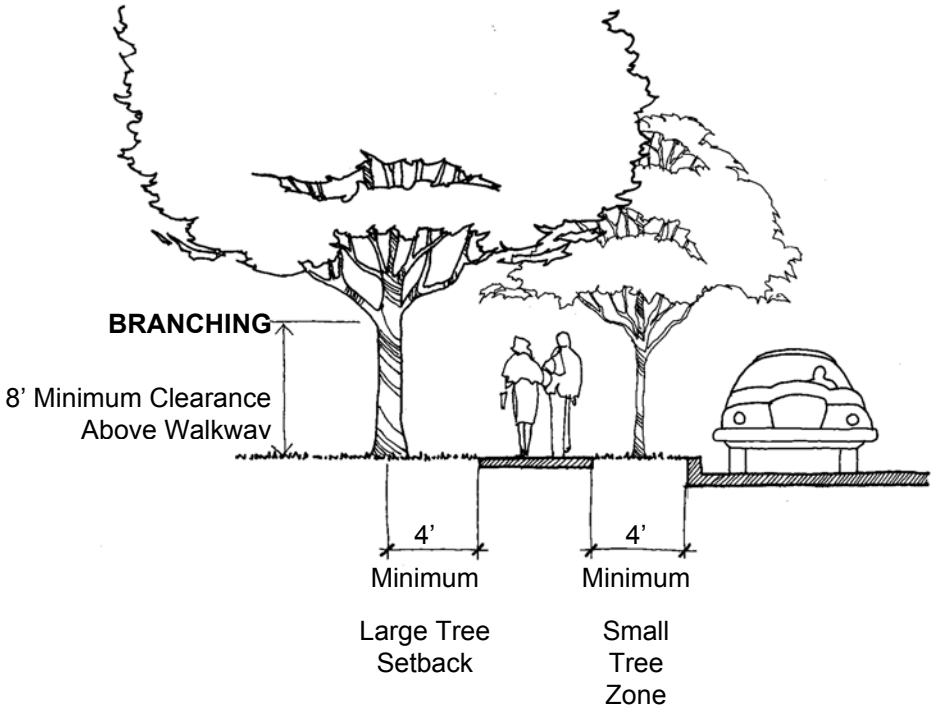
- ✘ Fruit and Nut Trees
- ✘ Trees with Thorns or Spines
- ✘ Catalpa
- ✘ Cherrylaurel, Carolina
- ✘ Cypress, Leyland
- ✘ Ginkgo (female)
- ✘ Hickories
- ✘ Mulberry, Red
- ✘ Oak, Chestnut
- ✘ Oak, Sawtooth
- ✘ Oak, Swamp Chestnut
- ✘ Orange, Osage
- ✘ Pecan
- ✘ Persimmon (female)
- ✘ Royal Paulownia
- ✘ Sweetgum
- ✘ Walnut, Black
- ✘ Willows

Design Standards for Road Frontage Areas

MINIMUM STREET TREE SPACING AND DISTANCE FROM INTERSECTION

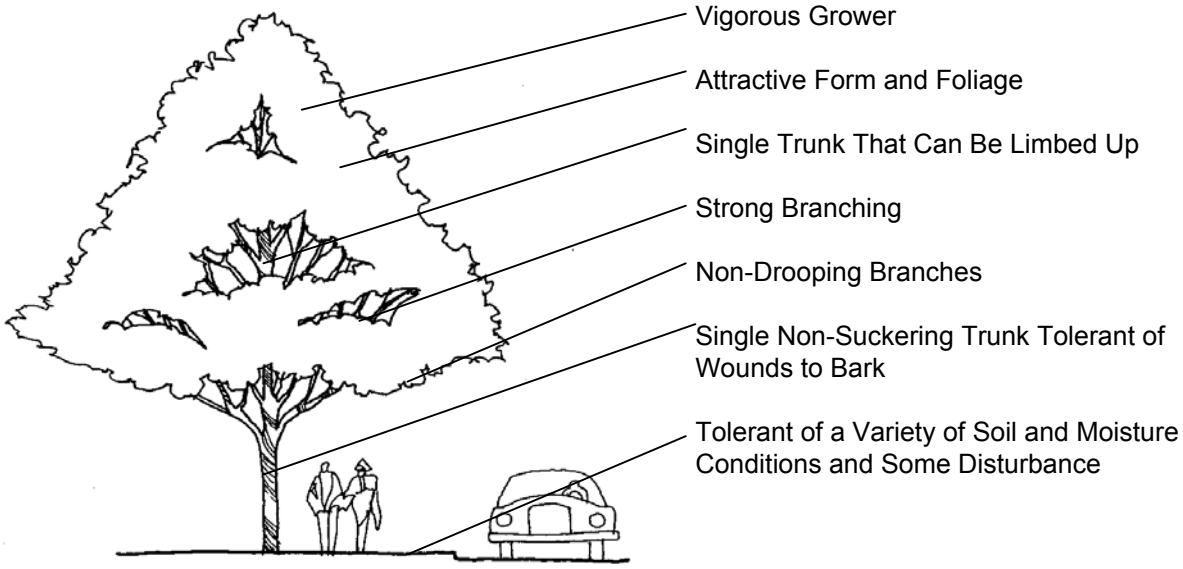


PREFERRED PLACEMENT OF URBAN STREET TREES

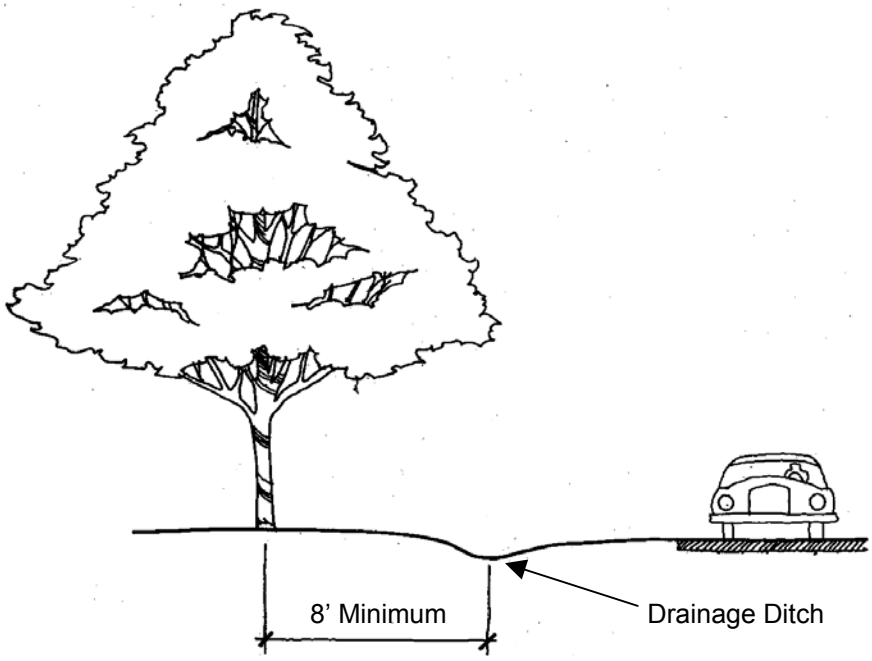


Design Standards for Road Frontage Areas (cont'd.)

DESIRABLE STREET TREE CHARACTERISTICS



PREFERRED PLACEMENT OF RURAL ROAD TREES



For more information on Road Frontage Areas . . .

refer to the following publications listed in the Reference section of the Appendix.

- *Arboriculture and the Law*
- *Athens-Clarke County Development Regulations*
- *Building Greener Neighborhoods: Trees as Part of the Plan*
- *Growing Greener Cities: A Tree-Planting Handbook*
- *Shading Our Cities: A Resource Guide for Urban and Community Forests*
- *Tree City USA Bulletin No. 4: The Right Tree for the Right Place*
- *Tree City USA Bulletin No. 3: Resolving Tree-Sidewalk Conflicts*
- *Tree City USA Bulletin No. 11: How to Prevent Tree-Sign Conflicts*
- *Tree City USA Bulletin No. 35: Protect Trees During Underground Work*

Notes:

Parking Lots

create a site situation for trees that occurs within commercial, industrial, and residential land use areas.

Trees growing in parking lots offset some of the many negative aspects of these sites, including sun, heat, glare, air pollution, stormwater runoff, and unattractiveness.

The parking lot is a difficult environment for trees. Successful conservation and planting of trees in parking lots depend on providing adequate soil volume, water, and nutrients for healthy tree growth. Tree species planted or conserved in parking lots should be selected to provide abundant shade, be heat and pollution tolerant, and effective at intercepting rainwater.

Trees in parking lots contribute the following ***benefits***:

- ☆ **provide shade and cooling to people, vehicles, and pavement**
- ☆ **reduce stormwater runoff**
- ☆ **improve air quality and reduce the amount of volatile organic compounds (VOCs) given off by parked cars**
- ☆ **screen parking areas from roadways and adjacent properties**
- ☆ **reduce glare**
- ☆ **beautify the landscape**

When planting or conserving trees in parking lots, avoid these ***common mistakes***:

- ✗ **small trees are planted where larger trees are possible**
- ✗ **trees are placed around the perimeter of the parking lot and not throughout**
- ✗ **trees are planted with low branching habits that spread into pedestrian zones and parking spaces**
- ✗ **species are planted that cannot tolerate high temperatures from surrounding pavement**
- ✗ **understory (shade-loving) trees are placed in full sun**
- ✗ **slow-growing species are planted**
- ✗ **trees are not provided with enough soil volume for good root growth; tree islands are too small**
- ✗ **soil in tree root zone is compacted and has low organic matter and nutrient content**
- ✗ **trees are planted too close to parking spaces and no protection is provided from car bumpers**
- ✗ **trees are expected to compete with groundcovers or grass, with no additional fertilization or water**
- ✗ **trees that produce heavy or hazardous litter are planted**

Best Management Practices for Parking Lots

1. **Plant one (1) large canopy tree for every seven (7) parking spaces in parking lots.**
2. **Select trees that can withstand the hot, dry microclimates and poor soil conditions of parking lots.**
3. **Plant moderately fast to fast growing trees to realize tree benefits as soon as possible, because parking lots and the trees in them often have short life spans.**
4. **When planting rows of trees include an assortment of species to avoid noticeable gaps when one dies or is damaged.**
5. **Maintain sight lines so motorists can see pedestrians and other vehicles through proper tree selection and regular pruning.**
6. **Insure there is adequate clearance from trees for vehicular turning, backing, and parking.**
7. **Provide curbs or wheelstops around tree planting areas and plant trees at least 30 inches (2.5 feet) inside the curb or wheelstop to avoid tree injury by vehicles.**
8. **Group trees in islands so that they can share rooting space.**
9. **Tree planting islands should have a minimum width of 12 feet.**
10. **The maximum distance between trees in linear tree islands should be 30 feet.**
11. **Provide the required minimum open soil surface areas for very small, small, medium, and large trees of 25, 100, 225, and 400 feet respectively.**
12. **Consider the use of structural soil beneath pavement to increase the volume of soil available to tree roots.**
13. **Consider the use of pervious pavements to increase the moisture penetration and gas exchange for tree roots.**
14. **Consider the use of uncurbed tree planting islands in the form of swales or linear shallow depressions that also serve to filter and absorb stormwater runoff.**
15. **Maintain an 8-foot minimum height to branching for vehicular and pedestrian clearance.**
16. **Irrigate tree islands to insure new tree survival and improve tree long-term tree health.**

The Best Trees for Parking Lots

- ☆ Crapemyrtle (S)
- ☆ Elm, Chinese (M)
- ☆ Elm, Winged (L)
- ☆ Hornbeam, European (M)
- ☆ Maple, Red (M)
- ☆ Maple, Trident (S)
- ☆ Oak, Shumard (L)
- ☆ Oak, Willow (L)
- ☆ Pine, Loblolly (L)
- ☆ Pistache, Chinese (M)
- ☆ Planetree, London (L)

S = Small 15-25'
M = Medium 25-40'
L = Large >40'

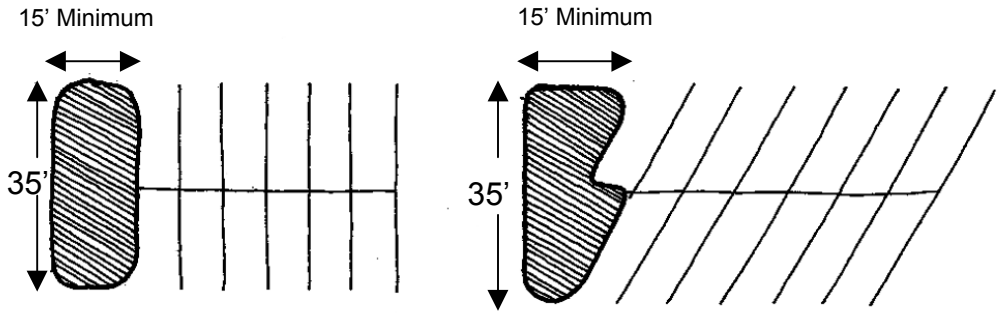
Trees to Avoid

- ✗ Fruit and Nut Trees
- ✗ Cherrylaurel, Carolina
- ✗ Dogwood, Flowering
- ✗ Fruit and Nut Trees
- ✗ Ginkgo (female)
- ✗ Hickories
- ✗ Locust, Black
- ✗ Locust, Honey
- ✗ Magnolias
- ✗ Maple, Japanese
- ✗ Maple, Silver
- ✗ Oak, Chestnut
- ✗ Oak, Pin
- ✗ Oak, Sawtooth
- ✗ Oak, Swamp Chestnut
- ✗ Orange, Osage
- ✗ Pecan
- ✗ Persimmon (female)
- ✗ Sweetgum
- ✗ Walnut, Black
- ✗ Willows

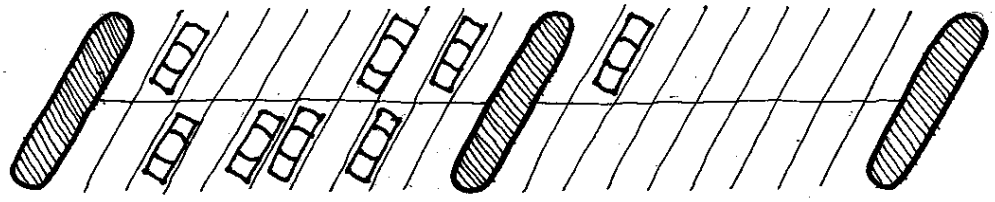
For additional information on appropriate tree species for **Parking Lots** refer to the **Athens-Clarke County Tree Species List** located in **Section 4.**

Design Standards for Parking Lots

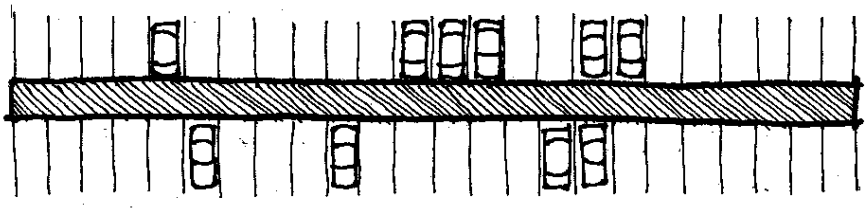
AISLE END PLANTING



PARKING ROW PLANTING

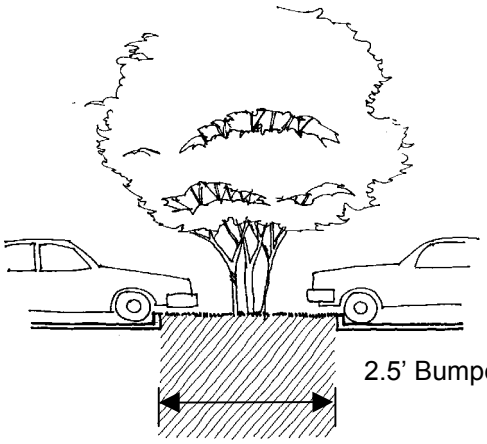


There are many possible layouts for parking lots including tree islands, row planters, or a combination of both.



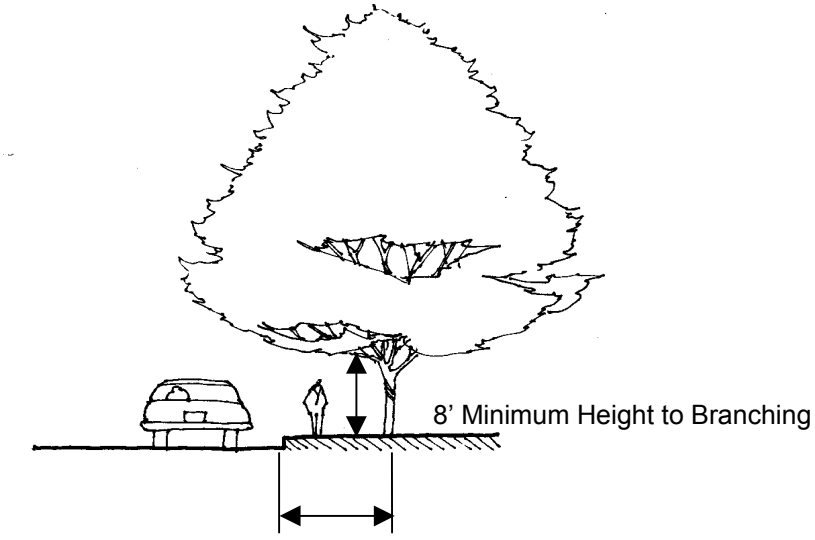
Design Standards for Parking Lots (cont'd.)

PLANTING BETWEEN PARKED CARS



12' Minimum Width

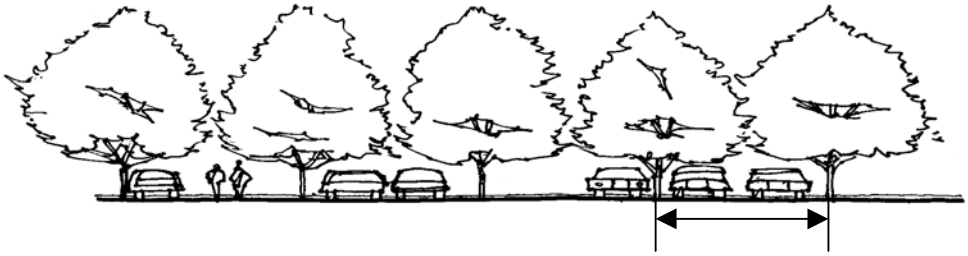
PLACEMENT OF TREES ALONG ENTRANCE DRIVES



8' Minimum Curb to Tree

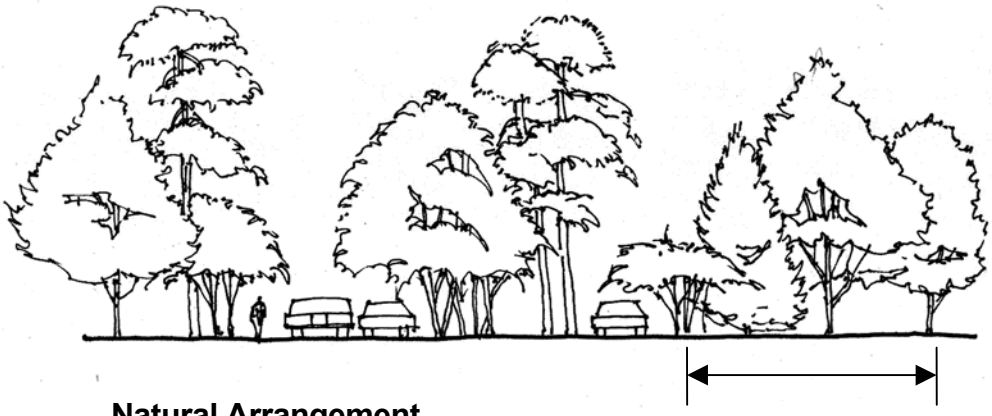
Design Standards for Parking Lots (cont'd.)

TREE ARRANGEMENT AND SPACING



Uniform Arrangement

30' Maximum Spacing

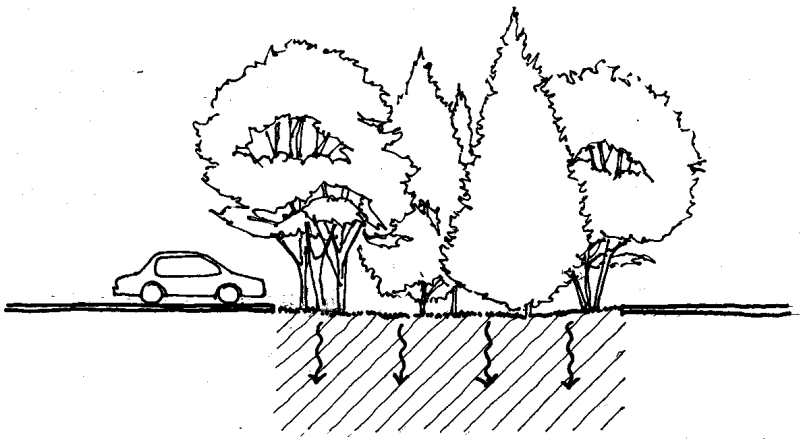


Natural Arrangement

20' Average Spacing

Design Standards for Parking Lots (cont'd.)

STORMWATER DETENTION AREAS



Create shallow depressions adjacent to paving to receive stormwater runoff. Plant with a variety of floodplain tree species that tolerate wetness and that give a natural appearance. Prepare soils to percolate water.

For more information on Parking Lots . . .

refer to the following publications listed in the Reference section of the Appendix.

- *Athens-Clarke County Development Regulations*
- *Growing Greener Cities: A Tree-Planting Handbook*
- *Tree City USA Bulletin No. 5: Living With Urban Soils*
- *Tree City USA Bulletin No. 11: How to Prevent Tree/Sign Conflicts*
- *Tree City USA Bulletin No. 17: How to Landscape to Save Water*
- *Tree City USA Bulletin No. 24: Trees and Parking Lots*
- *Trees and Development: A Technical Guide to Preservation of Trees During Land Development*

Notes:

Plazas and Downtown Settings

are places where people gather to work, eat, meet, shop, and relax, and are found predominantly within commercial, institutional, and residential areas.

Growing space for trees in these areas is limited. The majority are planted as opposed to conserved, are usually growing as single trees, and are often arranged in a linear or rectangular grouping. They are often planted in small tree wells (4 x 4 feet is common) and less often in larger landscape islands.

An abundance of pavement, poor quality and inadequate amounts of soil, close proximity to buildings and streets, air pollution, and high levels of human activity are characteristic of these areas. These characteristics create challenging conditions for tree survival and management.

Trees in plazas and downtown settings contribute the following ***benefits***:

- ☆ **enhance streetscape and hardscape design**
- ☆ **enhance architecture**
- ☆ **provide shade and cooling**
- ☆ **reduce glare**
- ☆ **provide a living component to built environments**
- ☆ **attract people to the area**

Common mistakes made in conserving and planting trees in plazas and downtown settings include:

- ✗ **wrong tree species are selected for the site conditions**
- ✗ **species are selected that drop excessive amount of fruit, limbs, or leaves**
- ✗ **trees with low branching habits spread into pedestrian zone**
- ✗ **trees grow too large for available space**
- ✗ **trees are not provided with enough soil volume for good root growth**
- ✗ **trees are expected to grow uniformly**
- ✗ **trees are not urban tolerant**

Best Management Practices for Plazas and Downtown Settings

1. **Match the species mature size to the amount of available growing space.**
2. **Select trees to enhance architectural design and do not block important building and structure detailing.**
3. **Plant trees where limbs will not impede access for delivery or emergency vehicles.**
4. **Don't assume that site conditions are the same throughout a plaza; plazas can have dramatic changes in temperature from one side to another due to microclimatic conditions created by surrounding buildings.**
5. **Consider alternative (permeable or open) paving systems that accommodate pedestrians and vehicles but increases moisture to tree roots and gas exchange between the roots and the surface.**
6. **Consider the use of structural soils to expand the amount of soil volume available to tree roots.**
7. **Locate trees where underground utilities and compacted soils won't constrict available area for tree roots.**
8. **Look above for overhead utilities that will limit mature tree size.**
9. **Protect trees from vandalism and other damage by limbing up and protecting with sturdy fencing or other barriers.**
10. **Avoid planting tree species that attract wildlife that can be a nuisance in urban settings.**
11. **Budget for increased maintenance costs in downtown.**
12. **Consider the use of structural soil beneath pavement to increase the volume of soil available to tree roots.**
13. **Consider the installation of root barriers along sidewalks and curbs and within tree wells to prevent tree roots from heaving and breaking pavers, sidewalks, and other hardscape.**
14. **Irrigate trees to insure new tree survival and to improve long-term tree health.**
15. **Prune trees regularly to maintain pedestrian and vehicular clearance.**

The Best Trees for Plazas and Downtown Settings

- ☆ Birch, River (M)
- ☆ Cherry, Yoshino (S)
- ☆ Crapemyrtle (S)
- ☆ Elm, Chinese (M)
- ☆ Gingko (M)
- ☆ Hornbeam, American (M)
- ☆ Hornbeam, European (M)
- ☆ Maple, Red (M)
- ☆ Maple, Southern Sugar (M)
- ☆ Maple, Trident (S)
- ☆ Oak, Shumard (L)
- ☆ Oak, Willow (L)
- ☆ Redbud, Eastern (S)
- ☆ Serviceberry, Downy (S)

S = Small 15-25'
M = Medium 25-40'
L = Large >40'

Trees to Avoid

- ✗ Fruit and Nut Trees
- ✗ Cherrylaurel, Carolina
- ✗ Dogwood, Flowering
- ✗ Fruit and Nut Trees
- ✗ Ginkgo (female)
- ✗ Hickories
- ✗ Locust, Black
- ✗ Locust, Honey
- ✗ Magnolias
- ✗ Maple, Japanese
- ✗ Maple, Silver
- ✗ Oak, Chestnut
- ✗ Oak, Pin
- ✗ Oak, Sawtooth
- ✗ Oak, Swamp Chestnut
- ✗ Orange, Osage
- ✗ Pecan
- ✗ Persimmon (female)
- ✗ Sweetgum
- ✗ Walnut, Black
- ✗ Willows

For additional information on appropriate tree species for **Plazas and Downtown Settings** refer to the **Athens-Clarke County Tree Species List** located in **Section 4.**

For more information on Plazas and Downtown Settings. . .
refer to the following publications listed in the Reference section of the Appendix.

- *Athens-Clarke County Development Regulations*
- *Blueprints for Successful Communities*
- *Growing Greener Cities: A Tree-Planting Handbook*
- *Tree City USA Bulletin No. 3: Resolving Tree-Sidewalk Conflicts*
- *Tree City USA Bulletin No. 5: Living With Urban Soils*
- *Tree City USA Bulletin No. 11: How to Prevent Tree-Sign Conflicts*
- *Tree City USA Bulletin No. 17: How to Landscape to Save Water*

Notes:

Buffers

are linear areas that border roadways, the edges of adjacent properties, or dissimilar land uses.

Trees are very effective buffers, either alone or with other vegetation. They may be planted in either groups or in rows, and spaced uniformly or in an irregular pattern. Natural **woodlands** conserved on a site that include overstory, understory, shrub, and herbaceous layers of vegetation are very effective buffers.

In some cases buffers may be limited in width and therefore in the amount of growing space available for trees. In most cases, however, trees in buffer areas remain relatively undisturbed after they are established and have a favorable amount of growing space.

Once planted, tree buffers require little maintenance to be effective. A commitment to replace dead or badly damaged trees to maintain uniformity is required when trees are planted in rows or more ordered arrangements.

Trees planted within buffer zones contribute the following ***benefits***:

- ☆ **provide visual screening**
- ☆ **provide privacy**
- ☆ **block unwanted night lighting and glare**
- ☆ **create a barrier to noise**
- ☆ **control, direct, or protect from wind**
- ☆ **absorb particulate matter and air pollution**

To insure your tree buffers are effective, avoid these ***common mistakes***:

- ✗ **wrong tree species are selected for the site conditions and intended purpose**
- ✗ **tree grows too tall or large for the available space, especially beneath utility lines**
- ✗ **lack of diversity of tree species and sizes**
- ✗ **trees are expected to grow uniformly**
- ✗ **trees are planted in single rows, instead of staggered**
- ✗ **understory is cleared from beneath existing canopy trees**
- ✗ **buffer is not wide enough**

Best Management Practices for Buffers

1. **Select low branching or multi-trunk species to provide visual and physical buffering to the ground.**
2. **Plant a variety of tree species and mature tree sizes.**
3. **Select trees with dense, evergreen foliage to provide screening year-round.**
4. **Select trees for their suitability to the existing topography, soils, and vegetation.**
5. **Conserve existing undisturbed woodlands with understory trees and shrubs for high quality buffers.**
6. **Leave the soil, litter layer, and groundcover undisturbed.**
7. **Plant trees in staggered pattern instead of a single row.**
8. **Plant as wide a buffer as possible to increase the benefits.**
9. **Maintain a minimum planted buffer width of 10 feet.**
10. **Maintain a minimum conserved, undisturbed buffer width of 25 feet.**

The Best Trees for Buffers

Evergreen

- ☆ Cherrylaurel, Carolina (M)
- ☆ Holly, American (M)
- ☆ Magnolia, Southern (L)
- ☆ Magnolia, Sweetbay (M)
- ☆ Pine, Loblolly (L)
- ☆ Pine, Virginia (M)
- ☆ Redcedar, Eastern (M)

Deciduous

- ☆ Baldcypress (M)
- ☆ Birch, River (M)
- ☆ Cherry, Japanese Flowering (S)
- ☆ Cherry, Yoshino (S)
- ☆ Crabapple, Japanese Flowering (S)
- ☆ Crapemyrtle (S)
- ☆ Dogwood, Flowering (S)
- ☆ Hornbeam, American (S)
- ☆ Maple, Red (M)
- ☆ Maple, So. Sugar (M)
- ☆ Maple, Trident (S)
- ☆ Plum, Purpleleaf (S)
- ☆ Redbud, Eastern (S)
- ☆ Redwood, Dawn (L)
- ☆ Serviceberry (S)

S = Small 15-25'
M = Medium 25-40'
L = Large >40'

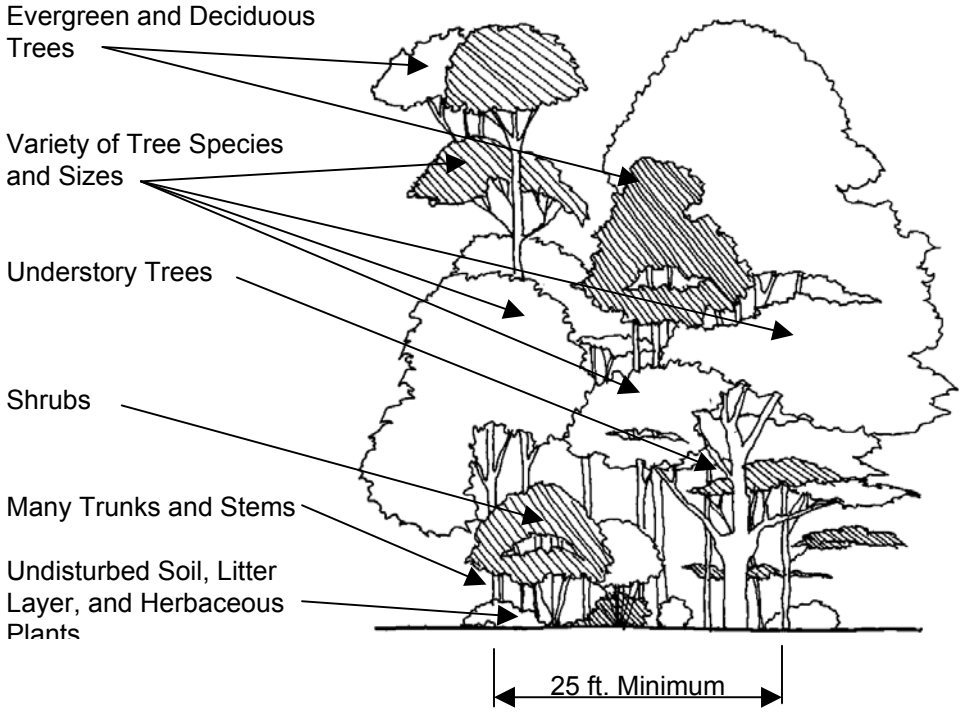
For additional information on appropriate tree species for **Buffers** refer to the **Athens-Clarke County Tree Species List** located in **Section 4.**

Trees to Avoid

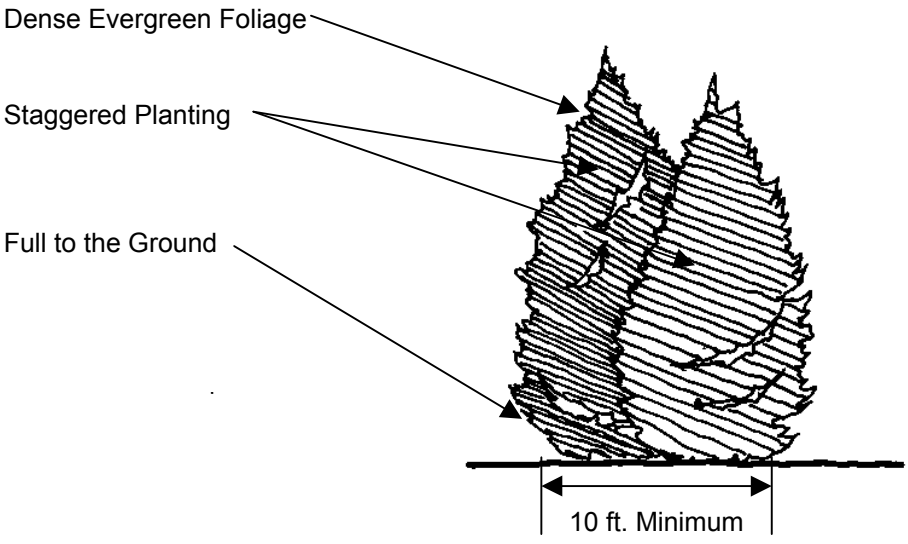
- ✗ Tall, upright, ueciduous trees
- ✗ Sugarberry
- ✗ Beech, American
- ✗ Elm, Winged
- ✗ Oak, Willow
- ✗ Cottonwood, Eastern
- ✗ Ginkgo (male and female)
- ✗ Pecan
- ✗ Elm, Lacebark

Design Standards for Buffers

NATURAL WOODLAND BUFFER



EVERGREEN BUFFER



For more information on Buffers . . .

refer to the following publications listed in the Reference section of the Appendix.

- *Athens-Clarke County Development Regulations*
- *Growing Greener Cities: A Tree-Planting Handbook*
- *Tree City USA Bulletin No. 13: Trees for Wildlife*
- *Tree City USA Bulletin No. 27: How to Manage Community Natural Areas*

Notes:

Riparian Zones and Drainage Areas

are associated with streams, rivers, and drainways. They are characterized by wetlands, alluvial soils, high water tables, and sometimes flooding. In many riparian zones, the topography includes a substantial slope from upland down to lowland areas.

Trees in these areas are an important part of the regional watershed system and have hydrological and ecological significance.

Trees in riparian and drainage areas contribute the following ***benefits***:

- ☆ **improve water quality**
- ☆ **create a natural landscape**
- ☆ **provide quality wildlife habitat, both aquatic and terrestrial**
- ☆ **control soil erosion**

When conserving or restoring trees in a riparian zone or drainage area, avoid these ***common mistakes***:

- ✗ **wrong tree species are selected for the site conditions**
- ✗ **high species diversity is not maintained**
- ✗ **exotic species are introduced or escape and become invasive**
- ✗ **trees are placed too far apart to control soil erosion with root growth**
- ✗ **understory (shade-loving) trees are placed in full sun**

Best Management Practices for Riparian Zones and Drainage Areas

1. **Conserve at least 70% tree canopy cover in riparian zones.**
2. **Save existing woodlands with undisturbed understory trees, shrubs, herbaceous plants, leaf litter, and soil.**
3. **Plant and conserve trees in mixed groups and stands.**
4. **Select species that are adaptable to alluvial soil conditions.**
5. **Manage areas containing young trees to develop valuable mature tree stands over time.**
6. **Avoid exotic species as many are aggressive along creeks and streams.**
7. **In lowland areas plant trees that can tolerate periodic flooding.**
8. **When removing trees in riparian zones, maintain a 75 foot undisturbed buffer along streams.**

The Best Trees for Riparian Zones and Drainage Areas

- ☆ Alder, Hazel (S)
- ☆ Baldcypress (L)
- ☆ Birch, River (M)
- ☆ Hornbeam, American (S)
- ☆ Magnolia, Sweetbay (M)
- ☆ Maple, Red (M)
- ☆ Oak, Water (L)
- ☆ Oak, Willow (L)
- ☆ Poplar, Yellow (L)

S = Small 15-25'
M = Medium 25-40'
L = Large >40'

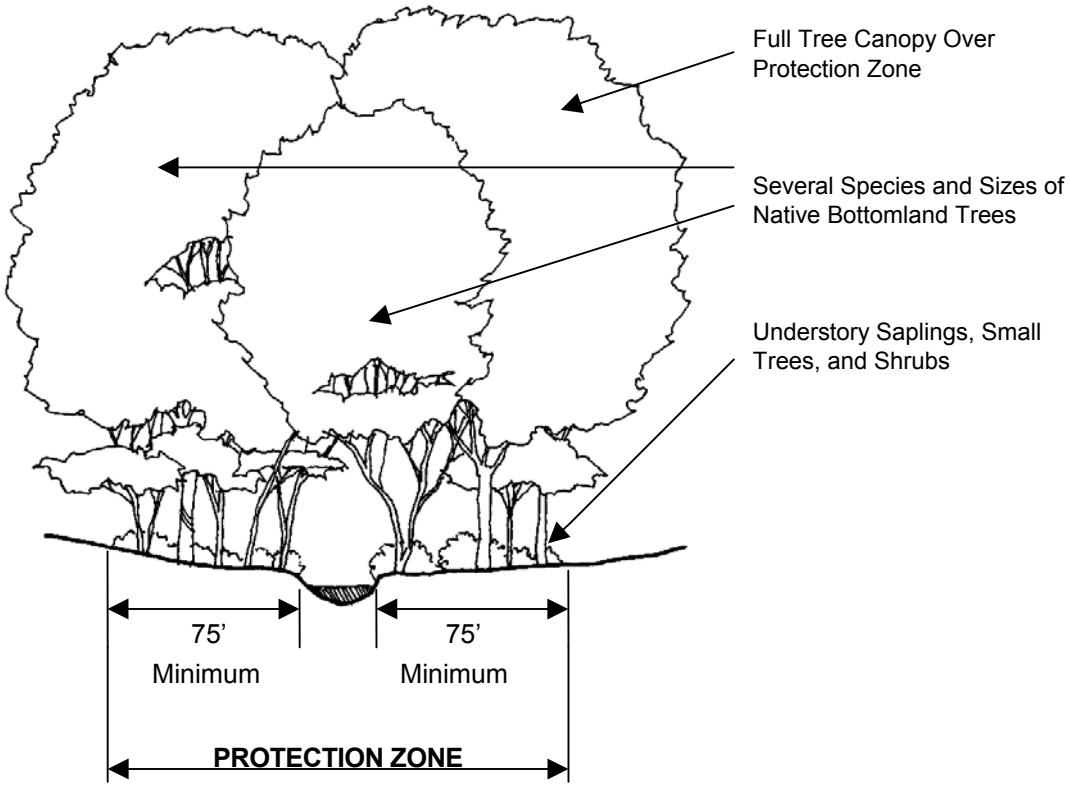
Trees to Avoid

- ✗ Exotic Trees and Shrubs
- ✗ Upland Hardwoods
- ✗ Cherrylaurel, Carolina
- ✗ Crapemyrtle
- ✗ Elm, Chinese
- ✗ Oak, Chestnut
- ✗ Oak, Pin
- ✗ Oak, Sawtooth
- ✗ Orange, Osage
- ✗ Paulownia, Royal
- ✗ Pine, Longleaf
- ✗ Pine, Slash
- ✗ Pistache, Chinese
- ✗ Waxmyrtle, Southern
- ✗ Zelkova, Japanese

For additional information on appropriate tree species for **Riparian Zones and Drainage Areas** refer to the **Athens-Clarke County Tree Species List** located in **Section 4**.

Design Standards for Riparian Zones and Drainage Areas

RIPARIAN ZONES



For more information on Riparian Zones and Drainage Areas . . .
refer to the following publications listed in the Reference section of the Appendix.

- *A Georgia Guide to Controlling Erosion with Vegetation: Establishing and Maintaining Vegetation on Erosive Sites*
- *Athens-Clarke County Development Regulations*
- *Environmental Management Requirements for Stream and River Corridors*
- *Georgia's Best Management Practices for Forestry*
- *Growing Greener Cities: A Tree-Planting Handbook*
- *Land Development Provisions to Protect Georgia Water Quality*
- *Riparian Forest Handbook: Appreciating and Evaluating Stream Side Forests*

Notes:

Utility Corridors

are linear landscape areas that contain power, gas, water, or sewer service. These corridors can be as narrow as 20 feet or as wide as 150 feet, often parallel roadways, and contain above and/or below ground lines. Within the corridors vegetation must be controlled to allow safe maintenance and repair of the utility lines. Long, narrow, linear swaths, these corridors create vegetation "edges" and can actually improve the ecological structure of our community forests. Animal, bird, and insect species that nest in the forest edge and forage in open areas are attracted to these corridors.

Trees within utility corridors contribute the following ***benefits***:

- ☆ **create tree-lined roadways**
- ☆ **screen utility lines from roadways and adjacent properties and soften their visual impact**
- ☆ **buffer wind, dust, and light**
- ☆ **enhance wildlife habitat**

When conserving or planting trees near or within utility corridors, avoid these ***common mistakes***:

- ✗ **trees are planted directly above underground utility service lines**
- ✗ **medium to large sized trees are planted directly beneath or too close to utility lines**
- ✗ **over-sized trees beneath utility lines are retained and routinely "topped"**

Best Management Practices for Utility Corridors

1. **Avoid trees with aggressive root systems near underground water and sewer lines.**
2. **Plant only small maturing trees beneath overhead electrical power lines to insure line clearance can be maintained.**
3. **Maintain adequate clearance from all overhead and underground utility lines to facilitate repairs and minimize impacts to trees.**
4. **Plant trees at least 10 feet from sewer lines, 15 feet from underground electrical power distribution lines, and 20 feet from underground electrical or gas transmission lines.**
5. **Plant medium trees at least 20 feet from overhead electrical distribution lines.**
6. **Plant large trees at least 40 feet from overhead electrical distribution lines.**
7. **Prune trees according to professional standards, employing natural target pruning to remove undesirable limbs at the branch collar.**
8. **Employ crown reduction pruning instead of tree "topping" to reduce tree size beneath utility lines.**
9. **Remove trees in conflict with overhead electrical power lines if clearance cannot be maintained through proper pruning.**
10. **Tunnel instead of trench beneath tree roots within the CRZ for the installation or repair of cable, phone, electric, gas, water, or sewer lines.**
11. **Never use spikes to climb trees during overhead utility line installation or repair.**
12. **Maintain at least 15 foot clearance between overhead power lines and tree limbs.**

The Best Trees for Utility Corridors with Overhead Lines

Small Trees Only

- ☆ Crapemyrtle (S)
- ☆ Dogwood (S)
- ☆ Maple, Trident (S)
- ☆ Plum, Purpleleaf (S)
- ☆ Cherry, Japanese Flowering (S)
- ☆ Crabapple, Japanese Flowering (S)
- ☆ Cherry, Yoshino (S)
- ☆ Magnolia, Southern 'Little Gem' (S)
- ☆ Redbud (S)

S = Small 15-25'
M = Medium 25-40'
L = Large >40'

For additional information on appropriate tree species for **Utility Corridors** refer to the **Athens-Clarke County Tree Species List** located in **Section 4.**

Trees to Avoid

Below Overhead Lines

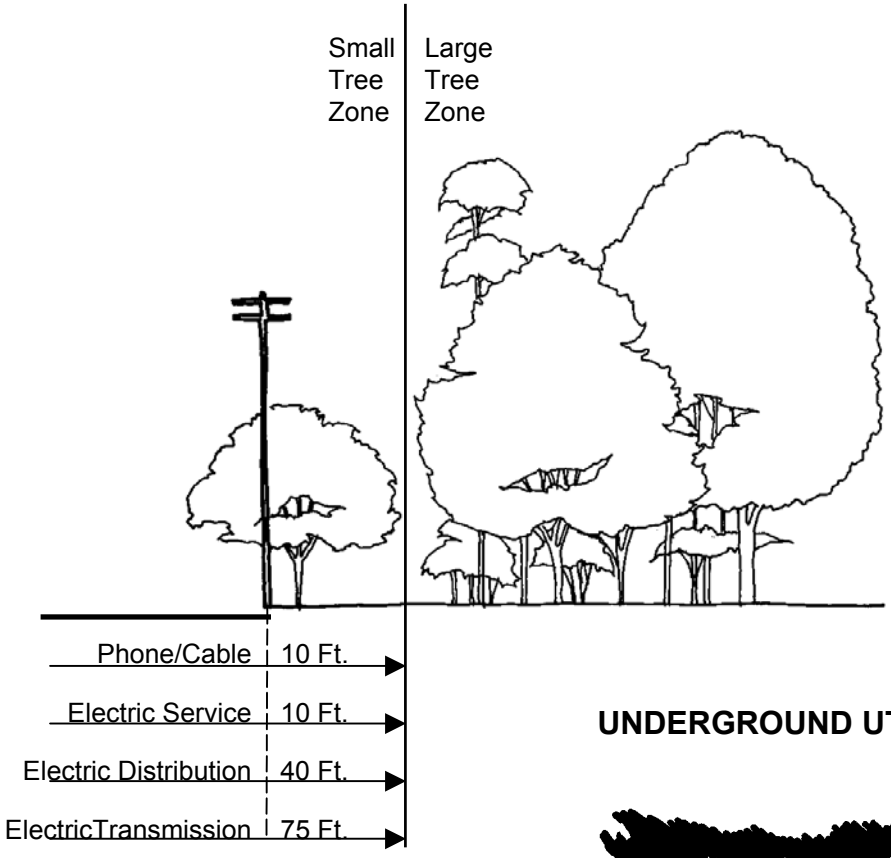
- ✗ Large and Medium Trees
- ✗ Cypress, Leyland
- ✗ Elm, Winged
- ✗ Ginkgo
- ✗ Hickories
- ✗ Holly, American
- ✗ Holly, Savannah
- ✗ Magnolia, Southern
- ✗ Maple, Red
- ✗ Maple, Sugar
- ✗ Oaks
- ✗ Pine, Loblolly
- ✗ Pine, Shortleaf
- ✗ Poplar, Yellow
- ✗ Redcedar, Eastern
- ✗ Sycamore, American
- ✗ Zelkova, Japanese

Near Underground Pipes

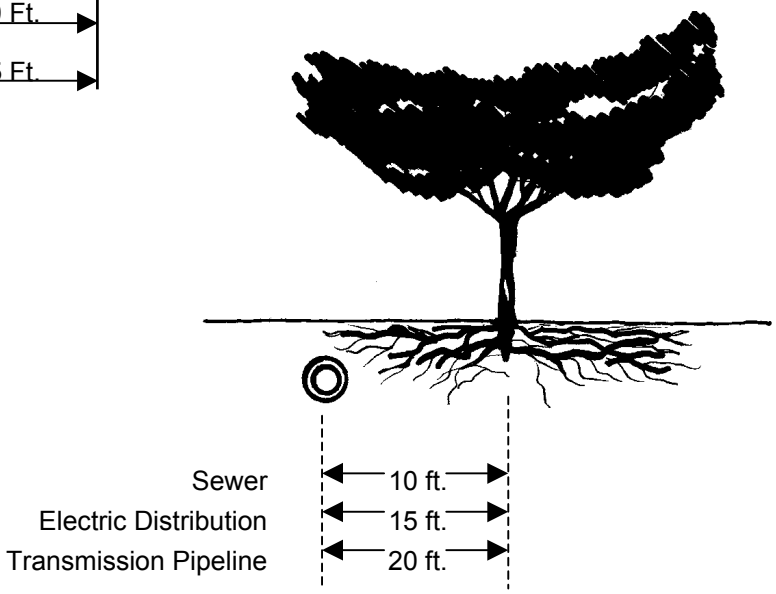
- ✗ Birch, River
- ✗ Boxelder
- ✗ Willows

Design Standards for Utility Corridors

OVERHEAD UTILITIES



UNDERGROUND UTILITIES



For more information on Utility Corridors . . .

refer to the following publications listed in the Reference section of the Appendix.

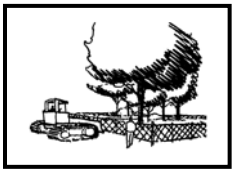
- *Pruning Trees Near Electric Utility Lines: A Field Pocket Guide for Qualified Line-Clearance Tree Workers*
- *Growing Greener Cities: A Tree-Planting Handbook*
- *Tree City USA Bulletin No. 4: The Right Tree for the Right Place*
- *Tree City USA Bulletin No. 8: Don't Top Trees!*
- *Tree City USA Bulletin No. 25: Tree Line USA*
- *Tree City USA Bulletin No. 35: Protect Trees During Underground Work*
- *Trees and Overhead Electric Wires*
- *Trenching and Tunneling Near Trees: A Field Pocket Guide for Qualified Utility Workers*

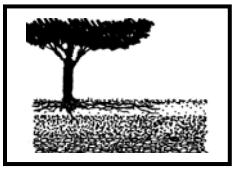
Notes:

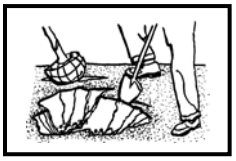
Notes:

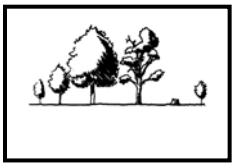
Section 3: Best Management Practices for Tree Care

Regardless of where trees are located in our landscapes, all trees require some level of care. This level of care generally increases as our interaction with the tree and our impact upon the tree increases. Trees in large landscaped areas, buffers, riparian zones, and drainage areas should require little more than a periodic inspection and passive protection. Trees growing along road frontages, in parking lots, in plazas and downtown settings, and in some utility corridors require a much higher level of care, since our interaction with them is frequent. The BMPs in this section address basic tree care activities.









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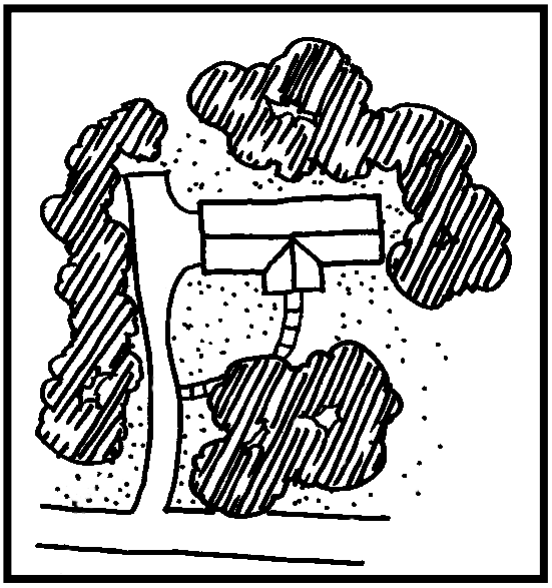
Tree Conservation



is the retention and protection of large and small areas of native forests and other predominantly wooded areas. These areas may be natural and undisturbed, or may be altered substantially by human activities.

By actively conserving trees, you can help to maintain our tree canopy, the largest component of our community's "green infrastructure". *Once our mature, wooded areas are removed for development, it will be at least 50 to 150 years before the trees planted in their place will achieve a similar size and canopy.*

The ***benefits*** of conserving trees in natural, undisturbed groups include:

- ☆ **reduced development and maintenance costs**
- ☆ **reduction in site preparation costs**
- ☆ **larger trees and greater canopy cover generating immediate benefits**
- ☆ **more diverse native plants and animals; native trees, once removed, are often irreplaceable**
- ☆ **healthier trees, ecosystems, watersheds, and environment**
- ☆ **sites that are easier to protect and maintain**

Some of the more ***common mistakes*** made when conserving trees are:

- ✗ **tree conservation is not considered when planning for development**
- ✗ **only large, old, or over-mature trees are conserved**
- ✗ **only unbuildable wetlands, floodplains, and steep slopes are conserved**
- ✗ **all buildable land is subdivided into house lots**
- ✗ **tree conservation areas are too small or narrow, increasing a tree's chances for uprooting and windthrow**
- ✗ **trees are removed or damaged unnecessarily**
- ✗ **severely damaged trees are retained, but not protected, and eventually decline and die resulting in higher costs for the property owner**
- ✗ **large-maturing, long-lived native trees are removed and replaced by small-maturing, short-lived, non-native trees.**

To maintain a healthy amount of tree canopy cover throughout ACC we must strive to retain and plant trees within all types of land use. Within each zone or land use category there is a minimum amount of area that should remain in landscaping and tree canopy to insure that our environment remains healthy. Athens-Clarke County has set a standard in the Development Regulations of maintaining landscaping and tree canopy cover *at or above* the levels listed in Table 1.

Table 1. Landscape and Tree Canopy Cover Standards By Zone and Land Use Category for Athens-Clarke County

Zone	Land Use Category	Landscaping*	Tree Canopy Cover*
RS	Residential-Single Family**	45%	60%
RM-1	Residential-Mixed Density	40%	50%
RM-2	Residential-Mixed Density	30%	45%
RM-3	Residential-Mixed Density	25%	40%
C	General Commercial	15%	30%
C-D	Commercial-Downtown	0%	0%
C-N	Commercial-Neighborhood	20%	35%
C-O	Commercial-Office	25%	40%
E-O	Employment-Office	15%	30%
E-I	Employment-Light Industrial	15%	30%
I	Industrial	5%	20%

*percent of the total site
**not included in the A-CC Development Regulations but recommended

The minimum number of mature trees of various canopy sizes required to achieve a certain tree canopy cover on one acre of land are shown in Table 2.

For combinations of tree sizes, multiply the number of small, medium, and large trees by their square foot area and add the totals together to determine the total tree canopy cover. Typical mature tree canopy area coverage by species is included in the ACC Tree Species List.

Table 2. Minimum Number of Mature Trees Required for Desired Tree Canopy Cover Percent on One Acre of Land (43,560 square feet)

Tree Canopy Cover %	Square Foot Equivalent	TREE CANOPY SIZE UNDER URBAN CONDITIONS			
		Very Small 150 sq ft	**Small** 400 sq ft	**Medium** 900 sq ft	**Large** 1,600 sq ft
5%	2,178	15	5	2	1
10%	4,356	29	11	5	3
15%	6,534	44	16	7	4
20%	8,712	58	22	10	5
25%	10,890	73	27	12	7
30%	13,068	87	33	15	8
35%	15,246	102	38	17	10
40%	17,424	116	44	19	11
45%	19,602	131	49	22	12
50%	21,780	145	54	24	14
55%	23,958	160	60	27	15
60%	26,136	174	65	29	16
65%	28,314	189	71	31	18
70%	30,492	203	76	34	19
75%	32,670	218	82	36	20
80%	34,848	232	87	39	22
85%	37,026	247	93	41	23
90%	39,204	261	98	44	25
95%	41,382	276	103	46	26
100%	43,560	290	109	48	27

Best Management Practices for Tree Conservation

1. **Prior to site development have a professional arborist or forester complete an inventory and evaluation of forest stands on the site. Ideally this should be done one growing season prior to the start of construction.**
2. **Record and map the location, species, trunk diameter (dbh), and canopy cover (crown dimensions), and condition of all significant trees or those matching species or size criteria set by local regulations.**
3. **Consider a conservation design for new residential subdivisions that maximizes open space conservation and common greenspace without reducing overall building density.**
4. **Conserve as many trees as possible in as large of groups as possible.**
5. **Conserve some non-wooded greenspace, such as meadows and fields, in addition to forested areas to create edges and increase plant and animal diversity.**
6. **Conserve contiguous areas of forest across property boundaries to enhance wildlife habitat and movement; create interconnected networks of protected greenspace using the conservation subdivision as the basic building block.**
7. **Conserve a diversity of tree species, sizes, and ages.**
8. **Conserve trees within various levels of the forest canopy—overstory, intermediate, and understory—including at least 3 species within each level.**
9. **When thinning a stand, maintain an optimal basal area between 35 and 70 square feet per acre of forested land (see Section 1 for information on how to calculate basal area).**
10. **Avoid and actively protect against injury to the roots, trunk, or crown of any tree that is to remain on site.**
11. **Protect tree conservation areas during construction with sturdy barriers (fencing) placed around their perimeter, just outside of the area and outside of the edge trees' CRZs.**
12. **Maintain natural forest conditions, leaving the soils, leaf litter, and understory plants intact.**
13. **Do not disturb the soil and tree roots by grubbing, grading, root raking, or underbrushing in tree conservation areas.**
14. **Remove poor quality trees, hazardous trees, trees that cannot be adequately protected, and those within 30 feet of the building footprint.**
15. **Prune the lower limbs of trees to improve or restore a view instead of topping or removing the trees.**
16. **Consider permanent protection of conservation areas through granting of conservation easements to the local government, neighborhood association, land trust, or other non-profit group.**

For more information on Tree Conservation . . .

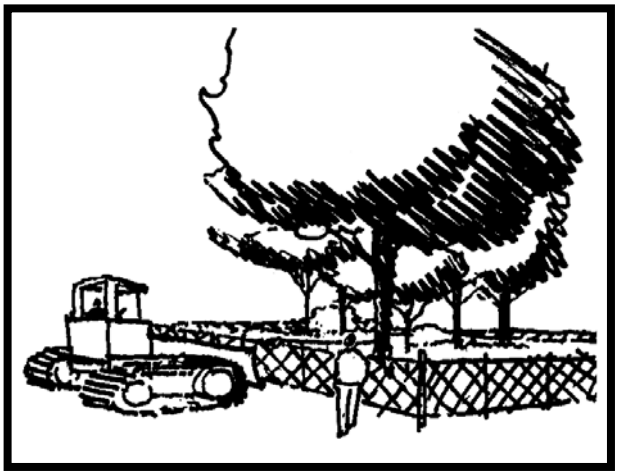
refer to the following publications listed in the Reference section of the Appendix.

- *Building Greener Neighborhoods: Trees as Part of the Plan*
- *Conservation Design for Subdivisions: A Practical Guide to Creating Open Space Networks*
- *Georgia Model Urban Forest Handbook*
- *Growing Greener Cities: A Tree-Planting Handbook*
- *Selecting Wooded Home Sites*
- *Tree City USA Bulletin No. 13: Trees for Wildlife*
- *Tree City USA Bulletin No. 20: A Systematic Approach to Building With Trees*
- *Tree City USA Bulletin No. 27: How to Manage Community Natural Areas*
- *Urban Forestry: A Manual for the State Forestry Agencies in the Southern Region*

Notes:

Notes:

Tree Protection



is any activity designed to preserve tree health by avoiding damage to tree roots, trunk, or crown. All trees should be protected throughout their lives from damage to maximize their health, useful life, function, and benefits. Small, newly planted trees need as much protection as large, mature trees. Tree protection can be passive or active.

Passive tree protection involves simply avoiding any disturbance or harmful activity near the tree. Active tree protection is required during land development, building construction and maintenance, infrastructure installation and maintenance, and other landscape changes that will have a major impact upon trees. For successful tree protection to occur, a good understanding of the concepts of the **critical root zone (CRZ)** and **tree protection zone (TPZ)** is required (see Section 1). Basically, both the CRZ and the TPZ extend out from the tree trunk 1.5 feet for every 1-inch of trunk diameter. A 20-inch diameter tree has a TPZ of 30 feet (radius around the tree).

Some of the ***benefits*** of protecting trees in new and existing developments are:

- ☆ **reduced long-term tree maintenance and replacement costs**
- ☆ **reduced site preparation and grading costs**
- ☆ **larger trees and greater canopy cover providing instantaneous benefits**
- ☆ **positive feedback from neighbors and good public relations**
- ☆ **more diverse native plants and animals; many native trees are unavailable in nurseries and are difficult to re-establish**
- ☆ **healthier trees, forest ecosystem, and environment**

To protect trees, avoid these ***common mistakes***:

- ✗ **no one knowledgeable about trees is involved in the planning and protection processes**
- ✗ **tree conservation and protection are not considered in development planning**
- ✗ **tree protection and "preservation" measures are attempted only after damage has occurred**
- ✗ **tree protection zones are not established around trees on construction sites**
- ✗ **tree protection zones are not clearly marked**
- ✗ **tree protection zones are not large enough**
- ✗ **fencing around tree protection zones is not sturdy enough**
- ✗ **tree trunk and crown are protected, but soil and roots are not**
- ✗ **tree protection is not monitored or enforced**

In addition to avoiding the above mistakes, avoid these ***harmful activities and types of damage*** within the CRZ and TPZ:

- ✗ **removing topsoil during grading without replacing it before planting trees**
- ✗ **trenching for utility line installation or repair**
- ✗ **trenching for irrigation system installation**
- ✗ **grade changes including both soil cuts and soil backfill**
- ✗ **root damage by grading or grubbing**
- ✗ **compacting soil with equipment, vehicles, material storage, and foot traffic**
- ✗ **soil contamination from equipment washouts (especially concrete) and vehicle maintenance**
- ✗ **installation and paving of parking lots, driveways, and walkways**
- ✗ **placing nails, screws, and spikes in trunks to attach mail boxes, signs, lighting, or other structures**
- ✗ **trunk wounds and broken limbs from vehicles and heavy equipment**
- ✗ **trunk wounds from string weed trimmers and lawn mowers**
- ✗ **fire injury or excessive heat**

Some tree species and some individual trees of the same species are more tolerant than others to these activities and damage. A tree's tolerance depends not only upon the species but also upon the conditions present prior to and at the time of the damage. Tree health, soil aeration and moisture, the time of year the damage occurs, how long the damage lasts, its severity, and the weather conditions prior to, during, and after the damage all contribute to the tree's response.

The construction tolerances of some of the most common tree species in Athens-Clarke County are shown in Table 3. A more complete list of species and their tolerance to construction damage can be found in the ACC Tree Species List.

Table 3. Tolerance Rating of Common Athens-Clarke County Tree Species to Construction Damage

Tree Species	Rating	Tolerances/Intolerances
Ash, Green	Good	tolerant of root pruning and loss, benefits from supplemental irrigation following injury, tolerant of saturated soils and fill
Ash, White	Moderate	intolerant of physical injury, poor compartmentalization and susceptible to decay, affected by soil conditions, including aeration and water availability, tolerant of root loss, intermediate in tolerance to saturated soils,
Birch, River	Good	variable tolerance of root loss and saturated soils, tolerant of minor amounts of fill, variable tolerance of root loss and saturated soils, tolerant of minor amounts of fill
Cherry, Black	Moderate	intolerant of physical injury, poor compartmentalization and susceptible to decay, intermediate tolerance to root loss, intolerant of saturated soils, select young, vigorous individuals for preservation
Crapemyrtle, Common	Good	N/A
Dogwood, Flowering	Moderate	physical injury, compartmentalization and decay, pest complications, including chronic and acute attacks, intolerant of site disturbance, intolerant of mechanical injury (poor compartmentalization), pest problems associated with development impacts
Elm, Winged	Good	N/A
Gingko	Good	tolerant of root pruning
Hackberry	Moderate	physical injury, compartmentalization and decay, soil conditions, including aeration and water availability, tolerant of root loss, intermediate or low in tolerance to saturated soils
Hickory, Mockernut	Moderate to Poor	intolerant of physical injury, poor compartmentalization and susceptible to decay, moderately tolerant of construction damage, tolerant of some fill, windfirm
Hickory, Pignut	Moderate	soil conditions, including aeration and water availability, moderately tolerant of construction damage, tolerant of some fill, windfirm, response constrained by soil and water availability
Holly, American	Good	tolerates some fill
Hornbeam, American	Moderate	soil conditions, including aeration and water availability, limited climatic tolerances, including native range, hardiness, and micro-climate change, intolerant of root loss and saturated soils, susceptible to two-lined chestnut borer particularly under conditions of environmental stress, limited tolerance to climatic change, tolerance greatest within native range
Magnolia, Southern	Moderate	physical injury, compartmentalization and decay, response dependent upon location, good within native range, poor outside of it
Maple, Red	Good	response associated with geographic location, tolerant of

Tree Species	Rating	Tolerances/Intolerances
		root pruning and saturated soils
Maple, Sugar	Poor to Moderate	tolerant of root loss, intolerant of saturated and fill soils
Oak, Black	Good	intolerant of root loss and saturated soils
Oak, Chestnut	Good to Moderate	soil conditions, including aeration and water availability, tolerant under good growing conditions
Oak, Northern Red	Good to Moderate	soil conditions, including aeration and water availability, limited climatic tolerances, including native range, hardiness, and micro-climate change, tolerant to root loss
Oak, Post	Good	better in the mid-eastern US than in the south
Oak, Southern Red	Good	response varies, can be largely intolerant of construction activity
Oak, Water	Good	tolerant of saturated soils
Oak, White	Good to Moderate to Poor	soil conditions, including aeration and water availability, intolerant of root loss and saturated soils, moderate tolerance to fill soil
Oak, Willow	Good to Moderate	soil conditions, including aeration and water availability
Pear, Callery (Bradford)	Moderate	intolerant of root pruning
Pecan	Moderate to Good	moderately tolerant of construction damage, tolerant of some fill
Pine, Loblolly	Good	moderate tolerance to root loss, intolerant of saturated soils, injury increases susceptibility to southern pine beetle
Pine, Shortleaf	Good to Moderate	pest complications, including chronic and acute attacks, tolerant of some fill soil
Poplar, Yellow	Poor	physical injury, wood compartmentalization and decay, intolerant of root pruning, sensitive to wounding (poor compartmentalization, response constrained by soil aeration and water availability
Redbud, Eastern	Moderate	soil conditions, including aeration and water availability
Redcedar, Eastern	Moderate	physical injury, wood compartmentalization and decay, soil conditions, including aeration and water availability, tolerant of root loss, intolerant of saturated soils, intolerant of mechanical injury
Sweetgum	Good	Intermediate response to fill and root injury, response varies according to pre-existing site conditions and within species variation

Ratings from *Relative Tolerance of Tree Species to Construction Damage* by Dr. Kim D. Coder, Extension Forest Resources, University of Georgia, June 1996, when available and otherwise from *Trees and Development: A Technical Guide to Preservation of Trees During Land Development* by Nelda Matheny and James R. Clark, 1998 by the International Society of Arboriculture (see the Reference section of the Appendix).

Successful, active tree protection involves three phases. The first phase is **planning** for tree protection activities prior to the beginning of construction and meetings with all parties assigned responsibility for tree protection. The second phase is **implementation and monitoring** of the agreed upon tree protection measures. The

third phase is **follow-up tree maintenance** after the activity is complete. Then, **ongoing protection** should be practiced for all trees on a daily basis.

Best Management Practices for Tree Protection

Planning

1. **Plan and budget for tree conservation and protection as part of the development process.**
2. **Plan for tree protection at least one growing season prior to the beginning of construction activities, where possible.**
3. **Employ the services of a professional arborist, urban forester, or other tree care professional to assist in tree protection planning, implementation, monitoring, and follow-up maintenance.**
4. **Plan for and protect trees located on adjacent property, protecting that portion of the roots, trunk, and crown growing into or over your property.**
5. **Evaluate soil health and past site damage and incorporate into tree protection measures.**
6. **Evaluate existing trees and select trees that will be conserved and protected based upon their location, species quality, health, and benefits.**
7. **Remove trees within 30 feet of the proposed building or structure.**
8. **Remove trees that cannot be protected, those having less than 15%-25% of their total height composed of tree crown, or those with more than one-third of the trunk wounded.**
9. **Do not remove the best trees and conserve the poorest quality trees during thinning.**
10. **Do not save trees that will not be protected.**
11. **Conserve and protect trees in groupings where possible to facilitate their protection and maintenance and to keep the forest structure intact.**
12. **Establish substantial penalties for tree damage and non-compliance with tree protection requirements.**
13. **Complete pre-construction tree maintenance, which should include mulching of the CRZ, fertilization, supplemental irrigation as necessary, and pruning to remove dead, structurally weak, and low hanging branches.**

Best Management Practices for Tree Protection (cont'd.)

Implementation and Monitoring

14. **Educate all workers on site about tree protection techniques and requirements.**
15. **Establish a TPZ equal to a tree's CRZ.**
16. **Establish TPZs early, prior to construction, using barriers or sturdy fencing around individual trees or groups of trees.**
17. **Protect high value trees not only with barriers, but also with stem, branch, and root padding or wraps.**
18. **Clearly identify the perimeter of TPZs with high visibility signs.**
19. **Establish one access route into the site and one exit route out of the site.**
20. **Confine construction offices, vehicular parking, worker break sites, and material storage to places outside of TPZs.**
21. **Alter the route of underground and overhead utility lines that would require trenching or severe pruning of protected trees.**
22. **Do not trench or excavate the soil within CRZs. Tunnel or bore at least 18 inches beneath CRZs to install utility lines.**
23. **Where tree roots must be cut, make only sharp, clean cuts to promote root regeneration.**
24. **Remove badly damaged trees that can attract insect and disease pests.**
25. **Monitor compliance with tree protection requirements and tree health regularly during construction.**

Follow-up Maintenance

26. **Complete post-construction tree maintenance, including pruning, mulching, fertilization, irrigation, and soil aeration where necessary.**
27. **Apply at least 1 inch of water per week by deep watering in the absence of adequate rainfall.**
28. **Fertilize trees with phosphorus, potassium, calcium, magnesium, and other macro- and micro-nutrients as indicated by a soil test, but wait at least one year to apply any nitrogen.**
29. **Fertilize lightly with nitrogen after 1 year, and then make annual light nitrogen applications for the next 3 to 5 years.**
30. **Inspect trees annually for at least 3 and up to 5 years after construction to look for changes in condition and signs of insects or disease, and to determine maintenance needs.**
31. **Remove trees that are badly damaged or in irreversible decline.**
32. **Continue to protect not only the large, established trees on the site but also those newly planted in the landscape.**

Best Management Practices for Tree Protection (cont'd.)

Ongoing Protection

33. **Maintain an "invisible" passive TPZ (at the future, maximum CRZ) around all trees throughout their lives.**
34. **Avoid damage to tree trunks and bark from mowers and string weed trimmers.**
35. **Avoid trenching in the CRZ for utility line and irrigation system installation.**
36. **Avoid damage to tree limbs and trunks during home maintenance and repair projects.**
37. **Avoid soil contamination from oil, gasoline, paint, paint thinner, or other chemical washouts.**
38. **Avoid crown (leaf) contamination from airborne particles from sanding, plaster repair, etc.**
39. **Avoid digging within the CRZ to plant shrubs, flowers, and turf that will compete with the tree for water and nutrients.**
40. **Avoid attaching wires, cables, conduit, mailboxes, or other objects to trees.**
41. **Do not park or drive cars, trucks, or heavy equipment within the CRZ.**
42. **Avoid placing paved walkways and driveways within the CRZ of valuable, large, and mature trees.**
43. **Keep the CRZ mulched at all times.**
44. **Increase a tree's CRZ and TPZ as the tree gets older and grows larger.**

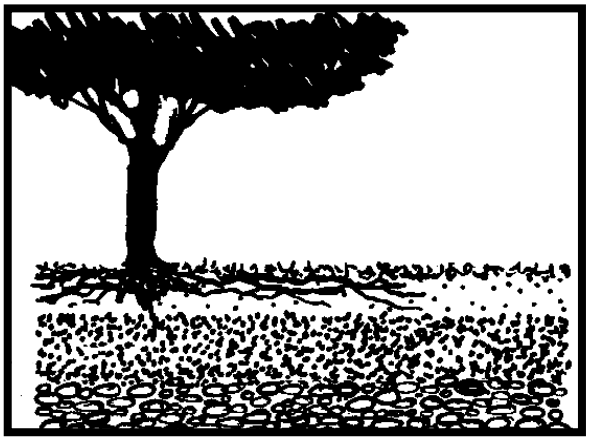
For more information on Tree Protection . . .

refer to the following publications listed in the Reference section of the Appendix.

- *Arborists' Certification Study Guide*
- *Assessing Construction Damage: Tree Damage Exposure and Recovery Times*
- *Athens-Clarke County Development Regulations*
- *Best Management Practices (BMPs) for Construction Sites*
- *Construction Damage Assessments: Trees and Sites*
- *How to Protect Natural Resources on Construction Sites: The Builder's Guide*
- *Relative Tolerance of Tree Species to Construction Damage*
- *Tree City USA Bulletin No. 7: How to Save Trees During Construction*
- *Tree City USA Bulletin No. 20: A Systematic Approach to Building With Trees*
- *Tree City USA Bulletin No. 35: Protect Trees During Underground Work*
- *Tree Support Systems: Cabling, Bracing, and Guying*
- *Trees and Building Sites*
- *Trees and Development: A Technical Guide to Preservation of Trees During Land Development*
- *Trenching and Tunneling: A Field Pocket Guide for Qualified Utility Workers*
- *Urban Forestry: A Manual for the State Forestry Agencies in the Southern Region*

Notes:

Soil Health Maintenance



is the preservation of natural soil conditions that are conducive to plant growth. Preserving *soil* health is essential to preserving tree *root* health, which in turn promotes *whole tree* health. While it seems that some trees will grow anywhere, most trees are particular about the soil conditions under which they will thrive.

Soil consists of basic components--mineral matter, organic matter, soil organisms, and pore spaces that hold water and oxygen. Both the texture of the soil (relative components of sand, clay, and loam) and the structure of the soil (arrangement of soil particles) are important factors in determining how much water and oxygen a soil can hold.

Soil fertility is also important, and can be evaluated using standard tests that measure the amount of phosphorous, potassium, calcium, magnesium, zinc, and manganese in the soil. The availability of these elements is affected by soil pH and organic matter content. Soil tests can determine the soil pH (acidity/alkalinity) and the amount of organic matter present by weight. The Cooperative Extension Service provides free soil sampling advice and soil sample analyses for a nominal fee. See the References section of the Appendix for contact information.

Maintaining soil health and adequate soil volume provides the following ***benefits***:

- ☆ **improved tree survival, growth, and longevity**
- ☆ **maintenance of structural integrity of the root system and reduction in the probability of whole tree failure**
- ☆ **allows for root development without intrusion of roots into sewer lines**
- ☆ **reduced soil erosion and improved water quality**

To maintain healthy soil and tree roots avoid these ***common mistakes*** within (and as far as possible beyond) the tree's critical root zone (CRZ):

- ✗ **compacting soil with foot, vehicle, and equipment traffic and materials storage**
- ✗ **cutting roots by trenching for utility line installation or repair**
- ✗ **grade changes, including cuts and fills**
- ✗ **change in water drainage patterns and water levels**
- ✗ **removal of topsoil without replacement**
- ✗ **soil contamination from equipment washouts, vehicle and lawn maintenance chemicals**

- ✗ **lack of adequate soil volume within and around hardscapes such as tree wells, plazas, and parking lots**
- ✗ **fertilization without testing**
- ✗ **heavy applications of fertilizer**
- ✗ **heavy applications of weed and feed products to turf within the root zones of trees**

Trees require adequate volumes of soil in which their roots can expand, allowing for tree growth. How much is enough? The amount of soil volume required by a tree varies with the species. An "adequate" volume of 920 cubic feet of healthy soil is recommended per square foot of tree trunk cross sectional area at dbh (per Kim D. Coder, see Reference section in the Appendix). Optimally, this volume is calculated for the potential, future diameter of the tree, and not its current size. The minimum soil depth recommended is 2.0 feet and the maximum soil depth is 3.0 feet.

It is very important to recognize that a tree's requirement for growing space and soil rooting volume increases as tree age and size increases. At the time they are planted, trees should be provided with enough growing space for their future, mature size*. If adequate soil volumes are not available throughout a tree's life, then much more intensive management is required and the tree will be reduced in size, condition, and useful life span.*

Table 4 below provides some examples of the recommended soil surface areas for various sizes of mature trees, using the basic requirement of 920 cubic feet of healthy soil per square foot of tree cross sectional area. The four diameters listed can be thought of as the average mature trunk size for small trees (6 to 12 inches), medium trees (24 inches), and large trees (36 inches). Athens-Clarke County has established minimum open soil surface area requirements by canopy size instead of trunk diameter, and these are also listed in Table 4.

Table 4. Recommended Soil Volumes and Surface Areas For Trees of Various Diameters

Tree DBH In Inches*	Trunk X-Sectional Area In Square Feet	Required Soil Volume In Cubic Feet	Required Soil Surface Area In Square Feet (2.5 Foot Soil Depth)	Approximate Radius of Circular Soil Surface Area In Feet	ACC Open Soil Surface Area Requirement in Square Feet
6 (VS)	.2	181	72 (~8.5 x 8.5)	**5**	**25 (5 x 5 feet)**
12 (S)	.8	736	294 (~17 x 17)	**10**	**100 (10 x 10 feet)**
24 (M)	3.1	2,852	1,141 (~34 x 34)	**20**	**225 (15 x 15 feet)**
36 (L)	7.1	6,532	2,613 (~50 x 50)	**30**	**400 (20 x 20 feet)**

*Letters in parentheses refer to the canopy size categories listed in the ACC Tree Species List.

Best Management Practices for Soil Health Maintenance

1. **Maintain favorable soil conditions for root and tree growth at all times.**
2. **Maintain adequate soil volumes for root growth throughout the life of the tree.**
3. **Sample soil to provide baseline information on nutrient availability, organic matter content, and pH.**
4. **Fertilize trees only as necessary and based upon the results of soil tests.**
5. **Maintain a pH of 5.0 to 6.0 for optimal tree growth for evergreen conifers, and 6.0 to 7.0 for most broadleaf trees; know the pH requirements of your trees.**
6. **Maintain a soil organic matter content of 5%.**
7. **Mulch trees to increase soil nutrient levels and organic matter content and improve soil structure.**
8. **Consider applications of mycorrhizae forming fungi (beneficial, naturally occurring) to improve water and nutrient uptake of trees in soils with low fertility.**
9. **Use trees with non-aggressive root systems near underground sanitary and storm sewer pipes; plant trees as far from pipes as possible.**
10. **Use root barriers to encourage roots to grow deeper near sidewalks, driveways, and walkways.**
11. **Preserve native soils; if topsoil must be removed for construction or site grading, store on site and outside of the CRZ of protected trees, and replace after grading is complete.**
12. **Maintain soil bulk densities below 1.4 g/cc in clay soils, and 1.8 g/cc in sandy soils.**
13. **Maintain macro-pore space between 12 to 21% of soil volume.**
14. **Avoid soil compaction within the CRZ; compaction decreases the amount of available water and oxygen and can injure or kill tree roots.**
15. **Avoid parking vehicles or heavy equipment, or storing construction materials, beneath trees.**
16. **Use vertical mulching techniques to improve soil aeration.**
17. **Consider the use of “structural soils” to improve root penetration while achieving soil compaction standards.**

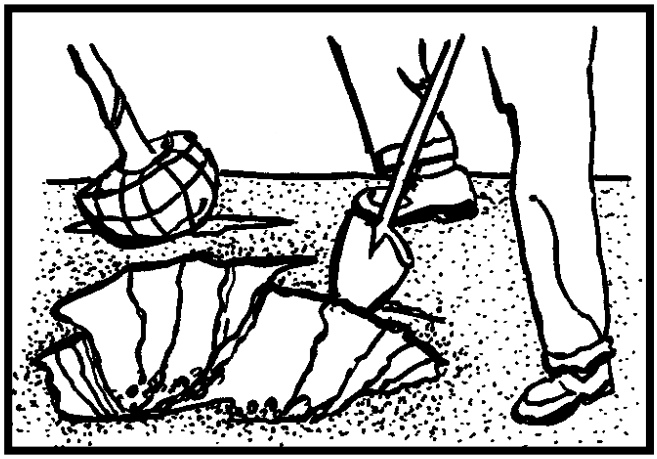
For more information on Soil Health Maintenance . . .

refer to the following publications listed in the Reference section of the Appendix.

- *Arborists' Certification Study Guide*
- *Root Growth Requirements and Limitations*
- *The Landscape Below Ground I: Proceedings of an International Workshop on Tree Root Development in Urban Soils*
- *The Landscape Below Ground II*
- *Trees and Development: A Technical Guide to Preservation of Trees During Land Development*
- *Tree City USA Bulletin No. 5: Living With Urban Soils*
- *Tree City USA Bulletin No. 35: Protect Trees During Underground Work*
- *Urban Forestry: A Manual for the State Forestry Agencies in the Southern Region*
- *Urban Soil in Landscape Design*

Notes:

Tree Establishment



consists of a series of steps that begins with the development of a planting plan designed to meet the objectives of the property owner or the requirements of local development regulations. Once a plan is developed, the establishment process continues with the selection of planting sites and appropriate species. The sites are prepared, trees are purchased and planted, new tree maintenance begins, and regular maintenance continues for at least 3 years, completing the establishment process.

New trees should be planted on a regular basis--to replace trees that are removed, to add to an existing group of trees, and to insure that our community forest remains diverse, dynamic, and stable. The ACC Tree Species List is a good source of detailed information about 166 important tree species and a useful tool for making tree selection and placement decisions.

The ***benefits*** of regular and successful tree establishment are:

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

Common mistakes made in tree establishment include:

- ✗ **not enough growing space provided and the tree grows too large for the available space**
- ✗ **inadequate soil volume provided with restricted root growth and decreased tree stability**
- ✗ **species planted does not meets the site conditions of available growing space, soil moisture and pH, sunlight, temperature, or general climate**
- ✗ **poor quality planting stock is selected, most often with co-dominant leaders (forked stems) or inadequate root systems**
- ✗ **tree is planted in a hole that is too small**
- ✗ **tree is planted too deep, below ground level**
- ✗ **regular after-planting care is not provided during the 3-year establishment period**
- ✗ **trees are staked unnecessarily**
- ✗ **tree watering rings remain in place longer than 1 year**
- ✗ **stakes and guy wires are incorrectly placed or left on longer than 1 year**

Best Management Practices for Tree Establishment

Tree Selection

1. **Match tree growth requirements with soil and environmental conditions on the site using the ACC Tree Species List.**
2. **Select a tree of appropriate size (at maturity) for the site.**
3. **Select native tree species for planting if they are available and where they match the site conditions, instead of non-native species.**
4. **Use proven, non-native species for special purposes or difficult situations.**
5. **Select only good quality planting stock, trees with a good quality root system, a straight trunk without wounds, a single, central leader (no "forked" stems), and a full, well-balanced crown.**
6. **Select trees that meet the minimum standards for root ball size and quality as defined in the American Standards for Nursery Stock.**
7. **Protect trees from wind damage during transport by covering with a tarp or landscape fabric.**

Site Selection

8. **Place trees where they have plenty of room to grow to maturity without their health or form being compromised by conflicts with infrastructure.**
9. **Provide trees with an adequate amount of soil volume for tree growth and stability.**
10. **Make sure there is now and will be at tree maturity adequate clearance from overhead utility lines, pedestrian and vehicular traffic, buildings, signs, and street lights.**
11. **Plant at least 10 feet from an underground utility line.**
12. **Plant only small maturing trees within 10 feet of an overhead utility line.**

Site Preparation

13. **ALWAYS call the Utilities Protection Center at 1(800)282-7411 for utility locates before you dig to install trees.**
14. **Till, harrow, or break up compacted soils in an area 5 to 10 times the width of the new tree's root ball or container.**
15. **Dig a planting hole that is at least 2 times and as much as 5 times the width of the new tree's root ball or container.**
16. **Dig the planting hole no deeper than the height of the new tree's root ball.**
17. **Do not add soil amendments such as peat moss or fertilizer to the planting hole.**

Best Management Practices for Tree Establishment (cont'd.)

Tree Planting

18. **Move the tree using only the root ball or container; avoid using the tree trunk as a "handle" to move trees, which can break tree roots and damage the trunk.**
19. **Plant the root ball at or slightly above ground level, never below.**
20. **Remove all tags, wires, string, straps, burlap, and wire baskets from the root ball.**
21. **Backfill the planting hole with the original soil.**
22. **Do not add fertilizer or other soil amendments to the planting hole.**
23. **Water once when the planting hole is halfway full of soil, and again thoroughly when full to eliminate air pockets.**
24. **Do not create a watering ring around the tree unless soil conditions are very dry; remove rings after one year.**
25. **Do not stake the tree unless it is unable to stand upright on its own; always remove stakes and guy wires after 1 year.**

New Tree Maintenance

26. **Mulch newly planted trees with leaves, pine straw, or other organic materials to 3-4" in depth and in a 5-foot radius around the tree, or as wide as possible; keep the mulch at least 5 inches from the tree trunk.**
27. **Prune only dead, broken, crossed, or rubbing branches; prune annually thereafter.**
28. **Water in the amount of 1" per week in the absence of adequate rainfall.**
29. **Establish tree protection zones (TPZs) around new trees during construction activities.**
30. **Inspect newly planted trees regularly to evaluate their condition and maintenance needs.**
31. **Remove tree watering rings after one year.**
32. **Remove stakes and guy wires after one year.**

Proper tree planting is essential to long-term tree survival and health. Figure 2 shows the recommended method for planting a tree.

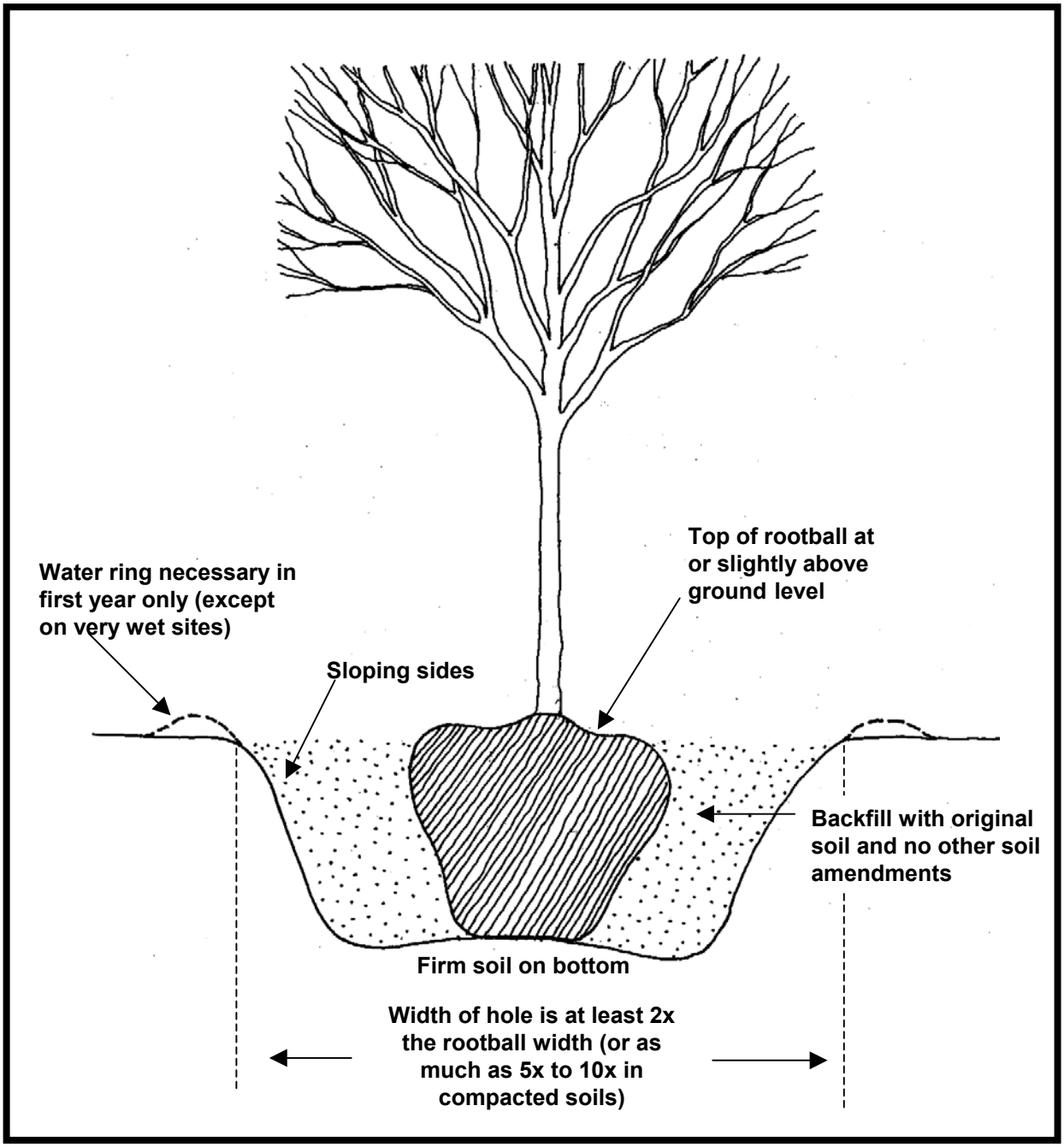


Figure 2. Recommended Tree Planting Method

For more information on Tree Establishment . . .

refer to the following publications listed in the Reference section of the Appendix.

- *American Standard for Nursery Stock*
- *Arborists' Certification Study Guide*
- *Guide to Southern Trees*
- *Horticopia CD-ROM*
- *Michael A. Dirr's Photo-Library of Wood Landscape Plants CD-ROM*
- *Plant Trees Right!*
- *Principles and Practice of Planting Trees and Shrubs*
- *Southern Trees CD-ROM*
- *Tree City USA Bulletin No. 4: The Right Tree for the Right Place*
- *Tree City USA Bulletin No. 5: Living With Urban Soils*
- *Tree City USA Bulletin No. 17: How to Landscape to Save Water*
- *Tree City USA Bulletin No. 19: How to Select and Plant a Tree*
- *Tree City USA Bulletin No. 26: Understanding Landscape Cultivars*
- *Trees of Georgia and Adjacent States*
- *Urban Forestry: A Manual for the State Forestry Agencies in the Southern Region*

Notes:

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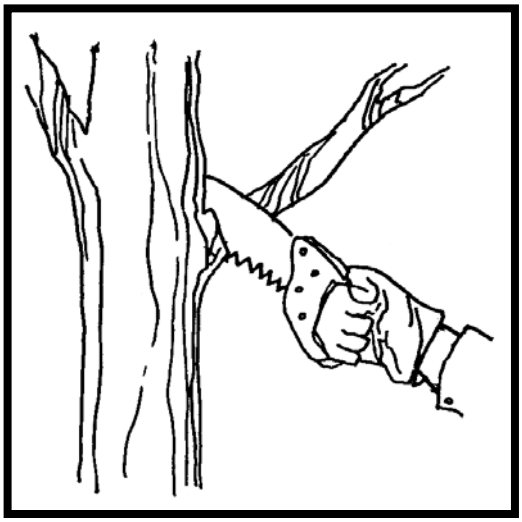
Tree Maintenance



is routine care given to a tree throughout its life to preserve or improve its health, function, and safety. The amount of maintenance a tree requires depends on the species, the tree's location in the landscape, its age, and the care (or abuse) it's been given. Basic tree maintenance begins with regular inspections to determine a tree's needs which may include **pruning**, **mulching**, **fertilization**, **irrigation**, and **pest management**. Each of these maintenance activities is discussed separately below.

Tree Pruning

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

The American National Standards Institute (ANSI) and the International Society of Arboriculture publish tree pruning and safety standards, known as ANSI A300-1995 Standards for Tree Care Ooperations (see "For more information…" at the end of this topic and the References section in the Appendix). Athens-Clarke County has adopted these professional standards for their public tree pruning operations.

The ***benefits*** of regular and correct tree pruning are:

- ☆ **better tree form, health, and structural integrity**
- ☆ **removal of decaying and diseased wood**
- ☆ **decrease in overall risk of limb failure**

Some of the ***common mistakes*** made in tree pruning include:

- ✗ **improper techniques such as topping, stub cuts, flush cuts, and stripping the bark beneath the pruning cuts**
- ✗ **using spikes to climb trees for pruning**
- ✗ **waiting until limbs get large to prune them**
- ✗ **pruning trees on a crisis only basis**
- ✗ **pruning to reduce tree size as a substitute for proper tree selection and placement**

Best Management Practices for Tree Pruning

1. **Hire only experienced professionals to prune trees; arborists certified by the International Society of Arboriculture are required to pass a written test of basic arboricultural knowledge and to attend continuing education courses to maintain their certification.**
2. **NEVER "top" trees. This is an unacceptable practice and greatly decreases tree health, safety, and longevity.**
3. **NEVER use climbing spikes or spurs while pruning trees, except during an emergency rescue.**
4. **Trees should be inspected before climbing to determine the amount and extent of hazards, and the tree owner should be notified of potentially hazardous or harmful conditions.**
5. **Keep pruning equipment sharp, clean, and in good operating condition.**
6. **When pruning limbs that show evidence of disease, clean pruning equipment between trees.**
7. **Always prune trees back to the parent branch or a lateral that is at least 1/3rd the diameter of the branch being pruned.**
8. **Prune just outside of the branch collar.**
9. **At time of planting, prune only to remove dead, broken, crossed, or rubbing branches.**
10. **Prune trees when young to develop branch structure, strength, and form.**
11. **Prune off one of two leaders on trees with co-dominant (forked) stems.**
12. **Prune trees regularly throughout their life to maintain vehicular, pedestrian, and sight clearance, and to remove deadwood and broken branches.**
13. **Make proper pruning cuts using the 3-cut method, avoiding stub cuts, flush cuts, and wounds to remaining limbs and trunk (see Figure 3).**
14. **Do not remove more than 1/4th of the foliage of a mature tree in any one growing season.**
15. **Do not remove more than 1/3rd of the foliage of a young tree in any one growing season.**
16. **Do not remove more than 1/4th of the foliage from a branch unless you are removing the entire branch.**
17. **Always wear personal protective safety equipment while pruning, including safety glasses.**
18. **NEVER prune (or remove) trees located near energized electrical service or other utility lines; to have a tree growing beneath utility lines pruned or removed, contact your utility service provider.**
19. **Talk to your utility provider about their needs for clearance and their pruning techniques designed to maintain that clearance.**
20. **Employ natural target pruning and crown reduction pruning when pruning trees for line clearance instead of “topping”.**

A recommended method commonly employed to safely remove large tree limbs is illustrated in Figure 3.

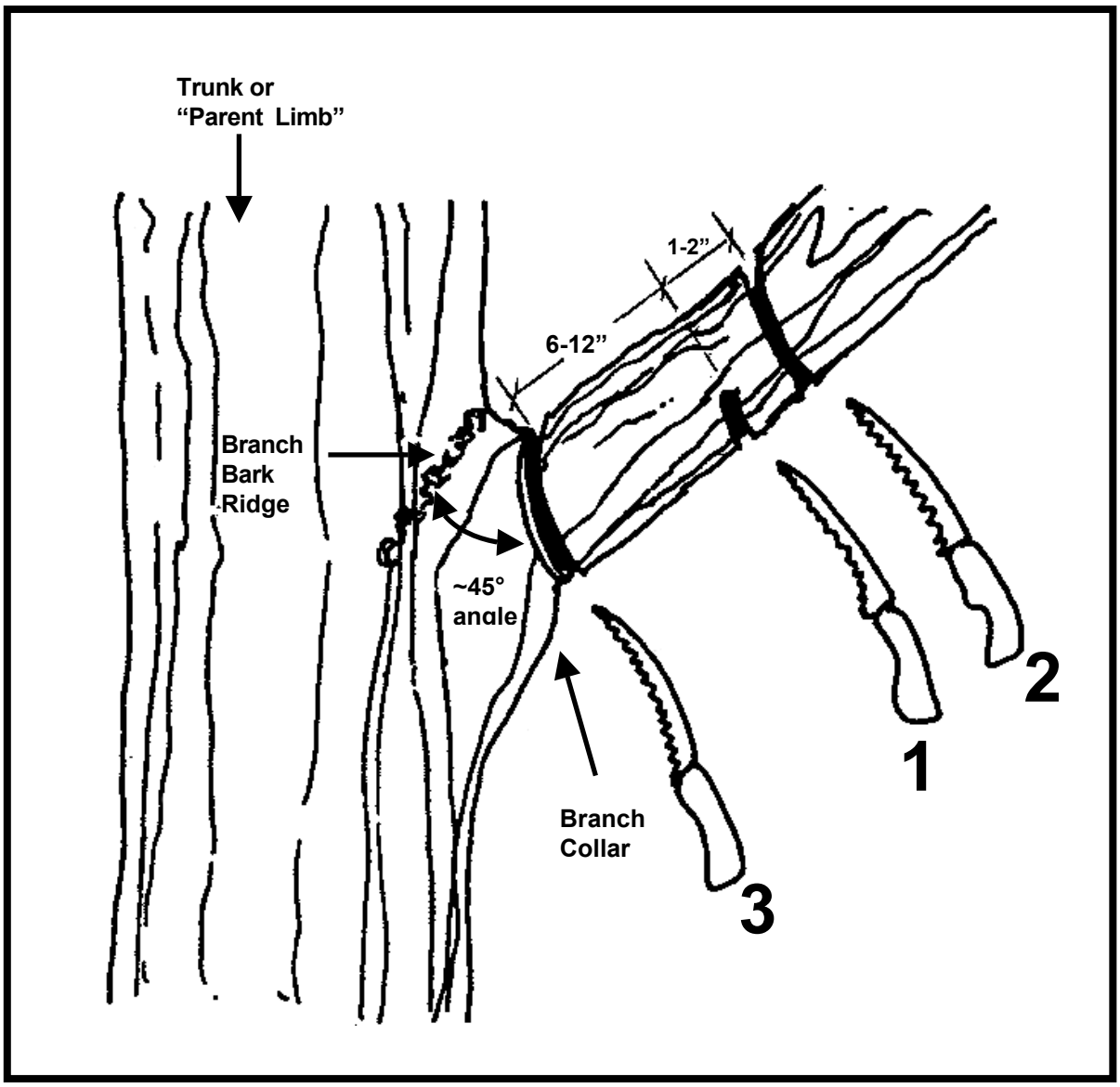


Figure 3. The 3-Cut Pruning Method

When removing a branch, make your cut back to the trunk or parent limb, just outside the branch collar, at an approximately 45 degree angle to the branch bark ridge. In Figure 3, Cut 1 is made first, then Cut 2 is made just outside of Cut 1. At this time the majority of the branch begins to fall, breaks at Cut 1, and is removed without stripping the bark below Cut 1. Cut 3 is then made just outside the branch collar or swelling at the base of the branch and the remainder of the branch or limb is removed.

For more information on Tree Pruning . . .

refer to the following publications listed in the Reference section of the Appendix.

- *ANSI A300-1995 American National Standard for Tree Care Operations—Standard Practices (Pruning)*
- *ANSI Z133.1-1994 American National Standard for Tree Care Operations—Safety Requirements*
- *Arborists' Certification Study Guide*
- *Assessing Pruning Wound Damage*
- *Pruning Effects on Tree Growth: Growth Regulation Consequences*
- *Pruning Shade Trees*
- *Pruning Trees Near Electric Utility Lines: A Field Pocket Guide for Qualified Line-Clearance Tree Workers*
- *Tree City USA Bulletin No. 1: How to Prune Young Shade Trees*
- *Tree City USA Bulletin No. 8: Don't Top Trees!*
- *Tree Pruning Guidelines*
- *Trees for Urban and Suburban Landscapes: An Illustrated Guide to Pruning*
- *Urban Forestry: A Manual for the State Forestry Agencies in the Southern Region*

Notes:

Tree Mulching

Mulching is the application of organic material on top of the ground over a tree's root system to improve soil moisture and fertility and to enhance root and tree growth. The objective in mulching is to recreate the conditions found in undisturbed, natural woodlands.

Mulching provides ***benefits*** to trees because it:

- ☆ **retains soil moisture**
- ☆ **moderates soil temperatures**
- ☆ **suppresses weed growth**
- ☆ **improves soil fertility and structure over time**
- ☆ **recreates the natural conditions under which trees grow in the forest, conditions which includes a thick layer of leaves and composted organic matter**
- ☆ **eliminates the need for mowing and weed trimming around the base of trees**

When mulching, these ***common mistakes*** are often made:

- ✗ **lack of regular mulch applications**
- ✗ **mulch ring is much too small and covers very little of the root zone of the tree**
- ✗ **mulch is piled up in a "volcano" fashion around the tree trunk**
- ✗ **mulch is touching the tree trunk**
- ✗ **black plastic, pine bark, or other impermeable materials are used for "mulch"**
- ✗ **string weed trimmers are used to cut weeds within mulch beds, often damaging tree trunks in the process**

Best Management Practices for Tree Mulching

1. **Use organic materials such as pine straw, leaves, aged wood chips, and compost; avoid grass clippings, pine bark, plastic, and rocks.**
2. **For newly planted trees, mulch an area at least six feet around the tree.**
3. **For established trees, mulch out to the dripline or as far out as practical.**
4. **Spread mulch in an even layer, 3-4" deep; avoid mounding the mulch around the tree trunk.**
5. **Keep mulch at least 5 inches from the tree trunk to avoid creating favorable places for pests.**
6. **Mulch twice per year, in the late spring and in fall during leaf fall.**
7. **Use a tree's own leaves for mulch.**
8. **Avoid using string weed trimmers around the base of trees to remove weeds within mulch beds; hand pull weeds or use a contact herbicide to kill weeds.**

As simple as mulching can be, if done improperly it can cause problems for the tree such as insect, disease, and rodent damage, or a decrease in soil aeration or moisture. Use Figure 4 as a guide for recommended mulching methods.

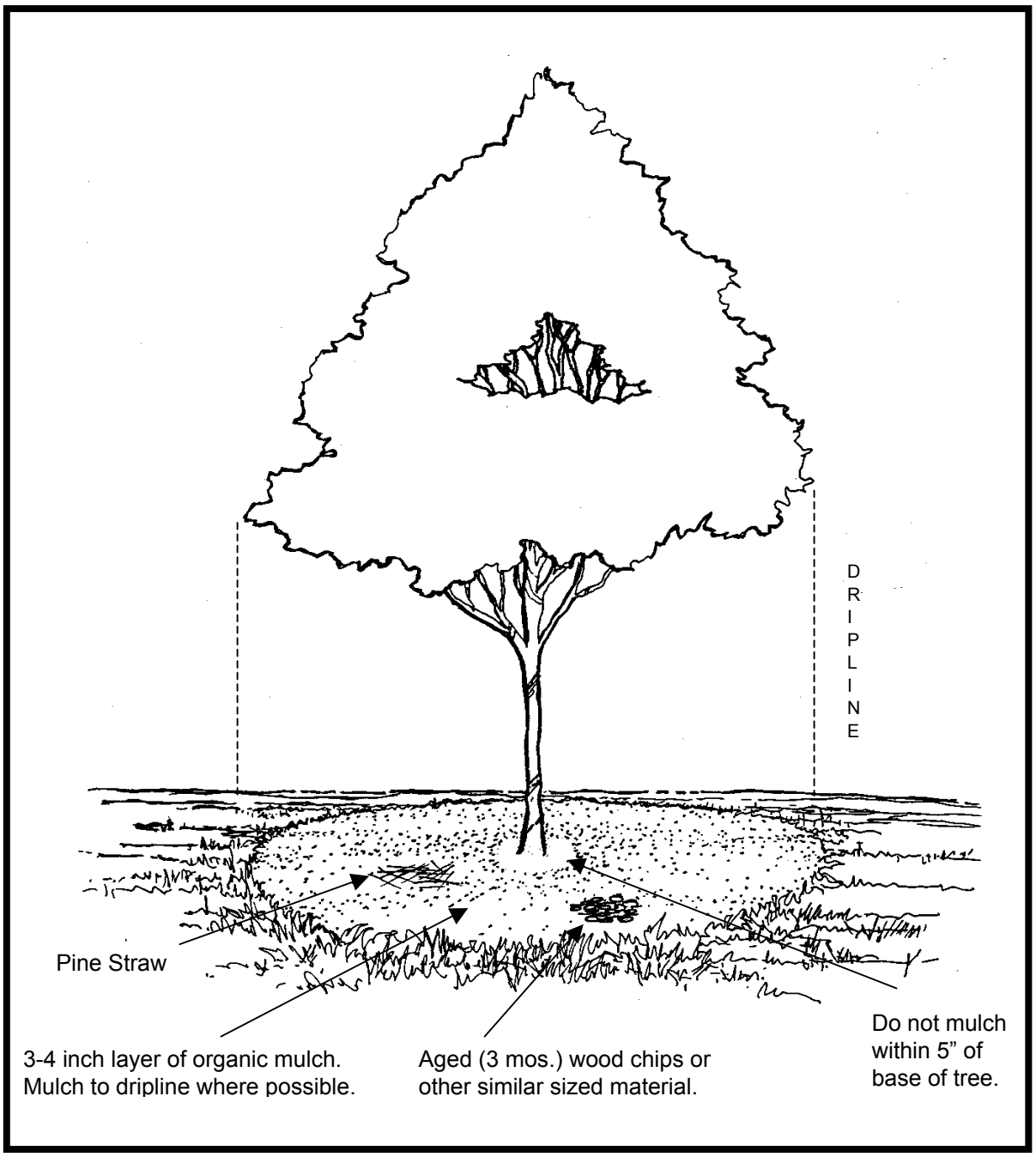


Figure 4. Recommended Method for Tree Mulching

For more information on Tree Mulching . . .

refer to the following publications listed in the Reference section of the Appendix.

- *Arborists' Certification Study Guide*
- *Nine Things You Should Know About Trees: #4 – The Value of Mulch*
- *Tree City USA Bulletin No. 5: Living With Urban Soils*
- *Tree City USA Bulletin No. 16: How to Recycle Shade Tree Materials*
- *Tree City USA Bulletin No. 17: How to Landscape to Save Water*
- *Tree Maintenance*
- *Urban Forestry: A Manual for the State Forestry Agencies in the Southern Region*

Notes:

Tree Fertilization

Fertilization is the application of nutrients to the soil or plant leaves to enhance growth. It should only be done for a specific purpose or to correct a specific deficiency discovered through soil testing or foliar analysis. The American National Standards Institute (ANSI) and the International Society of Arboriculture (ISA) have standards for tree fertilization that have been published as ANSI Standard A300 - Part 2 (1998) (see References section of the Appendix). The Cooperative Extension Service also provides fertilization advice and soil sample analysis, as do private laboratories.

The ***benefits*** of fertilization include:

- ☆ **healthier, more extensive root systems**
- ☆ **increased growth and larger trees at an earlier age**
- ☆ **healthier tree in better condition to defend itself against pests**

To enhance tree growth through fertilization, avoid these ***common mistakes***:

- ✗ **fertilization without knowledge of nutrient availability and deficiencies**
- ✗ **over fertilization, either too much at one time, or too often**
- ✗ **use of weed and feed fertilizers beneath trees**

Best Management Practices for Tree Fertilization

1. **Apply fertilizer based upon recommendations resulting from a soil test to address known deficiencies.**
2. **Do not apply fertilizer to newly planted, drought stressed, or severely wounded or injured trees.**
3. **Apply fertilizer when the roots are actively growing; late winter, early spring, and early summer are the best times to fertilize.**
4. **Use an NPK fertilizer ratio of 3:1:1 or 3:1:2 in the absence of a recent soil test.**
5. **Use slow release organic fertilizers with a salt index of less than 50.**
6. **Apply slow release fertilizers to trees at a rate between 2 and 4 pounds of nitrogen per 1000 ft^2 of root area.**
7. **Apply fertilizer to the CRZ of trees, from the trunk to the dripline, but only once to overlapping root zones.**
8. **Make sub-surface applications of fertilizer where turf or groundcover exists, or where runoff is likely.**
9. **Make sub-surface applications of fertilizer 4-12 inches deep, in holes that are 2-4 inches in diameter and spaced 12 to 36 inches apart. Fertilizer should not be closer than 2 inches to the surface.**
10. **Do not use fertilizer injections and implants into the trunk for routine fertilization.**

The amount of fertilizer that should be applied to achieve recommended nitrogen fertilization rates is listed in Table 5.

Table 5. Amount of Fertilizer of Various Formulations to Apply Per 1000 Square Feet to Achieve Specific Rates of Nitrogen Fertilization

N-P-K	Pounds of Fertilizer to Apply Per 1000 Sq Ft to Achieve a Rate of		
Fertilizer Formulation	2.0 lbs of N	3.0 lbs of N	4.0 lbs of N
5-X-X	40.0	60.0	80.0
10-X-X	20.0	30.0	40.0
15-X-X	13.3	20.0	26.7
20-X-X	10.0	15.0	20.0
30-X-X	6.7	10.0	13.3

For more information on Tree Fertilization . . .

refer to the following publications listed in the Reference section of the Appendix.

- *ANSI A300 (Part 2) – 1998 American National Standard for Tree Care Operations—Standard Practices (Fertilization)*
- *Arborists' Certification Study Guide*
- *Control of Nitrogen Levels in Trees*
- *Making Nitrogen Available to Trees*
- *Nitrogen Prescriptions for Trees*
- *Nitrogen Transformations in Soils*
- *Tree City USA Bulletin No. 5: Living With Urban Soils*
- *Tree Maintenance*
- *Uptake and Reduction of Nitrogen in Trees*
- *Urban Forestry: A Manual for the State Forestry Agencies in the Southern Region*

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Tree Irrigation

Irrigation involves the regular application of water to the root systems of a tree in the CRZ to supplement rainfall. Water is essential to tree growth, the absorption of elements and nutrients, and the production of food energy. Irrigation may be done simply using a hose, sprinkler, or bucket, or may be accomplished with a large capacity water tank or installed irrigation system.

Irrigation provides ***benefits*** such as:

- ☆ **better tree growth with fewer periods of stress and less susceptibility to insect and disease infestation**
- ☆ **better tree survival, less replanting, more economical tree establishment costs**
- ☆ **requires visits to the tree which can also serve as a time for regular tree inspections**

When watering trees, avoid these ***common mistakes***:

- ✗ **newly planted or damaged trees are not watered regularly during hot and dry periods**
- ✗ **too little water is applied during each irrigation period, or water runs off and does not penetrate the soil**
- ✗ **small amounts of water are applied too often, encouraging shallow rooting**
- ✗ **trees are watered too much and too frequently, keeping roots and soil "waterlogged"**
- ✗ **tree trunks are "watered" and remain wet for prolonged periods of time**
- ✗ **watering rings created at planting are not removed after one year**

Best Management Practices for Tree Irrigation

1. **Plant trees at or slightly above ground level to avoid creating a place where excessive water accumulates.**
2. **Match tree species to soil moisture conditions, utilizing upland and drought resistant trees where soil moisture is typically low, and lowland and flood tolerant species where soil moisture is typically high or where the site is frequently flooded.**
3. **Mulch trees to conserve water.**
4. **Water trees before they show signs of water stress.**
5. **In the absence of adequate rainfall, apply 1 inch of water per week during the growing season throughout the root zone of newly planted trees, damaged trees, or trees under stress.**
6. **Water during the hours of 10 p.m. to 8 a.m.**
7. **Water less often with greater amounts of water rather than more often with smaller amounts of water.**
8. **Apply water evenly throughout the outermost 75% of the CRZ.**
9. **Apply water slowly to avoid runoff outside of the CRZ.**
10. **Water during winter droughts, especially evergreen trees, but only if the soil surface temperature is greater than 40 degrees.**

The amount of water required for a tree depends upon its age, trunk diameter, and the size of its root zone. To determine the amount of water to apply to your tree's root zone, first calculate the radius of the CRZ. Then, calculate the number of seconds it takes you to fill a 5-gallon bucket of water with the hose or water delivery system you are using. Match that time to the closest number of seconds listed in Table 6 and to the radius of your CRZ to find the total application time required to water your tree. These numbers assume that you are watering the outermost 75% of the CRZ.

Table 6. Approximate Watering Time to Apply One Inch of Water Across Various Sized Critical Root Zones

Radius of CRZ (ft)	Volume of Water (gals) to Equal 1"	Total Application Time (minutes and hours) at a Delivery Rate of 5 Gallons Per				
		5 Sec	**15 Sec**	**30 Sec**	**45 Sec**	**60 Sec**
5	37	1 min	2 min	4 min	6 min	7 min
10	147	3 min	7 min	15 min	22 min	30 min
15	330	6 min	17 min	33 min	50 min	1 hr
20	587	10 min	29 min	1 hr	1 hr 30 min	2 hrs
25	917	15 min	46 min	1 hr 30 min	2 hr 30 min	3 hrs
30	1,322	22 min	1 hr	2 hrs	3 hr 30 min	4 hrs 30 min
35	1,799	30 min	1 hr 30 min	3 hrs	4 hr 30 min	6 hrs
40	2,349	39 min	2 hrs	4 hrs	6 hrs	8 hrs
45	2,973	50 min	1 hr 30 min	5 hrs	7 hrs 30 min	10 hrs
50	3,670	1 hr	3 hrs	6 hrs	9 hrs	12 hrs

For more information on Tree Irrigation . . .

refer to the following publications listed in the Reference section of the Appendix.

- *Arborists' Certification Study Guide*
- *Drought Damage to Trees*
- *Flood Damage to Trees*
- *Tree City USA Bulletin No. 17: How to Landscape to Save Water*
- *Urban Forestry: A Manual for the State Forestry Agencies in the Southern Region*
- *Water Movement in Trees*
- *Watering Trees*
- *Xeriscape: A Guide to Developing a Water-Wise Landscape*

Notes:

Pest Management

Pest Management is the control of weeds, insects, fungi, bacteria, or other tree pests through a variety of techniques and at a level that meets your management objectives. The best approach to pest management is an integrated one that utilizes prevention, biological controls, and--when warranted and absolutely necessary--chemical controls.

The ***benefits*** of timely pest management include:

- ☆ **increase in knowledge of impact and life cycle of tree pests**
- ☆ **reduction in the number of trees affected**
- ☆ **increased tree health with timely pest identification and management**

Some ***common mistakes*** made in managing tree pests include:

- ✗ **trees are planted that are highly susceptible to common pests**
- ✗ **changes in tree condition and pest symptoms and signs are ignored**
- ✗ **pest problems are allowed to reach catastrophic proportions before treatment is considered**
- ✗ **pesticides are over-used or are selected as the first option**
- ✗ **pesticides are applied at a stage when they are ineffective on or do not reach the pest**
- ✗ **tree trunks are painted white to defend against insects (this is not effective)**

Best Management Practices for Pest Management

1. **Plant trees where their needs will match the site conditions to prevent stress and predisposition of trees to pest attacks.**
2. **Mulch to relieve soil moisture stress and to suppress weeds; pull weeds *by hand* where necessary around the base of trees.**
3. **Protect tree roots, trunks, and limbs from wounds. Wounds are entry points for insects and diseases.**
4. **Learn the habits and life cycle of the pests affecting your trees, and know when to apply pesticides for the greatest effect.**
5. **Hire only experienced and knowledgeable professionals to apply pesticides; the State of Georgia has a licensing program for pesticide applicators.**
6. **Do not apply any soil active herbicides or weed-and-feed lawn formulations over the root systems of trees.**
7. **Contact the Cooperative Extension Service or Georgia Forestry Commission for instructions on collecting insect and disease organisms or signs for analysis and identification.**

For more information on Pest Management . . .

refer to the following publications listed in the Reference section of the Appendix.

- *Arborists' Certification Study Guide*
- *Diseases of Trees and Shrubs*
- *Insects That Feed on Trees and Shrubs*
- *Tree City USA Bulletin No. 37: Plant Health Care--What it Means to You*
- *Tree Maintenance*
- *Urban Forestry: A Manual for the State Forestry Agencies in the Southern Region*

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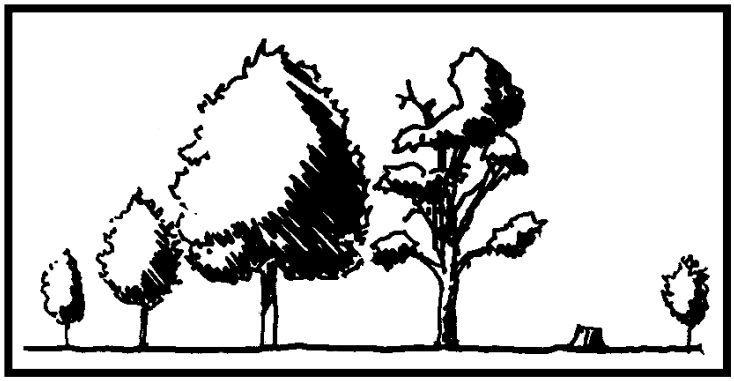
Tree Removal and Replacement



are activities that will have to occur for every tree at some point. The overall goals of tree removal and replacement are to maintain public safety and community forest health while also preserving tree canopy cover.

There are many reasons why trees must be removed. They may be growing in the wrong location, without adequate growing space, and are in conflict with hardscape (driveways, walkways, etc.) or other infrastructure (buildings, roadways, overhead utility lines). They may be old trees that are at the end of their normal life span. They may be dead or in poor or hazardous condition and require removal to protect the safety of the owner or the public in general. Whatever the reason for removal, the site should be evaluated to determine if another tree can be planted in the same or a nearby location to maintain tree canopy cover in the area.

The ***benefits*** of timely tree removal and replacement include:

- ☆ **reduced risk of failure with the prudent removal of trees**
- ☆ **reduced risk of pest infestations and damage to other trees**
- ☆ **additional space for new, vigorously growing trees**
- ☆ **dynamic, diverse community forest**
- ☆ **maintenance of tree stocking levels**

Common mistakes made in tree management that cause tree removals include:

- ✗ **trees are not provided with adequate space to grow to maturity**
- ✗ **large maturing trees are planted beneath utility lines**
- ✗ **trees are neglected and not routinely maintained**
- ✗ **tree preservation activities are undertaken only when a tree is in poor condition**
- ✗ **trees in poor condition without reasonable chances for improvement or repair are left to fall apart instead of being removed**
- ✗ **trees are planted that have a characteristic unsuitable for their location**

Best Management Practices for Tree Removal and Replacement

1. **Have an experienced arborist evaluate tree health and risk for failure before removing old, large, landmark, or historic trees, or trees damaged in a storm.**
2. **Hire only experienced professionals to remove trees.**
3. **Reduce the number and frequency of necessary tree removals through proper tree selection, placement, protection, and maintenance.**
4. **Evaluate trees at risk for failure using standard methods which include the assessment of the probability of failure, size of part that may fail, and the targets that may be affected should the tree fail.**
5. **Remove trees in irreversible health decline and poor condition.**
6. **Removes trees creating a hazardous situation that cannot be remedied with pruning, cabling and bracing, or removal of the target**
7. **Remove trees with characteristics in conflict with the site (oak with large acorns planted in a parking lot).**
8. **Remove trees located where growing space is inadequate.**
9. **Remove trees with unattractive form, or messy, hazardous, or noxious flowers or fruit.**
10. **Replace trees wherever and whenever possible, planting large canopy trees if space permits.**
11. **Request the local power company to remove trees located near or beneath utility lines; do not attempt to remove these trees yourself.**
12. **To preserve landmark or historic trees with an increased risk of partial or whole tree failure as long as possible, consider removing the target by restricting public access or moving valuable structures.**
13. **Positively identify ownership before authorizing tree removal.**

For more information on Tree Removal and Replacement . . .

refer to the following publications listed in the Reference section of the Appendix.

- *A Photographic Guide to the Evaluation of Hazard Trees in Urban Areas*
- *Arboriculture and the Law*
- *Arboriculture: Integrated Management of Landscape Trees, Shrubs, and Vines*
- *Arborists' Certification Study Guide*
- *The Body Language of Trees*
- *Tree City USA Bulletin No. 2: When a Storm Strikes*
- *Tree City USA Bulletin No. 14: How to Kill a Tree*
- *Tree City USA Bulletin No. 15: How to Recognize/Prevent Hazard Trees*
- *Tree Law Cases in the USA*
- *Tree Support Systems: Cabling, Bracing, and Guying*
- *Urban Forestry: A Manual for the State Forestry Agencies in the Southern Region*

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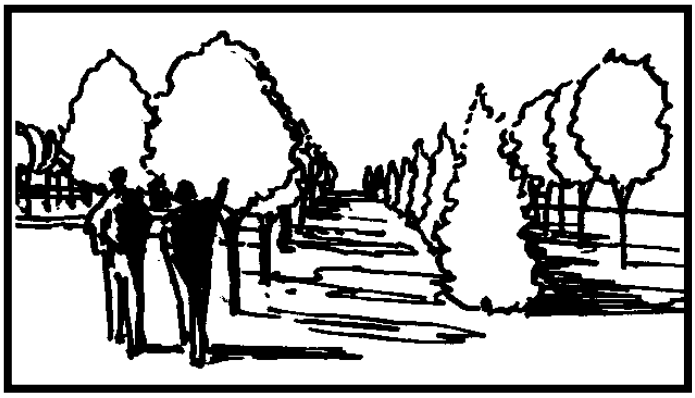
Section 4: Best Management Practices for Tree Species Selection

Tree Species Selection

is an important part of tree conservation and planting. There are more than 150 high quality, native tree species that should be conserved and planted within Athens-Clarke County.



These native species, together with a few proven non-native species, as well as some native and non-native species that are *not* recommended for planting, are listed in the ACC Tree Species List located on the following pages. The recommended trees included in the list are the choices of local, regional, and national experts. These species form a broad palette of trees for use in our landscapes.

Many of the important species characteristics and growth requirements that should be considered when making tree management decisions are included in the list. Table 7, which precedes the species list, contains a key to the symbols and categories used in the list.

The ***benefits*** of knowledgeable tree selection include:

- ☆ **a healthy environment with abundant tree canopy**
- ☆ **reduced tree maintenance with better species to site match**
- ☆ **diversity of species promoting forest stability**
- ☆ **varied and interesting landscape**

Some ***common mistake***s made when selecting trees to conserve or plant include:

- ✗ **reliance on non-native tree species**
- ✗ **reliance on a few popular species which are over planted**
- ✗ **incorrect species to site match**
- ✗ **small trees selected and planted where large growing spaces exist**

Best Management Practices for Tree Species Selection

1. **Plant and conserve good quality native trees wherever possible.**
2. **Plant large canopy trees wherever adequate space exists.**
3. **Maintain species diversity by conserving and planting a variety of tree species.**
4. **Plant no more than 10% of all trees in a given area with a single species.**
5. **Plant no more than 30% of all trees in a given area with a single genus (i.e., maple); and, plant no more than 30% of any one genus with a single species (i.e., red maple); and, plant no more than 30% of any one species using a single cultivar (i.e., 'Red Sunset' red maple).**
6. **Evaluate your site conditions—sunlight, soil pH, nutrient availability, soil moisture, and growing space--and select species for planting whose requirements match those conditions.**
7. **Select species that will best provide the function desired on the site (i.e., evergreen trees for buffering and screening).**

For more information on Tree Species Selection . . .
refer to the following publications listed in the Reference section of the Appendix.

- *Arborists' Certification Study Guide*
- *Guide to Southern Trees*
- *Horticopia CD-ROM*
- *Landscape Plants of the Southeast*
- *Manual of Woody Landscape Plants*
- *Michael A. Dirr's Photo-Library of Woody Landscape Plants CD-ROM*
- *Native Tree Families and Species of Georgia*
- *Native Trees of Georgia*
- *Southern Trees CD-ROM*
- *Tree City USA Bulletin No. 4: The Right Tree for the Right Place*
- *Tree City USA Bulletin No. 26: Understanding Landscape Cultivars*
- *Tree Selection for Drought Resistance*
- *Trees for Urban and Suburban Landscapes*
- *Trees of Georgia and Adjacent States*
- *Urban Forestry: A Manual for the State Forestry Agencies in the Southern Region*

Notes:

Notes:

The Athens-Clarke County Tree Species List

The ACC Tree Species List is intended to support the development code, site planning and design activities for tree conservation and establishment, and tree maintenance planning and decision-making. In the List trees are arranged alphabetically by the tree's common name with the "genus" listed first. For example, red maple is listed as "Maple, Red" (maple is the genus name). The Latin name is also listed for more definitive species identification. In some cases, the commonly planted variety or cultivar of the species has also been included.

Table 7. Key to Symbols and Tree Species Characteristic Descriptions

TREE CHARACTERISTIC	DESCRIPTION and ENTRY CHOICES
Species Common Name	**Entered with genus common name first, then species, then cultivar if applicable. For some species an alternate common name is included in parentheses.**
Latin Name	**Genus, species, and variety or cultivar; always italicized or underlined.**
CANOPY AREA FOR DEVELOPMENT CODE	
Square Feet of Canopy	**The total area projection of the crown onto the ground in square feet as typically achieved in urban situations with less than optimal growing conditions.**
Canopy Size Category	Very Small - 150 square feet with a 15 foot crown diameter *The minimum open soil surface area is 25 sq. ft.*
	Small – 400 square feet with a 25 foot crown diameter *The minimum open soil surface area is 100 sq. ft.*
	Medium – 900 square feet with a 35 foot crown diameter *The minimum open soil surface area is 225 sq. ft.*
	Large – 1,600 square feet with a 45 foot crown diameter *The minimum open soil surface area is 400 sq. ft.*
RECOMMENDED USES	
Level of Use	**The level of use that the tree should receive.**
	P = Plant New Trees and Conserve Existing Trees
	C = Conserve Existing Trees
	L = For Limited Planting or Conservation Only
	N = Do Not Plant
Large Landscape Areas **Road Frontages – Street** **Road Frontages – Yard** **Parking Lots** **Plazas and Downtown Settings** **Riparian Zones and Drainage Areas** **Utility Corridors**	**The site situation where the tree should be planted and/or conserved.** O = tree to avoid; not suitable Blank = may or may not be suitable x = good choice XX = excellent choice

Table 7. Key to Symbols and Tree Species Characteristic Descriptions

TREE CHARACTERISTIC	DESCRIPTION and ENTRY CHOICES
PHYSICAL CHARACTERISTICS	
Height Class in Urban Conditions	**Height class (ground to tip of leader or tallest branch) of a mature tree commonly achieved in urban situations with less than optimal growing conditions.**
	S = Small: 15-25 feet
	M = Medium: 25-40 feet
	L = Large: 40 feet and taller
Crown Class in Urban Conditions	**The width of the crown (at its widest point) commonly achieved in urban situations with less than optimal growing conditions.**
	VS = Very Small (150 square feet with a 15 foot crown diameter)
	S = Small (400 square feet with a 25 foot crown diameter)
	M = Medium (900 square feet with a 35 foot crown diameter)
	L = Large (1,600 square feet with a 45 foot crown diameter)
Mature Crown Form	**General shape of the tree's crown (leaves and branches).**
	Irregular
	Multi-Stemmed
	Oval (Columnar)
	Pyramidal
	Rounded
	Spreading
	Upright (Vase)
Typical Range of Mature Tree Height	**Typical range of height of tree in feet from ground to bud at tip of leader or tallest branch under various conditions.**
Typical Range of Mature Crown Width	**Typical range of spread of branches in feet at the widest diameter across the crown under various conditions.**
Leaf Type	**Persistence and type of leaf on the tree. Deciduous trees lose their leaves in the fall.**
	DB = Deciduous Broadleaf
	DC = Deciduous Conifer
	EB = Evergreen Broadleaf
	EC = Evergreen Conifer
Leaf Texture	**Relative size and appearance of leaves.**
	F = Fine
	M = Medium
	C = Coarse
Fall Leaf Color	**The typical color of the tree's fall foliage.**
	EV = evergreen
	BR = bronze or brown
	MA = maroon
	MU = multi-colored: maroon, red, orange, yellow
	OR = orange

Table 7. Key to Symbols and Tree Species Characteristic Descriptions

TREE CHARACTERISTIC	DESCRIPTION and ENTRY CHOICES
	RE = red
	YE = yellow
	I = insignificant color change
PHYSICAL CHARACTERISTICS (cont'd.)	
Flower Color	**For trees with showy flowers, indicates the typical flower color.**
	B = blue
	L = purple
	M = multiple colors: white, pink, purple, red, or others
	P = pink
	R = red
	W = white
	Y = yellow
	I = insignificant flowers: small with an unremarkable color
Flowering Time	**For trees with showy flowers, the general season of blooming for the species.**
Wildlife Value	**Indicates with an "X" if the tree produces flowers (nectar) or fruits that are consumed by insects, birds, or mammals.**
Excessive Litter	**Indicates with an "X" if the tree produces large or hazardous leaves, fruit, or other litter.**
ENVIRONMENTAL CHARACTERISTICS AND TOLERANCES	
Native Tree to Athens-Clarke Co.	**Indicates whether or not the tree is found naturally growing in the Athens-Clarke County area.**
	Y = Yes
	N = No
Growth Rate	**Typical rate of growth under urban conditions.**
	S = Slow: 1/2 to 1-1/2 feet/year
	M = Moderate: 1-1/2 to 2-1/2 feet/year
	F = Fast: 2-1/2 to 3+ feet/year
Average Life Span	**The average life span (useful service life) of the species when growing under average urban conditions. A tree is at the end of its useful service life when its risk of failure becomes unacceptable and cannot be improved or when the tree is no longer an asset due to its appearance or condition.**
	S = Short: less than 25 years useful service life.
	M = Moderate: 25 to 40 years useful service life.
	L = Long: 50 years or greater useful service life.
Net Effect on Air Quality	**The net monetary effects in cents attributable to the species on air quality; listed as a benefit (positive) or cost (negative). Includes the species net effect on ozone, sulfur dioxide, nitrogen dioxide, particulate matter (PM10), and carbon monoxide.**
Soil Moisture	**The typical soil moisture conditions for the species in its native habitat.**
	H = Hydric: wet and may be occasionally flooded for short periods
	M = Mesic: moist but moderately well- to well-drained

Table 7. Key to Symbols and Tree Species Characteristic Descriptions

TREE CHARACTERISTIC	DESCRIPTION and ENTRY CHOICES
	X = Xeric: dry and very well-drained

ENVIRONMENTAL CHARACTERISTICS AND TOLERANCES	
Drought Tolerance	**Tolerance of the species to infrequent rain, low soil moisture, full sun, and high temperatures.**
	Low = not tolerant to drought conditions
	Moderate = tolerant to mild drought conditions; moderately tolerant to severe drought conditions
	High = very tolerant to mild to severe and prolonged drought conditions
Preferred Soil pH	**Relative soil acidity or alkalinity preferred by the species. In many cases, a range of pH preference is given if it was available. In other cases, a general level is given. A pH of 7.0 is neutral, a pH of less than 7.0 is acidic, and a pH of greater than 7.0 is alkaline.**
	ac = acidic (5.0 to 6.0)
	sl ac = slightly acidic (6.0 to 7.0)
	nu = neutral (7.0)
	sl al = sl alkaline (7.0 to 8.0)
	al = alkaline (8.0 to 8.5)
	n/a = no information available
Light Requirement	**The amount of sunlight the species prefers or will tolerate. Trees that are typically found in the understory or are characteristic of late forest successional stages prefer shade or at least partial shade, while trees that typically form the overstory or are characteristic of early successional stages prefer full sun.**
	FS = Full Sun
	PS = Partial Shade
	SH = Shade
Construction Tolerance/Limitations	**The broad tolerance of the species in its home range to construction damage, and the limitations that constrain a species tolerance to damage.**
Tolerance	P = Poor
	M = Moderate
	G = Good
Limitations	I = physical injury, wood compartmentalization and decay
	P = pest complications, including chronic and acute attacks
	S = soil conditions, including aeration and water availability
	C = limited climatic tolerances, including native range, hardiness, and micro-climate change
	A = all of the limitations described above
Urban Tolerant Tree	**Based upon other characteristics and tolerances to urban conditions; an "X" indicates the species is suitable for planting under "tough" urban conditions.**

Athens-Clarke County Tree Species List

SPECIES COMMON NAME	LATIN NAME	CANOPY AREA FOR DEVELOPMENT CODE: Square Feet of Canopy	Canopy Size Category	RECOMMENDED USES: Level of Use	Large Landscape Areas	Road Frontages - Street	Road Frontages - Yard	Parking Lots	Plazas and Downtown Settings	Buffers	Riparian Zones and Drainage Areas	Utility Corridors	PHYSICAL CHARACTERISTICS: Height Class in Urban Conditions	Crown Class in Urban Conditions	Mature Crown Form	Typical Range of Mature Tree Height	Typical Range of Mature Crown Width	Leaf Type	Leaf Texture	Fall Leaf Color	Flower Color	Flowering Time	Wildlife Value	Excessive Litter	ENVIRONMENTAL CHARACTERISTICS AND TOLERANCES: Native Tree to Athens-Clarke Co.	Growth Rate	Average Life Span	Net Effect on Air Quality	Soil Moisture	Drought Tolerance	Preferred Soil pH	Light Requirement	Construction Tolerance/Limitations	Urban Tolerant Tree
Alder, Hazel (Tag)	*Alnus serrulata*	150	Very Small	P	XX					x	XX	x	S	VS	Multi-Stemmed	10-20	10-20	DB	M	YE	I				Y	F	S	n/a	W	M	acidic	FS	G/	X
Ash, Green	*Fraxinus pennsylvanica*	1,600	Large	P	XX	x	XX		x		x		L	L	Rounded	60-100	40-50	DB	M	MU	I		X		Y	F	M	0.090	W	H	sl ac-sl alk	FS	G/	
Ash, White	*Fraxinus americana*	1,600	Large	P	XX	x	XX		x		x		L	L	Rounded	50-80	30-60	DB	M	MA	I		X		Y	M	M	0.100	M	L	sl ac-sl alk	FS	M/IS	
Baldcypress	*Taxodium distichum*	900	Medium	P	x		XX			XX	XX		L	M	Pyramidal	50-100	20-50	DC	F	BR	I		X		N	M	L	0.032	M	H	ac-sl alk	FS	G/	X
Basswood, American (Linden)	*Tilia americana*	1,600	Large	C	x						x		M	L	Irregular	60-100	35-50	DB	C	YE	Y	Summer	X		Y	F	M	0.144	M	L	ac-alk	PS	P/A	
Beech, American	*Fagus grandifolia*	1,600	Large	P	XX					0	x		L	L	Oval	80-100	50-70	DB	M	YE	I		X		Y	S	L	0.160	M	L	acidic	FS	P/A	
Birch, River	*Betula nigra*	900	Medium	P	XX	x	XX	x	XX	XX	XX	0	M	M	Pyramidal	50-90	40-60	DB	F/M	YE	I				Y	F	M	0.117	M	L	acidic	PS	G/	
Birch, River 'Heritage'	*Betula nigra* 'Heritage'	900	Medium	P	XX	x	XX	x	XX	XX	XX	0	M	M	Pyramidal	50-90	40-60	DB	F/M	YE	I				Y	F	M	n/a	M	L	acidic	PS	n/a	
Blackgum (Tupelo)	*Nyssa sylvatica*	900	Medium	P	XX	x	XX				x		M	M	Oval	50-100	20-35	DB	M	RE	I		X		Y	S	M	-0.053	M	M	sl ac-sl alk	FS	G/	X
Boxelder	*Acer negundo*	900	Medium	C	x						x	0	L	M	Rounded	50-75	40-50	DB	M	YE	I		X		Y	F	S	0.036	W	M	adapt	FS	G/	
Buckeye, Bottlebrush	*Aesculus parviflora*	150	Very Small	P								x	S	VS	Multi-Stemmed	15-20	10-15	DB	M	YE	W	Summer	X		N	M	S	n/a	M	L	ac-adapt	SH	n/a	
Buckeye, Painted	*Aesculus sylvatica*	150	Very Small	P	x						x	x	S	VS	Rounded	15-25	5-15	DB	M	YE	P/Y	Spring	X		Y	M	S	n/a	M	L	ac-adapt	SH	n/a	
Buckeye, Red	*Aesculus pavia*	150	Very Small	P								x	S	VS	Rounded	10-15	10-15	DB	M	YE	R	Spring	X		N	M	S	n/a	M	L	ac	PS	M/I	
Buckthorn, Carolina	*Rhamnus caroliniana*	900	Medium	P	x	x	x				x		M	M	Oval	30-40	10-30	DB	M	OR	I		X		Y	M	S	n/a	M	M	ac-alk	FS	M/IS	
Buckthorn, Common	*Rhamnus cathartica*	900	Medium	L								x	S	M	Rounded	20-25	20-25	DB	M	YE	I		X		N	M	S	n/a	M	H	adapt	FS	n/a	X
Buttonbush, Common	*Cephalanthus occidentalis*	150	Very Small	P	x						x	x	S	VS	Multi-Stemmed	10-15	10-15	DB	M	YE	W	Late Summer	X		Y	M	S	n/a	W	L	n/a	FS	G/I	
Catalpa, Southern	*Catalpa bignonioides*	900	Medium	C	x	0		0			x		M	M	Rounded	30-40	30-40	DB	C	YE	W	Spring	X	X	Y	F	S	0.014	M	M	sl ac-sl alk	FS	G/	
Cedar, Deodar	*Cedrus deodara*	900	Medium	L	x								L	M	Pyramidal	40-100	40-100	EC	F	EV	I				N	M	L	-0.031	D	H	ac-sl alk	FS	g	
Cedar, Japanese	*Cryptomeria japonica*	900	Medium	L	x		x			x			L	M	Pyramidal	40-60	15-20	EC	F	EV	I				N	S	M	0.084	M	H	ac	FS	n/a	X
Chastetree (Vitex)	*Vitex agnus-castus*	150	Very Small	P		x	x	x	x			x	S	VS	Multi-Stemmed	15-20	10-20	DB	M	I	B/L/W	Summer	X		N	M	S	n/a	D	H	ac-alk	FS	n/a	X
Cherry, Black	*Prunus serotina*	900	Medium	C	x		x				x		L	M	Oval	50-90	15-50	DB	M	YE	W	Early Spring	X		Y	F	M	0.083	M	M	sl ac	FS	M/I	
Cherrylaurel, Carolina	*Prunus caroliniana*	900	Medium	C		0	x	0	0	XX	0		M	M	Oval	20-40	15-25	EB	M	EV	W	Spring	X		N	M	M	n/a	M	H	ac-sl alk	FS	G/	X
Cherry, Japanese Flowering	*Prunus serrulata*	400	Small	L			x		x	XX		XX	S	S	Rounded	20-30	20-30	DB	M	OR	P	Spring			N	F	S	0.013	M	L	ac-alk	FS	n/a	
Cherry, Yoshino	*Prunes x yedoensis*	400	Small	L			XX		XX	XX		XX	S	S	Rounded	20-45	20-40	DB	M	YE	P/W	Spring	X		N	F	S	n/a	M	L	ac	FS	n/a	
Chestnut, American	*Castanea dentata*	1,600	Large	N	susceptible to chestnut blight								L	L	-	-	-	-							Y									
Chestnut, Chinese	*Castanea mollissima*	1,600	Large	P	x		x						L	L	Rounded	40-60	40-60	DB	M	BR	W	Summer	X		N	S	L	n/a	D	M	ac-sl alk	FS	n/a	X
Chinaberry	*Melia azedarach*	900	Medium	N	weed tree; brittle wood								M	M											N									
Chinquapin, Allegheny	*Castanea pumila*	400	Small	C	x							x	S	S	Rounded	10-25	10-25	DB	M	BR	I		X		Y	S	S	n/a	D	H	n/a	FS	P/P	
Cottonwood, Eastern	*Populus deltoides*	1,600	Large	C	x					0	x		L	L	Pyramidal	50-100	20-75	DB	C	YE	I		X	X	Y	F	M	-0.708	M	M	sl ac-sl alk	FS	G/	X
Crabapple, Japanese Flowering	*Malus floribunda*	400	Small	L		x	x		x	XX		XX	S	S	Rounded	15-25	15-25	DB	M	YE	P	Spring	X		N	M	S	n/a	M	L	sl ac-sl alk	FS	n/a	
Crabapple, Southern	*Malus angustifolia*	400	Small	C	x	x	x				x	XX	S	S	Spreading	20-25	10-20	DB	M	YE	P	Spring	X	X	Y	M	S	n/a	M	L	sl ac-sl alk	FS	M/ICP	
Crapemyrtle, Common	*Lagerstroemia indica*	150	Very Small	P		XX	XX	XX	XX	XX	0	XX	S	VS	Multi-Stemmed	15-30	10-25	DB	F	RE	M	Summer			N	F	M	0.004	M	H	ac-sl alk	FS	n/a	X
Cypress, Leyland	*Cupressocyparis leylandii*	400	Small	L	x	0	x	x		x		0	M	S	Pyramidal	50-60	20-30	EC	F	EV	I				N	F	M	0.053	M	M	ac-alk	FS	g	
Devil's Walking Stick	*Aralia spinosa*	150	Very Small	N	large thorns								S	VS											Y									
Devilwood	*Osmanthus americanus*	400	Small	C	x		x						S	S	Rounded	15-25	10-15	DB	M	YE	W	Spring	X		Y	M	M	n/a	M	M		PS	M/I	
Dogwood, Flowering	*Cornus florida*	400	Small	P	XX	XX	XX	0	0	XX		XX	S	S	Spreading	15-30	15-30	DB	M	RE	W	Spring	X		Y	M	M	0.021	M	L	ac-nu	PS	M/IP	
Dogwood, Flowering Pink	*Cornus florida var. rubra*	400	Small	P	XX	XX	XX	0	0	XX		x	S	S	Spreading	15-30	15-30	DB	M	RE	P	Spring	X		Y	M	M	n/a	M	L	n/a	PS	n/a	
Dogwood, Kousa	*Cornus kousa*	400	Small	P		x	x			x		x	S	S	Rounded	10-20	10-20	DB	M	RE	W	Spring	X		N	S	S	n/a	M	L	ac	PS	n/a	
Dogwood, Swamp	*Cornus stricta*	400	Small	C	x						x	x	S	S	Rounded	10-25	10-25	DB	M	RE	W	Spring	X		Y	S	S	n/a	W	L	n/a	PS	G/I	
Elm, American	*Ulmus americana*	1,600	Large	C	x		x				x		L	L	Upright	50-100	30-70	DB	M	YE	I		X		Y	M	M	0.143	M	H	sl ac-sl alk	FS	M/P	
Elm, Chinese (Lace Bark)	*Ulmus parvifolia*	900	Medium	L	0	XX	XX	XX	XX	0	0		M	M	Upright	40-60	30-50	DB	F/M	YE	I				N	F	M	0.058	M	H	sl ac-sl alk	FS	n/a	X
Elm, Siberian	*Ulmus pumila*	900	Medium	N	pest susceptible; weed tree								L	M											N									
Elm, Slippery	*Ulmus rubra*	1,600	Large	C	x	x	x				x		L	L	Upright	70-80	30-50	DB	M	YE	I		X		Y	F	M	0.086	M	M	sl ac-sl alk	FS	M/P	

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Elm, Winged	*Ulmus alata*	1,600	Large	P	XX	XX	XX	XX		0	0		L	L	Upright	70-80	30-50	DB	F	YE	I				Y	M	M	0.034	M	H	sl ac-sl alk	FS	G/	X
Flametree, Chinese (Bougainvillea)	*Koelreuteria bipinnata*	400	Small	P			x						M	S	Rounded	20-40	20-40	DB	M	YE	Y	Summer			N	M	M	n/a	M	H	sl ac-sl alk	FS	n/a	X
Fringetree (Grancy Gray Beard)	*Chionanthus virginicus*	150	Very Small	P	x	x	x			x		x	S	VS	Oval	10-30	5-15	DB	M/C	YE	W	Spring	X		Y	M	S	n/a	M	L	acidic	PS	M/IS	
Fringetree, Chinese	*Chionanthus retusus*	150	Very Small	P		x	x			x		x	S	VS	Rounded	15-25	10-15	DB	M/C	YE	W	Spring	X		N	S	S	n/a	M	M	acidic	PS	n/a	
Ginkgo (Female)	*Ginkgo biloba*	1,600	Large	L	x	0	x	0	0	0			M	L	Pyramidal	50-75	30-60	DB	C	YE	I			X	N	S	L	0.108	M	H	sl ac	FS	g	X
Ginkgo (Male)	*Ginkgo biloba*	1,600	Large	P	x	XX	XX	x	XX	0			M	L	Pyramidal	50-75	30-60	DB	C	YE	I				N	S	L	0.108	M	H	sl ac	FS	g	X
Goldenraintree	*Koelreuteria paniculata*	400	Small	P		x	x	x	x	x			M	S	Rounded	20-40	20-40	DB	M	YE	Y	Summer			N	M	M	-0.087	M	H	sl ac-sl alk	FS	n/a	
Hackberry, Common	*Celtis occidentalis*	1,600	Large	C	x		x				x		L	L	Spreading	60-90	25-60	DB	F/M	YE	I		X		Y	M	M	0.060	M	H	sl ac-sl alk	FS	n/a	X
Hackberry, Georgia	*Celtis tenuifolia*	1,600	Large	C	x		x				x		M	L	Spreading	25-35	25-35	DB	F/M	YE	I		X		Y	S	M	n/a	D	H	sl ac-sl alk	FS	M/IS	
Hawthorne, Washington	*Crataegus phaenopyrum*	400	Small	P		x	x		x			x	S	S	Rounded	10-30	5-25	DB	F	MU	W	Late Spring	X		N	S	S	0.017	M	M	sl ac-sl alk	FS	g	
Hemlock, Eastern	*Tsuga canadensis*	1,600	Large	N	not heat tolerant; out of range								L	L											N									
Hickory, Bitternut	*Carya cordiformis*	1,600	Large	C	x	0	x	0	0				L	L	Oval	50-100	50-75	DB	M	YE	I		X		Y	F	L	0.069	M	L	acidic	FS	P/S	
Hickory, Mockernut	*Carya tomentosa*	1,600	Large	C	x	0	x	0	0				L	L	Oval	50-100	50-75	DB	M/C	YE	I		X	X	Y	S	L	0.059	D	H	sl ac	FS	MP/S	
Hickory, Pignut	*Carya glabra*	1,600	Large	C	x	0	x	0	0				L	L	Oval	50-100	50-75	DB	M	YE	I		X		Y	S	L	0.058	M	H	sl ac	FS	M/S	
Hickory, Sand	*Carya pallida*	1,600	Large	C	x	0	x	0	0				L	L	Oval	40-90	20-40	DB	M	YE	I		X		Y	S	M	n/a	D	H	sl ac	FS	M/	
Hickory, Shagbark	*Carya ovata*	1,600	Large	C	x	0	x	0	0				L	L	Oval	70-100	50-75	DB	M	YE	I		X		Y	S	L	0.064	M	M	sl ac	FS	P/S	
Hickory, Southern Shagbark	*Carya ovata var. australis*	1,600	Large	C	x	0	x	0	0				L	L	Oval	60-80	40-60	DB	M	YE	I		X		Y	S	L	n/a	M	M	sl ac	FS	n/a	
Holly, American	*Ilex opaca*	150	Very Small	P	x		XX	x		XX		0	M	VS	Pyramidal	20-70	15-25	EB	M	EV	I		X		Y	S	L	0.013	M	H	acidic	PS	G/	X
Holly, Deciduous (Possumhaw)	*Ilex decidua*	150	Very Small	C	x		x				x	x	S	VS	Rounded	10-20	10-20	DB	F	I	I		X		Y	M	S	n/a	W	H	ac-alk	PS	G/	
Holly, Fosters	*Ilex x attenuata* 'Fosteri'	150	Very Small	P			x	x	x	x			S	VS	Pyramidal	15-25	10-15	EB	F/M	EV	I		X		N	S	S	n/a	M	H	sl ac	FS	n/a	X
Holly, Ornamental Variety	*Ilex* species	150	Very Small	L			x	x	x	x		x	S	VS	Rounded	10-20	10-15	EB	M	EV	I				N	S	S	n/a	M	H	ac	FS	n/a	
Holly, Savannah	*Ilex x attenuata* `Savannah'	150	Very Small	P	x		x	x	x	x		0	M	VS	Pyramidal	30-45	10-15	EB	M	EV	I		X		N	M	S	n/a	M	H	ac-sl alk	FS	n/a	
Holly, Yaupon	*Ilex vomitoria*	150	Very Small	P		x	x	x	x		x		S	VS	Irregular	10-25	5-10	EB	F	EV	I		X		Y	S	S	n/a	D	H	ac-alk	FS	G/	X
Honeylocust	*Gleditsia triacanthos*	900	Medium	C	x		x	0	0				L	M	Irregular	60-80	30-50	DB	F	YE	I				Y	F	S	0.009	M	H	sl ac-sl alk	FS	G/	X
Hophornbeam, American	*Ostrya virginiana*	900	Medium	P	x		x	x			x		M	M	Oval	15-40	10-30	DB	F/M	YE	W	Summer	X		Y	S	M	0.032	M	H	ac-alk	SH	M/S	X
Hornbeam, Am. (Ironwood, Blue Beech)	*Carpinus caroliniana*	900	Medium	P	XX	XX	XX	x	XX	XX	XX		M	M	Oval	20-35	15-30	DB	F/M	YE	I		X		Y	S	M	0.009	M	M	sl ac-sl alk	PS	M/SC	
Hornbeam, European	*Carpinus betulus*	900	Medium	P		XX	XX	XX	XX	x			M	M	Oval	40-60	35-40	DB	F/M	YE	I		X		N	S	M	0.037	M	H	ac-alk	PS	n/a	X
Hornbeam, Japanese	*Carpinus japonica*	400	Small	L		x	x	x	x	x			M	S	Oval	20-30	20-30	DB	M	RE	I				N	S	M	n/a	M	M	adapt	PS	n/a	
Katsuratree	*Cercidiphyllym japonicum*	900	Medium	L	x		x						M	M	Spreading	40-60	35-60	DB	M	YE	I				N	F	L	n/a	M	L	ac-sl alk	FS	pm	
Locust, Black	*Robinia pseudoacacia*	900	Medium	C	x			0	0		x		L	M	Spreading	40-90	20-40	DB	F	YE	W	Spring	X		Y	F	M	-0.123	M	H	sl ac-sl alk	FS	G/P	X
Magnolia, Cucumber	*Magnolia acuminata*	1,600	Large	C	x		x	0			x		L	L	Upright	60-80	20-60	DB	C	YE	W	Spring	X		Y	F	M	n/a	M	L	acidic	PS	M/I	
Magnolia, Japanese (Saucer)	*Magnolia x soulangiana*	900	Medium	L			x	0				x	M	M	Upright	20-30	10-30	DB	C	YE	P	Late Winter			N	M	S	0.009	M	L	acidic	FS	n/a	
Magnolia, Southern	*Magnolia grandiflora*	1,600	Large	P	XX		XX	0		XX		0	L	L	Pyramidal	80-100	30-50	EB	C	EV	W	Late Spring	X	X	Y	M	L	0.002	M	M	acidic	FS	M/I	
Magnolia, Southern 'Little Gem'	*Magnolia grandiflora* 'Little Gem'	150	Very Small	P			x	0		x		XX	M	VS	Pyramidal	40-60	20-30	EB	C	EV	W	Late Spring	X	X	Y	S	M	n/a	M	L	acidic	FS	n/a	
Magnolia, Star	*Magnolia stellata*	150	Very Small	L		x	x					x	S	VS	Multi-Stemmed	15-20	15-20	DB	M	YE	W	Late Winter	X		N	S	S	n/a	M	M	acidic	PS	n/a	
Magnolia, Sweetbay	*Magnolia virginiana*	900	Medium	P	XX		x			XX	XX		M	M	Oval	30-60	20-40	EB	C	EV	W	Summer	X		Y	F	M	n/a	W	L	acidic	PS	G/	
Maple, Amur	*Acer ginnala*	400	Small	P		x	x					x	S	S	Rounded	15-25	15-25	DB	M	RE	W	Spring			N	M	M	0.008	M	M	adapt	FS	n/a	
Maple, Chalk	*Acer leucoderme*	900	Medium	P	x	x	x	x		x			M	M	Spreading	20-40	10-30	DB	M	I	I				Y	M	M	n/a	M	H	ac-sl alk	FS	P/A	X
Maple, Hedge	*Acer campestre*	900	Medium	P		x	x	x		x			M	M	Rounded	25-35	25-35	DB	M	YE	I				N	S	S	0.017	M	H	ac-alk	FS	n/a	X
Maple, Japanese	*Acer palmatum*	400	Small	L	0		x	0				x	S	S	Oval	15-25	10-25	DB	M	RE	I				N	S	S	0.008	M	L	sl ac-sl alk	PS	n/a	
Maple, Norway	*Acer platanoides*	900	Medium	N	pest susceptible								M	M											N									
Maple, Red	*Acer rubrum*	900	Medium	P	XX	XX	XX	XX	XX	XX	XX	0	M	M	Rounded	40-90	20-35	DB	M	RE	R	Late Winter	X		Y	F	L	0.084	M	L	sl ac	FS	G/	
Maple, Silver	*Acer saccharinum*	1,600	Large	L	0		x	0	0				L	L	Rounded	50-80	40-60	DB	M	YE	I				N	F	S	0.084	M	H	ac	FS	P/A	

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Maple, Southern Sugar (Florida Sugar)	*Acer barbatum*	900	Medium	P	XX	x	XX	x	XX	XX	x		M	M	Rounded	40-70	25-60	DB	M	OR	I			X	Y	M	M	n/a	M	H	ac	FS	M/IS	X
Maple, Sugar	*Acer saccharum*	1,600	Large	P	XX	XX	XX				x	0	L	L	Oval	60-80	30-50	DB	M	OR	I		X		Y	M	L	0.100	M	M	sl ac-sl alk	PS	pm	
Maple, Sugar 'Green Mountain'	*Acer saccharum* 'Green Mountain'	1,600	Large	P	XX	XX	XX					0	L	L	Oval	60-80	30-50	DB	M	OR	I		X		Y	F	L	0.100	M	M	sl ac-sl alk	PS	n/a	
Maple, Sugar 'Legacy'	*Acer saccharum* 'Legacy'	1,600	Large	P	XX	XX	XX					0	L	L	Oval	60-80	30-50	DB	M	OR	I		X		Y	F	L	0.100	M	M	sl ac-sl alk	PS	n/a	
Maple, Trident	*Acer buergeranum*	400	Small	P	0	XX	XX	XX	XX	XX		XX	S	S	Rounded	20-45	20-30	DB	M	MU	I				N	F	M	n/a	M	M	ac-alk	FS	n/a	X
Mimosa	*Albizia julibrissin*	900	Medium	N	pest susceptible; weed tree								M	M											N									
Mulberry, Red	*Morus rubra*	900	Medium	C	x	0		0	0		x		L	M	Rounded	40-70	20-50	DB	C	YE	I		X	X	Y	F	S	0.099	M	H	sl ac-sl alk	FS	G/	
Oak, Black	*Quercus velutina*	1,600	Large	C	x		x				x		L	L	Rounded	70-90	50-60	DB	M	RE	I		X		Y	M	L	-0.253	D	H	sl ac	FS	G/	
Oak, Cherrybark	*Quercus falcata var. pagodifolia*	1,600	Large	P	x		x				x		L	L	Rounded	60-100	30-50	DB	M	RE	I		X		Y	M	L	n/a	M	M	ac	FS	G/	
Oak, Chestnut	*Quercus prinus*	1,600	Large	P	x	0	XX	0	0		0		L	L	Rounded	50-80	30-60	DB	M	RE	I		X	X	Y	S	L	-0.342	D	H	acidic	FS	GM/S	
Oak, Diamond Leaf (Laurel)	*Quercus laurifolia*	1,600	Large	P	x	x	x						L	L	Rounded	60-80	50-60	DB	M	YE	I		X		N	M	L	n/a	M	M	ac-sl alk	FS	G/	
Oak, English	*Quercus robur*	1,600	Large	L		x	x						L	L	Rounded	40-60	40-60	DB	M	BR	I		X		N	S	M	-0.275	M	M	sl ac-sl alk	FS	n/a	
Oak, Georgia	*Quercus georgiana*	1,600	Large	C	x		x						L	L	Rounded	20-40	10-30	DB	M	BR	I		X		Y	M	M	n/a	D	H	ac-alk	FS	n/a	
Oak, Laurel	*Quercus hemisphaerica*	1,600	Large	P	x	x	x						L	L	Rounded	60-90	50-60	DB	M	BR	I		X		N	F	M	-0.314	D	H	adapt	FS	n/a	
Oak, Laurel 'Darlington'	*Quercus hemisphaerica* 'Darlington'	1,600	Large	P	x	XX	XX						L	L	Rounded	60-90	50-60	DB	F	BR	I		X		N	F	M	n/a	D	H	adapt	FS	n/a	
Oak, Live	*Quercus virginiana*	1,600	Large	N	out of range								L	L											N									
Oak, Northern Red	*Quercus rubra*	1,600	Large	P	XX	x	XX						L	L	Rounded	60-100	30-60	DB	M	RE	I		X		Y	F	L	-0.503	M	M	ac-sl ac	FS	GM/SC	
Oak, Nuttall	*Quercus nuttalli*	1,600	Large	P	x	x	x						L	L	Rounded	60-80	35-50	DB	M	RE	I		X		Y	M	L	n/a	M	M	ac	FS	n/a	
Oak, Oglethorpe	*Quercus oglethorpensis*	1,600	Large	C	x	x	x						M	L	Rounded	40-70	30-50	DB	M	RE	I		X		Y	S	M	n/a	W	M	n/a	FS	n/a	
Oak, Overcup	*Quercus lyrata*	1,600	Large	P	XX	XX	XX				x		L	L	Rounded	30-45	30-45	DB	M	BR	I		X		Y	M	L	-0.159	W	M	ac-sl alk	FS	G/	
Oak, Pin	*Quercus palustris*	1,600	Large	L	0	x	x	0	0		0		L	L	Pyramidal	40-100	20-50	DB	M	RE	I		X		N	M	M	-0.483	M	M	acidic	FS	mg	
Oak, Post	*Quercus stellata*	1,600	Large	C	x	x	XX						L	L	Rounded	40-50	35-40	DB	M/C	BR	I		X		Y	M	L	-0.327	D	H	ac-sl alk	FS	G/	
Oak, Sawtooth	*Quercus acutissima*	1,600	Large	L	0	0	x	0	0		0		M	L	Oval	50-60	30-60	DB	M	YE	I		X	X	N	F	M	-0.159	M	M	ac-sl alk	FS	n/a	
Oak, Scarlet	*Quercus coccinea*	1,600	Large	P	XX	XX	XX	x	x				L	L	Rounded	50-80	30-50	DB	M	RE	I		X		Y	M	L	-0.592	D	H	sl ac	FS	G/	
Oak, Shumard	*Quercus shumardii*	1,600	Large	P	XX	XX	XX	XX	XX				L	L	Rounded	60-100	30-70	DB	M	RE	I		X		Y	F	L	-0.265	M	H	ac-alk	FS	G/	
Oak, Southern Red	*Quercus falcata*	1,600	Large	P	XX	x	XX				x		L	L	Rounded	60-100	30-70	DB	M	OR	I		X		Y	M	L	-0.576	M	H	ac	FS	G/	
Oak, Swamp Chestnut	*Quercus michauxii*	1,600	Large	P	x	0	x	0	0		x		L	L	Oval	70-90	30-60	DB	M	YE	I		X		Y	M	L	-0.544	M	M	n/a	FS	G/	
Oak, Swamp White	*Quercus bicolor*	1,600	Large	P	x	x	x				x		L	L	Oval	70-90	30-60	DB	M	YE	I		X		Y	M	L	-0.457	M	M	n/a	FS	G/	
Oak, Water	*Quercus nigra*	1,600	Large	P	XX	x	XX				XX	0	L	L	Rounded	50-100	30-70	DB	M	YE	I		X		Y	F	M	-0.451	M	M	ac-sl alk	FS	G/	
Oak, White	*Quercus alba*	1,600	Large	P	XX	x	XX						L	L	Rounded	60-100	30-80	DB	M	RE	I		X		Y	S	L	-0.348	M	M	acidic	FS	GM/S	
Oak, Willow	*Quercus phellos*	1,600	Large	P	XX	XX	XX	XX	XX	0	XX	0	L	L	Rounded	40-100	30-60	DB	F/M	YE	I		X		Y	F	L	-0.314	M	H	acidic	FS	GM/S	X
Orange, Osage	*Maclura pomifera*	900	Medium	L	x	0	x	0	0		0		M	M	Spreading	30-40	30-40	DB	M/C	YE	I		X	X	N	F	L	0.000	D	H	sl ac-sl alk	FS	n/a	X
Parrotia	*Parrotia persica*	400	Small	L		x	x					x	S	S	Rounded	20-40	20-35	DB	M	OR	R	Spring			N	F	S	n/a	M	M	ac-sl alk		n/a	
Pear, Bradford	*Pyrus calleryana* `Bradford'	900	Medium	N	defective branch structure								M	M											N									
Pear, Callery Variety	*Pyrus calleryana*	900	Medium	N	defective branch structure								M	M											N									
Pecan	*Carya illinoensis*	1,600	Large	P	x	0	x	0	0	0			L	L	Upright	60-100	30-75	DB	M/C	YE	I		X	X	N	S	M	0.088	M	L	sl ac-sl alk	FS	mg	
Persimmon, Common	*Diospyros virginiana*	900	Medium	P	x	0	x	0	0		x		L	M	Oval	70-80	40-60	DB	M	RE	I		X	X	Y	M	S	0.058	M	H	ac-alk	FS	G/P	X
Pine, Eastern White	*Pinus strobus*	1,600	Large	N	pest susceptible; not heat tolerant								L	L											N									
Pine, Loblolly	*Pinus taeda*	1,600	Large	P	XX	x	x	XX		XX	x	0	L	L	Pyramidal	80-100	20-40	EC	F	EV	I		X		Y	F	M	0.016	M	M	acidic	FS	G/	
Pine, Longleaf	*Pinus palustris*	1,600	Large	C			x	x		x	0		L	L	Pyramidal	60-100	20-40	EC	F	EV	I		X		N	M	L	0.010	M	H	ac-sl alk	FS	GM/C	
Pine, Shortleaf	*Pinus echinata*	1,600	Large	P	XX	x	x	x		x	x	0	L	L	Pyramidal	60-100	20-40	EC	F	EV	I		X		Y	M	L	0.008	M	H	ac	PS	GM/P	
Pine, Slash	*Pinus elliotii*	1,600	Large	C			x	x		x	0		L	L	Pyramidal	60-100	20-50	EC	F	EV	I		X		N	F	M	0.010	M	M	ac-sl alk	FS	G/	
Pine, Virginia	*Pinus virginiana*	900	Medium	P	x		x	x		XX	x		M	M	Pyramidal	15-70	10-35	EC	F	EV	I		X		Y	F	S	0.003	M	H	ac	FS	G/	X

Athens-Clarke County Tree Species List

SPECIES COMMON NAME	LATIN NAME	CANOPY AREA FOR DEVELOPMENT CODE: Square Feet of Canopy	Canopy Size Category	RECOMMENDED USES: Level of Use	Large Landscape Areas	Road Frontages - Street	Road Frontages - Yard	Parking Lots	Plazas and Downtown Settings	Buffers	Riparian Zones and Drainage Areas	Utility Corridors	PHYSICAL CHARACTERISTICS: Height Class in Urban Conditions	Crown Class in Urban Conditions	Mature Crown Form	Typical Range of Mature Tree Height	Typical Range of Mature Crown Width	Leaf Type	Leaf Texture	Fall Leaf Color	Flower Color	Flowering Time	Wildlife Value	Excessive Litter	ENVIRONMENTAL CHARACTERISTICS AND TOLERANCES: Native Tree to Athens-Clarke Co.	Growth Rate	Average Life Span	Net Effect on Air Quality	Soil Moisture	Drought Tolerance	Preferred Soil pH	Light Requirement	Construction Tolerance/Limitations	Urban Tolerant Tree
Pistache, Chinese	*Pistacia chinensis*	900	Medium	P		x	XX	XX	x	x		0	M	M	Rounded	60-80	40-50	DB	M	RE	G	Spring	X		N	M	M	n/a	M	H	ac-alk	FS	n/a	X
Planetree, London	*Platanus x acerifolia*	1,600	Large	P	x	XX	XX	XX					L	L	Irregular	60-100	20-80	DB	C	YE	I				N	F	M	-0.415	M	H	sl ac-sl alk	FS	pg	X
Plum, Chickasaw	*Prunus angustifolia*	150	Very Small	C	x	0	x			x		x	S	VS	Rounded	10-20	10-20	DB	F	I	W	Late Winter	X		Y	M	S	n/a	M	H	sl ac-sl alk	FS	M/IS	
Plum, Purpleleaf	*Prunus cerasifera*	400	Small	L		x	x			XX		x	S	S	Rounded	10-25	10-25	DB	F	RE	P/W	Spring	X		N	M	S	0.014	M	M	sl ac-sl alk	FS	mg	
Poplar, Lombardy	*Populus nigra var. italica*	900	Medium	N	not heat tolerant								L	M											N									
Poplar, White	*Populus alba*	900	Medium	C			x						L	M	Oval	40-100	20-60	DB	C	YE	I				N	F	M	-0.417	M	H	ac-alk	FS	n/a	
Poplar, Yellow (Tuliptree)	*Liriodendron tulipifera*	1,600	Large	P	XX		x				XX	0	L	L	Oval	80-150	30-60	DB	C	YE	Y	Spring	X		Y	M	L	0.171	M	L	sl ac	FS	P/IS	
Redbud, Eastern	*Cercis canadensis*	400	Small	P	XX	XX	XX		XX	XX	x	XX	S	S	Spreading	25-50	15-25	DB	M	YE	P	Spring	X		Y	F	S	0.012	M	M	ac-sl ac	PS	M/S	
Redbud, Eastern White	*Cercis canadensis var. alba*	400	Small	P	x	XX	XX		XX	x	x	XX	S	S	Spreading	20-30	15-25	DB	M	YE	W	Spring	X		Y	F	S	n/a	M	M	ac-sl ac	PS	n/a	
Redbud, 'Forest Pansy'	*Cercis canadensis* 'Forest Pansy'	400	Small	P	x	XX	XX		XX	x	x	XX	S	S	Spreading	20-30	15-25	DB	M	YE	P	Spring	X		Y	F	S	n/a	M	L	ac-sl ac	PS	n/a	
Redbud, 'Oklahoma'	*Cercis reniformis* 'Oklahoma'	400	Small	P		XX	XX	x	XX			XX	S	S	Rounded	20-25	15-20	DB	M	YE	P	Spring	X		N	M	S	n/a	D	H	ac-sl ac	FS	n/a	X
Redbud, 'Texas White'	*Cercis reniformis* 'Texas White'	400	Small	P		XX	XX	x	XX			XX	S	S	Rounded	20-25	15-20	DB	M	YE	W	Spring	X		N	M	S	n/a	D	H	ac-sl ac	FS	n/a	
Redcedar, Eastern	*Juniperus virginiana*	900	Medium	P	x		XX	x		XX	x	0	M	M	Pyramidal	40-60	10-20	EC	F	EV	I		X		Y	S	M	-0.010	M	H	ac-nu	FS	M/IS	
Redwood, Dawn	*Metasequoia glyptostroboides*	900	Medium	P	x		XX	x		XX			L	M	Pyramidal	75-100	25-30	DC	F	BR	I				N	F	L	0.163	M	M	n/a	FS	n/a	X
Royal Paulownia (Princess-Tree)	*Paulownia tomentosa*	900	Medium	L		0	x	0	0		0		M	M	Irregular	30-50	20-50	DB	C	YE	P	Spring		X	N	F	S	0.022	M	M	ac-sl alk	FS	g	
Sassafras	*Sassafras albidum*	900	Medium	C	x		x			x	x		M	M	Oval	30-60	20-40	DB	M	OR	Y	Spring	X		Y	M	M	0.069	M	H	sl ac	FS	G/	
Serviceberry, Downy	*Amelanchier arborea*	400	Small	P	XX	XX	XX		XX	XX	x	x	S	S	Irregular	15-40	10-20	DB	M	OR	W	Spring	X		Y	S	M	0.004	M	M	acidic	PS	M/IS	
Silverbell, Carolina	*Halesia carolina*	900	Medium	P	XX	x	x				x		M	M	Irregular	30-60	20-35	DB	M	YE	W	Spring			Y	M	M	n/a	M	L	ac-sl alk	PS	M/ISC	
Smoketree, American	*Cotinus obovatus*	150	Very Small	L			x					x	S	VS	Oval	15-30	10-25	DB	M	MU	P	Spring			Y	M	S	n/a	D	H	sl ac-sl alk	PS	n/a	X
Smoketree, Common	*Cotinus coggygria*	150	Very Small	L			x					x	S	VS	Oval	10-15	10-15	DB	M	MU	P	Late Spring			N	M	S	n/a	D	H	sl ac-sl alk	FS	n/a	X
Sourwood	*Oxydendrum arboreum*	900	Medium	C	XX		x						M	M	Spreading	30-60	20-30	DB	M	RE	W	Summer			Y	M	S	0.018	M	M	ac-sl ac	FS	P/A	
Sparkleberry, Tree	*Vaccinium arboreum*	150	Very Small	C			x				x	x	S	VS	Irregular	10-20	5-10	DB	F	RE	W	Late Spring	X		Y	S	S	n/a	M	M	ac-sl alk	S	M/A	
Spruce Varieties	*Picea* species	900	Medium	N	not heat tolerant								L	M											N									
Sugarberry	*Celtis laevigata*	1,600	Large	C	x		x			0	x		L	L	Spreading	60-80	25-60	DB	F/M	YE	I		X		Y	M	M	0.118	M	M	ac	FS	G/I	
Sweetgum	*Liquidambar styraciflua*	1,600	Large	C	x	0	x	0	0		x		L	L	Oval	60-80	40-60	DB	M	MU	I		X	X	Y	F	L	-0.488	M	L	sl ac	FS	G/	
Sweetgum, Fruitless	*Liquidambar styraciflua* 'Rotundiloba'	1,600	Large	P	x		x	x					L	L	Oval	50-70	35-45	DB	C	MU	I				Y	M	M	n/a	M	L	ac-sl alk	FS	n/a	
Sycamore	*Platanus occidentalis*	1,600	Large	P	x		x				x	0	L	L	Oval	70-100	30-70	DB	C	BR	I			X	Y	F	M	-0.789	M	M	sl ac-sl alk	FS	G/	
Tallowtree, Chinese	*Sapium sebiferum*	900	Medium	N	invasive								M	M											N									
Tree-of-Heaven (Ailanthus)	*Ailanthus altissima*	900	Medium	N	brittle wood; weed tree								M	M											N									
Walnut, Black	*Juglans nigra*	1,600	Large	C	x	0	x	0	0		x		L	L	Rounded	60-70	50-70	DB	M	YE	I		X	X	Y	M	L	0.086	M	L	acidic	FS	P/IS	
Waxmyrtle, Southern	*Myrica cerifera*	150	Very Small	P			x	x		x	0	x	S	VS	Multi-Stemmed	10-30	10-30	EB	F	EV	I		X		N	M	S	n/a	M	M	ac-alk	FS	G/	
Willow, Black	*Salix nigra*	900	Medium	C	x	0		0	0		x	0	M	M	Irregular	30-40	30-40	DB	F/M	YE	I				Y	F	S	-0.177	W	L	n/a	FS	G/	
Willow, Weeping	*Salix babylonica*	1,600	Large	L	x	0	x	0	0			0	L	L	Rounded	30-70	20-70	DB	F/M	YE	I				N	F	M	-0.096	W	M	acidic	FS	mg	
Winterberry, Common	*Ilex verticillata*	150	Very Small	P	x	x	x			x	x	x	S	VS	Multi-Stemmed	5-15	5-10	DB	M	I	I		X		Y	M	S	n/a	M	L	ac	FS	G/	
Witchhazel, Common	*Hamamelis virginiana*	400	Small	P	x		x		x		x	x	S	S	Spreading	20-35	20-35	DB	M/C	YE	Y	Fall			Y	M	M	-0.009	M	M	sl ac	PS	M/IS	
Yellowwood, American	*Cladrastis kentukea*	900	Medium	L	x		x						M	M	Upright	30-50	40-50	DB	M/C	YE	W	Spring			N	M	M	0.013	M	M	n/a	PS	P/A	
Zelkova, Japanese	*Zelkova serrata*	1,600	Large	L			x		x		0	0	L	L	Upright	40-80	30-75	DB	M	RE	I				N	M	M	0.084	M	H	ac-sl alk	FS	n/a	X

Appendix

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Tree Management Cost Worksheet

The Tree Management Cost Worksheet on the following pages is designed to assist you in planning for your community tree projects. Places are provided for you to enter known or estimated costs for each activity listed, and for additional activities.

Tree Management Cost Worksheet

Tree Management Activity	# Units	Unit Cost	Total Cost	Notes
Tree Conservation				
Project Planning		$	$	
Tree Inventory, Mapping, and Evaluation		$	$	
		$	$	
		$	$	
		$	$	
Tree Protection				
Project Planning		$	$	
Establishing the Tree Protection Zone		$	$	
Fencing		$	$	
Fence Posts		$	$	
Signage		$	$	
Additional tree protection materials may be required, such as root padding, trunk wraps, or additional fencing, posts, and signs.				
Worker Education		$	$	
Inspection and Monitoring		$	$	
Pre- and Post-Construction Maintenance		$	$	
		$	$	
		$	$	
		$	$	
Tree Establishment				
Tree Selection		$	$	
Site Selection		$	$	
Site Preparation		$	$	
Tree Purchase and Planting		$	$	
Mulch		$	$	
Tree Trunk Protectors		$	$	
Root Barriers		$	$	
Structural Soil		$	$	
		$	$	
		$	$	
		$	$	

Tree Management Cost Worksheet

Tree Management Activity	# Units	Unit Cost	Total Cost	Notes
New Tree Maintenance		***Annual Maintenance for New Trees During the First 3 Years After Planting***		
Mulch		$	$	
Pruning		$	$	
Watering (5 times/mo for 3 months)		$	$	
Inspect while trees are being mulched, pruned, and watered.				
		$	$	
		$	$	
Established Tree Maintenance		***Routine and Periodic Maintenance for Established Trees***		
Mulch (annually)		$	$	
Inspection (every 1-5 years)		$	$	
Pruning (every 3-5 years)		$	$	
Soil Sampling (prior to fertilization)		$	$	
Fertilization (as necessary)		$	$	
Vertical Mulching (as necessary)		$	$	
Irrigation (during droughts)		$	$	
Pest Management (as necessary)		$	$	
Cabling/Bracing (as necessary)		$	$	
Lightning Protection (as necessary)		$	$	
Root Barriers (as necessary)		$	$	
Tree Removal (at end of service life)		$	$	
		$	$	
		$	$	
		$	$	

LONG-TERM COST SAVING STRATEGIES…

1. **Provide and maintain adequate growing space for trees.**
2. **Select good quality trees.**
3. **Plant trees correctly.**
4. **Water newly planted trees during the establishment period, the first 3 years after planting.**
5. **Mulch new and established trees annually.**
6. **Use leaf litter and wood chip mulch available for free from municipal or private sources.**
7. **Prune new trees early to develop a strong, healthy branch structure.**
8. **Prune established trees properly and regularly to maintain a safe and healthy condition.**
9. **Do not top trees.**
10. **Maintain soil and root health to maintain tree health.**
11. **Protect a tree's roots, trunk, and crown daily throughout its life.**
12. **Actively protect trees on building construction and utility installation and repair sites.**