



URBAN FOREST MANAGEMENT PLAN

The City of Knoxville, Tennessee

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Prepared for:

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Public Services Department


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Impacts of the Urban Forest

The urban forest provides a multitude of environmental services and environmental benefits to citizens, businesses, and visitors alike. Beyond shade and beauty, trees have practical benefits and real monetary value. The urban forest provides a community with valuable public services and benefits such as stormwater mitigation, improved water quality and air quality, reduced energy demands, increased real estate values and improved retail sales, and other sociological benefits. Together, these benefits could be worth over a million dollars to a community. The following sections describe some of the benefits that trees provide.

Stormwater Mitigation and Improved Water Quality

- 🌳 Trees reduce topsoil erosion, prevent harmful land pollutants contained in the soil from getting into our waterways, slow down water run-off, and ensure that groundwater supplies are continually being replenished.
- 🌳 For every 5 percent of tree cover added to a community, stormwater runoff is reduced by approximately 2 percent (Coder, 1996).
- 🌳 Research by the United States Department of Agriculture Forest Service (USDA) shows that in a 1-inch rainstorm over 12 hours, the interception of rain by the canopy of the urban forest in Salt Lake City reduces surface runoff by about 11.3 million gallons, or 17 percent. These values would increase as the canopy increases (American Forests, 1999).
- 🌳 Along with breaking the fall of rainwater, tree roots remove nutrients harmful to water quality and the biological communities within (American Forests, 1999).
- 🌳 Trees act as natural pollution filters. Their canopies, trunks, roots, and associated soil and other natural elements of the landscape filter polluted particulate matter out of the flow toward the storm sewers. Reducing the flow of stormwater reduces the amount of pollution that is washed into a drainage area. Trees use nutrients like nitrogen, phosphorus, and potassium—by-products of urban living—which can pollute streams (American Forests, 1999).





Carbon Dioxide Reductions and Improved Air Quality

- ✿ Trees remove (sequester) carbon dioxide (CO₂) from the atmosphere during photosynthesis to form carbohydrates that are used in plant structure/function and return oxygen back to the atmosphere as a by-product. Trees, therefore, act as a carbon sink by removing the carbon and storing it as cellulose in their trunk, branches, leaves, and roots while releasing oxygen back into the air.
- ✿ Trees shade homes and office buildings. This reduces air conditioning needs up to 30 percent, thereby reducing the amount of fossil fuels burned to produce electricity (Colorado Tree Coalition, <http://www.coloradotrees/benefits.htm>, viewed May 17, 2011).
- ✿ One tree that shades a home in the city will also save fossil fuel, cutting CO₂ buildup as much as 15 forest trees (Colorado Tree Coalition, <http://www.coloradotrees/benefits.htm>, viewed May 17, 2011).
- ✿ Planting trees remains one of the cheapest, most effective means of drawing excess CO₂ from the atmosphere (Prow, 1999).
- ✿ A single, mature tree can absorb carbon dioxide at a rate of 48 pounds per year and release enough oxygen back into the atmosphere to support two human beings (McAliney, 1993).
- ✿ The USDA Forest Service estimates that all the forests in the United States combined sequestered a net of approximately 309 million tons of carbon per year from 1952 to 1992, offsetting approximately 25 percent of United States human-caused emissions of carbon during that period (Colorado Tree Coalition, <http://www.coloradotrees/benefits.htm>, viewed May 17, 2011).
- ✿ Over a 50-year lifetime, a tree generates \$31,250 worth of oxygen, provides \$62,000 worth of air pollution control, recycles \$37,500 worth of water, and controls \$31,250 worth of soil erosion (Colorado Tree Coalition, <http://www.coloradotrees/benefits.htm>, viewed May 17, 2011).
- ✿ Trees remove other gaseous pollutants by absorbing them with normal air components through the stomates in the leaf surface (International Society of Arboriculture, 2005).
- ✿ Coder (1996) found that:
 - There is up to a 60 percent reduction in street level particulates with trees.
 - In one urban park (212 hectares), tree cover was found to remove daily 48 pounds of particulates, 9 pounds of nitrogen dioxide, 6 pounds of sulfur dioxide, 2 pounds of carbon monoxide, and 100 pounds of carbon.



Reduced Energy Demands

- 🌳 Trees lower local air temperatures by transpiring water and shading surfaces. Because they lower air temperatures, shade buildings in the summer, and block winter winds, they can reduce building energy use and cooling costs (Nowak, 1995).
- 🌳 USDA Forest Service estimates the annual effect of well-positioned trees on energy use in conventional houses at savings between 20 to 25 percent when compared to houses in wide-open areas (American Forests, 1999).
- 🌳 Trees help to cool cities by reducing heat sinks. Heat sinks are 6 to 19 degrees Fahrenheit warmer than their surroundings (Colorado Tree Coalition, <http://www.coloradotrees/benefits.htm>, viewed May 17, 2011).
- 🌳 A tree can be a natural air conditioner. The evaporation from a single, large tree can produce the cooling effect of 10 room-sized air conditioners operating 24 hours per day (Colorado Tree Coalition, <http://www.coloradotrees/benefits.htm>, viewed May 17, 2011).



Increased Real Estate Values and Improved Retail Sales

Studies have shown that:

- 🌳 Trees enhance community economic stability by attracting businesses and tourists.
- 🌳 People linger and shop longer along tree-lined streets.
- 🌳 Apartments and offices in wooded areas rent more quickly and have higher occupancy rates.
- 🌳 Businesses leasing office spaces in developments with trees find their workers are more productive and absenteeism is reduced (Colorado Tree Coalition, <http://www.coloradotrees/benefits.htm>, viewed May 17, 2011).
- 🌳 Property values increase 5 to 15 percent when compared to properties without trees (depends on species, maturity, quantity, and location).
- 🌳 A study indicated that trees added \$9,500, or more than 18 percent, to the average sale price of a residence in a suburb of Rochester, New York (Nowak, 1995).





Better Social Climate

- ✿ Two University of Illinois researchers (Kuo and Sullivan, 2001) studied how well residents of the Chicago Robert Taylor Housing Project were doing in their daily lives based upon the amount of contact they had with trees, and came to the following conclusions:
 - Trees have the potential to reduce social service budgets, decrease police calls for domestic violence, strengthen urban communities, and decrease the incidence of child abuse according to the study.
 - Residents who live near trees have significantly better relations with and stronger ties to their neighbors.
- ✿ Studies have shown that hospital patients with a view of trees out their windows recover much faster and with fewer complications than similar patients without such views (American Forests, 1999).
- ✿ Researchers found fewer reports of physical violence in homes that had trees outside the buildings. Of the residents interviewed, 14 percent of residents living in barren conditions have threatened to use a knife or gun against their children versus 3 percent for the residents living in green conditions (Prow, 1999).



Overview

To improve the effectiveness of Knoxville's urban forest management program and the urban forest, the City performed a comprehensive operational review of its current urban forestry program and a tree inventory. An independent contractor was hired to assess the status of the City's urban forest, estimate the costs and benefits of the urban forest to the community, analyze the current urban forest management system employed by the City, and ultimately make recommendations to the City about its urban forestry program. Davey Resource Group, a Division of The Davey Tree Expert Company (Davey), performed the urban forestry program assessment for the City of Knoxville and developed this Plan. The following tasks were performed by Davey and used in the development of this Plan:

- 🌳 The City's 2011 tree inventory was analyzed to better understand the state of Knoxville's current urban forest and its maintenance needs.
- 🌳 i-Tree Streets was utilized to estimate the benefits trees provide to the community and calculate the value of the investment the City makes in its trees (www.itreetools.org).
- 🌳 The organizational structure of and methods employed to carry out the City's urban forestry program were reviewed.
- 🌳 Opinions and observations about the City's urban forestry program were sought from both internal and external stakeholders.
- 🌳 City documents relating to urban forestry were assessed.

This Plan is divided into the following four sections:

Section 1: State of the Urban Forest—this section addresses trends identified during the City's tree inventory and uses i-Tree Streets to estimate the benefits of Knoxville's urban forest and calculate a cost-benefit ratio for the City's urban forestry program.

Section 2: Urban Forest Program Operations—presents an overview of the structure of the City's urban forestry program and voices opinions from stakeholders about Knoxville's urban forest and the City's current urban forestry program.

Section 3: Urban Forest Plan—summarizes all data gathered for this Plan and makes recommendations for optimizing the City's urban forestry program.

Section 4: Funding Opportunities—lists current funding and grant opportunities available for the urban forest.



Purpose

The purposes of this Plan are to assess the current state of Knoxville's urban forestry program and its urban forest and to make both short- and long-term recommendations which optimize the City's program and improve the sustainability of its public trees.

In addition to this Plan, a *Hazard Tree Remediation Plan* and *Storm Response Plan* were prepared by Davey in 2011. These plans are supplements to this Plan and address trees that need short-term, immediate, corrective maintenance actions and long-term storm planning, respectively.



Goals, Objectives, and Guiding Principles

Goals, Objectives, and Guiding Principles were developed through collaborations between the City of Knoxville and Davey.

Goals

- 🌳 To enhance, expand, and preserve the City's public urban forest via a review of related strategies, policies, standards, and actions.
- 🌳 Coordinate and improve the City's tree management program in an equitable, economic, and sustainable manner.
- 🌳 Implement an urban forestry planning tool.

Objectives

- 🌳 Utilize recently collected tree inventory data to assess the overall condition of Knoxville's publicly owned trees.
- 🌳 Calculate a cost-benefit ratio for Knoxville's tree management program using i-Tree Streets to illustrate a business-case scenario for investing in the City's urban forest.
- 🌳 Create a plan for the urban forest that includes an assessment of and makes recommendations for the management of Knoxville's public trees, including tree planting, maintenance, and removal; tree inventory database management; tree board function; grant opportunities; and public relations and education.
- 🌳 Recommend tree maintenance activities for the inventoried tree population over a five-year period and project a budget for the implementation of that tree work.
- 🌳 Develop specific plans for the immediate remediation of hazard trees and for storm readiness to supplement the urban forest management plan.

Guiding Principles

- 🌳 **Public Safety:** Ensure the safety of residents and visitors through proactive maintenance of public trees.
- 🌳 **Equal Opportunity:** All neighborhoods are targeted for enhancement through urban forestry.
- 🌳 **Commitment to Professionalism:** Enhance, expand, and preserve the City's public forest resource, maximizing its benefits and increasing its sustainability. Utilize current professional standards and proper arboricultural techniques.
- 🌳 **Education:** Educate the community to expand its support of urban forestry.



Section 1: State of the Urban Forest

In March, 2011, Davey arborists certified through the International Society of Arboriculture (ISA) performed complete and sample inventories of Knoxville's public trees. A total of 7,648 trees and 829 potential planting sites were inventoried in targeted project areas of Knoxville's urban forest. Project areas and the inventory type for each area were selected by the City.

Data were collected using pen-based field units equipped with geographic information system (GIS) data along with global positioning system (GPS) receivers. An ArcPad program was loaded onto field units for attribute (data fields) collection. This field data collection system created a tree layer with individual points (trees) tied to the location and the attributes collected. Measuring tools such as diameter tapes and Biltmore® Cruiser™ sticks were used to determine a tree's diameter at breast height (diameter). Sounding hammers were utilized to sound out possible internal defects occurring in the trunk, branches, or roots of suspicious trees. Data fields collected and location methods are described in Appendix A.



Tree inventory data were uploaded into i-Tree Streets to assess the benefits Knoxville's trees provide as well as calculate the cost-benefit ratio of the City's urban forestry program. i-Tree Streets is a computer model that is part of a suite of software applications called i-Tree. i-Tree was developed by the USDA Forest Service with the help of several industry partners. i-Tree provides tools that estimate the benefits and annual dollar values trees provide to a community.



Project Areas

Project areas for the inventory were selected by the City of Knoxville and included 14 parks, 8 neighborhoods, 5 neighborhood boulevards, 4 state route medians, and the Central Business Improvement District (CBID). A total of 7,648 trees and 829 planting sites were inventoried and evaluated within 32 project areas. Below is a list containing the project areas, the type of inventory, and the number of trees and planting sites collected in each project area.



CBID: full inventory of medians, tree lawns, and public spaces; 778 trees and 82 planting sites collected.

Neighborhood Boulevards: full inventories of medians and tree lawns; 1,238 trees and 194 planting sites inventoried.

Cherokee Boulevard: 628 trees
Emoriland Boulevard: 135 trees
Island Home Boulevard: 167 trees
North Hills Boulevard: 146 trees



State Route Medians: full inventories of medians; 592 total trees and 345 planting sites inventoried.

Asheville Highway/East Magnolia Avenue: 96 trees
Broadway: 49 trees
James White Parkway: 69 trees
Middlebrook Pike: 378 trees

Regional Parks and Greenways: full inventories within maintained/manicured areas in parks. Along greenways and walking paths, only hazardous trees were inventoried. Inventory included 4,257 trees and 51 planting sites.

Bearden Village Greenway: 103 trees
Caswell Park: 456 trees
Chilhowee Park: 554 trees
Fountain City Lake: 51 trees
Fountain City Park: 218 trees
Fountain City Skate Park: 21 trees
Holston River Park: 162 trees
Lakeshore Park: 698 trees
Morningside Park: 763 trees
Neyland Greenway: 95 trees
Third Creek Greenway: 177 trees
Tyson Park: 182 trees
Victor Ashe Park: 296 trees



Neighborhoods: sample inventories of City streets for use in i-Tree Streets analysis; 783 trees and 157 planting sites inventoried.

Black Oak: 56 trees
Emoriland/Fairmont: 162 trees
Fourth and Gill/Old North Knoxville: 66 trees
Holston Hills: 129 trees
Lake Forest: 95 trees
Oakwood/Lincoln Park: 47 trees
Morningside: 156 trees
South Haven: 123 trees
West Hills: 111 trees



Tree Inventory Analyses

By identifying trends in the urban forest, much can be learned about its composition, relative age, and health. Tree inventory data analyses provide baselines from which program recommendations are made and by which they can be measured.

The tree population characteristics assessed for this Plan include tree type and number, genus and species, diameter, condition, and primary and secondary maintenance needs.

The following tree population characteristics were analyzed:

- ✿ Genus and species composition—Tree species vary considerably in life expectancy and maintenance needs. It is essential to know the types of trees present in a managed landscape as they greatly affect tree maintenance needs and budgets.
- ✿ Size class distribution—Tree diameter helps define the general age and size class distribution for the total tree population.
- ✿ General health condition—Condition ratings provide information about each tree inventoried which can then be extrapolated for the population.
- ✿ Maintenance needs—Primary and secondary maintenance needs for each inventoried tree are identified and used to estimate workloads and cost.

Genus and Species Composition

The inventoried tree population of Knoxville’s streets and parks totals 7,648 trees. Fifty-seven genera and 134 species were present. Ten species accounted for 53.49 percent of the inventoried tree population (Table 1). *Cornus florida* (flowering dogwood) comprised 10.19 percent and *Acer rubrum* (red maple) comprised 9.64 percent of the inventoried tree population. Also notable were the genera *Acer* (maple) and *Quercus* (oak), which comprised 21.30 percent and 13.82 percent, respectively, of the inventoried tree population (Figure 1).

Table 1. Ten Most Common Species in Project Area

Species	Total	Percent of Population
<i>Cornus florida</i> (flowering dogwood)	779	10.19
<i>Acer rubrum</i> (red maple)	737	9.64
<i>Acer saccharum</i> (sugar maple)	566	7.40
<i>Quercus phellos</i> (willow oak)	454	5.94
<i>Lagerstroemia indica</i> (common crapemyrtle)	356	4.65
<i>Celtis occidentalis</i> (common hackberry)	296	3.87
<i>Platanus x acerifolia</i> (London planetree)	277	3.62
<i>Cercis canadensis</i> (eastern redbud)	227	2.97
<i>Magnolia grandiflora</i> (southern magnolia)	212	2.77
<i>Pinus strobus</i> (eastern white pine)	187	2.45
Total	4,091	53.49



Observations

Generally, in the field of urban forestry, it is recommended that no one species should account for more than 10 percent of the total population. Furthermore, no single genus should comprise more than 20 percent of the total population.

Knoxville's tree population shows relatively good diversity with no single species occurring at highly excessive rates. While flowering dogwood is a treasured species in the region, future plantings should be limited to avoid an increase in excess of the 10 percent threshold. Additionally, future plantings of red maple should be limited to keep this species under that threshold as well. The same is true for maples in general. Limit plantings of the maple genus to keep the genus threshold near or below the 20 percent level. Complete inventory frequency reports with current binomial nomenclature (botanical names) are included in Appendix B.

Size Class Distribution

Tree species have different lifespans and mature at different diameters, heights, and crown spreads. This means that the actual tree age cannot be assumed from diameter (size) alone. However, general classifications of size, such as small, medium, and large, can be used to describe the general characteristics of Knoxville's street and park tree population.

Small trees (6 inches or less in diameter) represent approximately 42.46 percent (3,247 trees) of the inventoried tree population (Figure 2). The term small does not mean that all trees in this class are of small growth-habit. For example, maple trees included in this group are simply young, recently planted trees. These trees, under normal conditions, will mature to medium- or large-sized trees ranging from 45 to 70 feet in height.

Trees from 7 to 18 inches in diameter are considered medium-sized trees and account for 42.57 percent (3,256 trees) of the tree population.

Trees greater than 18 inches in diameter are considered large-sized trees and comprise 14.97 percent (1,145 trees) of the tree population.

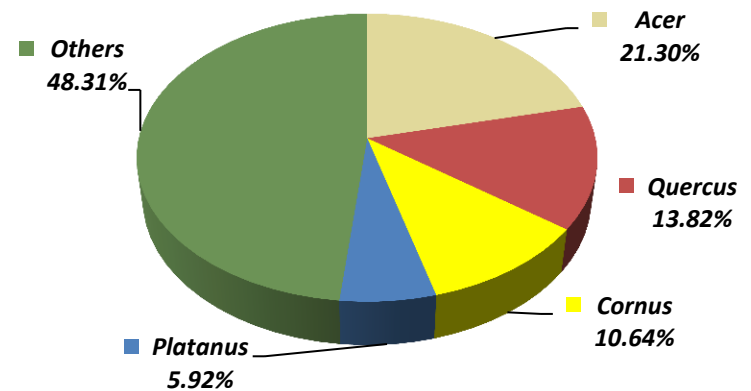


Figure 1. Distribution of Trees by Genus

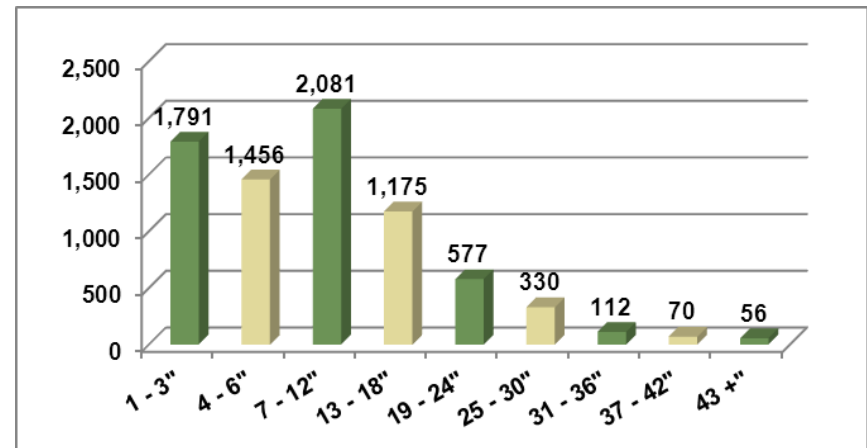


Figure 2. Size Class Distribution



Observations

Davey Resource Group recommends that the size class distribution of an urban forest population should be 20:60:20, reflecting the percentage of trees in each size group (small, medium, and large). This distribution maximizes the benefits larger trees provide while keeping a reliable number of smaller trees to eventually grow into larger-sized trees. Knoxville's current urban forest size class distribution percentages are 42:43:15. This may indicate an aggressive planting program and also may point to poor survival of trees.

Proper planning will help achieve a sustainable forest over time and improve the size class distribution of Knoxville's urban forest. A more aggressive tree maintenance program that includes care of newly planted trees, young-tree training, and systematic pruning will ensure more trees survive to eventually grow into larger diameter classes.

General Health and Condition

The condition of a tree is evaluated by considering several factors, including, but not limited to, root characteristics; branch structure; trunk, canopy, and foliage condition; and the presence of pests. Based on these factors, each tree inventoried was given a condition rating based on those defined by the ISA.

Table 2. Knoxville Tree Condition Ratings

Condition Rating	Total	Percent of Population
Excellent	1	0.01
Very Good	40	0.52
Good	1,176	15.38
Fair	4,844	63.34
Poor	1,372	17.94
Critical	101	1.32
Dead	114	1.49
Total	7,648	100.00

Knoxville's inventoried tree population was found to be mostly in fair condition (63.4 percent) (Table 2). A significant percentage (17.94 percent) was in poor condition. Dead trees and those in critical condition made up only 2.81 percent of the population. Trees rated in good condition or better account for 15.91 percent of the inventoried tree population.



Observations

In Knoxville's urban forest, generally:

- ✿ Dead and critical condition trees must be removed.
- ✿ Fair and poor condition trees may need improvements in structure. In most cases, relatively inexpensive pruning procedures that follow current professional standards should be employed. Over time, many small- and medium-diameter trees in fair and poor condition categories can improve with structural pruning.

Poor condition ratings given to mature trees were generally due to visible signs of decline and stress, including, but not limited to, decay, dead limbs, sparse branching, or poor structure. Where physical damage has occurred, trees may also become more susceptible to diseases and other problems. Often, poor condition ratings given to young or newly planted trees were due to severe physical damage or to a failure to thrive after planting.

Young trees can be seriously impacted by physical damage from vehicles, mowers, string trimmers, and poor pruning or installation practices. Vandalism is also a concern for young trees because of their small size, which makes them an easy target for destruction.

Primary Maintenance Needs

One objective of the tree inventory was to determine the current, appropriate maintenance needs for the tree population. The primary maintenance needs identified and recommendations made pertain to protecting public safety first and foremost. The primary maintenance needs were determined from field observations of the trunk, scaffold branches, and canopy of each tree, as well as the tree's location. All pruning and removal maintenance needs were based on the existence of potential safety risks to the public and, if completed, should enhance public safety and improve the overall condition of Knoxville's urban forest. The primary maintenance needs recommended include:

- ✿ Large tree clean
- ✿ Small tree clean
- ✿ Young tree training (structural pruning)
- ✿ Removal



Table 3 presents the total number of trees in each primary maintenance need category and the percent of the inventoried tree population. The following sections discuss each primary maintenance need in more detail.

Table 3. Primary Maintenance Needs

Primary Maintenance	Number of Trees	Percent of Population
Large Tree Clean	3,836	50.15
Small Tree Clean	1,522	19.90
Young Tree Train	1,599	20.91
Removal	691	9.04
Total	7,648	100.00

To assign a meaningful and consistent priority to each maintenance need, a risk rating was calculated for each tree. A full discussion of tree risk and risk reduction is provided in a supplemental document to this Plan, *Hazard Tree Remediation Plan* (Davey, 2011). Risk ratings are based on the risk assessment performed and the USDA Forest Service Community Tree Risk Rating System (Pokorny, *et.al*, 2003). Risk rating was calculated using the following formula:

$$\text{Risk Rating (3–10 total points)} = \text{probability of failure (1–4 points)} + \text{size of defective part (1–3 points)} + \text{probability of target impact (1–3 points)} + \text{optional subjective risk rating (0–2 points)}$$

The following risk ratings were assigned; however, in this Plan, only trees with moderate- and low-risk ratings were addressed. *The Hazard Tree Remediation Plan* (Davey, 2011) addresses all trees with severe- and high-risk ratings.

- None—Used for planting sites only (risk rating 0).
- Low—Trees designated as low (risk rating 3 or 4) had minor visible structural defects or wounds in areas with moderate to low public access.
- Moderate—Trees described as moderate (risk rating 5 or 6) had defects that may be cost-effectively or practically treated. The majority of trees in this category exhibited several moderate defects affecting less than 40 percent of a tree’s trunk, crown, or critical root zone.
- High—Trees designated as high (risk rating 7 or 8) had defects that may or may not be cost-effectively or practically treated. The majority of the trees in this category had multiple or significant defects affecting more than 40 percent of the trunk, crown, or critical root zone. Defective trees and/or tree parts were generally 4 to 20 inches in diameter and found in areas of frequent occupation, such as a main thoroughfare, congested streets, and/or near schools.
- Severe—Trees described as severe (risk rating 9 or 10) had defects that cannot be cost-effectively or practically treated. The majority of the trees in this category had multiple and significant defects present in the trunk, crown, or critical root zone. Defective trees and/or tree parts were generally larger than 20 inches in diameter and found in areas of frequent occupation, such as a main thoroughfare, congested streets, and/or near schools.



Large and Small Tree Clean

Large tree clean is the removal of dead, dying, broken, and/or diseased wood to minimize potential risk. Trees in this category are large enough to require bucket truck access or manual climbing. Small tree clean is the same process as large tree clean, but the term is used for small-growing trees that can be pruned from the ground. There were 3,836 trees recommended for large tree clean (50.15 percent) and 1,522 trees recommended for small tree clean (19.90 percent).

Analyzing only the 5,358 trees in need of cleaning, only 687 trees (12.82 percent) were identified as having high-risk rating values and 11 trees (0.21 percent) had severe-risk rating values. Trees with high- and severe-risk rating values are discussed in detail in the supplemental document to this Plan, *Hazard Tree Remediation Plan* (Davey, 2011). The remaining 4,660 trees (86.97 percent) requiring large and small tree clean have moderate- or low-risk ratings and should be considered as part of a cyclic, routine pruning program.

Although many of these pruning recommendations are considered low or medium priority, they can become high-priority liabilities if neglected for an extended period of time. Ideally, Knoxville will create a systematic program that provides tree pruning and maintenance on a block by block and neighborhood by neighborhood basis. This type of systematic approach provides tremendous efficiencies and increases the quantity and potentially the quality of tree work performed. A cyclic pruning program should decrease the occurrence of potentially dangerous broken branches and large-sized deadwood in the future. In a well-executed cyclic program, citizen requests for tree service that do not pose immediate safety concerns should be deferred until the next cycle of scheduled service for that neighborhood or block.

Young Tree Training (Structural Pruning)

Young tree training is pruning that corrects or eliminates weak, interfering, or objectionable branches in order to minimize future maintenance needs. Trees in this category are small in size (typically 20 feet or less in height) and can be pruned from the ground with hand pruners, small hand saws, or pole pruners. There were 1,599 trees (20.91 percent) recommended for young tree training. While this is a significant percentage of the tree population, it is one of the least labor-intensive practices and pays the highest dividends. Investing in early management of young trees through young tree training (structural pruning) may reduce the probability of young trees maturing into unhealthy and poorly formed, mature trees that require costly tree maintenance with larger, more expensive equipment. When young trees are provided structural pruning, they develop strong structure that is less prone to branch failure and requires less maintenance pruning as the tree matures.



These divergent stems with tight branch angles form weak branch attachments. Young tree training would avoid this problem.



Tree Removals

Trees fail from natural causes, such as disease, insects, and weather conditions, and from physical injury due to vehicles, vandalism, poisoning, and root disturbance. Some of the trees recommended for removal based on this inventory may be potential safety risks. Others may be very small trees or trees that are in severe decline but not yet a significant safety risk.

Six hundred and ninety one trees or 9.04 percent of the inventoried tree population were recommended for removal. Of these recommended removals, there were 407 (58.90 percent) trees identified as having a high-risk rating value and 72 (10.42 percent) trees identified as having a severe-risk rating value. Trees with high- and severe-risk rating values are discussed in detail in the *Hazard Tree Remediation Plan* (Davey, 2011). The remaining removals (212 trees) having moderate- or low-risk ratings should be removed within the next 5 years.

Observations

Analysis of Knoxville's primary tree maintenance needs indicates that a systematic (cyclical) tree pruning program is needed. Systematic pruning makes certain that trees are inspected and pruned on a regular basis and that care starts at a young age. Performing low-cost young tree training (structural pruning) will greatly reduce the need for future high-cost pruning to correct structural defects that create hazardous trees. Trees that receive regular pruning will live longer and grow into healthier specimens with fewer pruning needs.

Secondary Maintenance Needs

While the primary maintenance needs were discussed above, additional secondary maintenance needs as well as information about the presence of overhead utilities were identified during the inventory. Secondary maintenance needs include:

- ✿ Raise—Pruning to remove low branches that interfere with sight and/or traffic
- ✿ Reduce—Pruning to decrease height and/or spread of the crown in order to provide clearance for electric utilities, lighting, or other obstructions
- ✿ Thin—Selective removal of water sprouts, epicormic branches, and live branches to reduce density
- ✿ None—No secondary maintenance needs identified

The numbers of secondary maintenance needs identified in the project areas are found in Table 4.

Table 4. Secondary Maintenance Needs

Secondary Maintenance	Total	Percent of Population
Raise	407	5.32
Reduce	87	1.14
Thin	44	0.58
None	7,110	92.96
Total	7,648	100.00



Observations

There were no urgent trends identified in the secondary maintenance need categories. However, 407 trees (5.32 percent) need low limbs raised. Public safety can be enhanced by removing low limbs. Additionally, overall tree health can be enhanced by reducing or thinning a tree's canopy where needed.

Overhead Utilities

The presence of utilities above existing trees and available planting sites were collected during the inventory (Figure 3). A total of 1,255 existing trees (16.41 percent) had overhead utilities present, while 6,393 existing trees (83.59 percent) did not.

Observations

Of those existing trees with overhead utilities present, 748 (59.6 percent) were large- or medium-sized species that may interfere with wires or already require pruning. There were 507 small-growing species (40.40 percent) inventoried that will likely create conflicts in the future.

For planting site selection, the presence of overhead utilities dictates careful consideration. There were 829 vacant planting sites that were inventoried and 546 (65.86 percent) had no overhead utilities present, while 283 (34.14 percent) currently had overhead utilities.

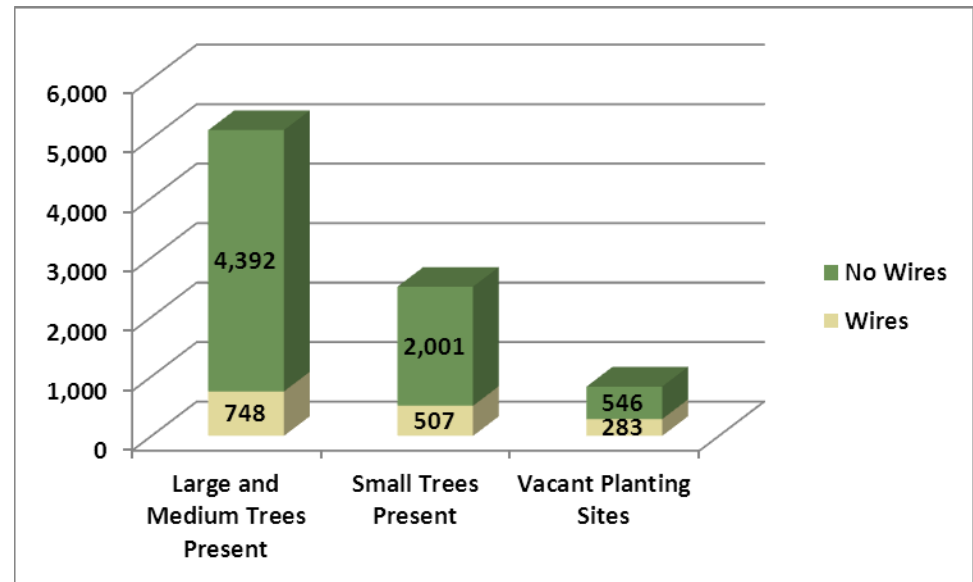


Figure 3. Overhead Utility Information



i-Tree Streets

Urban trees provide many benefits to their surrounding community. Shade and beauty are among the benefits many know well. However, there are many environmental services and economic benefits that trees provide that are not as well known. Trees save energy, reduce stormwater infrastructure needs and air pollution, and increase property values. The benefits of trees can be estimated using i-Tree Streets.

Using basic tree inventory information, the i-Tree Streets computer model calculates the benefits Knoxville's urban forest provides. As specified by i-Tree Streets, the City submitted citywide costs associated with its street tree management program. The following costs were provided by the City:

- 🌳 Annual Planting—\$40,000
- 🌳 Annual Pruning and Tree Removal—\$219,015
- 🌳 Stump Removal and Disposal—\$10,889
- 🌳 Pest and Disease Control—\$0
- 🌳 Establishment/Irrigation—\$0
- 🌳 Repair/Mitigation of Infrastructure Damage—\$5,300
- 🌳 Litter/Storm Clean-up and Leaves/Brush/Debris—\$1,814,481
- 🌳 Tree-Related Litigation and Settlements—\$520
- 🌳 Program Administration—\$228,858
- 🌳 Inspection—\$260,000
- 🌳 Electricity—\$8.854/Kwh
- 🌳 Natural Gas—\$1.0498/Therm
- 🌳 Average Home Resale Value—\$185,231 (current single-family median price)
- 🌳 Other Annual Expenditures—\$0

Any required inputs and costs not known or provided by the City were estimated using i-Tree Streets' preloaded unit prices or defaults. The program defaults are based on prices from Charlotte, North Carolina, the Reference City selected by the USDA Forest Service for the Piedmont Region.



Streets' default economic analyses use regional energy prices, property values, water prices, and stormwater costs. Regional energy prices, typical energy use, and water prices are collected from the utility companies in the Reference City. Property values and land-use distribution (single-family residence, multi-family residence, commercial, etc.) are determined from local data. Air pollutant emissions are calculated based on the regional mix of fuels used to produce electricity, natural gas consumption, and hourly weather data. Stormwater costs are estimated with the help of local stormwater officials. Prices for trees and tree maintenance are determined from surveys of municipal foresters and local arborists. All this information is incorporated into Streets as regional default values. Default values can be adjusted for local conditions; however, they were not adjusted for this study. To find out more about the default costs for Charlotte that were used when necessary for Knoxville's i-Tree Streets analysis in this Plan, see the *Piedmont Community Tree Guide, Benefits, Costs, and Strategic Planting* (2006) by McPherson, *et al.*

Results

The i-Tree Streets model was used to quantify tree benefits in eight representative Knoxville neighborhoods. Random sample inventories were performed in the following neighborhoods: Black Oak; Fourth and Gill/Old North Knoxville; Holston Hills; Lake Forest; Morningside; Oakwood/Lincoln Park; South Haven; and West Hills.

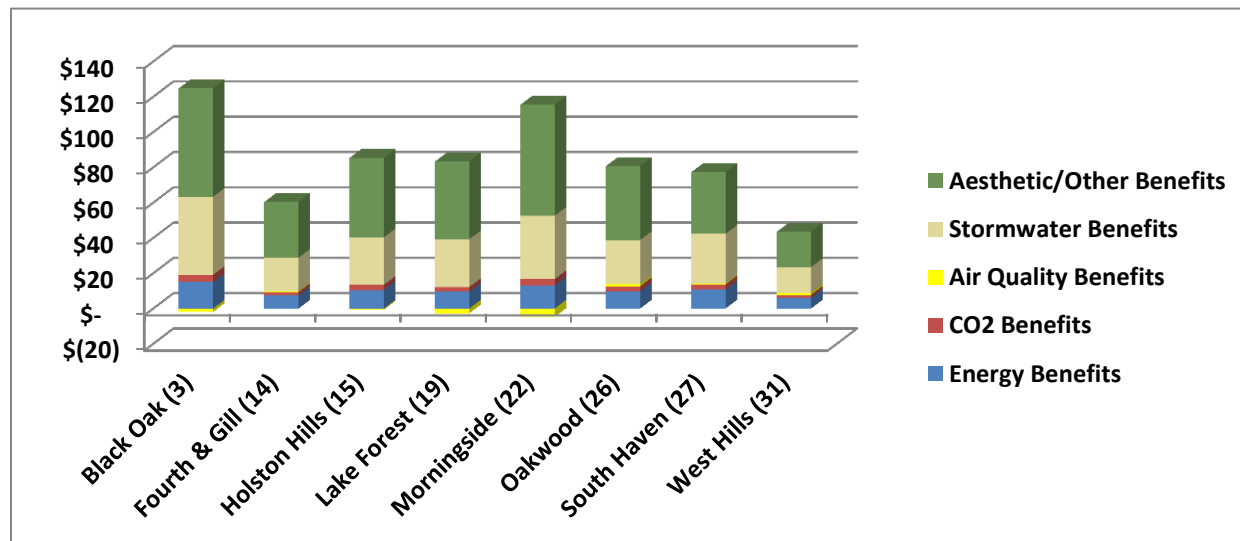


Figure 4. Annual Benefits by Category Within Each Neighborhood. Stormwater benefit estimates are based on a utility fee not applicable to Knoxville at this time.



For the eight neighborhoods studied, the total annual benefits of publicly owned street trees were \$600,307; the annual cost to manage these trees was estimated at \$174,338 (Table 5 and Figure 4). The net annual benefit to the community was \$425,969 with a positive benefit-cost ratio of \$3.44. These numbers indicate that for every dollar spent on Knoxville’s publicly owned street trees in those eight neighborhoods, the City receives \$3.44 in return. In the i-Tree neighborhood study areas, each tree provided an average of \$83 in environmental services and economic benefits to the community each year.

While i-Tree is a peer-reviewed model and provides a very useful tool for comparative values of tree benefits and costs, some of the benefit costs are based on a default value, including the stormwater benefit calculation, and are not applicable to the City of Knoxville at this time. The stormwater benefit value provided, however, does provide a reasonable comparative estimate of stormwater related benefits.

Appendix C contains a map of the sampled neighborhoods and a complete set of outputs for each neighborhood.

Table 5. Benefits and Costs Within Each Neighborhood

Neighborhood (Zone Number)	Estimated Total Trees	Costs (Dollars/Year)	Benefits (Dollars/Year)	Net Benefits (Dollars/Year)	Benefits per Tree (Dollars/Tree)	Benefit-Cost Ratio
Black Oak (3)	518	\$15,893	\$63,672	\$47,779	\$123	\$4.01
Fourth & Gill (14)	610	\$4,623	\$36,847	\$32,224	\$60	\$7.97
Holston Hills (15)	1,193	\$44,760	\$101,211	\$56,451	\$85	\$2.26
Lake Forest (19)	879	\$13,449	\$70,934	\$57,485	\$81	\$5.27
Morningside (22)	1,443	\$16,417	\$159,964	\$143,547	\$111	\$9.74
Oakwood (26)	435	\$10,954	\$35,089	\$24,135	\$81	\$3.20
South Haven (27)	1,138	\$26,714	\$87,932	\$61,218	\$77	\$3.29
West Hills (31)	1,027	\$41,529	\$44,657	\$3,128	\$44	\$1.08
Total	7,243	\$174,339	\$600,306	\$425,967	\$83	\$3.44



Observations

As shown in Table 6, neighborhoods with a higher number of large-diameter trees had more benefits. For future plantings, select tree species that will mature as large-sized trees to gain the most annual benefits.

Table 6. Total Annual Benefits and Size Class Distribution by Neighborhood

Neighborhood (Zone Number)	Number of Trees	Percent Small Trees 0- to 6-Inch Diameter	Percent Medium Trees 7- to 18-Inch Diameter	Percent Large Trees ≥19-Inch Diameter	Benefits	Benefits per Tree	Aesthetic/ Other Benefits	Stormwater Benefits*	Air Quality Benefits	CO ₂ Benefits	Energy Benefits
		Percent	Percent	Percent	(Dollars/Year)	(Dollars/Tree)	(Dollars/Tree)	(Dollars/Tree)	(Dollars/Tree)	(Dollars/Tree)	(Dollars/Tree)
Black Oak (3)	518	21	34	45	\$63,672	\$123	\$61	\$44	(\$2)	\$4	\$15
Fourth & Gill (14)	610	45	44	11	\$36,847	\$60	\$32	\$19	\$0	\$2	\$7
Holston Hills (15)	1,193	25	49	25	\$101,211	\$85	\$45	\$27	(\$1)	\$3	\$11
Lake Forest (19)	879	36	38	26	\$70,934	\$81	\$44	\$27	(\$3)	\$3	\$10
Morningside (22)	1,443	13	57	31	\$159,964	\$111	\$63	\$36	(\$5)	\$4	\$13
Oakwood (26)	435	32	43	26	\$35,089	\$81	\$42	\$25	\$1	\$3	\$10
South Haven (27)	1,138	28	40	33	\$87,932	\$77	\$35	\$28	\$0	\$3	\$11
West Hills (31)	1,027	49	41	10	\$44,657	\$44	\$20	\$15	\$1	\$2	\$6
Total	7,243				\$600,306						
Average		30	45	25		\$83	\$43	\$28	(\$1)	\$3	\$10

* The stormwater benefits calculation is based on default values for the Piedmont region that are not applicable to the City of Knoxville at this time.



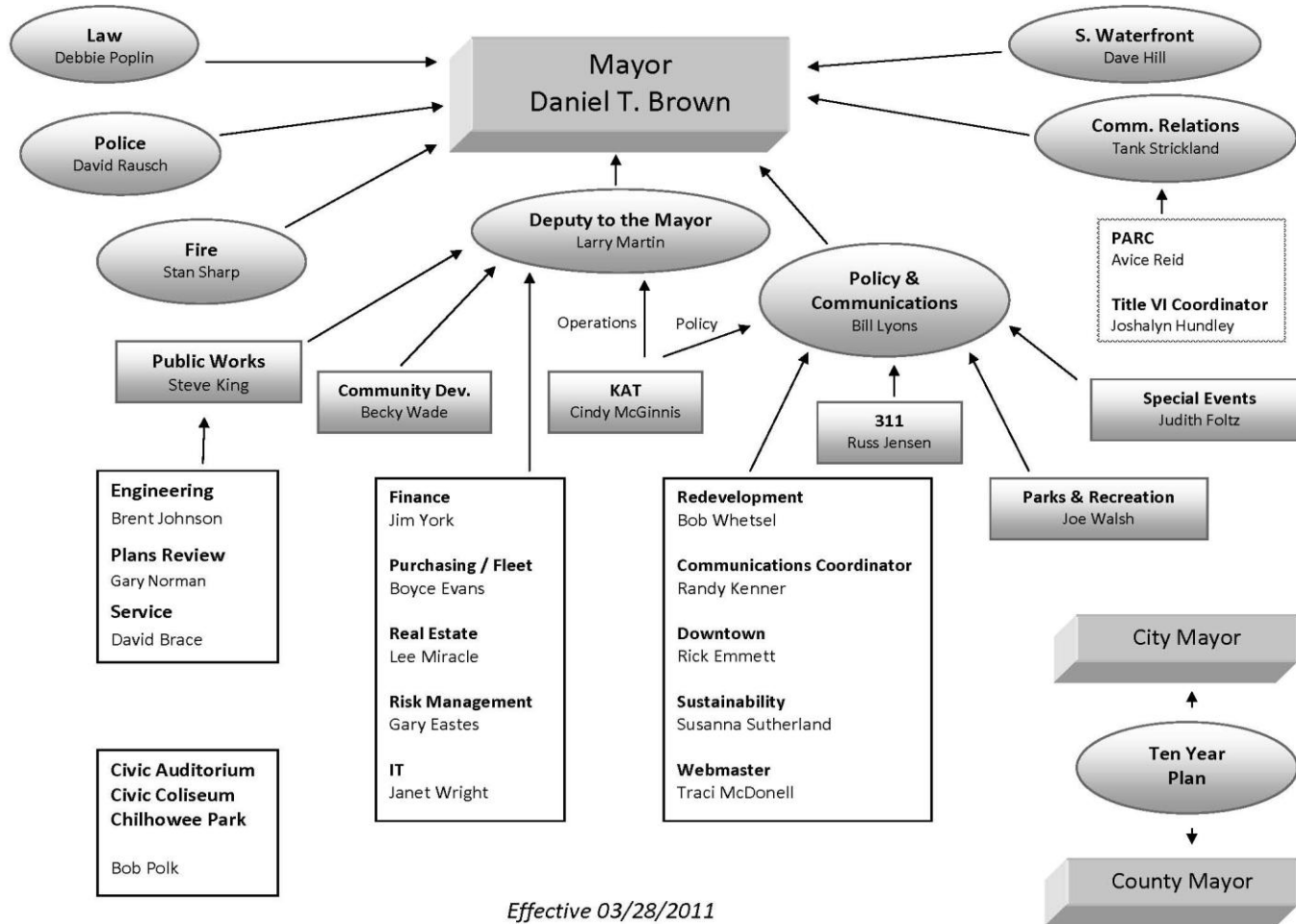
Section 2: Urban Forestry Program Operations

Organizational Overview

The City of Knoxville Public Service Department is responsible for all administration of trees on City-owned property. The Public Service Department is located within the Department of Public Works which reports directly to the City's Deputy Mayor and Mayor. The Department of Public Works is responsible for Public Service, Engineering, and Building Inspections/Plans Review and includes the management of nearly all of the City's infrastructure. Figure 5 provides an overview of the City's organizational structure.

The City's Public Service Department contains the Horticulture Division. The Horticulture Division has 52 employees who maintain greenways, parkways, and public spaces within Knoxville. Three maintenance crews perform the bulk of horticulture-related activities. One additional crew has an ISA Certified Arborist and an aerial lift truck, and staff who prune, water, mulch, and assist with maintenance of all City trees. Tree planting is performed by a private contractor. In addition to regularly scheduled activities, the Horticulture Division also responds to citizen requests for service. The ISA Certified Arborist provides technical oversight and works alongside foremen, equipment operators, and laborers who all report to the Horticulture Division Manager.

The City of Knoxville has an advisory Tree Board that formulates a Master Street Tree Plan for all municipal property and disseminates news and information regarding the selection, planting, establishment, and maintenance of trees. They also advise City Council on desirable legislation concerning the City's tree program. Created in 1992, the group hosts the City's annual Arbor Day ceremony, coordinates the submission of Tree City USA annual renewals, and works with the joint Knoxville-Knox County Metropolitan Planning Commission to develop tree planting plans.



Effective 03/28/2011

Figure 5. City of Knoxville Organizational Chart



Opinions About the City's Urban Forestry Program

In April, 2011, Davey solicited input and collected information about the City's current urban forestry program during a series of meetings in Knoxville with Knoxville's Public Service Department and other stakeholders. The meetings provided detailed information to be shared about program efficiencies and effectiveness and assimilated opinions about the City's urban forestry program.

The meetings included the following City stakeholders:

- 🌳 City Attorney's Office
- 🌳 Operations (department heads and Mayor)
- 🌳 Police Chief/Fire Chief Offices
- 🌳 Metropolitan Planning Commission
- 🌳 Stormwater Engineering Section
- 🌳 Policy and Communications Division
- 🌳 Knoxville Tree Board
- 🌳 Knoxville Utilities Board (KUB)
- 🌳 Public Service Department Staff
- 🌳 Horticulture Division Staff
- 🌳 City Council

In addition, a public meeting was held at the Cansler YMCA to gather public input about the City's urban forestry program. Following are expressed opinions about the City's urban forest program.

Newly Planted Trees

- 🌳 The City has specifications and species recommendations for tree planting in the CBID. While the specifications are adequate, concern was raised about whether the specifications were followed and/or enforced. Copies of the specifications for the 2011 tree planting season and the approved species list are found in Appendix D.
- 🌳 Even though the trees have a one-year guarantee per contract language with the installer, the Horticulture Department performs all maintenance and mulching after the initial planting. During the first year, City crews are responsible for watering each new tree one time per week (if needed), adding new mulch, staking (if needed), pruning of dead branches, and inspecting for insects and disease. Some input provided by City staff and stakeholders indicated that newly planted trees may not receive the watering and care needed to become fully established. According to some participants, examples existed where newly planted trees were not mulched or watered and died within the first year after planting.



Pictured above is a newly planted tree in Knoxville.



- Other comments stated that follow-up mulching was performed improperly with reported occurrences of mulch around public trees, forming large volcanoes around trees instead of creating a 3- to 4-inch thick mulch layer that thins to zero depth as it approaches the trunk. Improper mulching was also evidenced during the recent public tree inventory.

Tree Maintenance

- Comments indicated that trees did not receive structural pruning (young tree training) within the establishment years. This was also apparent during the recent tree inventory where nearly 21 percent of the inventoried trees were recommended for young tree training pruning.
- Additionally, it was learned that no systematic pruning takes place for Knoxville's public trees. Horticulture crews perform pruning "as needed" and respond to citizen requests for this service.
- Concern was raised that the number of tree removals per year may be close to the number of tree plantings per year. If planted trees do not survive, then the net result may be a reduction in the population of public trees. The City currently plants 400 trees per year. The number of trees removed is not tracked as a measurable category. The City reported that 1,249 trees were "serviced" (pruned or removed) in 2010. Estimates are that about twice as many trees are pruned than removed each year. If estimates are accurate, it would indicate that approximately 400 trees were removed in 2010.



Pictured above is a mulch volcano around a tree.



Knoxville provides curbside brush and yard waste pick-up every two weeks from February 1 to November 1 and leaf pick-up four times from November 1 to February 1. These activities account for \$1,814,481 of the City's \$2,626,763 overall urban forestry program budget (Table 7). There is strong support for these activities as they fit well with the City's current initiative of making recycling more available to residents. However, many individuals felt that it may be occurring at the expense of adequate amounts of tree planting and follow-up care for newly planted and regular maintenance of established trees. While 69.07 percent of the City's urban forestry costs are related to pick-up of leaves, brush, and woody debris, activities related to tree planting, pruning, and removal total 10.27 percent. Administration and inspection costs total 18.61 percent.

Table 7. Urban Forestry Program Costs

Cost Category	Annual Expense (Dollars)	Percent of Total Costs
Brush Pick-up	1,158,487	44.10
Leaf Pick-up	416,647	15.86
Inspection/Service Requests	260,000	9.91
Woody Litter Pick-up	239,347	9.11
Administration	228,858	8.71
Tree Removal	153,310	5.84
Tree Pruning	65,705	2.50
Infrastructure Damage	53,000	2.02
Tree Planting	40,000	1.52
Stump Removal	10,889	0.41
Litigation	520	0.02
Total	2,626,763	100.00



Section 3: Urban Forest Management Plan

A thorough review of the City's strategies, policies, and standards with regard to its tree management program, the recently completed tree inventory, and additional input from the City and stakeholders were used to make recommendations in this Plan. The Plan is focused on optimizing Knoxville's program in an equitable, economic, and sustainable manner and addressing tree maintenance and planting, tree inventory use, the Tree Board, and education and public relations.

Tree Maintenance

In its 1998 assessment of the nation's urban forests, the USDA Forest Service found that 37 percent of cities in the United States practice "crisis management", responding to accidents, impending hazards, and complaints rather than implementing a systematic tree maintenance program. Additionally, over 95 percent of whom identified the same five long-term tree care strategies—proper site and species selection, proper pruning techniques, minimization of construction damage, insect management, and tree health monitoring—as being critical to preserving the health and sustainability of the urban forest.

While crisis management may have strong political appeal and appear to cost less, it may not be the most cost-effective, efficient, or prudent method of providing much needed maintenance for trees.

Funding for tree maintenance programs can be difficult for some communities. While tree maintenance budgets are cut, tree planting remains an appealing expenditure as it creates a high profile event that captures the attention of media and citizens. Communities with healthy tree populations that maximize benefits for its citizens will find a balance between expenditures for tree planting and tree maintenance. It is difficult to sustain an urban forest without this balanced approach. The following sections provide a review of tree maintenance, current conditions, and makes recommendations to improve Knoxville's urban forest.

Pruning

Currently, Knoxville has no systematic pruning program for its street tree population. Pruning is performed as needed and typically is generated by a request from a resident. In various City parks, trees do receive planned pruning; however, there is no systematic program in place for this work. Foremen decide where pruning is needed.

A total of 1,249 trees were pruned and removed in 2010 within parks and on City streets. No records are maintained to determine specifics within each category and no City-wide public tree inventory exists.



This young tree has been pruned improperly, leaving stubs where pruning took place. The stubs will eventually decay and lead to poor tree structure.



During the recent partial inventory of the City, Davey observed that many trees had remnant stubs, and several trees had co-dominant stems and poor structure. And, several comments were received from City staff and stakeholders that better pruning practices were needed, particularly for young trees.

The City cooperates with the KUB policies about the pruning of trees along utility rights-of-way and easements. KUB provides electric service and other utilities in the Knoxville metropolitan area. In the study areas, 1,255 trees (16.41 percent) were under overhead power lines and 155 of those trees were identified as removals.

Mulching

In Spring, 2010, City crews mulched 1,364 trees. Trees planted within the last few years received mulch from City horticulture crews. Trees are planted by contractors per City specifications, but City crews are responsible for follow-up maintenance. City policy is to maintain a mulch ring around young trees that is three to four inches in depth, but not touching the tree's trunk, and the mulch covers an area four times the root ball. Many trees observed during the tree inventory were not mulched properly and have mulch at excessive depths in a "volcano" pattern. Concern was expressed about this practice by City staff and by many who attended informational meetings.

New Tree Watering

Newly planted trees were watered by horticulture crews 915 times in 2010. While there is no record of the number of times each tree was watered, this number suggests that each newly planted tree was watered at least twice. There were comments made during the informational meetings that several new plantings have failed in the past as a result of a lack of adequate follow-up watering.

Pest Detection

There is no active municipal program that inspects for insect or disease problems on a regular basis and no treatment or spray programs that occur. While many communities do not actively spray or treat for insect or disease problems, the need for a plan to proactively deal with exotic pests was expressed. City staff is aware of the presence of *Agrilus planipennis* (emerald ash borer) and Thousand Cankers Disease which is caused by *Pityophthorus juglandis* (walnut twig beetle) and an associated fungus, *Geosmithia* sp. nov., on *Juglans* (walnut) species. Knox County is part of a regulated quarantine area for both pests. Emerald ash borer was first found in Tennessee at a truck stop along I-40 near the Knox-Louden County line. Walnut trees infected with Thousand Cankers Disease were discovered in Knox County in July, 2010. This was the first identification of the disease east of Colorado and falls within the primary native range of Eastern black walnut. Knoxville currently has no program in place for dealing with the removal of trees that may succumb to either of these exotic pests. The walnut genus occurred in 1.15 percent of the recently inventoried areas and *Fraxinus* (ash) occurred 0.71 percent of the time. These are relatively small percentages for a public tree population, but there are also trees on private property to consider when developing a pest control or tree removal strategy. Appendix E contains information about both emerald ash borer and Thousand Cankers Disease.



Tree Maintenance Recommendations

- ✿ Place a high priority on developing a systematic (regularly scheduled) tree maintenance program that will schedule required tree maintenance just as vehicle maintenance is scheduled. As evidenced by the i-Tree Streets assessment of Knoxville, trees are valued assets. Like vehicles, trees are less costly to maintain and provide more predictable results if they are maintained in a systematic way. While the shift to a systematic maintenance program from an on-demand system takes a large amount of will, the benefits are lofty. The benefits include lower costs gained through efficiencies and better quality trees that are not only healthier and safer, they also look better.
- ✿ Table 3 provides a breakdown of the primary maintenance needs for trees within the project areas. Six hundred ninety one trees were recommended for removal. There were 407 identified for removal with high-risk rating values and 72 with severe-risk rating values. Trees with high- and severe-risk rating values are discussed in detail in the supplemental document to this Plan, *Hazard Tree Remediation Plan* (Davey, 2011). The remaining 212 trees have moderate- and low-risk rating levels and should be removed over the next 5 years at a rate that averages 42 trees per year. Table 8 provides an estimate of the number of maintenance activities needed and the associated costs to perform them each year to maintain a systematic program.
- ✿ Create one new staff position—Urban Forester. The Urban Forester will have primary and direct responsibility for the oversight and management of the City’s public tree resource. This position is important and should be a sole responsibility. The Urban Forester should be an ISA Certified Arborist with GIS ability. The Urban Forester should maintain tree inventory data, perform analyses, provide production reports, prepare maps of project areas, and plan for future work assignments. In addition to data management, he/she should be able to assign workloads, supervise staff, and adequately plan and budget for long-term systematic urban forest management.
- ✿ Re-organize the Horticulture Department staff to report to the new Urban Forester position and create two dedicated tree crews who perform high-quality arboriculture services on public trees in Knoxville. This reorganization may require the hiring of at least 2 to 3 additional staff members to operate aerial lift trucks and perform some limited climbing. It may also require the purchase of an additional aerial lift truck to support two crews.
- ✿ Enforce current Horticulture Department standards about pruning trees properly. Poor pruning creates wounds that last a lifetime, creating defects that could increase risk. Provide training for crews periodically to ensure that new employees are aware of proper pruning techniques.
- ✿ Enforce current Horticulture Department policies about mulching young trees. Provide training for crews periodically to ensure that new employees are aware of proper mulching techniques.
- ✿ Once the investment is made to plant new trees, ensure that the investment is a wise one and provide adequate moisture and young tree training pruning (structural pruning). Newly planted trees should receive at least one inch of water every week. Supplemental watering will be required if adequate amounts of natural rainfall do not occur. Assign a staff person the sole responsibility to monitor rainfall and ensure that newly planted trees are watered during their first two seasons. The chance of survival is greatly reduced for drought-stressed trees.
- ✿ Continue a strong dialogue and keep cooperation with the KUB. Its policies and practices relate to vegetation management and trees on public property. Continue cooperative efforts between the Horticulture Department and KUB to deal with “problem trees” that are located under overhead power lines. KUB crews may be able to provide additional support with removal of trees that continue to threaten power lines. KUB may also be willing to partner with the Horticulture Department with additional training sessions on proper pruning.



- ❁ Even though black walnut comprises 1.15 percent and ash species occurs at 0.71 percent of the tree population in the study area, City staff should monitor for the occurrence of Thousand Cankers Disease and emerald ash borer and plan for control strategies or budget for removal costs, as these lethal exotic pests kill public trees. Become familiar with the Tennessee Action Plan for Thousand Cankers Disease. The Tennessee Thousand Cankers Disease Action Plan (Haun, *et. al*, 2010) is available at http://tn.gov/agriculture/publications/regulatory/TN_TCD_ActionPlan.pdf. Appendix E contains maps of quarantine areas and rules.

Tree Planting

There is no structured or systematic program of priorities that guide the City's tree planting program; however, a *Tree Conservation & Planting Plan (2007)* was prepared by the Knoxville-Knox County Metropolitan Planning Commission. Decisions about planting locations are currently made jointly by the Deputy Director of Public Services, the City's Planning Coordinator in the Public Services Department, the City Arborist, and members of the Tree Board. Citizens can also request the planting of street trees adjacent to their property. The City typically honors these requests after the site has been inspected by City staff. Developers are typically required to plant trees to replace any lost during development, although there is no official program that involves Public Service.

Approximately 400 trees are planted each year from December to March utilizing the City's \$40,000 tree planting budget. Once locations for new trees on public property are determined, trees are planted by a private contractor. The City has developed specifications that are included as part of the tree planting contract. While the specifications include language about planting depth, there is no data to indicate that trees are planted at proper depths. Many trees delivered from nurseries have their first lateral root at depths up to 8 inches below the top of the root ball. If trees are planted with the first lateral root at that depth, experts agree that this will eventually lead to girdling roots. The City assumes all responsibility for watering, follow-up mulching, and staking.

While damaged and dead limbs are pruned during the first year, there is no indication that young tree training is performed to provide structurally well-formed trees. While a thorough set of specifications is included with the annual tree planting contract, there are questions about the effectiveness of post-planting inspections and enforcement of the contract specifications. City staff reports that tree survival is relatively poor, although there are no data to track survival rates.

Balled-and-burlapped trees 1-½ inches in caliper are planted and species vary from year to year. Species selection lists are included in the *Tree Conservation & Planting Plan (2007)*, although it is unclear if these lists are utilized. The tree planting specifications that are included with each year's contract include a species list as well.



This recently planted tree has received little follow-up care.



Tree Planting Recommendations

- ✿ Review and utilize the *Tree Conservation & Planting Plan* (2007) prepared by the Knoxville-Knox County Metropolitan Planning Commission. Consider removing ash species from the preferred list.
- ✿ Pre-inspect tree stock. Tag trees in the field prior to delivery by nurseries to ensure the delivery of quality stock.
- ✿ Inspect the work of tree planting contractors to ensure compliance with contract specifications. Planting depth and root ball depth are critical standards that need to be followed.
- ✿ Follow guidelines developed by KUB that promote planting the right tree in the right place. This will reduce future demands for pruning large trees that are planted under overhead wires.

Tree Inventory

In March, 2011, Davey's ISA Certified Arborists performed complete and sample tree inventories of select Knoxville neighborhoods. A total of 7,648 trees and 829 potential planting sites were inventoried in targeted project areas of Knoxville's urban forest. At this time, the City does not have a complete tree inventory database.

Tree inventories provide the foundation for a systematic tree management program that maximizes benefits. Some inventories are one-time events that provide a snapshot of an urban forest. This type of inventory often includes a to-do list and recommendations for accomplishing identified maintenance activities. Once the activities are complete, a municipality is then faced with a decision to re-inventory or wait for another motivational event to compel another inventory. Other inventories are complete inventories of a city's public tree resource and are updated on an on-going basis. This type of dynamic inventory provides on-demand information and, coupled with data management software, can create a powerful way to plan for maintenance and create accurate budgets. Municipalities that have complete inventories of their public trees report increased efficiencies in delivering services. A complete tree inventory provides the information that managers need to make timely decisions about managing their tree resource.

Inventories also improve community relations by linking requests for services to current and accurate data. Requests for service can be scheduled and tracked using tree inventory and management software. Inventory data can help a city with emergency preparedness and also provide tools for justifying expanded budgets. Maintaining good records of tree services that are provided to specific trees can be valuable when it's time to plan budgets, or if work history is needed to document activity when liability issues arise.

Data management software is available and should include active GIS capability and provide the opportunity to develop maps of service areas that improve communication and efficiencies. Maps of service areas and project sites can be powerful tools for crews who perform the work, and can provide guidance for long-term planning.



Tree Inventory Recommendations

- 🌳 Complete a City-wide public tree inventory
- 🌳 Utilize a data management software package as a tool to continually monitor and plan for systematic management of the public tree resource

Utilization of these tools will allow the City to track work accomplishments and budget more effectively.

Tree Board

A municipal tree board should create a strong bond between a municipal forestry department and private citizens. Some boards are advisory, while others have authority to provide program direction, approve plans, and purchase goods and services. Most boards are appointed by the mayor or city council, and operate in an advisory capacity to city staff and elected officials. Tree boards are typically the champions of urban forestry and advocate for strong urban forestry programs in their community.

The purpose of Knoxville's City Tree Board is to formulate a Master Street Tree Plan for all municipal property. The Board assists the City by providing information regarding the selection, planting, establishment, and maintenance of trees; and advising City Council on desirable legislation concerning the City's tree program. The Tree Board has specific duties that are created in Chapter 14 of the *Knoxville Tree Protection Ordinance* (City of Knoxville, 2005). Those duties include the following:

- 🌳 To study the problems and determine the needs of the City in connection with its tree program and to formulate a Master Street Tree Plan for all municipal property
- 🌳 To develop regulations and planting standards relative to the type and kind of trees to be planted on any municipal property
- 🌳 To assist City staff, elected officials, and citizens with the dissemination of news and information regarding the selection, planting, establishment, and maintenance of trees within the City and to make recommendations to City Council relative to desirable legislation concerning the tree program and activities for municipal property
- 🌳 To hold regular meetings to discuss tree issues and matters of the board
- 🌳 To recommend rules and procedures for approval by the City Council in order to perform its duties

Recent activities and projects of the Tree Board include: education and outreach about the importance of trees; annual Arbor Day Celebration which involves elementary school children; working with the Knoxville-Knox County Metropolitan Planning Commission to develop and carry out a Street Tree Planting Plan; helping to save the giant *Quercus acutissimae* (sawtooth oaks) in Market Square downtown; working with developers during the 2002 redesign of Krutch Park and Market Square to suggest replacement trees and trim existing trees; and collaborating with City residents to determine where new street trees will be planted.



Tree Board Recommendations

- ✿ The Tree Board should consider a strategic planning session to focus their activities over the next five years. The session should center on striving to be an advocate for trees while maintaining a cooperative relationship with City staff and elected officials.
- ✿ Utilize the i-Tree data analyses in this Plan as a strong tool to advocate the value of public trees. Consider developing a promotional campaign that promotes the benefits of trees based on i-Tree results.
- ✿ Continue to organize workshops with industry experts who provide training for homeowners about proper tree care.
- ✿ Maintain a diversity of membership on the Board to ensure a cross-section of experts, community advocates, and individuals with skills and interest in promoting trees are on the Board. Include individuals who may have limited tree knowledge, but possess skills related to effective board function.

Public Relations and Education

Public education is critical to reaching the goals of an urban forestry program in a community. Only by educating citizens, City officials, and others who impact the public forest will a community be able to achieve urban forest preservation and protection goals. Ordinances and guidelines alone will not guarantee success since stakeholder goals are often at odds—when it comes to public trees. Education that results in constructive dialogue provides a smooth path for improving an urban forestry program.

Knoxville holds an Arbor Day celebration each year at Ijams Nature Center that is sponsored and organized by the City Tree Board. Elementary schools are invited each year, a poster contest is held, and the event is attended by elected officials. Photographs of the event are typically posted on a portion of the City's website dedicated to urban forestry activities.

The Arbor Day Foundation has recognized Knoxville as a Tree City USA recipient for the last 19 years. This honor requires a yearly commitment to hold an Arbor Day event and includes an Arbor Day proclamation from the Mayor.



Public Relations and Education Recommendations

- 🌳 This Plan and its appendices contain important data and analyses about the benefits and costs associated with urban trees in public places in Knoxville. Information from the i-Tree analyses indicates that the City receives \$3.44 in return for every dollar it spends on its urban tree care program, and that each tree in the project area provides \$83 of benefits each year. These values are excellent tools to promote the value of trees in Knoxville and can help advocate for a more active urban forestry program.
- 🌳 City staff should continue to receive training and education about proper tree planting and maintenance activities. The art and science of arboriculture is changing rapidly. Knowledge of current techniques will promote tree health, reduce costs, and increase public safety. Knoxville has a useful set of policies and guidelines for many of its forestry activities, but if employees are not aware of current techniques, the guidelines are ineffective.
- 🌳 Develop public outreach campaigns aimed at educating the residents of Knoxville and gaining their support for the urban forestry program. Utilize i-Tree analysis results to advocate for the value of public trees.
- 🌳 Develop monthly evening or weekend tree care and landscaping seminars for residents. Invite guest experts from various disciplines in the green industry.
- 🌳 Write a monthly Tree Talk article for local newspapers, or prepare news releases for local media to highlight the benefits of trees.
- 🌳 Send newsletters to residents in areas of the City where systematic pruning will be conducted and describe the pruning program.
- 🌳 Develop a Tree Care door hanger/brochure for each residence where new trees are planted; this could help eliminate trunk damage and improper mulching and pruning of new trees via education of residents about proper tree care.
- 🌳 Expand the annual Arbor Day celebration held at Ijams Nature Center. The celebration could be developed as an all-day Saturday event, possibly held in Market Square area. Local merchants could sponsor the event. Include short programs on planting and pruning trees, as well as children's programs about trees. Additionally, the City could invite contractors to conduct demonstrations on tree planting, trimming, landscaping, species selection, etc. Organizers could also set up booths with tree information as helpful supplements for the general public.



Proposed Budget

Utilizing data from the 2011 tree inventory, a proposed budget for the recommended activities is found in Table 8. The budget is limited to the areas specified in the 2011 tree inventory.

The budget accounts for all recommended activities and provides a framework for achieving a systematic tree maintenance program. Using this framework will start the shift from on-demand services to a systematic method of accomplishing work. Even if only a portion of the recommended budget amounts can be allocated, making the shift for some of the maintenance categories will be a step in the right direction and create a healthier urban forest.



Table 8. Estimated Costs for Knoxville's Five-Year Urban Forestry Maintenance Program

Estimated Costs for Each Activity			2011		2012		2013		2014		2015		Five-Year Cost
Activity	Diameter Class	Cost/Tree (in dollars)	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	
Small Tree Prune	1-3"	\$20	100	\$2,000	100	\$2,000	100	\$2,000	100	\$2,000	100	\$2,000	\$8,000
	4-6"	\$30	63	\$1,890	63	\$1,890	63	\$1,890	63	\$1,890	63	\$1,890	\$7,560
	7-12"	\$75	47	\$3,525	47	\$3,525	47	\$3,525	47	\$3,525	47	\$3,525	\$14,100
	13-18"	\$120	5	\$600	5	\$600	5	\$600	5	\$600	5	\$600	\$2,400
	19-24"	\$170	1	\$170	1	\$170	1	\$170	1	\$170	1	\$170	\$680
Activity Total(s)			216	\$8,185	216	\$8,185	216	\$8,185	216	\$8,185	216	\$8,185	\$32,740
Large Tree Prune	1-3"	\$20	7	\$10	7	\$140	7	\$140	7	\$140	7	\$140	\$560
	4-6"	\$30	43	\$1,290	43	\$1,290	43	\$1,290	43	\$1,290	43	\$1,290	\$5,160
	7-12"	\$75	213	\$15,975	213	\$15,975	213	\$15,975	213	\$15,975	213	\$15,975	\$63,900
	13-18"	\$120	144	\$17,280	144	\$17,280	144	\$17,280	144	\$17,280	144	\$17,280	\$69,120
	19-24"	\$170	71	\$12,070	71	\$12,070	71	\$12,070	71	\$12,070	71	\$12,070	\$48,280
	25-30"	\$225	41	\$9,225	41	\$9,225	41	\$9,225	41	\$9,225	41	\$9,225	\$36,900
	31-36"	\$305	14	\$4,270	14	\$4,270	14	\$4,270	14	\$4,270	14	\$4,270	\$17,080
	37-42"	\$380	8	\$3,040	8	\$3,040	8	\$3,040	8	\$3,040	8	\$3,040	\$12,160
43"+	\$590	7	\$4,130	7	\$4,130	7	\$4,130	7	\$4,130	7	\$4,130	\$16,520	
Activity Total(s)			498	\$65,990	498	\$65,990	498	\$65,990	498	\$65,990	498	\$65,990	\$263,960
Training Pruning Program	1-3"	\$20	137	\$2,740	137	\$2,740	137	\$2,740	137	\$2,740	137	\$2,740	\$10,960
	4-6"	\$30	84	\$2,520	84	\$2,520	84	\$2,520	84	\$2,520	84	\$2,520	\$10,080
	7-12"	\$75	7	\$525	7	\$525	7	\$525	7	\$525	7	\$525	\$2,100
Activity Total(s)			228	\$5,785	228	\$5,785	228	\$5,785	228	\$5,785	228	\$5,785	\$23,140
Tree Removal (includes High Priority Hazards First Two Years)	1-3"	\$25	10	\$250	10	\$250	10	\$250	10	\$250	10	\$250	\$1,000
	4-6"	\$105	31	\$3,255	30	\$3,150	9	\$945	9	\$945	9	\$945	\$5,985
	7-12"	\$220	89	\$19,580	88	\$19,360	15	\$3,300	15	\$3,300	15	\$3,300	\$29,260
	13-18"	\$355	50	\$17,750	50	\$17,750	9	\$3,195	9	\$3,195	9	\$3,195	\$27,335
	19-24"	\$525	34	\$17,850	33	\$17,325	5	\$2,625	5	\$2,625	5	\$2,625	\$25,200
	25-30"	\$845	21	\$17,745	20	\$16,900	3	\$2,535	3	\$2,535	3	\$2,535	\$24,505
	31-36"	\$1,140	7	\$7,980	6	\$6,840	2	\$2,280	2	\$2,280	2	\$2,280	\$13,680
	37-42"	\$1,470	6	\$8,820	5	\$7,350	2	\$2,940	2	\$2,940	2	\$2,940	\$16,170
43"+	\$1,850	5	\$9,250	4	\$7,400	2	\$3,700	2	\$3,700	2	\$3,700	\$18,500	
Activity Total(s)			253	\$102,480	246	\$96,325	57	\$21,770	57	\$21,770	57	\$21,770	\$161,635
Tree Planting	Tree Purchase & Plant	\$200	253	\$50,600	246	\$49,200	57	\$11,400	57	\$11,400	57	\$11,400	\$134,000
Activity Total(s)			253	\$50,600	246	\$49,200	57	\$11,400	57	\$11,400	57	\$11,400	\$134,000
Activity Grand Total			1,448		1,434		1,056		1,056		1,056		615,475
Cost Grand Total				\$233,040		\$225,485		\$113,130		\$113,130		\$113,130	\$797,915



Conclusions

The City of Knoxville enjoys a fine urban forest that provides many benefits to the community. The i-Tree benefit-cost analysis revealed that for every dollar spent to operate the City's urban forestry program, the City yielded \$3.44 in return from its trees. For neighborhoods, usually each tree on the right-of-way provided \$83 in benefits each year. With a commitment to planting appropriate tree species and improving the quality and regularity of its tree maintenance activities, Knoxville could expect to increase these benefits to an even higher level in future years.

Currently, the City has no systematic tree maintenance program. Tree maintenance is performed on demand and calls are generated primarily by citizen requests. The City should shift its urban forestry program to a systematic, cyclic tree maintenance program. This management style shift will save money and time and improve the health and value of the urban forest. Additionally, a complete, citywide GIS-based tree inventory, coupled with data management software, would greatly improve the City's ability to shift to a systematic tree maintenance program. Knowing exactly what you have, where it's located, and what needs done greatly improves efficiency.

Overall, the condition of Knoxville's urban forest can be rated as fair. However, the addition of cyclic pruning and young tree training programs to the City's urban forestry program could improve the condition rating of many trees, and through time elevate the overall condition of the urban forest.

Interviews with City staff, Tree Board members, elected officials, and the public about urban forestry topics in Knoxville revealed that increased tree maintenance for established trees and follow-up tree care for new trees were desired. Increased public relations activities and educational opportunities for City staff and the general public will improve the City's ability to achieve its urban forestry goals. An informed public will support urban forestry programs, and a well-trained and knowledgeable staff will perform better quality work in a safe and effective manner.

The City of Knoxville has an opportunity to move from an on-demand urban forestry program to a systematic program. The initial management changes may require adding staff and equipment and increased planned work; however, the investment will pay dividends in increased public safety, improved program efficiency, and greater environmental services and economic benefits received from the urban forest.



Section 4: Funding Opportunities

Funding sources for tree care range from the City's general fund to joint programs with local companies. The following sources of support are available for tree care operations:

Federal Government Grants: While federal grants are currently limited, there are a few projects that may provide funding:

This U.S. EPA grant program provides financial assistance to eligible community groups who are working on or plan to carry out projects to address environmental justice issues. Funds can be used to develop a new activity or substantially improve the quality of existing programs:

U.S. EPA/Office of Environmental Justice
1200 Pennsylvania Avenue NW, Room 2232E
Washington, DC 20004
202-564-5396
<http://www.epa.gov/compliance/environmentaljustice/grants/index.html>

The USDA Forest Service provides grants through the National Urban and Community Forestry Advisory Council (NUCFAC) grant program; all funds must be matched at least equally (dollar for dollar) with non-federal source funds. This match may include in-kind donations, volunteer assistance, and private and public (non-Federal) monetary contributions. All matching funds must be specifically related to the proposed projects. Information is available at <http://www.fs.fed.us/ucf/nucfac>.

State Government Grants: Tennessee provides grants through its "Urban and Community Forestry" grants program. Information can be found at <http://www.state.tn.us/agriculture/forms/infopak.pdf>.

Other Grants: The Conservation Fund provides grants to non-profit organizations and public agencies. Monetary allocations range from \$500–\$2,500 through the American Greenways DuPont Awards Program sponsored by The Conservation Fund, The DuPont Corporation, and The National Geographic Society. Grant applications are due by March 31 of each year:

The Conservation Fund
1655 N. Fort Myer Drive, Suite 1300
Arlington, Virginia 22209
703-525-6300
www.conservationfund.org



Global ReLeaf dollars should be used to help cover the expenses associated with conservation- or restoration-oriented tree plantings. There is no specific guideline for grant amounts. Project proposals need to reach your Global ReLeaf Forest Technical Committee representative at:

American Forests
Attn: Global ReLeaf
P.O. Box 2000
Washington, DC 20013
202-737-1944
www.americanforests.org/global_releaf/

Foundation Grants: Many companies and estates operate foundation programs that contribute funds to worthy programs. Comprehensive listings of foundations in the United States are available at many public libraries. The Foundation Directory, National Data Book of Foundations, and the Foundation Grants Index, all published by the Foundation Center, are good references. Examples include Home Depot, Ford Foundation, and Wal-Mart.

Private Donations: Area corporations and organizations may donate funds to special tree planting and maintenance programs. Urban foresters can generate public support of tree care through programs involving memorial trees or special tree improvement projects.

Volunteer Groups: Urban foresters can encourage community organizations to donate funds, or organize fund-raising activities or other support for community tree planting and maintenance programs.

Cooperative Tree Planting Programs: In such programs, homeowners are offered a selected choice of street trees at a reduced price. In effect, a cooperative tree planting program allows the homeowner to assume some of the cost of street tree planting while the City can limit the species choices. Again, the key to the success of such a program is a detailed plan for implementing and publicizing the project.

Tree Damage Reimbursement: The City should pursue reimbursement for damages to any public tree caused by automobile accidents, nearby construction activity, or malicious intent. Consider revising the current tree ordinance language to allow the City to create a Tree Fund within the City's accounting system. Monies placed in the fund from the collection of damages or awards can be used to plant or care for trees within the City. Additionally, the City should consider charging a fee for trees that are removed from a construction site on private property and are not able to be replaced within ordinance requirements. Fees can vary based on tree size, species, and condition. Collected fees can be placed in the Tree Fund.

Establish a Tree Donation or Memorial Tree Program: Use Arbor Day as a focal point for promoting citizen interest in contributing to the community. For example, first establish where and when memorial trees will be planted. Decide the form of memorial, such as a plaque at the tree or a listing in a community register. Set a donation price per tree that includes the cost of purchasing and planting the tree, as well as any recognition given to the donor. Determine how donations will be collected and set a timeframe for the project. Take the same steps for publicizing the project; determine how, when, and where it should be announced, and how application forms will be distributed. Consider a kick-off ceremony, brochures, public service announcements, press releases, and other avenues of communication within the general public.



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Supplemental Plans

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APPENDIX A – Location Methodology and Data Collection Fields

Location Methodology

Several location attributes were collected during the inventory to help the City locate trees: mapping coordinate, area, tree location type, and block side and address location attributes. Mapping coordinates were collected during the inventory, and GPS systems can be used to locate each tree. The area 2 field indicates where the tree is located (*i.e.*, Morningside Park, Lake Forest, Middlebrook Pike). Tree location type indicates whether it is a park or street tree. Street trees are located using blockside and address attributes allowing the City to determine where a tree is located on a property and street, and in a neighborhood. Park trees are more difficult to locate since they are located in large parcels without an address, which in some cases (Third Creek Greenway) can extend for several miles. Davey suggests that the City utilize a combination of GIS and GPS information to locate park trees. Each tree has a unique tree identification number. GIS systems can query for the unique tree identification numbers, primary maintenance, risk ratings, area, or a combination of the four to locate and map individual trees, or groups of trees, within the parks or along the streets.

Mapping Coordinate

The mapping coordinates or X and Y coordinates for each individual tree were recorded. These coordinates were determined by using a combination of GIS and GPS technology.

Area

The area 2 data field denotes the park, neighborhood, street, or state route in which the tree was located.

Tree Location Type

The physical location of trees in relation to the public rights-of-way (ROW) and/or public space was recorded. Location types included park/public space and street.

Blockside and Address

Davey has developed a protocol for determining addresses, site numbers, and block side information to ensure consistent assignment of site location information. Individual sites (sites can refer to trees or vacant planting spaces) were inventoried by street name, address number, and site number. Each site was also assigned lot side and block side information. This protocol was designed so that urban foresters, contractors, or maintenance personnel can identify the correct site using Davey's site location information.



Each **address** includes a street name and address number. Addresses were determined from the actual address number posted on buildings. In instances where (A) there was no posted street number on a building; or (B) sites were located on vacant lots with no addressing data, addressing was matched as closely as possible to opposite or adjacent addresses by the data collector(s). An 'X' was entered in the address number assigned field for these fictitious addresses. For example, 37X Choice Avenue meant that an address was assigned to this building or vacant lot parcel. All of the park trees were given assigned addresses.

Each site at an address was assigned a **side code** based on whether it was located at the front (F), side (S), or rear (R) of the addressed lot. Medians (M) were also identified and assigned a fictitious address closest to an address on the right side of the street in the direction of collection. Each median segment was collected and numbered with an assigned address that was interpolated from addresses facing that median. If there were multiple median areas between two cross streets, each segment was given its own assigned address.

Multiple sites at the same address were distinguished from one another by assigning each site a separate site number. The basis of this location methodology was that the sites were collected and assigned site numbers in the direction of vehicular traffic flow. At each address, a separate number sequence was used for each side (front, side, rear, and median/island). This meant that the trees at the front were numbered 1 through 999 and, if trees were located on the side, rear, or median/island of that same address, each side was also numbered consecutively, again beginning with the number 1 and always in the direction of vehicular traffic flow.

The block side information was composed of an **on** street, a **from** street, and a **to** street:

- 🌳 The *on* street is the street that the site is actually located on. Be aware that some sites, e.g., those located on a side street, will be located on a street that is different from the actual address street. This means that the *on* street will not necessarily match the address street.
- 🌳 The *from* street is the cross street the data collector is moving away from when moving in the direction of traffic flow.
- 🌳 The *to* street is the cross street the data collector is moving toward when moving in the direction of traffic flow.



For example, in Diagram 1, the tree trimming crew in the truck was trying to find the tree located on the side of 226 E Mac Arthur St. This tree was actually located on Davis St., even though it was “addressed” to 226 E Mac Arthur St.



Diagram 1

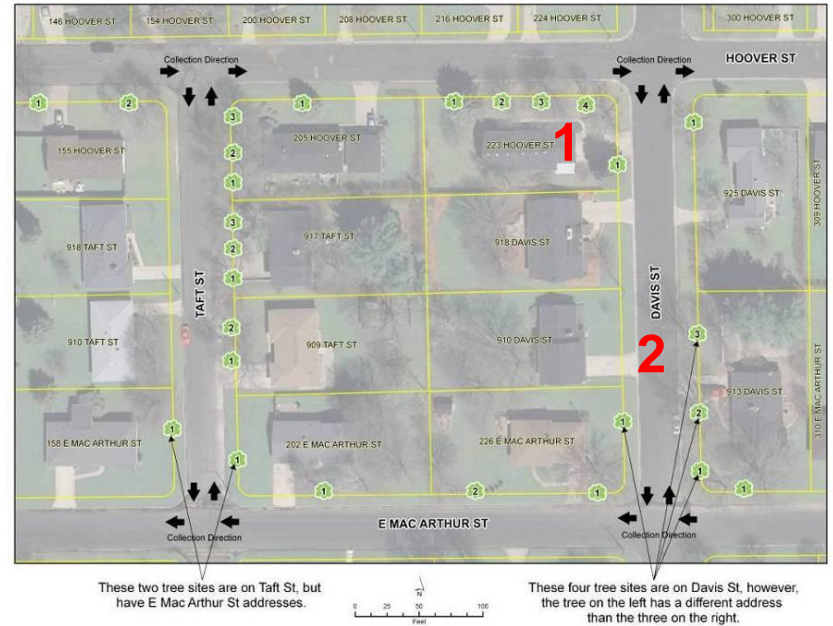


Diagram 2



Diagram 2 provides a visual example of how site numbering progressed during data collection:

The corner lots (labeled as 1 and 2 in Diagram 2) had location information similar to the following:

Corner Lot 1

Address: 205
Street: Hoover St.
Side: Front
Site: 1
Block: On: Hoover St.
From: Taft St.
To: Davis St.

Address: 205
Street: Hoover St.
Side: Side To
Site: 1
Block: On: Taft St.
From: E Mac Arthur St.
To: Hoover St.

Address: 205
Street: Hoover St.
Side: Side To
Site: 2
Block: On: Taft St.
From: E Mac Arthur St.
To: Hoover St.

Address: 205
Street: Hoover St.
Side: Side To
Site: 3
Block: On: Taft St.
From: 19th St.
To: Hoover St.

Corner Lot 2

Address: 226
Street: E Mac Arthur St.
Side: Side To
Site: 1
Block: On: Davis St.
From: Hoover St.
To: E Mac Arthur St.

Address: 226
Street: E Mac Arthur St.
Side: Front
Site: 1
Block: On: E Mac Arthur St.
From: Davis St.
To: Taft St.

Address: 226
Street: E Mac Arthur St.
Side: Front
Site: 2
Block: On: E Mac Arthur St.
From: Davis St.
To: Taft St.



Tree Inventory Data Fields

Davey collected the following data fields.

1. **Location**—Davey identifies the location of each tree and/or site. Street tree locations and planting sites are organized by sequential tree site number and road name, block side, or corner location. Park and open space trees are also organized by sequential tree site number and property name. An X and Y coordinate will be generated for each tree and site. This data field is for tree inventory only.
2. **Street Segment**—This data field is for the i-Tree Streets sample inventory only.
3. **Species type**—Trees are identified by genus and species using both botanical and common names and by cultivars where appropriate.
4. **Size**—Diameter is measured to the nearest inch in one-inch size classes at 4-½ feet above the ground, or diameter at breast height (DBH).
5. **Condition**—The general condition of each tree is rated according to the following categories adapted from the International Society of Arboriculture's rating system:

Excellent	100%
Very Good	90%
Good	80%
Fair	60%
Poor	40%
Critical	20%
Dead	0%

6. **Primary Maintenance Needs**—The following maintenance needs will be determined based on ANSI A300 standard specifications:

Removal. Trees designated for removal have defects that cannot be cost-effectively or practically treated. The majority of the trees in this category have a large percentage of dead crown.

Large Tree Clean. These trees require selective removal of dead, dying, broken, and/or diseased wood to minimize potential risk. Trees in this category are large enough to require bucket truck access or manual climbing.

Small Tree Clean. These trees require selective removal of dead, dying, broken, and/or diseased wood to minimize potential risk. These trees are small-growing, mature trees that can be evaluated and pruned from the ground.





Young Tree Train. These are young trees that must be pruned to correct or eliminate weak, interfering, or objectionable branches in order to minimize future maintenance requirements. These trees, up to 20 feet in height, can be worked with a pole pruner by a person standing on the ground.

Plant Tree. During the inventory, vacant planting sites can be identified by park location and site number. The size of the site is designated as small, medium, or large (indicating the ultimate size that the tree will attain), depending on the growing space available and the presence of overhead wires.

7. **Secondary Maintenance Needs**—The following secondary maintenance needs will be determined based on ANSI A300 standard specifications:

Raise. Trees requiring pruning to remove low branches that interfere with sight and/or traffic.

Reduce. Selective pruning to decrease height and/or spread of the crown in order to provide clearance for electric utilities and lighting.

Thin. The selective removal of water sprouts, epicormic branches, and live branches to reduce density.

None. No secondary maintenance is recommended for the tree.

8. **Risk Assessment**—A risk rating will be assigned using an assessment protocol based on the USDA Forest Service Community Tree Risk Rating System.

- **Probability of Failure** (1–4 points)—Identifies the most likely failure and rates the likelihood that the structural defect(s) will result in failure based on observed, current conditions.
- **Size of Defective Part** (1–3 points)—Rates the size of the part most likely to fail.
- **Probability of Target Impact** (1–3 points)—Rates the use and occupancy of the area that would be struck by the defective part.
- **Other Risk Factors** (0–2 points)—This category is used if professional judgment suggests the need to increase the risk rating. It is especially helpful to use when tree species growth characteristics become a factor in risk rating. For example, some tree species have growth patterns that make them more vulnerable to certain defects such as weak branch unions (silver maple) and branching shedding (beech).



9. **Risk Rating**—A Risk Rating of each tree is calculated based on the protocol of USDA Forest Service Community Tree Risk Rating System (Pokorny, *et.al.*, 2003). Generally, trees with the highest numeric risk ratings should receive corrective treatment first. The overall risk rating of the tree will be indicated, based on the sum of above risk assessment field values. See the formula below:

$$\text{Risk Rating (3–10 points)} = \text{probability of failure (1–4 points)} + \text{size of defective part (1–3 points)} + \text{probability of target impact (1–3 points)} + \text{optional subjective risk rating (0–2 points)}$$

Assigned risk is meant only to be used as a guideline to make safety-driven maintenance decisions and to direct normal tree maintenance programs efficiently. All risk ratings are based on observable defects at the time of assessment. All observations are made from the ground.

The following risk ratings will be assigned:

- **None.** Used for planting and stump sites only.
 - **Low.** Trees designated as presenting a *Low* risk have minor visible structural defects or wounds in areas with moderate to low public access.
 - **Moderate.** Trees designated as presenting a *Moderate* risk have defects that may be cost-effectively or practically treated. The majority of trees in this category exhibit several moderate defects affecting <40% of a tree's trunk, crown, or critical root zone.
 - **High.** Trees designated as presenting a *High* risk have defects that cannot be cost-effectively or practically treated. The majority of the trees in this category have multiple or significant defects affecting >40% of the trunk, crown, or critical root zone. Defective trees and/or tree parts are most likely between 4–20 inches in diameter and can be found in areas of frequent occupation, such as a main thoroughfare, congested streets, and/or near schools.
 - **Severe.** Trees designated as presenting a *Severe* risk have defects that cannot be cost-effectively or practically treated. The majority of the trees in this category have multiple and significant defects present in the trunk, crown, or critical root zone. Defective trees and/or tree parts are most likely larger than 20 inches in diameter and can be found in areas of frequent occupation, such as a main thoroughfare, congested streets, and/or near schools.
10. **Aboveground Utilities**—The inventory indicates the presence of overhead utilities at the tree site as well as current conflicts.
11. **Additional Notes**—Additional information of possible importance is noted here.
12. **Date of Survey**



APPENDIX B – Complete Inventory Frequency Reports

Species Frequency by Occurrence

Species (by frequency)	Total	Percent of Total Population
dogwood, flowering (<i>Cornus florida</i>)	779	10.19%
maple, red (<i>Acer rubrum</i>)	737	9.64%
maple, sugar (<i>Acer saccharum</i>)	566	7.40%
oak, willow (<i>Quercus phellos</i>)	454	5.94%
crapemyrtle, common (<i>Lagerstroemia indica</i>)	356	4.65%
hackberry, common (<i>Celtis occidentalis</i>)	296	3.87%
planetree, London (<i>Platanus x acerifolia</i>)	277	3.62%
redbud, eastern (<i>Cercis canadensis</i>)	227	2.97%
magnolia, southern (<i>Magnolia grandiflora</i>)	212	2.77%
pine, eastern white (<i>Pinus strobus</i>)	187	2.45%
redcedar, eastern (<i>Juniperus virginiana</i>)	184	2.41%
zelkova, Japanese (<i>Zelkova serrata</i>)	183	2.39%
sycamore, American (<i>Platanus occidentalis</i>)	176	2.30%
oak, pin (<i>Quercus palustris</i>)	141	1.84%
maple, silver (<i>Acer saccharinum</i>)	138	1.80%
oak, sawtooth (<i>Quercus acutissima</i>)	112	1.46%
cherry, black (<i>Prunus serotina</i>)	111	1.45%
cherry, Japanese flowering (<i>Prunus serrulata</i>)	110	1.44%
goldenraintree (<i>Koelreuteria paniculata</i>)	101	1.32%
elm, American (<i>Ulmus americana</i>)	98	1.28%
pear, Callery (<i>Pyrus calleryana</i>)	96	1.26%
walnut, black (<i>Juglans nigra</i>)	88	1.15%
boxelder (<i>Acer negundo</i>)	86	1.12%
hemlock, eastern (<i>Tsuga canadensis</i>)	80	1.05%
oak, white (<i>Quercus alba</i>)	75	0.98%
oak, scarlet (<i>Quercus coccinea</i>)	73	0.95%
sweetgum, American (<i>Liquidambar styraciflua</i>)	73	0.95%
oak, northern red (<i>Quercus rubra</i>)	68	0.89%

Species (by frequency)	Total	Percent of Total Population
tuliptree (<i>Liriodendron tulipifera</i>)	67	0.88%
ginkgo (<i>Ginkgo biloba</i>)	65	0.85%
hickory, mockernut (<i>Carya tomentosa</i>)	60	0.78%
holly, Chinese (<i>Ilex cornuta</i>)	59	0.77%
cherry/plum, spp. (<i>Prunus</i> spp.)	56	0.73%
oak, southern red (<i>Quercus falcata</i>)	53	0.69%
tree of heaven (<i>Ailanthus altissima</i>)	53	0.69%
elm, Chinese (<i>Ulmus parvifolia</i>)	49	0.64%
crabapple, flowering (<i>Malus</i> spp.)	43	0.56%
hawthorn, spp. (<i>Crataegus</i> spp.)	43	0.56%
mulberry, white (<i>Morus alba</i>)	42	0.55%
oak, post (<i>Quercus stellata</i>)	40	0.52%
birch, river (<i>Betula nigra</i>)	36	0.47%
pine, Virginia (<i>Pinus virginiana</i>)	36	0.47%
dogwood, Kousa (<i>Cornus kousa</i>)	35	0.46%
elm, Siberian (<i>Ulmus pumila</i>)	34	0.44%
fringetree, white (<i>Chionanthus virginicus</i>)	32	0.42%
unknown tree (unknown tree)	32	0.42%
honeylocust, thornless (<i>Gleditsia triacanthos inermis</i>)	31	0.41%
ash, white (<i>Fraxinus americana</i>)	29	0.38%
persimmon, common (<i>Diospyros virginiana</i>)	29	0.38%
catalpa, northern (<i>Catalpa speciosa</i>)	28	0.37%
maple, Amur (<i>Acer tataricum ginnala</i>)	27	0.35%
maple, trident (<i>Acer buergerianum</i>)	27	0.35%
ash, green (<i>Fraxinus pennsylvanica</i>)	25	0.33%
pine, longleaf (<i>Pinus palustris</i>)	23	0.30%
blackgum (<i>Nyssa sylvatica</i>)	22	0.29%
holly, American (<i>Ilex opaca</i>)	21	0.27%



Species (by frequency)	Total	Percent of Total Population
maple, hedge (<i>Acer campestre</i>)	21	0.27%
cypress, Leyland (<i>X Cupressocyparis leylandii</i>)	20	0.26%
locust, black (<i>Robinia pseudoacacia</i>)	20	0.26%
holly, Fosters (<i>Ilex x attenuata-Fosteri</i>)	17	0.22%
maple, Norway (<i>Acer platanoides</i>)	17	0.22%
pine, shortleaf (<i>Pinus echinata</i>)	17	0.22%
serviceberry, spp. (<i>Amelanchier</i> spp.)	17	0.22%
magnolia, saucer (<i>Magnolia x soulangiana</i>)	16	0.21%
pine, Austrian (<i>Pinus nigra</i>)	15	0.20%
arborvitae, eastern (<i>Thuja occidentalis</i>)	14	0.18%
juniper, spp. (<i>Juniperus</i> spp.)	14	0.18%
hickory, pignut (<i>Carya glabra</i>)	13	0.17%
elm, hybrid (<i>Ulmus</i> x)	12	0.16%
linden, American (<i>Tilia americana</i>)	10	0.13%
maple, Japanese (<i>Acer palmatum</i>)	10	0.13%
oak, black (<i>Quercus velutina</i>)	10	0.13%
spruce, Norway (<i>Picea abies</i>)	10	0.13%
willow, spp. (<i>Salix</i> spp.)	10	0.13%
hornbeam, European (<i>Carpinus betulus</i>)	9	0.12%
oak, water (<i>Quercus nigra</i>)	9	0.12%
pine, loblolly (<i>Pinus taeda</i>)	9	0.12%
crapemyrtle, queens (<i>Lagerstroemia speciosa</i>)	7	0.09%
falsecypress, Japanese (<i>Chamaecyparis pisifera</i>)	7	0.09%
spruce, Colorado (<i>Picea pungens</i>)	7	0.09%
willow, weeping (<i>Salix babylonica</i>)	7	0.09%
baldcypress, common (<i>Taxodium distichum</i>)	6	0.08%
viburnum, spp. (<i>Viburnum</i> spp.)	6	0.08%
willow, corkscrew (<i>Salix matsudana</i>)	6	0.08%
yellowwood (<i>Cladrastis kentukea</i>)	6	0.08%
birch, paper (<i>Betula papyrifera</i>)	5	0.07%
mulberry, red (<i>Morus rubra</i>)	5	0.07%
pecan (<i>Carya illinoensis</i>)	5	0.07%

Species (by frequency)	Total	Percent of Total Population
willow, black (<i>Salix nigra</i>)	5	0.07%
honeylocust (<i>Gleditsia triacanthos</i>)	4	0.05%
honeysuckle, spp. (<i>Lonicera</i> spp.)	4	0.05%
oak, swamp white (<i>Quercus bicolor</i>)	4	0.05%
osage-orange (<i>Maclura pomifera</i>)	4	0.05%
pine, Scotch (<i>Pinus sylvestris</i>)	4	0.05%
rose-of-sharon (<i>Hibiscus syriacus</i>)	4	0.05%
royal paulownia (<i>Paulownia tomentosa</i>)	4	0.05%
beech, American (<i>Fagus grandifolia</i>)	3	0.04%
cherry, Higan (<i>Prunus subhirtella</i>)	3	0.04%
falsecypress, Hinoki (<i>Chamaecyparis obtusa</i>)	3	0.04%
fringetree, Chinese (<i>Chionanthus retusus</i>)	3	0.04%
hawthorn, green (<i>Crataegus viridis</i>)	3	0.04%
hickory, shagbark (<i>Carya ovata</i>)	3	0.04%
magnolia, bigleaf (<i>Magnolia macrophylla</i>)	3	0.04%
magnolia, sweetbay (<i>Magnolia virginiana</i>)	3	0.04%
mulberry, paper (<i>Broussonetia papyrifera</i>)	3	0.04%
oak, blackjack (<i>Quercus marilandica</i>)	3	0.04%
oak, overcup (<i>Quercus lyrata</i>)	3	0.04%
oak, Shumard (<i>Quercus shumardii</i>)	3	0.04%
oak, spp. (<i>Quercus</i> spp.)	3	0.04%
poplar, Lombardy black (<i>Populus nigra Italica</i>)	3	0.04%
sassafras (<i>Sassafras albidum</i>)	3	0.04%
cherry, Yoshino (<i>Prunus x yedoensis</i>)	2	0.03%
chokecherry, common (<i>Prunus virginiana</i>)	2	0.03%
hickory, bitternut (<i>Carya cordiformis</i>)	2	0.03%
holly, spp. (<i>Ilex</i> spp.)	2	0.03%
mimosa (<i>Albizia julibrissin</i>)	2	0.03%
oak, chinkapin (<i>Quercus muehlenbergii</i>)	2	0.03%
oak, English (<i>Quercus robur</i>)	2	0.03%
plum, cherry (<i>Prunus cerasifera</i>)	2	0.03%
spruce, white (<i>Picea glauca</i>)	2	0.03%



Species (by frequency)	Total	Percent of Total Population
cedar, Atlas (<i>Cedrus atlantica</i>)	1	0.01%
cottonwood, eastern (<i>Populus deltoides</i>)	1	0.01%
euonymus, spp. (<i>Euonymus</i> spp.)	1	0.01%
hickory, spp. (<i>Carya</i> spp.)	1	0.01%
hophornbeam, American (<i>Ostrya virginiana</i>)	1	0.01%
magnolia, cucumbertree (<i>Magnolia acuminata</i>)	1	0.01%
magnolia, Kobus (<i>Magnolia kobus</i>)	1	0.01%

Species (by frequency)	Total	Percent of Total Population
magnolia, star (<i>Magnolia stellata</i>)	1	0.01%
magnolia, umbrella (<i>Magnolia tripetala</i>)	1	0.01%
oak, bur (<i>Quercus macrocarpa</i>)	1	0.01%
oak, chestnut (<i>Quercus prinus</i>)	1	0.01%
pine, spp. (<i>Pinus</i> spp.)	1	0.01%
poplar, white (<i>Populus alba</i>)	1	0.01%
spruce, Oriental (<i>Picea orientalis</i>)	1	0.01%



Species Frequency by Occurrence (Alphabetical)

Species (by frequency)	Total	Percent of Total Population
arborvitae, eastern (<i>Thuja occidentalis</i>)	14	0.18%
ash, green (<i>Fraxinus pennsylvanica</i>)	25	0.33%
ash, white (<i>Fraxinus americana</i>)	29	0.38%
baldcypress, common (<i>Taxodium distichum</i>)	6	0.08%
beech, American (<i>Fagus grandifolia</i>)	3	0.04%
birch, paper (<i>Betula papyrifera</i>)	5	0.07%
birch, river (<i>Betula nigra</i>)	36	0.47%
blackgum (<i>Nyssa sylvatica</i>)	22	0.29%
boxelder (<i>Acer negundo</i>)	86	1.12%
catalpa, northern (<i>Catalpa speciosa</i>)	28	0.37%
cedar, Atlas (<i>Cedrus atlantica</i>)	1	0.01%
cherry, black (<i>Prunus serotina</i>)	111	1.45%
cherry, Higan (<i>Prunus subhirtella</i>)	3	0.04%
cherry, Japanese flowering (<i>Prunus serrulata</i>)	110	1.44%
cherry, Yoshino (<i>Prunus x yedoensis</i>)	2	0.03%
cherry/plum, spp. (<i>Prunus</i> spp.)	56	0.73%
chokecherry, common (<i>Prunus virginiana</i>)	2	0.03%
cottonwood, eastern (<i>Populus deltoides</i>)	1	0.01%
crabapple, flowering (<i>Malus</i> spp.)	43	0.56%
crapemyrtle, common (<i>Lagerstroemia indica</i>)	356	4.65%
crapemyrtle, queens (<i>Lagerstroemia speciosa</i>)	7	0.09%
cypress, Leyland (<i>X Cupressocyparis leylandii</i>)	20	0.26%
dogwood, flowering (<i>Cornus florida</i>)	779	10.19%
dogwood, Kousa (<i>Cornus kousa</i>)	35	0.46%
elm, American (<i>Ulmus americana</i>)	98	1.28%
elm, Chinese (<i>Ulmus parvifolia</i>)	49	0.64%
elm, hybrid (<i>Ulmus</i> x)	12	0.16%
elm, Siberian (<i>Ulmus pumila</i>)	34	0.44%
euonymus, spp. (<i>Euonymus</i> spp.)	1	0.01%

Species (by frequency)	Total	Percent of Total Population
falsecypress, Hinoki (<i>Chamaecyparis obtusa</i>)	3	0.04%
falsecypress, Japanese (<i>Chamaecyparis pisifera</i>)	7	0.09%
fringetree, Chinese (<i>Chionanthus retusus</i>)	3	0.04%
fringetree, white (<i>Chionanthus virginicus</i>)	32	0.42%
ginkgo (<i>Ginkgo biloba</i>)	65	0.85%
goldenraintree (<i>Koelreuteria paniculata</i>)	101	1.32%
hackberry, common (<i>Celtis occidentalis</i>)	296	3.87%
hawthorn, green (<i>Crataegus viridis</i>)	3	0.04%
hawthorn, spp. (<i>Crataegus</i> spp.)	43	0.56%
hemlock, eastern (<i>Tsuga canadensis</i>)	80	1.05%
hickory, bitternut (<i>Carya cordiformis</i>)	2	0.03%
hickory, mockernut (<i>Carya tomentosa</i>)	60	0.78%
hickory, pignut (<i>Carya glabra</i>)	13	0.17%
hickory, shagbark (<i>Carya ovata</i>)	3	0.04%
hickory, spp. (<i>Carya</i> spp.)	1	0.01%
holly, American (<i>Ilex opaca</i>)	21	0.27%
holly, Chinese (<i>Ilex cornuta</i>)	59	0.77%
holly, Fosters (<i>Ilex x attenuata-Fosteri</i>)	17	0.22%
holly, spp. (<i>Ilex</i> spp.)	2	0.03%
honeylocust (<i>Gleditsia triacanthos</i>)	4	0.05%
honeylocust, thornless (<i>Gleditsia triacanthos inermis</i>)	31	0.41%
honeysuckle, spp. (<i>Lonicera</i> spp.)	4	0.05%
hophornbeam, American (<i>Ostrya virginiana</i>)	1	0.01%
hornbeam, European (<i>Carpinus betulus</i>)	9	0.12%
juniper, spp. (<i>Juniperus</i> spp.)	14	0.18%
linden, American (<i>Tilia americana</i>)	10	0.13%
locust, black (<i>Robinia pseudoacacia</i>)	20	0.26%
magnolia, bigleaf (<i>Magnolia macrophylla</i>)	3	0.04%
magnolia, cucumbertree (<i>Magnolia acuminata</i>)	1	0.01%



Species (by frequency)	Total	Percent of Total Population
magnolia, Kobus (<i>Magnolia kobus</i>)	1	0.01%
magnolia, saucer (<i>Magnolia x soulangiana</i>)	16	0.21%
magnolia, southern (<i>Magnolia grandiflora</i>)	212	2.77%
magnolia, star (<i>Magnolia stellata</i>)	1	0.01%
magnolia, sweetbay (<i>Magnolia virginiana</i>)	3	0.04%
magnolia, umbrella (<i>Magnolia tripetala</i>)	1	0.01%
maple, Amur (<i>Acer tataricum ginnala</i>)	27	0.35%
maple, hedge (<i>Acer campestre</i>)	21	0.27%
maple, Japanese (<i>Acer palmatum</i>)	10	0.13%
maple, Norway (<i>Acer platanoides</i>)	17	0.22%
maple, red (<i>Acer rubrum</i>)	737	9.64%
maple, silver (<i>Acer saccharinum</i>)	138	1.80%
maple, sugar (<i>Acer saccharum</i>)	566	7.40%
maple, trident (<i>Acer buergerianum</i>)	27	0.35%
mimosa (<i>Albizia julibrissin</i>)	2	0.03%
mulberry, paper (<i>Broussonetia papyrifera</i>)	3	0.04%
mulberry, red (<i>Morus rubra</i>)	5	0.07%
mulberry, white (<i>Morus alba</i>)	42	0.55%
oak, black (<i>Quercus velutina</i>)	10	0.13%
oak, blackjack (<i>Quercus marilandica</i>)	3	0.04%
oak, bur (<i>Quercus macrocarpa</i>)	1	0.01%
oak, chestnut (<i>Quercus prinus</i>)	1	0.01%
oak, chinkapin (<i>Quercus muehlenbergii</i>)	2	0.03%
oak, English (<i>Quercus robur</i>)	2	0.03%
oak, northern red (<i>Quercus rubra</i>)	68	0.89%
oak, overcup (<i>Quercus lyrata</i>)	3	0.04%
oak, pin (<i>Quercus palustris</i>)	141	1.84%
oak, post (<i>Quercus stellata</i>)	40	0.52%
oak, sawtooth (<i>Quercus acutissima</i>)	112	1.46%
oak, scarlet (<i>Quercus coccinea</i>)	73	0.95%
oak, Shumard (<i>Quercus shumardii</i>)	3	0.04%

Species (by frequency)	Total	Percent of Total Population
oak, southern red (<i>Quercus falcata</i>)	53	0.69%
oak, spp. (<i>Quercus</i> spp.)	3	0.04%
oak, swamp white (<i>Quercus bicolor</i>)	4	0.05%
oak, water (<i>Quercus nigra</i>)	9	0.12%
oak, white (<i>Quercus alba</i>)	75	0.98%
oak, willow (<i>Quercus phellos</i>)	454	5.94%
osage-orange (<i>Maclura pomifera</i>)	4	0.05%
pear, Callery (<i>Pyrus calleryana</i>)	96	1.26%
pecan (<i>Carya illinoensis</i>)	5	0.07%
persimmon, common (<i>Diospyros virginiana</i>)	29	0.38%
pine, Austrian (<i>Pinus nigra</i>)	15	0.20%
pine, eastern white (<i>Pinus strobus</i>)	187	2.45%
pine, loblolly (<i>Pinus taeda</i>)	9	0.12%
pine, longleaf (<i>Pinus palustris</i>)	23	0.30%
pine, Scotch (<i>Pinus sylvestris</i>)	4	0.05%
pine, shortleaf (<i>Pinus echinata</i>)	17	0.22%
pine, spp. (<i>Pinus</i> spp.)	1	0.01%
pine, Virginia (<i>Pinus virginiana</i>)	36	0.47%
planetree, London (<i>Platanus x acerifolia</i>)	277	3.62%
plum, cherry (<i>Prunus cerasifera</i>)	2	0.03%
poplar, Lombardy black (<i>Populus nigra Italica</i>)	3	0.04%
poplar, white (<i>Populus alba</i>)	1	0.01%
redbud, eastern (<i>Cercis canadensis</i>)	227	2.97%
redcedar, eastern (<i>Juniperus virginiana</i>)	184	2.41%
rose-of-sharon (<i>Hibiscus syriacus</i>)	4	0.05%
royal paulownia (<i>Paulownia tomentosa</i>)	4	0.05%
sassafras (<i>Sassafras albidum</i>)	3	0.04%
serviceberry, spp. (<i>Amelanchier</i> spp.)	17	0.22%
spruce, Colorado (<i>Picea pungens</i>)	7	0.09%
spruce, Norway (<i>Picea abies</i>)	10	0.13%
spruce, Oriental (<i>Picea orientalis</i>)	1	0.01%



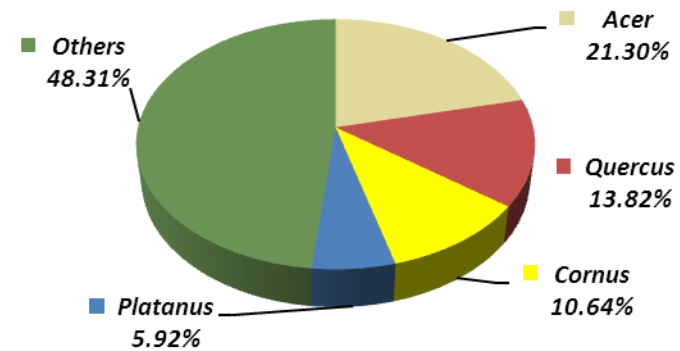
Species (by frequency)	Total	Percent of Total Population
spruce, white (<i>Picea glauca</i>)	2	0.03%
sweetgum, American (<i>Liquidambar styraciflua</i>)	73	0.95%
sycamore, American (<i>Platanus occidentalis</i>)	176	2.30%
tree of heaven (<i>Ailanthus altissima</i>)	53	0.69%
tuliptree (<i>Liriodendron tulipifera</i>)	67	0.88%
unknown tree (unknown tree)	32	0.42%
viburnum, spp. (<i>Viburnum</i> spp.)	6	0.08%

Species (by frequency)	Total	Percent of Total Population
walnut, black (<i>Juglans nigra</i>)	88	1.15%
willow, black (<i>Salix nigra</i>)	5	0.07%
willow, corkscrew (<i>Salix matsudana</i>)	6	0.08%
willow, spp. (<i>Salix</i> spp.)	10	0.13%
willow, weeping (<i>Salix babylonica</i>)	7	0.09%
yellowwood (<i>Cladrastis kentukea</i>)	6	0.08%
zelkova, Japanese (<i>Zelkova serrata</i>)	183	2.39%



Genus Frequency

Genus	Total	Percent
<i>Acer</i>	1,629	21.30%
<i>Quercus</i>	1,057	13.82%
<i>Cornus</i>	814	10.64%
<i>Platanus</i>	453	5.92%
Others	3,695	47.92%
TOTAL	7,648	100%



Genus	Total	Percent
<i>Lagerstroemia</i>	363	4.75%
<i>Celtis</i>	296	3.87%
<i>Pinus</i>	292	3.82%
<i>Prunus</i>	286	3.74%
<i>Magnolia</i>	238	3.11%
<i>Cercis</i>	227	2.97%
<i>Juniperus</i>	198	2.59%
<i>Ulmus</i>	193	2.52%
<i>Zelkova</i>	183	2.39%
<i>Koelreuteria</i>	101	1.32%
<i>Ilex</i>	99	1.29%
<i>Pyrus</i>	96	1.26%
<i>Juglans</i>	88	1.15%
<i>Carya</i>	84	1.10%
<i>Tsuga</i>	80	1.05%
<i>Liquidambar</i>	73	0.95%
<i>Liriodendron</i>	67	0.88%
<i>Ginkgo</i>	65	0.85%

Genus	Total	Percent
<i>Fraxinus</i>	54	0.71%
<i>Ailanthus</i>	53	0.69%
<i>Morus</i>	47	0.61%
<i>Crataegus</i>	46	0.60%
<i>Malus</i>	43	0.56%
<i>Betula</i>	41	0.54%
<i>Chionanthus</i>	35	0.46%
<i>Gleditsia</i>	35	0.46%
unknown	32	0.42%
<i>Diospyros</i>	29	0.38%
<i>Catalpa</i>	28	0.37%
<i>Salix</i>	28	0.37%
<i>Nyssa</i>	22	0.29%
<i>Picea</i>	20	0.26%
<i>Robinia</i>	20	0.26%
<i>Cupressocyparis</i>	20	0.26%
<i>Amelanchier</i>	17	0.22%
<i>Thuja</i>	14	0.18%

Genus	Total	Percent
<i>Chamaecyparis</i>	10	0.13%
<i>Tilia</i>	10	0.13%
<i>Carpinus</i>	9	0.12%
<i>Cladrastis</i>	6	0.08%
<i>Taxodium</i>	6	0.08%
<i>Viburnum</i>	6	0.08%
<i>Populus</i>	5	0.07%
<i>Hibiscus</i>	4	0.05%
<i>Lonicera</i>	4	0.05%
<i>Maclura</i>	4	0.05%
<i>Paulownia</i>	4	0.05%
<i>Broussonetia</i>	3	0.04%
<i>Fagus</i>	3	0.04%
<i>Sassafras</i>	3	0.04%
<i>Albizia</i>	2	0.03%
<i>Cedrus</i>	1	0.01%
<i>Euonymus</i>	1	0.01%
<i>Ostrya</i>	1	0.01%



Diameter Class Frequency

Diameter Class	Total	Percent of Population
1 - 3	1,791	23.42%
4 - 6	1,456	19.04%
7 - 12	2,081	27.21%
13 - 18	1,175	15.36%
19 - 24	577	7.54%
25 - 30	330	4.31%
31 - 36	112	1.46%
37 - 42	70	0.92%
43 +	56	0.73%
TOTAL	7,648	100.00%

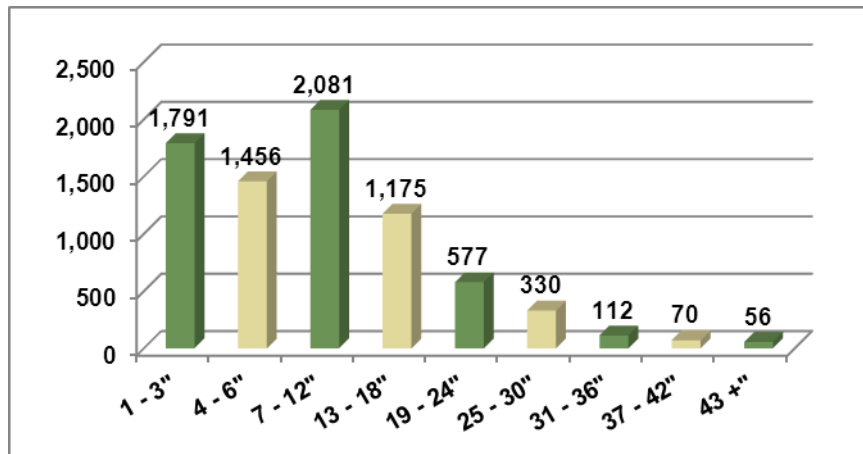


Figure 2. Size Class Distribution



Condition Rating Frequency

STUDY AREA TREE POPULATION
CONDITION RATINGS

Condition Rating	Total	Percent of Total Population
Excellent	1	0.01%
Very Good	40	0.52%
Good	1,176	15.38%
Fair	4,844	63.34%
Poor	1,372	17.94%
Critical	101	1.32%
Dead	114	1.49%
TOTAL	7,648	100.00%

Maintenance Definitions

Maintenance requirement information is collected to provide a basis for determining and prioritizing the primary maintenance needs of the City's inventoried tree population. The Primary Maintenance Recommendations are the main maintenance needs of the urban forest and should be addressed first; the Secondary Maintenance Recommendations are not high-risk safety pruning activities, but rather practices directed at improving the overall health, stability, and aesthetics of the urban forest. Davey Resource Group has identified maintenance activities that are of greatest importance to the overall management of the public tree population. This information is useful for preparing accurate budgets and for developing maintenance schedules. The following terms, based on the *American National Standards Institute (ANSI) A300 Tree, Shrub, and Other Woody Plant Maintenance – Standard Practices (Pruning)* (ANSI, 2001), are used to describe the maintenance requirements of each tree:

Primary Maintenance Needs

Removal

Trees designated for removal have defects that cannot be cost-effectively or practically treated. The majority of the trees in this category have a large percentage of dead crown. All trees with safety risks that could be seen as potential threats to persons or property and seen as potential liabilities to the client would be in this category. This category includes large, dead, and dying trees that are high-liability risks as well as those that pose minimal liability to persons or property (such as trees in poor locations or undesirable species).

Large Tree Clean

These trees require selective removal of dead, dying, broken, and/or diseased wood to minimize potential risk. Priority of work should be dependent upon the Risk Rating associated with the individual trees. Trees in this category are large enough to require bucket truck access or manual climbing.

Small Tree Clean

These trees require selective removal of dead, dying, broken, and/or diseased wood to minimize potential risk. Priority of work should be dependent upon the Risk Rating associated with the individual trees. These trees are small-growing, mature trees that can be evaluated and pruned from the ground.

Young Tree Train

These are young trees that must be pruned to correct or eliminate weak, interfering, or objectionable branches in order to minimize future maintenance requirements. Generally, these trees may be up to 20 feet in height and can be worked with a pole pruner by a person standing on the ground.



Secondary Maintenance Needs

Raise

Trees requiring pruning to remove low branches that interfere with sight and/or traffic. The following specs were used to denote a clearance issue; 8 feet over sidewalk for pedestrian clearance; 14 feet over roads for traffic clearance; and 7 feet in park and public space areas to allow for grounds maintenance.

Reduce

This is the selective pruning to decrease height and/or spread of the crown in order to provide structural clearance. This is often used in connection with a light or building clearance issue.

Thin

The selective removal of water sprouts, epicormic branches, and live branches to reduce density.

None

No secondary maintenance is recommended for the tree. This is used as the default value when the Primary Maintenance is Removal or Stump Removal.



Primary Maintenance Frequency

Primary Maintenance	Total	Percent of Population
Large Tree Clean	3,836	50.16%
Removal	691	9.04%
Small Tree Clean	1,522	19.90%
Young Tree Train	1,599	20.91%
TOTAL	7,648	100.00%

Secondary Maintenance Frequency

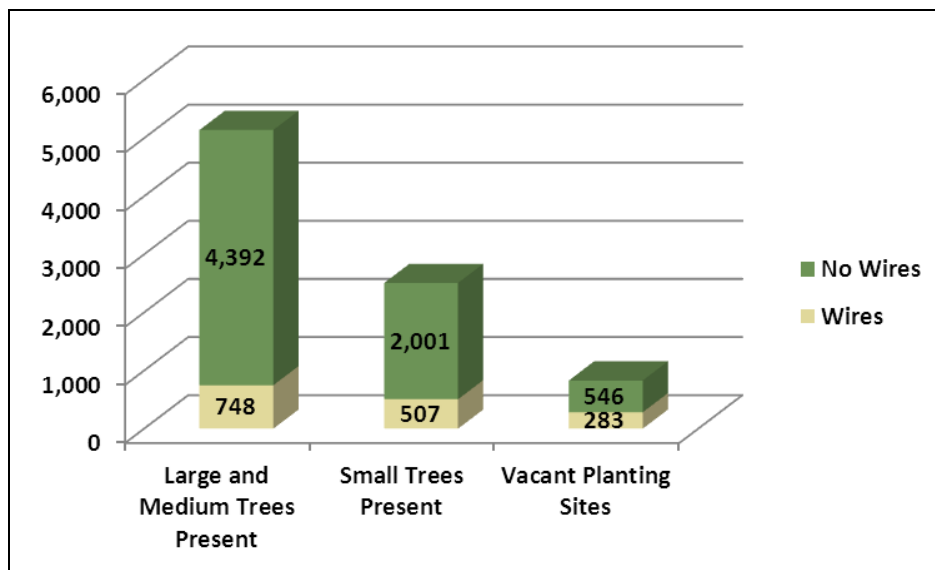
Secondary Maintenance	Total	Percent of Population
Raise	407	5.32%
Reduce	87	1.14%
Thin	44	0.58%
None	7,110	92.97%
TOTAL	7,648	100.00%



Overhead Utility Frequency

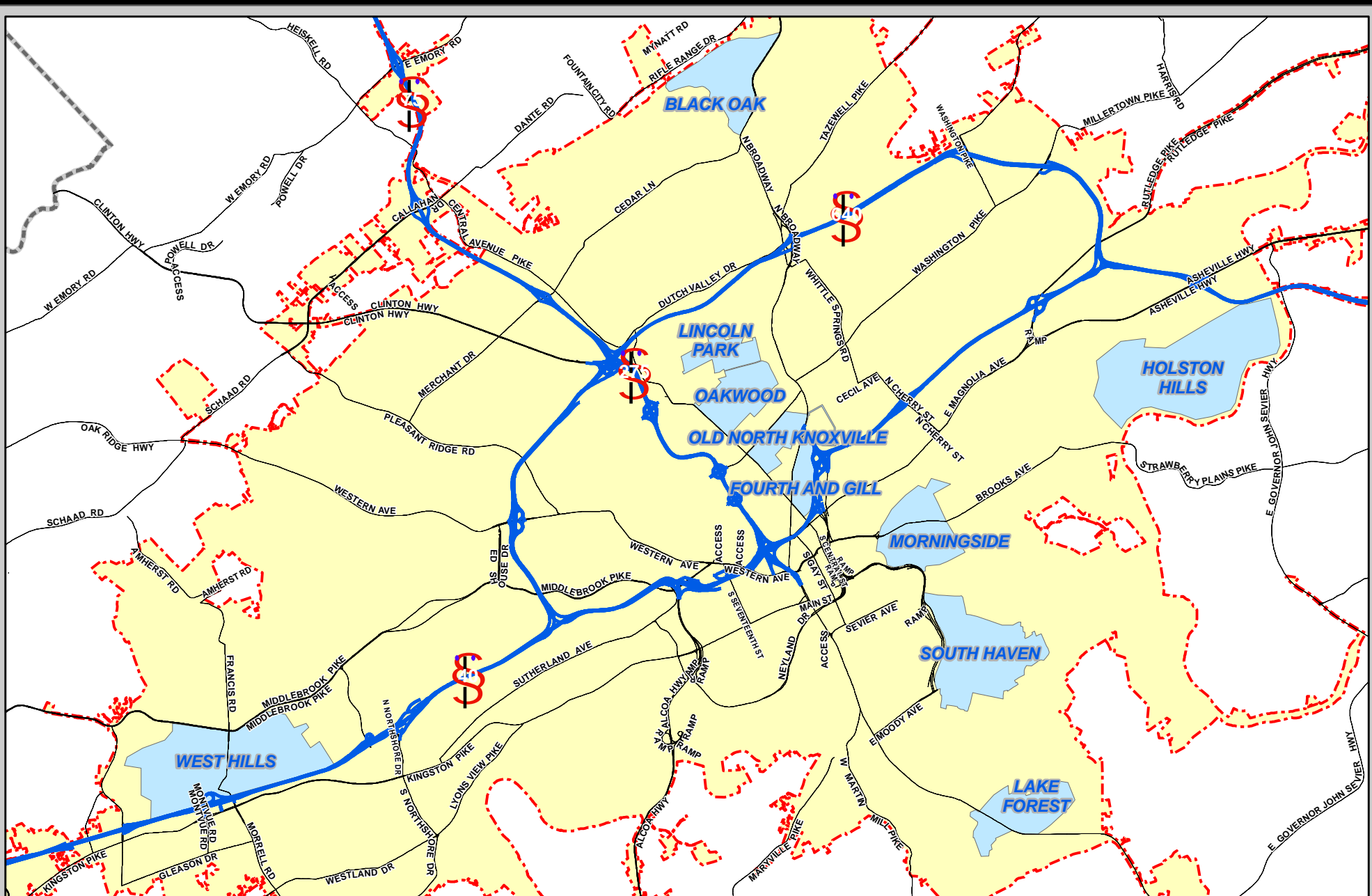
Overhead Utilities Status	Total	Percent
Trees Present - Wires Present	6,393	83.59% of trees
Trees Present - No Wires	1,255	16.41% of trees
Vacant Spots - Wires Present	283	34.14% of vacant spots
Vacant Spots - No Wires	546	65.86% of vacant spots

Trees and Vacant Spots Under Utility	Wires	No Wires
Large and Medium Trees Present	748	4,392
Small Trees Present	507	2,001
Vacant Spots	283	546
TOTAL: Trees	1,255	6,393
TOTAL: Vacant Spots	283	546



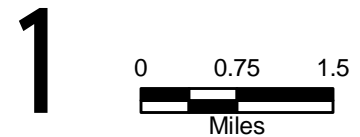


APPENDIX C – i-Tree Streets Tables



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Knoxville**Total Annual Benefits, Net Benefits, and Costs for Public Trees**

6/9/2011

Benefits	Total (\$) Standard Error	\$/tree Standard Error	\$/capita Standard Error
Energy	75,225 (±6,911)	10.39 (±0.95)	6.30 (±0.58)
CO2	20,164 (±1,853)	2.78 (±0.26)	1.69 (±0.16)
Air Quality	-8,264 (±759)	-1.14 (±0.10)	-0.69 (±0.06)
Stormwater	200,475 (±18,418)	27.69 (±2.54)	16.78 (±1.54)
Aesthetic/Other	312,707 (±28,729)	43.19 (±3.97)	26.17 (±2.40)
Total Benefits	600,307 (±55,152)	82.90 (±7.62)	50.25 (±4.62)
Costs			
Planting	2,655	0.37	0.22
Contract Pruning	4,361	0.60	0.37
Pest Management	0	0.00	0.00
Irrigation	0	0.00	0.00
Removal	10,898	1.51	0.91
Administration	15,189	2.10	1.27
Inspection/Service	17,256	2.38	1.44
Infrastructure Repairs	3,518	0.49	0.29
Litter Clean-up	120,427	16.63	10.08
Liability/Claims	34	0.00	0.00
Other Costs	0	0.00	0.00
Total Costs	174,338	24.08	14.59
Net Benefits	425,969 (±55,152)	58.83 (±7.62)	35.65 (±4.62)
Benefit-cost ratio	3.44 (±0.32)		

Knoxville

Annual Benefits of Public Trees by Species (\$/tree)

6/9/2011

Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$) Standard Error
dogwood, flowering	3.32	0.81	1.20	4.00	6.66	16.01 (±2.18)
oak, sawtooth	13.59	3.92	-4.99	34.57	76.40	123.48 (±80.81)
crapemyrtle, common	0.83	0.08	0.27	0.75	1.32	3.25 (±.87)
hackberry, common	15.46	4.24	-9.17	48.41	75.25	134.18 (±32.79)
redbud, eastern	3.56	0.88	1.29	4.31	6.95	16.99 (±4.53)
elm, American	11.46	3.48	4.23	27.43	44.25	90.84 (±19.35)
maple, sugar	19.79	3.93	4.54	50.06	65.88	144.20 (±41.5)
hemlock, eastern	7.64	1.77	4.21	14.82	9.33	37.77 (±23.2)
maple, silver	22.96	7.04	6.13	62.00	82.01	180.13 (±43.74)
cherry, black	15.67	4.24	-9.73	49.90	76.44	136.52 (±42.39)
tuliptree	16.87	3.72	-15.27	50.30	91.55	147.17 (±38.88)
pear, Callery	9.39	2.37	3.77	16.33	28.03	59.88 (±34.2)
oak, southern red	27.69	7.20	-2.32	94.15	111.52	238.25 (±80)
planetree, London	20.57	5.41	-14.97	71.19	89.80	172.00 (±121.69)
walnut, black	13.42	3.86	-5.11	34.59	75.09	121.85 (±39.19)
redcedar, eastern	6.17	1.40	3.41	11.64	7.36	29.97 (±8.74)
maple, red	9.08	2.72	2.14	25.80	50.66	90.41 (±33.46)
sycamore, American	20.99	5.55	-15.18	72.49	92.49	176.35 (±85.06)
oak, white	21.85	6.95	0.42	84.57	122.04	235.83 (±76.45)
persimmon, common	8.55	3.54	3.00	17.81	37.46	70.35 (±24.34)
unknown tree	7.38	2.19	-1.52	15.67	49.72	73.45 (±22.03)
tree of heaven	11.09	3.19	-4.61	29.76	63.13	102.56 (±53.7)
holly, American	3.08	0.68	1.80	4.39	3.81	13.76 (±6)
Plum	4.01	0.58	1.34	5.19	13.55	24.67 (±13.56)
OTHER STREET TRI	10.25	2.79	-0.71	27.31	42.43	82.07 (±212.28)

Population Summary of Public Trees

6/9/2011

Species	DBH Class (in)									Total Standard Error
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	
ACSA2										
planetree, London	0	9	18	18	37	28	9	18	0	139 (±98)
ACSA2 OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	9	18	18	37	28	9	18	0	139 (±98)
Broadleaf Deciduous Large (BDL)										
oak, sawtooth	0	0	46	296	129	0	0	0	0	472 (±309)
hackberry, common	18	28	65	83	46	74	18	9	0	342 (±84)
elm, American	0	37	83	46	83	18	0	0	9	277 (±59)
maple, sugar	0	9	83	65	28	46	18	9	0	259 (±75)
maple, silver	9	0	9	37	55	65	37	9	0	222 (±54)
cherry, black	0	0	83	55	28	28	9	18	0	222 (±69)
tuliptree	9	0	18	28	65	55	9	0	0	185 (±49)
oak, southern red	0	0	0	28	46	18	28	9	18	148 (±50)
walnut, black	0	0	18	83	18	9	0	0	0	129 (±42)
sycamore, American	0	0	18	28	28	9	28	9	0	120 (±58)
oak, white	0	9	18	0	28	18	46	0	0	120 (±39)
unknown tree	0	18	46	37	0	0	0	0	0	102 (±31)
tree of heaven	0	9	28	18	9	9	0	0	0	74 (±39)
BDL OTHER	28	28	92	166	120	65	46	0	18	564 (±100)
Total	65	139	610	971	684	416	240	65	46	3,237 (±455)
Broadleaf Deciduous Medium (BDM)										
maple, red	18	37	28	18	0	9	9	0	0	120 (±44)
persimmon, common	37	0	28	18	18	0	0	0	0	102 (±35)
BDM OTHER	28	65	74	37	28	9	0	0	0	240 (±58)
Total	83	102	129	74	46	18	9	0	0	462 (±91)
Broadleaf Deciduous Small (BDS)										
dogwood, flowering	194	583	546	46	0	0	0	0	0	1,369 (±186)
redbud, eastern	55	74	148	9	0	0	0	0	0	287 (±76)
pear, Callery	9	9	55	65	28	0	0	0	0	166 (±95)
Plum	18	9	37	9	0	0	0	0	0	74 (±41)
BDS OTHER	74	120	65	9	0	0	0	0	0	268 (±66)
Total	351	795	851	139	28	0	0	0	0	2,164 (±282)
Broadleaf Evergreen Large (BEL)										
BEL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Broadleaf Evergreen Medium (BEM)										
BEM OTHER	0	0	9	0	9	0	0	0	0	18 (±12)
Total	0	0	9	0	9	0	0	0	0	18 (±12)
BENI										
BENI OTHER	18	0	9	0	0	0	0	0	0	28 (±19)
Total	18	0	9	0	0	0	0	0	0	28 (±19)
Broadleaf Evergreen Small (BES)										
holly, American	0	28	37	9	0	0	0	0	0	74 (±32)
BES OTHER	18	28	18	0	0	0	0	0	0	65 (±36)
Total	18	55	55	9	0	0	0	0	0	139 (±47)
Conifer Evergreen Large (CEL)										
CEL OTHER	0	37	37	46	18	18	28	0	0	185 (±65)
Total	0	37	37	46	18	18	28	0	0	185 (±65)
Conifer Evergreen Medium (CEM)										
hemlock, eastern	0	9	74	65	83	0	0	0	0	231 (±142)
redcedar, eastern	28	9	28	37	18	9	0	0	0	129 (±38)
CEM OTHER	9	37	18	46	9	0	0	0	0	120 (±37)

Population Summary of Public Trees

6/9/2011

Species	DBH Class (in)									Total Standard Error
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	
Total	37	55	120	148	111	9	0	0	0	481 (±150)
Conifer Evergreen Small (CES)										
CES OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
COFL										
COFL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
DRG ASSIGNED (FROM PRIOR ISTREETS)										
crapemyrtle, common	250	102	0	0	0	0	0	0	0	351 (±94)
DRG ASSIGNED (FROM P	0	18	0	0	0	0	0	0	0	18 (±17)
Total	250	120	0	0	0	0	0	0	0	370 (±95)
ILOP										
ILOP OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
LA6										
LA6 OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Large (PEL)										
PEL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Medium (PEM)										
PEM OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Small (PES)										
PES OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
PRYE										
PRYE OTHER	0	18	0	0	0	0	0	0	0	18 (±12)
Total	0	18	0	0	0	0	0	0	0	18 (±12)
QUPH										
QUPH OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
ULAL										
ULAL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Grand Total	823	1,332	1,840	1,406	934	490	287	83	46	7,241 (±665)

Knoxville**Total Annual Benefits, Net Benefits, and Costs for Public Trees**

6/8/2011

Benefits	Total (\$) Standard Error	\$/tree Standard Error	\$/capita Standard Error
Energy	8,579 (±1,710)	15.08 (±3.01)	7.88 (±1.57)
CO2	2,268 (±452)	3.99 (±0.79)	2.08 (±0.42)
Air Quality	-1,061 (±211)	-1.86 (±0.37)	-0.97 (±0.19)
Stormwater	25,208 (±5,025)	44.30 (±8.83)	23.15 (±4.61)
Aesthetic/Other	35,000 (±6,976)	61.51 (±12.26)	32.14 (±6.41)
Total Benefits	69,994 (±13,951)	123.01 (±24.52)	64.27 (±12.81)
Costs			
Planting	242	0.43	0.22
Contract Pruning	398	0.70	0.37
Pest Management	0	0.00	0.00
Irrigation	0	0.00	0.00
Removal	993	1.75	0.91
Administration	1,385	2.43	1.27
Inspection/Service	1,573	2.76	1.44
Infrastructure Repairs	321	0.56	0.29
Litter Clean-up	10,978	19.29	10.08
Liability/Claims	3	0.01	0.00
Other Costs	0	0.00	0.00
Total Costs	15,893	27.93	14.59
Net Benefits	54,101 (±13,951)	95.08 (±24.52)	49.68 (±12.81)
Benefit-cost ratio	4.40 (±0.88)		

Knoxville

Annual Benefits of Public Trees by Species (\$/tree)

6/8/2011

Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$)	Standard Error
hackberry, common	16.35	4.49	-9.50	50.78	79.67	141.78	(±52.4)
oak, southern red	28.31	7.35	-2.32	96.95	113.39	243.68	(±156)
maple, sugar	31.14	5.86	6.61	92.39	79.74	215.73	(±115.55)
dogwood, flowering	1.92	0.39	0.69	2.14	4.70	9.84	(±3.98)
redcedar, eastern	3.06	0.65	1.60	5.44	5.53	16.29	(±11.1)
locust, black	23.73	6.39	-16.71	81.44	104.81	199.66	(±189.58)
elm, American	16.41	5.20	6.16	38.31	39.77	105.85	(±52.49)
hickory, mockernut	12.19	3.54	-5.16	33.17	69.69	113.44	(±107.72)
ash, white	12.19	3.54	-5.16	33.17	69.69	113.44	(±72.62)
tuliptree	17.64	3.87	-15.32	51.09	95.10	152.38	(±144.69)
pine, shortleaf	11.18	2.74	4.14	23.26	34.19	75.51	(±71.7)
Plum	7.46	1.19	2.52	10.25	24.14	45.56	(±43.27)
oak, white	19.18	6.13	0.32	75.07	106.50	207.20	(±132.64)
oak, swamp white	11.74	3.52	1.21	35.07	81.08	132.61	(±84.9)
boxelder	18.64	9.90	6.68	48.27	80.93	164.42	(±156.12)
maple, Japanese	1.09	0.09	0.38	1.04	3.00	5.59	(±5.31)
hickory, bitternut	12.52	3.63	-3.60	28.98	73.15	114.67	(±108.88)
hickory, shagbark	12.52	3.63	-3.60	28.98	73.15	114.67	(±108.88)
redbud, eastern	4.77	1.27	1.73	5.91	8.82	22.50	(±21.36)
walnut, black	26.49	7.21	-18.53	90.74	114.16	220.06	(±208.96)
crapemyrtle, common	1.55	0.20	0.51	1.53	3.57	7.36	(±6.99)
magnolia, umbrella	2.20	0.49	0.80	2.50	5.27	11.26	(±10.69)
blackgum	14.37	5.92	5.04	28.49	59.33	113.14	(±107.43)
chokecherry, common	2.32	0.23	0.77	2.69	11.77	17.79	(±16.89)
oak, blackjack	21.63	5.77	1.72	53.11	90.28	172.52	(±163.81)
arborvitae, eastern	0.34	0.02	0.17	0.36	1.60	2.49	(±2.36)
hemlock, eastern	12.48	2.93	7.07	24.72	10.34	57.55	(±54.65)
OTHER STREET TRI	0.00	0.00	0.00	0.00	0.00	0.00	(±NaN)

Population Summary of Public Trees

6/8/2011

Species	DBH Class (in)									Total Standard Error
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	
ACSA2										
ACSA2 OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Broadleaf Deciduous Large (BDL)										
hackberry, common	0	10	0	20	20	0	10	0	0	61 (±23)
oak, southern red	0	0	0	20	0	10	20	10	0	61 (±39)
maple, sugar	0	0	0	0	10	20	10	0	0	41 (±22)
locust, black	0	0	0	0	20	0	10	0	0	31 (±29)
elm, American	0	0	10	0	10	10	0	0	0	31 (±15)
hickory, mockernut	0	0	10	0	10	0	0	0	0	20 (±19)
ash, white	0	0	10	0	10	0	0	0	0	20 (±13)
tuliptree	0	0	0	10	0	10	0	0	0	20 (±19)
oak, white	0	0	10	0	0	0	10	0	0	20 (±13)
oak, swamp white	0	0	10	0	10	0	0	0	0	20 (±13)
hickory, bitternut	0	0	0	10	0	0	0	0	0	10 (±10)
hickory, shagbark	0	0	0	10	0	0	0	0	0	10 (±10)
walnut, black	0	0	0	0	0	10	0	0	0	10 (±10)
oak, blackjack	0	0	0	0	10	0	0	0	0	10 (±10)
BDL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	10	51	71	102	61	61	10	0	366 (±87)
Broadleaf Deciduous Medium (BDM)										
boxelder	0	0	0	0	10	0	0	0	0	10 (±10)
blackgum	0	0	0	10	0	0	0	0	0	10 (±10)
BDM OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	10	10	0	0	0	0	20 (±13)
Broadleaf Deciduous Small (BDS)										
dogwood, flowering	10	31	0	0	0	0	0	0	0	41 (±16)
Plum	0	0	10	10	0	0	0	0	0	20 (±19)
maple, Japanese	10	0	0	0	0	0	0	0	0	10 (±10)
redbud, eastern	0	0	10	0	0	0	0	0	0	10 (±10)
magnolia, umbrella	0	10	0	0	0	0	0	0	0	10 (±10)
BDS OTHER	0	0	0	0	0	0	0	0	0	0
Total	20	41	20	10	0	0	0	0	0	92 (±32)
Broadleaf Evergreen Large (BEL)										
BEL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Broadleaf Evergreen Medium (BEM)										
BEM OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
BENI										
BENI OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Broadleaf Evergreen Small (BES)										
BES OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Conifer Evergreen Large (CEL)										
pine, shortleaf	0	0	0	20	0	0	0	0	0	20 (±19)
CEL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	20	0	0	0	0	0	20 (±19)
Conifer Evergreen Medium (CEM)										
redcedar, eastern	10	10	0	10	0	0	0	0	0	31 (±21)
arborvitae, eastern	10	0	0	0	0	0	0	0	0	10 (±10)
hemlock, eastern	0	0	0	0	10	0	0	0	0	10 (±10)

Population Summary of Public Trees

6/8/2011

Species	DBH Class (in)									Total Standard Error
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	
CEM OTHER	0	0	0	0	0	0	0	0	0	0
Total	20	10	0	10	10	0	0	0	0	51 (±27)
Conifer Evergreen Small (CES)										
CES OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
COFL										
COFL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
DRG ASSIGNED (FROM PRIOR ISTREETS)										
crapemyrtle, common	0	10	0	0	0	0	0	0	0	10 (±10)
DRG ASSIGNED (FROM P	0	0	0	0	0	0	0	0	0	0
Total	0	10	0	0	0	0	0	0	0	10 (±10)
ILOP										
ILOP OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
LA6										
LA6 OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Large (PEL)										
PEL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Medium (PEM)										
PEM OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Small (PES)										
PES OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
PRYE										
chokecherry, common	0	10	0	0	0	0	0	0	0	10 (±10)
PRYE OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	10	0	0	0	0	0	0	0	10 (±10)
QUPH										
QUPH OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
ULAL										
ULAL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Grand Total	41	81	71	122	122	61	61	10	0	569 (±113)

Knoxville**Total Annual Benefits, Net Benefits, and Costs for Public Trees**

6/8/2011

Benefits	Total (\$) Standard Error	\$/tree Standard Error	\$/capita Standard Error
Energy	3,887 (±1,111)	6.74 (±1.93)	12.26 (±3.50)
CO2	1,076 (±308)	1.86 (±0.53)	3.39 (±0.97)
Air Quality	189 (±54)	0.33 (±0.09)	0.60 (±0.17)
Stormwater	11,023 (±3,151)	19.10 (±5.46)	34.77 (±9.94)
Aesthetic/Other	15,878 (±4,538)	27.52 (±7.87)	50.09 (±14.32)
Total Benefits	32,053 (±9,162)	55.55 (±15.88)	101.11 (±28.90)
Costs			
Planting	70	0.12	0.22
Contract Pruning	116	0.20	0.37
Pest Management	0	0.00	0.00
Irrigation	0	0.00	0.00
Removal	289	0.50	0.91
Administration	403	0.70	1.27
Inspection/Service	458	0.79	1.44
Infrastructure Repairs	93	0.16	0.29
Litter Clean-up	3,193	5.53	10.07
Liability/Claims	1	0.00	0.00
Other Costs	0	0.00	0.00
Total Costs	4,623	8.01	14.58
Net Benefits	27,430 (±9,162)	47.54 (±15.88)	86.53 (±28.90)
Benefit-cost ratio	6.93 (±1.98)		

Knoxville

Annual Benefits of Public Trees by Species (\$/tree)

6/8/2011

Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$) Standard Error
maple, red	1.16	0.41	0.39	1.40	9.16	12.51 (±8.58)
maple, sugar	10.62	2.61	3.11	19.46	50.18	85.98 (±48.2)
dogwood, flowering	2.28	0.55	0.90	2.91	4.64	11.28 (±5.17)
crapemyrtle, common	0.68	0.06	0.24	0.65	0.91	2.54 (±2.39)
Plum	3.56	0.53	1.30	4.92	12.96	23.27 (±21.9)
oak, southern red	22.45	6.49	-2.37	84.96	88.78	200.31 (±146.52)
maple, silver	12.84	4.11	3.94	34.74	45.81	101.43 (±51.95)
redbud, eastern	5.86	1.70	2.36	8.22	9.25	27.39 (±18.78)
holly, Chinese	0.94	0.19	0.55	0.94	0.79	3.40 (±3.2)
birch, river	0.58	0.06	0.20	0.75	6.01	7.60 (±7.15)
cypress, leyland	3.76	1.06	1.87	7.45	16.72	30.87 (±29.05)
ash, green	8.12	2.67	-2.09	19.66	51.08	79.44 (±74.75)
mulberry, white	1.99	0.42	0.72	2.69	11.39	17.22 (±16.2)
cherry, Yoshino	2.12	0.23	0.77	2.69	10.27	16.09 (±15.14)
maple, Japanese	2.01	0.49	0.80	2.50	4.60	10.40 (±9.79)
maple, Norway	15.72	3.65	4.45	33.17	61.54	118.53 (±111.54)
catalpa, northern	29.80	8.45	-30.65	132.29	107.81	247.71 (±233.1)
redcedar, eastern	2.56	0.68	1.57	5.87	6.87	17.55 (±16.51)
goldenraintree	3.41	0.77	1.24	4.63	16.78	26.83 (±25.25)
tuliptree	4.22	0.99	-1.35	8.51	33.63	45.99 (±43.28)
Crabapple	2.23	0.65	0.82	2.06	2.73	8.50 (±8)
magnolia, southern	14.42	2.71	2.98	50.19	32.86	103.16 (±97.08)
poplar, Lombardy blac	2.56	0.68	1.57	5.87	6.87	17.55 (±16.51)
chokecherry, common	2.12	0.23	0.77	2.69	10.27	16.09 (±15.14)
pear, Callery	4.54	1.39	1.93	7.18	16.51	31.53 (±29.67)
oak, water	11.31	3.66	-2.72	30.86	77.52	120.63 (±113.52)
oak, pin	38.28	10.82	-14.97	207.00	145.77	386.91 (±364.09)
oak, willow	4.96	1.72	-0.57	10.33	38.35	54.78 (±51.55)
willow, corkscrew	12.92	5.92	5.04	28.49	51.76	104.12 (±97.98)
elm, American	9.96	3.71	3.95	26.48	49.62	93.73 (±88.2)
OTHER STREET TRI	0.00	0.00	0.00	0.00	0.00	0.00 (±NaN)

Population Summary of Public Trees

6/8/2011

Species	DBH Class (in)									Total Standard Error
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	
Conifer Evergreen Medium (CEM)										
redcedar, eastern	0	0	9	0	0	0	0	0	0	9 (±8)
CEM OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	9	0	0	0	0	0	0	9 (±8)
Conifer Evergreen Small (CES)										
CES OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
COFL										
COFL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
DRG ASSIGNED (FROM PRIOR ISTREETS)										
crapemyrtle, common	35	9	0	0	0	0	0	0	0	44 (±41)
cherry, Yoshino	0	17	0	0	0	0	0	0	0	17 (±16)
DRG ASSIGNED (FROM P	0	0	0	0	0	0	0	0	0	0
Total	35	26	0	0	0	0	0	0	0	61 (±43)
ILOP										
ILOP OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
LA6										
LA6 OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Large (PEL)										
PEL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Medium (PEM)										
PEM OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Small (PES)										
PES OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
PRYE										
chokecherry, common	0	9	0	0	0	0	0	0	0	9 (±8)
PRYE OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	9	0	0	0	0	0	0	0	9 (±8)
QUPH										
QUPH OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
ULAL										
ULAL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Grand Total	122	140	166	87	26	9	9	0	17	577 (±165)

Knoxville**Total Annual Benefits, Net Benefits, and Costs for Public Trees**

6/8/2011

Benefits	Total (\$) Standard Error	\$/tree Standard Error	\$/capita Standard Error
Energy	9,872 (±2,121)	10.54 (±2.26)	3.22 (±0.69)
CO2	2,721 (±585)	2.90 (±0.62)	0.89 (±0.19)
Air Quality	-545 (±117)	-0.58 (±0.12)	-0.18 (±0.04)
Stormwater	25,281 (±5,432)	26.98 (±5.80)	8.24 (±1.77)
Aesthetic/Other	42,197 (±9,067)	45.03 (±9.68)	13.76 (±2.96)
Total Benefits	79,526 (±17,089)	84.87 (±18.24)	25.93 (±5.57)
Costs			
Planting	682	0.73	0.22
Contract Pruning	1,120	1.20	0.37
Pest Management	0	0.00	0.00
Irrigation	0	0.00	0.00
Removal	2,798	2.99	0.91
Administration	3,900	4.16	1.27
Inspection/Service	4,430	4.73	1.44
Infrastructure Repairs	903	0.96	0.29
Litter Clean-up	30,919	33.00	10.08
Liability/Claims	9	0.01	0.00
Other Costs	0	0.00	0.00
Total Costs	44,761	47.77	14.59
Net Benefits	34,765 (±17,089)	37.10 (±18.24)	11.34 (±5.57)
Benefit-cost ratio	1.78 (±0.38)		

Knoxville

Annual Benefits of Public Trees by Species (\$/tree)

6/8/2011

Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$)	Standard Error
dogwood, flowering	3.18	0.75	1.15	3.83	6.32	15.23	(±5.32)
elm, American	11.46	3.05	4.21	27.32	44.49	90.53	(±32.55)
walnut, black	11.75	3.42	-3.61	27.95	69.54	109.05	(±38.27)
cherry, black	18.04	4.87	-11.42	58.02	85.04	154.55	(±88.31)
redbud, eastern	3.51	0.88	1.27	4.24	6.97	16.87	(±9.76)
unknown tree	6.97	2.09	-1.32	14.53	48.49	70.76	(±23.27)
crapemyrtle, common	0.74	0.06	0.24	0.65	1.04	2.73	(±1.6)
oak, scarlet	18.64	4.86	1.59	44.20	77.30	146.59	(±110.35)
hackberry, common	21.10	5.85	-12.60	66.61	99.22	180.19	(±96.18)
boxelder	13.83	6.06	4.88	29.97	58.31	113.04	(±56.11)
maple, sugar	6.91	1.63	1.91	9.29	41.29	61.04	(±41.02)
holly, American	1.96	0.42	1.11	2.29	1.94	7.71	(±7.16)
redcedar, eastern	13.28	3.04	7.54	25.07	9.51	58.44	(±39.28)
planetree, London	14.82	4.18	-7.57	43.35	77.09	131.88	(±88.63)
oak, white	28.10	9.02	0.07	113.65	150.60	301.45	(±149.63)
oak, southern red	24.21	6.43	1.16	64.76	99.52	196.07	(±97.33)
hemlock, eastern	6.07	1.43	3.41	12.15	8.69	31.75	(±15.76)
maple, red	6.51	1.45	1.78	11.69	45.32	66.75	(±42.24)
hickory, mockernut	14.19	3.86	-9.11	46.56	65.72	121.22	(±76.71)
blackgum	8.49	2.35	2.91	13.14	34.65	61.56	(±38.95)
pine, shortleaf	24.42	6.03	9.50	66.06	45.35	151.36	(±95.78)
pine, Virginia	7.69	1.90	3.01	15.36	26.67	54.62	(±50.73)
sassafras	3.75	0.77	1.24	4.63	19.23	29.63	(±27.51)
OTHER STREET TRI	13.55	3.87	-1.09	35.66	57.70	109.69	(±343.79)

Population Summary of Public Trees

6/8/2011

Species	DBH Class (in)									Total Standard Error
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	
ACSA2										
planetree, London	0	0	7	7	0	7	0	0	0	22 (±15)
ACSA2 OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	7	7	0	7	0	0	0	22 (±15)
Broadleaf Deciduous Large (BDL)										
elm, American	0	15	15	22	22	0	0	0	7	80 (±29)
walnut, black	0	0	15	51	7	0	0	0	0	73 (±26)
cherry, black	0	0	15	22	15	15	0	7	0	73 (±42)
unknown tree	0	7	29	15	0	0	0	0	0	51 (±17)
oak, scarlet	0	0	0	22	7	7	0	0	0	36 (±27)
hackberry, common	0	0	0	7	7	15	0	0	0	29 (±16)
maple, sugar	0	7	15	0	0	0	0	0	0	22 (±15)
oak, white	0	0	0	0	7	0	15	0	0	22 (±11)
oak, southern red	0	0	0	0	15	7	0	0	0	22 (±11)
hickory, mockernut	0	7	0	0	0	7	0	0	0	15 (±9)
BDL OTHER	0	0	0	22	0	15	0	0	0	36 (±16)
Total	0	36	87	160	80	65	15	7	7	458 (±108)
Broadleaf Deciduous Medium (BDM)										
boxelder	0	0	7	7	7	0	0	0	0	22 (±11)
maple, red	0	0	15	0	0	0	0	0	0	15 (±9)
blackgum	0	0	15	0	0	0	0	0	0	15 (±9)
sassafras	0	15	0	0	0	0	0	0	0	15 (±13)
BDM OTHER	0	0	0	7	0	0	0	0	0	7 (±7)
Total	0	15	36	15	7	0	0	0	0	73 (±35)
Broadleaf Deciduous Small (BDS)										
dogwood, flowering	36	80	36	15	0	0	0	0	0	167 (±58)
redbud, eastern	7	15	29	0	0	0	0	0	0	51 (±29)
BDS OTHER	7	0	0	0	0	0	0	0	0	7 (±7)
Total	51	94	65	15	0	0	0	0	0	225 (±77)
Broadleaf Evergreen Large (BEL)										
BEL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Broadleaf Evergreen Medium (BEM)										
BEM OTHER	0	0	7	0	0	0	0	0	0	7 (±7)
Total	0	0	7	0	0	0	0	0	0	7 (±7)
BENI										
BENI OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Broadleaf Evergreen Small (BES)										
holly, American	0	15	7	0	0	0	0	0	0	22 (±20)
BES OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	15	7	0	0	0	0	0	0	22 (±20)
Conifer Evergreen Large (CEL)										
pine, shortleaf	0	0	0	7	0	0	7	0	0	15 (±9)
pine, Virginia	0	0	7	7	0	0	0	0	0	15 (±13)
CEL OTHER	0	0	0	7	7	0	0	0	0	15 (±13)
Total	0	0	7	22	7	0	7	0	0	44 (±34)
Conifer Evergreen Medium (CEM)										
redcedar, eastern	0	0	0	7	7	7	0	0	0	22 (±15)
hemlock, eastern	0	0	15	0	7	0	0	0	0	22 (±11)
CEM OTHER	0	0	0	0	7	0	0	0	0	7 (±7)
Total	0	0	15	7	22	7	0	0	0	51 (±17)

Population Summary of Public Trees

6/8/2011

Species	DBH Class (in)									Total Standard Error
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	
Conifer Evergreen Small (CES)										
CES OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
COFL										
COFL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
DRG ASSIGNED (FROM PRIOR ISTREETS)										
crapemyrtle, common	29	7	0	0	0	0	0	0	0	36 (±21)
DRG ASSIGNED (FROM P	0	0	0	0	0	0	0	0	0	0
Total	29	7	0	0	0	0	0	0	0	36 (±21)
ILOP										
ILOP OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
LA6										
LA6 OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Large (PEL)										
PEL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Medium (PEM)										
PEM OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Small (PES)										
PES OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
PRYE										
PRYE OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
QUPH										
QUPH OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
ULAL										
ULAL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Grand Total	80	167	233	225	116	80	22	7	7	937 (±201)

Knoxville

Annual Benefits of Public Trees by Species (\$/tree)

6/9/2011

Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$) Standard Error
dogwood, flowering	2.96	0.71	1.07	3.51	6.24	14.49 (±5.75)
tuliptree	15.13	3.31	-13.01	43.71	83.95	133.10 (±42.09)
sycamore, American	16.51	4.61	-9.04	49.87	83.14	145.08 (±81.48)
redbud, eastern	3.79	0.97	1.37	4.61	7.39	18.12 (±11.07)
persimmon, common	8.55	3.66	3.01	18.28	37.74	71.23 (±41.18)
dogwood, Kousa	2.20	0.49	0.80	2.50	5.27	11.26 (±10.43)
oak, white	24.32	7.81	0.20	96.99	131.68	260.99 (±136.43)
ash, white	16.93	4.26	-15.26	66.42	62.98	135.32 (±125.41)
redcedar, eastern	1.60	0.35	0.87	3.11	4.74	10.67 (±9.89)
crapemyrtle, common	0.54	0.03	0.17	0.43	0.41	1.57 (±1.46)
sweetgum, American	16.53	3.61	-13.97	47.32	93.39	146.88 (±136.12)
oak, scarlet	25.50	6.77	0.87	70.58	104.14	207.85 (±129.86)
elm, American	4.52	1.60	1.61	11.53	47.53	66.78 (±41.73)
maple, red	6.51	1.45	1.78	11.69	45.32	66.75 (±61.86)
maple, silver	15.62	3.94	4.59	28.66	62.04	114.84 (±106.43)
tree of heaven	1.89	0.51	0.30	2.39	17.29	22.39 (±20.75)
hickory, pignut	12.52	3.63	-3.60	28.98	73.15	114.67 (±106.27)
Pecan	26.49	7.21	-18.53	90.74	114.16	220.06 (±203.93)
holly, American	3.25	0.74	1.91	4.43	4.00	14.33 (±13.28)
walnut, black	12.52	3.63	-3.60	28.98	73.15	114.67 (±106.27)
pine, Virginia	27.49	6.91	10.30	75.22	52.48	172.40 (±159.77)
cherry, black	5.47	1.72	-0.57	10.33	43.95	60.90 (±56.44)
cherry, Japanese flowe	1.05	0.05	0.33	0.98	5.88	8.31 (±7.7)
oak, southern red	21.63	5.77	1.72	53.11	90.28	172.52 (±159.88)
oak, northern red	43.08	10.82	-14.97	207.00	167.09	413.03 (±382.76)
locust, black	12.52	3.63	-3.60	28.98	73.15	114.67 (±106.27)
linden, American	1.89	0.51	0.30	2.39	17.29	22.39 (±20.75)
OTHER STREET TRI	0.00	0.00	0.00	0.00	0.00	0.00 (±NaN)

Knoxville**Total Annual Benefits, Net Benefits, and Costs for Public Trees**

6/9/2011

Benefits	Total (\$) Standard Error	\$/tree Standard Error	\$/capita Standard Error
Energy	6,478 (±1,483)	9.63 (±2.20)	7.03 (±1.61)
CO2	1,735 (±397)	2.58 (±0.59)	1.88 (±0.43)
Air Quality	-1,766 (±404)	-2.62 (±0.60)	-1.92 (±0.44)
Stormwater	18,235 (±4,175)	27.10 (±6.20)	19.78 (±4.53)
Aesthetic/Other	29,647 (±6,788)	44.05 (±10.09)	32.16 (±7.36)
Total Benefits	54,329 (±12,438)	80.73 (±18.48)	58.93 (±13.49)
Costs			
Planting	205	0.30	0.22
Contract Pruning	336	0.50	0.36
Pest Management	0	0.00	0.00
Irrigation	0	0.00	0.00
Removal	841	1.25	0.91
Administration	1,172	1.74	1.27
Inspection/Service	1,331	1.98	1.44
Infrastructure Repairs	271	0.40	0.29
Litter Clean-up	9,290	13.80	10.08
Liability/Claims	3	0.00	0.00
Other Costs	0	0.00	0.00
Total Costs	13,449	19.98	14.59
Net Benefits	40,880 (±12,438)	60.74 (±18.48)	44.34 (±13.49)
Benefit-cost ratio	4.04 (±0.92)		

Population Summary of Public Trees

6/9/2011

Species	DBH Class (in)									Total Standard Error
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	
ACSA2										
ACSA2 OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Broadleaf Deciduous Large (BDL)										
tuliptree	7	0	7	14	28	21	0	0	0	78 (±25)
sycamore, American	0	0	14	21	21	7	7	0	0	71 (±40)
oak, white	0	0	7	0	0	7	14	0	0	28 (±15)
ash, white	7	0	0	0	0	0	7	0	0	14 (±13)
sweetgum, American	0	0	0	0	14	0	0	0	0	14 (±13)
oak, scarlet	0	0	0	0	7	7	0	0	0	14 (±9)
elm, American	0	0	14	0	0	0	0	0	0	14 (±9)
maple, silver	0	0	0	7	0	0	0	0	0	7 (±7)
tree of heaven	0	7	0	0	0	0	0	0	0	7 (±7)
hickory, pignut	0	0	0	7	0	0	0	0	0	7 (±7)
Pecan	0	0	0	0	0	7	0	0	0	7 (±7)
walnut, black	0	0	0	7	0	0	0	0	0	7 (±7)
cherry, black	0	0	7	0	0	0	0	0	0	7 (±7)
oak, southern red	0	0	0	0	7	0	0	0	0	7 (±7)
oak, northern red	0	0	0	0	0	0	0	0	7	7 (±7)
locust, black	0	0	0	7	0	0	0	0	0	7 (±7)
linden, American	0	7	0	0	0	0	0	0	0	7 (±7)
BDL OTHER	0	0	0	0	0	0	0	0	0	0
Total	14	14	50	64	78	50	28	0	7	305 (±54)
Broadleaf Deciduous Medium (BDM)										
persimmon, common	14	0	7	7	7	0	0	0	0	35 (±20)
maple, red	0	0	7	0	0	0	0	0	0	7 (±7)
BDM OTHER	0	0	0	0	0	0	0	0	0	0
Total	14	0	14	7	7	0	0	0	0	43 (±23)
Broadleaf Deciduous Small (BDS)										
dogwood, flowering	21	99	64	0	0	0	0	0	0	184 (±73)
redbud, eastern	7	14	43	0	0	0	0	0	0	64 (±39)
dogwood, Kousa	0	28	0	0	0	0	0	0	0	28 (±26)
cherry, Japanese flowering	7	0	0	0	0	0	0	0	0	7 (±7)
BDS OTHER	0	0	0	0	0	0	0	0	0	0
Total	35	142	106	0	0	0	0	0	0	283 (±114)
Broadleaf Evergreen Large (BEL)										
BEL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Broadleaf Evergreen Medium (BEM)										
BEM OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
BENI										
BENI OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Broadleaf Evergreen Small (BES)										
holly, American	0	0	7	0	0	0	0	0	0	7 (±7)
BES OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	7	0	0	0	0	0	0	7 (±7)
Conifer Evergreen Large (CEL)										
pine, Virginia	0	0	0	0	0	7	0	0	0	7 (±7)
CEL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	7	0	0	0	7 (±7)
Conifer Evergreen Medium (CEM)										

Population Summary of Public Trees

6/9/2011

Species	DBH Class (in)									Total Standard Error
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	
redcedar, eastern	7	0	7	0	0	0	0	0	0	14 (±13)
CEM OTHER	0	0	0	0	0	0	0	0	0	0
Total	7	0	7	0	0	0	0	0	0	14 (±13)
Conifer Evergreen Small (CES)										
CES OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
COFL										
COFL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
DRG ASSIGNED (FROM PRIOR ISTREETS)										
crapemyrtle, common	14	0	0	0	0	0	0	0	0	14 (±13)
DRG ASSIGNED (FROM P	0	0	0	0	0	0	0	0	0	0
Total	14	0	0	0	0	0	0	0	0	14 (±13)
ILOP										
ILOP OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
LA6										
LA6 OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Large (PEL)										
PEL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Medium (PEM)										
PEM OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Small (PES)										
PES OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
PRYE										
PRYE OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
QUPH										
QUPH OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
ULAL										
ULAL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Grand Total	85	156	184	71	85	57	28	0	7	673 (±154)

Knoxville

Annual Benefits of Public Trees by Species (\$/tree)

6/9/2011

Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$) Standard Error
oak, sawtooth	13.59	3.92	-4.99	34.57	76.40	123.48 (±76.68)
hackberry, common	12.86	3.51	-7.38	39.41	64.79	113.19 (±37.43)
planetree, London	22.01	5.71	-16.82	78.15	92.98	182.03 (±154.59)
dogwood, flowering	4.19	1.07	1.52	5.17	7.84	19.78 (±7.2)
pear, Callery	13.88	3.43	5.63	25.45	38.85	87.24 (±81.02)
maple, sugar	19.52	3.98	4.71	43.99	70.52	142.72 (±132.54)
tree of heaven	12.39	3.56	-5.60	34.45	69.10	113.90 (±72.07)
cherry, black	22.37	5.66	-19.20	84.57	89.91	183.30 (±95.43)
elm, American	6.01	1.99	2.19	14.81	39.78	64.79 (±38.05)
crapemyrtle, common	0.79	0.07	0.25	0.71	1.20	3.02 (±2.17)
unknown tree	8.10	2.37	-1.87	17.67	51.89	78.16 (±32.17)
sweetgum, American	18.04	3.93	-16.85	54.85	94.26	154.24 (±143.23)
mulberry, white	8.87	3.01	3.06	15.42	37.74	68.11 (±33.81)
maple, silver	21.38	6.03	5.98	50.17	81.00	164.56 (±152.81)
holly, American	5.50	1.23	3.28	9.10	7.86	26.96 (±17.06)
tuliptree	20.49	4.56	-19.36	62.70	108.72	177.11 (±112.07)
mulberry, red	8.99	2.67	-2.09	19.66	58.55	87.78 (±81.52)
cherry, Japanese flowe	3.70	0.48	1.23	4.65	14.89	24.96 (±23.18)
oak, pin	25.50	6.77	0.87	70.58	104.14	207.85 (±193.02)
OTHER STREET TRI	7.38	1.86	-4.13	23.30	34.08	62.50 (±141.6)

Knoxville**Total Annual Benefits, Net Benefits, and Costs for Public Trees**

6/9/2011

Benefits	Total (\$) Standard Error	\$/tree Standard Error	\$/capita Standard Error
Energy	14,891 (±3,586)	13.13 (±3.16)	13.24 (±3.19)
CO2	3,992 (±961)	3.52 (±0.85)	3.55 (±0.85)
Air Quality	-5,282 (±1,272)	-4.66 (±1.12)	-4.70 (±1.13)
Stormwater	40,790 (±9,824)	35.97 (±8.66)	36.26 (±8.73)
Aesthetic/Other	71,299 (±17,171)	62.87 (±15.14)	63.38 (±15.26)
Total Benefits	125,690 (±30,270)	110.84 (±26.69)	111.72 (±26.91)
Costs			
Planting	250	0.22	0.22
Contract Pruning	411	0.36	0.37
Pest Management	0	0.00	0.00
Irrigation	0	0.00	0.00
Removal	1,026	0.90	0.91
Administration	1,430	1.26	1.27
Inspection/Service	1,625	1.43	1.44
Infrastructure Repairs	331	0.29	0.29
Litter Clean-up	11,341	10.00	10.08
Liability/Claims	3	0.00	0.00
Other Costs	0	0.00	0.00
Total Costs	16,417	14.48	14.59
Net Benefits	109,273 (±30,270)	96.36 (±26.69)	97.13 (±26.91)
Benefit-cost ratio	7.66 (±1.84)		

Population Summary of Public Trees

6/9/2011

Species	DBH Class (in)									Total Standard Error
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	
COFL										
COFL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
DRG ASSIGNED (FROM PRIOR ISTREETS)										
crapemyrtle, common	22	7	0	0	0	0	0	0	0	29 (±21)
DRG ASSIGNED (FROM P	0	0	0	0	0	0	0	0	0	0
Total	22	7	0	0	0	0	0	0	0	29 (±21)
ILOP										
ILOP OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
LA6										
LA6 OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Large (PEL)										
PEL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Medium (PEM)										
PEM OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Small (PES)										
PES OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
PRYE										
PRYE OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
QUPH										
QUPH OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
ULAL										
ULAL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Grand Total	44	102	233	414	211	65	36	29	0	1,134 (±273)

Knoxville**Total Annual Benefits, Net Benefits, and Costs for Public Trees**

6/9/2011

Benefits	Total (\$) Standard Error	\$/tree Standard Error	\$/capita Standard Error
Energy	4,563 (±1,035)	9.83 (±2.23)	6.08 (±1.38)
CO2	1,299 (±295)	2.80 (±0.64)	1.73 (±0.39)
Air Quality	556 (±126)	1.20 (±0.27)	0.74 (±0.17)
Stormwater	11,611 (±2,633)	25.02 (±5.68)	15.46 (±3.51)
Aesthetic/Other	19,418 (±4,404)	41.85 (±9.49)	25.86 (±5.86)
Total Benefits	37,447 (±8,494)	80.70 (±18.31)	49.86 (±11.31)
Costs			
Planting	167	0.36	0.22
Contract Pruning	274	0.59	0.36
Pest Management	0	0.00	0.00
Irrigation	0	0.00	0.00
Removal	685	1.48	0.91
Administration	954	2.06	1.27
Inspection/Service	1,084	2.34	1.44
Infrastructure Repairs	221	0.48	0.29
Litter Clean-up	7,566	16.31	10.07
Liability/Claims	2	0.00	0.00
Other Costs	0	0.00	0.00
Total Costs	10,953	23.61	14.58
Net Benefits	26,494 (±8,494)	57.10 (±18.31)	35.28 (±11.31)
Benefit-cost ratio	3.42 (±0.78)		

Knoxville

Annual Benefits of Public Trees by Species (\$/tree)

6/9/2011

Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$) Standard Error
dogwood, flowering	3.80	0.98	1.38	4.63	7.49	18.28 (±7.42)
maple, silver	25.84	7.96	6.87	71.16	92.09	203.93 (±95.68)
cherry, black	8.29	2.48	-1.79	17.79	55.63	82.41 (±50.3)
crapemyrtle, common	1.29	0.16	0.43	1.26	2.78	5.91 (±4.37)
oak, white	16.02	4.95	0.94	55.10	98.75	175.76 (±129.92)
elm, American	13.38	4.39	4.93	32.93	47.89	103.52 (±54.02)
redbud, eastern	3.48	0.88	1.26	4.21	7.05	16.88 (±11.05)
holly, American	2.28	0.50	1.31	2.82	2.46	9.36 (±6.13)
cherry, Japanese flowe	2.32	0.23	0.77	2.69	11.77	17.79 (±16.87)
maple, Norway	8.91	2.09	2.43	12.60	51.01	77.05 (±73.04)
maple, red	14.35	3.49	3.55	34.50	87.49	143.38 (±135.92)
maple, sugar	17.45	3.65	4.45	33.17	70.54	129.27 (±122.55)
Pecan	12.52	3.63	-3.60	28.98	73.15	114.67 (±108.7)
Hawthorn	1.09	0.09	0.38	1.04	3.00	5.59 (±5.3)
redcedar, eastern	7.83	1.74	4.06	14.18	10.35	38.17 (±36.19)
sweetgum, American	0.62	0.05	0.13	0.64	6.89	8.33 (±7.9)
mulberry, white	8.49	2.35	2.91	13.14	34.65	61.56 (±58.36)
pine, eastern white	4.19	1.06	1.87	7.45	19.16	33.74 (±31.98)
sycamore, American	33.34	8.45	-30.65	132.29	123.58	267.01 (±253.12)
arborvitae, eastern	1.01	0.21	0.56	1.79	4.65	8.22 (±7.79)
OTHER STREET TRI	0.00	0.00	0.00	0.00	0.00	0.00 (±NaN)

Population Summary of Public Trees

6/9/2011

Species	DBH Class (in)									Total Standard Error
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	
COFL										
COFL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
DRG ASSIGNED (FROM PRIOR ISTREETS)										
crapemyrtle, common	10	30	0	0	0	0	0	0	0	39 (±29)
DRG ASSIGNED (FROM P	0	0	0	0	0	0	0	0	0	0
Total	10	30	0	0	0	0	0	0	0	39 (±29)
ILOP										
ILOP OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
LA6										
LA6 OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Large (PEL)										
PEL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Medium (PEM)										
PEM OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Small (PES)										
PES OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
PRYE										
PRYE OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
QUPH										
QUPH OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
ULAL										
ULAL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Grand Total	30	118	138	59	59	39	20	0	0	464 (±105)

Knoxville**Total Annual Benefits, Net Benefits, and Costs for Public Trees**

6/9/2011

Benefits	Total (\$) Standard Error	\$/tree Standard Error	\$/capita Standard Error
Energy	15,560 (±3,996)	10.79 (±2.77)	8.50 (±2.18)
CO2	4,176 (±1,073)	2.90 (±0.74)	2.28 (±0.59)
Air Quality	678 (±174)	0.47 (±0.12)	0.37 (±0.10)
Stormwater	40,756 (±10,467)	28.26 (±7.26)	22.26 (±5.72)
Aesthetic/Other	50,333 (±12,927)	34.90 (±8.96)	27.49 (±7.06)
Total Benefits	111,503 (±28,637)	77.33 (±19.86)	60.90 (±15.64)
Costs			
Planting	407	0.28	0.22
Contract Pruning	668	0.46	0.36
Pest Management	0	0.00	0.00
Irrigation	0	0.00	0.00
Removal	1,670	1.16	0.91
Administration	2,328	1.61	1.27
Inspection/Service	2,644	1.83	1.44
Infrastructure Repairs	539	0.37	0.29
Litter Clean-up	18,453	12.80	10.08
Liability/Claims	5	0.00	0.00
Other Costs	0	0.00	0.00
Total Costs	26,714	18.53	14.59
Net Benefits	84,789 (±28,637)	58.80 (±19.86)	46.31 (±15.64)
Benefit-cost ratio	4.17 (±1.07)		

Knoxville

Annual Benefits of Public Trees by Species (\$/tree)

6/9/2011

Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$) Standard Error
dogwood, flowering	3.54	0.89	1.28	4.28	7.05	17.05 (±4.93)
hemlock, eastern	8.28	1.92	4.57	16.08	9.62	40.47 (±36.39)
maple, sugar	25.48	4.81	5.45	73.79	70.38	179.90 (±79.65)
redbud, eastern	1.93	0.37	0.69	2.15	4.48	9.63 (±4.42)
maple, silver	22.23	6.94	5.90	60.55	79.85	175.47 (±80.54)
pear, Callery	3.73	1.02	1.44	5.22	13.90	25.30 (±24.2)
hackberry, common	24.97	6.84	-16.77	83.79	110.41	209.24 (±128.66)
elm, American	15.63	5.02	5.81	37.01	44.85	108.32 (±51.35)
persimmon, common	9.25	4.10	3.26	20.72	40.82	78.17 (±41.06)
tuliptree	19.17	4.24	-17.56	57.58	103.61	167.03 (±87.73)
mulberry, paper	6.12	1.56	2.08	8.89	26.94	45.59 (±43.61)
falsecypress, Japanese	7.83	1.74	4.06	14.18	10.35	38.17 (±36.51)
walnut, black	15.72	4.50	-6.67	42.49	84.29	140.33 (±92.61)
crapemyrtle, common	0.54	0.03	0.17	0.43	0.41	1.57 (±1.04)
pine, shortleaf	22.76	5.71	8.45	60.74	48.46	146.12 (±139.75)
poplar, Lombardy blac	0.34	0.02	0.17	0.36	1.60	2.49 (±2.38)
cherry, black	12.19	3.54	-5.16	33.17	69.69	113.44 (±74.87)
locust, black	10.41	2.94	-4.72	29.20	56.36	94.19 (±62.16)
OTHER STREET TRI	16.95	5.34	-4.17	56.19	61.44	135.76 (±548.21)

Population Summary of Public Trees

6/9/2011

Species	DBH Class (in)									Total Standard Error
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	
ACSA2										
ACSA2 OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Broadleaf Deciduous Large (BDL)										
maple, sugar	0	0	23	12	12	23	12	12	0	94 (±42)
maple, silver	0	0	12	23	12	0	35	0	0	82 (±38)
hackberry, common	0	0	0	0	12	47	0	0	0	59 (±36)
elm, American	0	0	12	12	23	12	0	0	0	59 (±28)
tuliptree	0	0	0	0	23	12	0	0	0	35 (±18)
walnut, black	0	0	0	12	12	0	0	0	0	23 (±15)
cherry, black	0	0	12	0	12	0	0	0	0	23 (±15)
locust, black	0	12	0	0	12	0	0	0	0	23 (±15)
BDL OTHER	12	0	0	12	0	12	12	12	0	59 (±23)
Total	12	12	59	70	117	106	59	23	0	457 (±132)
Broadleaf Deciduous Medium (BDM)										
persimmon, common	12	0	12	0	12	0	0	0	0	35 (±18)
mulberry, paper	0	12	12	0	0	0	0	0	0	23 (±22)
BDM OTHER	0	12	0	0	12	12	12	0	0	47 (±26)
Total	12	23	23	0	23	12	12	0	0	106 (±50)
Broadleaf Deciduous Small (BDS)										
dogwood, flowering	35	129	211	0	0	0	0	0	0	375 (±109)
redbud, eastern	47	23	12	0	0	0	0	0	0	82 (±38)
pear, Callery	12	12	47	0	0	0	0	0	0	70 (±67)
BDS OTHER	12	0	12	0	0	0	0	0	0	23 (±15)
Total	106	164	281	0	0	0	0	0	0	551 (±180)
Broadleaf Evergreen Large (BEL)										
BEL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Broadleaf Evergreen Medium (BEM)										
BEM OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
BENI										
poplar, Lombardy black	23	0	0	0	0	0	0	0	0	23 (±22)
BENI OTHER	0	0	0	0	0	0	0	0	0	0
Total	23	0	0	0	0	0	0	0	0	23 (±22)
Broadleaf Evergreen Small (BES)										
BES OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Conifer Evergreen Large (CEL)										
pine, shortleaf	0	0	0	0	12	12	0	0	0	23 (±22)
CEL OTHER	0	0	0	0	0	0	12	0	0	12 (±11)
Total	0	0	0	0	12	12	12	0	0	35 (±25)
Conifer Evergreen Medium (CEM)										
hemlock, eastern	0	0	59	59	82	0	0	0	0	199 (±179)
falsecypress, Japanese	0	0	0	23	0	0	0	0	0	23 (±22)
CEM OTHER	12	12	0	0	0	0	0	0	0	23 (±15)
Total	12	12	59	82	82	0	0	0	0	246 (±179)
Conifer Evergreen Small (CES)										
CES OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
COFL										

Population Summary of Public Trees

6/9/2011

Species	DBH Class (in)									Total Standard Error
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	
COFL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
DRG ASSIGNED (FROM PRIOR ISTREETS)										
crapemyrtle, common	23	0	0	0	0	0	0	0	0	23 (±15)
DRG ASSIGNED (FROM P	0	0	0	0	0	0	0	0	0	0
Total	23	0	0	0	0	0	0	0	0	23 (±15)
ILOP										
ILOP OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
LA6										
LA6 OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Large (PEL)										
PEL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Medium (PEM)										
PEM OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Small (PES)										
PES OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
PRYE										
PRYE OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
QUPH										
QUPH OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
ULAL										
ULAL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Grand Total	188	211	422	152	235	129	82	23	0	1,442 (±370)

Knoxville

Annual Benefits of Public Trees by Species (\$/tree)

6/9/2011

Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$) Standard Error
dogwood, flowering	3.44	0.85	1.25	4.16	6.79	16.49 (±3.36)
crapemyrtle, common	0.80	0.07	0.26	0.73	1.25	3.12 (±1.45)
maple, silver	28.03	8.99	7.26	82.23	95.02	221.52 (±163.4)
cypress, leyland	1.14	0.30	0.71	1.49	7.08	10.72 (±10.17)
holly, Chinese	2.07	0.44	1.19	2.61	2.46	8.77 (±5.72)
spruce, Colorado	5.35	1.21	2.82	10.03	9.11	28.51 (±15.78)
hemlock, eastern	4.88	1.09	2.57	9.01	8.31	25.85 (±14.31)
maple, Japanese	2.68	0.62	0.97	3.15	5.70	13.12 (±6.77)
dogwood, Kousa	1.46	0.22	0.52	1.53	3.75	7.48 (±3.86)
redcedar, eastern	7.72	1.78	4.24	14.93	9.52	38.19 (±19.73)
maple, red	21.24	6.32	4.78	64.97	114.27	211.58 (±137.97)
birch, river	8.49	2.35	2.91	13.14	34.65	61.56 (±40.14)
redbud, eastern	3.48	0.88	1.26	4.21	7.05	16.88 (±11.01)
hackberry, common	3.68	1.11	-0.14	6.36	30.62	41.64 (±27.16)
persimmon, common	4.56	1.21	1.56	6.95	20.77	35.04 (±22.85)
magnolia, saucer	2.93	0.68	1.05	3.47	5.91	14.04 (±9.16)
pear, Callery	8.32	2.13	3.26	13.23	26.25	53.19 (±34.69)
oak, southern red	39.28	10.06	-9.48	168.72	154.08	362.66 (±236.49)
oak, post	15.08	4.52	1.45	45.45	101.21	167.71 (±109.36)
OTHER STREET TRI	13.19	3.11	-1.82	34.10	44.29	92.87 (±142.97)

Knoxville**Total Annual Benefits, Net Benefits, and Costs for Public Trees**

6/9/2011

Benefits	Total (\$) Standard Error	\$/tree Standard Error	\$/capita Standard Error
Energy	6,877 (±1,037)	6.16 (±0.93)	2.42 (±0.36)
CO2	1,784 (±269)	1.60 (±0.24)	0.63 (±0.09)
Air Quality	1,267 (±191)	1.14 (±0.17)	0.45 (±0.07)
Stormwater	16,261 (±2,451)	14.57 (±2.20)	5.71 (±0.86)
Aesthetic/Other	22,353 (±3,369)	20.03 (±3.02)	7.85 (±1.18)
Total Benefits	48,542 (±7,317)	43.50 (±6.56)	17.06 (±2.57)
Costs			
Planting	632	0.57	0.22
Contract Pruning	1,039	0.93	0.37
Pest Management	0	0.00	0.00
Irrigation	0	0.00	0.00
Removal	2,596	2.33	0.91
Administration	3,618	3.24	1.27
Inspection/Service	4,111	3.68	1.44
Infrastructure Repairs	838	0.75	0.29
Litter Clean-up	28,687	25.71	10.08
Liability/Claims	8	0.01	0.00
Other Costs	0	0.00	0.00
Total Costs	41,529	37.21	14.59
Net Benefits	7,013 (±7,317)	6.28 (±6.56)	2.46 (±2.57)
Benefit-cost ratio	1.17 (±0.18)		

Population Summary of Public Trees

6/9/2011

Species	DBH Class (in)									Total Standard Error
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	
COFL										
COFL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
DRG ASSIGNED (FROM PRIOR ISTREETS)										
crapemyrtle, common	111	40	0	0	0	0	0	0	0	151 (±70)
DRG ASSIGNED (FROM P	0	0	0	0	0	0	0	0	0	0
Total	111	40	0	0	0	0	0	0	0	151 (±70)
ILOP										
ILOP OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
LA6										
LA6 OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Large (PEL)										
PEL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Medium (PEM)										
PEM OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Palm Evergreen Small (PES)										
PES OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
PRYE										
PRYE OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
QUPH										
QUPH OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
ULAL										
ULAL OTHER	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0 (±0)
Grand Total	231	312	332	131	30	30	30	10	10	1,116 (±168)



APPENDIX D – 2011 Tree Planting Specifications (Central Business Improvement District)

BID EVALUATION SHEET

Submit your total price for one installed tree of each species. All trees should be single-stem with central leader, either container grown or balled and burlapped.

1 ½" CALIPER TREES:

UNIT BID PRICE

<u>London Plane Tree</u> Plantanus acerifolia "Bloodgood"	_____
<u>Trident Maple</u> Acer buergeranum	_____
<u>Sugar Maple</u> Acer saccharum 'Green Mountain'	_____
<u>Red Maple,</u> Acer rubrum 'Autumn Flame'	_____
<u>Hedge Maple</u> Acer campestre	_____
<u>Shumard Oak</u> Quercus shumardii	_____
<u>Willow Oak</u> Quercus phellos	_____
<u>Pin Oak</u> Quercus palustris	_____
<u>Chestnut Oak</u> Quercus montana	_____
<u>Bur Oak</u> Quercus macrocarpa	_____
<u>English Oak</u> Quercus robur 'fastigiata'	_____

1 1/2" CALIPER TREES: (continued)

UNIT BID PRICE

Gingko (only male)

Gingko biloba

Black Gum

Nyssa sylvatica

Sweet Gum

Liquidambar styraciflua

Babylon Weeping Willow

Salix babylonica

Littleleaf Linden

Tilia cordata

Tulip Poplar

Liriodendrom tulipifera

Zelkova

Zelkova serrate 'Village Green'

Southern Magnolia

Magnolia grandiflora (branched to ground)

Sweet Bay Magnolia

Magnolia virginiana

Sycamore

Platanus occidentalis

Beech

Fagus grandifolia

Korean Dogwood

Cornus kousa

Redbud, White

Cercis canadensis 'alba'

1 1/2" CALIPER TREES: (continued)

UNIT BID PRICE

Sourwood

Oxydendron arboreum

Yoshino Cherry

Prunus xyedoensis

Bald Cypress

Taxodium distichum

Ash

Fraxinus excelsior

Loblolly Pine

Pinus taeda

Shortleaf Pine

Pinus echinata

Flowering Dogwood

Cornus florida 'Cherokee Chief'

Cornus florida 'Cherokee Princess'

Cornus florida 'Appalachian Spring'

Eastern Redbud

Cercis canadensis

Golden Raintree

Koelreutaria paniculata

White Pine

Pinus strobus

Honey Locust

Gleditsia triacanthos var. inermis

Serviceberry

Amelanchier arborea

Fringe Tree

Chionathus virginicus

1 1/2" CALIPER TREES: (continued)

UNIT BID PRICE

Quansan Cherry

Prunus serrulata

Foster Holly

Ilex X attenuata "Fosteri"

Weeping Cherry
Prunus x subhirtella var pendula

Japanese Maple
Acer palmatum

Japanese Black Pine
Pinus thunbergii

SHRUBS:

UNIT BID PRICE

Nellie R. Stevens' Holly
Ilex

Crapemyrtle
(balled & burlapped 4'-6' tall)
Assorted varieties

TOTAL

**CITY OF KNOXVILLE
PUBLIC SERVICE DEPARTMENT - HORTICULTURE SECTION
TREE PURCHASE AND INSTALLATION
BID SPECIFICATIONS**

Purpose

The City of Knoxville is seeking bids for the sale and installation of trees of varying species within the Central Business Improvement District which is broadly defined as the area between Neyland Drive/James White Parkway moving north to Depot Street, and from Henley Street moving east to Hall of Fame (see attached map). Total trees planted by the City will depend on the price per tree and location. Trees will be planted in tree wells and other urban street tree spaces within the CBID. All locations will be within the physical limits of the City of Knoxville. The City desires to contract with a company that will provide and plant trees using the following specifications:

Tree Installation Specifications

1. **Plant Materials:** All plant materials shall comply with the specifications set forth in the American Standard for Nursery Stock ANSI Z60, current edition. All plant materials must meet all phytosanitary, nursery inspection, pest freedom, plant regulation, certification, and all other legal requirements of the Tennessee Department of Agriculture Division of Regulatory Services. All nursery stock certificates, registration or certification tags, seals, etc. shall be furnished to the City of Knoxville Arborist when plants are installed. Plant materials shall be free of wounds and abrasions, and fresh pruning cuts shall be less than 1" in diameter. Only natural, self-decomposing materials shall be provided for balled and burlapped material.
2. **Tree Well Excavation:** The City of Knoxville will remove everything above the ground surface where a tree is currently planted. The contractor will assume the responsibility of removing the stump, tree roots, all other soil and any subsequent material in order to properly replant a new tree. The contractor will be responsible for the removal and proper disposal of the current soil in the tree wells and any other debris.
3. **Planting Hole:** Planting hole shall be excavated with sloped side 2 ½ - 3 times the diameter of the container or root ball. Mechanical diggers may be used but must be excavated with a hand tool to slope sides and scarify glazed surfaces. Planting holes shall be 1" to 2" higher than the surrounding soil and the bottom shall be undisturbed compacted soil. Before placing the root ball in the hole the contractor will be sure the depth of the hole is the same as, or slightly less than the distance between the topmost structural root and the bottom of the root ball. After watering in with 2/3 of the specified backfill in the hole, the remaining top 1/3 of burlap, twine, rope, and wire basket shall be cut, removed and discarded. If there is evidence of circling or girdling roots, they shall be cut and removed. All water and watering tools will be supplied by the contractor. Use of a KUB hydrant water meter is allowable.
4. **Backfill:** The contractor will furnish off-site borrow as planting soil for the trees that is freely draining and absent of subsoil, large stones, earth clods, sticks, stumps, clay lumps, roots or other objectionable, extraneous matter or debris. An inoculant comparable to Diehard by Horticultural Alliance shall be used per manufacturer instructions. Soil shall be a uniform blend of these components: 1) base topsoil 2) coarse and medium sands and 3) compost. The organic content shall be 5-7% by

weight. The soil's pH shall be neutral. Fertilizer shall be used at the soil surface at a composition and rate approved by the City Arborist. Thorough watering shall be provided at the time of installation. Proof the backfill meets these requirements shall be provided to the City Arborist.

5. **Staking:** Trees should not be staked unless necessary. If staking materials are installed, they should be removed after a reasonable period of time and before trunk girdling can occur. If staking materials are used, they must be approved by the City of Knoxville Arborist before installation.
6. **Mulch:** Mulch must be a well composted, temperature stabilized hardwood or recycled greenwaste material and shall not exceed 4" in length and ½" in width. No recycled woodwaste or dyed mulches shall be used. A 6' circle of mulch shall be installed where space allows and shall be 3" – 4" in depth, uniform in appearance and shall not touch tree trunk. Mulch shall be supplied by the contractor and shall be approved before installation by the City of Knoxville Arborist. Mulching and soil placement in pits must be completed in such a way that the pit area does not become a tripping hazard for pedestrians.
7. **Weather:** Trees will not be installed into wet sites, water-logged soils, or sites where precipitation has occurred within 72 hours unless approved by City of Knoxville Horticulture Services Manager. No tree shall be accepted with a frozen root ball.
8. **Tennessee One-Call System:** The contractor will be required to contact Tennessee One-Call at each job site and comply with all related directives for utilities.
9. **Work Zone Traffic Safety:** The contractor shall comply with all specifications and standards of the manual on Uniform Traffic Control Services for Streets and Highways (MUTCD).
10. **Inspection:** A City Horticulture Arborist or representative will be present when trees are installed. Weekend plantings shall be coordinated with the City arborist.
11. **Public Safety:** The contractor will be responsible for public safety at job sites. All contractor employees or subcontractor employees shall wear an ANSI reflective vest, shirt or jacket.
12. **Time Frame:** Planting time will be from February 1 through March 15.
13. **Warranty:** The contractor will warrant all trees for a period of one year after the date of provisional acceptance against defects including death and unsatisfactory growth in the opinion of the City Arborist and Public Service Director.
14. **Site Damage:** If the Contractor disturbs the infrastructure, including but not limited to grades, lawn areas, curbs, sidewalks, driveways, pavement, signage, plant material, water wells, backfilled and/or mulched areas, through the maintenance or installation operation, the damage shall be fixed immediately at no cost to the City.
15. **Clean Up:** Upon completion of work, the Contractor shall remove equipment, excess materials, tools, debris and rubbish from the site every day. All dirt and debris shall be legally disposed of by the Contractor. The work site shall be returned to a state

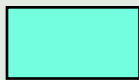
comparable to prior to work performed with any surrounding sidewalks broom swept and clean.

16. **Completion:** Upon completion of work, notify City Horticulture Inspector at least ten (10) days prior to requested date of inspection for provisional acceptance. Where inspected work does not comply with requirements, replace rejected work until re-inspected by City Inspector and found to be acceptable.
17. **Final Acceptance:** One year after provisional acceptance of the work in total, the City Inspector inspects the work for final acceptance. Upon satisfactory completion of repairs and/or replacements, the City Inspector certifies, in writing, the final acceptance of the work.
18. **Evaluations will be made based on the cost for installation of trees at each site specified using the suggested species. (See Bid Evaluation Sheet)**
19. The City of Knoxville reserves the right to waive or to reject any or all bids, to evaluate bids, and to accept any bid which, in its opinion, may be in the best interest of the City.
20. All bidders must be licensed contractors as required by the Contractors' Licensing Act of 1994, and all acts amendatory thereof.



APPENDIX E – Emerald Ash Borer and Thousand Cankers Disease Information

2011 Tennessee Emerald Ash Borer Quarantine



Emerald Ash Borer Quarantined Areas

(June 2011)

In Tennessee, EAB quarantines exist for **Blount, Knox and Loudon Counties**. The following are regulated articles:

- (a) Emerald Ash Borer; firewood of all hardwood (non-coniferous) species; nursery stock, green lumber, and other material living, dead, cut, or fallen, including logs, stumps, roots, branches, mulch and composted and uncomposted chips of the genus *Fraxinus*.
- (b) Any other article, product, or means of conveyance not listed in paragraph (a) of this section may be designated as a regulated article if the Commissioner determines that it presents a risk of spreading Emerald Ash Borer and notifies the person in possession of the article, product, or means of conveyance that it is subject to these regulations.



**RULES
OF
THE TENNESSEE DEPARTMENT OF AGRICULTURE
DIVISION OF REGULATORY SERVICES**

**CHAPTER 0080-06-10
EMERALD ASH BORER QUARANTINE**

TABLE OF CONTENTS

0080-06-10-.01	Establishment and Purpose of Quarantine	0080-06-10-.06	Issuance and Cancellation of certificates
0080-06-10-.02	Definitions	0080-06-10-.07	Compliance Agreements and Cancellation
0080-06-10-.03	Regulated Articles	0080-06-10-.08	Assembly and Inspection of Regulated Articles
0080-06-10-.04	Quarantined Areas	0080-06-10-.09	Attachment and Disposition of Certificates and Limited Permits
0080-06-10-.05	Conditions Governing the Movement of Regulated Articles from Quarantined Areas	0080-06-10-.10	Penalties

0080-06-10-.01 ESTABLISHMENT AND PURPOSE OF QUARANTINE.

- (1) The destructive pest known as Emerald Ash Borer (*Agrilus planipennis*) is established in other states and has been found in Tennessee. This pest can be extremely injurious to Tennessee's ash trees (genus *Fraxinus*) and ash nursery stock. Therefore, it would be in the best interest of Tennessee's citizens, agriculture and silviculture that a quarantine be established against it.
- (2) A quarantine is hereby established to regulate the movement of those articles that pose a significant threat of spreading Emerald Ash Borer.

Authority: T.C.A. §§ 43-6-104 and 43-6-106(9). **Administrative History:** Original Rule filed June 5, 1974. Repeal filed September 13, 2001; effective January 28, 2002. Emergency rule filed August 6, 2010; effective through February 2, 2011.

0080-06-10-.02 DEFINITIONS.

- (1) "Commissioner" means the commissioner of the Tennessee Department of Agriculture, or any individual authorized to act for the commissioner.
- (2) "Certificate" means a document that is issued for a regulated article by the commissioner or by a person operating under a compliance agreement and that represents that such article is eligible for movement in accordance with 7 C.F.R. § 301.53-5(a).
- (3) "Compliance agreement" means a written agreement between the Tennessee Department of Agriculture, the United States Department of Agriculture - Animal and Plant Health Inspection Service and a person engaged in growing, handling, or moving regulated articles, in which the person agrees to comply with the provisions of this chapter and any conditions imposed under this chapter. Any authority granted to the holder of a compliance agreement shall only pertain to articles owned by such holder.
- (4) "Emerald Ash Borer" means the insect known as Emerald Ash Borer (*Agrilus planipennis* [Coleoptera: Buprestidae]) in any stage of development.
- (5) "Infestation" means the presence of Emerald Ash Borer or the existence of circumstances that make it reasonable to believe that Emerald Ash Borer is present.

(Rule 0800-06-10-.02, continued)

- (6) "Limited permit" means a document in which the commissioner or a person operating under a compliance agreement affirms that a regulated article belonging to that person that is not eligible for a certificate can be moved only to a specified destination and in accordance with conditions specified on the permit. Any authority granted to the holder of a limited permit shall only pertain to articles owned by such holder.
- (7) "Moved" (movement, move) means shipped, offered for shipment, received for transportation, transported, carried, or allowed to be moved, shipped, transported, or carried.
- (8) "Person" means any association, company, corporation, firm, individual, joint stock company, partnership, society, or any other legal entity.
- (9) "Quarantined area" means an area that has been placed under quarantine, as determined by the Tennessee Department of Agriculture.
- (10) "Regulated article" means an article capable of harboring or carrying Emerald Ash Borer, as determined herein.

Authority: T.C.A. §§ 43-6-104 and 43-6-106. **Administrative History:** Original Rule filed June 5, 1974. Repeal filed September 13, 2001; effective January 28, 2002. Emergency rule filed August 6, 2010; effective through February 2, 2011.

0080-06-10-.03 REGULATED ARTICLES.

- (1) The following are regulated articles:
 - (a) Emerald Ash Borer; firewood of all hardwood (non-coniferous) species; nursery stock, green lumber, and other material living, dead, cut, or fallen, including logs, stumps, roots, branches, mulch and composted and uncomposted chips of the genus *Fraxinus*.
 - (b) Any other article, product, or means of conveyance not listed in paragraph (a) of this section may be designated as a regulated article if the commissioner determines that it presents a risk of spreading Emerald Ash Borer and notifies the person in possession of the article, product, or means of conveyance that it is subject to these regulations.

Authority: T.C.A. §§ 43-6-104 and 43-6-106. **Administrative History:** Original Rule filed June 5, 1974. Repeal filed September 13, 2001; effective January 28, 2002. Emergency rule filed August 6, 2010; effective through February 2, 2011.

0080-06-10-.04 QUARANTINED AREAS.

- (1) The following areas in Tennessee are designated as quarantined areas:
 - (a) Knox County – The entire county.
 - (b) Loudon County – The entire county.
 - (c) Other counties where the Emerald Ash Borer is found to be present by the commissioner, or counties determined by the commissioner to be at high risk for the presence of Emerald Ash Borer. Such counties shall be conspicuously posted on the department's website at <http://state.tn.us/agriculture/regulatory/plants.html>.

Authority: T.C.A. §§ 43-6-104 and 43-6-106(9). **Administrative History:** Original Rule filed June 5, 1974. Repeal filed September 13, 2001; effective January 28, 2002. Emergency rule filed August 6, 2010; effective through February 2, 2011.

(Rule 0080-06-10-.08, continued)

0080-06-10-.05 CONDITIONS GOVERNING THE MOVEMENT OF REGULATED ARTICLES FROM QUARANTINED AREAS.

Regulated articles may be moved from a quarantined area only if moved:

- (1) With a certificate or limited permit issued and attached in accordance with 7 C.F.R. § 301.53–5 and 7 C.F.R. § 301.53–8;
- (2) Without a certificate or limited permit and:
 - (a) The regulated article is moved by the United States Department of Agriculture for experimental or scientific purposes; or
 - (b) The regulated article originates outside the quarantined area and is moved through the quarantined area under the following conditions:
 1. The points of origin and destination are indicated on a document accompanying the regulated article; and
 2. The regulated article, if moved through the quarantined area during the period of April 1 through September 30 or when the ambient air temperature is 40 °F or higher, is moved in an enclosed vehicle or is completely covered to prevent access by Emerald Ash Borer; and
 3. The regulated article is moved directly through the quarantined area without stopping (except for refueling or for traffic conditions, such as traffic lights or stop signs), or has been stored, packed, or handled at locations approved by the commissioner as not posing a risk of infestation by Emerald Ash Borer; and
 4. The article has not been combined or commingled with other articles so as to lose its individual identity.

Authority: T.C.A. §§ 43-6-104 and 43-6-106. **Administrative History:** Original Rule filed June 5, 1974. Repeal filed September 13, 2001; effective January 28, 2002. Emergency rule filed August 6, 2010; effective through February 2, 2011.

0080-06-10-.06 ISSUANCE AND CANCELLATION OF CERTIFICATES.

- (1) The commissioner or a person operating under a compliance agreement may issue a certificate for the movement of a regulated article if he or she determines that the regulated article:
 - (a) Is apparently free of Emerald Ash Borer, based on inspection; or
 - (b) Has been grown, produced, manufactured, stored, or handled in a manner that, in the judgment of the commissioner and based on an inspection, prevents the regulated article from presenting a risk of spreading Emerald Ash Borer; and
 - (c) Is to be moved in compliance with any additional emergency conditions that the commissioner may impose in order to prevent the artificial spread of Emerald Ash Borer; and
 - (d) Is eligible for unrestricted movement under all other federal domestic plant quarantines and regulations applicable to the regulated articles.

(Rule 0080-06-10-.08, continued)

- (2) The commissioner or a person operating under a compliance agreement may issue a limited permit for the movement of a regulated article not eligible for a certificate if he determines that the regulated article:
 - (a) Is to be moved to a specified destination for specific processing, handling, or use (the destination and other conditions to be listed on the limited permit), and this movement will not result in the spread of Emerald Ash Borer because the pest will be destroyed by the specific processing, handling, or use; and
 - (b) Is to be moved in compliance with any additional emergency conditions that the commissioner may impose in order to prevent the spread of Emerald Ash Borer; and
 - (c) Is eligible for unrestricted movement under all other federal domestic plant quarantines and regulations applicable to the regulated article.
- (3) The commissioner may issue blank certificates and limited permits to a person operating under a compliance agreement in accordance with 7 C.F.R. § 301.53–6, or may authorize the reproduction of blank certificates and limited permits for use on shipping containers. These certificates and limited permits may then be completed and used for the movement of regulated articles as needed, provided such articles meet all of the requirements of paragraph (1) or (2) of this section.
- (4) Any certificate or limited permit may be canceled orally or in writing by the commissioner whenever he determines that the holder of the certificate or limited permit has not complied with this chapter. If the cancellation is oral, the cancellation will become effective immediately, and the cancellation and the reasons for the cancellation will be confirmed in writing as soon as circumstances permit.

Authority: T.C.A. §§ 43-6-104 and 43-6-106. **Administrative History:** Original Rule filed June 5, 1974. Repeal filed September 13, 2001; effective January 28, 2002. Emergency rule filed August 6, 2010; effective through February 2, 2011.

0080-06-10-.07 COMPLIANCE AGREEMENTS AND CANCELLATION.

- (1) Persons engaged in growing, handling, or moving regulated articles may enter into a compliance agreement if such persons review with the commissioner each provision of the compliance agreement. Any person who enters into a compliance agreement with the Tennessee Department of Agriculture must agree to comply with the provisions of this chapter.
- (2) Any compliance agreement may be canceled orally or in writing by the commissioner whenever the commissioner determines that the person who has entered into the compliance agreement has not complied with this chapter or any conditions imposed under this chapter. If the cancellation is oral, the cancellation will become effective immediately, and the cancellation and the reasons for the cancellation will be confirmed in writing as soon as circumstances permit.

Authority: T.C.A. §§ 43-6-104 and 43-6-106. **Administrative History:** Original Rule filed June 5, 1974. Repeal filed September 13, 2001; effective January 28, 2002. Emergency rule filed August 6, 2010; effective through February 2, 2011.

0080-06-10-.08 ASSEMBLY AND INSPECTION OF REGULATED ARTICLES.

- (1) Persons requiring certification or other services shall request the services from the commissioner at least 48 hours before the regulated article is to be moved.

(Rule 0080-06-10-.08, continued)

- (2) The regulated articles must be assembled at the place and in the manner that the commissioner designates as necessary to comply with this chapter.

Authority: T.C.A. §§ 43-6-104 and 43-6-106. **Administrative History:** Original Rule filed June 5, 1974. Repeal filed September 13, 2001; effective January 28, 2002. Emergency rule filed August 6, 2010; effective through February 2, 2011.

0080-06-10-.09 ATTACHMENT AND DISPOSITION OF CERTIFICATES AND LIMITED PERMITS.

- (1) A regulated article must be plainly marked with the name and address of the consignor and the name and address of the consignee and must have the certificate or limited permit issued for the movement of a regulated article securely attached at all times during movement to:
 - (a) The regulated article;
 - (b) The container carrying the regulated article; or
 - (c) The consignee's copy of the accompanying document, provided that the description of the regulated article on the certificate or limited permit, and on the document, are sufficient to identify the regulated article; and
- (2) The carrier must furnish the certificate or limited permit authorizing movement of a regulated article to the consignee at the destination of the shipment.

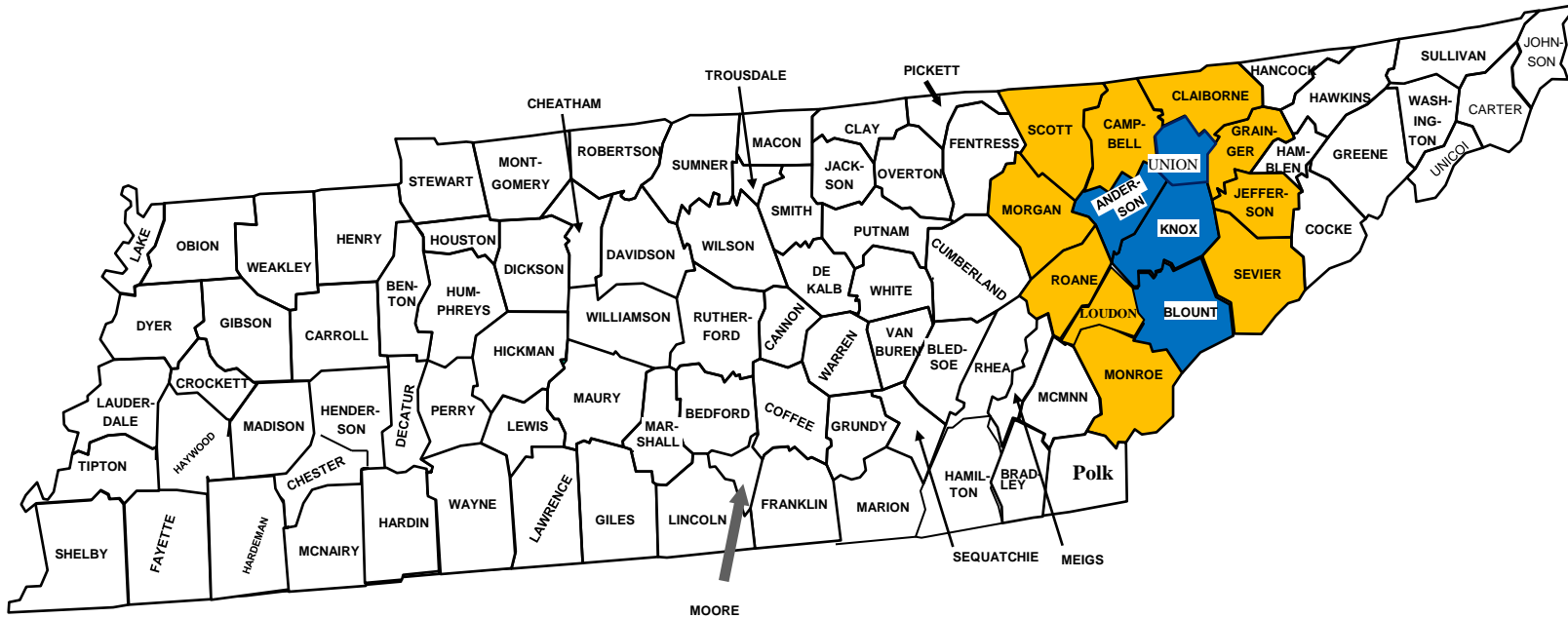
Authority: T.C.A. §§ 43-6-104 and 43-6-106. **Administrative History:** Original Rule filed June 5, 1974. Repeal filed September 13, 2001; effective January 28, 2002. Emergency rule filed August 6, 2010; effective through February 2, 2011.

0080-06-10-.10 PENALTIES.

Any person who violates any of the provisions of this chapter is subject to civil and criminal penalties pursuant to Chapter 0080-06-25 and T.C.A. § 43-6-112, respectively.

Authority: T.C.A. §§ 4-3-204, 43-6-104, 43-6-106 and 43-6-112. **Administrative History:** Original Rule filed June 5, 1974. Repeal filed September 13, 2001; effective January 28, 2002. Emergency rule filed August 6, 2010; effective through February 2, 2011.

2010 Tennessee TCD Quarantine



Thousand Cankers Disease September 2010 Quarantined Areas

Anderson, Blount, Knox, Union



Thousand Cankers Disease Buffer Regulated Areas

**Campbell, Claiborne, Grainger, Jefferson
Loudon, Monroe, Morgan, Roane, Scott,
Sevier**

**RULES
OF
TENNESSEE DEPARTMENT OF AGRICULTURE**

**CHAPTER 0080-06-11
THOUSAND CANKERS QUARANTINE**

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0080-06-11-.01 ESTABLISHMENT AND PURPOSE OF QUARANTINE.

- (1) The destructive pest complex known as Thousand Cankers Disease (*Pityophthorus juglandis* and *Geosmithia morbida*) is established in other states and has been found in Tennessee. This disease can be extremely injurious to Tennessee's walnut trees (genus *Juglans*) and walnut nursery stock. Therefore, it would be in the best interest of Tennessee's citizens, agriculture and silviculture that quarantine be established against it.
- (2) A quarantine is hereby established to regulate the movement of those articles that pose a significant threat of spreading Thousand Cankers Disease.

Authority: T.C.A. §43-6-104, 43-6-106 and 43-6-106(9). **Administrative History:** Original rule certified June 5, 1974. Repeal filed September 17, 2008; effective January 28, 2009. Emergency rule filed September 1, 2010; effective through February 28, 2011.

0080-06-11-.02 DEFINITIONS.

- (1) "Commissioner" means the commissioner of the Tennessee Department of Agriculture, or any individual authorized to act for the commissioner.
- (2) "Certificate" means a document that is issued for a regulated article by the commissioner or by a person operating under a compliance agreement which represents that such article is eligible for movement in accordance with this chapter.
- (3) "Compliance agreement" means a written agreement between the Tennessee Department of Agriculture and a person engaged in growing, handling, or moving regulated articles, in which the person agrees to comply with the provisions of this chapter and any conditions imposed under this chapter. Any authority granted to the holder of a compliance agreement shall only pertain to articles owned by such holder.
- (4) "Thousand Cankers Disease" means the insect vector *Pityophthorus juglandis* in any stage of development and the fungus *Geosmithia morbida* sp. nov.
- (5) "Infestation" means the presence of Thousand Cankers Disease or the existence of circumstances that make it reasonable to believe that Thousand Cankers Disease is present.
- (6) "Limited movement permit" means a document in which the commissioner or a person operating under a compliance agreement affirms that a regulated article that is not eligible for

(0080-06-11-.02, continued)

a certificate can be moved only to a specified destination and in accordance with conditions specified on the permit. Any authority granted to the holder of a limited permit shall only pertain to articles owned by such holder.

- (7) "Moved" (movement, move) means shipped, offered for shipment, received for transportation, transported, carried, or allowed to be moved, shipped, transported, or carried.
- (8) "Person" means any association, company, corporation, firm, individual, joint stock company, partnership, society, or any other legal entity.
- (9) "Quarantined area" means an area that has been placed under quarantine, as determined by the Tennessee Department of Agriculture.
- (10) "Regulated article" means an article capable of harboring or carrying Thousand Cankers Disease, as determined herein.
- (11) "Regulated buffer area" means a county in Tennessee whose boundary touches the boundary of a county that is under quarantine for Thousand Cankers Disease.

Authority: T.C.A. §43-6-104 and 43-6-106. **Administrative History:** Original rule certified June 5, 1974. Amendment filed and effective January 11, 1975. Amendment filed May 16, 1975; effective June 15, 1975. Amendment filed January 23, 1995; effective May 31, 1995. Amendment filed September 11, 1998; effective January 28, 1999. Repeal filed September 17, 2008; effective January 28, 2009. Emergency rule filed September 1, 2010; effective through February 28, 2011.

0080-06-11-.03 REGULATED ARTICLES.

- (1) The following are regulated articles:
 - (a) The Walnut Twig Beetle, *Pityophthorus juglandis*, in any living stage of development;
 - (b) The fungal pathogen *Geosmithia morbida*.
 - (c) Firewood of any non-coniferous (hardwood) species.
 - (d) All plants and plant parts of the genus *Juglans* including but not limited to nursery stock, budwood, scionwood, green lumber, and other material living, dead, cut, or fallen, including logs, stumps, roots, branches, mulch and composted and uncomposted chips.
 - (e) Any article, product, or means of conveyance when it is determined by the Commissioner to present the risk of spread of the Walnut Twig Beetle, *Pityophthorus juglandis*, or the fungal pathogen, *Geosmithia morbida* sp. nov. and the commissioner notifies the person in possession of the article, product, or means of conveyance that it is subject to these regulations.
 - (f) Specific exceptions are nuts, nut meats, hulls, processed lumber (one hundred percent (100%) bark-free, kiln-dried with squared edges), and finished wood products without bark, including walnut furniture, instruments, and gun stocks derived from the genus *Juglans*.

Authority: T.C.A. §43-6-104 and 43-6-106. **Administrative History:** Original rule certified June 5, 1974. Repeal filed September 17, 2008; effective January 28, 2009. Emergency rule filed September 1, 2010; effective through February 28, 2011.

0080-06-11-.04 QUARANTINED AREAS.

- (1) The following areas in Tennessee are designated as quarantined areas:
- (a) Knox County – The entire county.
 - (b) Blount County – The entire county.
 - (c) Other counties where the thousand cankers disease is found to be present by the commissioner, or counties determined by the commissioner to be at high risk for the presence of thousand cankers disease. Such counties shall be conspicuously posted on the department's website at <http://state.tn.us/agriculture/regulatory/plants.html>.

Authority: T.C.A. §43-6-104, 43-6-106 and 43-6-106(9). **Administrative History:** Original rule certified June 5, 1974. Repeal filed September 17, 2008; effective January 28, 2009. Emergency rule filed September 1, 2010; effective through February 28, 2011.

0080-06-11-.05 REGULATED BUFFER AREAS.

- (1) The following counties in Tennessee are designated as regulated buffer areas:
- (a) Anderson – the entire county.
 - (b) Grainger – the entire county.
 - (c) Jefferson – the entire county.
 - (d) Loudon – the entire county.
 - (e) Monroe – the entire county.
 - (f) Sevier – the entire county.
 - (g) Union – the entire county.
 - (h) Other counties in Tennessee whose boundary touches the boundary of a quarantined county for the presence of Thousand Cankers Disease. Such counties shall be conspicuously posted on the department's website at <http://state.tn.us/agriculture/regulatory/plants.html>.

Authority: T.C.A. §43-6-104 and 43-6-106. **Administrative History:** Original rule certified June 5, 1974. Repeal filed September 17, 2008; effective January 28, 2009. Emergency rule filed September 1, 2010; effective through February 28, 2011.

0080-06-11-.06 MOVEMENT OF REGULATED ARTICLES FROM QUARANTINED AREAS.

- (1) Regulated articles may be moved from and through a quarantined area only if moved:
- (a) With a certificate or limited permit issued and attached in accordance with this chapter.
 - (b) Without a certificate or limited permit only when the regulated article originates outside the quarantined area and is moved through the quarantined area under the following conditions:

(0080-06-11-.06, continued)

1. The points of origin and destination are indicated on a document accompanying the regulated article; and
2. The regulated article is moved directly through the quarantined area without stopping (except for refueling or for traffic conditions, such as traffic lights or stop signs), or has been stored, packed, or handled at locations approved by the commissioner as not posing a risk of infestation by Thousand Cankers Disease; and
3. The article has not been combined or commingled with other articles so as to lose its individual identity.

Authority: T.C.A. §43-6-104 and 43-6-106. **Administrative History:** Original rule certified June 5, 1974. Repeal filed September 17, 2008; effective January 28, 2009. Emergency rule filed September 1, 2010; effective through February 28, 2011.

0080-06-11-.07 MOVEMENT OF REGULATED ARTICLES FROM REGULATED BUFFER AREAS.

- (1) Regulated articles may be moved from and through a regulated buffer area only if moved:
 - (a) With a certificate or limited permit issued and attached in accordance with this chapter.
 - (b) Without a certificate or limited permit only when:
 1. The regulated article originates outside the quarantined or other regulated buffer area and is moved through the regulated buffer area under the following conditions:
 - (i) The points of origin and destination are indicated on a document accompanying the regulated article; and
 - (ii) The regulated article is moved directly through the regulated buffer area without stopping (except for refueling or for traffic conditions, such as traffic lights or stop signs), or has been stored, packed, or handled at locations approved by the commissioner as not posing a risk of infestation by Thousand Cankers Disease; and
 - (iii) The article has not been combined or commingled with other articles so as to lose its individual identity; or
 2. The regulated article is moved directly to a quarantined area or directly to another regulated buffer area.

Authority: T.C.A. §43-6-104 and 43-6-106. **Administrative History:** Original rule certified June 5, 1974. Repeal filed September 17, 2008; effective January 28, 2009. Emergency rule filed September 1, 2010; effective through February 28, 2011.

0080-06-11-.08 ISSUANCE AND CANCELLATION OF CERTIFICATES.

- (1) The commissioner or a person operating under a compliance agreement may issue a certificate for the movement of a regulated article if he or she determines that the regulated article:
 - (a) Is apparently free of Thousand Cankers Disease, based on inspection; or

(0080-06-11-.08, continued)

- (b) Has been grown, produced, manufactured, stored, or handled in a manner that, in the judgment of the commissioner, prevents the regulated article from presenting a risk of spreading Thousand Cankers Disease; and
 - (c) Is to be moved in compliance with any additional emergency conditions that the commissioner may impose in order to prevent the artificial spread of Thousand Cankers Disease; and
- (2) The commissioner or a person operating under a compliance agreement may issue a limited movement permit for the movement of a regulated article not eligible for a certificate if he determines that the regulated article:
- (a) Is to be moved to a specified destination for specific processing, handling, or use (the destination and other conditions to be listed on the limited permit), and this movement will not result in the spread of Thousand Cankers Disease because the pathogen will be destroyed by the specific processing, handling, or use; and
 - (b) Is to be moved in compliance with any additional emergency conditions that the commissioner may impose in order to prevent the spread of Thousand Cankers Disease; and
- (3) The commissioner may issue blank certificates and limited permits to a person operating under a compliance agreement in accordance with this chapter or authorize reproduction of the certificates or limited permits on shipping containers, or both, as requested by the person operating under the compliance agreement. These certificates and limited permits may then be completed and used, as needed, for the movement of regulated articles marketed by such person that have met all of the requirements of paragraph (1) or (2) of this section.
- (4) Any certificate or limited permit may be canceled orally or in writing by the commissioner whenever he determines that the holder of the certificate or limited permit has not complied with this chapter. If the cancellation is oral, the cancellation will become effective immediately, and the cancellation and the reasons for the cancellation will be confirmed in writing as soon as circumstances permit.

Authority: T.C.A. §43-6-104 and 43-6-106. **Administrative History:** Original rule certified June 5, 1974. Repeal filed September 17, 2008; effective January 28, 2009. Emergency rule filed September 1, 2010; effective through February 28, 2011.

0080-06-11-.09 COMPLIANCE AGREEMENTS AND CANCELLATION.

- (1) Persons engaged in growing, handling, or moving regulated articles may enter into a compliance agreement if such persons review with the commissioner each provision of the compliance agreement. Any person who enters into a compliance agreement with the Tennessee Department of Agriculture must agree to comply with the provisions of this chapter.
- (2) Any compliance agreement may be canceled orally or in writing by the commissioner whenever the commissioner determines that the person who has entered into the compliance agreement has not complied with this chapter or any conditions imposed under this chapter. If the cancellation is oral, the cancellation will become effective immediately, and the cancellation and the reasons for the cancellation will be confirmed in writing as soon as circumstances permit.

Authority: T.C.A. §43-6-104 and 43-6-106. **Administrative History:** Original rule certified June 5, 1974. Repeal filed September 17, 2008; effective January 28, 2009. Emergency rule filed September 1, 2010; effective through February 28, 2011.

0080-06-11-.10 ASSEMBLY AND INSPECTION OF REGULATED ARTICLES.

- (1) Persons requiring certification, requesting a limited movement permit, or requesting other similar services shall request the services from the commissioner at least 48 hours before the regulated article is to be moved.
- (2) The regulated articles must be assembled at the place and in the manner that the commissioner designates as necessary to comply with this chapter.

Authority: T.C.A. §43-6-104 and 43-6-106. **Administrative History:** Original rule certified June 5, 1974. Repeal filed September 17, 2008; effective January 28, 2009. Emergency rule filed September 1, 2010; effective through February 28, 2011.

0080-06-11-.11 ATTACHMENT AND DISPOSITION OF CERTIFICATES AND LIMITED MOVEMENT PERMITS.

- (1) A regulated article must be plainly marked with the name and address of the consignor and the name and address of the consignee and must have the certificate or limited movement permit issued for the movement of a regulated article securely attached at all times during movement to:
 - (a) The regulated article;
 - (b) The container carrying the regulated article; or
 - (c) The consignee's copy of the accompanying document, provided that the description of the regulated article on the certificate or limited movement permit, and on the document, are sufficient to identify the regulated article; and
- (2) The carrier must furnish the certificate or limited movement permit authorizing movement of a regulated article to the consignee at the destination of the shipment.

Authority: T.C.A. §§ 43-6-104 and 43-6-106. **Administrative History:** Emergency rule filed September 1, 2010; effective through February 28, 2011.

0080-06-11-.12 PROHIBITED ENTRY INTO TENNESSEE.

- (1) Regulated articles from the areas listed below are prohibited entry into Tennessee.
 - (a) Arizona
 - (b) California
 - (c) Colorado
 - (d) Idaho
 - (e) Nevada
 - (f) New Mexico
 - (g) Oregon
 - (h) Utah

(0080-06-11-.12, continued)

- (i) Washington
 - (j) Any other area of the United States where federal or state plant regulatory officials have determined Thousand Cankers Disease to be present.
- (2) The only exception to this prohibition is when a permit for the movement of any regulated article is issued by the commissioner for research purposes only. At a minimum, in order to receive such permit, the regulated article must be inspected at the point of origin, a state phytosanitary certificate must be issued by the state plant regulatory official in the state of origin, and notice that the article will be shipped to Tennessee must be given to the Tennessee Department of Agriculture, Plant Certification Section, at least twenty-four (24) hours prior to shipment.

Authority: T.C.A. §§ 43-6-104 and 43-6-106. **Administrative History:** Emergency rule filed September 1, 2010; effective through February 28, 2011.

0080-06-11-.13 PENALTIES.

Any person who violates any of the provisions of this chapter is subject to civil and criminal penalties pursuant to Chapter 0080-6-25 and T.C.A. § 43-6-112, respectively. Regulated articles transported in violation of this quarantine may be destroyed, or returned to the point of origin, at the discretion of the commissioner. The cost of such destruction or return shall be borne by the violator.

Authority: T.C.A. §§ 4-3-204, 43-6-104, 43-6-106 and 43-6-112. **Administrative History:** Emergency rule filed September 1, 2011; effective through February 28, 2011.