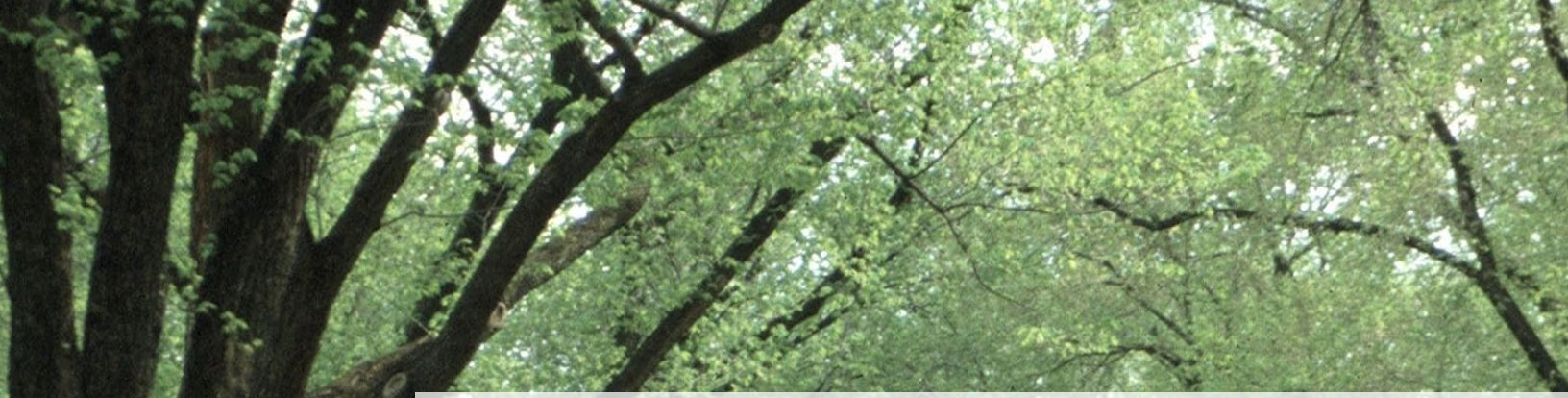

Street Tree Assessment Report

Culpeper, Virginia

Overview

Street trees are a vital community asset that enhance our day-to-day lives and mitigate many of the negative impacts of urbanization. In 2010, a sample street tree inventory was conducted in Culpeper, Virginia to assess tree abundance, composition, functional benefits, and monetary value. Trees residing within the right-of-way along 23% of public streets were surveyed to determine their species, size, condition, and placement. Inventory data were collected by Virginia Tech for this assessment report. The inventory data were analyzed using i-Tree Streets assessment software developed by the U.S. Forest Service.

Key Findings

- Culpeper has an estimated 1,734 street trees.
- Culpeper's five most abundant street tree species are red maple, flowering dogwood, eastern white pine, sugar maple, and Leyland cypress.
- Each year, Culpeper's street trees intercept about 2.6 million gallons of rainfall and sequester over 370 thousand pounds of carbon dioxide.
- In total, Culpeper's street trees provide over $94 thousand in benefits annually or roughly $55 per tree.
- The replacement value of Culpeper's street trees is estimated at about $3.5 million.

Prepared by Virginia Tech
Department of Forest Resources and Environmental Conservation

http://urbanforestry.frec.vt.edu/

arborist@vt.edu

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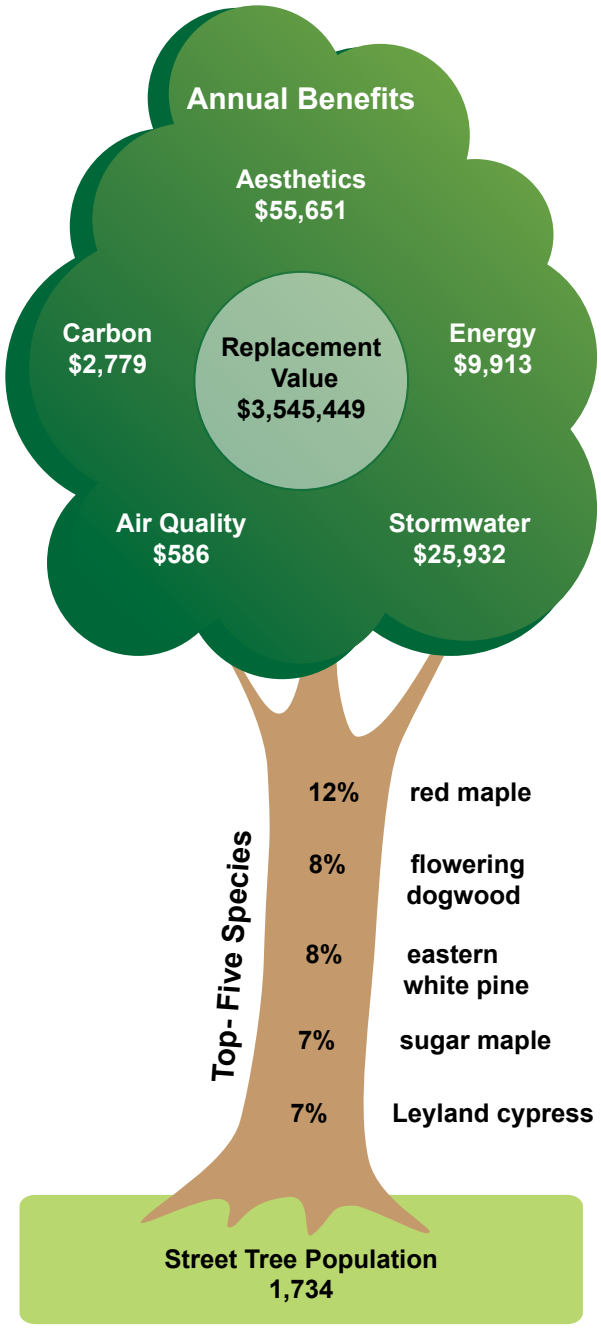
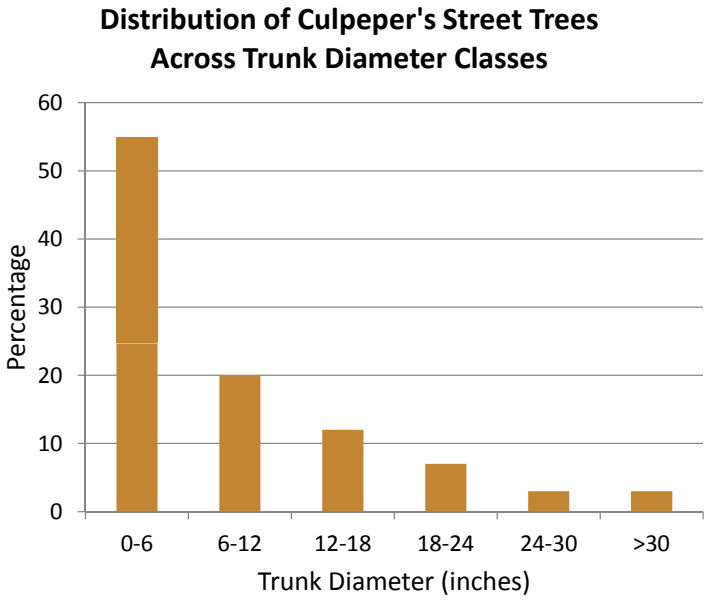
Street Tree Abundance and Composition

Culpeper's estimated street tree population is 1,734. Culpeper's street trees provide about 17 acres of canopy, which cover roughly 0.4% of the land area. The five most abundant species are red maple (12%), flowering dogwood (8%), eastern white pine (8%), sugar maple (7%), and Leyland cypress (7%). The most important species (accounting for leaf area and canopy cover in addition to tree count) include eastern white pine (12%), red maple (8%), sugar maple (7%), black cherry (7%), and flowering dogwood (4%).

Large-stature, broadleaf deciduous trees are the most common tree form amongst Culpeper's street trees, but are nearly equaled by small-stature, broadleaf deciduous trees. About 75% of Culpeper's street trees are smaller than 12 in. trunk diameter while about 3% are larger than 30 in. The majority of Culpeper's street trees (~90%) were rated in fair to good condition.





Relative abundance of Culpeper's street trees by foliage type and mature height class.

Foliage Type	Small (< 25')	Medium (25 - 45')	Large (> 45')	Total	% of Total
Broadleaf Deciduous	476	362	481	1,319	**76**
Broadleaf Evergreen	66	4	0	70	**4**
Conifer Evergreen	0	49	296	345	**20**
Total	**542**	**415**	**777**	**1,734**	**100**
% of Total	**31**	**24**	**45**	**100**	

Street Tree Benefits and Value

Gross annual benefits provided by Culpeper's street trees are valued at $94,861. These benefits come from contributions that street trees make to real estate aesthetics, rainfall interception, energy conservation, air pollution reduction, and CO_2 sequestration. Each year, Culpeper's street trees intercept roughly 2.6 million gallons of rainfall, conserve a combined 86 megwatt-hour of electricity and 3,213 therms of natural gas for home cooling and heating, absorb 2,494 pounds of air pollution, and remove about 370 thousand pounds of carbon from the atmosphere. In addition, Culpeper's street trees currently store about 4 million pounds of carbon, which is valued at over $30 thousand.

On a per-tree basis, the most beneficial tree species are black cherry ($183 per year), pin oak ($168 per year), black walnut ($123 per year), Norway maple ($113 per year), and eastern white pine ($104 per year). These values reflect the large size that these trees have attained, providing abundant leaf area and canopy cover. The average street tree provides about $55 in gross benefits annually. Gross benefits do not account for annual costs associated with planting, maintenance, or removal, which were not available for this analysis.

The replacement value of Culpeper's street trees is estimated at $3,545,449. This is the value of street trees as a structural asset, and reflects the cost to replant trees in a quantity sufficient to replace their current level of functional benefits. Because a large street tree produces the same amount of benefits as numerous nursery-sized trees, replacing a large tree would require significant resources that may not be feasible due to both spatial and budgetary constraints.

Gross annual benefits provided by Culpeper's street trees.

Benefit Type	Resource Units	Total $	Avg. $/Tree
Aesthetic enhancements	–	55,651	32.11
Rainfall Interception (gallons)	2,619,175	25,932	14.96
Energy Conservation[1]	–	9,913	5.72
Electricity (MWh)	86	6,552	–
Natural Gas (therms)	3,213	3,361	–
Air Pollution reduction (lb)[2]	2,494	586	0.34
CO_2 sequestration (lb)[3]	370,472	2,779	1.60
Total Benefits	**–**	**94,861**	**54.73**

[1]Sum of electricity and natural gas conservation.

[2]Net pollution reduction (O3, NO2, PM10, and SO2) accounting for pollutant deposition, pollutant avoidance, and BVOC emissions. Note, if Resource Units value is negative, BVOC emissions exceeded pollution reduction. If only total $ is negative, then BVOC pricing exceeded pollutant pricing, but pollution reduction still occurred.

[3]Net sequestration accounting for gross tree sequestration, tree decomposition emissions, and tree maintenance machinery emissions.

Street Tree Opportunities

Culpeper has a highly valuable street tree population. To sustain this resource and its benefits, the town should continue to focus on planting diverse, functional species and maintaining trees to ensure their health, safety, and appearance. Urban forestry experts generally recommend that a municipal tree population comprise no more than 10% of a single species and 20% of a single genus in order to minimize impacts of pest outbreaks and other species-specific disorders. At 12% of the total street tree population, red maple is above the species threshold. Similarly, the maple genus comprises approximately 21% of the street tree population. Although maples are proven performers, planting efforts should temper their use to ensure the diversity and heath of Culpeper's street trees.

One of the most noxious pests threatening Virginia's street trees is emerald ash borer, an insect introduced from Asia that has killed millions of native ash trees in the United States. Fortunately, native ash species comprise just 2.8% of Culpeper's street trees and account for only 1.1% of the street tree canopy cover. However, Culpeper must remain vigilant in managing street tree diversity because there is ongoing risk of unforeseen introduction of noxious tree pests into the United States.

About 30% of Culpeper's street tree population comprises small-stature species such as flowering dogwood, which make a substantially smaller contribution to annual benefits than large-maturing trees. For example, the average pin oak in Culpeper provides over 8 times the gross annual benefits of the average flowering dogwood. While dogwood is an attractive, resilient species, preference should be given to planting large-maturing trees whenever landscape conditions allow.

The size distribution of Culpeper's street trees suggests a stable age structure. Because street trees inevitably grow old and die or must be removed to accommodate land use changes, an ample number of young trees must always exist in order to sustain street tree benefits. The fact that the two diameter classes that encompass the largest percentage of the total street tree population are the 0-6 and 6-12 inch diameter classes, respectively, is a source of optimism. However, there are relatively few trees greater than 18 inch diameter, which may indicate that street trees are failing to reach maturity or large-stature species have not been adequately planted in the past. Ongoing planting efforts, with particular focus on large stature, highly functional tree species, should be taken to ensure a high level of benefits will be provided by Culpeper's street trees for the future.

This assessment has reported gross benefits of Culpeper's street trees, which may not fully reflect the true value of this vital resource. Direct and indirect costs of administering and managing street trees can vary considerably based on species composition, tree size distribution, and other local environmental and economic factors. Therefore, findings of this report should be carefully interpreted in the context of local circumstances that impact tree benefits and costs.

About This Report

This report was co-authored by Eric Wiseman and Julia Bartens with the Department of Forest Resources and Environmental Conservation at Virginia Tech. Report layout and design by Sarah Gugercin.

This report was made possible through grants from the Virginia Department of Forestry and the U.S. Forest Service. Technical assistance was graciously provided by the Davey Resource Group.

Inventory data were analyzed using i-Tree Streets assessment software version 4.0.4. Benefit estimates were based on i-Tree modeling data from the Charlotte, North Carolina reference city in the South Climate Zone. The 2010 median home price, used to calculate street tree aesthetic benefits for Culpeper was $251,200 as reported by the U.S. Census Bureau in http://quickfacts.census.gov/qfd/index.html. Additional information about methods used in this street tree assessment can be found on our website.

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