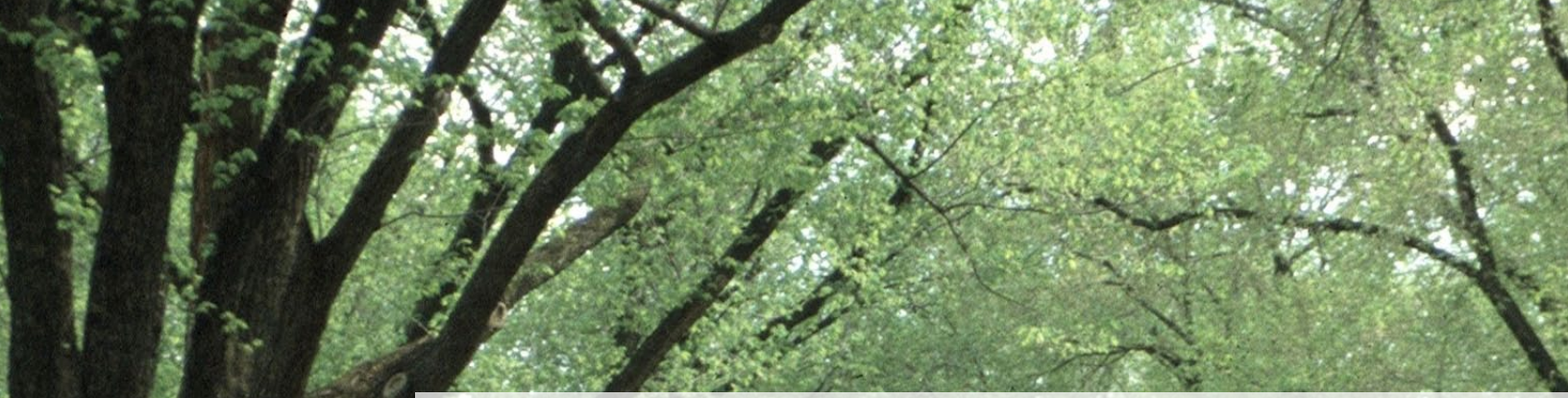

Street Tree Assessment Report

Roanoke, 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 2008, a sample street tree inventory was conducted in Roanoke, Virginia to assess tree abundance, composition, functional benefits, and monetary value. Trees residing within the right-of-way along 5% 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

- Roanoke has an estimated 43,371 street trees.
- Roanoke's five most abundant street tree species are sugar maple, flowering dogwood, Siberian elm, Callery pear, and eastern white pine.
- Each year, Roanoke's street trees intercept about 107 million gallons of rainwater and sequester over 14 million pounds of carbon dioxide.
- In total, Roanoke's street trees provide about $2.6 million in benefits annually or roughly $60 per tree.
- The replacement value for Roanoke's street trees is estimated at over $33 million.

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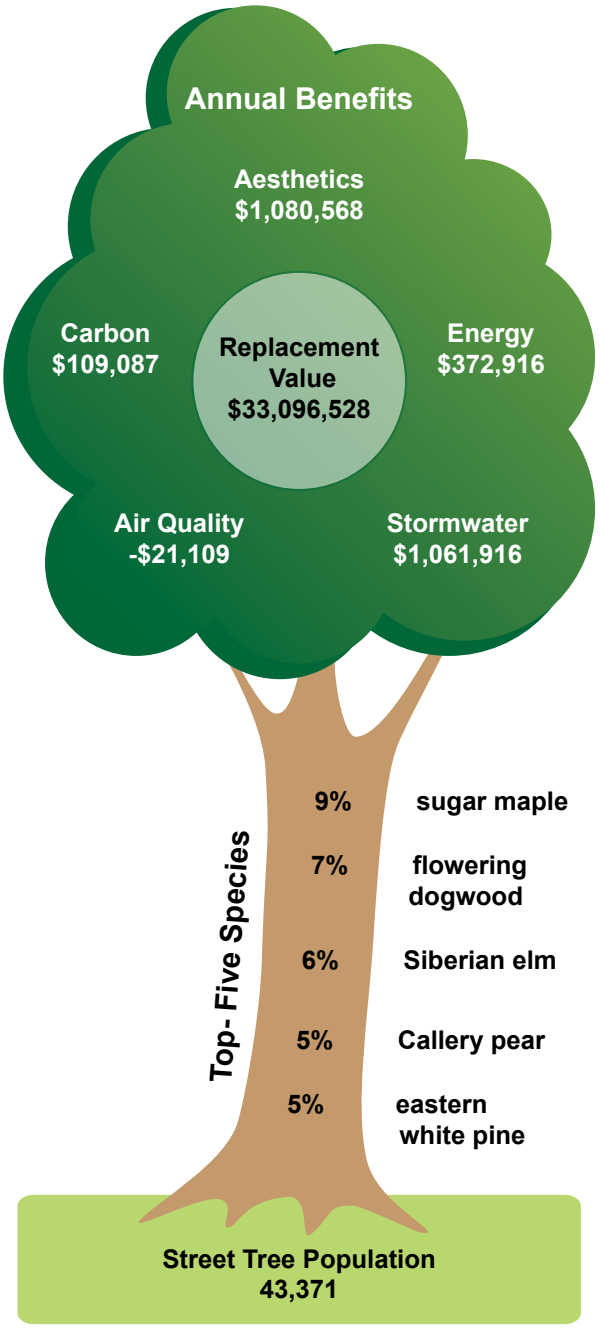
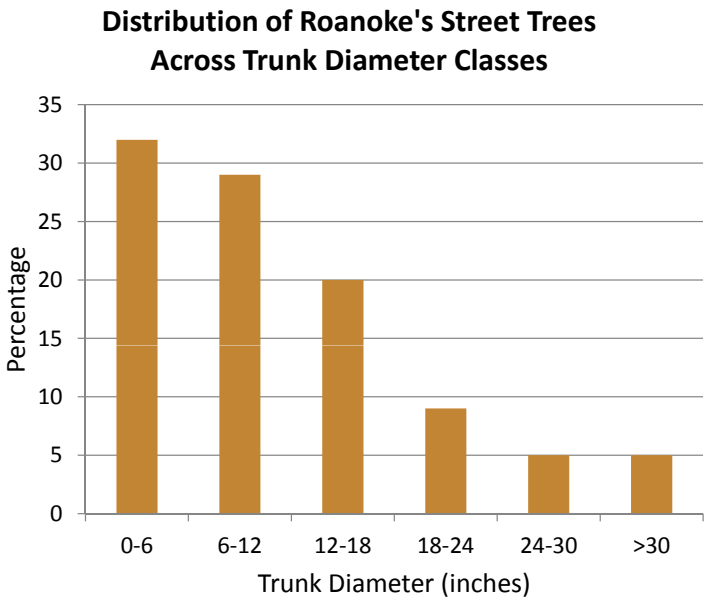
Street Tree Abundance and Composition

Roanoke's estimated street tree population is 43,371. Roanoke's street trees provide about 656 acres of canopy, which cover roughly 2.4% of Roanoke's land area. The five most abundant species are sugar maple (9%), flowering dogwood (7%), Siberian elm (6%), Callery pear (5%), and eastern white pine (5%). The most important species (accounting for leaf area and canopy cover in addition to tree count) include sugar maple (14%), Siberian elm (7%), white ash (5%), Norway maple (5%), and eastern white pine (5%).

Large-stature, broadleaf deciduous trees are the most common tree form amongst Roanoke's street trees. Over 60% of Roanoke's street trees are smaller than 12 in. trunk diameter while less than 5% are larger than 30 in. The majority of Roanoke's street trees (~85%) were rated in fair to good condition.





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

Foliage Type	Small (< 25')	Medium (25 - 45')	Large (> 45')	Total	% of Total
Broadleaf Deciduous	7,417	7,862	19,705	34,984	81
Broadleaf Evergreen	2,506	162	0	2,668	6
Conifer Evergreen	707	2,344	2,668	5,719	13
Total	**10,630**	**10,368**	**22,373**	**43,371**	**100**
% of Total	**25**	**24**	**51**	**100**	

Street Tree Benefits and Value

Gross annual benefits provided by Roanoke's street trees are valued at $2,603,378. 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, Roanoke's street trees intercept roughly 107 million gallons of rainfall, conserve a combined 3,290 megawatt-hour of electricity and 118 thousand therms of natural gas for home cooling and heating, and remove about 14 million pounds of carbon from the atmosphere. In addition, Roanoke's street trees currently store about 168 million pounds of carbon, which is valued at over $1.2 million. Although Roanoke's street trees have a net positive impact on air pollution – removing over 11,000 pounds of pollutants annually –its current mix of tree species heavily emits biogenic volatile organic compounds (BVOCs), which results in a negative monetary value for pollution reduction.

On a per-tree basis, the most beneficial tree species are silver maple ($152 per year), white ash ($147 per year), London planetree ($145 per year), sweetgum ($126 per year), and littleleaf linden ($111 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 $60 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 Roanoke's street tree population is estimated at $33,096,528. 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 Roanoke's street trees.

Benefit Type	Resource Units	Total $	Avg. $/Tree
Aesthetic enhancements	–	1,080,568	24.91
Rainfall Interception (gallons)	107,256,774	1,061,916	24.48
Energy Conservation[1]	–	372,916	8.60
Electricity (MWh)	3,290	249,690	–
Natural Gas (therms)	117,807	123,226	–
Air Pollution reduction (lb)[2]	11,457	-21,109	-0.49
CO_2 sequestration (lb)[3]	14,544,916	109,087	2.52
Total Benefits	**–**	**2,603,378**	**60.02**

[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

Roanoke has a highly valuable street tree population. To sustain this resource and its benefits, the city 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 9% of the street tree population, sugar maple is nearing the species threshold. Collectively, maple species account for 23% of the street trees. Although maples are proven performers, planting efforts should temper their use to ensure the diversity and heath of Roanoke'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 2.6% of Roanoke's street trees and account for only 5.5% of the street tree canopy cover. However, Roanoke 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 75% of Roanoke's street tree population comprises medium- and large-stature species such as maple and oak. This is a favorable distribution given that larger trees provide higher levels of benefits, yet presence of overhead utility lines may require planting of small-stature tree species in certain places to minimize power disruptions and pruning costs.

The size distribution of Roanoke'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, 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 Roanoke's street trees for the future.

Roanoke's street trees comprise a number of species that produce large amounts of BVOCs, which are precursors to ground-based ozone. Heavy emitters of BVOCs in Roanoke include white ash, sweetgum, and London planetree. Roanoke should consider planting more low-BVOC street trees such as gingko, linden, and certain maples if maximizing air quality benefits is a key community objective. However, this planting strategy should not compromise efforts to maximize canopy cover or species diversity. Urban forestry experts generally believe that trees have a net positive impact on air quality, regardless of BVOC emissions, by lowering air temperature and reducing fossil fuel combustion in urban areas.

This assessment has reported gross benefits of Roanoke'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.

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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 Roanoke was $128,700 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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