

Street Tree Assessment Report

Waynesboro, 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 2004, a partial street tree inventory was conducted in Waynesboro, Virginia to assess tree abundance, composition, functional benefits, and monetary value. In this partial inventory, all street trees located within the public right-of-way on designated "Tree Streets" were inventoried (see end of report for a listing of these streets) to determine their species, size, condition, and placement. Inventory data were provided by Waynesboro for this assessment report. The inventory data were then analyzed using i-Tree Streets assessment software developed by the U.S. Forest Service.

Key Findings

- Waynesboro has an estimated 254 street trees residing on "Tree Streets".
- Waynesboro's five most abundant species are Norway maple, red maple, flowering dogwood, sugar maple, and Callery pear.
- Each year, Waynesboro's street trees intercept over 656 thousand gallons of rainfall and sequester about 92 thousand pounds of carbon dioxide.
- In total, Waynesboro's street trees provide about \$19 thousand in benefits annually or roughly \$76 per tree.
- The replacement value of Waynesboro's tree-street trees is estimated at about \$490 thousand.

Prepared by Virginia Tech
Department of Forest Resources and
Environmental Conservation

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

arborist@vt.edu

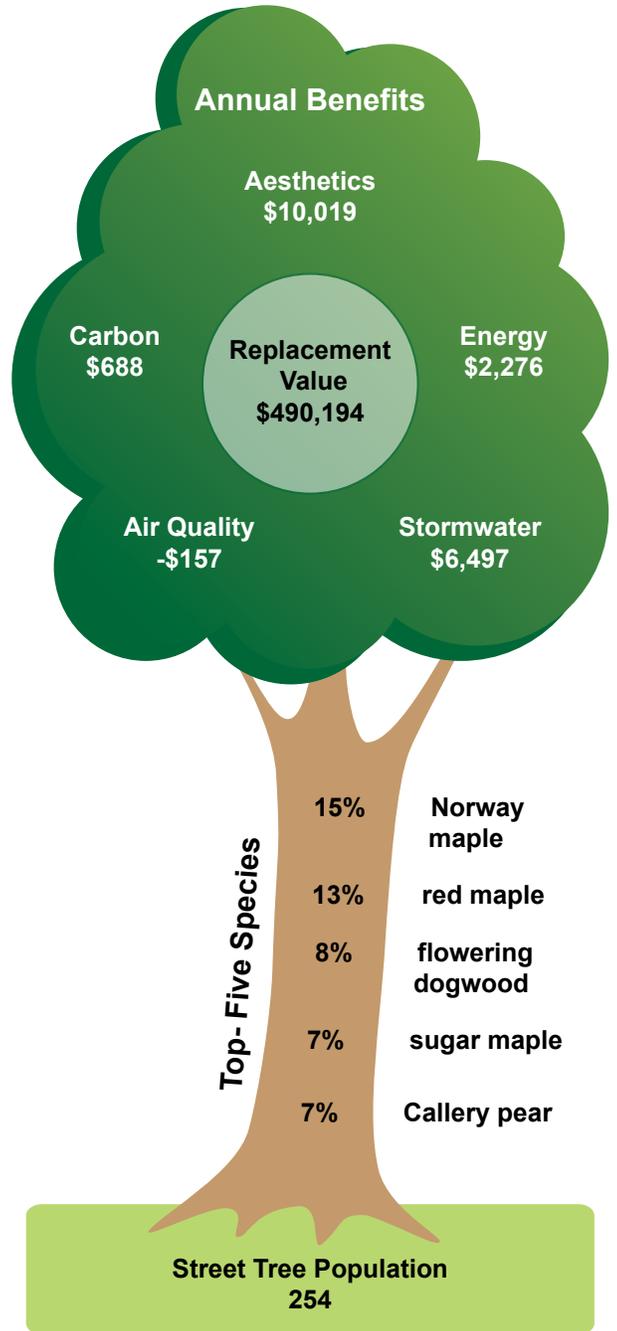
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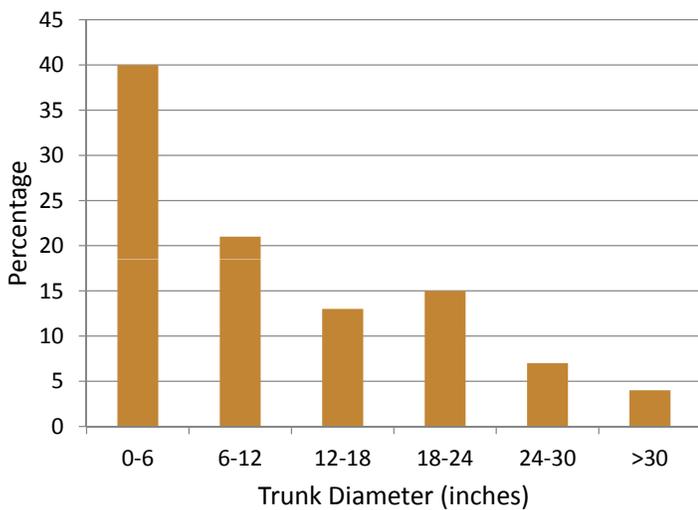
Street Tree Abundance and Composition

Waynesboro’s estimated street tree population is 254. Waynesboro’s street trees provide about 4 acres of canopy. The five most abundant species are Norway maple (15%), red maple (13%), flowering dogwood (8%), sugar maple (7%), and Callery pear (7%). The most important species (accounting for leaf area and canopy cover in addition to tree count) include Norway maple (29%), northern red oak (11%), silver maple (10%), red maple (9%), and sugar maple (8%).

Large-stature, broadleaf deciduous trees are the most common tree form amongst Waynesboro’s street trees. About 60% of Waynesboro’s street trees are smaller than 12 in. trunk diameter while less than 5% are larger than 30 in. The majority of Waynesboro’s street trees (~92%) were rated in poor condition.



Distribution of Waynesboro's Street Trees Across Trunk Diameter Classes



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

Foliage Type	Small (< 25')	Medium (25 - 45')	Large (> 45')	Total	% of Total
Broadleaf Deciduous	64	69	109	242	95
Broadleaf Evergreen	2	0	0	2	1
Conifer Evergreen	1	0	9	10	4
Total	67	69	118	254	100
% of Total	26	27	47	100	

Street Tree Benefits and Value

Gross annual benefits provided by Waynesboro’s street trees are valued at \$19,323. These benefits come from contributions that street trees make to real estate aesthetics, rainfall interception, energy conservation, air pollution reduction, and CO₂ sequestration. Each year, Waynesboro’s street trees intercept roughly 656 thousand gallons of rainfall, conserve a combined 20 megawatt-hour of electricity and 731 therms of natural gas for home cooling and heating, and remove about 92 thousand pounds of carbon from the atmosphere. In addition, Waynesboro’s street trees currently store over 1 million pounds of carbon, which is valued at over \$7,600. Although Waynesboro’s street trees have a net positive impact on air pollution – removing over 63 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 (\$165 per year), Norway

maple (\$162 per year), tulip poplar (\$161 per year), Northern red oak (\$155 per year), and black walnut (\$124 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 \$76 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 Waynesboro’s tree-street trees is estimated at \$490,194. 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 Waynesboro's street trees.

Benefit Type	Resource Units	Total \$	Avg. \$/Tree
Aesthetic enhancements	–	10,019	39.44
Rainfall Interception (gallons)	656,184	6,497	25.58
Energy Conservation ¹	–	2,276	8.96
Electricity (MWh)	20	1,512	–
Natural Gas (therms)	731	764	–
Air Pollution reduction (lb) ²	63	-157	-0.62
CO ₂ sequestration (lb) ³	91,685	688	2.71
Total Benefits	–	10,019	39.44

¹Sum of electricity and natural gas conservation.

²Net 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.

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

Street Tree Opportunities

Waynesboro 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. Both Norway maple (15%) and red maple (13%) exceed the species threshold. Flowering dogwood is also approaching the threshold at 8% abundance. Collectively, maple species account for over 30% of the street trees. Although maples are proven performers, planting efforts should temper their use to ensure the diversity and health 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, no native ash street trees were tallied during the inventory, suggesting that ash trees are absent or in very low abundance in Waynesboro. No native ash trees should be planted for the foreseeable future due to the presence of ash borer throughout Virginia.

About 74% of Waynesboro'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 relative size distribution of Waynesboro's tree-street trees suggests a stable age structure. Because tree-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, with only 8% of the surveyed trees in good or fair condition, tree planting and maintenance efforts need to be increased to improve the health and stability of Waynesboro's street trees. Priority should be given to planting large stature, highly functional tree species to ensure a high level of benefits will be provided by Waynesboro's tree-street trees for the future.

Waynesboro's tree-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 Waynesboro include tulip poplar and black walnut. Waynesboro should consider planting more low-BVOC street trees such as ginkgo, 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 Waynesboro's tree-street trees, which may not fully reflect the true value of this vital resource. Direct and indirect costs of administering and managing tree-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 Waynesboro was \$169,700 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](#).

"Tree Streets" included the following: Cedar Ave, Cherry Ave, Chestnut Ave, Laurel Ave, Linden Ave, Locust Ave, Magnolia Ave, Maple Ave, Oak Ave, Pine Ave, Poplar Ave, and Walnut Ave.

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