

Street Tree Assessment Report

Fredericksburg, 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 Fredericksburg, Virginia to assess tree abundance, composition, functional benefits, and monetary value. Trees residing within the right-of-way along 10% 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

- Fredericksburg has an estimated 20,792 street trees.
- Fredericksburg's five most abundant street tree species are red maple, sweetgum, Virginia pine, sugar maple, and crapemyrtle.
- Each year, Fredericksburg's street trees intercept over 33 million gallons of rainfall and sequester about 5 million pounds of carbon dioxide.
- In total, Fredericksburg's street trees provide about \$1.7 million in benefits annually or roughly \$83 per tree.
- The replacement value of Fredericksburg's street trees is estimated at about \$49 million.

*Prepared by Virginia Tech
Department of Forest Resources and
Environmental Conservation*

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

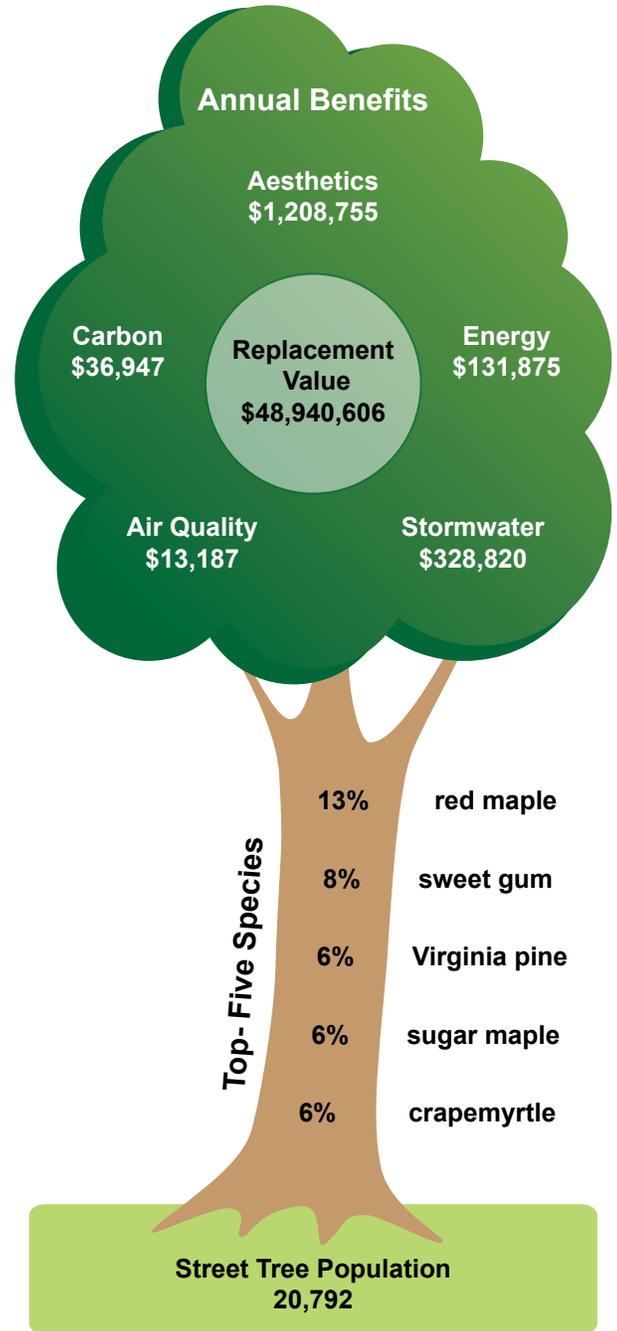
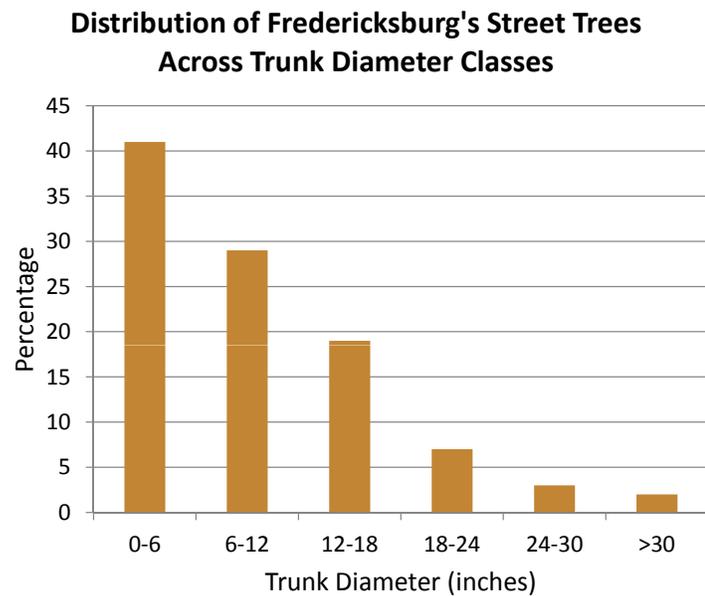
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Street Tree Abundance and Composition

Fredericksburg’s estimated street tree population is 20,792. Fredericksburg’s street trees provide about 226 acres of canopy, which cover roughly 3.4% of the land area. The five most abundant species are red maple (13%), sweetgum (8%), Virginia pine (6%), sugar maple (6%), and crapemyrtle (6%). The most important species (accounting for leaf area and canopy cover in addition to tree count) include red maple (15%), sugar maple (14%), sweetgum (5%), willow oak (5%), and Callery pear (4%).

Large-stature, broadleaf deciduous trees are the most common tree form amongst Fredericksburg’s street trees. About 70% of Fredericksburg’s street trees are smaller than 12 in. trunk diameter while less than 3% are larger than 30 in. The majority of Fredericksburg’s street trees (~86%) were rated in fair to good condition.



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

Foliage Type	Small (< 25')	Medium (25 - 45')	Large (> 45')	Total	% of Total
Broadleaf Deciduous	3,768	4,302	8,553	16,623	80
Broadleaf Evergreen	1,212	41	0	1,253	6
Conifer Evergreen	21	2,475	420	2,916	14
Total	5,001	6,818	8,973	20,792	100
% of Total	24	33	43	100	

Street Tree Benefits and Value

Gross annual benefits provided by Fredericksburg's street trees are valued at \$1,719,584. 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, Fredericksburg's street trees intercept roughly 33 million gallons of rainfall, conserve a combined 1,144 megawatt-hour of electricity and 43 thousand therms of natural gas for home cooling and heating, absorb 7,257 pounds of air pollution, and remove about 4.9 million pounds of carbon from the atmosphere. In addition, Fredericksburg's street trees currently store nearly 44 million pounds of carbon, which is valued at over \$334 thousand.

On a per-tree basis, the most beneficial tree species are white oak (\$214 per year), sugar maple (\$191 per year), American sycamore (\$155 per year),

northern Hackberry (\$150 per year), and willow oak (\$145 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 \$83 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 Fredericksburg's street trees is estimated at \$48,940,606. 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 Fredericksburg's street trees.

Benefit Type	Resource Units	Total \$	Avg. \$/Tree
Aesthetic enhancements	–	1,208,755	58.14
Rainfall Interception (gallons)	33,211,843	328,820	15.81
Energy Conservation ¹	–	131,875	6.34
Electricity (MWh)	1144	86,803	–
Natural Gas (therms)	43,090	45,072	–
Air Pollution reduction (lb) ²	7,257	13,187	0.63
CO ₂ sequestration (lb) ³	4,926,232	36,947	1.78
Total Benefits	–	1,719,584	82.70

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

Fredericksburg 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 13% of the total street tree population, red maple is above the species threshold. Collectively, the maple genus comprises approximately 25% of the street tree population in Fredericksburg. Planting efforts should temper the use of maple species to ensure the diversity and health of Fredericksburg'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 1.24% of Fredericksburg's street trees and account for only 1.08% of the street tree canopy cover. However, Fredericksburg 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 Fredericksburg'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 Fredericksburg'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 Fredericksburg's street trees for the future.

This assessment has reported gross benefits of Fredericksburg'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 Fredericksburg was \$335,800 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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