

Climate Change & Missoula's Urban Forests

2016 Tree Canopy Assessment



Adapted by Becca Boslough, Climate Smart Missoula
from 'An Assessment of Missoula's Urban Canopy' by Chris Carlson,
Missoula Department of Parks and Recreation

Spring 2016



About this project

Missoula's early investment in a healthy urban forest helped our city claim the nickname the Garden City, and our community has since reaped the rewards. The trees that line our streets and backyards can help us adapt to climate change, cool us during the summer heat, filter pollutants from the atmosphere, reduce energy bills, and provide habitat for birds and critters to co-exist with us.

Missoula's urban forest faces a number of challenges. Older neighborhoods have aging trees that demand attention and replacement. Trees in newer neighborhoods require care to reach their full potential. In-fill and re-development projects require more planning to integrate trees into city-scape.

The goal of the Missoula Parks and Recreation Department's *Urban Canopy Assessment* was to provide a robust and repeatable estimate of forest cover on public and private lands in Missoula at the neighborhood scale. The information generated can be used to improve planning efforts, and allows for measurable goals for maintenance and expansion of forest cover in Missoula.

The assessment used aerial photography and tools developed for citizen science ([i-Tree Canopy](#)) to estimate the percent cover of trees and other surface covers in each of 20 neighborhoods in Missoula. We classified 6200 randomly generated points (250 points per square mile) as one of five types of cover: 1) Tree; 2) Grass/Shrubs; 3) Dirt/Gravel; 4) Impervious; or 5) Water. After classifying each point as one of these cover types, we used boundaries of neighborhoods, public lands, land use types, and census blocks as tools summarize the distribution of, and environmental services provided by, our urban forest.



[View of Missoula from Mt. Sentinel, photo by Gabe King]

Climate Change and Missoula's Urban Forest

Communities can use urban forests as a tool for climate change adaptation. The benefits that our urban forest provides, such as cooling us during the summer, are not only good for the community as a whole, but serve a secondary purpose to help Missoula build resilience in the face of a changing climate. Our urban forest can help Missoula adapt to climate change in ways that enhance quality of life and mitigate or solve anticipated problems. Planning for multiple benefits is part of good urban forest management.

This document focuses on the study by Missoula's Parks and Recreation Department together with the benefits of urban forests related to climate change adaptation. Notably, there are many ways to adapt communities to climate change, but this document focuses only the 'tree-centric' approaches.

Key Findings from the 2016 Urban Canopy Assessment

Surface covers in Missoula

- There are an estimated 2,053 acres of trees in Missoula, an average of 13.4% cover (+/- 17.6 ac).
- Tree cover ranges from 6% to 24% in the least and most forested neighborhoods (*Figure 1*).
- Almost 1/3 of the city is covered by impervious surfaces. 20% of the city is covered by streets and structures, 11.5% of the city is covered by parking lots, patios, or sidewalks.

Land ownership

- 68% of the urban forest is on privately owned land, 25% of the forest is on city land or in the public right of way (*Figure 3*).

Land Use

- Trees cover 15.9% of Residential lands, which cover 58% of the City land base (*Fig. 2*).
- Trees cover 4.2% of land designated as Neighborhood- or Community-Mixed use (12% of the City).
- Trees cover 7.4% of land designated as Regional Commercial or Urban Center (10% of the city).

Census blocks

- We found a positive correlation ($r=0.21$) between tree cover, and median home value. For every additional percent of tree cover, median home value was estimated to increase by \$4121.

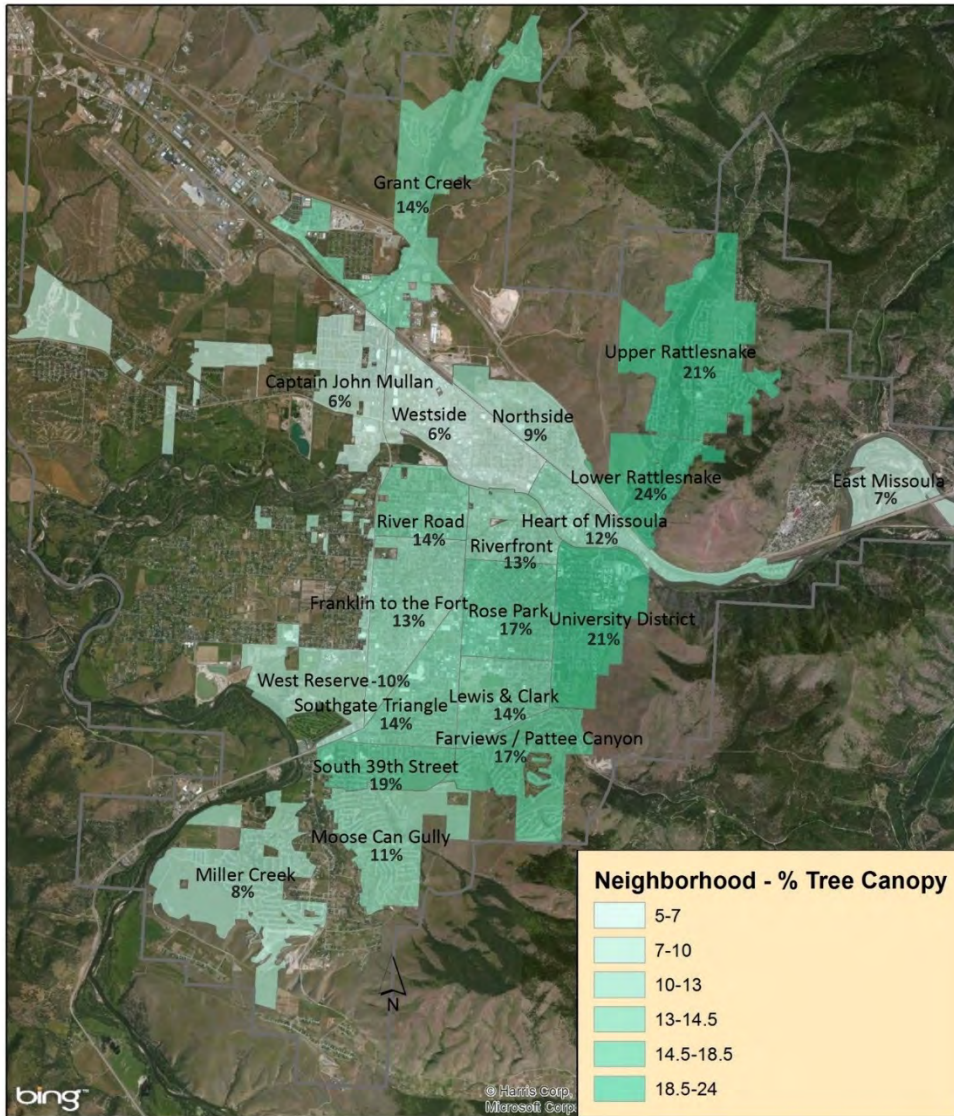
Economic Value of Missoula's Urban Forest

- The annual value of environmental services from Missoula's forest is estimated as \$8.63 million, including benefits such as home energy savings, air quality improvements, carbon capture, and storm water diversion. The replacement value of the forest is estimated as \$239 million.
- Trees managed by the city provide an estimated \$2.5 million in annual environmental services. Privately owned trees provide \$5.8 million in annual services (*Table 1*).

Benefit	Estimated \$ Value of public or street trees	Estimated \$ value of privately owned urban forest	Estimated \$ value of Missoula's full Urban forest
Energy Savings	\$285,117	\$678,578	\$997,910
CO ₂ capture	\$53,055	\$152,512	\$224,282
Air Quality	\$31,874	\$65,884	\$96,888
Stormwater	\$369,745	\$879,993	\$1,294,108
Aesthetic/Other	\$1,719,021	\$4,091,270	\$6,016,574
Total annual benefits	\$2,458,812	\$5,868,237	\$8,629,761
Replacement value	\$68,475,533	\$162,971,769	\$239,664,366

Table 1. Estimated annual value of environmental services provided by the urban forest, and assessed replacement value. Estimates are provided separately for publicly owned, privately owned, and the overall urban forest (including county, state, federal land in city limits).

Figure 1. Tree Canopy Assessment for the City of Missoula by Neighborhood, 2016



Benefits of Missoula’s Urban Forest

Providing Shade and Reducing Heat

Providing shade and reducing heat is an important function of our urban forests. When planted in the right place, trees can provide shade to homes, businesses, roads, and parking lots. Trees and vegetation lower surface and air temperatures by providing shade as well as through evapotranspiration. Shaded surfaces, for example, may be 20–45°F (11–25°C) cooler than the peak temperatures of unshaded materials. Evapotranspiration, alone or in combination with shading, can help reduce peak summer temperatures by 2–9°F (1–5°C).

Researchers have found that planting deciduous trees or vines to the west is typically most effective for cooling, especially if they shade windows and part of the building's roof. Furthermore, planting large canopy trees in parking lots provides welcome shade that makes summer parking more pleasant. And as an added benefit, asphalt lasts longer in shaded areas.



Reduce Energy Bills

By providing shade and windbreaks and reducing heat, trees can also reduce energy costs. A study in the *Journal of Arboriculture* showed that just three large trees around your home—two on the west side and one on the east—can provide enough shade to reduce your air-conditioning costs by 30% in the summer. And, when placed properly to reduce wind exposure, they can reduce heating bills in the winter by 2-10%.

Filter pollutants

A healthy urban forest can also reduce air pollution. Trees remove air pollutants (dust, ash, pollen, and smoke) by trapping particulate matter in their leaves, needles, and bark. They also absorb carbon dioxide and dangerous gases, and in turn, replenish the atmosphere with oxygen. Better air quality reduces health care costs, and improves the quality of life for everyone, especially those with compromised health, such as asthmatics.

Stormwater Management

Trees can be part of a rainwater management system, while enhancing the visual appeal of the built environment. Urban trees can help with stormwater in several ways. First, they intercept rainfall, allowing water to be absorbed into the tree, roots, and soil. This means that cities do not have to build as many artificial stormwater controls, saving time and money. Second, they purify water on its way into the ground by removing some of the pollutants collected. Third, the water retained by the urban forest helps sustain the growth of the urban trees, parks, and vegetation. All of these services, provided naturally instead of artificially, help save the city a significant amount of money each year.

Conserve water and reduce soil erosion

Trees create organic matter on the soil surface from their leaf litter and their roots increase soil permeability. Not only does this lead to reduced surface runoff of water from storms, but also reduced soil erosion and sedimentation of the Clark Fork River. Trees help increase ground water recharge, capture some chemicals that would otherwise end up in our streams and rivers, and reduce wind erosion of soil.

Create Habitat

Trees and associated plants create local ecosystems that provide habitat and food for birds and animals. They offer suitable mini-climates for other plants that would otherwise be absent from urban areas. Biodiversity is an important part of urban forestry.

Mitigation

First off, trees and forests sequester and store carbon, performing an important function in the natural carbon cycle and helping to mitigate climate change. Trees can also indirectly limit CO₂ emissions when they are positioned effectively so that they shade a house. Providing shade and evapotranspiration near homes reduces building energy needs for cooling, allowing homeowners to reduce carbon emissions from energy use.

Figures & Additional Information

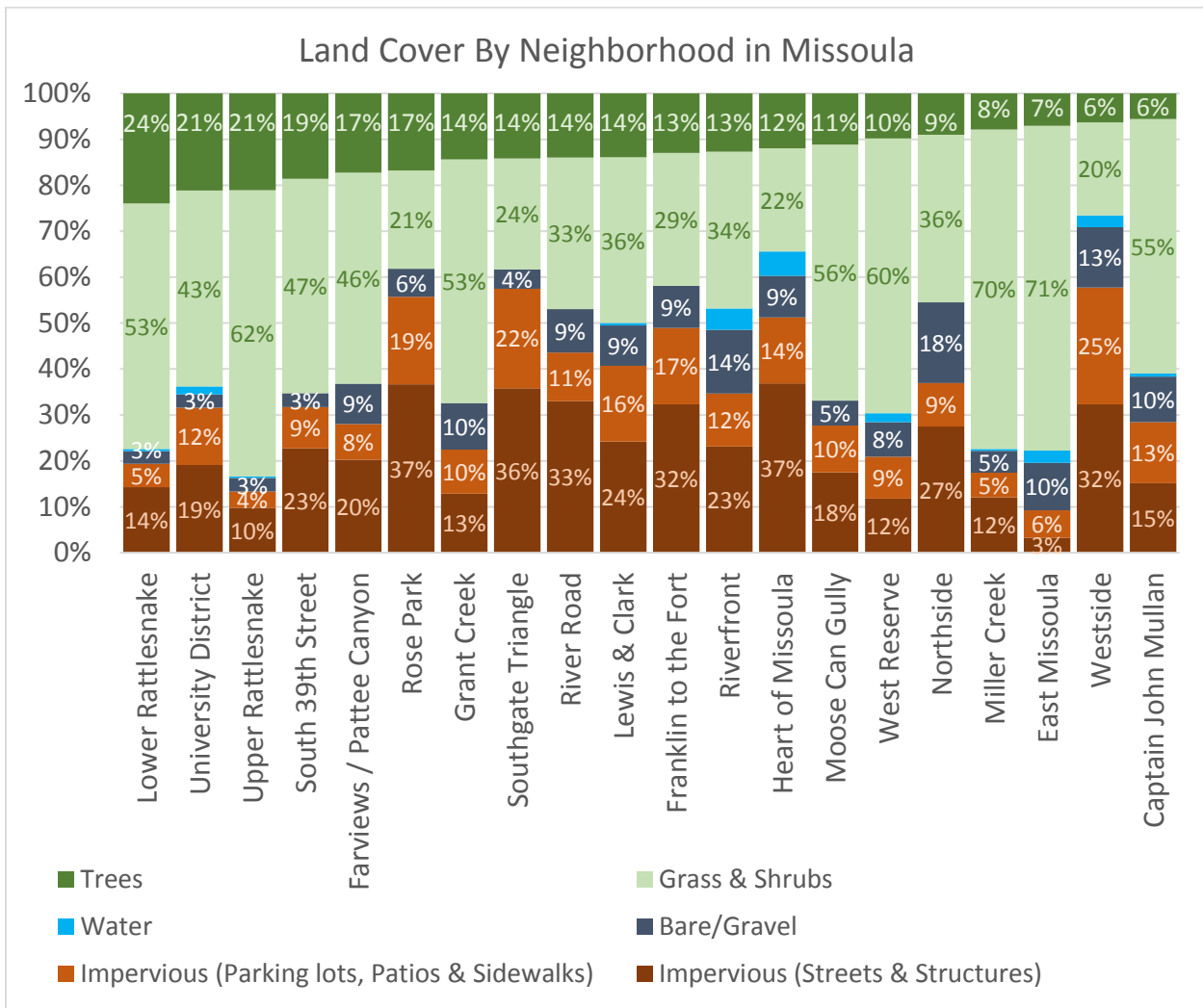


Figure 2. Percent ground cover by neighborhood in Missoula, arranged from most tree cover (Rattlesnake, University neighborhoods) to lowest tree cover (John Mullan, Westside, East Missoula). The overall average tree cover within Missoula City limits is estimated at 13.4% (+/- 0.85%, 95% confidence).

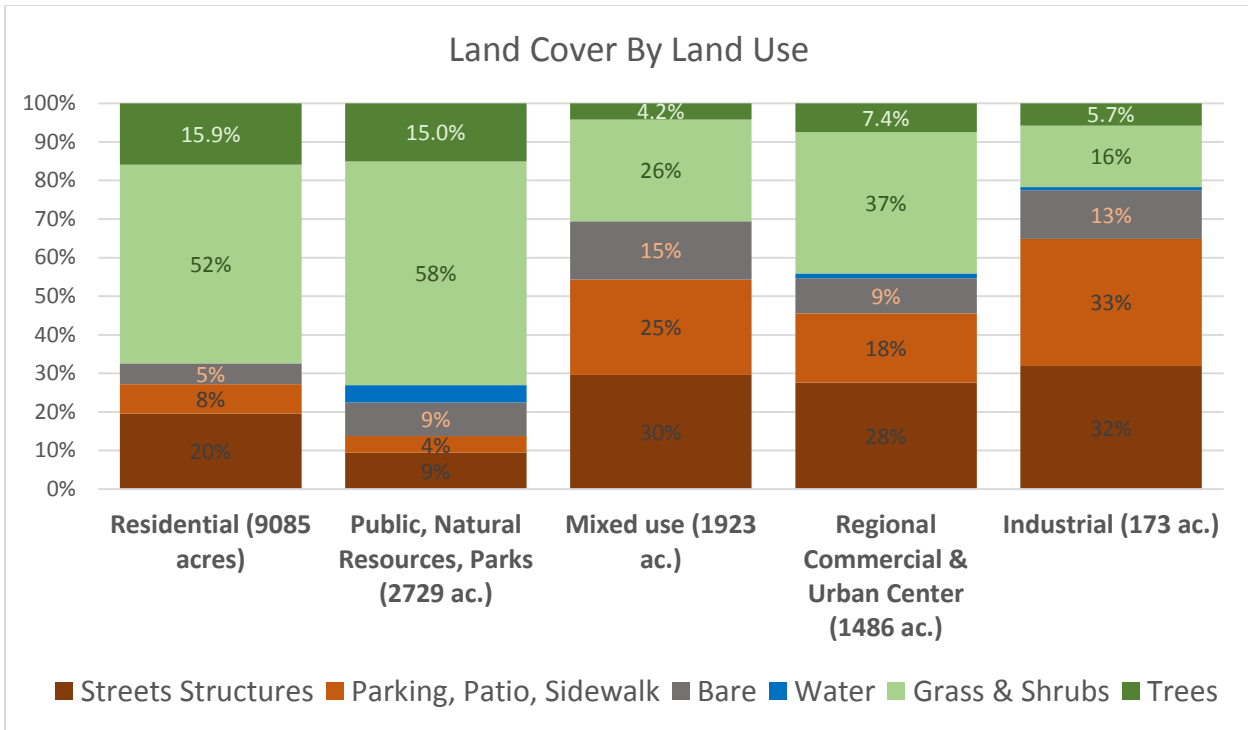


Figure 3. Percent ground cover by land use category in Missoula, as defined by the 2015 “Our Missoula” growth policy adopted in November 2015. In this chart, we combined similar categories for purpose of readability and display (e.g. “Neighborhood mixed use” and “Community mixed use” were combined into one category).

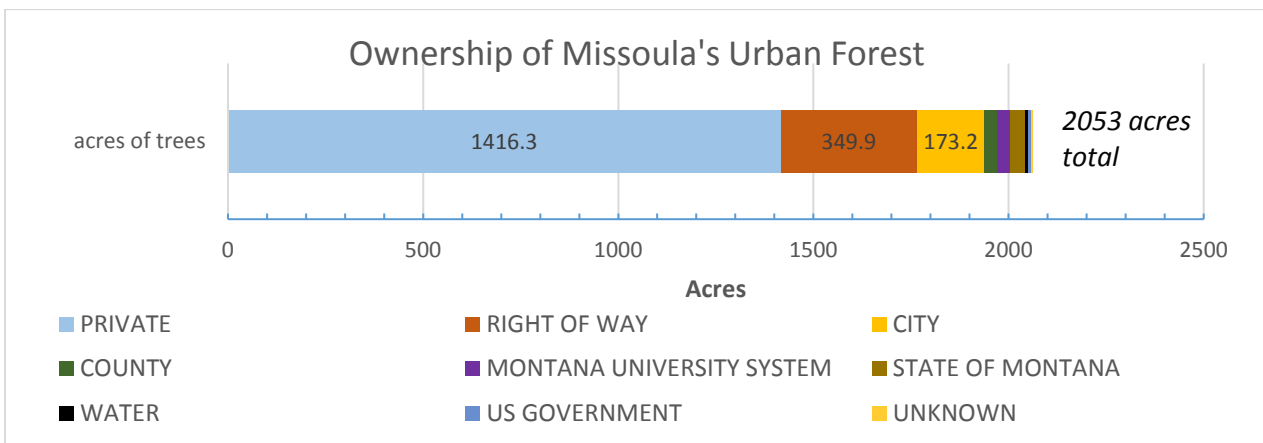


Figure 4. Estimated ownership of Missoula’s forest, in acres. 68.8% of the urban forest is in private ownership, 17% in the right of way, 8.4% on City owned land, and about 1.5% each on County, University, and State lands.

References

Nowak, David J, D.E. Crane, J.C. Stevens. 2006. Air pollution removal by urban trees and shrubs in the United States. *Urban forestry and Urban Greening* 4: 115-123. [link](#)

Missoula Urban Forest Master Management Plan. Adopted April, 2015. [link](#)

i-Tree Canopy Technical Notes. David Nowak, Jeffrey Walton, Eric Greenfield. www.itreetools.org.

http://www.retooling.ca/_Library/docs/Urban_Forests_Guide.pdf

<http://www.americanforests.org/our-programs/urbanforests/whywecare/>

Simpson, J.R. and McPherson, E.G. Potential of Tree Shade for Reducing Residential Energy Use in California. *Journal of Arboriculture*. 1996, 22(1), 10-18.

<http://statesatrisk.org/report-card/montana>

<https://www.epa.gov/heat-islands/using-trees-and-vegetation-reduce-heat-islands>

http://www.fs.fed.us/psw/programs/uesd/uep/products/11/800TreeCityUSABulletin_55.pdf

<http://www.state.sc.us/forest/urbben.htm>

<http://www.americanforests.org/our-programs/urbanforests/whywecare/>

<http://www.thenatureofcities.com/2016/03/06/why- conserve-small-forest-fragments-and-individual-trees-in-urban-areas/>

