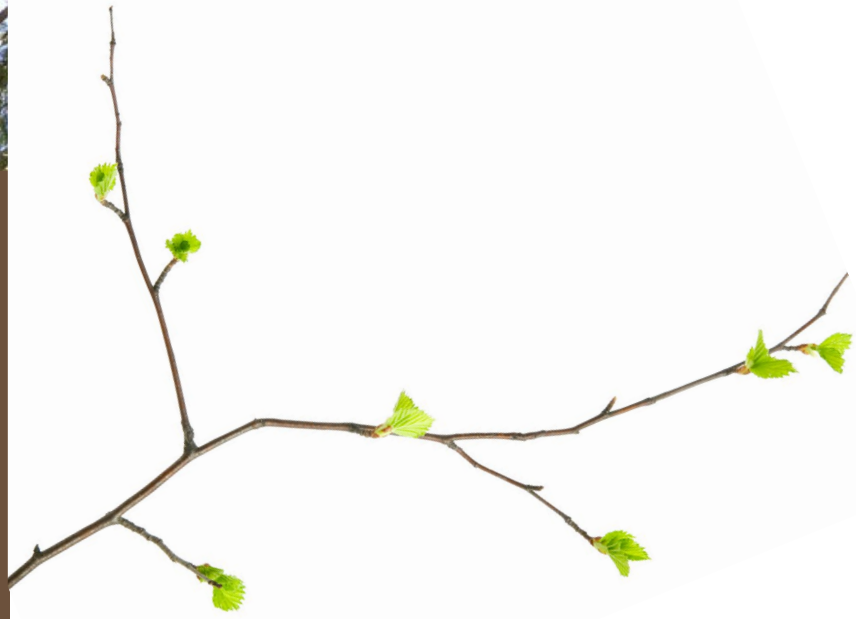
Salem Street Trees: Sample Inventory



CITY OF Salem AT YOUR SERVICE

November 2018

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KEY FINDINGS

- Based on the statistical sample inventory, with an accuracy of +/-10%, Salem's estimated street tree population totals 71,502 (+/- 5895) trees.
- The maple family (Aceraceae) represents the most abundant tree type among Salem's street trees. Norway maples (Acer platanoides) and red maples (Acer rubrum) are the most commonly found species. Salem's high percentage of maples is an area of vulnerability for the city, as it exceeds urban forestry guidelines for maintaining diversity and resilience in the canopy.
- The majority (76%) of street trees were found to be in good or fair condition.
- Smaller, younger trees are underrepresented in the street tree population.
- More than half of Salem's street trees are growing in sites that are not planting strips. These sites include yards, medians, and undeveloped areas without sidewalks.
- The environmental and aesthetic benefits that Salem's street trees provide annually are valued at an estimated $6,772,170.

BACKGROUND

City of Salem

The City of Salem is located in the central Willamette Valley of western Oregon. The mild climate is classified as Mediterranean with dry summers and 39 inches of average annual rainfall during the cooler months. Salem's population is estimated at 167,421 people. The city area is 48.5 square miles.

Street Tree Inventory Overview

During summer 2018, the City of Salem conducted its first street tree inventory. This initial effort was not a full inventory, but rather a 4% sample of the city's total street segments. The street segments surveyed were randomly generated and are statistically representative of the total street tree population +/- 10%.

The primary objective of the street tree inventory is to gain a more detailed understanding of Salem's urban forest structure. By knowing the location, species, condition, and size of existing street trees, the City can implement more effective practices for planting and maintaining healthy trees in the future.

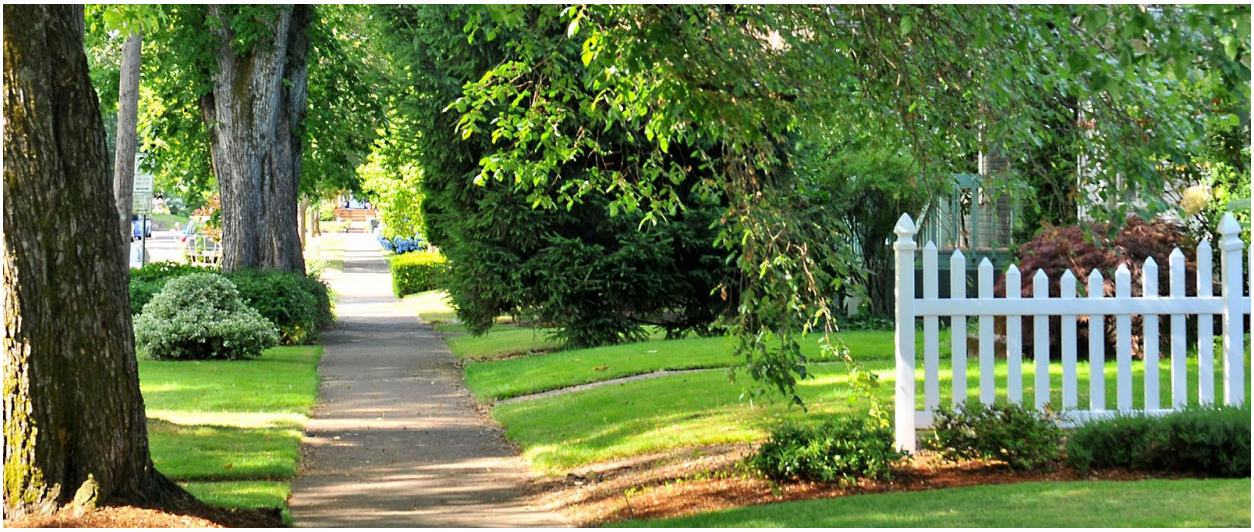
METHODS

Statistical Sample Inventory

Instead of completing a full inventory that would require surveying every individual tree, a partial or sample inventory of Salem's street trees was conducted. A sample inventory provides a statistically accurate way to detect general patterns and trends in the urban forest, such as whether certain tree species are over-planted and general tree health. In order to achieve a 10% standard error for the total population of street trees citywide, we selected a sample size of 4% of the total street segments in the City.

The number of street segments to sample was determined by calculating the total number of street segments in the city—a street length between two intersections—in the city, and then randomly selecting 4% of the street segments to be surveyed for street trees. The total street segment population excluded private roads and driveways, freeways, and street segments less than 150 feet. The segment includes both sides of the street unless the lanes were separated by a planted median (e.g. Wallace Road NW), in which case one street side and the median were inventoried.

The sample was generated using ArcGIS Pro Random Number Generator, and produced a sample size of 250 street segments. The street segments include all types of streets (local, collector, arterial, parkways) scattered throughout the city in different types of zoning (residential, commercial, industrial), thereby providing an accurate representation across the city. A map of inventoried street segment is shown on Figure 1.



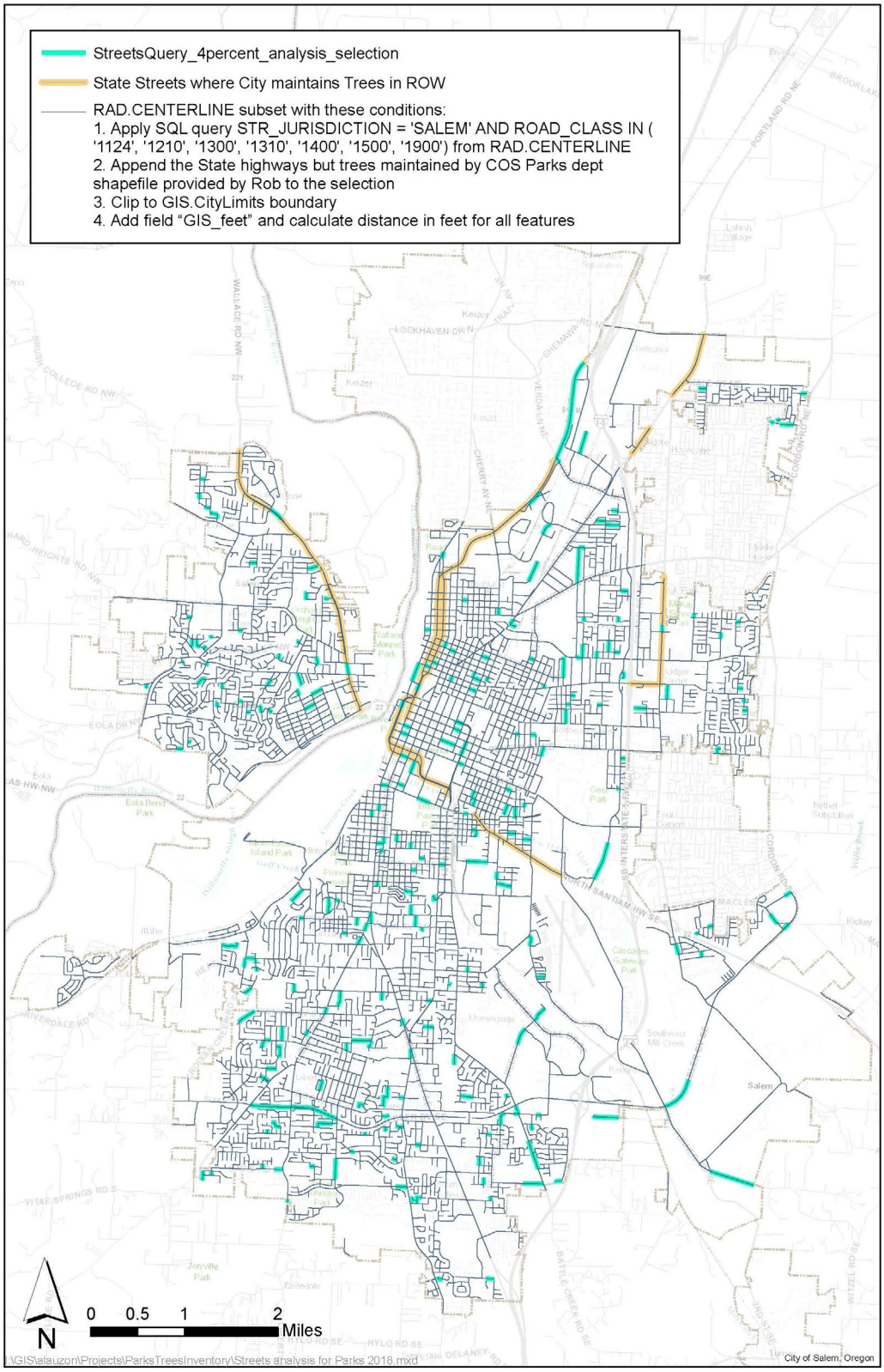


Figure 1: Street segments used in 4% sample inventory of street trees for City of Salem

Data Fields

For each street segment surveyed, the following data were collected for all trees located in the right of way:

1. Location: GPS coordinates.
2. Address: Address for adjacent tax lot.
3. Tree type: identified to species or genus.
4. Size: Size was determined by measuring the diameter at breast height (dbh)(measured at 4.5 feet from ground).
5. Condition: Tree health was categorized as one of four conditions:
    a. Good—Tree is vigorous, structurally sound, and has a full crown.
    b. Fair—Tree appears in average condition. May have small dead limbs and need structural pruning.
    c. Poor—Tree is in general state of decline. May have significant wounds, disease, or decay.
    d. Dead or Dying—Tree is dead or nearly dead.
6. Site type:
    a. Planting strip—designated planting area located in right-of-way between sidewalk and road.
    b. Planting area behind sidewalk—planting area behind sidewalk, frequently adjacent to parking lots of commercial properties.
    c. Yard—residential yard located in right-of-way, sidewalk is present.
    d. Curb, no sidewalk—residential yard located in right-of-way, sidewalk is not present.
    e. No curb, no sidewalk—undeveloped right-of-way with no sidewalk, curb, or designated planting area.
    f. Median—planting area in street dividing two lanes of traffic.
    g. Cutout—small planting area cut out of sidewalk, frequently located in downtown business area.
7. Presence of overhead utility wires: Overhead utilities were recorded in one of three categories:
    a. No wires.
    b. Non-primary wires (present but not conflicting).
    c. Primary wires (present and conflicting).
8. Empty planting sites: Potential planting spaces for street trees were recorded with details about the site type, as well as the quantity and size of trees appropriate for the site.

Data Collection

Street tree inventory data was collected at each of the 250 street segments in the statistical sample. Workers in the field recorded data for every tree located in the right-of-way using a tablet and the ArcGIS Collector application. Diameter was determined with a diameter measuring tape. If the tree had stems that split below 4.5 feet, the diameter was measured lower on the trunk. If a tree species was unable to be identified in the field, leaf and fruit specimens were collected and reviewed in the office with other identification tools (guidebooks, plant databases, etc.). Planting strip width was also measured and recorded. The potential size and quantity of trees for each empty planting site was recorded assuming the largest size tree appropriate for that site.

Analysis

After all segments in the sample were surveyed, the data was downloaded from Collector as an Excel spreadsheet. The spreadsheet was reviewed for errors and missing data was filled in. Calculations and charts were generated in Excel for: species, genus, family, size, condition, evergreen vs. broadleaf, land use, and site type.

Environmental benefits were calculated using "i-Tree Streets" software. I-Tree Streets is an analysis tool that uses tree inventory data to quantify the annual dollar value of environmental services such as energy conservation, carbon dioxide reduction, stormwater control, air quality improvement, and property value increase. For this program, the data had to be formatted using specific codes and uploaded to an Access database.

RESULTS

For the 2018 sample inventory, a total of 250 street segments across the City of Salem were surveyed. Data was collected on a total of 1,535 street trees. Empty planting sites, as well as street segments that had no street trees, were also recorded. Based on the survey numbers, the total population of street trees in Salem is estimated at 71,502.

Street segments	Surveyed population of street trees	Empty planting sites	Street segments with no street trees	Total estimated population of street trees (+/- 10% margin of error)
250	1,535	257	56	71,502 (+/- 5,895) = 65,607 – 77,397

Table 1: Sample numbers

Species Diversity and Tree Type Composition

At the species level, the two most abundant tree types surveyed are Norway maples (*Acer platanoides*) and red maples (*Acer rubrum*). Other maple species rank fifth. Douglas-fir (*Pseudotsuga menziezii*) is the only evergreen tree ranked in the top 10 most abundant trees.

Common Name	Scientific Name	# of Trees	% of Total
Norway maple	*Acer platanoides*	270	18%
Red maple	*Acer rubrum*	111	7%
Cherry	*Prunus species*	102	7%
Callery pear	*Pyrus calleryana*	96	6%
Maple, other	*Acer species*	95	6%
Ash	*Fraxinus species*	87	6%
Doug-fir	*Pseudotsuga menziezii*	67	4%
Little-leaf linden	*Tilia cordata*	53	3%
Northern red oak	*Quercus rubra*	43	3%
Sweetgum	*Liquidambar styraciflua*	35	2%

Table 2: The 10 most abundant street tree types inventoried

At the genus and family levels, maples (*Acer, Aceraceae*) are the most abundant.

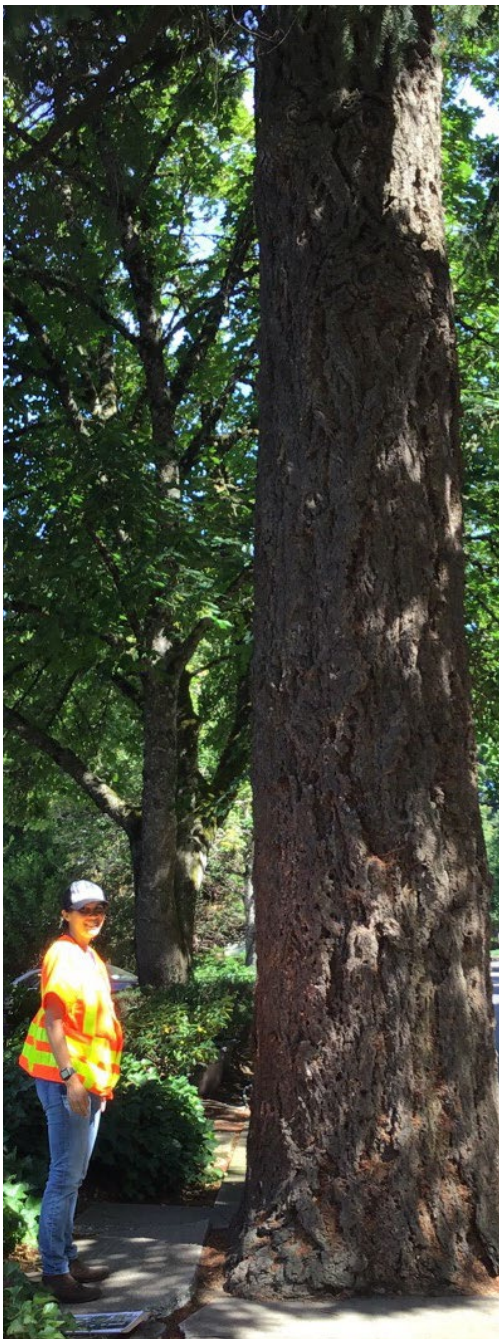
Genus	# of Trees	% of Total
Acer	551	36%
Prunus	137	9%
Pyrus	97	6%
Fraxinus	94	6%
Tilia	86	6%
Quercus	85	6%
Pseudotsuga	67	4%
Betula	55	4%
Liquidambar	35	2%
Pinus	32	2%

Table 3: The 10 Most Abundant Street Tree Genera

Family Name	Tree types included in family	# of Trees	% of Total
ACERACEAE	maple	551	36%
ROSACEAE	cherry, plum, apple, hawthorn, pear, mountain-ash	257	17%
PINACEAE	Douglas-fir, hemlock, spruce, pine, fir, cedar	130	8%

Family Name	Tree types included in family	# of Trees	% of Total
FAGACEAE	oak, beech	94	6%
OLEACEAE	ash	94	6%
BETULACEAE	birch, hornbeam, alder	86	6%
TILIACEAE	linden	86	6%
ULMACEAE	elm, zelkova	47	3%
HAMAMELIDACEAE	sweetgum, Persian ironwood	40	3%

Table 4: The 10 Most Abundant Street Tree Families



Resiliency and Functional Assessment

The general urban forestry standard for achieving diversity and resilience in street tree populations is the 10-20-30 rule. This guideline states that an individual species should represent no more than 10% of the total tree population. Individual genera should not exceed 20%, and individual tree families should not exceed 30% of the population. More recent studies have determined that the 10-20-30 rule may be insufficient in protecting urban forests from widespread diseases and other threats. Consequently, some cities have adopted more ambitious targets to better protect their urban forest resources (for example, the City of Portland has 5-10-20 goal).

At 18%, Norway maples are significantly overrepresented as a species in Salem's street tree population. The Maple genus and family also exceed their respective targets (both make up 36% of the population). Red maples, cherries, pears, other maples, and ash are also overrepresented based on the more conservative 5-10-20 goal.

The vast majority of Salem's street trees are broadleaf deciduous species. This is not surprising, as evergreen trees are not currently on the recommended planting list of

city street trees due to the generally large size at maturity and traffic visibility issues. However, evergreen species can provide greater year-round environmental benefits, and it would be advantageous to increase their numbers in the future in appropriate locations.

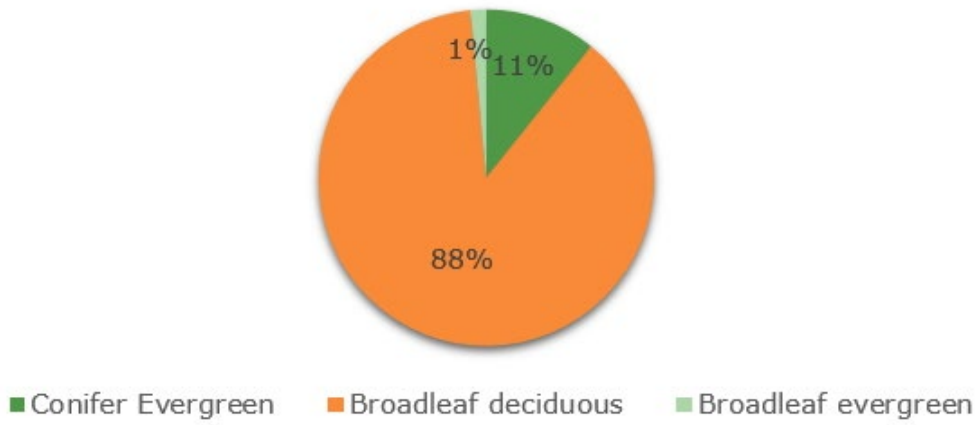


Figure 2: Functional tree types

Tree Condition and Size

Most of the trees surveyed were determined to be in fair or good condition. Norway maples, cherries, birches, and little-leaf lindens were the most common species to be classified as poor. The primary reasons for poor classifications were decay and cavities, and/or large trees that had been topped due to conflicting overhead utility lines.

The DBH (diameter at breast height) was collected for each tree that was surveyed in the inventory. This measurement provides information about the overall size and age of the street tree population. An ideal distribution has young trees representing the highest percentage, and gradually tapers off with medium and large mature trees. Our sample shows that young trees are under-represented in the population. This is a concern because it means that there are not enough young trees to offset the aging ones that will need to be replaced soon.

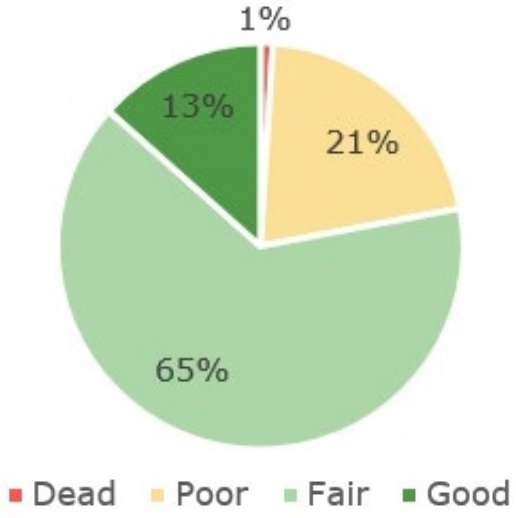


Figure 3: Street tree condition

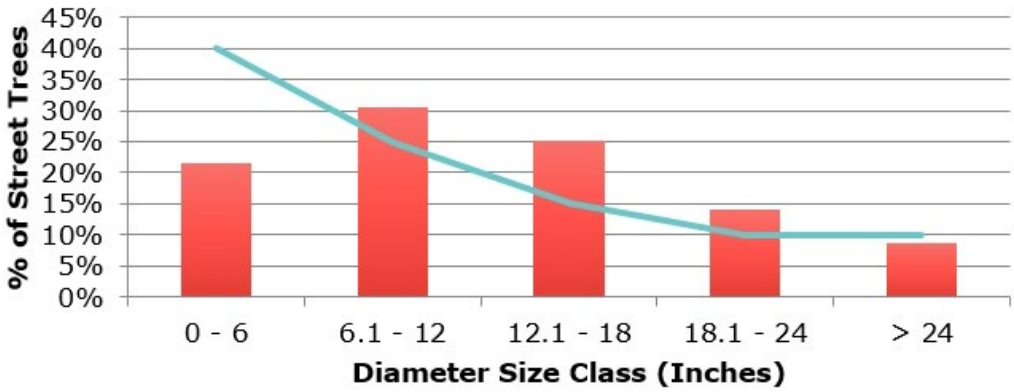


Figure 4: Street tree diameter, compared with ideal distribution

Planting Sites

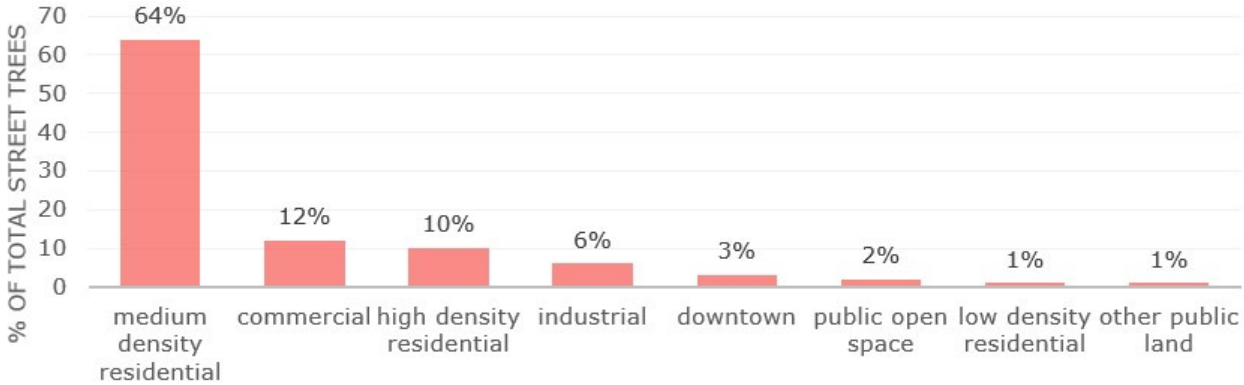


Figure 5: Street trees by land use

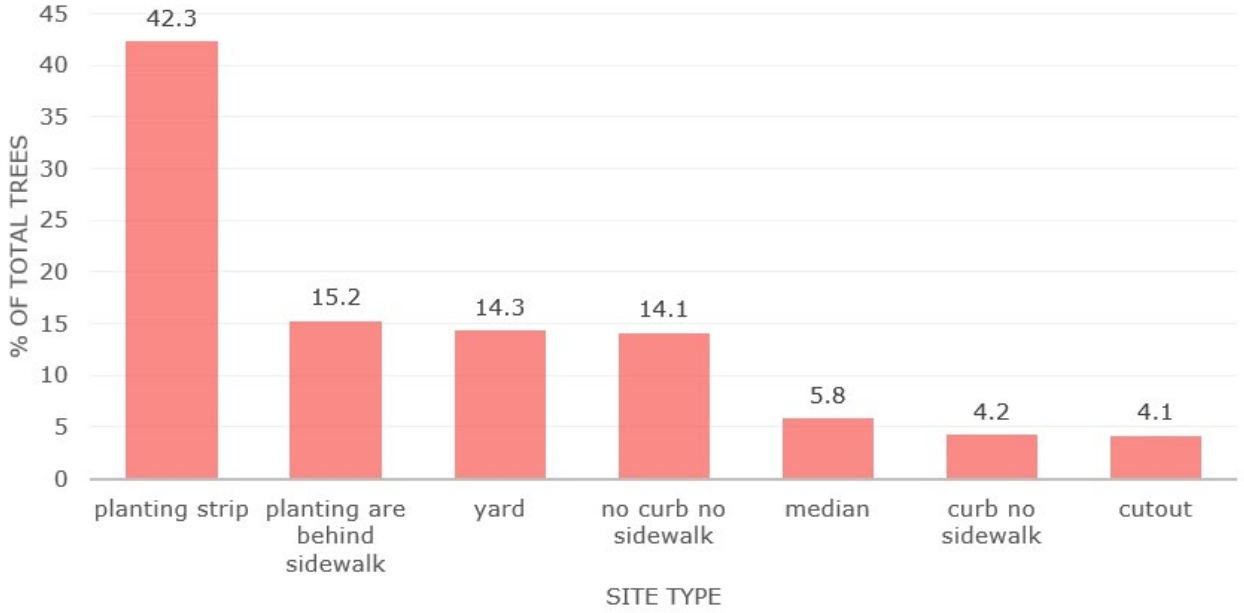


Figure 6: Street trees by site type

Environmental Benefits

The urban forest provides many benefits, such as energy savings, reduction in greenhouse gases, improving air and water quality by filtering pollutants and infiltrating rainfall, as well as increasing property values and improving neighborhood and city aesthetics.

Based on analysis with i-Tree Streets, Salem's urban forest provides the following annual benefits.

Benefits	Total ($)	Total ($) per tree
Energy	276,007	3.86
CO2	72,318	1.01
Air Quality	141,595	1.98
Stormwater	1,952,820	27.31
Aesthetic/Other	4,329,428	60.55
Total	**$6,772,170**	**$94.71**

Table 5: Valuation of Annual Environmental and Aesthetic Benefits

RECOMMENDATIONS

- Plant more trees! Younger trees are needed to replace aging population.
- Select more diverse species for new plantings. Avoid maples, and deemphasize cherries, pears, and ash.
- Plant more evergreen trees to achieve greater environmental benefits.
- Use empty site data to identify planting opportunities.
- Expand inventory for greater accuracy. Focus on low canopy neighborhoods.
- Utilize i-Tree data to help meet citywide environmental goals.

REFERENCES

- Western Washington and Oregon Community Tree Guide
- Trees for Urban Planting: Diversity, Uniformity, and Common Sense
- i-Tree Streets
- Street Tree Diversity in Eastern North America and Its Potential for Tree Loss to Exotic Borers
- Street Tree Inventory Report: City of Portland