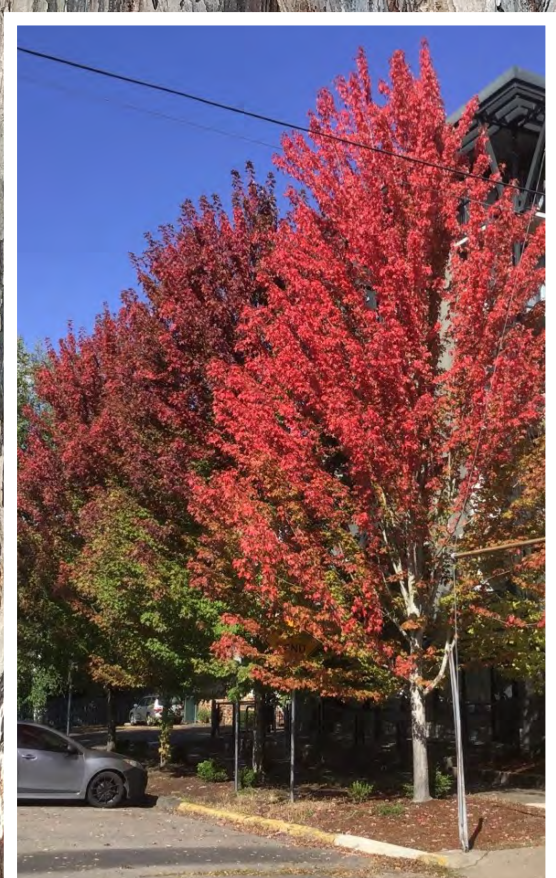
Salem Street Trees: Sample Inventory

City of Salem

December 2019



CITY OF Salem AT YOUR SERVICE

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CONTENTS

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Cover Photos of trees inventoried in 2019 (clockwise from top left):

1. Blossoms of tree form honeysuckle (*Lonicera spp*). A Salem heritage tree and the last remaining tree from a planting done in the later part of the 19th century as part of a federal beautification project.
2. Sequoia (*Sequoiadendron giganteum*) street tree providing year-round environmental services.
3. Red maples (*Acer rubrum*) providing beauty and shade for the southern exposure of a building.
4. Background photo: Closeup of sequoia bark (*Sequoiadendron giganteum*).

Figure 1. View of Salem looking northeast toward Mount Hood.

KEY FINDINGS

- Based on the combined 2018/2019 statistical sample inventory with a relative standard error of 6.20%, Salem's estimated street tree population totals 42,892 (+/- 2,661) trees.
- The maple family (Sapindaceae, also known as Aceraceae) represents the most abundant tree type among Salem's street trees (32%). 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 (Santamour 1990).
- Most street trees were found to be in good or fair condition (18.1% and 66.5% respectively).
- Younger trees and evergreen trees are underrepresented in the street tree population.
- The annual environmental and aesthetic benefits that Salem's street trees provide are valued at an estimated $4,116,336.

BACKGROUND

City of Salem

The City of Salem is located in the central Willamette Valley of western Oregon. The mild climate is classified as cool Mediterranean with dry summers and 39.6 inches of average annual rainfall. Most of this rain falls during the winter months. Historically, the driest months of July and August average 0.46 inches and 0.45 inches, respectively. Ten-year data from 2008 to 2017 record an average rainfall of just 0.245 inches and 0.374 inches respectively for July and August (National Oceanic and Atmospheric Administration, no date).

Salem's estimated 2019 population is 167,220 people. The Salem city limit encompasses 48.45 square miles and contains 549 linear miles of public streets.

Street Tree Inventory Overview

During the summer of 2018, the City of Salem conducted its first street tree inventory using a random statistical sample method. The inventory effort was continued in 2019. The primary objective of the street tree inventory is to gain a more detailed understanding of the quantity, health, and diversity of Salem's street trees. By knowing the species, condition, and size of existing street trees, the City can implement more effective practices for planting and maintaining healthy trees in the future. The City can also better predict the future structure of the street tree canopy based on current trends.

A comprehensive inventory of Salem's street trees would give the best information from which to make management decisions. However, a tree by tree inventory is very costly and is still just a snapshot in time. Instead of completing a full inventory, a random sample inventory of Salem's street trees was conducted. This is the second year of the sample inventory. With each sample inventory, the level of accuracy improves.

METHODS

Random Statistical Sample Methodology

In the summer of 2018, a 4% sample of the City's total street segments was surveyed. This survey was designed to yield a roughly 10% standard error. An additional 5.13% of street segments were sampled in late summer and fall of 2019 for a combined sample size of just over 9% of all street segments. The previously sampled segments from 2018 were excluded from the 2019 survey. The street segments surveyed were randomly generated and are statistically representative of the total street tree population. The combined standard error is +/- 6.2%. See Nowak et al. (2014) for a deeper understanding of this sampling method.

The sample was determined by calculating the total number of city street segments. A street segment is a street length between two intersections and excludes private roads, driveways, and freeways. Street segments are commonly the length of a city block but can vary widely from under 150 feet to just over a mile. Segments under 150 feet in length were excluded from the random sample. There are 6,240 segments in the City that meet these criteria for the inventory. Segments were then randomly selected using the "Random Number Generator" in ArcGIS Pro. Some city streets contain two street segments divided by a median. When sampling such a street we chose to inventory the trees in the median (if there were any) and the trees on only one side of the street. For instance, if the segment was the north side of an east/west running street, we inventoried the trees in the meridian and the trees on the north side of the street, leaving the trees on the south side un-inventoried.

Using this methodology, the sample size was 320 street segments in 2019. Combined with the 250 segments in 2018, the City has surveyed a total of 570 street segments. Figure 2 shows the locations of the inventoried street segments.

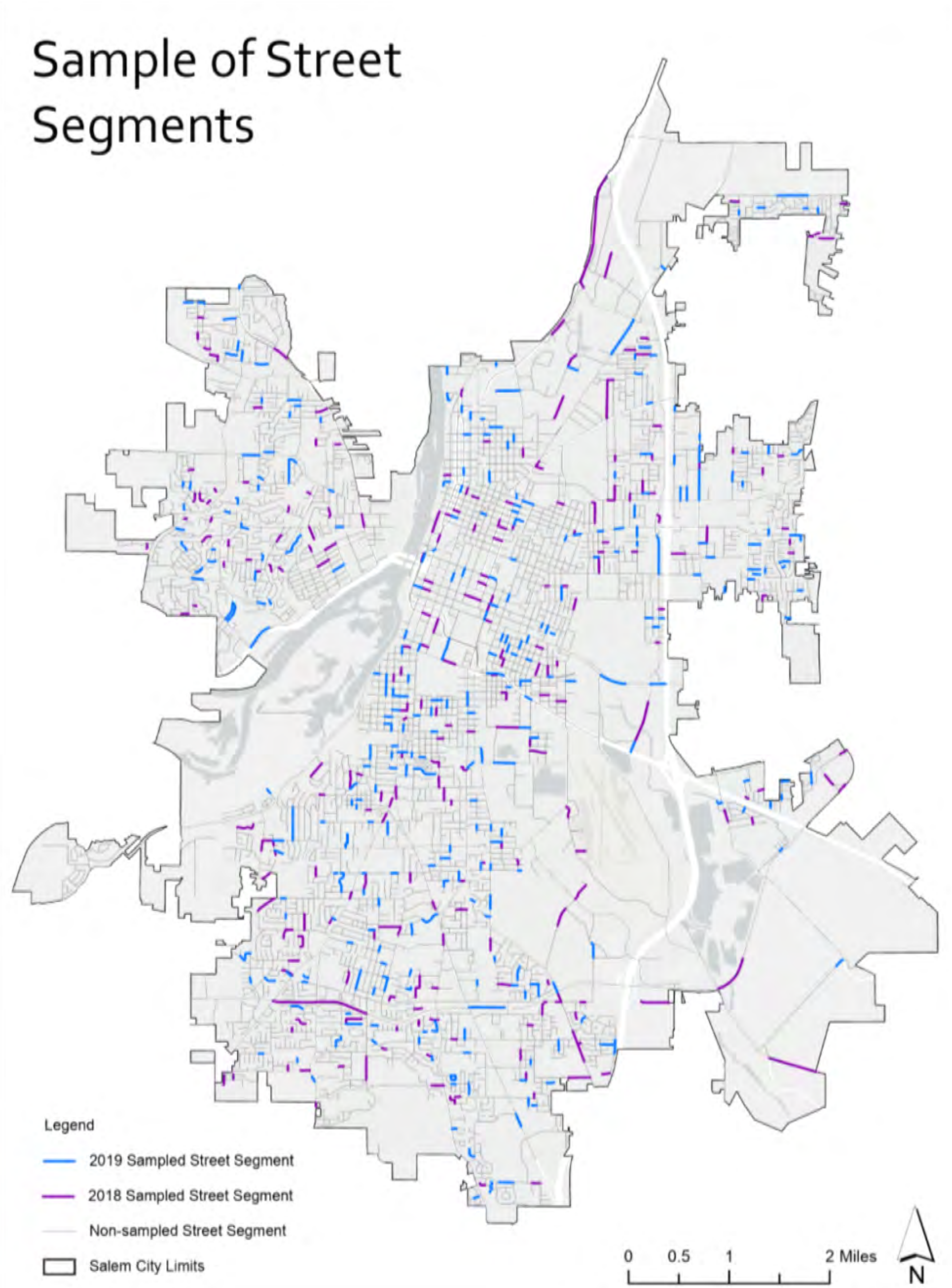


Figure 2. Map of street segments sampled.

Data Fields

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

Location: GPS coordinates

Address: Address for adjacent tax lot

Tree type: Trees were identified to genus and species. When known, the named cultivar was also recorded.

Size: Size was determined by measuring the diameter at breast height (equal to roughly 4.5 feet from base of tree).

Tree Condition: Tree condition was recorded as one of four categories:

Good—Tree is vigorous, structurally sound, and has a full crown.

Fair—Tree appears in average condition. May have small dead limbs or wounds and/or need structural pruning.

Poor—Tree is in a general state of decline. May have significant wounds, disease, or decay.

Dead or Dying—Tree is dead or nearly dead.

Specific Conditions: The following specific conditions were also noted when present:

Topped—The top of the tree has been removed or the ends of major branches have been lopped off (rounded over). This typically happens to larger growing trees under power lines or when adjacent property owners attempt to reduce the size of trees.

Cavities—hollow spaces in the trunk or in large limbs.

Fungus—Fungal fruiting structures noted either growing out of the tree or at the base of the tree.

Large Dead Limbs—Dead limbs 2 inches or greater in diameter.

Notes/Planting Area Notes: Specific comments were made as needed regarding the tree or its growing site.

Planting Area Type:

Planting strip—designated planting area located in right-of-way between sidewalk and road/curb.

Planting area behind sidewalk—planting area behind curb or attached sidewalk, frequently adjacent to parking lots of commercial properties.

Yard—residential yard located in right-of-way, sidewalk is present. Curb-tight sidewalks are common in newer neighborhoods.

Curb, no sidewalk—residential yard located in right-of-way, sidewalk is not present.

No curb, no sidewalk—street right-of-way with no sidewalk, curb, or designated planting area.

Median—planting area in street dividing opposing lanes of traffic.

Planting Area Width—the usable planting area measured in feet. This is commonly from the inside edge of the curb to the sidewalk. In the case of a curb-attached sidewalk or no sidewalk, this is the measurement from the back of the sidewalk or the edge of the curb to the approximate adjacent tax lot line. Impervious surfaces are not included in this measurement.

Presence of overhead utility wires: Overhead utilities were recorded in one of three categories:

No wires—no overhead utility lines.

Non-primary wires—Overhead utility lines are present but not conflicting. These are overhead utilities such as communication lines and power lines less than or equal to 220 volts (house drops).

Primary wires—Power lines greater than 220 volts are present and conflicting. These are above the pole-mounted transformer and are typically the highest utility lines on a power pole.

Empty planting sites: Potential planting spaces for street trees were recorded.

Data Collection

At each of the street segments in the statistical sample, data were collected by City urban forestry staff familiar with tree assessment and identification. Data were recorded in the field for every tree located in the right-of-way using a tablet and the ArcGIS Collector application. The Collector application communicates with a Salem Maps Online GIS project that stores the data points (trees) and their accompanying attributes (data fields). Diameter was measured at 4.5 feet high using a diameter tape. This is a measuring tape that records the diameter of a tree trunk when wrapped around its circumference (see Figure 3). If the tree had stems that split between 1 foot and 4.5 feet, the diameter was measured below the split at the point of smallest trunk circumference. The diameter of multi-stem trees that split lower than 1 foot were calculated using a formula that adds the diameter of the largest stem to half the diameter of subsequent stems (as in: A+1/2B+1/2C) (City of Portland 2019). If a tree species was unable to be identified in the field, leaf and fruit specimens, along with pictures of bark and tree form, were collected and reviewed in the office with other identification tools such as guidebooks, plant databases, etc.

Figure 3. Using a diameter tape to find the diameter at breast height.

Analysis

After all segments in the sample were surveyed, the data were downloaded from Salem Maps Online as a Microsoft Excel spreadsheet. The spreadsheet was reviewed for errors and missing information was filled in. Calculations and charts were generated in Excel for tree type (species, genus, family), size, condition, evergreen vs. deciduous, etc.

Environmental benefits were calculated using iTree Streets software. For this program, the data had to be formatted using specific tree codes and uploaded to a Microsoft Access database that was then imported into the iTree Streets program.

STREET TREE COMPOSITION

Population

For the combined 2018/2019 sample inventory, a total of 570 street segments were surveyed across the City of Salem. Data were collected on a total of 3,918 street trees. Empty planting sites and sample street segments that had no street trees were also recorded. Based on the combined survey numbers, the total population of street trees in Salem is estimated at 42,892. (Table 1)

The reported total population from the 2018 Inventory was 71,502 trees. This report was in error. The revised population estimate from the 2018 inventory year is 39,792 trees.

The 2019 estimate was 45,954 trees. This estimate, combined with the revised estimate from 2018, gives us our current best estimate of 42,892 trees.

Table 1: Combined 2018/2019 sample statistics

	Street segments	**Empty planting sites**	**Street segments with no space for trees**	**Population of street trees (standard error)**
Sampled:	570	727	103	3,918
Estimated total population:	6,240	7,959	1,127	42,892 (=/-) 2,661)

Tree Condition

The city streetscape is a tough environment for trees to survive in. Limited soil volume, compacted soils, reflected heat from hardscapes, and impacts from vehicles are just a few of the stressors for street trees. For trees to perform well, they must be adapted not only to Salem's climate but also to these harsh conditions. Nevertheless, well selected and well-maintained trees can survive and even thrive. Tree condition was evaluated as a combination of health (vigor) and structural integrity. Trees were classified as good, fair, poor, or dead based on the criteria given in the Methods section of this report.

Results

Table 2 shows the majority of the trees surveyed (85%) were determined to be in fair or good condition while 15% were poor or dead. The species most commonly reported as poor or dead are flowering cherry (39% poor or dead) and European white birch (36% poor or dead).

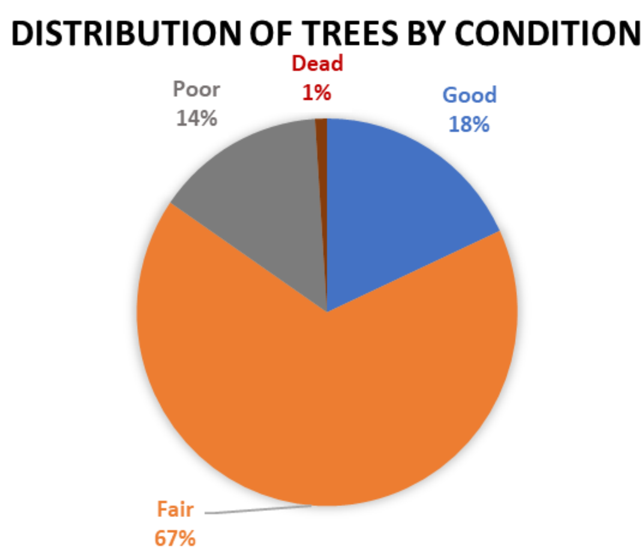


Table 2. Condition of Street Trees

Discussion

At 85% good or fair, Salem's street trees are generally healthy. Two of the poorer condition trees are cherries and European white birch. Cherries are short-lived and prone to disease, while European white birch, along with other white bark birches, are also fairly short-lived and have been succumbing to a combination of summer drought and bronze birch borer infestations. Other reasons for poor condition classifications included trees in steep decline, decay, and cavities, and large trees that have been topped either by the power company or by over-zealous adjacent property owners. Many of the fair condition trees require only remedial work to bump them up into the good category, often just the removal of dead or damaged limbs. Though only 1% of our street trees are dead, these trees at the least are unsightly and do not add value to Salem's streetscape. At the worst, they may be hazardous. Removing these trees should be a high priority.

GOOD **FAIR** **POOR**

Figure 4. Examples of good, fair, poor street trees.

Street Tree Diversity

The general urban forestry standard for achieving diversity and resilience in street tree populations is the 10-20-30 target (Santamour 1990.). 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 target may not be adequate for sufficiently protecting urban forests from widespread diseases and other threats (DeepRoot 2013). Consequently, some cities have adopted more ambitious targets to better protect their urban forest resources. For example, the City of Portland has a 5-10-20 goal, while the Morton Arboretum proposes a 5-10-15 rule (The Morton Arboretum, n.d.). The goal of these targets is to ensure a balance and diversity of trees so that a specific disease or insect infestation (such as Emerald Ash Borer) does not decimate a city's tree canopy.

In the tables on the following page, the red shading indicates where the city is not meeting the 10-20-30 guideline, while the yellow shading indicates where the city is not meeting the more restrictive 5-10-20 target.

Results

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

Table 3 shows the ten most abundant street tree species. Maple make up approximately 28% of Salem's street trees.

Table 3. The 10 most abundant street tree species

SPECIES	% of Trees
Acer platanoides (Norway maple)	13.3%
Acer rubrum (Red maple)	12.1%
Pseudotsuga menziesii (Douglas fir)	6.7%
Prunus spp (Cherry, flowering)	4.6%
Pyrus calleryana (Pear, flowering)	4.6%
Liquidambar styraciflua (Sweetgum)	4.2%
Quercus rubra (Northern red oak)	2.8%
Tilia cordata (Littleleaf linden)	2.3%
Acer macrophyllum (Bigleaf maple)	2.3%
Fraxinus oxycarpa (Raywood ash)	2.3%

Table 5 shows the diversity and percent of the ten most common street tree genera in the sample inventory. Trees in the maple genus (*Acer*) make up approximately 32% of Salem's street tree population.

Table 4. The 10 Most Abundant Street Tree Genera

GENUS	% of Trees
Acer (Maples)	31.9%
Prunus (Cherries, Plums)	8.9%
Quercus (Oaks)	6.7%
Pseudotsuga (Douglas fir)	6.7%
Fraxinus (Ashes)	5.0%
Pyrus (Pears)	4.7%
Liquidambar (Sweetgums)	4.2%
Betula (Birches)	3.3%
Tilia (Lindens)	3.2%
Pinus (Pines)	2.8%

Table 5 shows the most common street tree families. The Sapindaceae family (almost entirely maples) accounts for 32% of Salem's street trees.

Table 5. The 10 Most Abundant Street Tree Families

FAMILY	% of Trees
Sapindaceae (Maples, Horsechestnuts)	32.0%
Rosaceae (Apples, Cherries, Plums, etc.)	15.7%
Pinaceae (Needle-leaved conifers)	11.6%
Fagaceae (Oaks, Beeches)	7.0%
Betulaceae (Birches, Alders)	5.7%
Oleaceae (Ashes)	5.1%
Altingiaceae (Sweetgums)	4.2%
Cupressaceae (Scale-leaved conifers)	3.6%
Malvaceae (Lindens)	3.2%
Ulmaceae (Elms)	2.6%

Discussion

Overall, Salem's street tree species are moderately diverse. Though the inventory did not consider the age of neighborhoods, there is probably much less diversity in the street tree population of newer developments. Developers and homebuilders tend to use a very limited palette of tree species, typically red maples, callery pears, and a few species of ash.

At 13% and 12 % respectively, Norway maples and red maples are overrepresented in Salem's street tree population, given common urban forestry guidelines. Maples are over abundant at the genus and family level as well. Based on the more conservative 5-10-20 rule, Douglas fir is also overabundant. This species, though, may have been overrepresented in the street segments sampled; its actual abundance is probably closer to 5%. Of concern also are the trees in the Rosaceae (Rose) family. These include cherries, plums, and crabapples. Though not technically overabundant at 16% of the population, they have several issues; they are prone to disease and pests, are short-lived, and do not provide as many ecosystem benefits compared to larger-growing species. Collectively, the maple family and the rose family make up 48% of the street tree population.

Another potential concern is our ash species (*Fraxinus*). The Emerald Ash Borer has devastated ash trees in much of the eastern United States and has spread as far west as Colorado. Infested ash trees will lose most of their canopy in 2 years and will die within three to four years (Emerald Ash Borer Information Network, n.d.). If the infestation spreads to Salem, the City could lose essentially all our ash trees. At 5% of our street tree population, we would lose over 2,000 trees. That would be a significant loss of ecosystem services and a strain on the urban forestry budget for removal and disposal of dead and dying trees.

Importance Value

The importance value is a measure of how much a species dominates the urban forest tree canopy and is calculated by the iTree Streets program. The calculation is based on the species' abundance and size (McPherson and Rowntree 1989, 15-17). Given the same abundance, 10% for instance, a larger tree with greater canopy cover will have a greater importance value than a smaller tree. The recommended maximum for a single species is an importance value of 10. This is because the loss of a single species through a pest or disease outbreak would have a disproportionately large impact on the overall urban forest tree canopy.

Results

Table 6 shows the importance value rankings of the top ten street tree species.

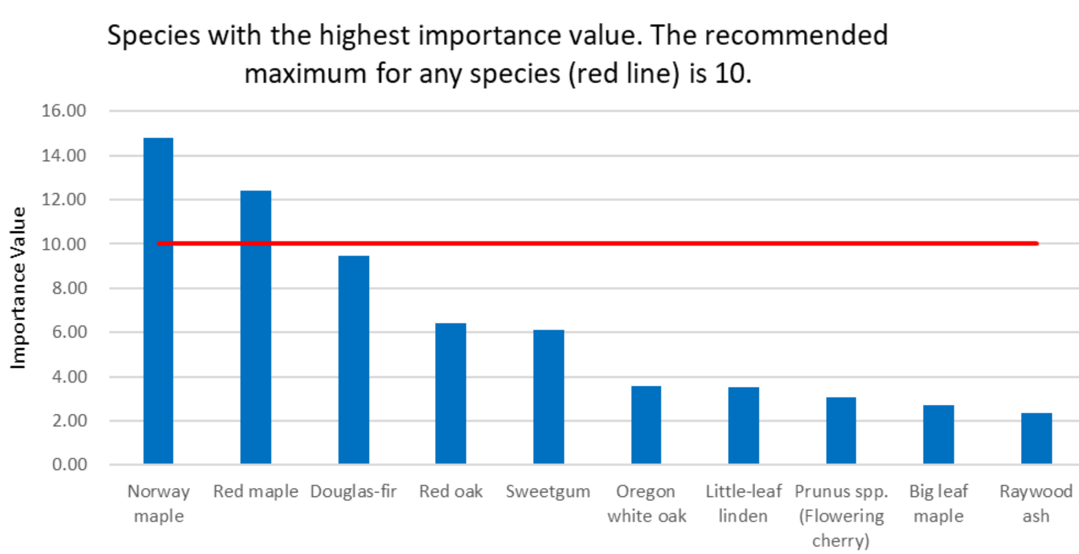


Table 6. Importance Value of Top 10 Street Tree Species

Discussion

Norway maple has an importance value of 14.8 while red maple has a value of 12.4. Norway maple and red maple are also overabundant based on this way of analyzing the data. Based on this information, Salem should move away from planting maple trees. Douglas fir is close to the recommended maximum at an importance value of 9.5; however, this tree is rarely planted now as a street tree. All other species are well under that mark.

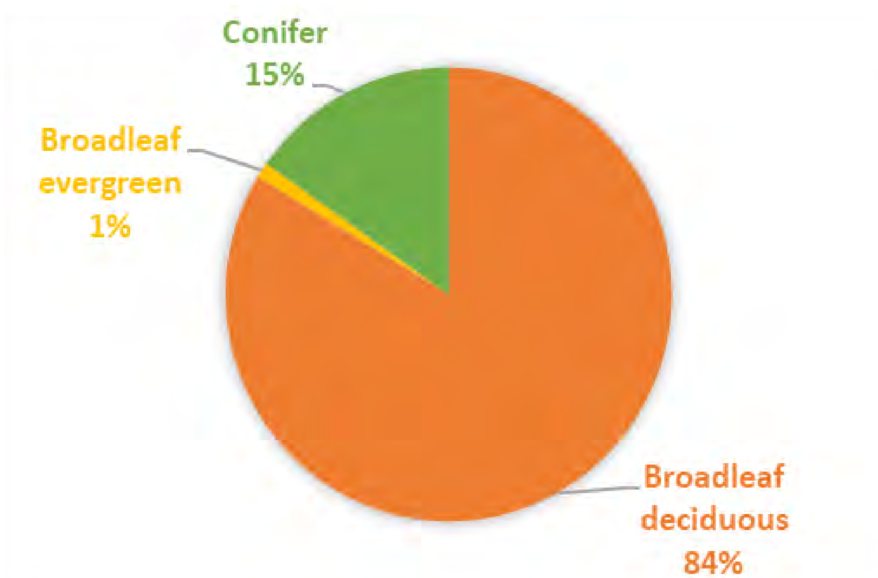
Tree Type Composition

Tree type is broken into three broad categories: evergreen conifer, deciduous broad-leaved, and evergreen broad-leaved (such as southern magnolia and Pacific madrone). There are also some deciduous conifers such as bald cypress and larch. For the purpose of this analysis, those trees would be classified with deciduous broad-leaved. Though Salem does have a small population of deciduous conifer street trees (mostly bald cypress), none of them showed up on the sample inventory. These three categories are helpful in determining the level of ecosystem services provided by our street tree population.

Results

Table 7 shows that most of Salem's street trees are broadleaf deciduous species (84%). Conifers make up 15% of the street trees and broadleaf evergreens constitute only 1% of the street tree population.

Table 7. Tree Type Composition



Discussion

Large evergreen species provide greater year-round environmental benefits compared to deciduous trees. An important ecosystem service of street trees is the interception of rain with a subsequent reduction in peak flows of stormwater into our storm drains and then into our area streams. Since most of Salem's precipitation occurs during the leaf off period, deciduous trees do not intercept as much rain water as do evergreen conifers. One study of forest trees found that conifers intercept between 20 and 40% of annual rainfall, while hardwoods intercept only about 10 to 20% of annual rainfall (Clapp 2014). Another study found that urban conifers perform even better, perhaps due to denser crowns associated with a more open-grown setting. Douglas fir (*Pseudotsuga menziesii*) was found to have an average interception rate of 49.1% while western redcedar (*Thuja plicata*) on average intercepted 60.9%.

Percentage of Large Maturing Trees Being Currently Planted

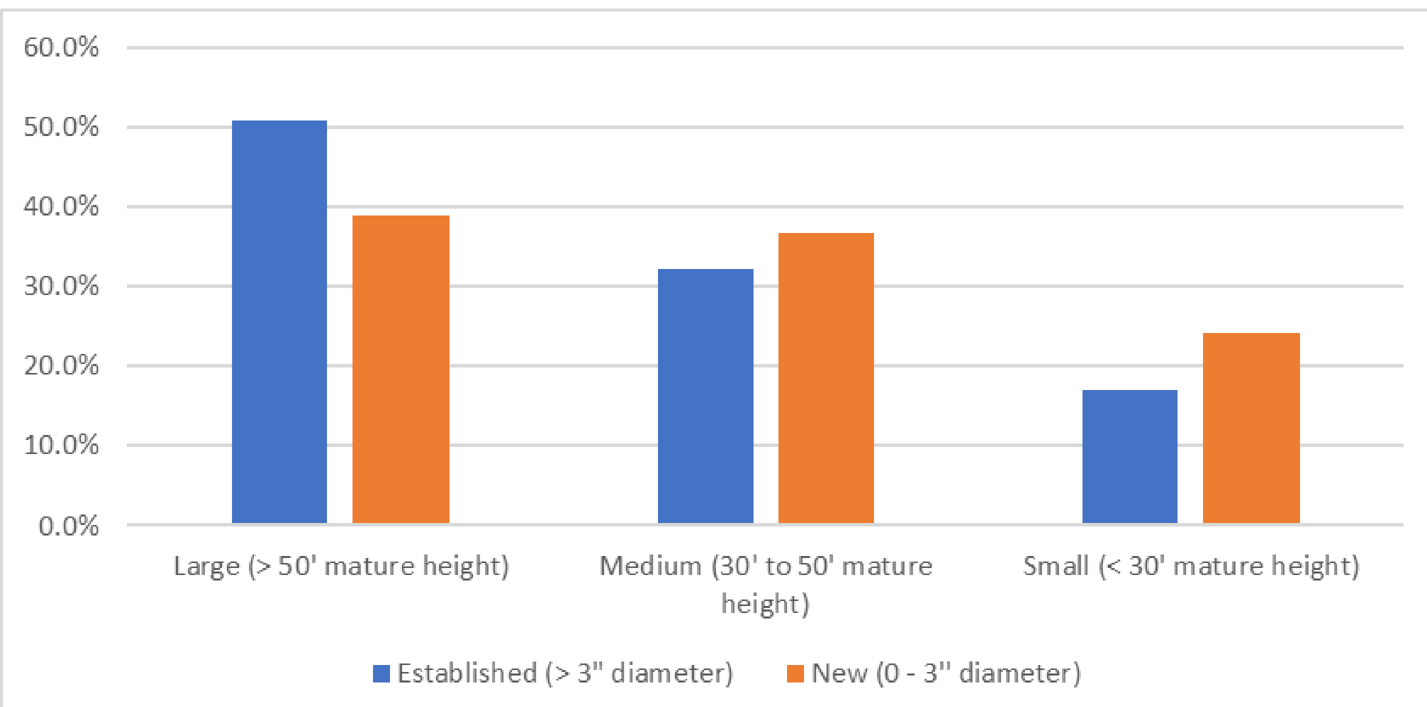
Large-maturing trees will have greater ecosystem benefits as they mature compared to small-maturing trees. Shade, stormwater interception, pollution particulate capture, and carbon sequestration are all increased with the increased canopy cover of large-maturing trees. Therefore, it is useful to analyze the mature size class of recently planted trees in order to predict future canopy cover.

Results

Table 8 shows the mature size of recently planted trees compared to established trees. Fifty one percent (51%) of our established trees (those with a diameter of over 3 inches) are in the large maturing size class while only 17% are in the small maturing size class. Of the recently planted trees (with a diameter of less than 3 inches), only 39% are in the large-maturing size class and the percentage of medium and small trees being planted has increased.

Figure 5. A coniferous Douglas fir tree as a street tree.

Table 8. Percentage of Large, Medium, Small Maturing Trees Being Planted Compared to Established Trees.



Discussion

Based on the current trend, the overall canopy cover of our street trees will decline since a greater percentage of small-maturing trees are being planted compared to the established tree population. Fortunately, of the approximately 8,000 vacant planting sites, over 65% are sufficiently sized for large-maturing trees. That is, they are at least 6 feet wide and have no overhead primary power lines. Moving forward, the City should strive to plant the largest maturing trees that the site constraints will permit.

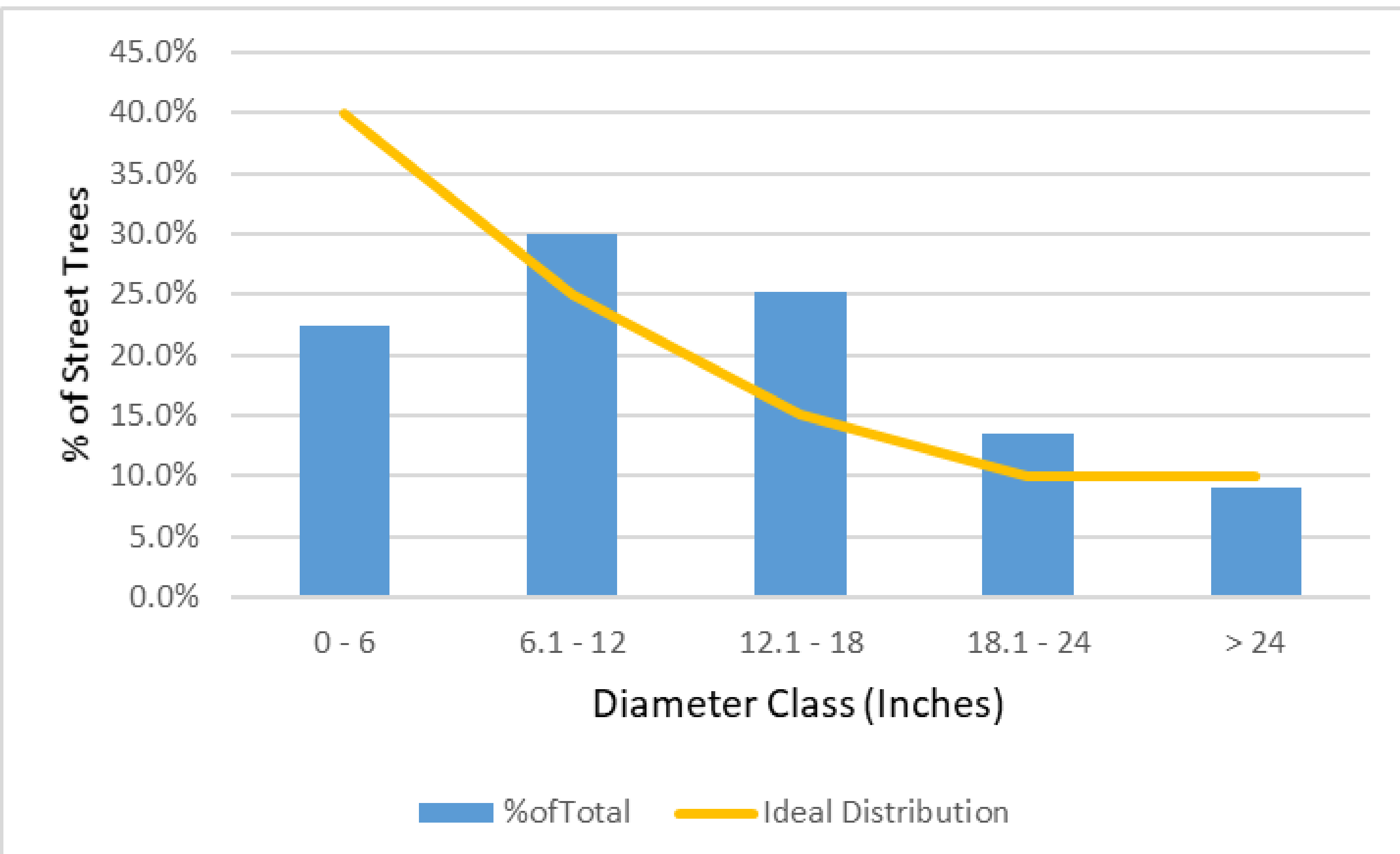
Age Distribution

The DBH (diameter at breast height) was collected for each tree that was surveyed in the inventory. This measurement can be used as a proxy for the overall age distribution of the street tree population (McPherson, van Doorn, and de Goede 2016, 107). Though different species of trees will mature at different rates and at different sizes, older trees will generally have a larger diameter at breast height. An ideal distribution has young trees representing the highest percentage (40%) and gradually tapers off with medium and large mature trees (McPherson, van Doorn, and de Goede 2016, 107). The larger percentage of trees in the youngest size class accounts for a level of mortality that is to be expected as trees mature.

Results

Our sample shows that at 22%, young trees are underrepresented in the population. Mid-life trees are somewhat overrepresented, while mature trees are close to the ideal.

Table 9. Salem's Street Tree Diameter Classes Compared to an Ideal Distribution Line



Discussion

The underrepresentation of young trees is a concern because it means that there may not be enough younger trees to replace the aging ones as they begin to decline. Newly planted trees require several decades to grow into a place of prominence in the urban forest canopy. Maintaining a stable population assures that there will always be enough trees growing into the mature size class. Another benefit of striving for this ideal distribution is that maintenance costs can be balanced over time; maintaining older trees and removing them as they senesce is a large part of an urban forestry budget. To be clear, though, the objective is not to decrease the abundance of mature trees; rather, it is to increase the abundance of young trees.

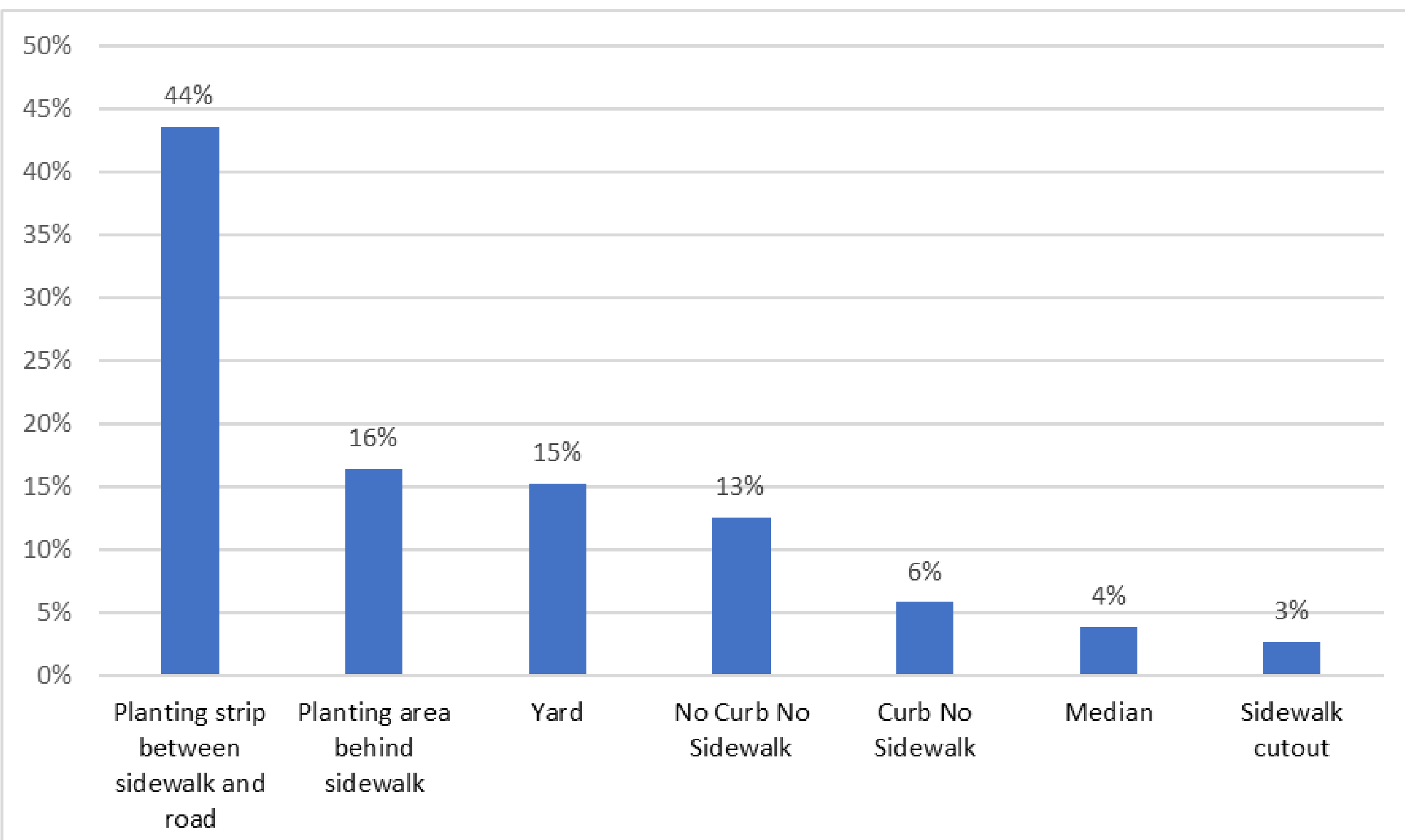
Planting Site Composition

There are many different types of right-of-way planting sites within a typical city. They range from streets with no curb or sidewalk and an ill-defined right-of way edge to a well-defined planting area between curb and sidewalk. In the latter case, the right-of-way edge is typically directly behind the sidewalk. One of the advantages of a planting strip between curb and sidewalk is that the trees in this area are more easily recognized by residents as street trees.

Results

The planting strip between curb and sidewalk (at 43.5%) is the most common planting site type in Salem. Trees in the street medians (planting areas between opposing lanes of traffic) and sidewalk cutouts (typically downtown) comprise another 6.5%. All other planting types—those in which ownership of the right-of-way trees is not as obvious—comprise 50% of the street tree population.

Table 10. Distribution of Trees by Planting Site Type



Discussion

Most of Salem's older neighborhoods have well-defined planting strips between street and sidewalk while many of our newer residential neighborhoods have curb attached sidewalks with a right-of-way that extends into the front yard. In these cases, the adjacent resident often believes that the trees located in this area are private trees. These trees are more likely to be removed without a permit or trimmed in a manner that does not comply with City standards. Also, yards are more likely to be planted with species that do not meet street tree criteria.

BENEFITS

Trees provide a variety of well-proven social, economic, and environmental benefits. Street trees are particularly important since they are adjacent to the impervious surfaces of roads and sidewalks. They intercept rainfall and funnel rain to the ground, allowing for infiltration and slowing stormwater runoff. Even in winter when leaves are off, branches intercept rain, though to a lesser extent. This reduction and slowing of runoff benefits stream quality and can reduce the need to make costly upgrades to stormwater infrastructure.

Trees also improve air quality by sequestering carbon (an important means of combating climate change) and by trapping pollution particulates. The shade created by larger-maturing trees also benefits us in many ways. They make the urban environment more tolerable on hot summer days. With enough trees, along with other urban vegetation, the heat island effect of the urban core can be mitigated (Elmes et al. 2017). Shade has also been shown to increase the usable life of paved streets. The shade from well-placed trees can also reduce the need for air-conditioning, saving power and further reducing our carbon footprint.

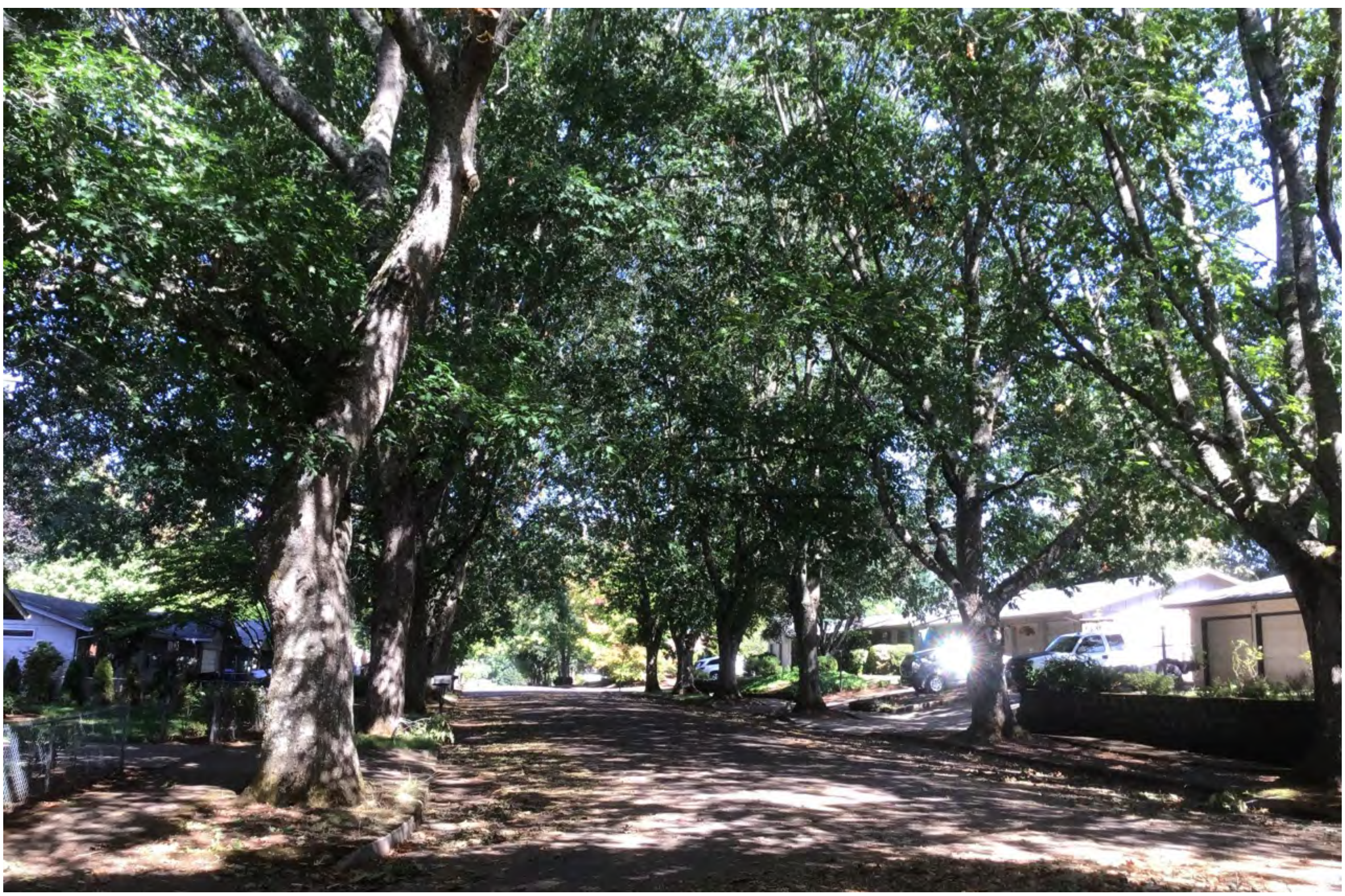


Figure 6. Residential street shaded by mature red oak trees (*Quercus rubra*).

Many of the intangible benefits of trees can be challenging to quantify but are very real (Vibrant Cities Lab, n.d.). Trees provide a sense of place, positively defining the areas in which we live and work and helping us to feel connected to those areas. The sense of nearness to nature instills peace, well-being, and health in our increasingly hectic lives. Doctors have begun prescribing time in nature to relieve various physical, mental, and emotional problems. The healing benefits of nature, even a view of trees outside the window, have been well-documented (Ulrich 1984). People also tend to spend more time outside getting fresh air and exercise when shade trees are present. Trees have been found to help us live longer and give us a higher quality of life (Chung 2017).

Trees in shopping districts have been shown to benefit business. People will tend to spend more time and money in stores that have well cared for trees along the streets and in the parking lots (Wolf 1999). Well-placed and well-maintained trees have also been shown to increase property values. Many other benefits, including a reduction in crime and reduced traffic speeds, are correlated with the presence of healthy street trees.

The habitat benefits of Salem's street trees are also important. In our increasingly urbanized and fragmented natural environment, urban habitat is an important refuge for native wildlife. Urban trees provide nesting, forage, and cover for song birds that have been declining across North America (Rosenberg, et al. 2019). Many of our trees are an important source of nectar for native pollinators that are also declining. It has been found that cities often have a more diverse population of native bees than the surrounding countryside due to the loss of quality habitat in rural areas (Hall, 2016). Street trees can play as much of a role in supporting pollinators as do backyard gardens.

Environmental and Esthetic Benefits of Salem's Street Trees

Below is an estimate of the annual economic benefits that Salem's current street tree population provides based on the iTree Streets calculations. The average annual benefit per tree is $96. This adds up to 4.1 million dollars annually. Larger-maturing trees provide more overall benefits. Salem's red oak trees, for instance, average $233 of annual benefits, while crabapples only provide $15.30 per year. When the cost of maintenance is factored in, somewhere between $23 and $35 per tree annually, our smaller-growing trees may yield a negative benefit. This is yet another reason to plant and care for larger-growing trees.

Table 11. Valuation of Annual Environmental and Aesthetic Benefits

Benefits	Total ($)	Standard error	$/tree
Energy	168,189	7.2	3.92
CO2	40,776	6.9	0.95
Air Quality	86,198	7	2.01
Stormwater	1,224,840	7.3	28.56
Aesthetic/Other	2,596,334	7.3	60.53
Total Benefits	4,116,336	7.2	95.97

RECOMMENDATIONS

Based on the information gathered and analyzed for the street tree inventory and current best management practices for a healthy urban forest, the following measures are recommended:

- ► Continue adding resilience to our street tree population by planting diversified species which are well adapted to our current and changing climate.
- ► Consider adopting guidelines such as a 5-10-20 target concerning the desired percentages of species, genera, and families of street trees.
- ► Consider adding large-maturing conifers to our recommended street tree list and planting them where space and other considerations allow. More broadleaf evergreen trees could also be planted as they also provide year-round benefits and currently account for only 1% of our total street tree population.
- ► Explore outreach programs to better inform citizens about our street tree program and the benefits provided by street trees. Very often our residents don't know which trees are in the street right-of-way. Even when they do know, they often don't know that the care of street trees is regulated by the City.

Key Points

- ► Plant more trees! Younger trees are needed to replace trees as they age.
- ► Select more diverse species for new plantings. Avoid maples, and deemphasize cherries, pears and ash.
- ► Plant more evergreen trees where appropriate to achieve greater environmental benefits.
- ► Plant large-maturing trees where space allows.
- ► Use empty site data to identify planting opportunities. Focus on low canopy neighborhoods.
- ► Expand the street tree inventory for greater accuracy and usability.

Future inventory options

As resources allow, performing a complete street tree inventory would yield even more valuable information moving forward. It would give us a better basis from which long-range management plans could be formulated. For example, a complete inventory is an important first step in developing a risk assessment of our street tree population. The sample inventory can give us an idea of how many mature trees we have with condition problems, but since it is only a small sample of the total street trees it cannot map the location of all poor condition trees for further assessment and monitoring. A complete inventory would also give us the ability to map the location of ash trees and develop an action plan to prepare for the threat of Emerald Ash Borers. One option is to conduct periodic full inventories, for instance, every ten years.

A possible next step toward a complete inventory could be to survey sections of the city such as the downtown core, the historic districts, or perhaps older neighborhoods where many of the largest street trees reside.

Many cities, including Eugene, Oregon, have chosen to build a street tree inventory over time by incorporating an inventory into their daily management activities. When an inspector visits a tree or a group of trees, they enter it into the inventory or, if it's already inventoried, they update the information. Likewise, when a tree crew performs work on the trees or plants trees, they update the information as they go.

Alternatively, a combination of methods could be employed. Urban forestry staff could inventory 10% every year along with a continual update of the inventory as individual trees are visited. This way the inventory is a living database that gives an accurate representation of the street tree population and informs long-range and daily management decisions. Citizen-science is also a way to engage volunteers to conduct tree inventories in specific areas. Portland, for instance, relies on volunteers that they train to conduct street tree inventories. An added advantage of utilizing volunteer labor is that Salem neighborhoods will have knowledgeable tree advocates caring for the urban forest. While this is a great outreach and engagement tool, quality control and volunteer management will require staff time.

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