PORTLAND PARKS & RECREATION

Healthy Parks, Healthy Portland

Street Tree Inventory Report
City of Portland
April 2017

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Cover Photos (from top left to bottom right):

1) Pear (*Pyrus* sp.) and ash (*Fraxinus* sp.) line a typical center city neighborhood.
2) Compound foliage of a Kentucky coffee tree (*Gymnocladus dioicus*), a large form street tree that remains uncommon in Portland.
3) Scarlet oak (*Quercus coccinea*), an alternative to maples for a bright display of fall color.
4) Bambooleaf oak (*Quercus myrsinifolia*), is evergreen and unlike deciduous trees provides benefits year round.
5) Large scented flowers of a broadleaf evergreen southern magnolia (*Magnolia grandiflora*).
6) These broadleaf evergreen silverleaf oaks (*Quercus hypoleucoides*) in Irvington were the first of their kind to be planted as street trees in Portland.
7) Chinese pistache (*Pistacia chinensis*) offers a brilliant display of color in the fall, and performs well in Portland's dry summer climate.
8) Portland's most common street trees are Norway maple (*Acer platanoides*) and ornamental plum (*Prunus* spp.). *Acer* and *Prunus* together comprise 39% of the street tree population.

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Contents

Volunteers guided by Portland Parks & Recreation Urban Forestry staff collected data on all 218,602 street trees in 95 neighborhoods to compile Portland's first complete street tree inventory. The data have been used to inform the creation of Neighborhood Tree Plans to guide volunteers in caring for their community's trees.

Key Findings

This report provides the results of Portland's street tree inventory conducted between the years 2010 - 2016, along with Portland Parks & Recreation (PP&R) Urban Forestry staff recommendations. Staff and volunteers collected data on 218,602 Portland street trees.

URBAN FOREST STRUCTURE

- **Portland's street tree population is dominated by maple, plum, and cherry and does not meet recommended species diversity guidelines.** While 55 families were found in this inventory, only two families, Rosaceae and Sapindaceae, account for 52% of the street tree resource. Of 145 genera found, the *Acer* (maple) and *Prunus* (plum, cherry) genera account for almost 39% of all street trees, leaving Portland's street tree population vulnerable to pests, pathogens, and effects of a changing climate.

- **Broadleaf deciduous trees, which drop their leaves in winter, make up 92% of the population.** A greater empahsis on planting evergreen trees for year-round benefits would create a more resilient, sustainable urban forest.

- **Portland's rights-of-way host too few mature trees (>18" DBH), while populations of young and mid-size trees are slightly over represented.** However, age class is not distributed evenly throughout the Portland street tree population, with higher proportions of older trees in neighborhoods close to the city center.

- **Only 20% of Portland's street trees are large form varieties, and large form trees make up just 17% of those recently planted.** Trees with a large size at maturity are necessary to increase canopy cover and the benefits they provide for Portland's residents. Planting the estimated 17,921 large available spaces identified in this inventory will maximize tree canopy in Portland's rights-of-way.

- **Small form trees are increasingly planted across all planting sites.** Without greater focus on the planting of large form trees in large sites, goals for increasing canopy and maximizing the benefits generated by Portland's urban forest will be difficult to meet.

TREE CONDITION

- **More than 90% of trees inventoried are in fair or good condition.** However, 40% of the trees that are rated poor are in the Rosaceae family including nearly one-quarter of all trees in the *Prunus* genus.

PLANTING SITES AND STOCKING LEVEL

- **Only 60% of Portland's street tree planting sites have trees.** Generally, stocking levels are lower in unimproved rights-of-way and in smaller improved sites. Planting efforts should focus in low canopy neighborhoods and on the largest sites with no overhead high voltage wires first, as large form trees will provide the most long-term benefits.

- **Only 33% of Portland's large planting sites contain trees large enough for the site.** Citywide, there are 76,899 undersized trees. Small form trees planted in large and medium planting sites are a missed opportunity because larger trees contribute many times more benefits than do smaller ones.

- **There are 19,072 available large sites across the city.** This represents an opportunity to plant large form trees.

- **Uneven distribution of larger sites poses a challenge to the growth and longevity of street trees in many neighborhoods.** While small planting sites make up only 25% of the sites where street trees were inventoried citywide, in some neighborhoods more than three-quarters of sites are small. In these areas, creative expansion of planting sites or increased planting on private property may be the only ways to adequately expand canopy.

URBAN FOREST VALUE AND BENEFITS

- **Portland's street trees produce an estimated $28.6 million annually in environmental and aesthetic benefits.** The replacement value of this resource is $753 million. Planting efforts focused on appropriately sized trees distributed across the City to ensure that future benefits are equitably distributed among all residents.

Clockwise from top left: 1) Only 60% of street tree planting sites have trees in Portland. In total, 79,843 sites are available for planting, 19,072 of them large sites such as this one in the Hollywood neighborhood. Large, empty sites present a great opportunity to increase canopy in many areas of the city. 2) With a DBH of 50.5", this Douglas-fir (Pseudotsuga menziesii) *is the largest diameter street tree in Brentowood-Darlington. Large form conifers in unimproved sites are high-value assets to the community providing year round benefits, and may be at risk as these rights-of-way are developed.*

About Portland's Street Tree Inventory

THE IMPORTANCE OF STREET TREES

Street trees are an important public asset in urban environments, serving as a buffer between our transportation corridors and our homes while providing multiple economic, environmental, and social benefits such as cleaner air and water, cooler summer temperatures, and safer streets. These benefits continue to increase over the lifetime of the tree, making their planting and maintenance one of the best investments a city and its residents can make.

While street trees are only one component of Portland's urban forest, they are particularly important because they are the trees that residents interact with most. Having adequate information about the street tree population allows both City staff and the community to make informed decisions about species selection, planting, and maintenance priorities. Information on the location, condition, and diversity of the street tree population enables our communities to steward this resource and ensure its continued benefits into the future.

THE INVENTORY PROCESS

Portland's Tree Inventory Project began in 2010 with a single pilot neighborhorhood street tree inventory, and in the following years this collaboration between community volunteers and Urban Forestry expanded across the city. Community groups made a two-year commitment that involved tree inventory, data analysis, creation of a stewardship-focused Neighborhood Tree Plan, and execution of stewardship and education events. Although the focus of this report is on the findings from the inventory, one of the primary goals of the project was to build a network of volunteer groups and urban forestry advocates.

Portland regulates street tree removal, planting, and maintenance through a permitting process, and property owners are responsible for the care and maintenance of adjacent street trees. Creating a healthy urban forest depends on the active engagement of residents to care for their street trees.

Each neighborhood inventory began with the organization of volunteers into Tree Teams. Tree Teams sought local support for the project, selected staging sites, and recruited volunteers to collect data. Urban Forestry staff provided training, tools, and event organization. Over multiple work days, data was collected on tree species, size, health, and site conditions (more information on methods can be found in Appendix A). Data was entered into an ArcGIS database by volunteers in the Urban Forestry office. Staff analyzed data for each neighborhood and presented findings at an annual Tree Summit in the fall. At the Summit, neighborhood groups developed Tree Plans that set achievable goals to improve existing trees, expand tree canopy, and connect the neighborhood with City and nonprofit resources. The resulting Neighborhood Tree Plans are based on the inventory findings, and recommend specific actions to improve and expand the community's street tree resource. Urban Forestry continues to partner with groups to organize stewardship events aimed at meeting Tree Plan goals, including pruning, planting, and educational workshops.

By the end of 2016, all 95 of Portland's neighborhoods were included in the street tree inventory project and together volunteers and staff identified, measured, and mapped more than 218,000 street trees. Fifty-one

neighborhoods participated in the volunteer partnership and 44 neighborhood inventories were completed by Urban Forestry staff. Some neighborhoods are noted as partially inventoried, because their rights-of-way are dominated by wooded natural areas and are not suited to the inventory method employed in this project. Partial inventories therefore included only street trees in improved rights-of way (Appendix C). Thus, total number of street trees reported here is an underestimate of total trees in City rights-of-way.

The Tree Inventory Project supports Portland's *Urban Forest Management Plan* goals: to manage the urban forest in order to maximize community benefits for all residents; to develop and maintain support for the urban forest; and to protect, preserve, restore, and expand Portland's urban forest. The completion of the street tree inventory meets a core objective of Portland's *Urban Forest Action Plan* (UFAP), a primary goal of which is enhanced canopy. This inventory provides data to inform planning and management for desired outcomes identified in the UFAP, including the targeting of low income and low canopy neighborhoods for street tree planting. The periodic updating of the inventory will provide important data for change analysis over time.

Data from the inventory are available to the public in spreadsheet or ArcGIS format. Visit the Tree Inventory Project website at *http://portlandoregon.gov/parks/treeinventory* to learn more about the project and download reports, data, and maps.

Street Tree Inventory Findings

Study Area

The City of Portland, with a population of over a half million residents, is the largest city in Oregon. Located the northern end of the Willamette Valley at the confluence of the Willamette and Columbia Rivers, Euro-American settlement began in the 1830s with today's downtown well established as a port city by the beginning of the 20th century.

The city is bisected by the Willamette River. Urbanized flat lands extend from the east bank, interrupted by low remnant volcanic peaks. Wooded hills rise on the City's west side above Portland's downtown which occupies a narrow floodplain. Industrial lands occupy much of the area along the Willamette and Columbia rivers, especially north of downtown. Eighty percent of Portland's population is spread through residential neighborhoods east of the Willamette River.

The history of Portland's urban forest starts with its early identity as "Stumptown" for the clearing of forested land to make way for rapid settlement. Portland quickly reestablished its urban forest in part guided by a Frederick Law Olmsted's 1903 plans for public parks and parkways. Portland's urban forest is not distributed equally across the landscape, with much higher rates of canopy cover in the forested hills of the city's west side, which include the 5,000 acre Forest Park. East of the river, where urbanization rapidly increased in the second half of the 20th century, canopy cover is more sparse and fragmented.

History, land use, and development patterns have an important effect on the presence and condition of street trees. Areas of Portland that were designed without the inclusion of street trees or with small planting spaces limit the potential for street trees, while unimproved rights-of-way with no defined tree planting space are common in large areas of east Portland not annexed by the city until the 1980's or later. With redevelopment and new designs that include adequate space for trees, there is opportunity for increased use of street trees to expand overall tree canopy. Because care and maintenance of Portland's street trees is the responsibility of the adjacent property owner, rates of homeownership and income level also influence the presence and condition of trees, as the cost of proper maintenance over a tree's lifetime can be a barrier to planting and care.

Portland's climate is known as a modified Mediterranean climate characterized by summer dry and winter wet patterns with an average minimum temperature of 15 to 20°F and average annual rainfall of 36 inches.

Tree canopy covers 31% of Portland (Portland Parks and Recreation 2017). Portland's citywide average population density is 7 persons per acre (Table 1). Home ownership averages 54% citywide. Forty-five percent of households are considered low-income.

Table 1: Portland demographics

Demographics (2010 Census)	Portland
Land area	85,376 acres
Population	583,776
Density	7 persons/acre
Race	72% white, 9% Hispanic/Latino, 7% Asian, 6% black, 4% mixed race,1% Native American, 1% Pacific Islander
% of properties occupied by homeowners	54%
% of low income households	45%

Urban Forest Composition

SPECIES DIVERSITY AND TREE TYPE COMPOSITION

A diverse tree population in terms of species, age, form, and function maximizes urban forest benefits through time while minimizing costs and risk. Maintaining a diverse species mix is a critical way to promote a healthy and resilient urban forest. The conventional metric for evaluating urban forest species diversity is the 10-20-30 rule (Santamour 1990), according to which the urban forest population consists of no more than 10% of one species, 20% of one genus, or 30% of one family. However, this guideline has been found to be inadequate in some cases, leaving cities vulnerable to catastrophic forest loss due to pests and pathogens (Raupp et. al 2006). Considering Portland's temperate climate, where a great variety of trees are able to thrive, limiting this to 5-10-20, as other progressive urban forestry programs have, should be the goal. Trees were identified to the genus or species level and categorized as "tree types" (Appendix A).

Results

Portland's public rights-of-way host a wide variety of tree types. The street tree population consists of 216,750 living trees of 161 types (Appendices A, B). Norway maple is the most common tree type, representing 8.9% of all street trees (Table 2). Red maple, cherry, pear, and plum are also common, representing 7.1%, 6.3%, 5.4%, and 5.3% of trees, respectively. The most common 15 tree types comprise 64.6% of the resource, leaving the remaining tree types to each represent 1.8% or less of the street tree population.

Table 2: The 15 most abundant street tree types

Common Name	Scientific Name	# of Trees	% of Total	Mean DBH
maple, Norway	*Acer platanoides*	19,209	8.9%	14.3
maple, red	*Acer rubrum*	15,475	7.1%	10.2
cherry	*Prunus* spp.	13,683	6.3%	11.6
pear	*Pyrus* spp.	11,700	5.4%	8.8
plum	*Prunus* spp.	11,449	5.3%	10.0
maple, other	*Acer* spp.	10,635	4.9%	8.6
ash	*Fraxinus* spp.	9,291	4.3%	9.3
dogwood	*Cornus* spp.	8,667	4.0%	5.5
oak, deciduous	*Quercus* spp..	7,056	3.3%	11.3
crabapple	*Malus* spp.	6,779	3.1%	5.7
birch	*Betula* spp..	6,338	2.9%	13.0
linden	*Tilia* spp.	5,490	2.5%	13.4
hawthorn	*Crataegus* spp.	5,416	2.5%	8.7
maple, Japanese	*Acer palmatum*	4,665	2.2%	5.3
snowbell	*Styrax* spp.	4,106	1.9%	2.9
all other		76,791	35.4%	10.2
Total		*216,750*	*100.0%*	*10.0*

The total number of tree types indicates that many species of trees can thrive in Portland, resulting in the potential for a high level of diversity within the city's urban forest. However, this is not reflected in the current distribution of trees across tree types. Although 161 different types were inventoried, the top 15 tree types account for almost two-thirds of Portland's street tree resource, while the bottom 138 tree types account for less than 1% each and collectively for only 22% of the resource. Of the neighborhoods with complete inventories, the number of tree types within a neighborhood ranged from 28 (Old Town-Chinatown) to 112 (Richmond), with a median of 88 tree types.

One hundred and forty-five genera are represented in Portland's street tree population; the top ten genera represent two-thirds of all trees. The *Acer* genus comprises the largest portion of the resource at 26.7%,

followed by *Prunus* at 11.9% (Figure 1). All other genera comprise 5.4% of the resource or less each.

Fifty-five families are represented in the city and the ten most abundant families comprise 82.7% of the resource (Table 3). Sapindaceae and Rosaceae are the most common families and represent 27.6% and 24.5% of trees, respectively. All other families represent 5.1% or less of the resource each.

The Bottom Line

The City of Portland does not meet the 5-10-20 guideline, nor do any of Portland's neighborhoods. Only seven neighborhoods meet the

Figure 1: The 15 most abundant street tree genera, with recommended maximum (10%) in red

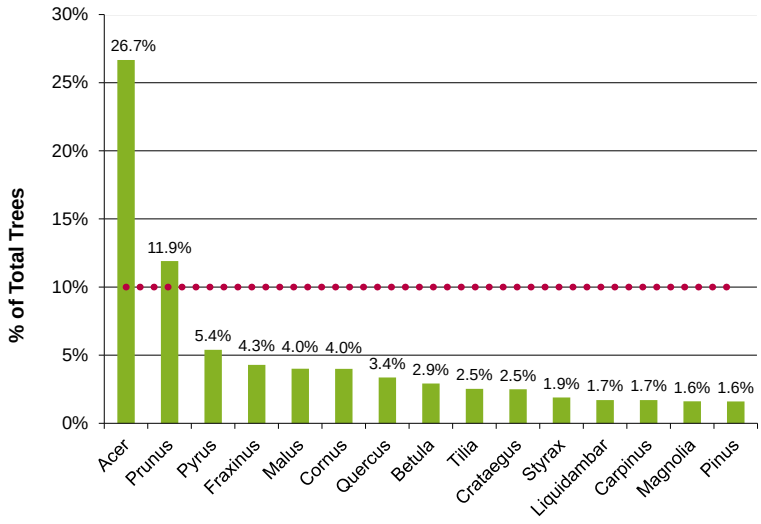


Table 3: The 10 most abundant tree families

Family Scientific Name	Tree Types Included in the Family	# of Trees	% of Total
Sapindaceae	boxelder, golden rain tree, horsechestnut, maple	59,875	27.6%
Rosaceae	apple, Catalina ironwood, cherry, crabapple, hawthorn, loquat, medlar, mountain-ash, ninebark, peach, pear, photinia, plum, Prunus (other), quince, serviceberry	53,119	24.5%
Betulaceae	alder, birch, hazelnut, hophornbeam, hornbeam	11,103	5.1%
Oleaceae	ash, fringe tree, lilac tree, olive, wax-leaf privet	10,710	4.9%
Cornaceae	dogwood, dove tree, tupelo	10,559	4.9%
Pinaceae	cedar, Chinese silver fir, Douglas-fir, fir, hemlock, larch, pine, spruce	9,147	4.2%
Fagaceae	beech, chestnut, golden chinkapin, Japanese chinkapin, oak, tanoak	8,628	4.0%
Malvaceae	Chinese parasol tree, linden, rose of Sharon	5,613	2.6%
Leguminosae	Amur maackia, black locust, golden chain tree, honey locust, Kentucky coffeetree, mimosa tree, pagoda tree, redbud, yellow wood	5,354	2.5%
Ulmaceae	elm, zelkova	5,269	2.4%
all other		37,373	17.3%
Total		*216,750*	*100.0%*

criteria for the 10-20-30 rule. Of most concern is that the *Acer* genus, which has over double the recommended percentage for a single genus. Combined, the *Acer* and *Prunus* genera represent over 39% of all street trees. Furthermore, over half of all trees belong to only two families, Sapindaceae and Rosaceae.

*These red maples (*Acer rubrum*) in Hollywood are commonly planted street trees in commercial districts throughout Portland. The* Acer *genus represents over a quarter of all street trees in Portland.*

Loss of street trees can have significant impact at the neighborhood scale. Increasing diversity at the genus and family level can help reduce risk and expense due to the introduction of Asian longhorned beetle, emerald ash borer, or other potential pests and pathogens which predominately attack only select genera. To illustrate impact from pests, Portland's neighborhoods are mapped according to their level of pest vulnerability (Appendix D). Forty-two percent of street trees in Portland are susceptible to emerald ash borer, Asian longhorned beetle, Dutch elm disease, or bronze birch borer. At the neighborhood level, rates of vulnerability to these pests ranged from 24% in Centennial and Russell to 75% in Eastmoreland. Fewer than one-third of Portland's neighborhoods have street tree populations less than 35% vulnerable. Neighborhoods with lowest vulnerability have benefited from the most recent planting efforts that emphasize diverse species. A higher proportion of remnant native conifers also contributes to low vulnerability in certain neighborhoods.

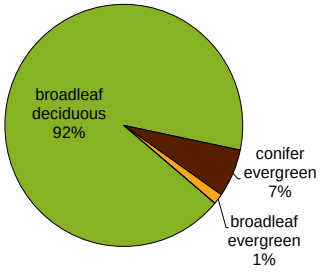
FUNCTIONAL TREE TYPE

Trees are categorized into functional types: broadleaf, conifer, or palm and either deciduous or evergreen. In Portland, where the majority of precipitation falls in winter, evergreens reduce storm water runoff during these wet months, improving water quality in our streams and rivers when this function is most needed. During the dry summer months, many evergreen conifers are less reliant on water availability than broadleaf deciduous trees which require more water to drive photosynthesis. Despite their advantages, conifers are challenging to place in rights-of-way, as they typically require larger spaces and their growth form conflicts with overhead wires and traffic sightlines.

Results

Broadleaf deciduous trees dominate the landscape, accounting for 92% of all street trees in Portland (Figure 2). Coniferous evergreens comprise the next largest portion of Portland's street trees at 7%. Broadleaf evergreen trees comprise just 1% of the total.

Figure 2: Functional tree types



Distribution of evergreen tree types within neighborhoods in Portland is uneven, with older more developed neighborhoods closer to the city center having a lower proportion of evergreens (Appendix E). Outer east side neighborhoods with more unimproved rights-of-way and remnant mature conifers have a higher proportion of evergreens, while west side neighborhoods such as Hillsdale and West Portland Park have the most evergreens at over 30%.

The Bottom Line

The street tree population is dominated by broadleaf deciduous trees. Increasing use of evergreens, both broadleaf and conifer, would enhance certain benefits including reduced storm water runoff, and also provide winter cover and habitat for urban wildlife. Though conifers still need adequate water during establishment, in general they require less water than broadleaf deciduous trees during the increasingly warm and dry Portland summers. Large planting sites without overhead wires provide an opportunity for planting these important trees.

SIZE CLASS DISTRIBUTION

Age diversity ensures the continuity of canopy coverage and benefits through time. Although tree species have different life spans and mature at different sizes, older trees will generally have a larger size, as measured by diameter at breast height (DBH). As trees increase in size and age, the value of the tree and the magnitude of the benefits that the tree provides also increase until the tree nears the end of its lifespan and begins to decline.

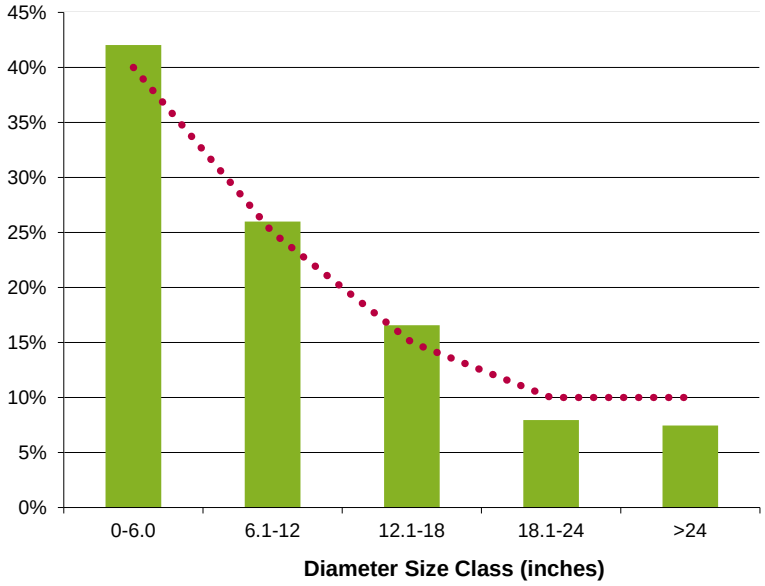
The general management principle underlying size class distribution is to maintain a consistent proportion of young trees in the population—recognizing that there will be some level of mortality as trees grow—while also keeping a good distribution of mid to large sized trees. This will ensure a sustainable age class structure and produce maximum urban forest benefits over time.

Trees were categorized into diameter size classes (Figure 3). Trees that are 0" to 6.0" in diameter represent young trees. Trees that are 6.1" to 18" in diameter represent midlife trees, as well as mature, small form trees. Trees that are 18.1" or greater in diameter represent mature trees.

Results

Portland's streets host a wide range of tree sizes from the smallest sapling to the largest tree, an 86.5" DBH giant sequoia (*Sequoia giganteum*). The greatest proportion of trees are in the mid-size diameter size classes. Mid-size trees account for 42.6% of the inventory with 26% percent of all trees 6.1" to 12" DBH, and 16.6% between 12.1" and 18". Small diameter trees with DBH between 0" and 6.0" represent 42% of trees and only 15.4% are larger than 18.1" DBH.

Figure 3: Trees by diameter size class, with ideal distribution in red



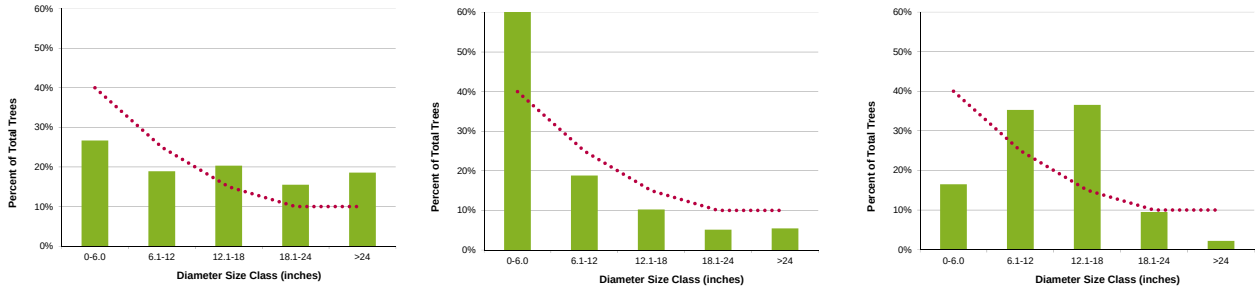
The Bottom Line

Citywide, it appears that the size class distribution of street trees is nearly ideal, with older trees slightly underrepresented, however this distribution masks the wide variation in distribution curves at the neighborhood level.

Long-established residential neighborhoods, planned from the outset with wide rights-of-way and close to the city center

tend to have a higher proportion (over 30%) of trees over 18" DBH (see Irvington, Figure 4), and lack the adequate population of young trees needed to replace a maturing canopy over time (Appendicies F, G). In neighborhoods further east of the city center or dominated by narrower rights-of-way, young trees make up 30% or more of the street tree population (see Centennial, Figure 4) (Appendix G). Neighborhoods with more commercially zoned properties are dominated by mid-sized trees, lacking in young trees needed to sustain a healthy size class distribution (see Lloyd District, Figure 4).

Figure 4: Trees by diameter size class, with ideal distribution in red, in the Irvington (left), Centennial (center), and Lloyd District (right) neighborhoods.

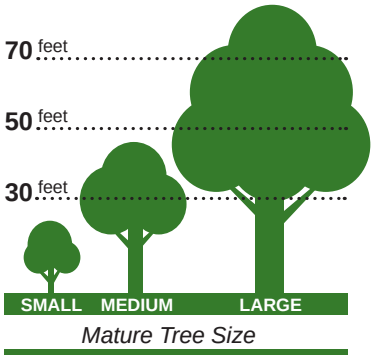


Currently young trees are slightly over represented in Portland, likely the result of successful tree planting efforts in recent years. Ideally, Portland would have a greater proportion of larger trees, and caring for today's young trees is the only way to accomplish that goal.

MATURE TREE FORM DISTRIBUTION

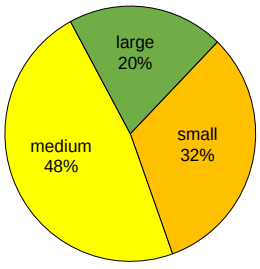
Mature tree size is determined by the height, canopy width, and general form of the tree at maturity; tree types are classified as small, medium, or large. Generally, small trees grow to 30' in height, medium trees grow to 50' in height, and large trees grow over 50' in height (Figure 5). Large form trees also have the potential for greatest longevity, living longer than most small form trees.

Figure 5: Tree form sizes



While some neighborhoods, due to their design, may not have many spaces big enough to accommodate large form trees, it is important that existing large spaces are planted with trees that will grow to be large at maturity. The cost to a community of under planting large spaces can be great over the course of a tree's lifetime. Research has shown that while small and large form trees have similar annual costs of care and maintenance, a large form tree will live four times longer on average and provide over 16 times the benefits over its lifetime (CUFR 2006). In the case of certain benefits, the disparity is much greater; for example, large trees have been found to remove 60-70 times more air pollution annually than small trees (Nowak 1994).

Figure 6: Mature tree size



Results

Small form trees account for 32% of the resource, medium form trees account for 48% of the resource, and large form trees account for 20% of the resource in Portland (Figure 6).

The mature tree form distribution varies between neighborhoods, primarily due to differences in development and size of available planting sites. Neighborhoods west of the Willamette River have the highest proportion of large form trees at 38% or more (e.g. Hillsdale, Hillside), while small form trees represent the majoity of trees in neighborhoods developed with a greater number of small planting sites (e.g. Boise, Argay).

The Bottom Line

Long lived and large form trees provide substantially more benefits than small and medium form trees. Therefore, planting trees that will be large at maturity helps to ensure that canopy cover and its benefits will be maintained or enhanced even as some trees die or are removed. Portland's most common large form tree types include deciduous oak, linden, and pine. Planting, maintenance, and care for young, large form trees will ensure that when they reach maturity, they will provide the most benefits to the community and the environment.

IMPORTANCE VALUE

Another way to evaluate how reliant a community is on a single tree type is importance value. Importance value is a calculation based on relative abundance and relative leaf area. In other words, it accounts for how many trees of the type there are and how much of the city's street tree canopy they represent at the time of inventory. The value informs us which tree types dominate the urban forest structure. For example, a tree type might represent 10% of a population, but have an importance value of 25 because of its large average size. Conversely, another tree type representing 10% of the population may only have an importance value of 5 if it represents young or small form trees.

Importance values tell us which tree types provide the bulk of the benefits for a particular snapshot in time and will change through time as trees grow and species composition changes. Reliance on only a few tree types of high importance value is risky, as loss from a pest, pathogen, or a catastrophic event may put excessive strain on the urban forest even though only a single tree type may be affected.

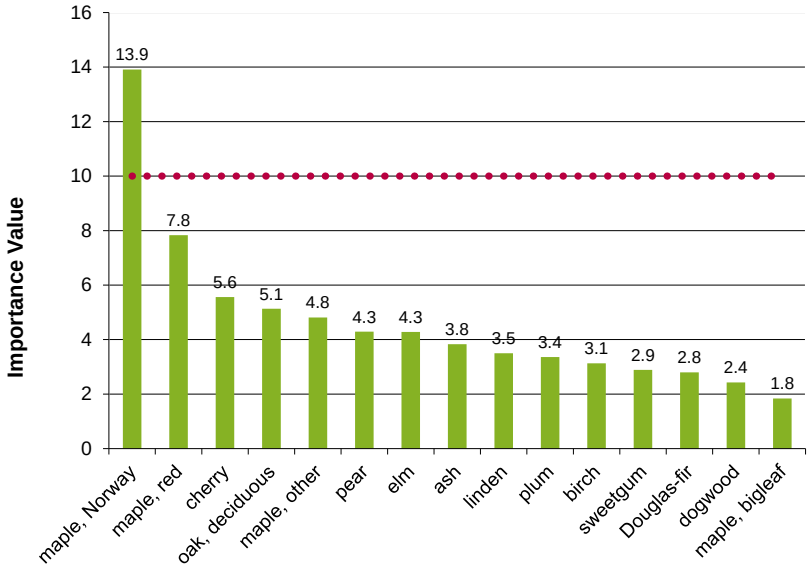
Importance values were calculated using iTree Streets, an urban forest analysis software suite developed by the USDA Forest Service.

Results

Norway maple has the highest importance value of any tree type at 13.9 (Figure 7). Thus, Portland's urban forest is reliant on this species due to its current size and abundance in the city. The next highest importance value is red maple at 7.8. All other tree types had importance values of 5.6 or less.

Although Norway maple and red maple score high in importance value for most Portland neighborhoods as well

Figure 7: Tree types with the highest importance values, with recommended maximum (10) in red



as citywide, Norway maple is displaced by other tree types in a few neighborhoods. For example, in Argay, dogwood has the highest importance value of 17.6. In Goose Hollow, deciduous oak and red maple have the highest importance values, 17.5 and 14.1 respectively. Douglas-fir has the highest importance value for neighborhoods with mature remnant stands of conifers such as Hillsdale, Powellhurst-Gilbert, and Parkrose Heights at 17.6, 17.4, and 14.3, respectively.

The Bottom Line

Trees with the highest importance values, such as Norway maple and red maple should be de-emphasized in future plantings to ensure that the street tree population is less susceptible to loss from a pest or pathogen impacting those tree types. Portland's heavy reliance on these tree types in the present means that their loss would have a serious impact on the Portland's urban forest.

Douglas-fir's high importance value in some neighborhoods is a reflection on the localized abundance of larger trees of this species. As many of these mature Douglas-fir are remnant trees located in unimproved sites, preserving and accommodating them through future development will ensure their continued high value contribution to the neighborhood.

Increasing the level of maintenance of these large, mature trees will also help prolong their lifespan, reduce hazards, and keep these high value members of the urban forest contributing most effectively to the city.

Tree Condition

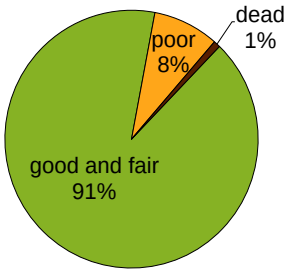
The urban environment is a challenging place for trees to thrive because of limited growing space, compacted soil, poor air quality, and direct damage from vehicles and pedestrians. Tree condition reflects species hardiness, site conditions, and maintenance history. Street trees that are well suited to Portland's climate are able to withstand the challenges of growing in an urban environment, and have been well maintained, are generally the most successful.

Tree condition was assessed by assigning trees to one of four categories: good, fair, poor, or dead. These general ratings reflect whether or not a tree is likely to continue contributing to the urban forest (good and fair trees) or whether the tree is at or near the end of its life (poor and dead trees). Because determining the difference between good and fair ratings is subjective, these categories are reported together.

Results

The majority of street trees in Portland, 91%, are in good or fair condition, while 8% are poor and 1% of trees are dead (Figure 8).

Figure 8: Tree condition



Of the most commonly found tree types, the healthiest trees are deciduous oak and linden, of which 97% are rated good or fair (Table 4). Pear, red maple, and Japanese maple have over 95% of trees in good or fair condition. In poorest condition are hawthorn, cherry, and plum, of which, 21%, 19%, and 16% are rated poor, respectively. Interestingly, 40% of all trees in Portland that are rated poor are in the Rose family and 24% are in the Prunus genus.

Tree size, and thus life stage, did impact tree condition ratings. The greatest percentage of dead trees occurs within the 0" to 3.0" DBH class, with 51% of dead trees in this diameter size class. The bulk of these young trees likely died due to lack of adequate watering. Young trees need 15 gallons of water each week during Portland's dry summer months for the first two years after planting. Establishment of young trees is critical

as it is not until trees attain larger sizes that they provide the greatest benefits.

The size class with the greatest percentage of trees in poor condition were those with DBH between 6.1" and 18" with more than 45% of trees rated poor within this diameter size class. While larger, more mature trees naturally decline with age, preventative maintenance including proper pruning (e.g., not topping) can extend their lifespan and reduce their risk of failure.

Table 4: Tree condition for the most abundant tree types

Common Name	Scientific Name	% of Total (# of Trees)	
		Good/Fair	Poor
ash	*Fraxinus* spp.	92.9% (8,634)	7.1% (657)
birch	*Betula* spp.	88% (5,575)	12% (763)
cherry	*Prunus* spp.	81.5% (11,154)	18.5% (2,529)
crabapple	*Malus* spp.	87.2% (5,908)	12.8% (871)
dogwood	*Cornus* spp.	91.7% (7,949)	8.3% (718)
hawthorn	*Crataegus* spp.	79.2% (4,292)	20.8% (1,124)
linden	*Tilia* spp.	97% (5,327)	3% (163)
maple, Japanese	*Acer palmatum*	95.4% (4,451)	4.6% (214)
maple, Norway	*Acer platanoides*	90.4% (17,373)	9.6% (1,836)
maple, other	*Acer* spp.	94.8% (10,084)	5.2% (551)
maple, red	*Acer rubrum*	95.2% (14,733)	4.8% (742)
oak, deciduous	*Quercus* spp.	97% (6,843)	3% (213)
pear	*Pyrus* spp.	95.1% (11,129)	4.9% (571)
plum	*Prunus* spp.	84.5% (9,671)	15.5% (1,778)
snowbell	*Styrax* spp.	94.5% (3,879)	5.5% (227)

The Bottom Line

Large trees in poor condition pose the largest potential risk of failure (i.e., falling apart). Proper early maintenance on young trees, such as structural pruning, is much less expensive than attempting to correct issues in larger trees that have been unmaintained or improperly pruned. Important maintenance activities for young trees include structural pruning to remove co-dominant leaders and pruning trees for branch clearance over sidewalks and roadways to reduce the likelihood of branches being hit by vehicles. Though only a small portion of the street trees in Portland are in poor condition, a substantial proportion of the hawthorn, cherry, and plums are in poor and declining condition. Furthermore, these three tree types are all in the Rosaceae family which is over represented and therefore replacement of these trees represents a great opportunity to improve Portland's urban forest. All poor rated trees should be monitored and individually evaluated for potential risk and replacement opportunities.

Planting Site Composition and Stocking Level

Planting site composition varies greatly amongst neighborhoods and this directly impacts their capacity for growing large trees that provide the most canopy coverage and benefits. While some neighborhoods are fortunate to have inherited wide planting sites and mature trees, many areas of Portland struggle to establish tree canopy in small planting sites, which are challenging spaces for trees to grow due to limited soil and growing space. Understanding the composition and distribution of planting sites across the city allows for a more strategic tree planting effort and informs us of potential challenges to tree planting and tree growth within the right-of-way.

PLANTING SITES

Street trees grow in a diverse array of planting sites ranging from traditional grassy strips between curbs and sidewalks, to concrete cutouts, and unimproved areas without curbs or sidewalks. Tree growth is limited by site width; wider sites provide more soil to support growth and more space aboveground to reduce conflicts with sidewalks and streets. Overhead high voltage wires limit the height of trees, as trees will be pruned away from wires for safety.

Planting site sizes are categorized as small, medium, or large based on the width of the planting site and presence of overhead wires. These categories reflect the mature tree size that can be supported by the site. In other words, small planting sites can support small trees such as dogwoods and snowbells and large planting sites can support large trees such as oaks and elms. Improved planting sites (i.e., with curbs and sidewalks) generally have a clearly defined width while unimproved sites (i.e., without curbs and sidewalks) do not.

Results

Most street trees in Portland are found in improved rights-of-way sites with only 17.6% in unimproved rights-of-way (Table 5). Strips are the most common tree planting site representing 66.9% of site types. Individual neighborhoods are often dominated by particular site types. For instance, in many commercial districts and older neighborhoods, 95% or more of sites are improved (e.g. Pearl District, University Park, Brooklyn), while west of Willamette River and in outer eastside neighborhoods more than half of sites are unimproved (e.g. Hillsdale, Parkrose, Mill Park, Brentwood-Darlington) (Appendix H).

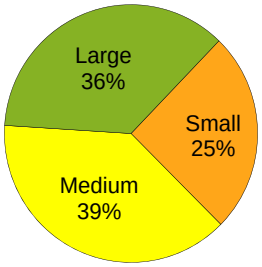
Table 5: Planting site types

Site Type		# of Trees	% of Total
improved sites	curbtight	7,546	4.2%
	cutout	16,799	9.3%
	median	2,099	1.2%
	strip	120,896	66.9%
	swale	1,380	0.8%
	other	12	0.0%
	Improved Totals	*148,732*	*82.4%*
unimproved sites	curb only	13,071	7.2%
	no curb or sidewalk	17,302	9.6%
	other	1,502	0.8%
	Unimproved Totals	*31,875*	*17.6%*
Overall		**180,607***	**100.0%**

**data on planting site types was not collected before 2013*

In Portland, 25% of planting sites where street trees are found are small, 39% are medium, and 36% are large sites (Figure 9). As with site types, site size prevalence varies between neighborhoods. Neighborhoods with the highest proportion of small sites are north and east side residential neighborhoods including Sunnyside, King, and Kenton, where between 59% and 77% of planting sites are small (Appendix I). Neighborhoods with a higher proportion of large sites include residential areas with unimproved streets on Portland's west side such as West Portland Park where 71% of planting sites are large, and east side neighborhoods intentionally planned with wide rights-of-way including Rose City Park, Laurelhurst, and Eastmoreland with 54%, 56%, 78% large sites respectively (Appendix J).

Figure 9: Planting site sizes



STOCKING LEVEL

Street tree stocking level reflects the percentage of planting spaces that are currently occupied by trees. In Portland, trees are more likely to be planted in large planting sites and improved planting sites. Because this project did not inventory all available planting sites, but only sites where trees are currently growing, data for planting site sizes were supplemented with available planting space data collected by Urban Forestry and the Bureau of Environmental Services (BES) staff between 2009 and 2016 (See Appendix A for methods).

Results

Ideally, stocking level should be near 100%. Portland's overall stocking level is 60%, and according to BES data, 79,843 empty spaces have been identified for tree planting. The majority of available planting sites in Portland are in improved sites which are 64% stocked. Unimproved sites are 43% stocked (Table 6). Higher stocking levels are generally observed in larger planting sites and large, improved planting sites are at least 71% stocked.

Table 6: Street tree stocking level

Size Type	Size Size	Planting Site Description	Stocking Level	Available Planting Spaces
improved sites	small	3.0 - 3.9' with or without wires	60%	25,246
	medium	4.0 - 5.9' with or without wires, ≥6.0' with wires	64%	19,602
	large	≥6.0' without wires	71%	11,384
	uncategorized	mixed	68%	1,811
	Improved Site Totals		*64%*	*58,043*
unimproved sites	medium	4.0 - 5.9' with or without wires, ≥6.0' with wires	39%	12,996
	large	≥6.0' without wires	43%	6,769
	uncategorized	mixed	58%	2,035
	Unimproved Site Totals		*43%*	*21,800*
Total			**60%**	**79,843**

Of sites available for planting, 41% are medium, 32% are small, and 23% are large. Data were not collected to appropriately categorize 5% of available sites. Depending on the number of uncategorized sites within a given neighborhood, stocking level data may not provide detailed information on the types of sites available for planting.

Stocking levels vary between neighborhoods and in general, commercial neighborhoods and neighborhoods with improved rights-of-way have higher stocking levels (Appendix K). Neighborhoods with the highest stocking levels include Downtown, Old Town-Chinatown and Alameda, which are 90%, 86%, and 83% stocked, respectively. Outer east side neighborhoods with a higher proportion of unimproved rights-of-way have lower stocking levels. Neighborhoods stocked at or below 50% include Wilkes, Hazelwood, and Cully, which are stocked at 47%, 40%, and 23%, respectively.

RIGHT TREE IN THE RIGHT PLACE

Selecting an appropriately sized tree for the site is important for maximizing benefits and minimizing avoidable costs. A tree well suited to its location has fewer obstacles to reaching maturity which maximizes the benefits it provides the community and the environment over its lifetime. An inappropriately sized tree, however, may cost more to maintain, be less healthy, and have a shorter lifespan thereby providing fewer benefits.

A small form tree planted in a large planting site is a missed opportunity because larger trees contribute many times more benefits than do smaller ones. Planting these sites and replacing undersized trees is especially important in neighborhoods that contain few large planting sites to begin with. Although permits and appropriate species selection are required to plant street trees, historically trees may have been planted without regard to appropriate tree selection.

Results

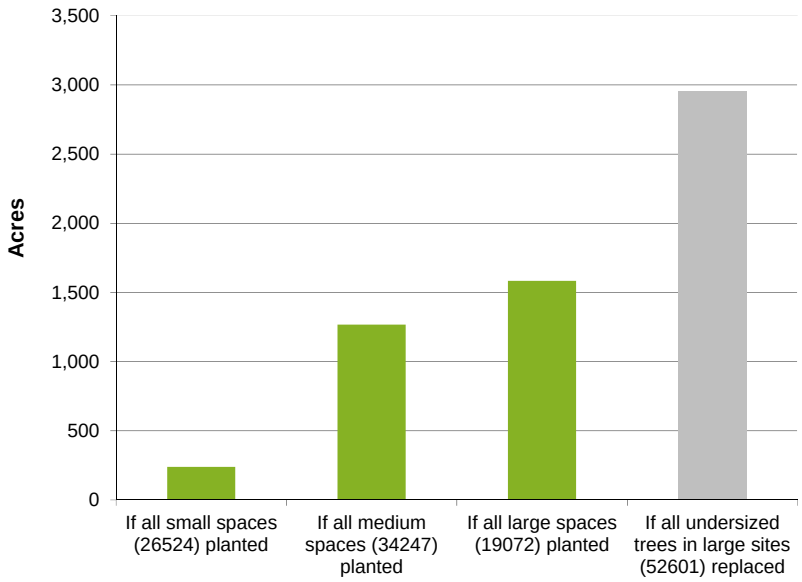
Overall, 45% of trees are planted in sites that are the appropriate size for their mature form (Table 7). Thirty-five percent of all trees are too small for their planting site, and 20% of trees are too large for their site.

Table 7: Tree form fit in planting sites

Fit	% of trees	# of trees
Tree form is too small for the site	35%	76,899
Tree form is appropriate size for the site	45%	97,414
Tree form is too big for the site	20%	42,437
Total	*100%*	*216,750*

Looking closer at only the large sites, 67% of trees are undersized for the site.

Figure 10: Potential acres of tree canopy from planting



The Bottom Line

Planting all available sites with appropriately sized trees will ensure that trees live to maturity at the least cost to homeowners and the community. Because of the importance of large trees to the urban forest, planting large, empty spaces should be a top priority, followed by replacing poor condition, undersized trees in large planting sites. Citywide, this includes an estimated 19,072 large sites and 4,772 poor condition, undersized trees in large planting spaces. Planting only the large, empty spaces would yield 1,583 acres of potential canopy in 30 years (Appendix A, Figure 10). These benefits are almost ten times greater than if small trees are planted in these large sites.

How would planting all available spaces impact Portland's canopy? Planting all sites would provide 3,089 additional acres. Furthermore, if all of the currently undersized trees in large planting spaces had been planted with large form trees, this would add another 2,955 acres of potential canopy. Combined, taking these actions would increase Portland's total canopy cover from 31% to 37%.

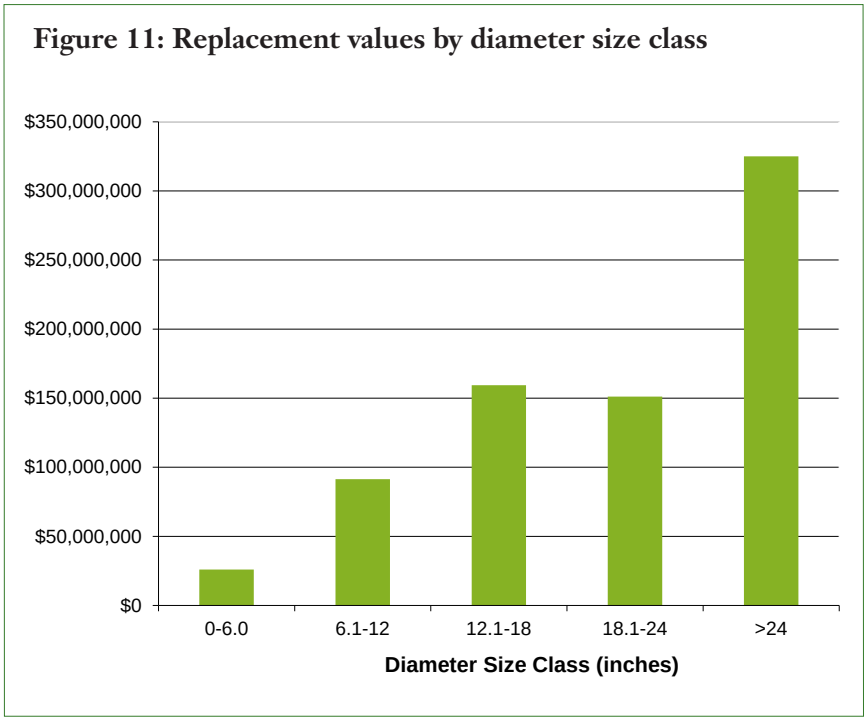
Replacement value

Replacement value is an estimate of the full cost of replacing a tree at its current size and condition, should it be removed for some reason. Replacement value is calculated using the tree's current size, along with information on regional species ratings, trunk diameter, and replacement costs. Replacement values were calculated using iTree Streets. Replacement values are generally highest for the largest, more abundant tree types.

Results

The replacement cost of Portland's street tree population is valued at $753 million, or $3,400 per tree (Figure 11). The most valuable size classes of trees are those greater than 24". Because value increases with the size of the tree, even though trees that are greater than 24" only make up 7.5% of the population, they account

for 43% of the total replacement value. The tree types with the greatest replacement values are Norway maple ($110 million), cherry ($55 million), and red maple ($51 million). These three tree types account for 29% of the total replacement value.



The Bottom Line

Similar to importance value, high replacement values are both a function of the abundance and size of an existing tree type and do not necessarily represent tree types that should be planted in the future. Healthy, diverse, and resilient urban forests have high replacement values as a whole with no one tree type representing a disproportionate amount. De-emphasizing tree types that are already over represented in the population will decrease vulnerability to pests and pathogens in the future. The high replacement value for the city's largest trees shows the need to care for and protect the largest, most valuable trees in the city.

Environmental and Aesthetic Benefits

The amount of environmental and aesthetic benefit a tree may provide over its lifetime is a function of its mature size and longevity. Trees with a larger mature size and longer life span such as Douglas-fir or oak will provide significantly greater benefits than small ornamental trees such as dogwoods or snowbells. The calculation indicates the benefits that trees currently provide: as trees grow and the population changes, benefits derived from the various tree types will also change.

Portland's street tree population was assessed to quantify the dollar value of annual environmental services and aesthetic benefits provided by trees: aesthetic/property value increase, air quality improvement, carbon dioxide reduction, energy savings, and storm water processing. Calculations were made using iTree Streets. The iTree model relies on tree size and species from the inventory, as well as Portland's current pricing for electricity and natural gas, regional benefit prices for air quality, regional storm water interception costs, and median home resale value (Zillow 2016).

Results

Portland's street trees provide approximately $28.6 million annually in environmental services and aesthetic benefits (Table 8). An average street tree in Portland provides $131 worth of benefits annually.

Large form trees produce more benefits on average than smaller trees. Of the most common tree types, deciduous oak and Norway maple provide the highest annual benefits per tree, at approximately $217 - $250 per tree (Table 9). Linden and red maple also provide a high level of annual benefit between $176 and $206. Snowbell and crabapple provide the least amount of benefits, ranging from $15 to $38 annually.

Table 8: Valuation of annual environmental and aesthetic benefits

Benefits	Total ($)	Total ($) per tree
Aesthetic/Other	$18,390,371	$84.12
Air Quality	$330,276	$1.51
CO_2	$158,629	$0.73
Energy	$5,348,063	$24.46
Stormwater	$4,415,877	$20.20
Total	*$28,643,217*	*$131.01*

Table 9: Average annual environmental and aesthetic benefits provided by the most abundant street tree types

Tree Type	Aesthetic/ Property Value	Air Quality	CO_2 Reduction	Energy Savings	Stormwater Processing	Total ($) per tree
ash	$97.29	$1.33	$0.68	$20.64	$15.99	$135.93
birch	$72.63	$1.74	$0.42	$27.48	$22.28	$124.56
cherry	$44.46	$1.46	$0.53	$22.24	$15.64	$84.33
crabapple	$26.92	$0.45	$0.52	$7.01	$3.38	$38.28
dogwood	$61.42	$0.48	$0.27	$10.98	$7.90	$81.05
hawthorn	$45.17	$0.85	$1.08	$13.08	$6.58	$66.75
linden	$137.64	$2.17	$0.84	$35.33	$30.64	$206.61
maple, Japanese	$100.77	$0.75	$0.42	$12.15	$9.91	$124.00
maple, Norway	$132.71	$2.77	$1.28	$43.26	$36.76	$216.79
maple, other	$113.39	$1.48	$0.73	$23.35	$19.31	$158.25
maple, red	$119.42	$2.00	$0.71	$31.93	$21.88	$175.94
oak, deciduous	$171.11	$2.51	$1.13	$40.60	$35.40	$250.75
pear	$44.64	$1.71	$0.61	$22.28	$16.91	$86.15
plum	$52.38	$0.98	$1.24	$15.15	$7.63	$77.38
snowbell	$11.24	$0.15	$0.14	$2.36	$1.05	$14.95

The Bottom Line

Large, empty planting spaces represent not only an opportunity to expand canopy, but also represent thousands of dollars in potential environmental and aesthetic benefits to Portland residents. If all 17,921 of the available large planting spaces were planted with appropriately sized large form trees, in 30 years they will have provided $35 million in net benefits. Conversely, if all available large planting spaces were planted with small form trees, over the same time period they would have only provided $3.7 million, approximately one tenth the value, in net benefits.

Carefully selecting and planting appropriately sized trees directly impacts the amount of benefits provided by the urban forest. Trees that live longer will always produce more benefits to the community—small form trees have a much shorter lifespan than large form trees and may begin to decline after 30 years, just when large form trees are reaching maturity with decades of benefits to the community to come.

The Future Forest of Portland

RECENT PLANTING TRENDS

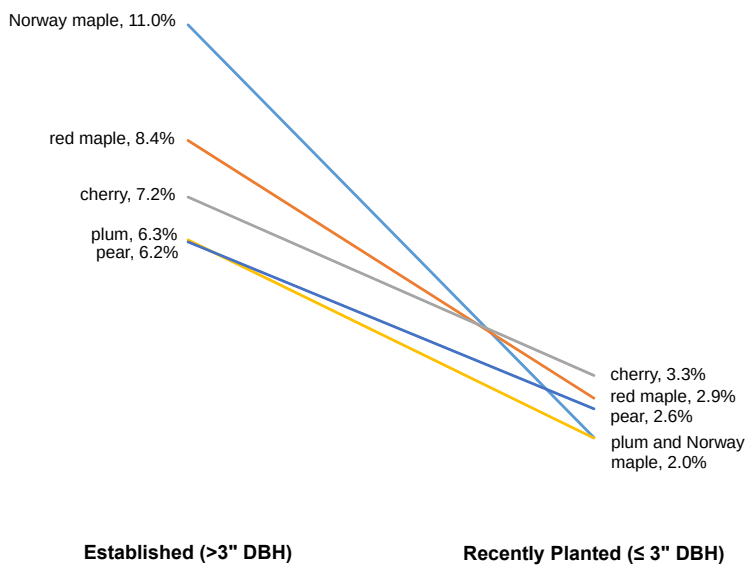
Different species of trees fall in and out of favor over time due to developments in the nursery industry, tree performance, and personal preferences. Portland's street tree population reflects this history, and by comparing the most recently planted trees to the rest of the population one can infer what that trend may mean for the future. Ideally, new plantings will be diverse and show increases in the planting of those large form species which maximize environmental and aesthetic benefits. Established trees (>3" DBH) are compared to recently planted trees (≤3" DBH) and those with a change of 2.0% or greater were graphed to illustrate recent trends in planting (Figure 12, 13).

Results

Norway maple (-9.0%), red maple (-5.6%), and cherry (-3.9%), which make up over 26% of Portland's established street trees as a whole, have been planted far less often in recent years, which will lead to greater long-term species diversity (Figure 12). The steep decline of Norway maple is likely due to the listing of the species on the City's nuisance plant list, which means it is no longer permitted for right-of-way planting.

Of tree types that have increased in number, snowbell and dogwood are seeing the largest increase, with changes of +4.1% and +3.4%, respectively. Even with increased plantings, each are still below the recommended 5% threshold for a single species (Table 2, Figure 13). Other species trending up include paperbark maple (+2.4%), Persian ironwood, tupelo, and crabapple (each +2.3%).

Figure 12: Planting trend: Tree types planted less frequently



A comparison between recently planted and established street trees by functional type shows that the proportion of broadleaf deciduous trees remains unchanged at 92% (Figure 14). Gains have been made in the proportion of broadleaf evergreen tree types, from 1% up to 3%, however these gains have been matched by a decrease in coniferous evergreens (7% to 5%).

The Bottom Line

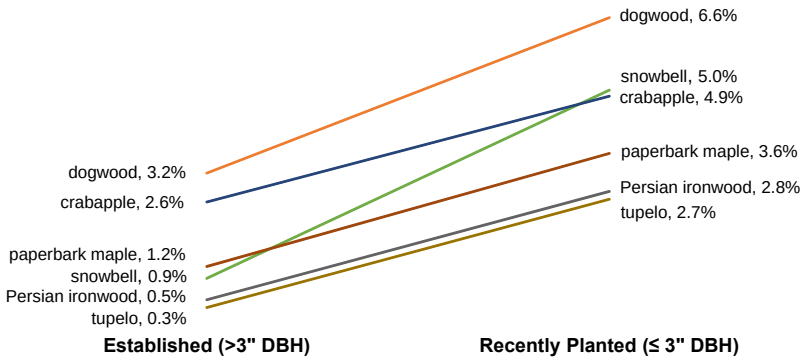
Unfortunately, recent planting trends show that no large form trees are trending up with a change of +2% or greater. And although paperbark maple is trending up, Norway maple and red maple are significantly decreasing, and this is a positive trend as the *Acer* genus and Sapindaceae family are over represented in Portland. Plum, cherry, and pear, are also decreasing, another positive trend, as all belong to the over represented Rosaceae family. Plum and cherry are also small form, short lived trees.

Trees planted more frequently in recent years include some diverse species that are new to the street tree

population. Persian ironwood and tupelo are non-existent or very uncommon in the established tree population. These tree types are medium form trees and will help diversify Portland's urban forest.

Recent planting trends show only a slight trending up of broadleaf evergreen tree types but a decrease in evergreen conifers. Citywide, there is ample opportunity to increase diversity of functional types by planting more evergreen species, both conifers and broadleaf evergreen, in place of broadleaf deciduous tree types which are over represented as a functional type.

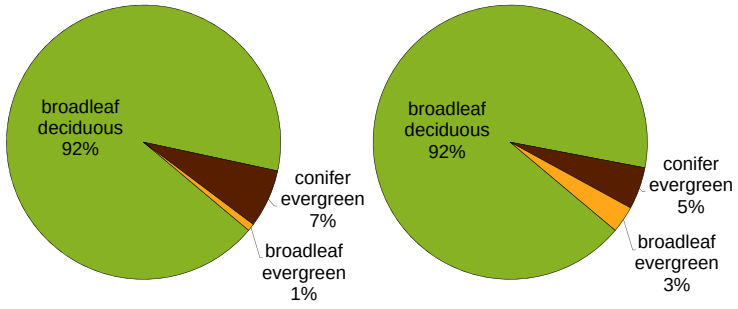
Figure 13: Planting trend: Tree types planted more frequently



TREE COMPOSITION WITHIN LARGE, MEDIUM, AND SMALL PLANTING SITES

Ideally, the mature form of a tree should match the size of its planting site. Appropriately-sized trees maximize benefits to the community while minimizing costly infrastructure conflicts. Table 7 provides an overall picture of undersized trees in Portland, however a closer look at where the most recently planted trees have been planted can show whether trends in planting are moving in the right direction. The mature form of recently planted trees (≤ 3" DBH) found in large, medium, and small planting sites was compared to established trees (> 3" DBH).

Figure 14: Planting trend: Functional tree type



Results

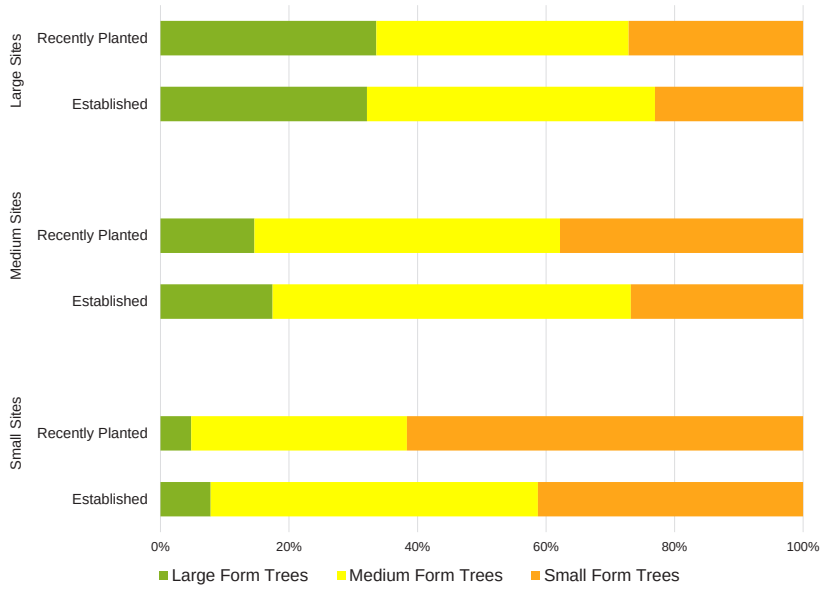
The proportion of large form trees being planted in large sites has held steady at approximately one-third of all trees planted in large sites in Portland (Figure 15). Medium form trees make up the largest proportion of trees planted in large sites, although they are decreasing while small form trees are increasing in large sites. Similarly, in medium sites, small form trees are increasing while medium form trees are decreasing. Small form trees have shown the largest increase in small sites and at over 60%, now make up the largest proportion of recently planted trees across all site sizes.

The Bottom Line

Recent plantings in Portland show an increase in small form trees and a decrease in medium form trees

across all sites. Little progress has been made in planting large form trees in large sites, with small and medium form trees representing approximately two-thirds of recently planted trees in those areas. With small trees representing a quarter of those recently planted in large sites, an increase, and over a third of those recently planted in medium sites, this represents a missed opportunity. Continued efforts to plant appropriately-sized trees in Portland's rights-of-way will ensure that tree canopy and its benefits are maximized in the city over the long-term.

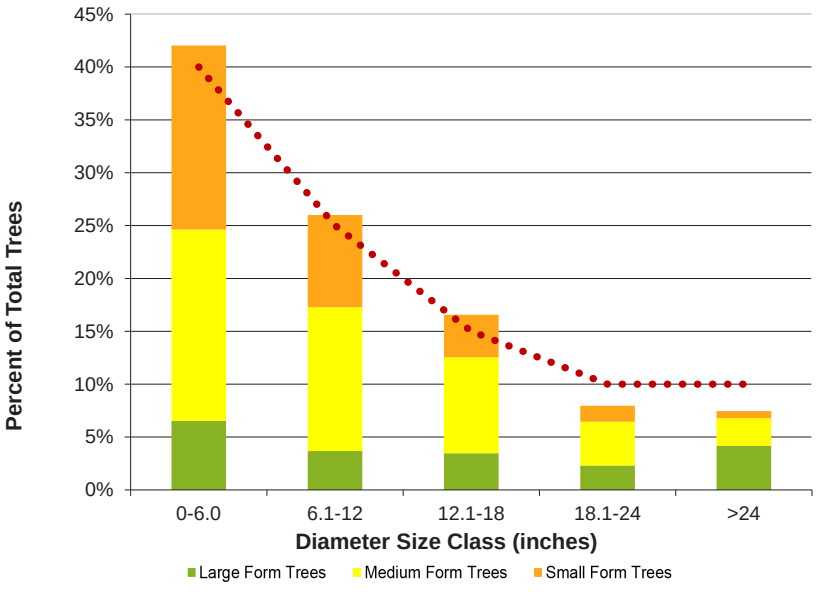
Figure 15: Planting trend: Mature tree form size shifts



SIZE CLASS AND MATURE TREE FORM

Planting efforts should be focused on maintaining a continuity of canopy coverage and benefits over time. Where possible, planting trees that will grow into the largest size classes is preferable, in order to maintain a stable population of these high value trees as they reach the end of their lifespan and are removed. Because small form trees are not likely to mature beyond 18" DBH and will not contribute to the larger size classes, tracking the number of young large form trees in smaller size classes provides important information in predicting whether canopy benefits will be maximized into the future with an adequate proportion of large trees. The mature form of trees within each diameter size class is reported below.

Figure 16: Mature form of trees by size class



Results

While the overall size class distribution curve looks to be nearly ideal (see Figure 3), the largest diameter size classes are under target. Figure 16 shows that the number of large stature trees currently in medium diameter

size classes is not enough to meet the ideal proportion of large diameter trees in the future. Twenty-five percent of trees in the 12.1" to 18" DBH size class are small form trees, 55% are medium form trees, and only 20% are large form trees.

The Bottom Line

Healthy, large diameter trees are the most valuable to Portland's residents, providing the most environmental and aesthetic benefits. In order to meet and sustain an ideal number of large trees in the future, an increased focus on planting of large form trees in appropriately sized spaces is needed. Current planting trends show that most species that are increasing in popularity are small form trees, and that large sites are increasingly being planted with small form trees. The proportion of trees in the largest size classes can only increase by planting trees that will mature to over 18" DBH, in sites that can accommodate that growth into the future.

Clockwise from top left: 1) Dogwoods are the most commonly planted tree in recent years. Street trees should be selected from a wide variety of genera to increase diversity and decrease risk of catastrophic loss due to pests and pathogens. 2) Without proactive efforts to plant large form trees in available spaces, neighborhoods with mature tree-lined streets are at risk of losing canopy as aging trees are lost from the population. 3) The large planting space that houses the small form redbud in the forground is much better suited to the large form oak in the background, which will provide many times more benfits over its lifetime.

Recommendations

Portland Parks & Recreation Urban Forestry works with residents to manage Portland's street trees. Working together using the information provided in this report, the list of recommendations below provides a "to-do list" for protecting preserving, and expanding this valuable resource into the future.

INCREASING RESILIENCE TO PEST, PATHOGENS, AND CLIMATE CHANGE

- Reduce dependence on trees in the Sapindaceae and Rosaceae families, and specifically trees in the *Acer* and *Prunus* genera by planting a diverse array of species, genera, and families. Just ten genera account for two-thirds of all street trees. A more diverse urban forest will be more resilient to pests, pathogens, and changing climate conditions. Select species for planting from Urban Forestry's Approved Street Tree Lists (www.portlandoregon.gov/trees/plantinglists).

- Plant tree species that are adapted to a range of climate conditions in order to decrease vulnerability to climate change. Portland's street tree population is being affected by changes in climate. Increasingly warm and dry springs and summers have stressed trees that up to this time have survived in our climate, especially those from summer rainfall areas.

- Evaluate existing street tree permitting and planting programs to assess their impact on species composition and distribution. Set goals for increasing the proportion of high performing, under represented tree species with low pest vulnerability.

Planting species that are new and uncommon in Portland's street tree population, like this young cork oak (Quercus suber), *helps to improve the diversity of the urban forest.*

OPTIMIZING CANOPY

- Prioritize planting of large, high-performing trees that will provide high levels of benefits over their lifetime. Currently, the proportion of trees in larger diameter size classes is below the recommended target, and there are not enough recently planted large form trees to make up this deficit over time. Large form trees would be best planted in the estimated 19,072 large planting sites (>6' wide without overhead wires) that have been identified for planting.

- Maintain and care for large, mature trees. Only 15% of trees in Portland are larger than 18" in diameter. Trees provide the most benefits as they reach maturity and tree care is also the most expensive for these large trees. Increasing the level of maintenance of large, mature trees will help prolong their lifespan, reduce hazards, and keep these high value members of the urban forest contributing to the city.

- Encourage removal and replacement of dead trees and assessment of trees in poor condition. Nine percent of Portland's trees are dead (1,852 trees) or in poor condition (18,372 trees).

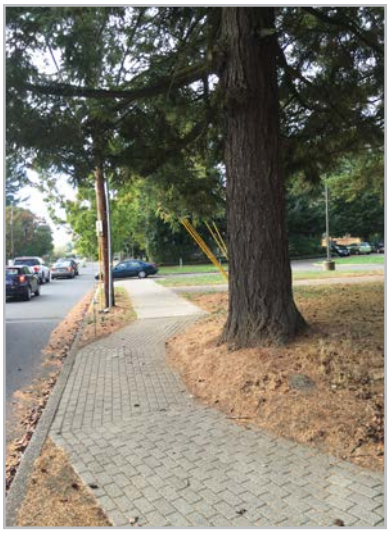
- Encourage replacement of underperforming species, including undersized trees in large rights-of-way, with higher functioning, appropriately sized trees. In large planting sites, 67% of trees have been identified as being too small for their respective site, 4,772 of which are in poor condition. Furthermore,

nearly 40% of trees rated as poor are in the Rosaceae family. Given that this family is already over represented in the street tree population, these trees should be evaluated on an individual basis for replacement.

- Assess permitting and planting programs for effectiveness in stocking sites with appropriately sized trees. Portland's street tree planting sites are underutilized. Although 36% of street tree planting sites are large, only 20% of street trees are large form trees. Over two-thirds of planted large sites in Portland are stocked with small or medium form trees.
- Explore funding options for public maintenance of Portland's street trees. These trees are a public resource which provide $28.6 million in annual benefits for all Portlanders, but the cost of their maintenance can be a barrier to planting and care for some residents. Proper maintenance and proactive management of this resource would result in longer-lived trees, fewer hazards, and a more equitably distributed canopy over time.

IMPROVING EQUITABLE DISTRIBUTION OF STREET TREES

- Prioritize street tree planting efforts in low canopy neighborhoods and neighborhoods with low stocking levels. Many neighborhoods are 50% stocked or less and offer the most opportunity to increase canopy cover by planting in existing empty sites. In areas where available sites are predominantly small, extra efforts will be needed to equitably distribute canopy. Creative expansion of planting sites and increased planting on private property may be the only way to meet canopy goals in some neighborhoods.
- Accommodate larger existing trees as development takes place in unimproved rights-of-way. Unimproved rights-of-way in outer east Portland neighborhoods contain many large trees, often conifers which are rare east of the Willamette River. It is especially important in these neighborhoods to protect and retain existing mature trees, and create spaces which can support their growth as rights-of-way are improved.
- Focus outreach and education resources on increasing stakeholder involvement and volunteer stewardship in low income, low canopy neighborhoods, especially in east Portland neighborhoods historically underserved by the City.
- Establish programs or incentives for expanding access to canopy benefits in low income, low canopy neighborhoods. Canopy benefits are unevenly distributed throughout Portland, however ample opportunity exists to increase these benefits in low canopy neighborhoods.
- Explore funding programs for assisting low income property owners to care for their trees.



Creating room for new and existing large trees will be important as unimproved streets undergo development.

EDUCATION AND ACTION – ADVOCATING FOR TREES IN YOUR NEIGHBORHOOD

Neighborhood Tree Teams created as part of the Tree Inventory Project can have a tremendous impact on their community's urban forest. Below is a list of actions that Tree Teams can take to expand and enhance the tree canopy in their own neighborhoods.

- Properly water and establish young trees. With 23% of trees being 3" DBH or less, special attention should be paid to this vulnerable population. Mortality is highest among newly planted trees. Young trees represent the future generation of street trees, and early care and training will pay off in higher survival and future benefits.
- Structurally prune young trees to promote proper form as street trees. This includes removing low limbs for pedestrian and traffic clearance and removing co-dominant leaders. Structural pruning is critical in the first ten years after planting and can prevent future problems and expense. The 42% of Portland's street trees that are 6" DBH or less and should be evaluated for structural pruning needs.
- Plant trees in all available planting spaces but plant in the smallest spaces last. Trees in small planting spaces provide fewer benefits and are more likely to cause sidewalk and clearance problems in a shorter time than if they were planted in larger spaces. Portland's street tree stocking level is 60% and 79,843 spaces are available for planting street trees (Appendix K).
- Educate property owners on how to properly care for young street trees (pruning, watering, and mulching) in order to reduce unintended damage and delay future problems and conflicts with infrastructure.
- Promote the importance and benefits of large form species and mature trees within the community, especially evergreen and native trees.
- Recruit members to your Tree Team! Urban Forestry knows that local Tree Teams are the best stewards of their urban forest, and the more support a community has from its residents, the more a Tree Team can accomplish. Start by creating a Tree Plan based on the neighborhood's findings, and work with Urban Forestry to conduct stewardship projects.

*Young street trees like this hardy rubber tree (*Eucommia ulmoides*) benefit greatly from early establishment care and structural pruning in the first ten years after planting.*

Planting appropriately-sized trees such as this large form sequoia (Sequoiadendron giganteum) *in a large site, ensures that tree canopy and its benefits are maximized in the long term.*

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Appendices

Appendix A: Methods

Street trees are defined in this project as woody plants in the public right-of-way with a single or few trunks and a minimum mature size of 15'. Between the years 2010 and 2016, street trees adjacent to every tax lot within the neighborhood boundaries were inventoried by trained volunteers and Urban Forestry staff.

DATA COLLECTED

Data collected included: tree type identified to species or genus, tree condition, location, size (diameter at breast height), planting site width, planting site type, and presence of overhead high voltage lines.

Tree type: Trees were identified to the genus or species. Six maples were identified to the species level: bigleaf (*Acer macrophyllum*), Japanese (*A. palmatum*), Norway (*A. platanoides*), paperbark (*A. griseum*), red (*A. rubrum*) and silver (*A. saccharinum*) maples. All other maple species were identified as "maple, other." All dead trees were listed as "unknown" tree type, as identification of these plants was uncertain.

Tree condition: Trees were rated as good, fair, poor, or dead. These general ratings reflect whether or not a tree is likely to continue contributing to the urban forest (good and fair trees) or whether the tree is at or near the end of its life (poor and dead trees). The following guidelines were used:

Good: The tree has strong structure and is healthy and vigorous with no apparent problems. Trunks are solid with no bark damage and the crown is full. Roots show no signs of heaving or visible crossing, and there are no major wounds, decay, conks, or cavities.

Fair: The tree is in average condition. Structural problems may be present, including results of pruning for high voltage electrical lines. Tree may have dead branches and some canopy loss. Wounds are minimal and there is no major decay.

Poor: The tree is in a general state of decline as indicated by major wounds, root heaving, dead limbs resulting in major canopy loss, and/or visible signs of decay indicated by major rot or fungal growth.

Dead: The tree is dead with no live leaves. Dead trees were excluded from data analysis, with the exception of tree condition statistics and total number of trees inventoried.

Tree size: Diameter at breast height (4.5' above ground) was measured with a diameter tape. Measurements of trees with branches, forks, or swelling at 4.5' were taken lower on the tree so a representative size was obtained. Trees with three or fewer multiple stems were measured individually and Urban Forestry staff made final diameter calculations using the formula $\sqrt{(x^2+y^2+z^2)}$. Trees with greater than three multiple stems were measured below branching.

Planting site type: Planting site types were placed into one of the following categories.

Improved sites:
Curbtight: The curb and sidewalk are continuous, and tree is planted adjacent to tax lot.
Cutout: The site is a concrete cutout, also called a tree pit or tree well.
Median: The site is in the middle of the street separated by a curb.
Planting strip: The tree is a planting strip between a curb and a sidewalk.
Swale: The tree is in the middle of a bioswale designed for storm water capture.

Unimproved sites:
Curb only: The site has a curb but no sidewalk.

No curb or sidewalk: The site has no curb or sidewalk.
Other: Sites not falling under above scenarios.

Planting site width: Planting site width was measured for all improved site types except curbtight areas. Planting strips were measured from the inside of the curb to the beginning of the sidewalk and cutouts, medians, and swales were measured from inside edge to inside edge perpendicular to the street. No widths were taken for unimproved planting site types or curbtight areas.

High voltage wires: The presence of high voltage wires above the planting space was recorded.

Stocking level: Planting space size and availability is subject to a number of guidelines, including width of the planting site, presence/absence of high voltage power lines, and distance from conflicts (property lines, stop signs, and underground utilities). Because this project did not inventory all available planting sites, but only sites where trees are currently growing, data for planting site sizes were supplemented with available planting space data collected by Urban Forestry and the Bureau of Environmental Services between 2009 and 2016. These data were compared with existing tree data collected at the same time and used to calculate stocking level. Some industrial, commercial, and multi-family residential areas may have been excluded in the analysis, making this a conservative estimate of available sites. Appenidx K shows only those neighborhoods where stocking level data was collected.

DATA COLLECTION METHODS

Volunteer neighborhood coordinators recruited volunteers to conduct street tree inventories during work days. Volunteers interested in being inventory team leaders attended a half-day training to learn to identify tree species and site conditions, and how to collect and record data.

During work days, team leaders were paired with novice volunteers to collect data in a three to four block area. Groups were given a clipboard containing a map, data entry sheets, tree type abbreviations, and a list of trees planted by Friends of Trees in the neighborhood. Volunteers wore safety vests and carried a 2-sided diameter/measuring tape for measuring tree size and site width, a tree identification book, and bags for collecting samples.

In addition to Urban Forestry staff, one or more volunteer arborists-on-call were available on inventory work days to assist volunteers with questions. Accuracy was stressed as highly important, and volunteers utilized the arborist-on-call to verify species identification as questions arose. Data were collected on paper maps and forms, and later digitized in ArcGIS by Urban Forestry staff and trained volunteers.

Accuracy of volunteer-collected data was checked by Urban Forestry staff and corrections were made as necessary. Remaining areas not completed during inventory work days were inventoried by volunteer team leaders or staff. A 10% sample of the final data found species identifications to be more than 95% accurate.

Where needed, Urban Forestry staff supplemented volunteer collected data. In 19 neighborhoods, Urban Forestry conducted partial inventories, only collecting data in improved rights of way. Appendices D – J show only those neighborhoods that were completely inventoried.

CALCULATION OF BENEFITS AND CANOPY PROJECTION

Projected benefits were calculated using 30-year estimates of average annual net benefits provided in the Western Washington and Oregon Community Tree Care Guide (McPherson et al. 2002). Projected canopy cover estimates assume the mature spread of small, medium, and large trees to 20'x 20', 40' x 40', and 60' x 60', respectively. In some cases the data for available planting spaces from the Bureau of Environmental Services (BES) included planting sites that were not categorized by size. Therefore, for the purposes of calculating projected benefits, these spaces were assumed to have a similar proportion of small, medium, and large sites, as were categorized by BES in the neighborhood.

Appendix B: Street trees by tree type

Common Name	Scientific Name	Family	# of Trees	% of Total	Mean DBH
alder	*Alnus* spp.	Betulaceae	443	0.2%	9.4
Amur maackia	*Maackia amurensis*	Leguminosae	326	0.1%	3.5
apple	*Malus domestica*	Rosaceae	1,915	0.9%	5.4
arborvitae	*Thuja arborvitae*	Cupressaceae	394	0.2%	6.9
ash	*Fraxinus* spp.	Oleaceae	9,291	4.3%	9.3
azara	*Azara* spp.	Salicaceae	45	0.0%	2.0
baldcypress	*Taxodium distichum*	Taxodiaceae	39	0.0%	3.4
bay laurel	*Laurus nobilis*	Lauraceae	27	0.0%	4.0
beautyberry	*Callicarpa* spp.	Lamiaceae	1	0.0%	0.5
bee-bee tree	*Tetradium daniellii*	Rutaceae	2	0.0%	0.5
beech	*Fagus* spp.	Fagaceae	1,092	0.5%	5.7
birch	*Betula* spp.	Betulaceae	6,338	2.9%	13.0
black locust	*Robinia pseudoacacia*	Leguminosae	1,105	0.5%	17.4
boxelder	*Acer negundo*	Sapindaceae	474	0.2%	15.0
California lilac	*Ceanothus* spp..	Rhamnaceae	14	0.0%	6.1
California torreya	*Torreya californica*	Taxaceae	2	0.0%	0.0
camellia	*Camellia* spp.	Theaceae	30	0.0%	6.1
camphor tree	*Cinnamomum* spp.	Lauraceae	3	0.0%	5.1
cascara	*Rhamnus purshiana*	Rhamnaceae	1,255	0.6%	2.1
Catalina ironwood	*Lyonothamnus* spp.	Rosaceae	2	0.0%	5.6
catalpa	*Catalpa* spp.	Bignoniaceae	409	0.2%	17.2
cedar	*Cedrus* spp..	Pinaceae	714	0.3%	17.4
chaste tree	*Vitex* spp.	Lamiaceae	10	0.0%	7.2
cherry	*Prunus* spp..	Rosaceae	13,683	6.3%	11.6
chestnut	*Castanea* spp..	Fagaceae	251	0.1%	19.6
China-fir	*Cunninghamia lanceolata*	Taxodiaceae	6	0.0%	21.8
Chinese parasol tree	*Firmiana simplex*	Malvaceae	1	0.0%	5.9
Chinese pistache	*Pistacia chinensis*	Anacardiaceae	258	0.1%	2.4
Chinese silver fir	*Cathaya argyrophylla*	Pinaceae	1	0.0%	0.0
Chinese toon	*Toona sinensis*	Meliaceae	1	0.0%	6.0
chitalpa	*x Chitalpa tashkentensis*	Bignoniaceae	42	0.0%	3.4
citrus	*Citrus* spp.	Rutaceae	4	0.0%	3.2
corktree	*Phellodendron* spp.	Rutaceae	12	0.0%	4.2
crabapple	*Malus* spp.	Rosaceae	6,779	3.1%	5.7
crape myrtle	*Lagerstroemia indica*	Lythraceae	852	0.4%	2.5
cryptomeria	*Cryptomeria* spp.	Taxodiaceae	88	0.0%	5.9
cypress	*Cupressus* spp.	Cupressaceae	345	0.2%	4.5
dawn redwood	*Metasequoia glyptostroboides*	Taxodiaceae	59	0.0%	6.2
devil's walking stick	*Aralia* spp.	Araliaceae	16	0.0%	7.6
dogwood	*Cornus* spp.	Cornaceae	8,667	4.0%	5.5
Douglas-fir	*Pseudotsuga menziesii*	Pinaceae	3,141	1.4%	20.3
dove tree	*Davidia involucrata*	Cornaceae	19	0.0%	3.4
elderberry	*Sambucus* spp.	Caprifoliaceae	20	0.0%	6.6
elkhorn cedar	*Thujopsis dolobrata*	Cupressaceae	8	0.0%	4.5
elm	*Ulmus* spp.	Ulmaceae	3,358	1.5%	19.2

Common Name	Scientific Name	Family	# of Trees	% of Total	Mean DBH
empress tree	*Paulownia tomentosa*	Paulowniaceae	60	0.0%	12.2
eucalyptus	*Eucalyptus* spp.	Myrtoideae	92	0.0%	7.7
euptelea	*Euptelea pleiosperma*	Eupteleaceae	3	0.0%	3.4
false cypress	*Chamaecyparis* spp.	Cupressaceae	1,529	0.7%	9.3
fig	*Ficus* spp.	Moraceae	465	0.2%	3.9
fir	*Abies* spp.	Pinaceae	339	0.2%	11.7
fragrant epaulette tree	*Pterostyrax hispidus*	Styracaceae	1	0.0%	2.3
franklinia	*Franklinia alatamaha*	Theaceae	24	0.0%	1.0
fringe tree	*Chionanthus* spp.	Oleaceae	233	0.1%	2.3
giant sequoia	*Sequoiadendron giganteum*	Taxodiaceae	250	0.1%	29.8
ginkgo	*Ginkgo biloba*	Ginkgoaceae	2,023	0.9%	4.1
glorybower	*Clerodendrum* spp.	Verbenaceae	1,359	0.6%	4.6
golden chain tree	*Laburnum* spp.	Leguminosae	369	0.2%	6.3
golden chinkapin	*Chrysolepis chrysophylla*	Fagaceae	1	0.0%	2.5
golden rain tree	*Koelreuteria paniculata*	Sapindaceae	808	0.4%	7.2
hackberry	*Celtis occidentalis*	Cannabaceae	334	0.2%	4.3
hardy rubber tree	*Eucommia ulmoides*	Eucommiaceae	48	0.0%	3.3
hawthorn	*Crataegus* spp.	Rosaceae	5,416	2.5%	8.7
hazelnut	*Corylus* spp.	Betulaceae	340	0.2%	7.0
hemlock	*Tsuga* spp.	Pinaceae	192	0.1%	9.5
hickory	*Carya* spp.	Juglandaceae	10	0.0%	21.5
holly	*Ilex* spp.	Aquifoliaceae	523	0.2%	9.1
honey locust	*Gleditsia triacanthos*	Leguminosae	1,412	0.6%	7.3
hophornbeam	*Ostrya* spp.	Betulaceae	280	0.1%	3.5
hornbeam	*Carpinus* spp.	Betulaceae	3,702	1.7%	8.0
horsechestnut	*Aesculus* spp.	Sapindaceae	1,254	0.6%	27.2
incense cedar	*Calocedrus decurrens*	Cupressaceae	554	0.3%	12.3
Japanese chinquapin	*Castanopsis cuspidata*	Fagaceae	1	0.0%	9.8
Japanese raisin tree	*Hovenia dulcis*	Rhamnaceae	2	0.0%	9.6
Japanese spice bush	*Lindera obtusiloba*	Lauraceae	1	0.0%	6.1
jujube	*Ziziphus jujuba*	Rhamnaceae	12	0.0%	3.0
juniper	*Juniperus* spp.	Cupressaceae	142	0.1%	7.5
katsura	*Cercidiphyllum japonicum*	Cercidiphyllaceae	1,604	0.7%	6.5
Kentucky coffeetree	*Gymnocladus dioica*	Leguminosae	91	0.0%	3.4
larch	*Larix* spp.	Pinaceae	30	0.0%	9.3
lilac tree	*Syringa reticulata*	Oleaceae	1,085	0.5%	4.1
linden	*Tilia* spp.	Malvaceae	5,490	2.5%	13.4
loquat	*Eriobotrya japonica*	Rosaceae	14	0.0%	2.9
madrone	*Arbutus menziesii*	Ericaceae	108	0.0%	5.8
magnolia, deciduous	*Magnolia* spp.	Magnoliaceae	1,868	0.9%	4.5
magnolia, evergreen	*Magnolia* spp.	Magnoliaceae	1,639	0.7%	3.7
maple, bigleaf	*Acer macrophyllum*	Sapindaceae	2,609	1.2%	16.3
maple, Japanese	*Acer palmatum*	Sapindaceae	4,665	2.1%	5.3
maple, Norway	*Acer platanoides*	Sapindaceae	19,209	8.8%	14.3
maple, other	*Acer* spp.	Sapindaceae	10,635	4.9%	8.6
maple, paperbark	*Acer griseum*	Sapindaceae	3,842	1.8%	4.0
maple, red	*Acer rubrum*	Sapindaceae	15,475	7.1%	10.2

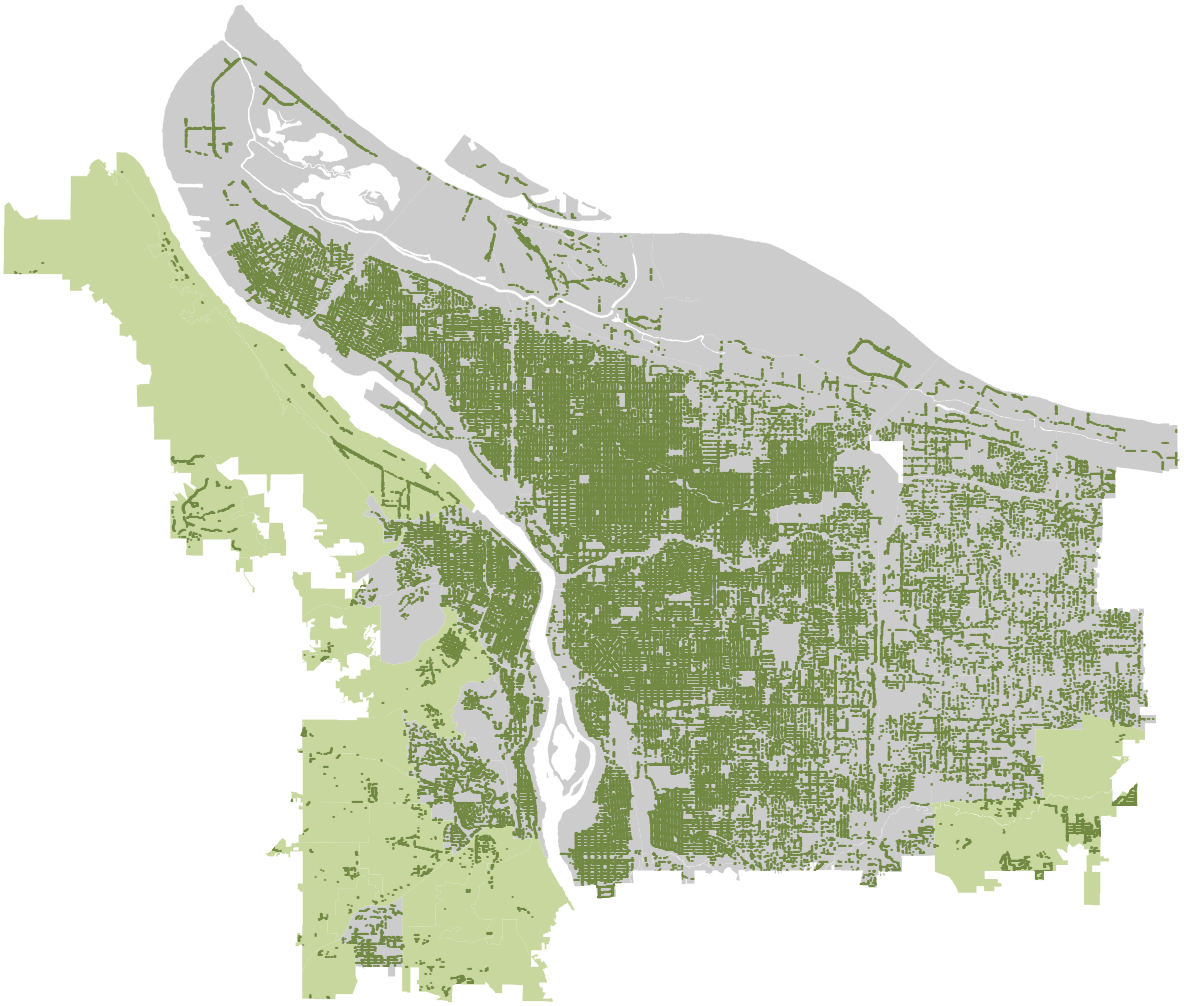
Common Name	Scientific Name	Family	# of Trees	% of Total	Mean DBH
maple, silver	*Acer saccharinum*	Sapindaceae	904	0.4%	29.8
medlar	*Mespilus* spp.	Rosaceae	18	0.0%	2.5
melliodendron	*Melliodendron xylocarpum*	Styracaceae	1	0.0%	5.0
mimosa tree	*Albizia julibrissin*	Leguminosae	212	0.1%	11.1
monkey puzzle	*Araucaria araucana*	Araucariaceae	26	0.0%	6.6
mountain-ash	*Sorbus* spp.	Rosaceae	765	0.3%	10.3
mulberry	*Morus* spp.	Moraceae	200	0.1%	12.9
myrtlewood	*Umbellularia californica*	Lauraceae	104	0.0%	11.3
ninebark	*Physocarpus* spp.	Rosaceae	2	0.0%	0.4
oak, deciduous	*Quercus* spp.	Fagaceae	7,056	3.2%	11.3
oak, evergreen	*Quercus* spp.	Fagaceae	225	0.1%	4.5
oleaster	*Elaeagnus* spp.	Elaeagnaceae	14	0.0%	5.9
olive	*Olea* spp.	Oleaceae	99	0.0%	2.4
oriental arborvitae	*Platycladus orientalis*	Cupressaceae	6	0.0%	18.3
osage orange	*Maclura pomifera*	Moraceae	16	0.0%	1.4
pagoda tree	*Sophora japonica*	Leguminosae	84	0.0%	10.7
palm	*Trachycarpus* spp.	Arecaceae	325	0.1%	5.7
paw paw	*Asimina triloba*	Annonaceae	37	0.0%	2.2
peach	*Prunus persica*	Rosaceae	181	0.1%	3.0
pear	*Pyrus* spp.	Rosaceae	11,700	5.4%	8.8
pearlbloom tree	*Poliothyrsis sinensis*	*Salicaceae*	*1*	*0.0%*	*0.3*
pecan	*Carya illinoinensis*	*Juglandaceae*	*21*	*0.0%*	*12.6*
Persian ironwood	*Parrotia persica*	*Hamamelidaceae*	*2,235*	*1.0%*	*3.2*
persimmon	*Diospyros* spp.	*Ebenaceae*	*209*	*0.1%*	*3.4*
photinia	*Photinia* spp.	*Rosaceae*	*25*	*0.0%*	*8.1*
pine	*Pinus* spp.	*Pinaceae*	*3,471*	*1.6%*	*12.1*
planetree	*Platanus* spp.	*Platanaceae*	*1,300*	*0.6%*	*18.0*
plum	*Prunus* spp.	*Rosaceae*	*11,449*	*5.2%*	*10.0*
poplar	*Populus* spp.	*Salicaceae*	*861*	*0.4%*	*13.4*
prickly ash	*Zanthoxylum* spp.	*Rutaceae*	*3*	*0.0%*	*0.9*
Prunus, other	*Prunus* spp.	*Rosaceae*	*503*	*0.2%*	*7.3*
quince	*Cydonia oblonga*	*Rosaceae*	*28*	*0.0%*	*4.0*
redbud	*Cercis* spp.	*Leguminosae*	*1,457*	*0.7%*	*5.0*
redwood	*Sequoia sempervirens*	*Taxodiaceae*	*61*	*0.0%*	*21.3*
rose of Sharon	*Hibiscus syriacus*	*Malvaceae*	*122*	*0.1%*	*4.7*
salt cedar	*Tamarix* spp.	*Tamaricaceae*	*1*	*0.0%*	*19.4*
sassafras	*Sassafras albidum*	*Lauraceae*	*17*	*0.0%*	*4.8*
seaberry	*Hippophae rhamnoides*	*Eleagnaceae*	*18*	*0.0%*	*1.6*
serviceberry	*Amelanchier* spp.	*Rosaceae*	*639*	*0.3%*	*2.6*
seven son flower	*Heptacodium miconioides*	*Caprifoliaceae*	*132*	*0.1%*	*1.8*
silverbell	*Halesia* spp.	*Styracaceae*	*28*	*0.0%*	*4.9*
smoketree	*Cotinus* spp.	*Anacardiaceae*	*497*	*0.2%*	*3.0*
snowbell	*Styrax* spp.	*Styracaceae*	*4,106*	*1.9%*	*2.9*
sourwood	*Oxydendrum arboreum*	*Ericaceae*	*132*	*0.1%*	*2.5*
Southern beech	*Nothofagus* spp.	*Nothofagaceae*	*7*	*0.0%*	*2.6*
spindle tree	*Euonymus* spp.	*Celastraceae*	*9*	*0.0%*	*3.1*
spruce	*Picea* spp.	*Pinaceae*	*1,259*	*0.6%*	*11.4*

Common Name	Scientific Name	Family	# of Trees	% of Total	Mean DBH
stewartia	*Stewartia pseudocamellia*	*Theaceae*	*631*	*0.3%*	*1.8*
strawberry tree	*Arbutus* spp.	*Ericaceae*	*47*	*0.0%*	*3.3*
sumac	*Rhus* spp.	*Anacardiaceae*	*68*	*0.0%*	*3.8*
summit cedar	*Athrotaxis x laxifolia*	*Cupressaceae*	*1*	*0.0%*	*0.0*
sweetgum	*Liquidambar* spp.	*Altingiaceae*	*3,703*	*1.7%*	*16.8*
sycoparrotia	*Sycoparrotia X sycoparrotia*	*Hamamelidaceae*	*12*	*0.0%*	*2.4*
tanoak	*Notholithocarpus densiflorus*	*Fagaceae*	*2*	*0.0%*	*4.6*
tea tree	*Leptospermum* spp.	*Myrtaceae*	*4*	*0.0%*	*2.3*
tree-of-heaven	*Ailanthus altissima*	*Simaroubaceae*	*830*	*0.4%*	*11.3*
tulip poplar	*Liriodendron tulipifera*	*Magnoliaceae*	*685*	*0.3%*	*17.5*
tupelo	*Nyssa* spp.	*Cornaceae*	*1,873*	*0.9%*	*2.6*
umbrella pine	*Sciadopitys verticillata*	*Sciadopityaceae*	*8*	*0.0%*	*5.0*
unknown	unknown	unknown	*1,851*	*0.8%*	*6.0*
viburnum	*Viburnum* spp.	*Adoxaceae*	*18*	*0.0%*	*4.5*
walnut	*Juglans* spp.	*Juglandaceae*	*2,351*	*1.1%*	*17.3*
wax-leaf privet	*Ligustrum lucidum*	*Oleaceae*	*2*	*0.0%*	*5.8*
Western redcedar	*Thuja plicata*	*Cupressaceae*	*1,341*	*0.6%*	*16.4*
willow	*Salix* spp.	*Salicaceae*	*614*	*0.3%*	*11.0*
wingnut	*Pterocarya* spp.	*Juglandaceae*	*31*	*0.0%*	*26.7*
witch hazel	*Hamamelis* spp.	*Hamamelidaceae*	*27*	*0.0%*	*3.0*
yellow wood	*Cladrastis kentukea*	*Leguminosae*	*298*	*0.1%*	*3.4*
yew	*Taxus* spp.	*Taxaceae*	*43*	*0.0%*	*9.4*
zelkova	*Zelkova serrata*	*Ulmaceae*	*1,911*	*0.9%*	*5.8*
Grand Total			*218,602*	*100.0%*	*10.0*

Appendix C: Trees inventoried 2010-2016

Portland Street Tree Inventory 2010-2016

Trees inventoried



Trees Inventoried

Complete neighborhood inventory

Partial neighborhood inventory - improved sites only

PORTLAND PARKS & RECREATION

Healthy Parks, Healthy Portland

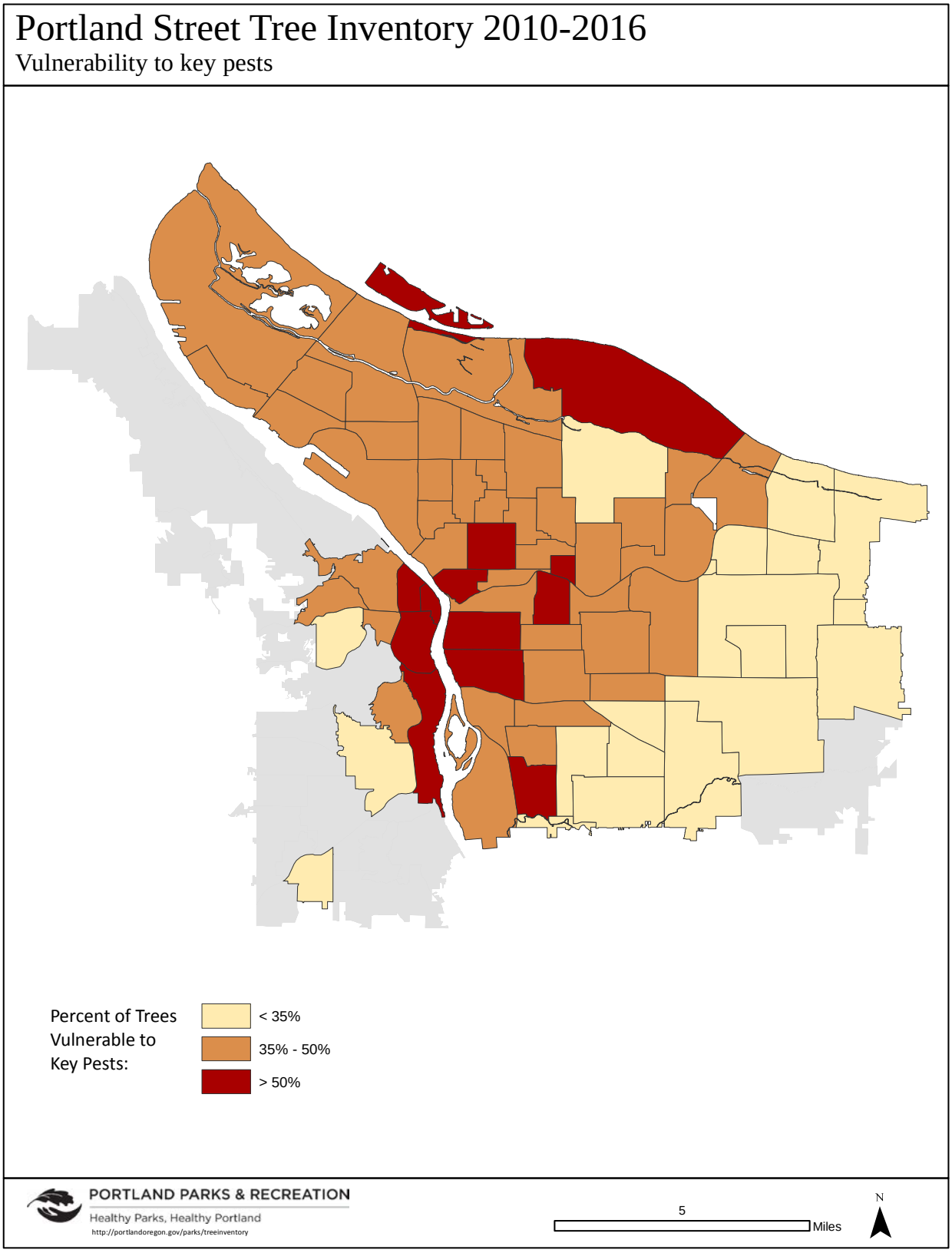
http://portlandoregon.gov/parks/treeinventory

5

Miles

N

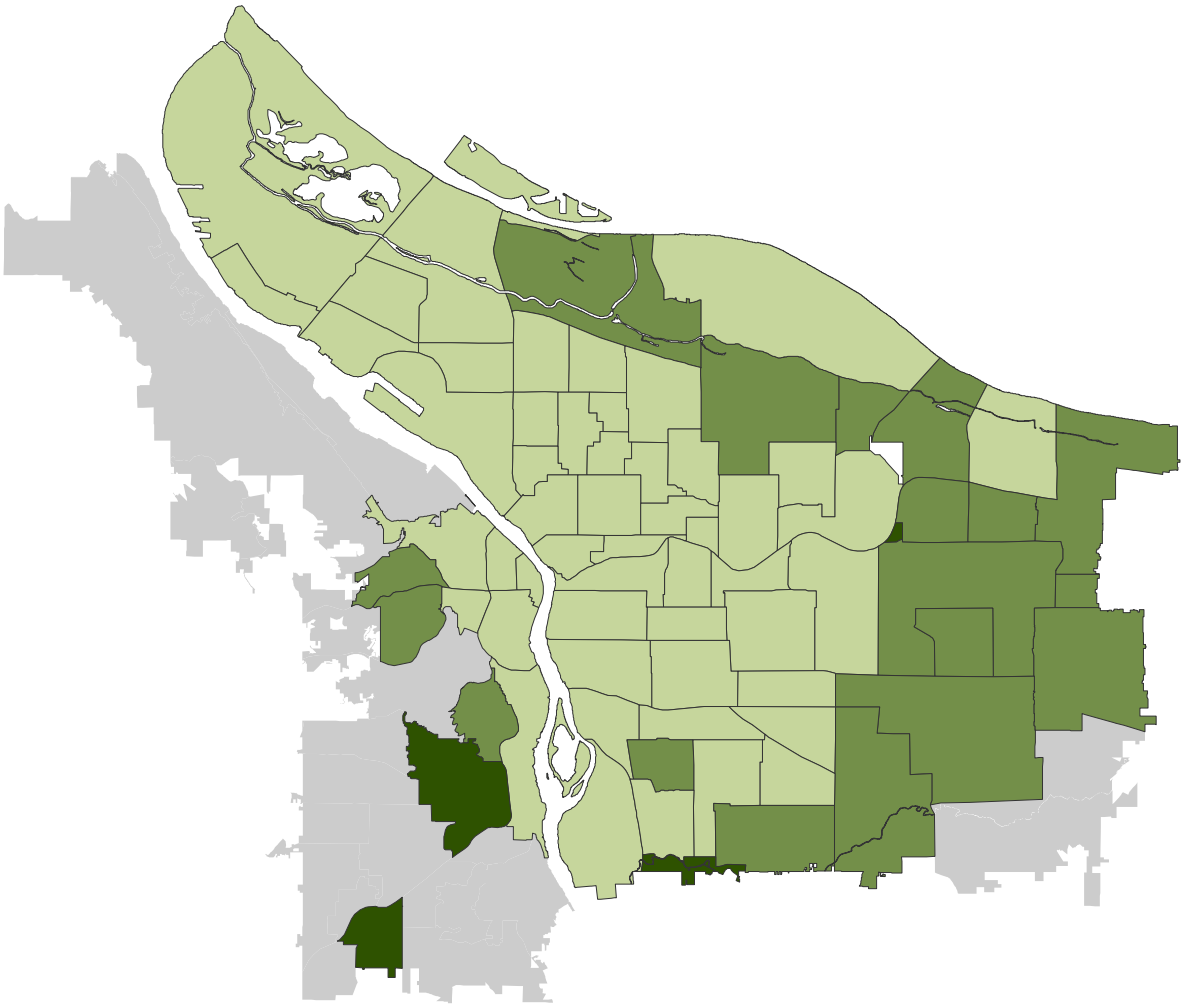
Appendix D: Vulnerability to key pests



Appendix E: Evergreen street trees

Portland Street Tree Inventory 2010-2016

Evergreen trees



Percent of trees evergreen:

- < 10%
- 10% - 25%
- > 25%

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http://portlandoregon.gov/parks/treeinventory

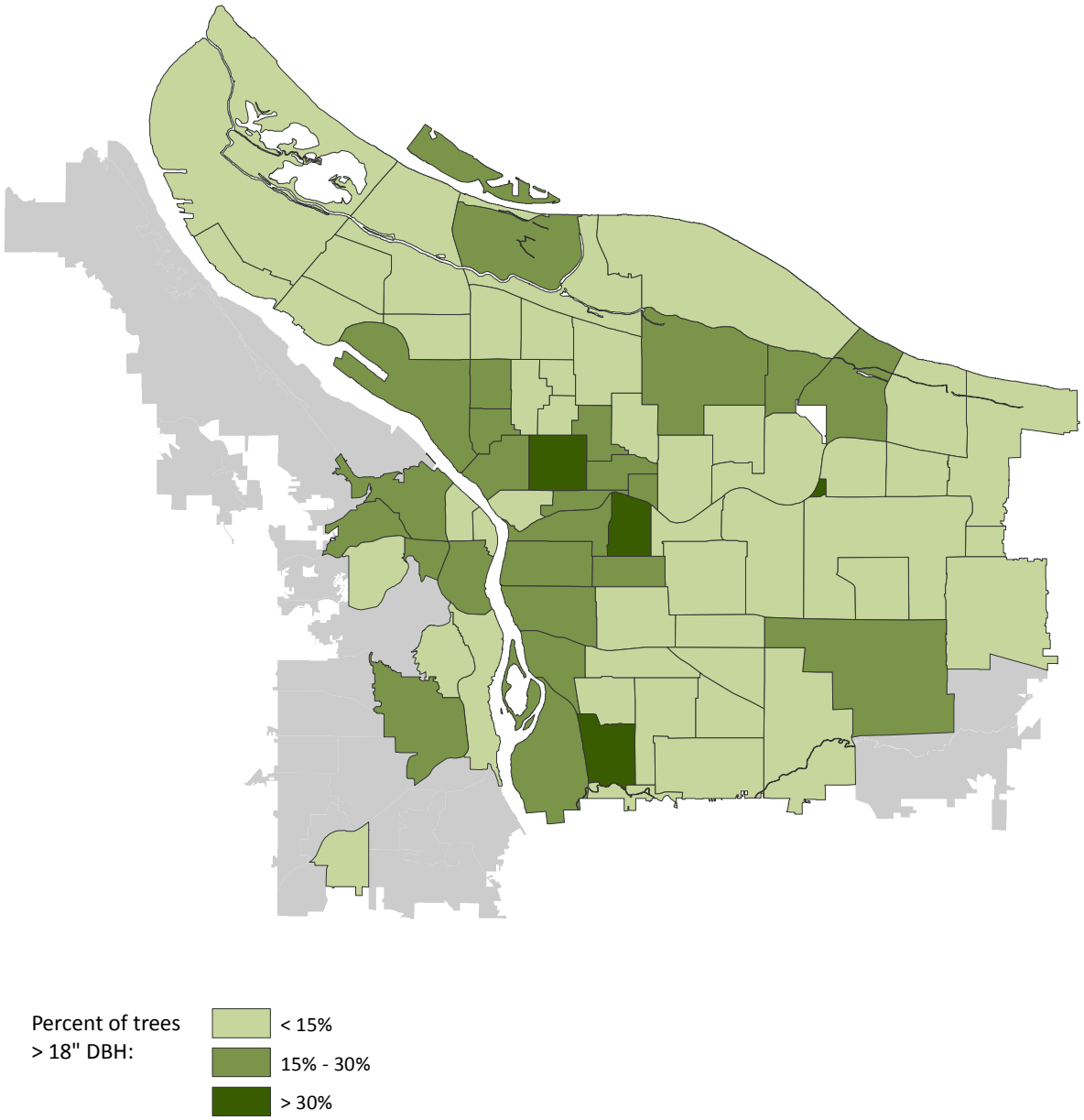
5 Miles

N

Appendix F: Mature street trees

Portland Street Tree Inventory 2010-2016

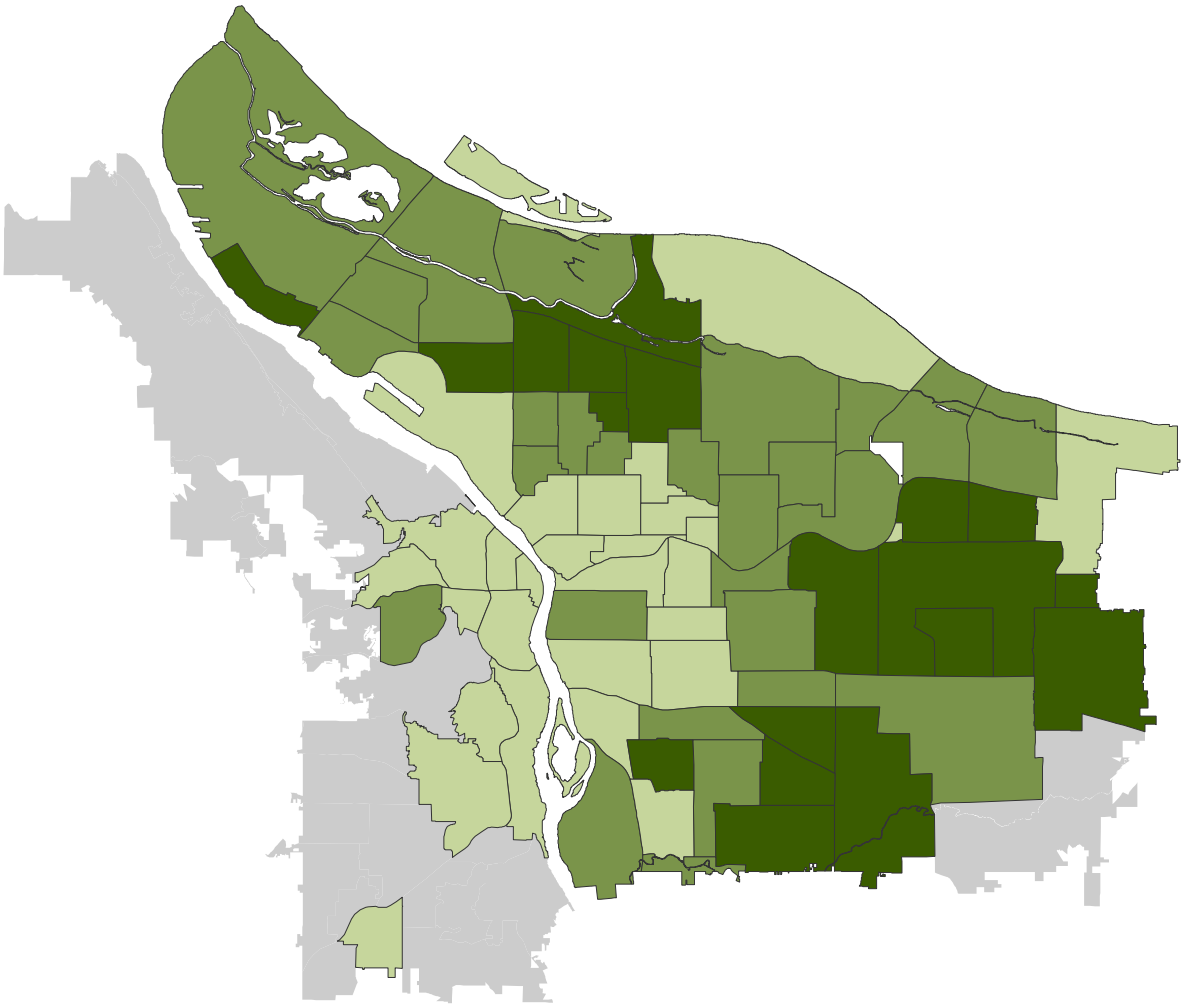
Mature trees (trees > 18" DBH)



Appendix G: Young street trees

Portland Street Tree Inventory 2010-2016

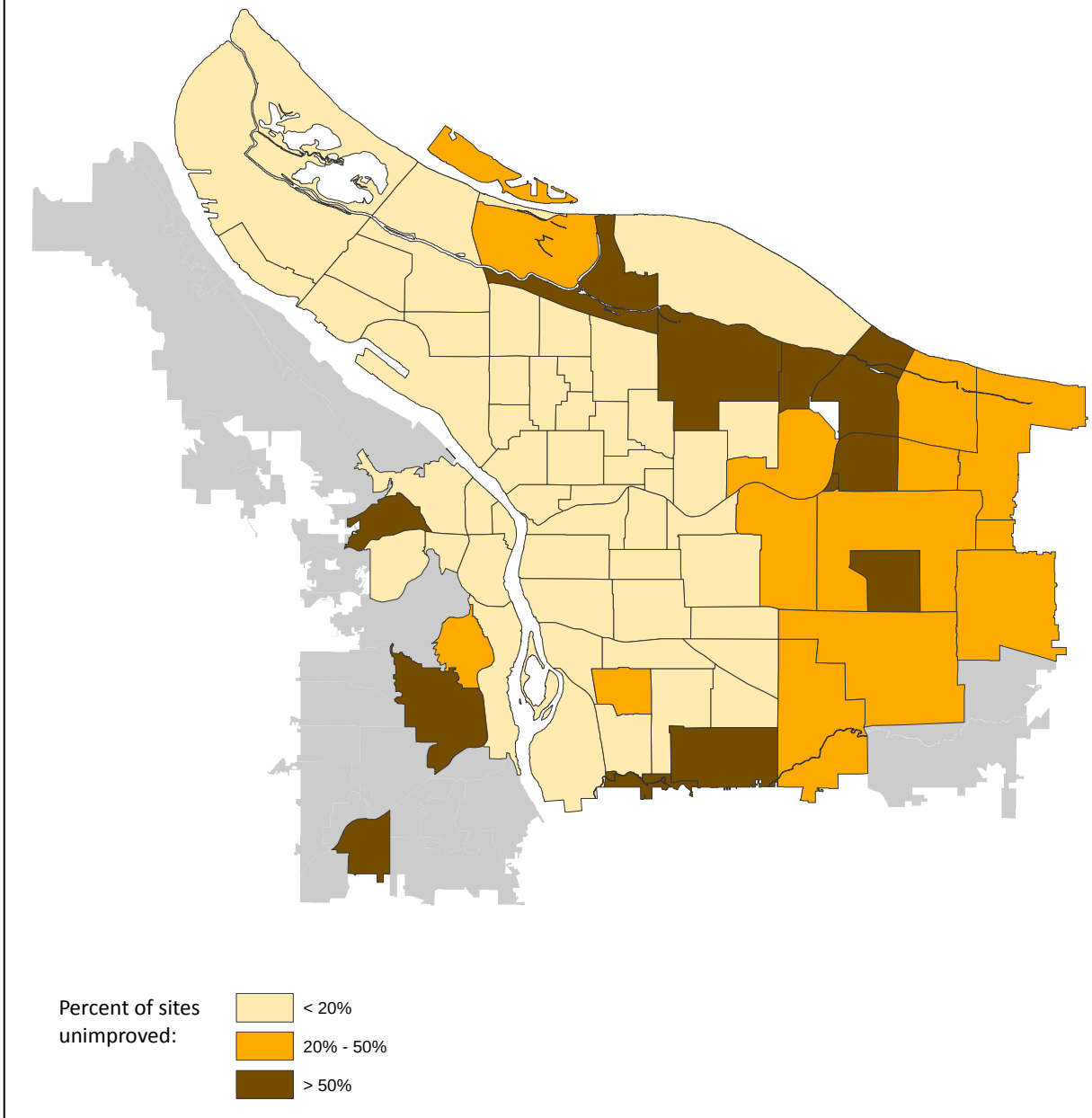
Young trees (trees ≤ 3” DBH)



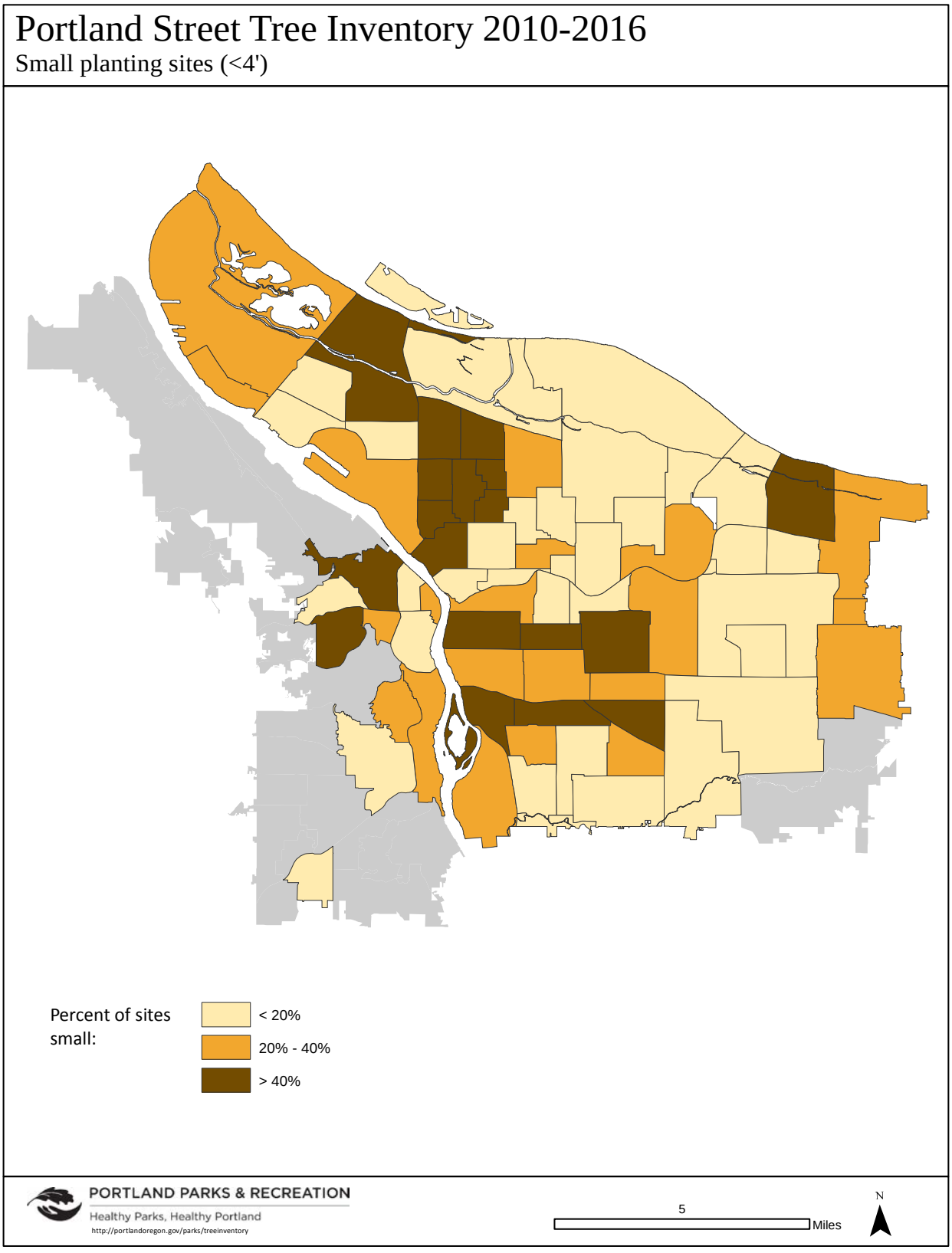
Appendix H: Unimproved planting sites

Portland Street Tree Inventory 2010-2016

Planting site types



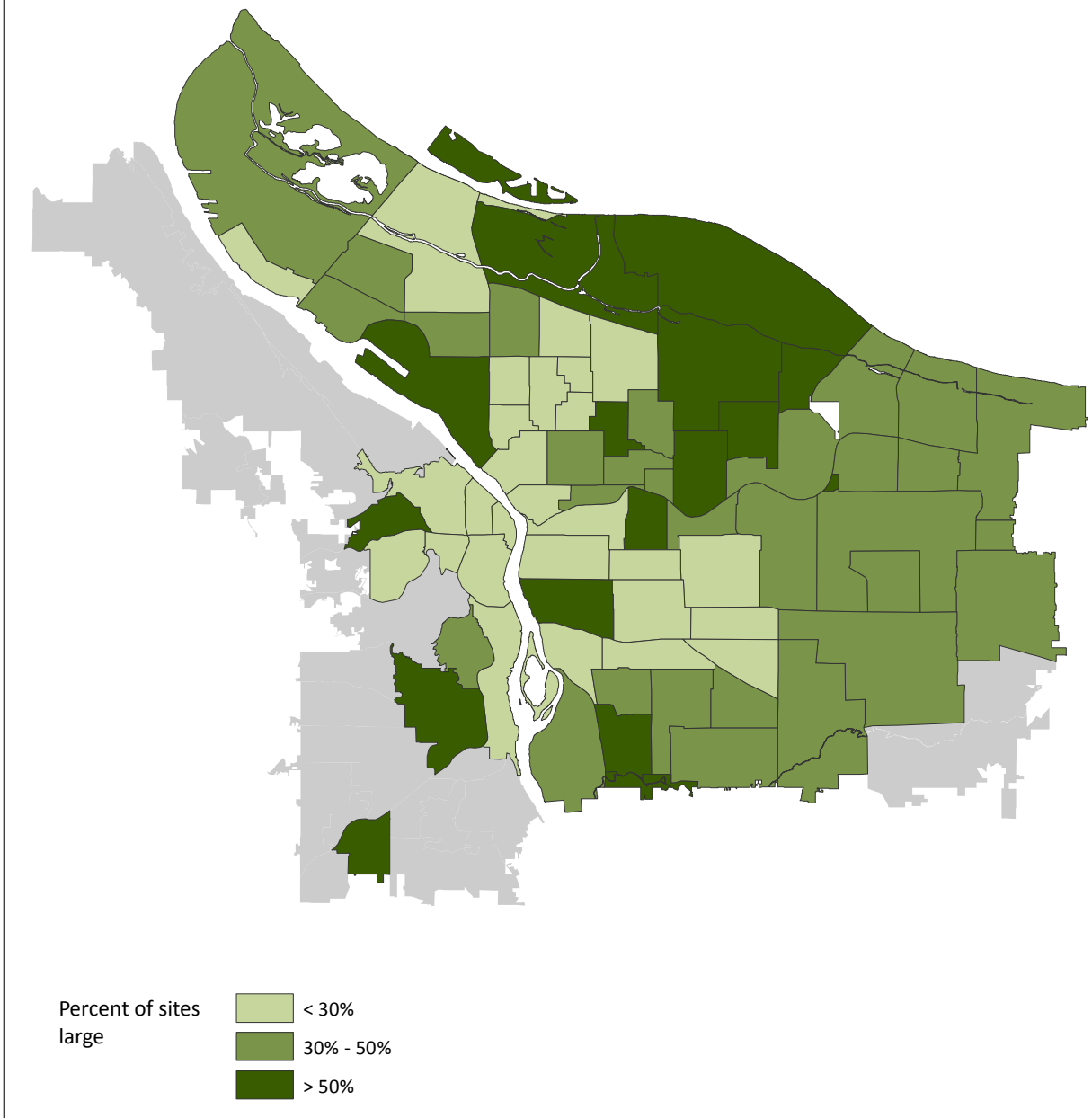
Appendix I: Small planting sites



Appendix J: Large planting sites

Portland Street Tree Inventory 2010-2016

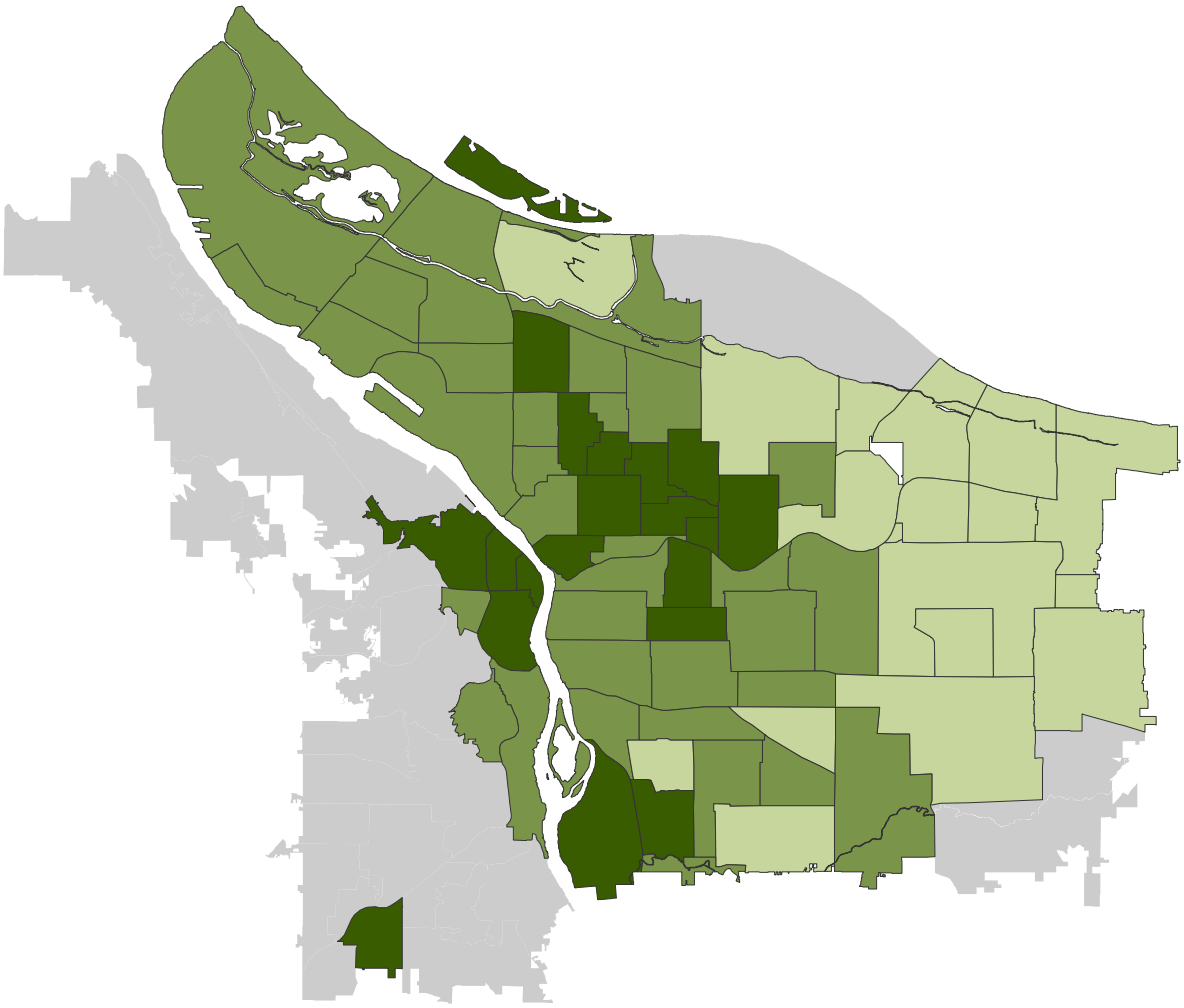
Large planting sites (6' or greater without overhead high voltage wires)



Appendix K: Stocking level

Portland Street Tree Inventory 2010-2016

Stocking level



Percent of planting sites stocked:

- < 50%
- 50% - 70%
- > 70%

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5 Miles

N

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Healthy Parks, Healthy Portland

Portland Parks & Recreation manages Portland's street trees in partnership with residents. To learn more about stewardship activities in your neighborhood and across the city, visit: www.portlandoregon.gov/trees/getinvolved.

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