DRAFT

Urban Forest Management Plan

City of Seattle
July 2012

Goal

Seattle's urban forest is a thriving and sustainable mix of tree and understory species and ages, that creates a contiguous and healthy ecosystem that is valued and cared for by the City and all of its residents as an essential environmental, economic, and community asset.

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1. Introduction

1.1. Purpose of the Plan

The City has set up the goal to achieve 30% canopy cover by 2037. According to results from the 2009 satellite assessment of 2007 data, Seattle has about 23% canopy cover.[1]

The purpose of the Urban Forest Management Plan (UFMP) is to identify goals and strategies that will help Seattle maintain, preserve, restore, and enhance its urban forest over the next 25 years.

To assist in this task, the Plan establishes a model of planning, assesses existing conditions, identifies challenges and opportunities, and develops recommendations for the city as a whole and for separate management units. This document, produced in 2012, represents the first comprehensive update of the UFMP since its creation in 2007.

What is our urban forest?

Seattle's urban forest consists of all trees and understory plants on public and private property. This urban forest includes a diverse mix of vegetation, managed by a broad group of individuals and groups and located in a range of natural and urban settings including natural areas, developed parks, other City of Seattle owned properties, right-of-way, and private property.

Why develop a plan?

A resource of this magnitude requires careful management to ensure its preservation, restoration, and enhancement. Managing trees in a city differs from managing forests in rural settings. Urban forest management goals such as increasing tree canopy, improving public safety, providing native habitat, and recreational and educational opportunities, must be balanced with other urban goals such as accommodating growth and facilitating transportation. The UFMP is the City's plan to integrate management of the many issues and opportunities posed by Seattle's urban forest resources.

Additionally, all natural systems change over time. If we want these changes to enhance the urban forest, they must be actively managed. Studies repeatedly support the fact that urban forests deteriorate when human intervention is not a proactive part of urban forest management. This decline can be seen in many of Seattle's greenbelts where invasive English ivy is strangling trees and preventing native species from growing because these areas were historically considered 'natural' and therefore not requiring maintenance. Lack of management is also evident where trees are planted in places that don't allow for growth which can lead to conflict with power lines and other utilities. Proactive management is needed to keep our trees sustainable and in balance with other urban priorities.

1.2. Environmental, economic, and social value of the urban forest

A healthy, well-managed urban forest provides numerous benefits for the community.

[1] It's important to note that canopy cover assessments have standard error ranges up to +/- five percentile points.

Environmental values

The urban forest is a fundamental aspect of Seattle's natural habitat that provides important ecosystem services for the city through stormwater retention, air and water pollution reduction, climate change mitigation and heat island effect reduction.

Seattle's urban forest is home to a diverse wildlife and provides food, shelter, and nesting opportunities that are essential to supporting this wildlife. Trees provide shade that cools streams, intercept rainwater, and lessen the impacts from storm events. As a result, fluctuations in stream flows are reduced and stream water quality is improved, which positively affects fish and other aquatic life. By reducing runoff and capturing pollutants, trees also help protect water quality in Puget Sound, Lake Washington, and Lake Union.

The urban forest also acts as the lungs of the city, filtering pollutants and sequestering carbon dioxide and other climate change causing gases. These services have been shown to reduce asthma, improve public health, and will be increasingly important as we move to address climate change.

Economic values

Trees are a critical element of our city's green infrastructure providing the ecological services we already mentioned (capturing rainwater to reduce stormwater runoff and flooding and filtering pollutants from water and air) as well as improved habitat and beauty.

Recent studies from the University of Washington and other research institutions have shown that trees positively affect the economic vitality of communities by increasing property values, shopping frequency, and office occupancy rates, while lowering crime rates and health care costs.

Social values

The presence of many trees can often define a neighborhood, and conversely, the absence of trees can do the same. Many studies show that people enjoy trees and are more comfortable in the presence of trees than they are without them in a landscape. The fact that many people plant a tree in memory of a loved one is a strong indication that we see trees as symbols of life and longevity. There are studies that show that people in tree-lined neighborhoods are more likely to spend time outside, getting to know their neighbors, and building community (Kuo et.al. 1998)[2].

Street trees keep streets and sidewalks cool in the summer and provide scale and interest in the winter. They also calm traffic and separate pedestrians and vehicles. Seattle's system of tree-lined bike and pedestrian trails are well used and valued as a resource to promote exercise and a healthier lifestyle. Among other benefits, trees have been shown to improve hospital recovery times, reduce air pollution and stress on children with asthma, improve children's performance in school, reduce noise, and overall make the urban environment more pleasant.

Research shows that trees provide numerous benefits, including energy savings, air pollution reduction, runoff reduction, and property values, that far surpass the cost of maintaining trees, including tree purchase, planting, pruning, irrigation, pest and disease prevention and control, removal and disposal, sidewalk repair, leaf litter cleanup, liability, and administration. A large tree in the Pacific Northwest provides over 300% return in investment over its lifetime.[3]

[2] Kuo, F.E., Sullivan, W.C., Coley, R.L., & Brunson, L. (1998). Fertile ground for community: Inner-city neighborhood common spaces. *American Journal of Community Psychology*, 26(6), 823-851.

[3] McPherson, E.G., Simpson, J.R., Peper, P.J., Xiao, Q. 2011. Trees pay us back in the Pacific Northwest region. Pacific Southwest Research Station, USDA Forest Service. Web: http://www.fs.fed.us/psw/programs/uesd/uep/products/18/812uesd_uep_tpub_PacificNorthwest.pdf

2. A model for urban forest management

Unlike timber forests that are grown primarily to produce forest *products*, urban forests are valued because they provide *services* such as stormwater retention, improved air quality, increased property values, and beauty. Urban forests are also more directly affected by the pressures of their location in developed areas. Given this fact, additional management intervention is necessary to keep city trees and forest lands within cities sustainable and healthy. To that end, the UFMP uses a planning model framework built around a basic understanding of the unique characteristics of urban forests.

Seattle's UFMP is informed by an approach developed in "A Model of Urban Forest Sustainability" (Clark et al. 1997)[4] and updated in "Criteria and Indicators for Strategic Urban Forest Planning and Management" (Kenney et al. 2011)[5]. This model recognizes the challenges, benefits, and opportunities unique to urban trees. Seattle's sustainable urban forest model is built around four principles from this model:

- Sustainability is a broad, general goal that results in the maintenance of environmental, economic, and social functions and benefits over time.
- Urban forests primarily provide services rather than goods.
- Sustainable urban forests require human intervention.
- Trees growing on private lands compose the majority of urban forests, including Seattle's.

The UFMP has adapted the sustainability model to provide a structure that organizes our goals and strategies. Although we've altered the main titles, we use the same three primary management elements as those of the model:

The Urban Forest Resource: the characteristics of the trees themselves, as individuals or in forest stands, and how we assess them.

Management Framework: the policy, planning, and programs -including staff, funding, and tools- brought to bear by the City on its urban forest.

Community Stewardship: the way residents are engaged in planning and caring for trees.

Because of the differences between developed property, streetscapes, parklands, remnant forests, and other areas, the urban forest cannot be viewed as a single unit for management purposes.

This plan defines nine management units that cover all the lands in the city. Using these land-use types allows for easy coordination of GIS mapping layers and for related planning initiatives. The units include eight distinct areas that were selected based upon physical characteristics and one, Right-of-way, which goes through each of the other eight units. Figure 1 shows the geographic distribution of the management units.

The following are the nine units for the Plan:

1. Single-Family Residential
2. Multi-Family Residential
3. Commercial/Mixed-Use
4. Industrial
5. Institutional
6. Downtown
7. Developed Parks
8. Parks Natural Areas
9. Right-of-way

Management Units (MUs)

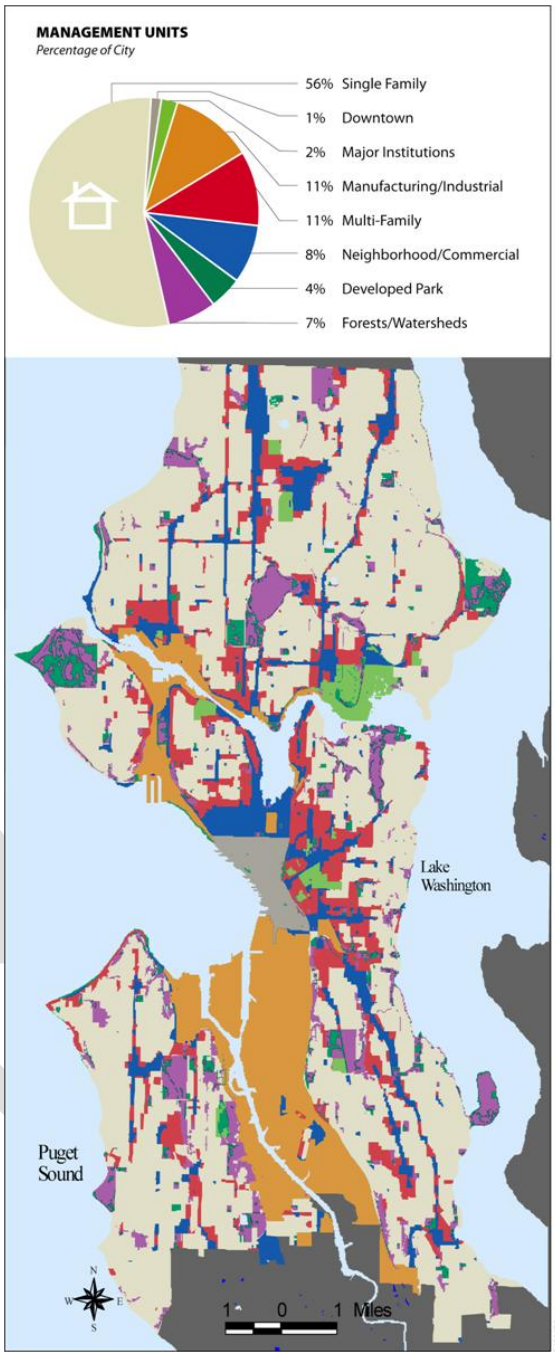
The purpose of defining urban forest management unit (MUs) is to allow analysis and planning for all of our forest resources at the level where real 'on-the-ground' actions can or are likely to take place.

[4] Clark, J. R., N. P. Matheny, G. Cross & V. Wake. 1997. A Model of Urban Forest Sustainability. *Journal of Arboriculture*, 23(1)17-30.

[5] Kenney, W. Andy, van Wasseanaer, Philip J.E., & Satel, Alexander L. 2011. Criteria and Indicators for Strategic Urban Forest Planning and Management. *Arboriculture & Urban Forestry*. 37(3):108-117.

Figure 1. Seattle's urban forest canopy cover: distribution by management unit

**Right-of-Way/Street Trees is distributed throughout all of the management units and also calculated separately*



It's also important to consider the different types of ownership and management structures governing individual trees and property. For the purpose of this plan, we consider three types of trees: public, private, and street trees.

Public trees are those whose ownership and management falls exclusively on City government, such as trees in developed parks and in natural areas, and landscaping on other City property.

Private trees are those found on private property. However the City plays an important regulatory and supporting role for these trees.

Street Trees are those found in the public right-of-way and are managed cooperatively between the Seattle Department of Transportation (SDOT) and adjacent property owners.

In a later section of the UFMP, we'll use the above mentioned management elements and management units to structure goals and strategies.

2.1. **The Urban Forest Resource**

Understanding the state of the urban forest resource is a critical step in active management. To this end, the City of Seattle is committed to undertaking periodic city-wide canopy assessments and more detailed analysis as practical. These efforts have focused on three:

- City-wide canopy assessment: assessment of canopy cover by remote aerial sensing such as satellite or LIDAR imaging providing a low-cost method of surveying canopy quantity.
- Sampling surveys: detailed analysis of selected sites, which can be extrapolated to provide data on the overall quality of a larger area.
- Inventories of strategic assets: tree-by-tree measurement and geolocation to provide a detailed assessment of quantity and quality.

Below is a summary of key efforts the City has undertaken. Results of these efforts are summarized in Chapter 3: State of the Urban Forest.

Canopy cover assessment

In order to create a baseline to monitor progress toward the canopy cover goal, in 2010 the City commissioned a canopy cover assessment using 2 foot by 2 foot resolution Quickbird multi-spectral satellite imaging. This process was undertaken for two sets of data from 2002/3 and 2007. While a specific margin of error was not provided it is important to note that all canopy cover assessments have a margin of error.

The City also commissioned canopy cover assessments in1998 using 40 foot by 40 foot LandSat data and in 2001 using LIDAR data; however, these efforts used low accuracy techniques and are thus not discussed in this plan.

Using information gathered during the 2007 canopy cover assessment, the City developed planting potential data in an attempt to better inform existing canopy cover goals. The analysis identified areas of pervious surface that did not have tree canopy cover and used an algorithm to determine the number of trees that could fit in these spaces using simulated 10ft, 15ft and 25ft canopy diameter trees. This analysis resulted in a measurement of planting potential measured both in number of trees and canopy area at maturity. Because this analysis includes areas which may be inappropriate for trees such as playfields and gardens, areas with limitations due to utilities, or areas where property owners may desire other uses further analysis and ground truthing is necessary for this data to be useful in analyzing current goals.

Integrated Urban Forest Assessment (i-Tree)

The Green Cities Research Alliance, a collaboration between the University of Washington, King County, Forterra, and the City of Seattle, conducted a sampling survey of Seattle's trees using the program i-Tree Eco[6] (previously known as the UFORE model). i-Tree is a peer-reviewed software suite from the USDA Forest Service that provides urban forestry analysis and benefits assessment tools.

[6] i-Tree Eco – http://www.itreetools.org/eco/index.php

Data collection began in Seattle in the summer of 2010 and was completed in the summer of 2011. Data was collected from 223 plots that were randomly selected within each of Seattle's forest management units as defined by the UFMP. This survey produced data on evergreen vs. deciduous breakdown, size, and condition information that have been incorporated into this UFMP update. Further analysis of information regarding species diversity, density, leaf area and biomass, pest susceptibility, and species origin and invasiveness is required.

Parks Vegetation and Forest Management Plans

Even though the Department of Parks and Recreation (Parks) has not had the resources to develop a complete inventory of the estimated 100,000 trees in developed parks, it has completed over 120 vegetation or forest management plans for individual parks over the last 15 years. These plans include assessments of existing conditions including the health of the urban forest. Information on individual parks is available at the Parks' website.[7]

Street Tree Inventory

The Department of Transportation (SDOT) conducted an inventory of street trees in 1992 for all areas of the city with curbs and gutters. While this inventory has not been comprehensively updated, SDOT has continued to add trees that have been planted through SDOT Capital Improvement Projects, Bridging the Gap levy, SCL's Urban Tree Replacement Program, Seattle reLeaf's Trees for Neighborhoods program, and permits received by the City. Today, around 140,000 trees are included in the inventory including the approximately 40,000 City-maintained street trees.

In 2012, SDOT made individual tree information available to the public via their web-based street tree map[8] (Figure 2). Users can obtain the common and scientific name, the inventory identification number, the tree diameter, the street address, the party responsible for maintenance, the date the tree was planted or inventoried, and the date the tree was last checked, by clicking on an individual tree.

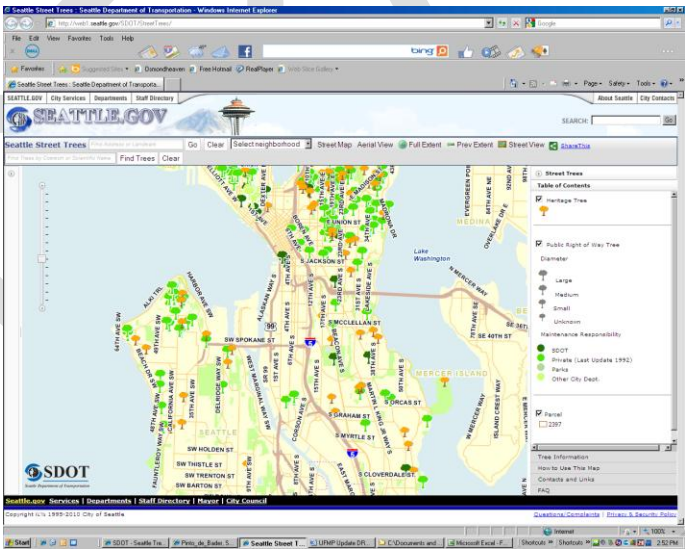


Figure 2. SDOT's street tree online map

[7] www.seattle.gov/parks/horticulture/vmp.htm.

[8] Seattle Department of Transportation. Seattle Street Trees. Web http://web1.seattle.gov/SDOT/StreetTrees/

2.2. **Management Framework**

This section describes the City of Seattle's framework for managing the urban forest resource including direct management of City-owned or maintained trees and regulations, incentives, and programs for private property trees.

Interdepartmental coordination

Several City departments are involved in the management of the urban forest. Effective interdepartmental coordination is essential for consistent delivery of urban forestry programs.

Urban Forest Interdepartmental Team

The Urban Forest Inter-departmental Team (IDT) is a cooperative effort of eight City departments that have tree management responsibilities (Table 1) in charge of implementing the UFMP.

By providing an opportunity for staff to meet regularly, the IDT allows members to keep each other informed of and work together on actions that will impact the urban forest and that are either undertaken or proposed within their departments.

Table 1. City of Seattle urban forest responsibilities by department

Department	Responsibilities
Seattle Parks and Recreation (Parks)	Seattle Parks and Recreation manages trees over 6,000 acres of developed parks, boulevards, natural areas, and other publicly-owned open spaces, including about 100,000 trees in developed parks and over 585,000 trees in the forested areas of parks. Parks must balance a wide range of recreational goals including the desire for picnic, sports, and play areas. Contact: Horticulture & Forestry Manager, (206) 684-4108 Senior Urban Forester, (206) 684-4113 www.seattle.gov/parks/horticulture/
Seattle Department of Transportation (SDOT)	Seattle Department of Transportation is responsible for the management of trees in the right-of-way (street trees), including design, installation, and stewardship of trees and landscapes associated with public right-of-way and permitting of actions that could impact these trees. Since 2007 SDOT has planted an average of over 1,200 trees per year. SDOT also maintains over 40,000 street trees and regulates planting and maintenance of another 100,000 street trees. They must balance canopy cover goals with the need to minimize tree conflicts with surrounding infrastructure and transportation safety requirements. Contact: Urban Forest Manager, (206) 233-7829 City Arborist (206) 615-0957 www.seattle.gov/transportation/forestry.htm
Seattle Center	Seattle Center manages trees in its 74-acre campus. It hosts hundreds of community events and three major festivals each year. There is constant pressure on the trees and landscape from resident organizations, promoters, and residents. Contact: Landscape Supervisor, (206) 615-0880 www.seattlecenter.com
Seattle City Light (SCL)	Seattle City Light is responsible for ensuring safe and reliable power delivery through the comprehensive and environmentally responsible management of the

	vegetation that their lines and infrastructure impact. City Light maintains an Urban Tree Replacement Program that works closely with the City's reLeaf program and its Trees For Neighborhood program. City Light is challenged by the prevalence of inappropriately sized trees that grow into utility lines. Contact: Arboriculturist, (206) 386-1902 www.seattle.gov/light/vegetation
Seattle Public Utilities (SPU)	Seattle Public Utilities (SPU) works to maintain and restore the urban forest because it provides significant storm water mitigation benefits by intercepting and absorbing rainwater. Slowing the flow and improving water quality reduces the need for built infrastructure and mitigates flooding. SPU supports several programs that promote healthy urban forests including Restore Our Waters, the City's reLeaf program, Green Seattle Partnership and the Green Stormwater Infrastructure program. Contact: (206) 615-1668 www.seattle.gov/trees
Office of Sustainability and Environment (OSE)	Office of Sustainability and the Environment leads policy development and coordination for city-wide urban forest issues including management of the Urban Forest IDT, staffing of the Urban Forestry Commission, coordination of inter-departmental issues, reporting progress, and updating of the Urban Forest Management Plan. Contact: (206) 684-3194 www.seattle.gov/environment/urban_trees.htm
Department of Planning and Development (DPD)	Department of Planning and Development is responsible for the development, permitting, and enforcement of regulations for trees on private property both during and outside of the development process including tree protection, landscaping, environmentally critical area, and nuisance requirements. DPD is also responsible for stewarding the City's Comprehensive Plan, which includes broad policy direction for managing the urban forest. Contact: Public Resource Center, (206) 684-8467 (questions about regulations) Code Enforcement, (206) 615-0808 www.seattle.gov/dpd/trees
Finance and Administrative Services (FAS)	FAS manages properties and facilities owned or leased by the City. This includes buildings serving the Seattle Fire Department, Seattle Police Department, downtown City government office buildings, campuses housing City construction and heavy maintenance vehicles, various buildings throughout the community, as well as City-owned vacated property. Their goal is to preserve as many trees as possible on all sites, and to create sustainably landscaped areas around buildings and properties while ensuring the safety of tenants and property via proper tree planting, maintenance, and pruning. Contact: (206) 233-5104 www.seattle.gov/fas/

Management of public and street trees

Urban trees require active management. The City of Seattle is directly responsible for management of trees in three management units: Parks Natural Areas, Developed Parks, and Right-of-Way, as well as for management of trees on City property. Through this work, the City strives to implement the goals of the UFMP while also supporting other City goals such as protecting public safety, facilitating mobility, accommodating recreational facilities, and providing vibrant open space.

Planting and Establishment

The first three years of a tree's life, also known as the establishment period, are typically the most maintenance-intensive. Establishment requires attention to tree selection, site preparation, planting, watering, staking, pruning, and mulching to support tree survival. Street trees require additional watering because of the impervious paved surfaces that surround them, which also radiate heat increasing evaporation and decreasing water availability to the tree.

Each year City departments plant new trees and follow the City's two-for one tree replacement policy where departments are instructed to plant two trees for each tree they remove from City property. In 2011 Parks planted close to 600 trees, SDOT planted over 800 street trees with Bridging the Gap levy funds, the City's reLeaf Program distributed 1,000 trees to Trees for Neighborhoods program participants, 375 of which were planted by residents thanks to SCL's support of the program and as part of the Urban Tree Replacement Program. Seattle Center planted 12 trees in its Nob Hill project. Departments remove trees as part of ongoing maintenance and hazard abatement efforts. In 2011 all departments combined removed 734 trees. The Citywide total of new trees planted was over 2,600, fulfilling the two-for-one policy.

Pruning

Pruning is a specialized type of maintenance that can be done reactively to eliminate hazards such as obstructed traffic signs or removing branches at risk of falling (Figure 3). Pruning can also be done preventively for tree health and safety. Proactive pruning for health and safety is done to remove diseased or insect-infested wood, improve air flow to reduce disease and insects, remove crossing or rubbing branches (Figure 4), develop a strong structure, remove broken limbs to encourage wound closure and prevent hazards, and prevent obstructions with signs and pedestrian traffic.

Figure 3. Hazard response on street trees

Figure 4. Structural pruning in young trees is critical to establish safe, strong branches in mature trees

City staff and their contractors follow industry standards as defined in the International Society of Arboriculture's (ISA) tree pruning guidelines and/or those in the ANSI A300 pruning standards and the Z133.1 safety standards. Many of Seattle's urban forestry managers and tree-crew personnel are ISA Certified Arborists. An increasing number of arborists in the region's tree service firms are also ISA certified. Additionally, other specific practices are laid out in various departmental guides including the Parks Best Management Practice manual, the SDOT Street Tree manual, and other City landscaping and maintenance plans.

Pruning cycle – the length of time it would take a department to prune each of the trees for which they are responsible based on annual workload – is often used to measure the amount of care trees are receiving. Table 2 shows how current pruning cycles within each department compare to industry standards. One of the City's goals is for SDOT and Parks to approximate industry standard pruning cycles.

Table 2. Estimated maintenance needs of City of Seattle trees

Department	Industry standard vs. current pruning cycle	# of trees department is responsible for
SDOT	5 – 7 Years vs. 13.4 years	40,000+ trees
Parks	5 – 7 years vs. 18 years	100,000 trees
SCL*	4 years*	n/a

*Utilities have no industry standard related to tree pruning cycle.

Due to limited resources, SDOT and Parks spend the majority of time and resources on corrective measures and imminent hazard response. Deferred preventive maintenance for street trees and trees in developed parts is a key issue. Performing structural pruning of young trees is more cost effective than corrective pruning or hazards later.

Maintenance Record Keeping

Seattle has been working on improving maintenance records to facilitate workload planning. Having information available also assists greatly in answering questions from the public regarding how and where tree maintenance resources are being used.

SDOT currently uses a system that provides basic cost information about tree care operations and is working on integrating this information with their inventory data. Parks maintains data in a number of formats depending upon the type of work and where it was performed. The Green Seattle Partnership Parks Forest Restoration Program has developed online work recording system that allows volunteers, contractors, and staff to enter work completed.

Managing Woodwaste Products

City urban forestry operations generate considerable amounts of byproducts from large logs to leafy compostable materials. Ideally these 'waste' products are recycled in the form of mulch, compost, or material for higher value products such as furniture or cabinetry. The City has a process in place for dealing with City-generated green waste on a broad scale.

Shared Street Tree Management

While the City is responsible for all aspects of management for most of these trees, street trees often have shared tree management responsibilities**.** Approximately 75% of street trees have been planted by private residents or community groups, and are therefore the responsibility of the abutting property owner to maintain. Many property owners are unaware of this responsibility or are unable or unwilling to maintain those trees. SDOT tree crews are frequently dispatched to prune or remove privately-maintained trees that pose a risk to pedestrians and motorists. About 25% of crew time is spent responding to such calls.

Regulations for private property

The City has developed regulations and incentives with the goal of maintaining and enhancing a thriving and diverse urban forest that maximizes the environmental, economic, and social benefits of trees, while recognizing other citywide goals and policies for sustainability and growth management relating to density, transportation, housing affordability, and urban design; and accommodating property owner's desires for solar access, solar energy, gardens, accessory structures, views, access, and risk management.

Under the existing code, regulations governing trees on private property are contained primarily in three City codes:

- **Tree Protection regulations**, Seattle Municipal Code (SMC) Chapter 25.11, which regulates tree removal both outside of and during the development process
- The **Land Use Code**, SMC Title 23, which has standards for the planting of trees and vegetation as part of standards governing new development throughout the city
- **Environmentally Critical Areas (ECA) regulations,** SMC Chapter 25.09 which regulates trees and vegetation in and surrounding environmentally critical areas such as wetlands, streams, shorelines, landslide-prone areas and associated buffers
- **Stormwater code**, SMC Title 22 Subtitle VIII, gives credit for trees and other green infrastructure in determining requirements for new development
- **Street and Sidewalk Use code**, SMC Title 15, contains standards for the care of privately-maintained street trees and permit requirements for planting, pruning, or removing any street trees.

A summary of regulations affecting urban trees can be found at www.seattle.gov/dpd/trees.

2.3. Community Stewardship

The majority of Seattle's urban forest is located on private property. Consequently, broad appreciation for the benefits and needs of trees and engagement in the planning, planting, and care of trees is essential to the long-term health of the asset. This section describes the ways in which the City engages the community in stewardship of the urban forest.

Planning and policy development

Seattle residents have opportunities to participate in urban forest planning and policy development through public involvement during major plan development, participation in oversight and planning committees, and through the Board of Parks Commissioners, Planning Commission, Design Commission, and the Urban Forestry Commission.

The Urban Forestry Commission (www.seattle.gov/urbanforestrycommission) was established in 2009 to advise the Mayor and City Council concerning the establishment of policy and regulations governing the protection, management, and conservation of trees and vegetation in the City of Seattle. The Urban Forestry Commission worked closely with the Urban Forest IDT on the 2012 update of the UFMP.

Outreach and education

The City has an important role in fostering residents' understanding of the environmental, economic, and community benefits of trees as well as proper tree selection, planting, and care. City departments provide information through the City's website, the reLeaf website[9], brochures and other publications, environmental learning center activities, and during volunteer events.

[9] Seattle reLeaf. Web www.seattle.gov/trees

The City's reLeaf program implements strategies to engage residents in urban forest stewardship. The program provides information and support for residents to understand the value of trees and how to care for them; facilitates access to urban forest organizations and events throughout the city; and works closely with City departments and community organizations to make urban forest outreach efforts accessible, understandable, and coordinated in the eyes of the public. The program maintains, develops, and delivers outreach tools and materials such as the reLeaf website, brochures, presentations, workshops, and trainings; engages Seattle residents in tree planting and stewardship; and leverages federal and state funds, along with thousands of volunteer hours through the Tree Ambassador, Urban Orchard Stewards, and Trees for Neighborhoods programs.

Departments continue to work on achieving higher levels of coordination using reLeaf as their main outreach tool.

Volunteer opportunities

Seattle residents volunteer many thousands of hours of support for the City's urban forestry programs each year. Some of the key programs include:

Green Seattle Partnership: this effort is a partnership of the City of Seattle (Parks, SPU, and OSE) with the non-profit Forterra to leverage City resources, grants and volunteers to restore 2,500 acres of forested parklands by 2025. Volunteers plant trees and maintain park vegetation in developed and forested parklands, contributing over 90,000 hours of work in 2011 alone. In many cases, Forest Stewards stand out as active volunteers and receive training in organizing and directing forest restoration, tree planting, and maintenance projects. Non-profit organizations such as Nature Consortium and Earth Corps have been important partners in this effort.

The Heritage Tree Program: a partnership between the City and PlantAmnesty, a local non-profit, to identify and give recognition to trees distinguished by botanical, historic, or landmark significance. Since 1993, a committee composed of Certified Arborists and residents have identified over 131 trees and three collections (Kubota Gardens, Arboretum, and University of Washington campus) that have been listed as Heritage Trees.

Traffic Circle Volunteers: SDOT recruits and trains volunteers to maintain over 1,000 traffic circles and other street-side landscaped areas.

Tree Ambassador: Seattle reLeaf's Tree Ambassador project trains neighborhood leaders to become stewards of urban trees and engage their local community in tree planting and care. This is a SPU-led effort with strategic support from, Parks, SDOT, and Forterra. Funding has been provided by a grant from the U.S. Forest Service's Urban and Community Forest Program.

Figure 5. Tree Ambassador program participants learning to prune young trees

Urban Orchards Stewards: This project works with residents to become stewards of existing public orchards. The work is being implemented through a partnership between Parks and non-profit City Fruit and has been funded by Washington State grant funds.

Figure 6. Urban Orchard Stewards at a work party

Many departments also work with business and community groups on a variety of planting, street repair, and design projects. By engaging with local businesses and groups on these projects, the City is able to get more done with limited funds and develop stewards that will continue to support the urban forest in their community.

Incentives

The City also maintains a number of incentive programs to further encourage planting and preservation of trees.

- **Development Standard Departures**: applicants may apply for departures from development standards to preserve an existing tree during development
- **Trees for Neighborhoods**: this reLeaf program provides free trees for Seattle residents to plant in their yards and planting strips. Program participants also receive free watering bags, training in proper planting and care, and ongoing tree care support. This program planted 2,300 trees between 2009-2011, including fruit trees, evergreen trees, small trees under power lines, and street trees.
- **Stormwater rates**: SPU considers land cover in their calculation of stormwater rates for larger property owners

The City continues to seek opportunities for additional incentives. In the past, the City successfully partnered with private businesses to sponsor discount tree coupons that were popular and gave residents flexibility as to where trees were planted. Enhanced stormwater rates, assistance with disposal of leaves, or technical assistance could be considered in the future.

3. State of the Urban Forest

Seattle has between 1.6 and 3 million trees and a diversity of understory plants, occurring within a diverse range of environments from natural areas with multi-story plants to downtown areas with individual trees planted in small tree pits. Overall, the urban forest of Seattle is a highly managed environment which has been profoundly shaped by its past and future residents.

In the early 1900s, nearly the entire forest, consisting primarily of large Douglas fir, Western red cedar, and Western hemlock, were milled into lumber. This profound alteration of the landscape has had a deep impact on the urban forest which can still be seen today. In developed areas, the existing urban forest is almost entirely planted by human hands.

Plant selection and location in most areas tend to be the product of decisions about landscaping undertaken by many successive owners and reflecting changing personal preference. While trees and vegetation in this environment tends to be fairly young due to competing needs and the changing preference of successive owners, there are many trees that are still original to the first wave of development and have become very large. In our natural areas, the wholesale removal of conifers left a small seed source to renew the coniferous forest. Instead, deciduous native alders and big-leaf maples claimed the land and became the second-growth remnant forests (or woodlands) of today. These trees have grown to maturity in many areas, but are starting to experience accelerated decline due to the high number of trees that are reaching the end of their life at the same time.

At the same time, invasive species such as English ivy and Himalayan blackberry represent a growing portion of the urban forest both in landscaped and natural areas which represents a substantial threat to the health of the urban forest.

Below is a summary of some the key indicators of our urban forest as well as unique environments that warrant additional discussion.

3.1. **City-wide**

Canopy Cover

Analysis of 2007 QuickBird satellite data found that Seattle has about 23% canopy cover or approximately 13,000 acres of canopy. Canopy cover was also determined by management unit as shown in Table 3.

Table 3. Existing Canopy cover by management unit

Management unit	Land area (acres)	% of city land area	Estimated 2007 canopy cover
Single-Family	30,452	56%	26%
Multi-Family	5,982	11%	17%
Commercial/Mixed Use	4,350	8%	10%
Downtown Seattle	544	1%	9%*
Industrial	5,982	11%	4%
Institutional Properties	1,088	2%	19%
Parks: developed sites	2,175	4%	25%
Parks: natural areas	3,807	7%	80%
Citywide	54,379		23%
Right-of-way	14,682	27%	18%

*Shading caused by downtown tall buildings was the reason why canopy cover for this management unit was under represented. SDOT analysis of their existing tree inventory confirmed that downtown's canopy cover is closer to 9%.

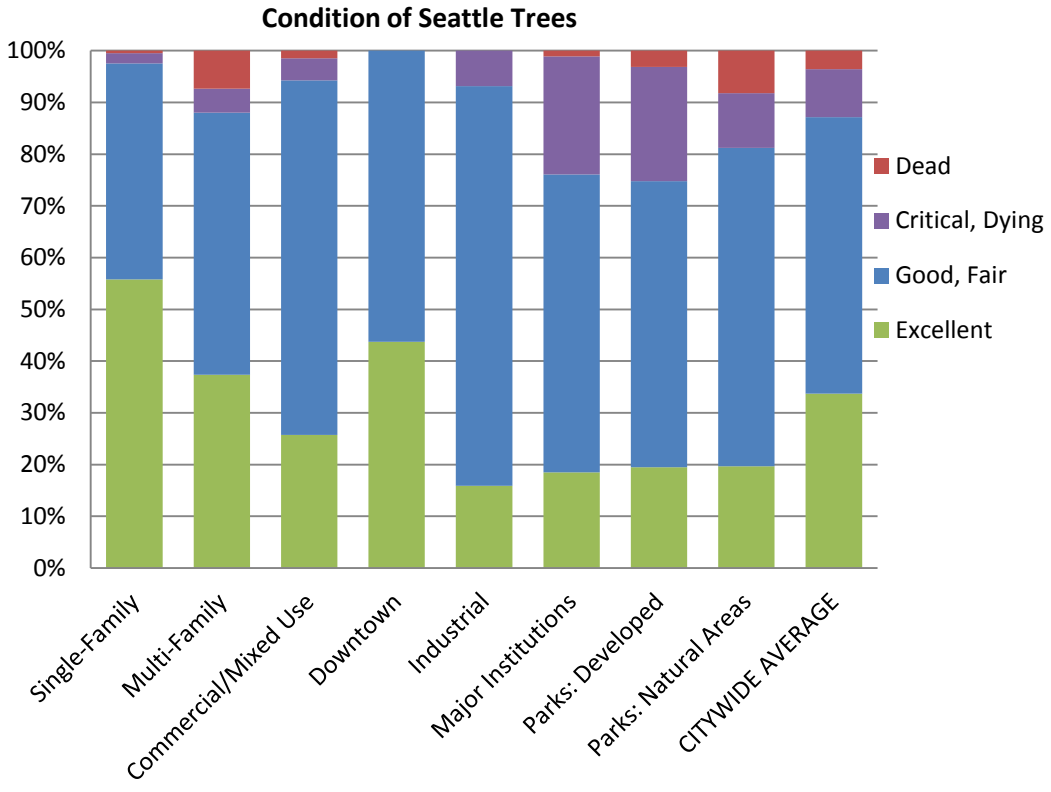
While canopy cover is a critical measure of overall health of the urban forest, it is difficult to establish guidelines for what canopy cover should be. While it is obvious that canopy cover is substantially less then it was prior to European settlement and substantially more than it was after the timber harvests of the early 1900s, a more detailed comparison to historical conditions is not reliable because good canopy analysis technologies have only been developed in recent years. Comparison to other cities is also very difficult due

to the unique conditions of each location (geographic size, level of density, amount of parks land, amount of roadway, amount of environmentally critical areas, industry composition, climate, etc.).

Health and Longevity

The iTree survey generated basic data on the health of trees as well as the average diameter of trees. This data is summarized in Figures 7 below. While this data provides an important snapshot of the urban forest, it is difficult to draw conclusions about this data without long-term information to understand trends or comparative data for similar cities. Overall, this information suggests that Seattle's trees are within generally acceptable ranges for tree health.

Figure 7: Condition of Trees by Management Unit



Species and age diversity

The iTree survey provided two measurements that help to quantify this aspect of the urban forest: breakdown of evergreen and deciduous and average diameter of trees.

Evergreen trees are those that maintain their leaves (broadleaf) or needles (conifer) all year long; while deciduous trees shed their leaves or needles in the winter. Native Pacific Northwest forests tend to be predominately evergreen conifers (cedars, pine, spruce, hemlock, fir, pine, etc.) with a smaller mix of deciduous trees (maple, cottonwood, alder, etc.) focused in disturbed areas or on steep slopes. Broadleaf evergreens are almost entirely exotics (holly, magnolia, etc.) with the exception of the Pacific madrone which generally grows on steep slopes in limited areas. Evergreen trees tend to provide greater

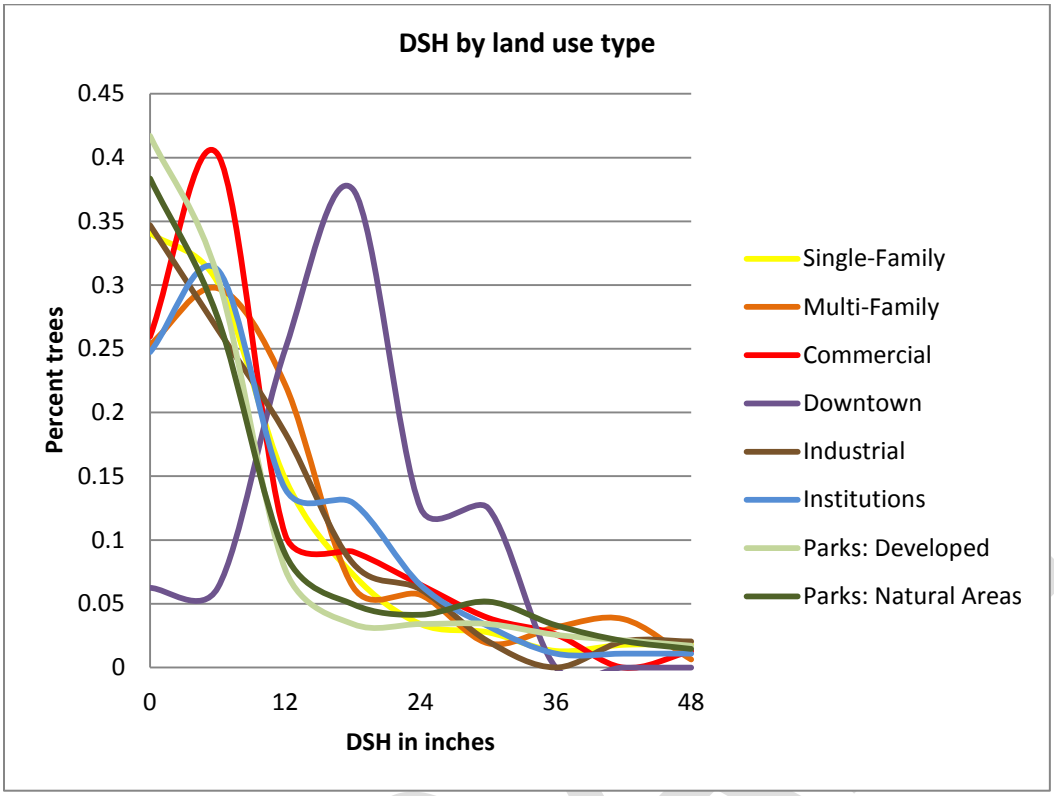
environmental benefits because they maintain their canopy during the rainy season so they slow and reduce stormwater run-off and absorb more carbon dioxide and air pollutants as they are active yearlong. Evergreen trees also are longer-lived and tend to have much greater size potential which is one reason why residents are often hesitant to plan them and why they are only allowed as street trees in limited situations. Citywide, 31% of trees are evergreens (22% conifers and 9% broadleaf) and 69% are deciduous trees, although this ratio varies substantially between different land use types (Table 4).

Table 4: Evergreen/Deciduous Breakdown

Land Use	Evergreen		Deciduous
	Broadleaf	Conifer	
Single-Family Residential	15%	34%	51%
Multi-Family Residential	9%	9%	82%
Commercial/Mixed Use	0%	40%	60%
Downtown Seattle	0%	0%	100%
Industrial	0%	32%	68%
Major Institutional	0%	16%	84%
Parks: Developed	8%	20%	71%
Parks: Natural Areas	8%	10%	82%
City-wide	9%	22%	69%

Citywide, about 34% of trees are 6” in diameter-at-standard height (DSH) or smaller and 64% of trees are 12’ in diameter or smaller. The prevalence of smaller-sized trees suggest that most trees are well below their growth potential; however, without additional data it is not possible to distinguish the cause of this pattern which could be due to the predominance of small species trees, frequent removal, or even to a increase in the planting of new trees.

Figure 8: Diameter of Trees by Management Unit



Invasive Species

Invasive species are those that are not originally native to an area and can out-compete other vegetation to the detriment of the overall ecosystem. In Seattle, English laurel, English holly, Himalayan blackberry, English ivy, and morning glory represent some of the most prevalent and problematic invasive species. The iTree survey calculated the percentage of the total trees that are represented by English laurel and English holly which is show in Table 5.

Table 5: Percentage of Trees that are English Laurel or English Holly

Land Use	English laurel	English holly
Single-Family Residential	4%	3%
Multi-Family Residential	1%	2%
Commercial/Mixed Use	0%	0%
Downtown Seattle	0%	0%
Industrial	0%	0%
Major Institutional	0%	0%
Parks: Developed	0%	1%
Parks: Natural Areas	5%	3%

As mentioned before the three management units that are fully managed by the City are Developed Parks, Natural Areas, and Right-of-Way. Below is specific information on the state of the urban forest in these management units.

3.2. **Developed Parks**

Developed Parks represent only 4% of the city's land base, but play an important role in the urban forest as they experience a high volume of use from individuals looking to enjoy the city's natural beauty. While a great deal of work has gone into assessments of the urban forest in individual parks, there is little data on the City's developed park system as a whole. Below are three key issues that are currently being faced by Developed Parks.

Hazard Mitigation
Although it is very comparable to major institutions, a land use with similar characteristics, developed parks have a large amount of trees in critical or dying condition. This indicator is not surprising given the presence of many trees that are reaching the end of their lives, an abundance of tree species such as big leaf maple and cottonwoods that are prone to hazard conditions, and limited maintenance budgets, but is also a concern as hazard tree mitigation is a high priority within this area. Due in part to this condition, tree removal makes up one third of the current crews' workload, which reduces the budget for other work including preventive maintenance which could reduce future hazard mitigation workload.

Tree replanting
Currently, Parks has an underfunded two-for-one tree replacement program. Removed trees are scheduled for replacement if necessary, however funding for the program has not kept up with the demand for replanting. New capital projects typically do include tree replacement as do major maintenance-funded landscape restoration projects. A modest number of trees are planted each year within Parks' general fund programs. New tree planting should focus first on replacement trees so that the original architecture/design of a park can be restored.

Wood and green waste recycling
It is currently estimated that Parks alone produces the equivalent of over 2,500 cubic yards of chipped wood mulch annually that is used by the landscape and forest restoration program. Valued woods, such as oak, elm, cedar, and walnut are sold for recycling. A larger amount of 'clean-green' waste is produced through maintenance operations and hauled to private vendors for composting. In turn, the City often buys back the composted material for use in landscapes. While most wood and green waste products are recycled, it is costly to do so. Reviews of use patterns of wood waste have found that current methods of use are as efficient as the current demand the system will allow. In 2011 a wood recycler offered to handle all wood wastes for Parks in exchange for the valued wood. The recycler found that the volume of materials would not provide benefit to either party of the agreement.

3.3. **Parks Natural Areas**

This management unit represents 7% of the city's land base and is comprised of publicly owned forests, riparian corridors, meadows, wetlands, and portions of parks that are in a natural state including some true remnant forest. Ecosystem complexity and value varies greatly within these areas, most of which are steep hillsides and watershed ravines. This management unit contains most of Seattle's salmon-bearing streams including about eight miles of urban creeks within 800+ acres of watersheds and more than 100 miles of trails.

The current canopy coverage in this management unit is 80%. A very low percentage of trees (18%) in the Parks Natural Areas management unit are evergreen (8% broadleaf and 10% conifers) and too many (82%) are deciduous. Most of the trees in this management unit are second-growth deciduous forests that

are past their prime and are in serious decline. The presence of highly invasive species is a further threat to trees and understory in this management unit. Forest restoration projects, such as the GSP, are working to combat this situation. Thousands of seedlings are planted during restoration activities each year with support from thousands of volunteer residents.

3.4. **Right-of-way**

This management unit consists of the city's street network and transportation corridors excluding right-of-way that remain unopened due to location on steep slopes or in parks. It is managed by SDOT and represents 27% of the city's land base. While it is included as part of the other management units, it is also listed separately due to the unique challenges and opportunities it faces. Of the more than 140,000 trees along Seattle's right-of-ways, SDOT maintains about 40,000. The remaining 100,000 are regulated by the City through permits issued by SDOT for tree removals and new plantings within street-side planting strips.

The current canopy coverage in this management unit is 18%. Because the Seattle i-Tree survey did not gather right-of-way specific data, existing condition information is based on inventory data from 1992 and visual observations. Size distribution of street trees in residential areas has not changed much in the last 10 years. Nearly 50% of residential street trees have diameters of 5" or less and are relatively young. Many others are larger, with diameters of 6 to 20", yet are young enough to provide benefits for many more years.

Diversity
Seattle's current tree inventory includes 105 different genera (subdivisions) and over 310 species. Diversity, however, is a problem because 67% of the street tree population is made up of just seven genera with *Prunus* (cherries, plums, and laurel) being the most widely planted at 24%, with *Acer* (maples) ranking second at 18%. Together, *Prunus* and *Acer* comprise 42% of Seattle's street trees, a number that goes against the general recommendation that no more than 10% of any one genus predominate the urban forest. Planting levels greater than 10% in any one species should be discouraged.

Distribution
Seattle's street trees have a broad range of size classes (a proxy for age) although the number of 20"-diameter (large) trees has decreased. More trees are being planted than lost, precluding any sudden barrenness as trees reach the end of their lifespan. In residential areas, the size distribution of street trees has been virtually unchanged for a decade. Nearly half of these trees are relatively young and have diameters of 5" or less (Table 6). Many others are larger, with diameters of 6 to 20 inches, yet are young enough to provide benefits and services for many more years. In residential areas, off-street trees are on average generally larger than on-street trees, but no data have been collected on their sizes.

Table 6. Diameter classes of Seattle's residential street trees

Diameter	0 - 5"	6 - 12"	13 – 20"	21 – 30"	>30"
Original inventory	38,232 (47.2%)	29,808 (36.8%)	8,424 (10.4%)	3,240 (4.0%)	1,296 (1.6%)
Current sampling	63,008 (48.9%)	48,190 (37.4%)	13,400 (10.4%)	2,577 (2.0%)	1,675 (1.3%)

SDOT estimates that about 20% of street trees could be considered as candidates for removal due to improper location (large trees under utility lines, conflict with underground utilities, sidewalks, insufficient growing space, etc.) or structural and health issues. SDOT currently removes trees only if they pose an

imminent hazard or if removal allows the City to take advantage of opportunities to remove or replace trees as part of a larger planting project. SDOT also frequently removes privately-maintained unhealthy trees when they become imminent hazards.

4. Challenges and Opportunities

There are multiple challenges and opportunities for increasing the city's canopy cover. Below are the major issues that must be considered as part of urban forest management.

Balancing multiple goals

While most Seattle residents greatly value and enjoy trees, trees in an urban environment must be balanced with city-wide goals such as property rights, growth management, transportation, economic development, and urban design as well as the goals of property owners such as access to sunlight, views, aesthetics, or competing uses such as vegetable gardens or play areas. Within the right-of-way, trees must be planted to accommodate sidewalks, utilities, and other infrastructure. In situations where multiple goals compete, the requirements of maintenance to remove leaves, deal with fruit, and pay for pruning or damage caused by dropped branches can also become a substantial issue.

Lack of knowledge about proper tree care

Improper maintenance impairs tree health and shortens tree lifespan. Being the owner of healthy trees requires an investment in proper maintenance. The City and tree organizations have worked hard to foster public awareness that tree topping is bad for tree health and creates ugly and unsafe trees. Education is an ongoing process, but even for people who know how to correctly prune, it is difficult and sometimes costly to prune mature trees that require climbing, large equipment, and specialized skills. These challenges have lead to relatively poor tree maintenance practices on private property overall. Basic education about the needs of urban trees and proper methods for pruning and maintenance could produce substantial improvements over the long term.

Invasive species

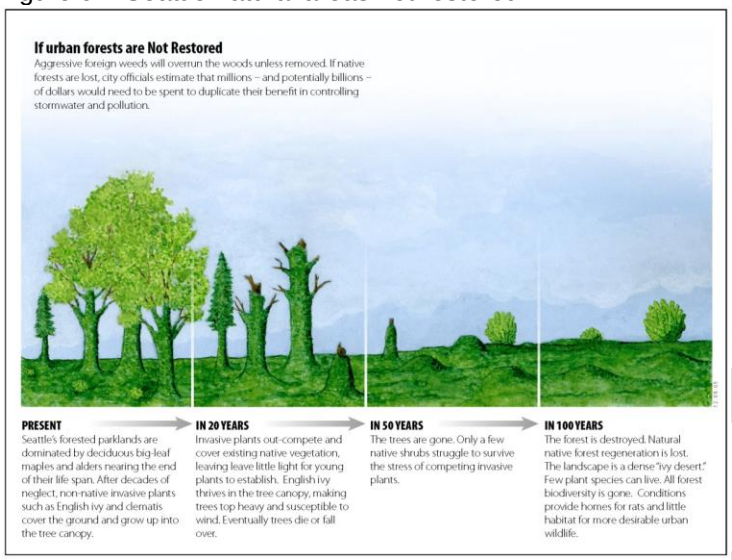
Over the years many foreign tree and shrub/ground cover plant species have been introduced to the Seattle region only to become invasive, threatening the native species. Trees like, English holly, English laurel, tree of heaven, and others now flourish in our forests in place of more desirable native species. Likewise, shrubs and ground covers like English ivy, Himalayan blackberry, and Japanese knotweed threaten our forest floors and riparian corridors.

Over time, these species have the potential to completely replace native species which provide more habitat and stormwater benefits. Shrubs and ground covers in particular can smother existing trees and prevent replacement trees from growing which, if unchecked, can result in the complete loss of trees. This is particularly true in our natural areas where the first generation of trees planted after logging is reaching maturity and dying off at an elevated rate. Today, over 70% of Seattle's remnant forests have some invasive plants and about 50% are moderately to heavily invaded according to data provided by the Seattle Urban Nature Project (now a part of EarthCorps).[10] Not only should we avoid planting these non-native species, we should also support programs such as the GSP that will remove these invasive plants over time.

[10] http://www.earthcorps.org/index.php

If our forested parklands are not restored, aggressive non-native vegetation will dominate the urban forest unless removed. In 100 years, the trees will be gone. Potentially billions of dollars in services will be lost (figure 9).

Figure 9 – Seattle natural areas not restored



If forested parklands are restored by removing invasive vegetation and planting native trees and shrubs, the urban forest will return to a more sustainable condition. In 100 years, the forest will provide the city valuable services and better resist invasive plant infestations (Figure 10).

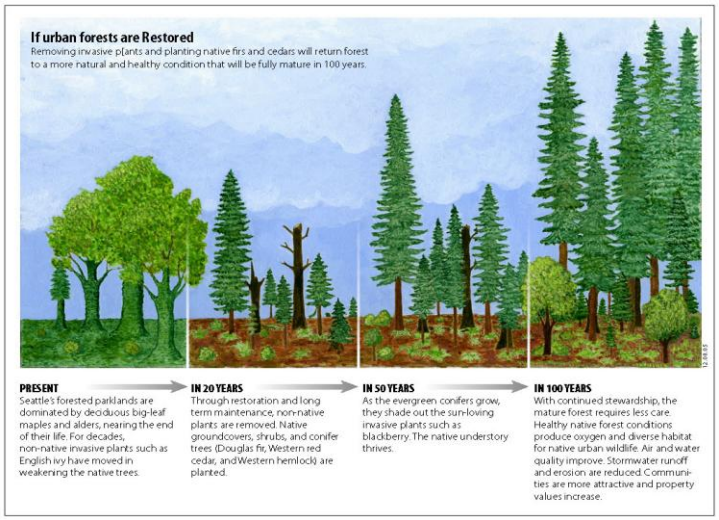


Figure 10 - Seattle natural areas after restoration

Views

One of the attributes that makes Seattle such a beautiful city is its views. Maintaining or creating views of distant panoramas or local streets represent a major challenge in managing the urban forest. Because views involve distant locations, this issue crosses property lines and impacts a variety of areas including public and private trees. Views also are very subjective. While some people value distant panoramas that

are completely unobstructed, many other people desire trees to frame their view. In addition to concerns from private property owners, the City also provides protections for mapped views from 85 sites throughout the city to ensure that all residents can enjoy the opportunity to share in views.

Because of the amount of land it manages, Parks typically deals with more view issues than any other City department. Parks and the City's perspective on providing private view relief have changed over time. Until the late 1980s, the City allowed publicly-owned trees to be topped to retain or create private views. By 1990 that practice was no longer allowed. Parks' tree policy[11], revised in 2001, clearly states that public trees cannot be topped or removed for the purposes of retaining or creating a private view. Park's policy is to permit view relief only if it can be accomplished through pruning that meets the City's arboricultural standards, and is performed by certified arboricultural contractors, and under the direction of Park's Senior Urban Forester. On private land, the City also limits pruning in Environmentally Critical Areas, such as steep slopes, to ensure that this work does not result in impacts that could impact stormwater management and slope stability.

Desire for views represents a major obstacle to encouraging more planting and preservation on private property in the hilly areas of the city. Similarly, neighborhood support for tree planting in the right-of-way where views may be affected will be a major challenge.

Staff will evaluate the feasibility and potential impacts of creating a city-wide view policy.

Utilities

Conflicts between trees and utilities represent a challenge both for SCL and SPU. SCL prunes and removes trees for electrical safety and reliability and encourages replacement with species appropriate for under overhead wires to avoid such conflicts. Also, underground utilities located in the planting strip constrict the space for healthy tree growth. Tree roots can damage sidewalks and make them unsafe for pedestrians. To address these issues, the City has developed a Master Tree List[12] to clarify which species may be appropriate in certain locations as well as standards for locating trees near other infrastructure.

Freight mobility

Many commercial and industrial businesses in Seattle depend on the movement of goods by road, rail, and ship. The need for freight corridors, loading, and staging areas can result in conflicts within the right-of-way, where trees can impact travel lanes and can be damaged by moving trucks, as well as on private property, where businesses need flexible storage space on their lot leaving very little land available for trees. Consequently, planting in freight corridors and industrial areas must consider the additional requirements and harsh conditions of these areas and avoid locations that do not provide adequate planting space. Additionally, planting in these areas will be significantly more expensive than other areas due to the requirements of removing paving, de-compacting soils, and creating curbs or other barriers to protect trees from freight.

Green roofs and green infrastructure

The high percentage of area given to buildings and parking lots creates a challenge for accommodating trees, but also creates opportunities for incorporating green roofs, swales, pervious pavements, and other

[11] Parks and Recreation. Tree Management, Maintenance, Pruning and/or Removal. Department Policy & Procedure Number 060-P 5.6.1. Effective June 1, 2001. Web http://www.seattle.gov/parks/Publications/policy/treepolicy.pdf

[12] http://www.seattle.gov/trees/docs/2011-Master_Tree_List.pdf

strategies. The City should encourage these low-impact development approaches, but should carefully monitor how they affect the opportunities for trees through competition for space and changing hydrology due to stormwater retention.

Density and urban design

The denser areas of Seattle pose additional issues for accommodating trees. Residential developments must consider additional car parking, multiple entrances, multiple private open space demands, more utility connections, and increased competition for light. Trees in business districts can create additional concerns about blocking signs or limiting area available for parking, gathering spaces, or other desires. Busy sidewalks mean more use and activities including bus stops, cafes, art, and street furniture that must be balanced with street trees. Concerns about crime in the downtown core have also highlighted the need to design public landscapes that are safe and inviting by ensuring that trees allow clear sightlines and do not create dark areas. Consequently, it is important to tailor education and outreach programs to the unique needs and conditions of these environments and to consider trees early in the design process for new buildings and public spaces to ensure trees are seen as necessary component of livability rather than an impediment to great design.

Climate change

While trees help to absorb climate change-causing gases, they are also subject to the impacts of a changing climate. Many plant species do not require a substantial change in their environmental conditions to be greatly affected. As our climate changes, differences in temperature, rainfall, and sunlight may have an impact on the health and composition of Seattle's urban forest.

Even though the USDA Plant Hardiness Zone Map now places Seattle as an 8B zone, recent work with the University of Washington's Center for Climate Change found that for the metropolitan area of Seattle, the climatic changes in terms of degrees will be minimal as compared with the rest of the state. This report is expected to be released in August 2012.

A legacy of stewardship

In 1903, the Seattle City Council hired the Olmstead Landscape Architecture firm to design a city wide park system. John Charles Olmsted surveyed the city and came up with a plan for 37 parks and playgrounds, including Interlaken, Seward, Green Lake, Woodland, Arboretum and Jefferson parks as well as scenic drives such as Lake Washington and Magnolia boulevards. This grand plan along with other major efforts such as the purchase of green belts in the 70s, multiple park levies, and the Green Seattle Partnership have demonstrated that Seattleites are willing to work hard to support their local environment.

Seattle is also consistently voted as one of the "Greenest" cities in the country. In 1982, a contest created the City's official nickname, The Emerald City, with reference to the lush evergreen forests of the area. The moniker of "Emerald City" and a group of passionate residents and businesses provides an opportunity to promote the planting and preservation of the urban canopy to ensure the quality of life that is associated with our city.

5. Goals, Strategies, and Actions

5.1. Goal

The goal of Urban Forest Management Plan is to support an urban forest that is a thriving and sustainable mix of tree and understory species and ages and creates a contiguous and healthy ecosystem that is valued and cared for by the City and all of its residents as an essential environmental, economic, and community asset.

In order to meet the UFMP goal, the City has identified four specific indicators: canopy cover, health and longevity, age and species diversity, and invasive species.

Canopy Cover

The Urban Forest IDT developed canopy cover goals as part of developing the initial version of the UFMP in 2007. In developing these goals, the IDT considered the following factors to define an ambitious but realistic goal for the UFMP planning horizon:

- Land-use mix in Seattle and other City land-use goals (e.g. encouraging density, facilitating freight mobility, etc.)
- Estimated 2001 canopy cover and general planting opportunities
- American Forests' recommendations and benchmarked with other cities.
- Advice from external experts from other cities, consultants, the University of Washington, and the public

This work resulted in a goal of increasing canopy cover to 30% by 2037 as well as establishing canopy cover goals by management unit (Table 7). It should be noted that the level of uncertainty in existing canopy cover estimates for individual management units has not been determined due to limited funding for field verification, so these goals represent scales of magnitude rather than exact figures.

In developing the 2012 UFMP update, the canopy cover goals were not updated despite updated data on estimated canopy cover. The IDT felt the canopy cover goals were intended to establish long term goals and that it was preferable to wait for more data points before adjusting the goals. The IDT anticipates updating these goals as part of the next update of the UFMP when new canopy cover assessments and more detailed planting potential analysis will be available. Consequently, the canopy cover goals by management units should be seen as general guideposts for success rather than specific targets for charting annual progress or for prioritizing work.

Table 7. Canopy cover goals by management unit

Management unit	Estimated 2007 canopy cover	2037 canopy cover goal
Single-Family	26%	33%
Multi-Family	17%	20%
Commercial/Mixed Use	10%	15%
Downtown Seattle	9%[1]	12%
Industrial	4%	10%[2]
Institutional Properties	19%	20%
Parks: developed sites	25%	25%
Parks: natural areas	80%	80%
Citywide	23%	30%
Right-of-way[3]	18%	24%

[1] The assessment of 2007 satellite data encountered difficulties measuring Downtown due to tall buildings casting shadows over trees. SDOT did an analysis of their inventory and estimated that current Downtown canopy cover is closer to 9%.

[2] The assessment of 2007 satellite data suggested higher canopy cover levels than had previously been expected for all management units except for the Industrial which decreased from 8% to 4%. However, canopy cover goals for management units were not changed as part of this UFMP update. Consequently, the difference between the current canopy and the goal was increased but this shift is not intended represent a change in the City's overall strategy and the canopy cover goal will be reevaluated as part of the next UFMP update.

[3] Right-of-way trees are also included in each of the land-use types

Health and Longevity

At this time, the City does not have sufficient long-term data to establish a goal for health and longevity conditions of the urban forest. Instead, the City will seek to conduct regular sample-based inventories of public and private trees indicating tree conditions and risk level in order to monitor this indicator.

Age and Species Diversity

At this time, the City does not have sufficient long-term data to establish a goal for species and age diversity of the urban forest. Instead, the City will seek to conduct regular sample-based inventories of public and private trees indicating tree conditions and risk level in order to monitor this indicator. Additionally, the City will continue to communicate the value of diversity and high prevalence of certain types of trees that are currently over planted in order to support the overall goal of increasing the diversity of our urban forest.

Some urban forestry professionals advocate for the use of no more than 10% of any one species or cultivar, and no more than 20% of any genus or 30% of any family. These are good general guidelines to follow, and efforts should be made to educate residents and tree suppliers on the value of a diverse plant palette. The key to sustainability in urban forests lies not in the selection of any single "ideal tree" with a particular set of characteristics but in biological diversity within urban plantings in order to minimize plant maintenance needs, and losses that are the result of monoculture plantings or overuse of a genus or species.

Age diversity will result naturally if the City has a sustained planting and replacement plan. Seattle has a fairly young street tree population, and as long as trees are selected that have reasonable longevity, age diversity should be less of a concern than species diversity.

Typically, "approved tree lists" do not have numerical restrictions on species that might be overplanted, and logically, the most commonly planted species are generally those that are available in large quantities at numerous retail locations. Striving to replace 1-2% of our trees every year will result in a more diverse age distribution that will support sustainability of our urban forest. Seattle's Master Tree List can be found in the reLeaf website.[13]

Invasive Species

At this time, the City does not have sufficient long-term data to establish a goal for invasive species. In general, it is our goal to engage residents to avoid planting these invasive species, and to continue to support programs such as the Green Seattle Partnership that will remove these invasive plants from our urban forest over time to the point where routine maintenance will be sufficient.

5.2. **Strategies**

The strategies of the UFMP are:

- **Understand** the character and complexity of the urban forest resource.
- **Coordinate** interdepartmental and interagency communication, cooperation, and decision-making.
- **Preserve and restore** the urban forest on City property.
- **Regulate** private property to ensure minimum standards for care of the urban forest.
- **Inspire, inform, and engage** the community in active stewardship of Seattle's urban forest.

5.3. **Action agenda**

The City's work to grow the urban forest spans all land uses, work that is reflected in our action agenda. Department workplans focus on those aspects of the urban forest that they can manage. For example SDOT manages trees in the Right-of-way and the Parks department has primary responsibility for the Developed Parks and Parks Natural Areas management units. The City encourages tree growth on private property areas over which it doesn't have direct control through regulations, incentives, outreach, and education. The Seattle reLeaf program currently focuses efforts on the Single and Multi- family Residential management units because they represent the largest portion of the city's land mass (67%) and therefore the biggest opportunity for planting new trees.

Table 8 shows the general goals of the UFMP and associated recommended actions. The goals and actions have been grouped into the three elements of the urban forest sustainability model: Urban Forest Resource, Management Framework, and Community Stewardship.

Each goal statement is followed by short, mid- and long-term recommendations/actions to achieve the goals. Implementation will require policy, program, and budget coordination, as well as long-term and stable funding. Accomplishing these goals is essential for the City to achieve urban forest sustainability. These actions generally apply to trees throughout the city as opposed to those trees found within a specific

[13] http://www.seattle.gov/trees/docs/2011-Master_Tree_List.pdf

forest Management Unit as described in the next section. The timeline definitions for implementing the proposed actions are as follows:

- Short-term actions will be completed by 2017. Typically these are actions that are either already partially implemented, budget neutral, or have agreed upon new funding in place.
- Mid-term actions are 5 to 10 years out. These are actions that might require operational restructuring or reorganization, limited additional funding, technological improvements, or 'tooling-up' on the part of internal or external partners.
- Long-term actions are 10 or more years on the horizon. These actions may have significant budget implications, may involve organizational change, and might require significant fund raising.

5.4. **Funding**

In order to establish adequate and sustainable funding for urban forestry efforts, the City will strive to do the following:

- Develop tools for measuring and monetizing the comprehensive benefits provided by a healthy urban forest in Seattle.
- Use asset management and triple bottom line cost-benefit analysis in assessing urban forest related projects.
- Identify and establish dedicated funding sources for street trees. Explore creative financing mechanisms to ensure alternative funding to supplement general fund revenues.
- Develop a coordinated approach to seek funding from sources such as local and regional foundations, industry, and corporations.
- Work with the business and non-profit communities (i.e. Seattle Parks Foundation) to create a tree donation account or other funding strategies.
- Explore funding opportunities with the business community and with regional donors, particularly for special projects identified in a management plan.
- Explore creative financing mechanisms to obtain funding for City urban forestry programs.

Table 8. Action Agenda for the Urban Forest Management Plan

Strategy	Short-term actions (1 - 5 years)	Mid-term actions (5 – 10 years)	Long-term actions (10+ years)
Urban Forest Resource			
Understand the characteristics and complexity of the urban forest resource	• Undertake citywide canopy cover assessment every five years. • Assess cost of undertaking tree sampling every five years. • Continue to regularly update forest typing in Parks natural areas. • Continue to update SDOT street tree inventory. • Analyze Seattle i-Tree survey data to better understand existing conditions of our urban forest. • Continue to develop modeling for tree ages, sizes, and life expectancy, accounting for species and site factors, to estimate management needs and costs in natural areas. • Analyze tree planting potential data for all management units. Undertake pilot to ground truth information. • Evaluate habitat corridor and waterways gaps in the industrial management unit.	• Complete tree inventory of developed parks. • Develop better indicators for species distribution, age distribution, and health citywide. • Evaluate potential ecological corridor planning. • Capitalize on research being undertaken by others to quantify the financial value associated with the social benefits afforded by the urban forest.	• Develop dynamic inventory processes that can be updated and maintained for street and park trees.
Management Framework			
Coordinate interdepartmental and interagency communication, cooperation, and decision-making	• Continue to convene the Urban Forest Interdepartmental Team as the group primarily responsible for implementing the UFMP through the work of the represented departments. • Continue to identify and address interdepartmental policy and project issues. • Integrate urban forest management planning with other City efforts affecting	• Assess feasibility and potential impacts of creating a citywide policy regarding trees and views.	• Conduct urban forestry activities as a citywide program with a de-emphasis on the roles of specific departments. • Review urban forestry staff functions, roles and responsibilities toward achievement of management efficiencies.

Strategy	Short-term actions (1 - 5 years)	Mid-term actions (5 – 10 years)	Long-term actions (10+ years)
	vegetation, such as Green Stormwater Infrastructure, Green Factor, etc., open spaces, and sustainable development. • Develop decision-making tools related to tree retention or removal decisions where infrastructure conflicts exist.		
Preserve and Restore the urban forest on City property	<u>Planning and design:</u> • Develop policy to prioritize expenditures (outreach and education; maintenance, preservation, and restoration; and planting). • Continue to revise and update City BMPs for tree and forest maintenance on a 5-year cycle. • Implement a hazard tree abatement program for street trees. • Develop metrics for soils, species diversity, and hydrologic information to help create sustainable forests requiring less maintenance. • Design public spaces to maintain clear sightlines and avoid creating dark, unwelcoming spaces. • Encourage understory plantings in tree planting projects. • Explore opportunities to maximize available planting space by using existing and new technologies such as root barriers, Silva Cells and/ or specialized soil mixes. • Expand the use of tree planting strips rather than tree pits with grates to provide greater rooting area and enhanced stormwater mitigation.	• Develop an urban forest maintenance plan for street trees. • Develop a risk assessment plan for street trees.	• As utility repair/replacement work is undertaken, consider removing underground utilities from planting strips to increase street tree planting opportunities.
	<u>Planting:</u> • Plant two trees for each tree removed across all departments.		

Strategy	Short-term actions (1 - 5 years)	Mid-term actions (5 – 10 years)	Long-term actions (10+ years)
	Maintenance: • Seek to combine maintenance of adjacent areas such as shoreline street ends and street trees to reduce overall costs. • Train staff in tree protection practices. • Provide public education and outreach regarding reasons for tree removals.	• Identify and prioritize invasive species removal from City properties. • Seek to reduce pruning cycle to industry standards.	
	Tracking: • Develop consistent methodologies for tracking and reporting tree work and for performance metrics. • Purchase or develop a tree management software system to track work performed on park trees. • Continue development of database management tools to assist with monitoring, documentation, and evaluation of forest restoration work. • Link Vegetation Management Plan hazard tree needs to the work order system in priority order for removal.	• Develop reporting methodology that can support a dynamic inventory process.	• Link work record system with inventory so updates are continuous.
Regulate private property to ensure minimum standards for care of the urban forest	• Update existing regulatory framework to promote the goals of the UFMP and mitigate the impacts of development while providing flexibility for property owners to balance multiple goals and competing uses. • Submit proposed Street Tree Ordinance for City Council adoption. • Continue to engage community stakeholders to identify opportunities and barriers for tree planting and preservation on private property. • Explore opportunities to expand the range of incentives available for tree planting and retention including subsidized planting, job programs, and	• Continue to evaluate the effectiveness of incentives and regulations and make changes on a regular basis. • Explore opportunities to modify stormwater rates to better reflect the values of trees. • Explore opportunities for allowing staging in the right-of-way to allow additional tree retention.	• Consider burying certain overhead utility lines to increase street tree planting opportunities.

Strategy	Short-term actions (1 - 5 years)	Mid-term actions (5 – 10 years)	Long-term actions (10+ years)
	technical assistance. • Consider expanding and tailoring Trees for Neighborhoods program to serve new populations such as apartment dwellers, business, etc. • Improve design of street tree pits including standards for soil volume, soil composition, and minimizing issues with tree grates. • Efforts in industrial areas will focus on maximizing canopy on Industrial Landscape Streets, riparian areas, and commercial and retail properties.		
Community Stewardship			
Inspire and inform the community about the benefits of the urban forest and proper tree care practices	• Strengthen citywide approaches to communicating about trees. • Continue to provide resources about urban forestry to public through newsletters, permitting, websites, and other resources. • Revise materials to encourage "right tree in right place" but also encourage large trees and more diverse species where appropriate • Provide materials on best practices for tree preservation during construction • Provide information of trees that thrive in harsh conditions • Continue to identify special trees and mark their historic, biological, or other traits with signs or other means through the Heritage Tree Program. • Implement Green Seattle Urban Forestry tree curricula in K-12 schools. • Deliver education programs, such as Forestry U, to all communities to engage traditionally underserved	• Partner with realtors to distribute information as part of home purchase to make new buyers of property aware of their responsibility for maintenance of privately owned right-of-way trees. • Partner with nurseries and landscape industry to make quality information and plant materials available to the public, particularly information to discourage the sale of invasive plant species.	• Develop community service opportunities with schools and other institutions for urban forest stewardship projects.

Strategy	Short-term actions (1 - 5 years)	Mid-term actions (5 – 10 years)	Long-term actions (10+ years)
	neighborhoods.		
Engage the community in active stewardship of the urban forest	• Work closely with Urban Forestry Commission on development of policies and programs to implement and achieve UFMP goals. • Engage the public with developing UFMP updates. • Expand volunteer stewardship opportunities through the GSP, "Friends of" groups, Tree Ambassador, and other programs. • Provide residents the opportunity to plant trees on Parks property to commemorate major life events. • Provide opportunities for education-based groups such as fraternities, sororities, and clubs to become involved with planting trees on their campuses. • Encourage major institutions to develop landscape management plans to actively manage their urban forest resources. Identify and work with the largest institutions first. • Use the Major Institution Master Planning process to identify opportunities for planting and preserving trees. • Work with private property owners and major public industrial operators to explore tree planting opportunities in industrial areas. • Work with local universities to pursue the research agenda. • Consider expansion of Neighborhood Business District grants for tree planting.	• Create the mechanism that will allow an active partnership with the community service element of the Seattle Public Schools and other institutions. • Seek tree planting opportunities with the cemeteries in Seattle. • Provide adjacent property owners and tree service companies with the skills and knowledge to properly care for non-SDOT owned trees in the right-of-way. • Institute a program to acknowledge and publicize contributions to urban forestry by residents, businesses, institutions, and neighborhood group organizations.	• Continue exploring ways to engage the community based on experience from implementation of existing programs. • Explore mechanisms to collaborate with universities and the private sector on long-term urban forestry science.

6. Research agenda

During ongoing management of the urban forest and development of this plan, the City has identified multiple areas in which the City and urban forest managers in general could benefit from additional knowledge. The following are specific research areas that are beyond the ability of the City to develop at this point in time, but would be excellent opportunities for universities or other research groups to explore in order to support greater knowledge for the field.

1. Develop tools for understanding the complete life-cycle costs of deferred tree planting and maintenance

2. Develop tools for comparing the costs and benefits of maintenance in different pruning cycles

3. Develop comprehensive systems for monetizing urban forest benefits (ecosystems, stormwater, health, crime, business, etc.) based on local conditions. In particular, the following elements are found to be particularly problematic:

    a. Public health benefits
    b. Energy benefits including summer cooling, winter solar access, and wind reduction
    c. Climate change over complete life cycle given end uses (decomposition, wood chipping, commercial harvest)

4. Develop a more detailed method for quantifying stormwater and water quality benefits for individual trees based on canopy, species, location, etc.

5. Analyze research that provides quantitative data on the benefits of trees as a Race and Social Justice issue for community improvement and cultural engagement.

Appendix A: References/Bibliography

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