GREEN SEATAC PARTNERSHIP

URBAN FOREST ENHANCEMENT GUIDE

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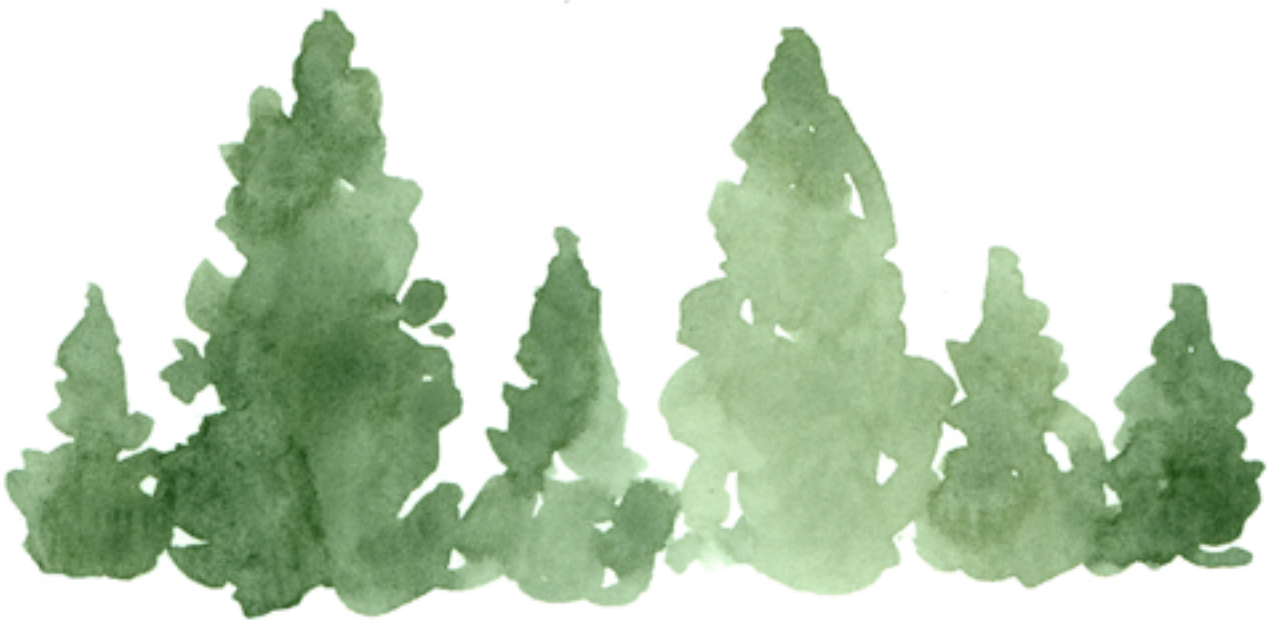

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ACKNOWLEDGMENTS

The Port of Seattle funded this work through its Airport Community Ecology (ACE) Fund. With the Port's support, Forterra was tasked with evaluating the health and condition of SeaTac's urban forest and developing a plan to help ensure that SeaTac's vision of a sustainable, healthy city continues to become a reality. Because of this funding, SeaTac—along with Des Moines and Burien, who both have their own Green City Partnership — joins Seattle, Tacoma, Snoqualmie, Kent, Redmond, Kirkland, Everett, Puyallup, Tukwila, Issaquah, and Shoreline as members of the Green Cities Network. These 14 Green Cities and one County in the Puget Sound region are in three counties (King, Pierce, and Snohomish), collectively serve a population of more than 3 million people, and aim to restore and steward more than 13,000,000 acres of land. As part of this robust network of resources and expertise, the Green SeaTac Partnership will help ensure a livable and healthy region.

The Green City Partnerships share three core goals:

- Improve city residents' quality of life and connection to nature, and provide increased ecosystem benefits by restoring our forested parks and natural areas and enhancing urban forests.
- Galvanize an informed and active community.
- Ensure long-term sustainable funding and community support.

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EXECUTIVE SUMMARY

SeaTac is a city known for its diverse, business-minded, and family-friendly community. It is home to a large urban mountain-biking trail system, the regionally prized Highline SeaTac Botanical Garden, beloved Angle Lake, and sections of the Des Moines Creek Trail. Urban forests play a vital role in SeaTac's environmental, economic, and public health — as they do in all our cities. According to the US Census Bureau, as of 2010, 80% of the United States population lives in urban areas, and those residents rely heavily on the natural resources found in the urbanized centers. These resources have economic value because of their contributions to stormwater management, ambient-temperature reduction, reduction of air pollution, and their ability to create social connections within communities, among other benefits.

Forterra created this Urban Forest Enhancement Guide to provide a strategy for enhancing SeaTac's urban forest through active restoration and management of its trees, natural areas, and parks. "The urban forest is defined to comprise all trees in the urban area, inclusive of individual street trees and clusters of park trees" (Endreny 2018). Urban forests provide services to the people and the surrounding ecosystem. They are increasingly recommended by national and state environmental protection agencies to mitigate the harmful impacts of air and water pollutants, harmful emissions, and the negative effects of urban heat and noise (Wolf and Robbins 2015). Protecting, enhancing, and maintaining the trees that comprise SeaTac's urban forest — in neighborhoods and urban areas, along streets, and in parks — is critical to the health and welfare of the citizens of SeaTac and will have a positive impact on the entire region.

Although this guide recommends ambitious actions and is only possible with the help of an engaged community and volunteer leaders, it is important for the health of the city's environment and its people. SeaTac's trees face the same kinds of pressures and problems as many urban forests: canopy-cover decline and removal, fragmentation, an influx of invasive species, declining tree health due to age, and resource limitations for management and maintenance. These pressures diminish the benefits provided by the urban forest, thereby diminishing quality of life for SeaTac residents.

The vision outlined in this guide is to have a healthy urban forest in SeaTac that supports — and is supported by — an aware and engaged community. The envisioned urban forest enhancement program, initiated by a collaborative working group called the Green SeaTac Partnership, would restore and maintain forested parklands and increase tree-canopy cover throughout the city, all while centering equity and fostering appreciation and understanding of the long-term benefits that the urban forest provides to the City of SeaTac.

For this report, two measures of urban forest health were taken: an analysis of the urban canopy cover and a detailed health assessment of SeaTac's 186 acres of forested parkland. The analysis found that, as of 2017, the City of SeaTac (not including Sea-Tac Airport) had a **canopy cover of 25**%. However, in the Pacific Northwest, where cities now cover land that was once dense forest, there is an ecological capacity for **40% or more canopy cover**. This guide recommends that a concerted effort be made to increase canopy cover in the city through increased awareness of its benefits, community engagement, financial investment, and planting trees on both public and private land. The results of the forested-parks health assessment indicate that much of the work in caring for SeaTac's forested public land will require intense invasive-plant removal. Once that is complete, managers and volunteers can help forested parks regenerate by initiating a major planting effort to ensure there are young trees growing to one day replace the mature trees in the current canopy. Finally, maintaining and monitoring sites over the long term will prevent them from returning to a pre-restoration condition.

This guide recommends a 20-year commitment to actively maintain SeaTac's forested parks and begin to increase canopy cover through volunteer initiatives supported by a team of City staff and consultants. In order to better determine what resources would be necessary, Forterra conducted a cost analysis using the existing Green Cities model. This analysis determined the total cost of an urban forest enhancement program for SeaTac to be $6 million (in 2019 dollars). Though this is a significant investment, the cost of effectively managing these lands without volunteer involvement and solely using skilled field crews is estimated to be more expensive — and does not guarantee long-term success or community ownership. However, working side by side with City staff, volunteers in a 20-year program are forecasted to leverage up to an additional $2.1 million in value for the City.

Based on the condition-assessment results, this guide recommends a long-term, whole-forest management approach for SeaTac's urban forest. It also outlines potential target areas for tree planting and provides several tools during the implementation phase that could assist in increasing canopy cover throughout SeaTac.

This guide could easily be amended to become an Urban Forest Enhancement Plan, which, if adopted, would result in a healthy, functioning urban forest and improved ecosystem benefits, such as cleaner air and improved wellness for SeaTac residents.

The intent of this document is to provide a thorough health assessment of SeaTac's forested parklands, recommend goals and objectives to enhance the current conditions of its urban forest, and suggest actions that will provide outcomes that benefit SeaTac's people and ecosystem.

This guide's major recommendations are:

1. Begin the active, adaptive management of SeaTac's urban forest with a vision of continuing this practice into the future to ensure lands in active restoration remain ecologically healthy and the city's forest continues to provide numerous benefits to the City of SeaTac.

2. Enroll all 186 acres of forested parkland and natural areas surveyed in active restoration and maintenance within the next 20 to 30 years.

3. Begin to increase SeaTac's tree-canopy cover by planting and caring for trees, replacing trees that are lost due to disease and development, and centering equitable distribution of trees across the entire city.

4. Create an inclusive and successful volunteer program that encourages participation from a diverse network of individuals, families, schools, businesses, and nonprofits. Center equity so that the program encourages residents to participate in urban-forest enhancement in their own neighborhood, in ways that are accessible to all.

5. Engage long-term volunteers in this work by providing a high level of training and expertise, rewarding and celebrating service, and engaging a diverse volunteer base with a variety of skill sets.

6. Secure stable, sustainable funding so that the program has staff resources as well as the potential to utilize contracted crews when necessary to accomplish long-term forest health, community-development, and program-administration goals.

1. INTRODUCTION

Imagine a city devoid of trees and vegetation. Consider what the air and water might be like without the natural filtration that plants provide. What would it sound like on a windy day? What would spring look like? Would the summer sun be overwhelming without the shade that trees provide?

Urban forests play a vital role in the environmental, economic, and public health of every city. Despite its value, SeaTac's urban forest is declining in health and needs active management in order to survive. By enhancing this urban forest, in both parks and neighborhoods, we can preserve the numerous benefits that trees, plants, and green spaces provide to the people who live, work, and play here.

These benefits include absorbing stormwater runoff, returning oxygen back to the air, sequestering carbon, stabilizing steep slopes, reducing flooding and erosion, filtering fine and ultrafine particulates from the air, reducing noise pollution, and more (USDA Forest Service 2018). Areas with increased vegetation, specifically leaves, capture more particulates in the tree canopy and clean the air. These same areas have healthier soils, which clean the water by filtering polluted runoff. As well, the urban forest enhances the livability of neighborhoods, makes SeaTac more beautiful, offers shade on the hottest days, and provides habitat for local wildlife.

In its work, the Port of Seattle has recognized both the importance of the urban forest and the impact Port operations have on neighboring communities and the ecosystems there. Because of this, the Port developed its Airport Community Ecology (ACE) Fund, which supports the work of community-based projects and nonprofits in the three cities — SeaTac, Burien, and Des Moines — that are closest to the airport. The Port selected the Green Cities Partnership, managed by Forterra, as the recipient for a portion of its ACE funding to help engage community members in order to restore, maintain, and increase urban forests in those cities.

Historically, development has been the largest threat to both natural areas and urban tree density in the Puget Sound region's urban and suburban centers. Our cities were once predominantly forested lands, but over time, areas of dense forest were reduced to accommodate houses and businesses. There are still small pockets of forest (in parks, for example), but unfortunately, in the past, these areas were left unmanaged because there was a belief that it was better to keep human impact as minimal as possible. Yesterday's scientists didn't see every tree — even those on private land or planted next to a sidewalk — as part of a larger whole.

However, by studying urban systems, we have learned that trees and plants in urban areas make up a new type of forested ecosystem: the urban forest. This environment faces unique pressures and needs more care than we once believed. Invasive species, litter, pollution, the redirection of creeks, the diversion of stormwater, and the isolation of dense pockets of plants (such as in parks) reduce the forest's natural ability to thrive within cities and suburban areas. We now know we must actively manage urban forests by removing invasive species, helping regenerate young trees, monitoring for and responding to pests, watering young trees during times of drought, pruning trees, performing maintenance, and more. The urban forest needs our help and continual support. Green City Partnerships work alongside City staff to engage a volunteer effort in order to fulfill this important role.

Scientists and municipalities have also begun to recognize the many benefits of having more trees within the city landscape: in neighborhoods, on school grounds, at libraries, and on travel corridors. Trees are of huge benefit to the people who live among them, providing services such as cleaner, cooler air; improved water quality; community connections; and even mental health benefits. Because of our past misunderstanding and lack of care, our urban forests are disappearing — not just to development, but because they are unhealthy. When we lose urban forests, we lose the services they provide. Many studies have proven that educating and engaging residents and securing a strong commitment of care can quickly change the health of a city's forest (USDA Forest Service 2018).

What Is an Urban Forest?

An urban forest encompasses all the trees in a defined urban area, such as a city. Urban forests broadly include the trees in urban parks; on city streets; in residential areas, including private yards and shared residential spaces; trees in community spaces (such as libraries and public gardens) and in greenways, river corridors, wetlands, nature preserves, and natural areas; shelter belts of trees; and working trees at industrial brownfield sites, among others (USDA Forest Service 2018).

What Is Canopy Cover?

Imagine you are a bird flying over a city (or a human in an airplane) in the summer months. As you look down on your city, what percentage of the ground is covered (obscured from view) by trees? That amount is called the canopy cover of an area. In 2017, the City of SeaTac had a canopy cover of 25%. If you include Sea-Tac Airport, that figure goes down to 21%.

This guide recommends the active management and, when needed, restoration of the tree cover already present in SeaTac. In assessing the forested lands within SeaTac's park system, the Partnership identified a potential for an overall loss of canopy without intervention. The dominance of nonnative plant species is a major cause of the loss of biodiversity and the degradation of urban forests (Pimentel et al. 2000; Soulé 1991). These invasive weeds lack natural population control (e.g., predators, diseases) and are capable of rapid reproduction; they can quickly blanket the ground and prevent native plants from reseeding (Boersma et al. 2006). At the same time, invasive vines such as English ivy climb into treetops, where they can block light from reaching a tree's leaves, thus preventing the trees from making food until, eventually, the trees die. This problem is exacerbated by the fact that a significant portion of the Puget Sound region's forest canopy is now composed of relatively short-lived, mature deciduous trees, such as maples, that are coming to the end of their life spans. As these trees die, new seedlings are not present to replace them, resulting in a loss of forests over time.

The Need for a Green SeaTac Partnership

SeaTac's degrading urban forests can significantly benefit from intervention to help reverse their decline and prevent major loss of ecological services, such as cleaner air. Thanks to the Port of Seattle's ACE Fund, Forterra has created this guide and is initiating the Green SeaTac Partnership, a coordinated effort with enhancement of the city's urban forest as its mission. This guide doesn't just define the problems, but offers implementation suggestions for the recovery and enhancement of SeaTac's urban forest, primarily through community engagement and volunteerism.

With continued population growth anticipated throughout the Puget Sound region, SeaTac's residential and business density will be higher in the future. One of the challenges facing the city is how to balance this growth while maintaining a strong economy

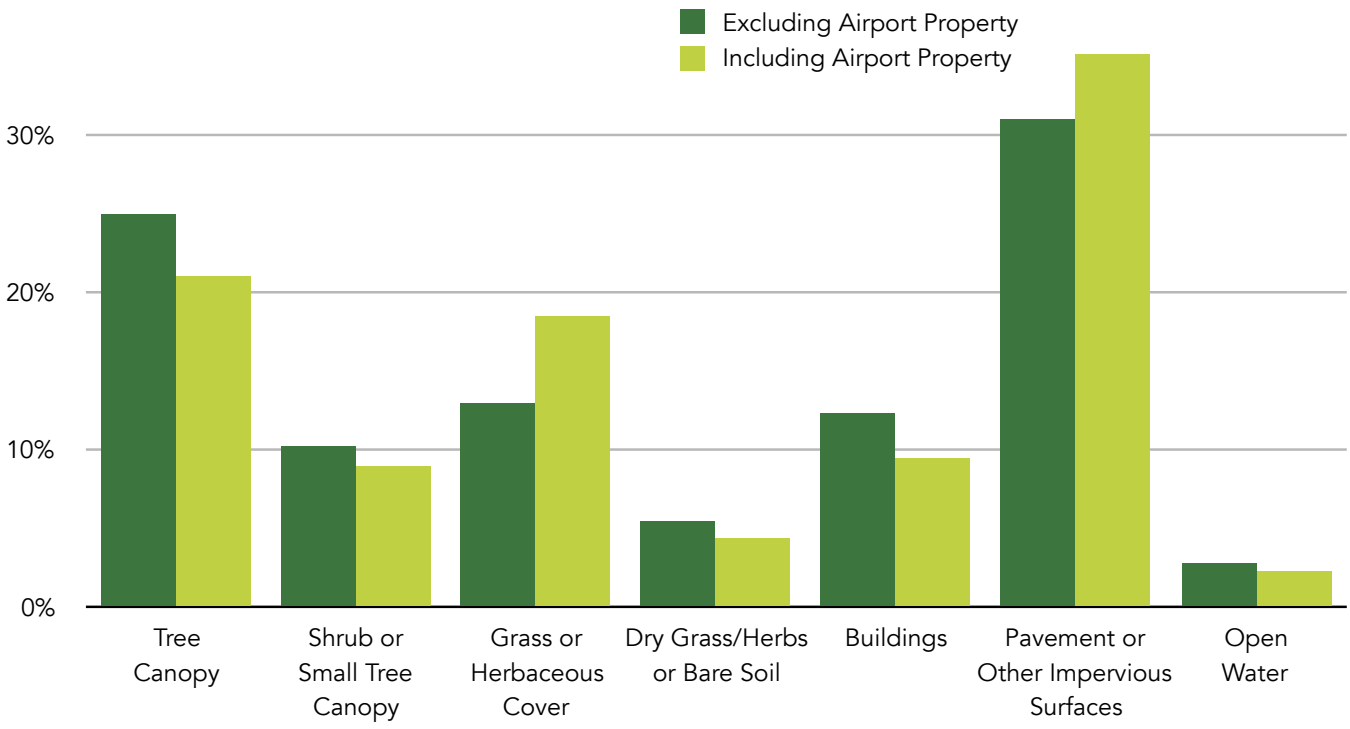


Figure 1: Comparison of land-cover proportions with and without airport property

and exceptional quality of life. For example, increasing high-density housing, including condominiums and multifamily developments, often results in residents having less access to open space and natural settings. Studies have proven that this is detrimental to health and wellness (USDA Forest Service 2018). Thus, it is important to protect and enhance SeaTac's canopy cover, when possible, in order to preserve and enhance the city's urban forest and the services it provides.

Because green space is an important element of livable, attractive communities, it provides benefits beyond environmental services. Urban developments such as condominiums, townhouses, and office parks are considered by residents to be more desirable when they are located near parks and natural areas that are accessible by bike or on foot (Tyrväinen and Miettinen 2000). Parks, trails, and natural areas give city residents recreational opportunities and a connection to nature and their community that can help sustain an active, urban life. Trees and green space are also associated with a variety of measurable public health benefits by providing people with access to nature and low or no-cost exercise, both of which have links to stress reduction, mental health, and increased physical wellness (see Chapter 2).

In 2005, Forterra launched the Cascade Agenda, a 100-year vision for conservation and economic growth in the Pacific Northwest, with a focus on building livable urban communities. The Port of Seattle recognizes that airport operations impact neighboring communities and, therefore, those communities should see increased benefits. **A continuing Green SeaTac Partnership will help bring this combination of expertise and support to SeaTac's urban forest.** The cost of doing nothing is very high: some areas of SeaTac have a current trajectory of a complete loss of tree canopy due to invasive species presence and lack of young trees. Taking steps to reverse this trend is crucial for the health of the city's urban forests — and the city itself.

Similar Green City Partnerships have already seen success in Seattle, Tacoma, Kirkland, Redmond, Kent, Everett, and Puyallup. In 2019, the Green Cities Network is 14 cities strong and is making ecosystem-wide, regional change. During the writing of this plan, Snohomish County became the first county to make the commitment as a Green County. **Together, these partnerships are establishing one of the largest urban-forest-restoration networks in the nation.** This network of municipalities holds annual summits and quarterly meetings where ideas are exchanged and solutions offered. Thanks to the Port of Seattle's ACE Funding, the City of SeaTac can join this impressive, innovative network and contribute to the health and livability of the entire Puget Sound region.

2. MORE THAN JUST GREEN:

URBAN FORESTS HAVE MANY BENEFITS

The benefits of caring for SeaTac's urban forest are myriad, and they affect all aspects of the community. Research indicates that urban forests give people a higher quality of life (Dwyer et al. 1992), provide ecosystem services such as flood prevention, create opportunities to improve physical and mental health, reduce crime, and provide opportunities to enjoy nature close at hand. They help keep the air and water cleaner, provide habitat for native wildlife, and make communities more livable and beautiful (see Table 1).

A conifer can remove 50 pounds of particulates from the air per year (Dwyer et al. 1992).

Just 20 minutes in nature can significantly lower stress hormones such as cortisol (Hunter et al. 2019).

Air filtration alone by urban trees in Washington State is valued at $261 million.

Nationwide, urban trees prevent 670,000 cases of acute respiratory conditions annually (Nowak et al. 2018).

Every 1% increase in a city's usable or total green space results in a 4% lower rate of anxiety/mood disorder treatment (Nutsford et al. 2013).

Buffers of trees and shrubs can reduce 50% of noise detectable by the human ear (USDA Forest Service 1998), including high-frequency noise, which is the most distressing to people (McPherson et al. 2001).

TABLE 1 | Benefits of Urban Forests

Reduce Stormwater Runoff	Urban forests can reduce annual stormwater runoff by 2%–7%, and a mature tree can store 50–100 gallons of water during large storms (Fazio 2010). Green streets, rain barrels, and tree planting are estimated to be three to six times more effective in managing stormwater per $1,000 invested than conventional methods (Foster et al. 2011).
Improve Water Quality	Plant roots absorb water, much of which is full of pollutants in an urban environment. Some pollutants are filtered and transformed by bacteria and other microorganisms in the soil (Prince George's County 2007); others are transformed by plants through metabolism or trapped in woody tissues and released when a tree decomposes.
Reduce Erosion	As the tree canopy slows the speed of rain falling on the earth, rainwater has less energy to displace soil particles. Soils under a canopy and the thick layer of leaf litter are protected from the erosive energy of rainwater (Xiao et al. 1998).
Improve Air Quality	Plant leaves absorb carbon dioxide and produce oxygen through photosynthesis. The surfaces of leaves trap airborne dust and soot (McPherson et al. 1994), removing millions of pounds of air pollutants annually from the air in a city (American Forests 2001).
Provide Wildlife Habitat	Native wildlife has unique requirements for food and shelter. Healthy urban forests under restoration have been demonstrated to increase species diversity (Ruiz-Jaén and Aide 2006).
Reduce Energy Use and Combat Climate Change	A 25-foot tree reduces annual heating and cooling costs of a typical residence by an average of 8%–12% (Wolf 1998). Urban forests can also lower ambient temperatures of nearby urban areas (Nowak and Heisler 2010), which lowers energy consumption. Trees absorb carbon dioxide and store the carbon in woody tissues, reducing the amount of carbon dioxide in the atmosphere. Each year, an acre of trees absorbs the amount of carbon produced by driving a car for 26,000 miles (Nowak 2011).
Buffer Noise	Tree canopies dampen sound by intercepting sound waves (Herrington 1974). Noise buffers composed of trees and shrubs can reduce 50% of noise detectable by the human ear (USDA Forest Service 1998), including high-frequency noise, which is the most distressing to people (McPherson et al. 2001).

Table #1 | Benefits of Urban Forests (cont.)

Boost Local and Regional Economies	Urban forestry supports job creation and retention, resulting in added individual income and increased local, state, and federal taxes (California Department of Forestry and Fire Protection 2011). Homes that border urban forests are often valued at up to 5% more than comparable homes farther from parks (Tyrväinen and Miettinen 2000), and street trees add value to homes as well (Donovan and Butry 2010).
Build Community	Physical features, particularly natural ones, play an important role in creating vital neighborhood spaces (Sullivan et al. 2004). Urban green spaces and parks provide gathering places for people of different backgrounds to integrate and connect with each other. Greener neighborhoods can encourage social bonding between neighbors and improve social connections. Residents who are more attached to their community have higher levels of social cohesion and social control, and less fear of crime, and their neighborhoods display more signs of physical revitalization (Brown et al. 2003).
Make Communities More Attractive	Trees are the most important factor in influencing the perception of a community's aesthetic value (Schroeder 1989). Trees and natural landscapes are associated with reduced aggression and violence (Kuo and Sullivan 2001b), and less graffiti, vandalism, and littering (Brunson 1999).
Foster Physical Wellness and Fitness	People in communities with high levels of greenery or green space are more likely to be physically active (Maas et al. 2006; Ellaway et al. 2005). In fact, people who use parks and open spaces are three times more likely to achieve recommended levels of physical activity than nonusers (Giles-Corti et al. 2005).
Improve Mental Health and Function	The experience of being in nature helps restore the mind after the mental fatigue of work or studies, improving productivity and creativity (Kaplan 1995; Hartig et al. 1991). A recent study found that just 20 minutes of walking in nature significantly lowers stress hormones (Hunter et al. 2019).
Help Children Develop	Experience with nature helps children develop cognitively, emotionally, and behaviorally by connecting them to environments that encourage intellectual development, imagination, and social relationships (Isenberg and Quisenberry 2002; Heerwagen and Orians 2002). Green settings and green play areas also decrease the severity of attention deficit disorder in children (Taylor et al. 2001).
Stewardship Activities Benefit Health and Wellness	Volunteer stewards of all ages who regularly remove invasive species, plant trees, and perform other stewardship activities are likely to gain health benefits from physical exertion. In one hour, a 150-pound person can burn 440 calories from digging, gardening, and mulching, and 330 calories from light gardening such as planting trees (www.choosemyplate.gov). Strong community relationships are built from sharing personal stories, exchanging information, and working together to achieve common goals (e.g., community forest improvements).

Economic Benefits

The Puget Sound region's forests provide measurable, valuable services that affect us every day. In 1998, American Forests, a nonprofit citizens' conservation organization, analyzed Washington State's urban forests. Its study revealed that these trees removed 38,990 tons of air pollution — a service that is valued at $261.6 million in 2019. The study also showed that the trees created a 2.9 billion-cubic-foot reduction in runoff, a service valued at $9.2 billion, adjusted for inflation (American Forests 1998). Were these forests to be lost, these dollar values become the costs associated with building new infrastructure to carry out functions such as stormwater runoff. Some functions, such as air filtration and cooling, could not be replicated.

Air-Quality Improvement

A city with abundant and healthy vegetation enjoys significantly higher air quality. Conifers, specifically, can remove 50 pounds of particulate pollutants from the air per year (Dwyer et al. 1992), which is correlated with a reduced incidence of asthma in children and other related respiratory health issues in people of all ages (Lovasi et al. 2008). Trees remove soot and other pollutants through their leaves and branches, and evergreen trees do this work year-round. More recent studies have found that conifers, in particular, are natural filters for ultra-fine particle pollutants, and they actually remediate or decontaminate both air and water in a process called phytoremediation. One study likened trees as the "green liver and lungs" of urban areas (Abd ElAziz et al. 2015). In 2006, the total amount of air pollution removed by urban trees annually within the United States was estimated to be 711,000 metric tons (Nowak et al. 2006).

Water-Quality Improvement

Neighborhoods with fewer trees have the potential for increased stormwater, pollutants, and chemicals flowing into their water supply and systems, resulting in flood damage, health risks, and increased taxpayer dollars to treat the water (Seitz and Escobedo 2008). Trees absorb and filter water through their roots, and the loss of trees means the loss of these vital services. Trees also help soils that have been compacted by human intervention and no longer absorb water; they do this by sending down roots, which make paths that stormwater can follow in a process called infiltration (Bartens et al. 2008).

Mental Health Benefits

Higher percentages of neighborhood green space are associated with significantly lower levels of depression, anxiety, and stress, and one article found that "greening could be a mental health improvement strategy in the United States" (Beyer et al. 2014). Many of the health benefits of trees and green spaces come from their ability to improve the mood and mental health of the people who live around them. Immersion in natural settings is impactful, but even viewing trees through a window can reduce stress and improve outcomes for everyone from students in a classroom to patients in hospitals (USDA Forest Service 2018). In the community survey the Partnership conducted (see Chapter 4), 41% of respondents said they are already using parks to relax and increase their mental wellness (see Appendix H5). Increasing this benefit is as simple as ensuring an equitable distribution of trees and green spaces that are accessible to residents and encouraging people to look or go outside.

Climate-Change Mitigation

Urban forests also help combat climate change and the effects of air pollution through carbon capture. Trees, as they grow, capture carbon dioxide through the process of photosynthesis. They store the carbon from the absorbed carbon dioxide in the woody mass of their branches and trunks, and release oxygen into the air. It is estimated that Washington State's urban trees are responsible for the sequestration of more than 500,000 tons of carbon per year (Nowak and Crane 2002). Each acre of healthy, mature, dense Western Washington forest could be responsible for the storage of more than 300 tons of carbon, which translates to the removal of more than 1,100 tons of carbon dioxide from the atmosphere (Smithwick et al. 2002). For example, the average passenger vehicle emits about 4.6 metric tons, 11,000 pounds, of carbon dioxide per year (EPA 2018). According to the EPA, each acre of healthy forest can remove carbon dioxide emissions for approximately 2.4 vehicles per year. Once they are restored, SeaTac's 186 acres of dense forest in parks have the potential to mitigate the emissions of nearly 450 cars per year.

Trees in an urban setting combat the "urban-heat-island effect" caused by paved surfaces absorbing and radiating heat from the sun. Trees produce shade, reflect sunlight well above the pavement, and convert sunlight through photosynthesis. Urban forests also create microclimates that move air and further cool their surroundings.

They have been shown to significantly lower ambient temperatures, making hot days more comfortable and reducing energy consumption needed for artificial cooling (Kurn et al. 1994). A single 25-foot tree reduces a typical residence's annual heating and cooling costs by an average of 8%–12% (Wolf 1998).

While invasive plants such as ivy and blackberry also carry out photosynthesis to sequester carbon and create oxygen, they are shorter lived and contain less biomass than mature conifers. This makes them less effective at removing carbon dioxide from the atmosphere and storing it. Additionally, they often do not supply adequate habitat for local native wildlife and are much less effective at providing other ecosystem functions than healthy native Northwest forest communities. Invasive plants typically exclude other plants, so they do not foster the diversity that keeps natural areas healthy and stable.

Each 10% increase in overall urban tree canopy generates a 2 degree F reduction in ambient heat (Wolf 2008). Urban trees are particularly vital for reducing heat stress and decreasing the size and effect of the urban heat island (Zupancic et al. 2015). Trees have the unique ability to use evapotranspiration to provide micro-cooling. Zupancic also found that green spaces that are connected and closely spaced can improve the flow of cool air throughout an entire city.

Decreased Crime

Studies have shown that urban forest and healthy green spaces decrease crime (Kuo and Sullivan 2001a). Recently, the Chicago Region Trees Initiative (CRTI) has been mapping and studying this correlation between trees and reductions in crime. According to CRTI Director Lydia Scott, "Communities that have higher tree population have lower crime. [In] areas where trees are prevalent, people tend to be outside, mingling, enjoying their community" (Nolan 2017). The CRTI team used new technology to check that the correlation wasn't due to socioeconomic or other factors. Another study found that Philadelphia experienced an 18%–27% reduction in reports of narcotics possession in areas with enhanced vegetation (Kondo et al. 2015). Restoration projects led by the community help reclaim such areas as positive public spaces that are welcoming for everyone, and they regularly bring more watchful attention to areas, increasing a sense of public ownership and responsibility.

Community tree planting also helps reduce crime throughout a city. In a separate study, Kuo and Sullivan studied 98 apartment buildings in an inner-city neighborhood of Chicago and found that regardless of the socioeconomics of the residents of an apartment building, "the greener a building's surroundings are, the fewer total crimes" (Kuo and Sullivan 2001b). Troy et al. (2012) found that a 10% increase in tree canopy was associated with a roughly 12% decrease in crime.

More research would still be needed to quantify the economic and ecosystem benefits of SeaTac's urban forest. That said, drawing from the wide body of knowledge and related studies outlined here, we know that the cost of doing nothing to maintain the health of the city's urban forest will be high and have negative effects on SeaTac's environmental, economic, and public health. As development throughout the region continues at a rapid pace, preserving and potentially enhancing our remaining urban forest is now more important than ever.

3. THE CHALLENGE

THREATS TO THE URBAN FOREST

SeaTac's Urban Forest

Most people, when asked to picture a forest, imagine a scene dappled with sunlight, where trees tower overhead, birds chirp, and the air smells like conifers. Urban forests such as SeaTac's are not what most people typically picture when thinking of forest. That said, SeaTac is home to 186 acres of dense forest, primarily located in parks, as well as thousands of single trees and small groves throughout the city. Of SeaTac's 25% canopy cover, 42% is on residential land and about 14% is on parks and other public land (see Figure 2).

Challenges and Threats to Sustainability

Urban forests face unique challenges and pressures that require specific attention. The following section outlines seven primary issues that prevent urban forests from sustaining themselves or pose risks to current and future ecological sustainability:

- Fragmentation and development
- Declining habitat quality
- Invasive species: plants and insects
- Native vegetation struggling to regenerate
- Harmful use: intentional and unintentional
- Climate change
- Lack of homeowner education and resource allocation

Fragmentation and Development

Habitat fragmentation is a forest threat that is inevitable in urban environments. Fragmentation occurs when contiguous forested areas are divided by development. This fragmentation decreases the valuable internal habitat of the forest and increases edge effects because these areas receive more human interference, are more disturbed, and receive more sunlight than contiguous forest. As well, pollination can be challenging when fragmentation isolates populations of plants — plants that are farther from each other have less likelihood of sharing pollen by wind or insects. This can lead to seeds going unfertilized and a lack of tree regeneration. Fragmentation also disrupts the connecting corridors used as habitats for birds, amphibians, and mammals.

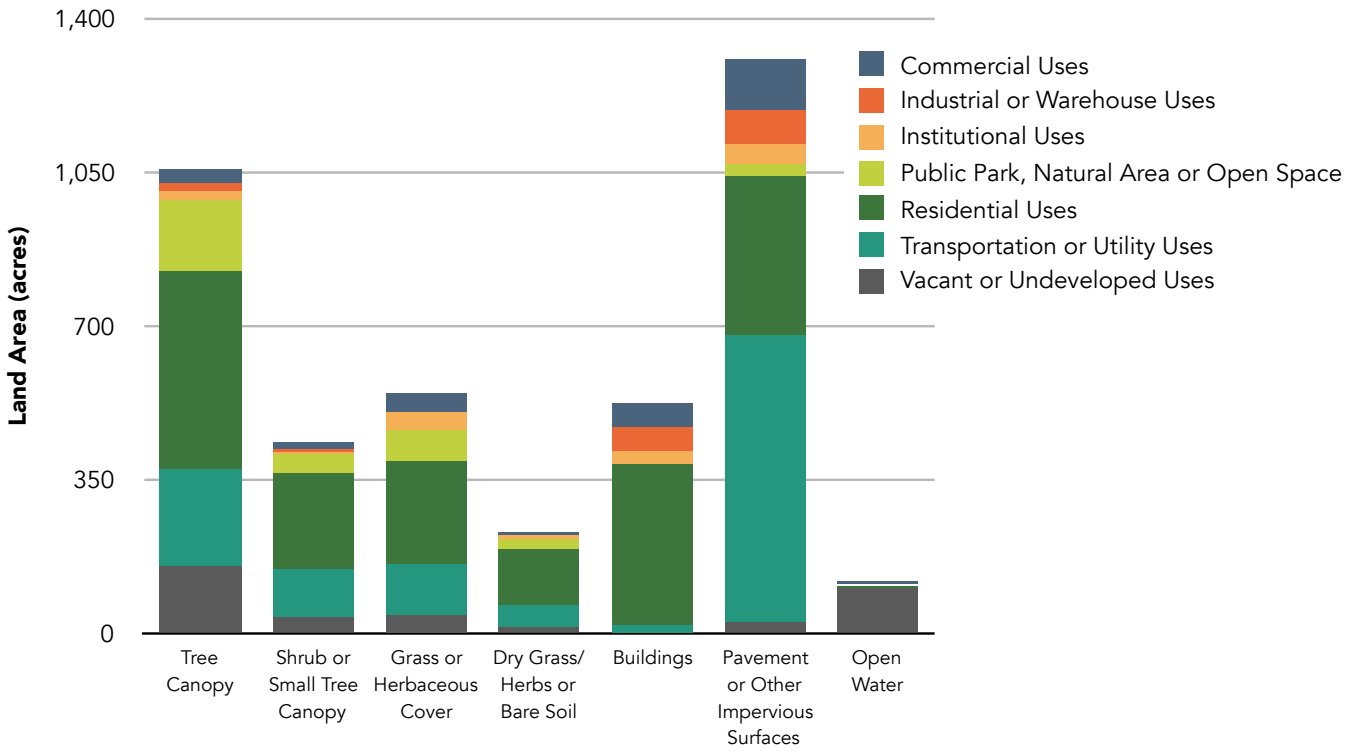


Figure 2: Distributions of land-use categories by land-cover type

Urban forests exist in human-use areas; if the benefits of healthy forest are desired, planning and development must consider how and where to keep dense forest as uninterrupted as possible. Carefully considered urban planning of green belts, parks, tree-related municipal policies, and neighborhood-specific regulations and association agreements can reduce fragmentation and contribute to the health of the urban forest. These intact green corridors can serve as the "skeleton" of a city's green infrastructure, supported by individual trees or small groves of trees.

Declining Habitat Quality

Several factors contribute to the loss of habitat quality in SeaTac's forests and natural areas. Compared with the region's native forest composition, deciduous trees make up much more of SeaTac's forest canopy than is typical in a healthy Northwest forest. Deciduous trees are early-colonizing species and help establish a forest in disturbed areas. Under natural conditions, as deciduous trees begin to die off, they are typically replaced by longer-lived conifers; however, SeaTac's urban forest no longer grows under natural conditions. Deciduous red alder, cottonwoods, and bigleaf maples now dominate the majority of SeaTac's forest overstory. Of the forested parkland surveyed, 84% is dominated by deciduous trees.

The high proportion of deciduous trees in SeaTac's forest indicates that there will be a pronounced decline in tree canopy in the near future. Many of the deciduous trees — both native and nonnative — are nearing the end of their natural life spans. As they die, more sunlight can reach the ground, resulting in perfect growing conditions for aggressive, invasive plants to flourish. The loss of tree canopy allows invasive plants to become the dominant species in many parts of the city, inhibiting the new growth of new trees and plants. Without intervention, such as planting young native trees to create the next generation of canopy, the data suggests that the natural death of these deciduous trees could lead to a loss of much of SeaTac's forest overstory.

Invasive Species: Plants and Insects

Invasive plants now outcompete native understory plants in many of SeaTac's private, park, and urban areas. Aggressive, nonnative shrubs and vines cover the ground, preventing tree seedlings and other native plants from receiving sunlight and nutrients. Robust Himalayan and evergreen blackberry bushes spread along the ground in large thickets, and birds disperse the seeds to new locations. Invasive blackberry grows densely, choking out native plants and destroying native habitat for wildlife species. Himalayan blackberry is the dominant invasive plant in SeaTac's natural areas: it is the primary invasive species found in 66% of the surveyed areas and is present as either the primary, secondary, or tertiary invasive species in 94% of forested public land. English ivy is the primary invasive species in 27% of the Partnership's project area, and English holly is the third most common invasive species. One or more of these three species is found in every site, and a small number of other aggressive invasive species round out the full picture of the threat facing SeaTac's struggling natural areas (see Figure 15).

English ivy can kill a healthy deciduous tree within 20 years by spreading up from the understory into the tree canopy. Ivy can easily spread from neighboring residential landscapes, where it becomes a serious problem, as experienced by many other cities throughout the region. Once ivy becomes established, an intense investment of time and resources is required to remove it. Where English ivy is in the early stages of blanketing forest floors and trees in SeaTac, the opportunity exists to remove the existing growth and prevent further spread and a much bigger future cost of management.

As invasive species begin to dominate the urban forest, the diversity of food and habitat available throughout the seasons is diminished. While some animals, such as rats, can live and even thrive in the dense monocultures of blackberry or ivy, quality habitat for most native wildlife is degraded by invasive species. In addition, environmental benefits such as stormwater retention, erosion control, and carbon sequestration are greatly decreased when invasive species displace healthy trees and forested areas. If the spread of invasive species is not prevented, the result is degraded forests and natural areas overrun with sprawling thickets of blackberry and engulfed in ivy.

Non-native, invasive insects can also have catastrophic effects on a region's natural resources and do not contribute to the natural ecological processes found in healthy natural open spaces. Wood-boring beetles have been documented in the northeastern US and California since 1996. The Asian long-horned beetle (*Anoplophora glabripennis*) and the citrus long-horned beetle, which arrive on wood pallets from Asia, are known to attack and kill maple trees and other deciduous hardwoods (Haack et al. 2010); they arrived in our region in 2001, but have since been eradicated. Outbreaks of Asian and European gypsy moths have been documented here, though successful control efforts have prevented populations from establishing. In areas where full populations have

established, such as in the Northeastern and Midwestern United States, gypsy moths — which forage by defoliating trees — have weakened trees and degraded wildlife habitat on millions of forested acres. Weakened trees then succumb to other pests or disease. In the Pacific Northwest, gypsy moths have been known to attack red alder, Douglas-fir, and western hemlock (Boersma et al. 2006).

Information is available through the Washington Invasive Species Council and US Department of Agriculture (USDA) Animal and Plant Health Inspection Service. The Green Cities program, with funding from the USDA Forest Service, has developed a monitoring protocol for Asian long-horned beetle species. This protocol is specifically designed for community members to become citizen-scientists and volunteer to assist in detection; it could be offered as a training by the Green SeaTac Partnership in the future.

Native Vegetation Struggling to Regenerate

Native-tree-canopy regeneration — especially of conifers — is greatly limited in SeaTac's forest for several reasons. First, the landscape-scale loss of native conifer trees due to residential and commercial development has reduced the seed bank for these trees. At the same time, invasive plants have reduced native-tree regeneration by outcompeting or smothering those tree seedlings that do grow. This guide recommends a commitment to restoring forested public land and engaging landowners in removing invasive plants and planting trees. Landowners in residential or commercial areas can select trees that best fit their desires: fall colors, ease of care, and size can determine which tree to plant. In parks and natural areas, where restoration of the forest could occur, native trees are recommended.

In the face of a changing climate, native plants and trees are usually resilient to summer drought, but are not capable of this when threatened and stressed for resources by invasive plant presence. Private homeowners and City managers may choose to plant nonnative trees and plants on their property, and street trees are often nonnative, but it is important to know the difference between a nonnative plant and one that is both nonnative and invasive. By removing these invasive plants and planting noninvasive trees, shrubs, and ground cover on both private and public land, residents and managers can help the process of tree regeneration move forward. This is critical to ensure the future vitality of the city's urban forest and the many ecosystem and human health benefits it provides.

Harmful Use: Intentional and Unintentional

In addition to the indirect effects of human development, harmful and often illegal activity, especially in parks, has had a direct impact on SeaTac's urban forest. People misuse parks, harm community trees, and destroy spaces that are meant to benefit them, though this is often unintentional and a byproduct of inequity or miseducation. Trees are damaged and cut for views, park trees are taken for firewood, and other vegetation is injured in acts of vandalism. Dumped garbage and yard waste is a common problem in parks and natural areas throughout the city. Illegally dumped garbage can leach chemicals into the ground, attract rodents or other pests, and smother understory vegetation. Encroachments onto public land from adjoining private-property owners bring with them a number of problems for natural areas: primarily, the removal of native vegetation for the establishment of ornamental landscaping, lawns, or personal views. Almost all community forests also feel the impact of neighbors' access paths, built structures, and domestic animals.

While addressing all types of illegal activity will require sensitivity, the issue of homeless encampments is undoubtedly among the most complex. The model in other Green Cities is to approach encampments on project-area sites with sensitivity toward all involved, and work with social services organizations whenever possible to come up with action plans in the combined best interest of people experiencing homelessness, neighbors, volunteers, and the urban forest itself. It is imperative to employ best practices for both the health and safety of volunteers and the just and equitable treatment of the individuals experiencing homelessness and their belongings.

When forested urban areas are unmanaged, they can quickly be perceived as a refuge for unintended and illegal activity, such as drug use and violent crime, because they are seen as abandoned or forgotten land. This is an unfortunate perception, as it is often untrue: well-managed green space doesn't encourage crime, but rather, it reduces it (USDA Forest Service 2018). The issue is that management is costly and challenges many communities, especially in an urban setting and with limited staff capacity. When illegal activity takes place, forested areas can become known more for the harmful pursuits they harbor than for the valuable benefits they provide. Reversing this perception takes a concerted effort, but simply bringing more attention and activity to these areas helps enormously. The Green Cities Partnership model

uses the entire community to assist in this management through community work parties, educational walks, and events.

Climate Change

The Pacific Northwest region faces climate-change impacts that include warmer winters; hotter, drier summers; and changes in precipitation (Littell et al. 2009). Climate change is expected to negatively impact the health and resilience of forests and natural areas by shifting the habitat conditions of native tree species that are common in Puget Sound lowland forests (Kim et al. 2012). Shifts in growing conditions, such as changes to summer and winter temperatures and soil moisture, can directly affect tree health and vigor, and make trees more susceptible to mechanical or physical failure, insect infestations, and disease (Littell et al. 2010).

Restoration and conservation of urban forests and natural areas therefore become increasingly important in addressing these changes. Restoration efforts are essential to preserve forest and natural-area health, and ensure the critical ecosystem functions these resources provide, such as reducing urban-heat-island effects, sequestering carbon, and mitigating stormwater impacts from increased precipitation. To improve the ability of forests and natural areas to mitigate, as well as adapt to, climate-change stressors, adaptation and resilience strategies will need to be integrated into general management practices and park-specific stewardship plans. Using current science, shared experience, and practical considerations for under-resourced municipalities, the Green Cities Network has been developing best management practices for how and when to water; these practices could be incorporated into volunteer training, future network work sessions, and site-specific management plans.

Lack of Homeowner Education and Resource Allocation

A final threat to SeaTac's urban forest is that private-property owners lack resources relating to urban forest care, management, and maintenance. With just under half of SeaTac's canopy cover existing on residential and private land, this education and resource allocation is imperative. Homeowners often inherit trees from previous owners, and in the past there were fewer resources for private tree management. Without these resources, many homeowners and landowners choose to remove healthy trees due to the potential expenses associated with aging, large trees. Other Green Cities have identified ways to provide this education and training both within their Partnerships and through connecting residents with other programs and resources, such as the King Conservation District.

Resource Limitations on Urban Forest Management and Maintenance on Public Lands

Historically, resources for tree and forest management and maintenance, such as in parks, have been limited in cities. In the past, it was widely believed that forests and natural areas, even in urban environments, could take care of themselves, which tended to discourage managers from allocating sufficient funds for the care of urban forests. Many Northwest parks and natural areas were left to benign neglect under the assumption that they were self-sustaining and without the understanding that they were susceptible to changing conditions and outside influence. This passive management directly led to declining health in unsupported urban forests and other natural areas. Unfortunately, but unsurprisingly, the longer active management is postponed, the more expensive it becomes, as existing tree canopy declines or is removed, invasive species spread prolifically, and threats compound.

Fortunately, scientists studying these trends began to realize that urban forests needed a more active approach. Instead of placing blame on past managers, it is important to remember that this is new information that has resulted in an increasing commitment to protect and restore healthy, urban forests in many of the world's cities. To uphold this new science, **this guide recommends investing in the active management of the urban forest in SeaTac.** Across the globe, trees are now recognized as city and community assets — also known as green infrastructure — and need to be maintained as such with attendant planning, policy, and budgeting. Unfortunately, SeaTac's level of need exceeds current City staffing and funding. This guide suggests engaging the community in a more structured effort to manage the urban forest and leverage additional partner investment and volunteer engagement to meet this need.

4. UNDERSTANDING THE CHALLENGE IN CONTEXT

In order to fully understand SeaTac's challenges and needs, we conducted a process to obtain feedback from residents regarding how and where they would like to see the enhancement of its urban forest. SeaTac is one of the most diverse cities in the US. The EPA has identified areas and neighborhoods in the city with high levels of negative environmental impacts — in fact, every census district in the City of SeaTac faces these environmental challenges (EPA 2019). These high impacts disproportionally occur in and affect neighborhoods with elderly, low-income, and immigrant populations. Social vulnerability refers to a community's ability to be resilient when confronted by external stresses such as pollution or natural or human-caused disasters. According to the CDC, who created a Social Vulnerability Index to measure this ability, "Reducing social vulnerability can decrease both human suffering and economic loss." All of SeaTac's census districts have a moderate to high score on the Social Vulnerability Index (EPA 2019).

In creating this guide, we felt it was imperative to include a diversity of voices and obtain feedback from the community this guide will serve. Thus, we engaged the community in three ways: through an online and paper survey, a community open house, and two small community meetings. For the purposes of this community engagement, the Green Partnerships in SeaTac, Des Moines, and Burien, all funded through the Port of Seattle's ACE Fund, worked together to generate feedback, as many residents use parks in all three cities, and many work in one city while living in another. Forterra contracted Global to Local, an organization with roots in the communities, to ensure that the feedback received was representative of the entire population of these three cities.

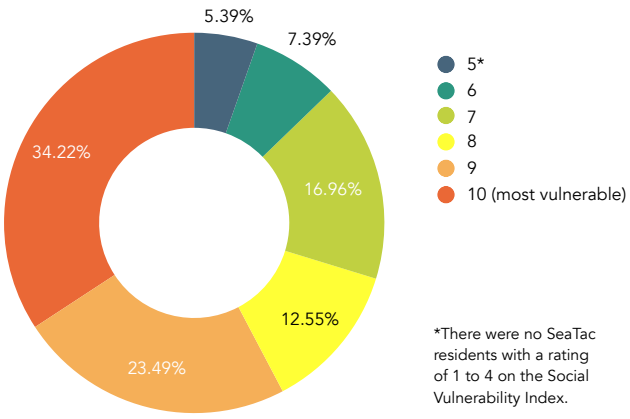


Figure 3: Ratings of social vulnerability in SeaTac by proportion of the city

What Is Environmental Justice?

Some environmental factors, such as canopy cover and pollution, are disproportionately distributed across populations of people. The EPA recognizes that negative environmental factors are concentrated in areas where there are low-income earners, a majority of people of color, immigrant communities, and the elderly. Environmental justice, as defined by the EPA, is "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies."

The EPA gives a metric for achieving environmental justice: "When everyone enjoys the same degree of protection from environmental and health hazards, and equal access to the decision-making process to have a healthy environment in which to live, learn, and work."

Community Engagement Process

One of the main goals of the process was to ensure that community perspectives — particularly those of residents from historically marginalized groups — informed the priorities and activities of the new Partnerships from the outset. Forterra conducted outreach in two main ways: tailored engagement via the Community Connectors model with Global to Local, which targeted individuals from difficult-to-reach communities through in-person surveys and small community meetings; and traditional engagement in the form of open houses and digital surveys, which was meant to gather feedback from a broad audience.

Community Survey

Forterra developed an eight-question survey designed to gather quantifiable data on community members' priorities related to urban forestry and green space. The community survey was available online and also often administered in person by a Community Connector, who

was a paid representative of Global to Local. Forterra commissioned a translation agency to translate the survey into three non-English languages that are commonly spoken among the communities represented by the Connectors: Spanish, Somali, and Filipino.

In total, we collected survey responses from 162 individuals. Of these surveys, 58 came through Connectors, 26 were completed at one of the open house events, and 14 were completed at small community meetings. The remaining 64 surveys were completed online. Of the 158 respondents, 40% live in the City of SeaTac (see Figure 4), and 58% indicated that they often visit parks there (see Appendix H5).

The most popular activity that respondents participate in when they visit parks is "view[ing] nature, trees, flowers, birds, wildlife, etc.," which was closely followed by "relax[ing]." When asked to select the three health- or environment-related issues that were most important to them, 70% of respondents chose air pollution and 55% chose water quality — the two most common responses. While clean air and water were the top environmental priorities for community members, a significant proportion of respondents also indicated that they valued access to nature/natural beauty; quality of life/mental health; and safe spaces for relaxing and having fun — each of these issues was chosen by 41% of respondents (Appendix H5).

When they were asked to identify areas in their city where they would like to see more trees, it was clear that parks were a priority for many participants, as well as community/public spaces such as churches, libraries, schools, and bus stops. Many people also mentioned roadways, indicating that street trees are also in demand among survey respondents. The idea of planting more trees to serve as a visual/sound buffer between residents and industry (e.g., airport activities, construction, warehouses) was also commonly mentioned. Finally, some respondents were interested in developing ways to incentivize homeowners to plant trees on their property.

Open Houses

The Partnerships hosted three Open House events throughout the fall of 2018: one in SeaTac on Saturday, October 20th; one in Des Moines on Monday, October 29th; and one in SeaTac on Wednesday, November 7th. The Open Houses served a dual purpose: to provide information to community members about the project and to gather input from residents about stewardship priorities in their neighborhoods. There were several "stations" set up around the room that provided participants the opportunity to learn more about Green Cities Partnerships, engage with research that has been conducted thus far, and provide both site-specific and general feedback on areas where they would like to see more trees and/or restoration efforts. The Port of Seattle

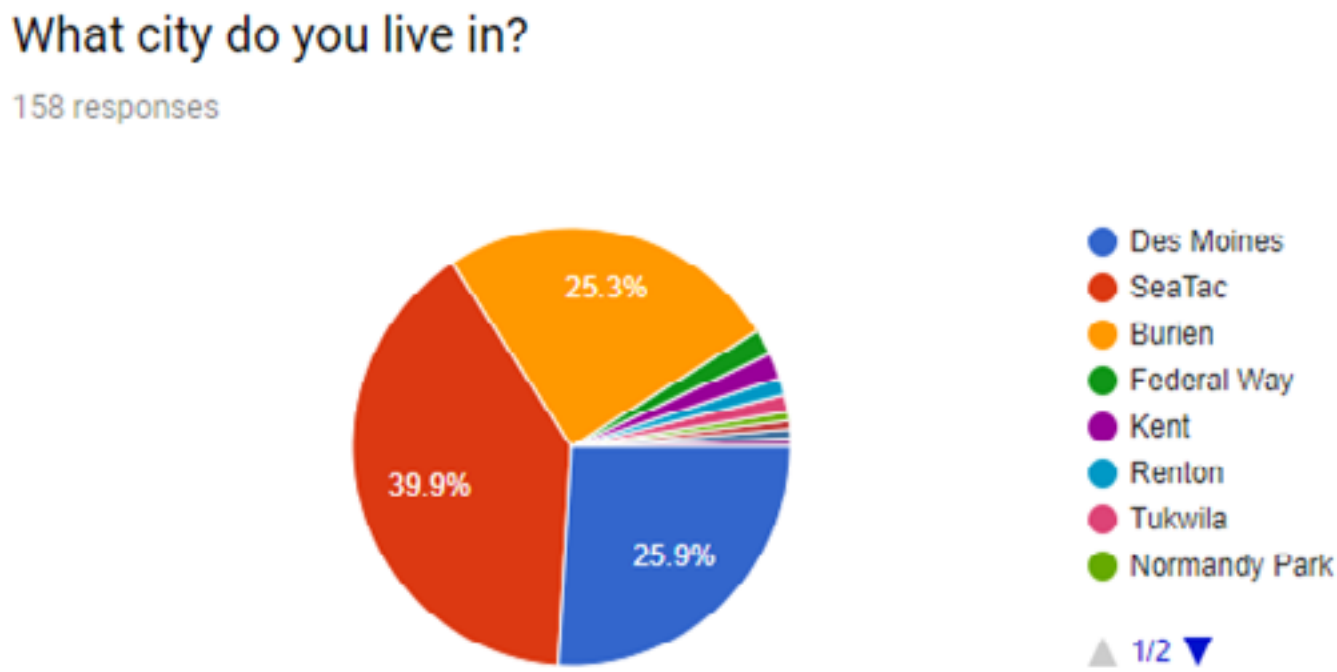


Figure 4: City of residence of surveyed respondents

also hosted a table with information on ACE Fund priorities and activities.

Overall, the Partnerships engaged 74 guests at the open house events, including 25 guests in SeaTac. These numbers reflect individuals who signed in at the events, and therefore may underrepresent the actual number of people who participated.

From the open-house-feedback activities, we gained input related to site-specific stewardship priorities, types of landscapes where residents want to see more trees, and general community feedback. There were also several comments about planting trees near areas undergoing development in order to provide a buffer between residents and development activities. For a full listing of feedback collected at the Open House events, see Appendix H6.

How Does SeaTac's 25% Canopy Cover Measure Up?

Across the United States, the suitability of land for trees varies widely. Imagine Phoenix, once a large and beautiful desert, being densely planted like a forest — it just doesn't make sense. Thus, in the US, an average of 33.6% urban canopy cover is a number we probably could improve on, but it covers diverse landscapes. Here in Western Washington, our potential for tree cover varies as well, but according to most research, the potential for trees in cities that were once forested is about 40%–60%. Currently, a few cities, such as Redmond, are leading the pack with high canopy goals.

- *Average national urban-canopy-cover: 33.6%*
- *Average canopy cover in Redmond, WA: 38%*

Small Community Meetings

The Partnership conducted two small community meetings in SeaTac and six, in total, in all three cities. These meetings were focused around groups not already represented in the surveys or at community open houses. In SeaTac, Partnership representatives attended meetings at the Senior Center and met with high school students from Tyee High School's Filipino Association and National Honor Society. From these meetings, the Partnership gained perspectives about accessibility and inclusivity that would inform any future projects and programs.

High school students, specifically, spoke about how the smaller parks in their neighborhoods were not made up of much forest and that access to larger parks is very limited. They acknowledged how big (distance-wise) SeaTac is and how long it can take to get from one end to another, mentioning that they use buses to get around town and would appreciate more greening of bus stops in order to increase shade.

Several students mentioned how much planting and maintaining trees would mean to their school grounds. They wanted their school to be the recipient of potential tree giveaways and education around the benefits of trees. The students were interested in learning how to monitor and maintain trees. Finally, the students were excited about the potential for the Partnership to supplement their school curriculum with hands-on skill building in career paths such as urban forest management, tree care, and community outreach.

At the Senior Center meeting, participants repeatedly expressed that access is a primary issue in their lives. For example, tree roots upending sidewalks are often unrepaired due to resource constraints. This can be a major burden for seniors and others who need mobility assistance such as walkers and wheelchairs. Seniors felt their need for accessible paths was at odds with their desire for greener, shaded walkways. Seniors who are long-time residents fondly remember a greener SeaTac at a time when development was considerably less. They expressed nostalgia for the trees but also talked about the expensive and burdensome reality of owning and maintaining trees on their own property. With assistance, seniors would like to be the recipient of a tree-distribution program, but would need help getting trees planted on their property, as well as follow-up tree care.

Centering Equity and Diversity

A number of studies have concluded that the distribution of urban green space is related to measures of socioeconomic status, such as income, race/ethnicity, education, and occupation. These studies regularly report that neighborhoods with higher socioeconomic status enjoy greater access to nearby green space (Gordon-Larsen et al. 2006; Jennings and Johnson Gaither 2015; Wen et al. 2013). We also know that people living near parks and green space have less mental distress, are more physically active, and have extended life spans (USDA Forest Service 2018). When we reviewed community feedback, obvious patterns emerged, especially the community's concerns surrounding environmental health

and wellness — namely air pollution and mental health.

Studies show that poorer communities are at higher risk of exposure to air pollution and the effects of extreme heat (Huang et al. 2011). Trees and vegetation in parks can help reduce air pollution directly by removing pollutants and reducing air temperature, both of which contribute to smog (Nowak and Heiseler 2010). In 2010, in the United States alone, trees removed 17.4 million tons of air pollution, which prevented 850 human deaths and 670,000 cases of acute respiratory symptoms (Nowak et al. 2018).

Higher tree density in urban areas is also associated with decreased risk of depression (Astell-Burt et al. 2014). When people live more than 1 kilometer (0.6 mile) away from green space (or blue space, such as beaches), they report a 42 percent increase in stress levels (Stigsdotter et al. 2010). Every 1% increase in a city's useable or total green space results in a 4% lower rate of anxiety/mood disorder treatment (Nutsford et al. 2013). The data paints a clear picture: if communities are concerned with mental health and wellness, air pollution, and other environmental health concerns, they should enhance and preserve green spaces across cities and plant more trees — especially in areas where people live and work.

Because not all areas can support tree planting, the Partnership recommends targeting areas with lower canopy cover, greater potential for planting sites, and little current access to green spaces. Using this guide and the maps provided can help managers to better prioritize projects.

Canopy-Cover Analysis: Canopy Cover in Relation to Schools

A Michigan study found that, after controlling for student socioeconomic status and racial/ethnic makeup, building age, and size of school enrollment, views from school windows (namely, cafeteria and classroom windows) with greater quantities of shrub and tree cover were positively associated with higher standardized test scores, elevated graduation rates, and a higher percentage of students planning to attend a four-year college. These schools also had fewer incidences of criminal behavior (Matsuoka 2010). A 2016 study found that classrooms with views of green landscapes had significantly better performance on tests of attention (Li and Sullivan 2016). Because of studies like this, it is important to consider how SeaTac's schools compare in their access to trees (Figure 5). Remembering that SeaTac's overall canopy cover is at 25%, we analyzed the percent of canopy cover within a quarter mile of each school (the distance of a short walk or possible viewshed); see Appendix D for a map that illustrates the results.

Schools with 10%–20% canopy cover within a quarter mile:

- McMicken Heights Elementary School
- Bow Lake Elementary School
- Seattle Christian School
- Global Connections High School
- Chinook Middle School
- Tyee High School
- Academy of Citizenship and Empowerment
- Madrona Elementary School

Schools with 21%–30% canopy cover within a quarter mile:

- New Glacier Middle School site
- Valley View Early Learning Center

Schools with 40%–50% canopy cover within a quarter mile:

- Kent Mountain View Academy

With this information, SeaTac can be intentional about increasing canopy cover close to its schools. And because schools are also located in neighborhoods, the benefits of increasing canopy cover in these areas can have a double impact. Because schools connect to almost all of SeaTac's community groups, they should be prioritized for forest-canopy enhancement.

Canopy-Cover Analysis: Canopy Cover in Relation to Public Housing

In 2001, researchers studied 169 children who lived in identical public-housing buildings in a city with varying levels of nature nearby. In 2001, researchers studied 169 children who lived in identical, public housing buildings in an urban city with varying levels of nature nearby. They found that the more natural the view from the child's home, the higher the child scored on tests of concentration, impulse control, and delayed gratification. These researchers suggested that, "when housing managers and city officials cut budgets for landscaping

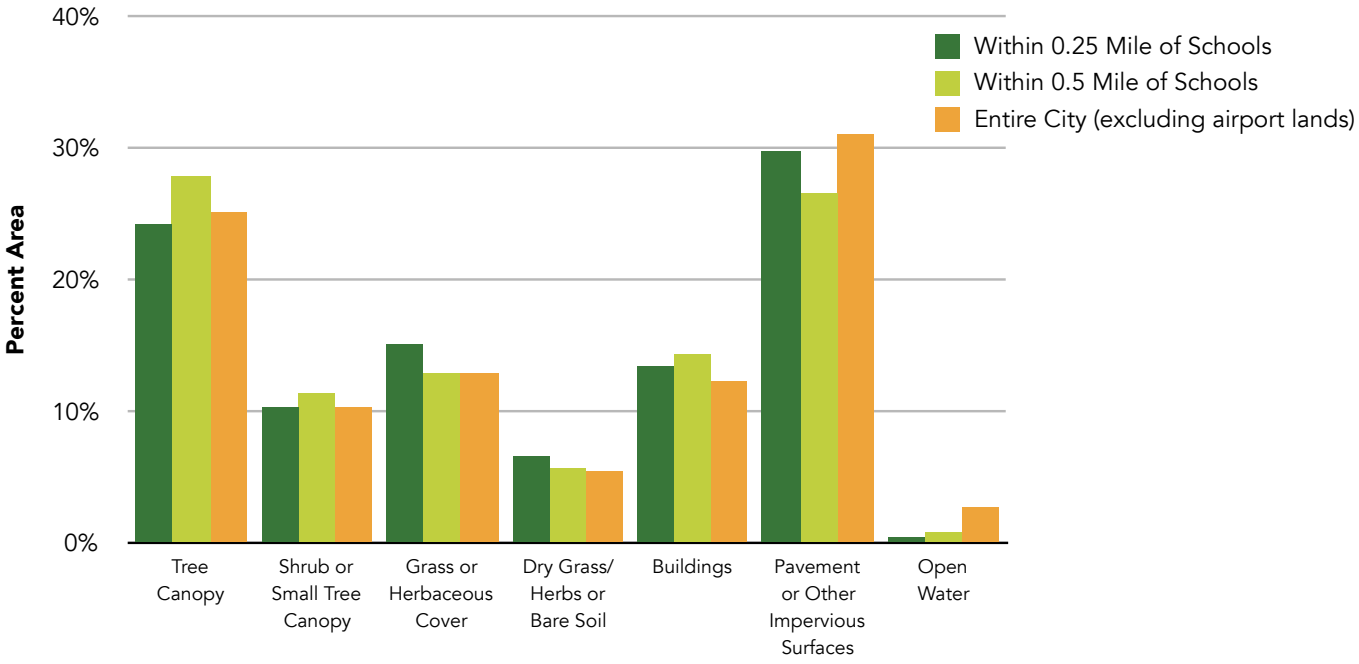


Figure 5: and cover in proximity to schools compared with citywide totals

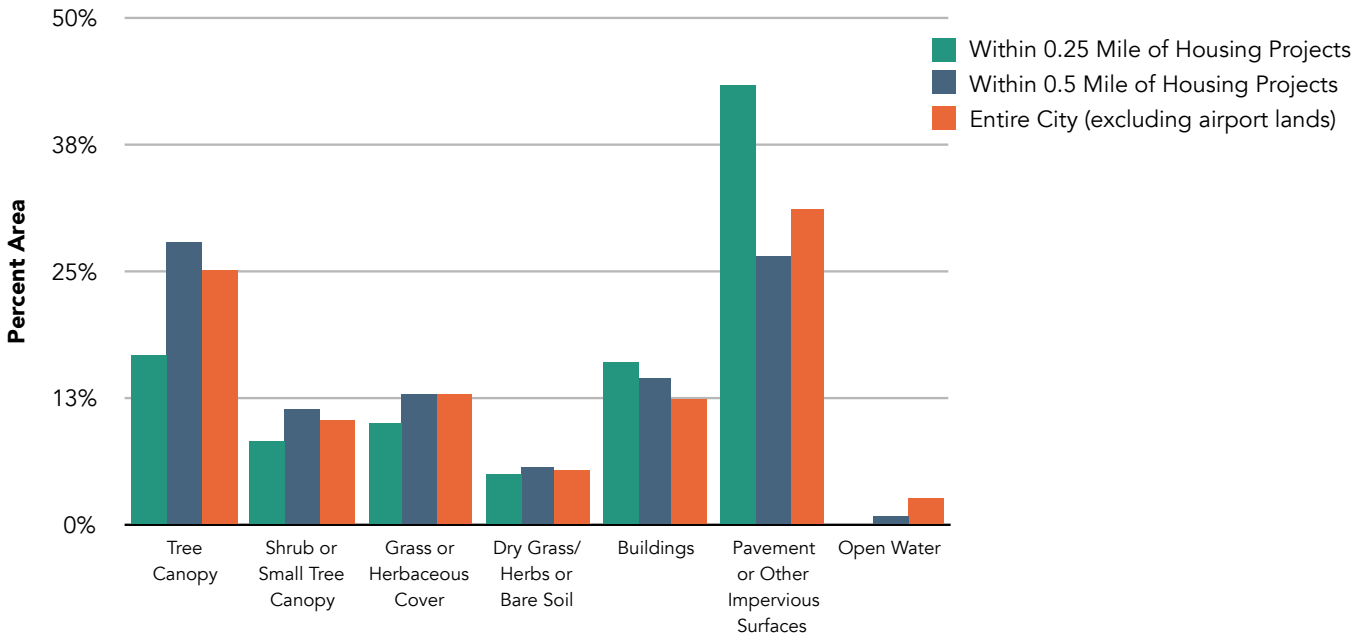


Figure 6: Land cover in proximity to public housing compared with citywide totals

Photo: Larisa Lumba

Figure 7: Illustration of canopy cover in a city neighborhood

[in cities], they deprive children of more than just an attractive view" (Faber Taylor et al. 2002and others, 2001). Of course, that means that the opposite is also true: managers and city officials who prioritize green space and planting around public-housing sites improve people's lives.

In 2017, a tree-canopy analysis at SeaTac's public-housing sites found that all sites could improve canopy cover, especially in comparison to citywide averages.

At 10%–15%, Corinthian and Windsor Heights have the least amount of canopy cover within a quarter mile of the site. Carriage House had 15%–20% canopy cover, which is also less than the city's average. Only Abbey Ridge had 20%–25% canopy cover within a quarter mile — closer to the citywide average. With all the evidence we have about how enhancing canopy cover greatly effects the lives of residents, it is recommended that the City of SeaTac engage with the Green SeaTac Partnership to prioritize increasing canopy cover in these areas.

5. MEETING THE CHALLENGE

This guide makes suggestions for how to meet the challenges and provide the benefits elaborated in the previous chapters. The mission of any project is the heart of its work, and this guide's mission is to offer SeaTac a path to:

- **Engage the community**
- **Enhance and maintain a healthy urban forest**
- **Increase quality of life**
- **Protect resources for all to enjoy**

Already, the City of SeaTac has committed staff time to learning about the Green Cities model and has suggested potential projects that would be appropriate to this guide. Through the Port's funding, Forterra has initiated the Partnership with SeaTac's Parks, Community Programs & Services Department; the Port of Seattle; and volunteers. We intend to engage Highline Public Schools, the Highline SeaTac Botanical Garden, other nonprofits besides Forterra, community and corporate sponsors, and the SeaTac community at large, including park users, private landowners, and local businesses.

The Green SeaTac Partnership's members share a vision of:

- A healthy, sustainable urban forest and an engaged community invested in our shared environment.
- This urban forest contains multi-aged canopies of trees, where invasive plants pose a low threat and, where appropriate, a diverse assemblage of plants provides a multitude of benefits to the ecosystem (as outlined in Table 1).
- This urban forest is distributed equitably throughout the city, rather than being concentrated solely in areas of prosperity, and is supported by both City staff and the community.

Current Green SeaTac Partnership Members

City of SeaTac

Parks, Community Programs & Services

The City of SeaTac's Parks, Community Programs & Services Department currently manages many of the sites within the Green SeaTac project area and helps promote stewardship of park land through volunteer action. Parks staff have already applied for funding that could help begin the restoration of some of the 186 acres of SeaTac's forested parkland. While the department is currently at capacity addressing its many duties, its staff will continue to promote additional Green SeaTac Partnership projects and events.

Port of Seattle

The Port of Seattle selected the Green City model as one way of giving back to an area impacted by its operations. Through the ACE Fund, it is investing in a small-grant program for projects and nonprofits doing community-based work in these three cities, as well as the initiation of the Green City Partnerships. The Port's community-engagement team will be participating in events, connecting the Partnership with its organizational contacts, overseeing the community-development aspects of the work, and acting as an advisor. The Port's commissioners and staff are invested in the success of all three ACE-funded Green City Partnerships and are committed to assisting the Partnership beyond simply funding the work.

Additionally, the Port has also completed a forest health assessment with American Forest Management of the urban forest located on airport property. Its team is committed to similar actions, including the restoration of forest on Port-owned lands.

Forterra

Forterra is the state's largest conservation and community-building organization working to create great communities and conserve great lands. Forterra's Green Cities Department supports all Green City Partnerships and works to keep all Partnerships connected through the Green Cities Network. The Green Cities Network facilitates quarterly focus groups that are open to all Partnership staff; distributes training, grant, and other announcements via the Network listserv; and offers technical and general assistance to participating Green City partner agencies.

Forterra will continue to work alongside partner agencies and the public to articulate and advance the goals of the Green SeaTac Partnership. Forterra will initiate the Partnership by creating a Forest Steward Program in

SeaTac and beginning to restore priority sites through volunteer events, including Green SeaTac Day, through the end of 2020 at least. It will also initiate education and engagement around increasing canopy cover in the city through tree distribution to private homeowners and landowners, community-based tree plantings, educational tree walks, and tree-care trainings. It will encourage community tree volunteerism throughout the program and conduct the initial community outreach and volunteer recruitment for all aspects of the Partnership. Forterra may also provide additional skilled field crews, program management, outreach, marketing, development, and greater coordination and connection to the regional Green Cities Network, if needed, through possible future grants or contract funding.

Volunteers and the Community at Large

Volunteers donate their time to the Partnership by helping restore and enhance SeaTac's urban forest, leveraging the financial resources of Green SeaTac partner agencies, and allowing more areas to be actively cared for. They bolster community interest and support for local parks and natural areas through their advocacy, and build critical local ownership of, and investment in, public spaces.

In the first two years, a key responsibility of Forterra will be to provide community members with training, site-planning assistance, support, and encouragement. Forterra or another nonprofit may be contracted to retain this role throughout the life of the Partnership or it couldbe made part of a City staff position.

Potential Sponsors

Corporate sponsors will have opportunities to support the Partnership with financial donations and beyond. Many businesses offer their employees opportunities to volunteer for various community projects. Corporations and local businesses will be invited to participate in volunteer restoration events, providing a substantial volunteer labor resource. Sponsors may also be asked to make other contributions as appropriate. For example, it is not uncommon for businesses to help defray expenses by donating event supplies, coffee and snacks, or services such as graphic design, advertising, or event planning as an in-kind donation to the Partnership. In return, these organizations receive the opportunity to engage with the community and contribute to a healthier, more livable urban environment.

6. ASSESSING THE URBAN FOREST

Effective and efficient natural-resource management can only be accomplished if planners, field staff, and decision makers have up-to-date environmental information on which to base actions. Empowered with clear, systematically collected data, managers will be able to understand on-the-ground conditions, identify the strategies and resources needed to accomplish the work, and identify priorities. With this in mind, Forterra employed two methods for assessing SeaTac's urban forest: its density throughout the City and its health.

Part I: Land-Cover Classification and Canopy-Cover Analysis

For the first time in the Green Cities Network, Forterra's GIS team teamed up with Core GIS, a small, local, woman-owned geospatial firm, to survey the forest canopy cover through a land-cover classification of the City of SeaTac. This provided us with a clear picture of land use in the entire city (see Figure 7). Forterra's GIS experts then developed maps and tools that can help encourage equity when increasing forest canopy in the city. As mentioned in Chapter 7, we also used community feedback and data from the land-cover classification to help inform our recommendations for future implementation projects.

Methods

The first step in performing a neighborhood canopy assessment was to map the extent of tree canopy and other land-cover types throughout SeaTac. This work was subcontracted to CORE GIS, which has considerable experience producing this sort of land-cover classification data. The CORE GIS team conducted these analyses using the same methodology in all three ACE Green Cities.

CORE GIS derived the data using guided classification techniques based primarily on four-band aerial imagery captured during the summer of 2017 by the USDA National Agricultural Imagery Program (NAIP) at a resolution of 1 meter. They stratified vegetated areas by height into three classes (tree, shrub, grass/herb), based on height information obtained from 2016 King County LiDAR data. The team further refined preliminary results through the use of vector data delineating building footprints and paved areas provided by each of the cities or digitized by hand as needed, along with 2015 King County impervious-surface data created using remote-sensing techniques.

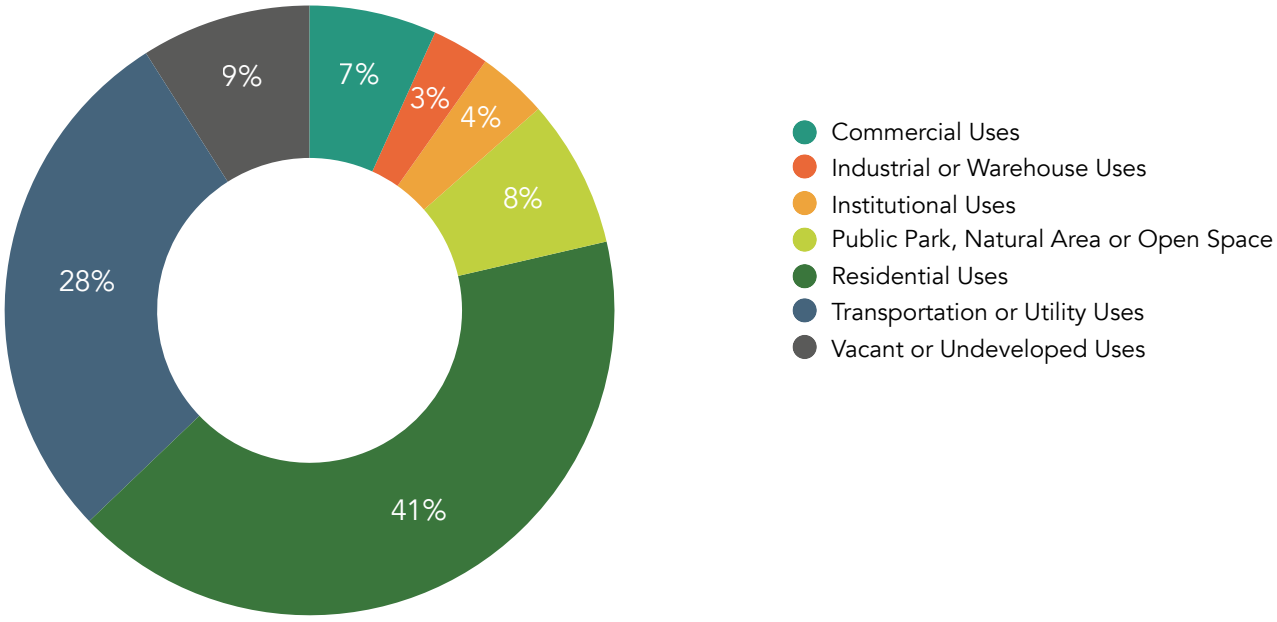
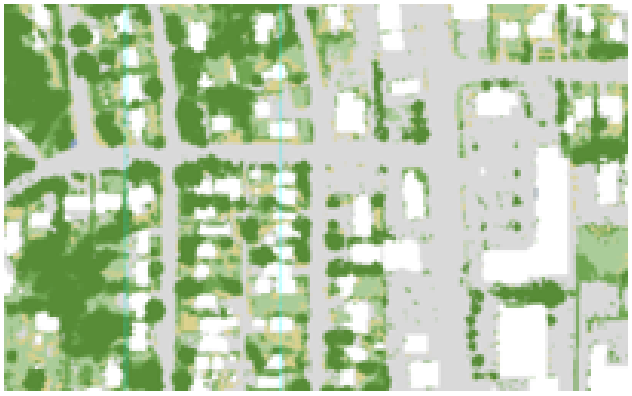


Figure 8: Land use in the City of SeaTac

The resulting spatial data set includes the following seven land-cover classes, visually portrayed below:

- Tree canopy
- Shrub or small-tree canopy
- Grass or herbaceous cover
- Dry grass/herbs or bare ground
- Buildings
- Pavement and other impervious surfaces
- Open-water areas



This 2017 land-cover-classification data set was rated at a 97% accuracy averaged across all seven classes, which lies well above the 85% level of accuracy that is widely held to be acceptable for land-cover data produced using this approach. The first application for this data was to calculate the distributions of all seven cover classes within SeaTac.

"Land use" refers to how land is used or managed by humans. Classification systems commonly adopted in the context of municipal planning and management tend to differentiate, at the most basic level, commercial, industrial, residential, governmental/institutional and undeveloped/vacant uses. For the purposes of this plan, we measured the following land-use classifications using the use-category codes defined by the Washington Department of Revenue:

- Commercial
- Industrial or warehouse
- Institutional
- Public park, natural area, or open space
- Recreational (private or commercial)
- Residential
- Transportation or utility
- Vacant or undeveloped

The Department of Revenue model as used by King County employs more than 125 different classes. This provides more detail than is practical for this plan's purposes, so we simplified by combining similar county present-use categories into this final list of eight, more general categories.

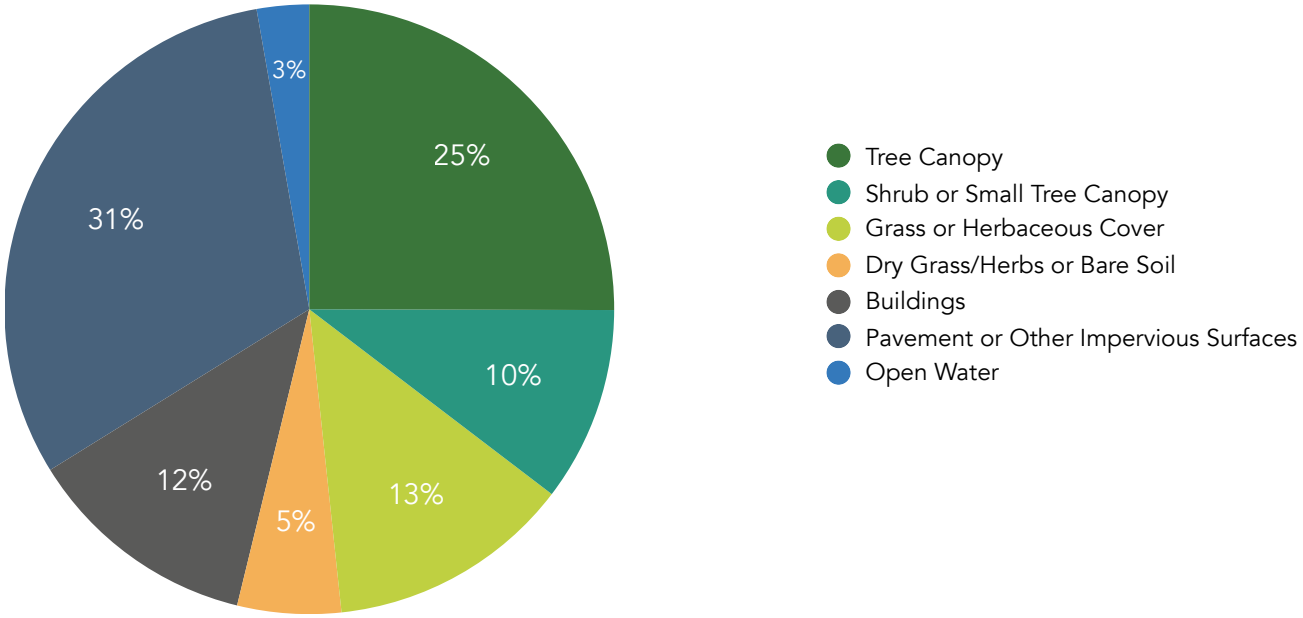


Figure 9: Land-cover distribution in the City of SeaTac

How Big Is 186 Acres?

At 186 acres, SeaTac's forested parklands, combined together, represent an area that is equivalent to 140 regulation American football fields, a little under the size of five Southcenter Malls, or roughly twice the size of North SeaTac Park.

Results

As a primary objective of this project, Forterra mapped and measured the distribution of tree canopy and other land-cover types across SeaTac to provide a general indication of urban forest health in each of these communities. In addition to citywide statistics on total and percent area, we calculated the distribution of land-cover types coincident with the following locations or landscape characteristics:

1. Existing land use
2. Social vulnerability (Appendix C)
3. Proximity to schools (Appendix D)
4. Proximity to public housing projects (Appendix E)

These statistics are intended to serve as indicators of a community's current access to the social and health benefits associated with tree canopy, as well as to identify potential stewardship activities and guide equitable and sustainable development.

Part II: Parks and Natural Areas Health Assessment

In addition to the previous analysis, Forterra conducted a forest health assessment to characterize habitat conditions across SeaTac's forested parks and natural areas, and develop its citywide restoration plan. Although this work will not meaningfully increase canopy cover, it will ensure that the present canopy cover in these areas is not lost. For the purposes of this plan, when looking at forest health, we assessed parks with large portions of forested area, as well as dense-forest and natural areas. Combined together, this land makes up 186 acres, roughly 3% of SeaTac's total land area.

Methods

The habitat assessment focused on the 186 acres of forested and natural area parkland owned and/or managed by the City of SeaTac and King County. The parcels included in the Partnership's scope are those that currently support, or have the potential to support, (1) native lowland-forest communities with tree-canopy cover greater than 25% and (2) forested and shrub-dominated wetlands or emergent wetlands that do not support a full tree canopy. While landscaped parks and street trees provide important ecological benefits and should be targeted for maintenance and tree planting where desired, they have not been included in this assessment, but are included in the Partnership's canopy assessment. Open water was also not included in the health assessment.

Tree-iage and the Forest Landscape Assessment Tool

Baseline ecological data was collected during the fall of 2017 using a rapid-assessment data-collection protocol called the Forest Landscape Assessment Tool (FLAT), developed by the Green Cities Research Alliance (https://

www.fs.usda.gov/pnw/tools/forest-landscape-assessment-tool-flat-rapid-assessment-land-management). FLAT is based on the "tree-iage" model, originally developed by the Green Seattle Partnership. Tree-iage is a prioritization tool, based on the concept of medical triage, that uses habitat composition (e.g., canopy cover or native plant cover) and invasive plant cover as the two parameters to prioritize restoration (Ciecko et al. 2016).

The FLAT adaptation builds on the existing framework of the tree-iage model to characterize additional habitat attributes beyond tree canopy and invasive plant cover. These include tree age and size class, native understory species present, and indicators of threats to forest health, including low tree-canopy vigor, root rot, mistletoe, and bare soils due to erosion. We also documented the presence of regenerating trees (canopy species less than 5 inches in diameter at breast height), which play an important role in the forest's long-term sustainability.

In addition, we deemed each stand "plantable" or "not plantable" based on whether site conditions were appropriate for tree-seedling establishment.

Rapid-assessment methodologies such as FLAT produce a snapshot of the overall condition at any one site and on a landscape or city scale. The data serves as a high-level baseline from which finer-scale, site-specific restoration planning can be conducted; site-by-site analysis will need to be done as work progresses to help ensure the most appropriate restoration practices and species composition are chosen for each site. Green SeaTac partners could continue to develop more-detailed site-level stewardship plans to further assess planting conditions and outline management recommendations as more park sites are prioritized for restoration activities.

Prior to field data collection, natural areas within the defined project area were classified through digital orthophoto interpretation, dividing each stand into one of

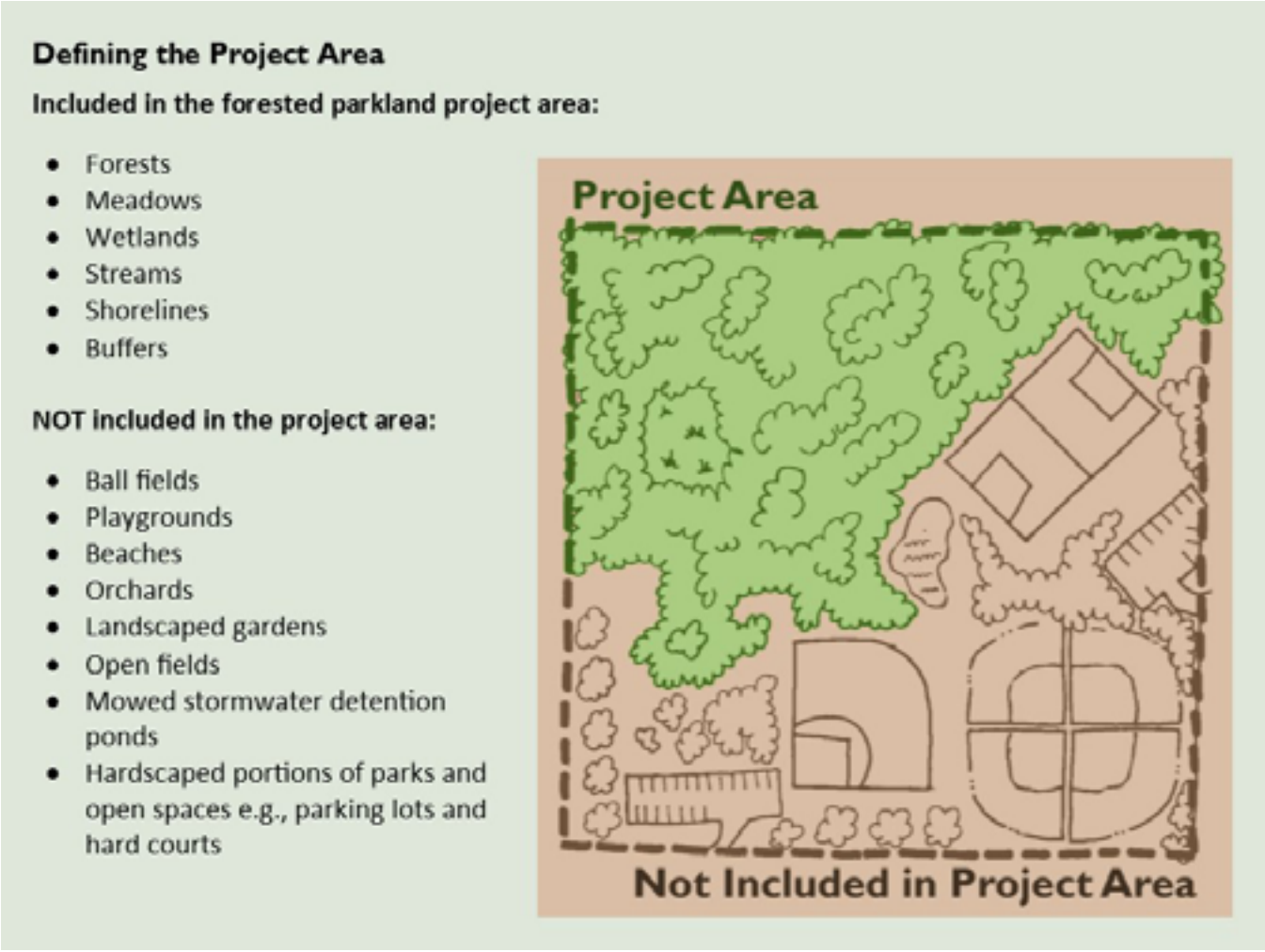


Figure 10: How the Green SeaTac Partnership project area was defined

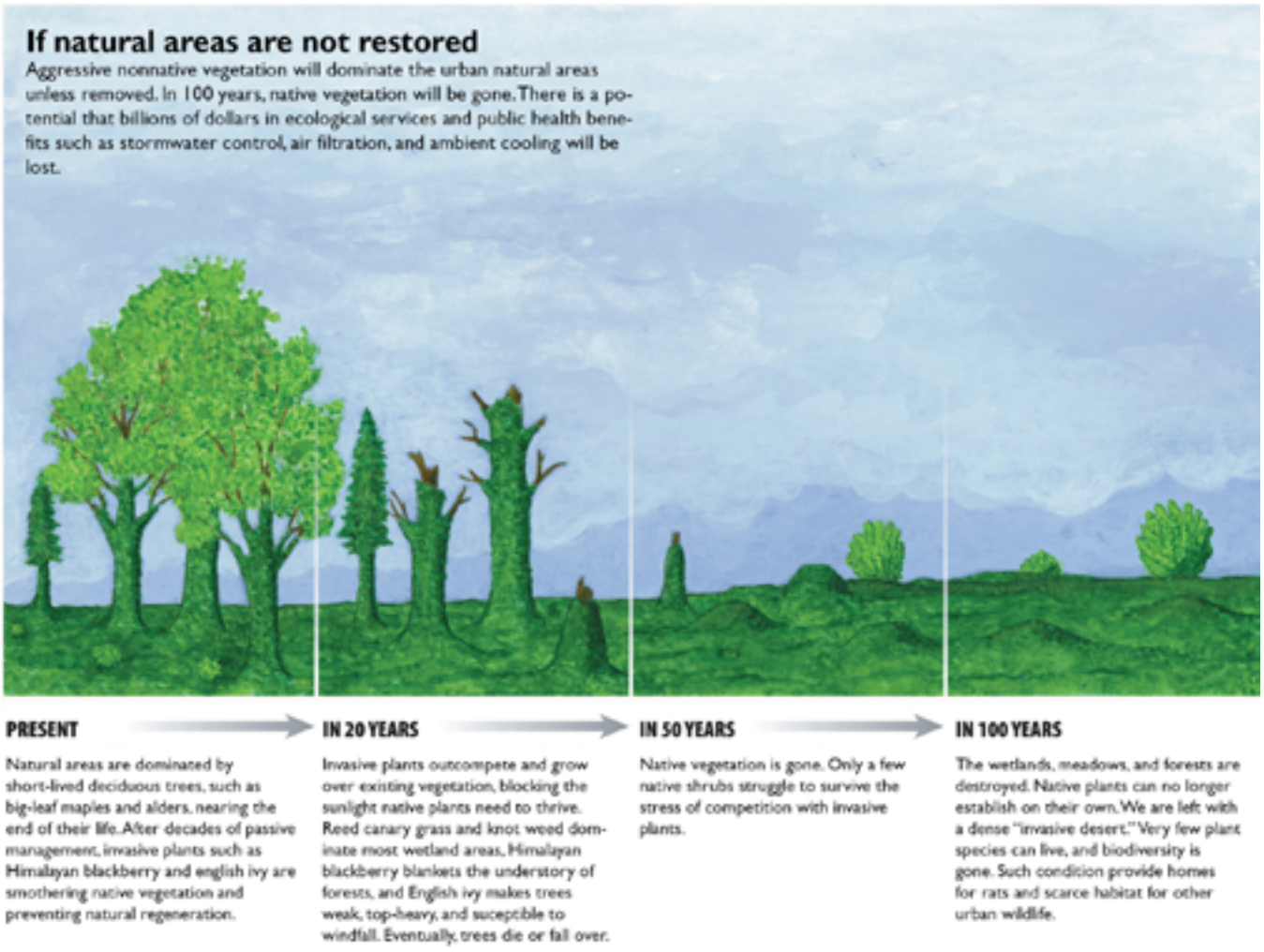


Figure 11: Illustration of the forest's potential if it is not restored

five categories: forested, natural, open water, hardscaped, or landscaped. These initial stand-type delineations were ground-verified in the field, and if necessary, the delineations were corrected, or the boundaries were adjusted in the GIS. The delineated stands are referred to as Management Units (MUs). All MUs were assigned unique numbers to be used for field verification and data tracking. Since hardscaped and landscaped areas are not suitable for active native-vegetation management, they were removed from the total acreage targeted by the Partnership.

In the field, we surveyed each MU to identify its specific habitat type (e.g., conifer forest, deciduous forest, riparian shrubland, etc.) and also to capture information on primary and secondary overstory species and size class, as well as primary and secondary understory species. (Primary refers to those species most abundant in the MU, and secondary refers to the second-most-abundant species.)

From this data, we assigned a value (high, medium, or low) to each MU for habitat composition, according to the following breakdown:

HIGH:

MUs with more than 25% native tree-canopy cover, in which evergreen species and/or madrones make up more than 50% of the total canopy.

OR, MUs with more than 25% native tree canopy in partially inundated wetlands that can support 1%–50% evergreen canopy.

OR, MUs in frequently inundated wetlands that cannot support evergreen/madrone canopy.

MEDIUM:

MUs with more than 25% native tree-canopy cover, in which evergreen species and/or madrones make up

between 1% and 50% of the total canopy.

OR, MUs with less than 25% native tree canopy in partially inundated wetlands that can support 1%–50% evergreen/madrone canopy.

LOW:

MUs with less than 25% native tree-canopy cover.

OR forests with more than 25% native tree canopy, in which evergreen species and/or madrones make up 0% of the total canopy.

In addition, each MU was assigned one of the following invasive-cover threat values:

HIGH:
MUs with more than 50% invasive species cover.

MEDIUM:
MUs with between 5% and 50% invasive species cover.

LOW:
MUs with less than 5% invasive species cover.

Tree-iage Categories

After we assigned habitat-composition and invasive-species-cover values, we used a matrix system to assign a tree-iage category or priority rating to each MU (see Table 2). Categories range from 1 to 9. One represents high-quality habitat and low invasive-species threat, and 9 represents low-quality habitat and high invasive-species threat. An MU that appears in tree-iage category 3 scored high for habitat value and high for invasive cover threat. MUs scoring low for habitat value and medium for invasive cover threat were assigned to category 8 based on the tree-iage model.

It is important to reiterate that we collected this data to provide a broad view of the habitat conditions of SeaTac's forested land and open space. Data collection occurred at the management-unit scale, but because MUs are different sizes (ranging from 0.02 acre to 9.14 acres), we present results here using average conditions associated with each MU. Small pockets within MUs may differ from the average across the stand. When the plan refers to specific data in a given area, the term "MU acre" will be used. Keeping in mind the purpose of the FLAT analysis, this assessment can help prioritize future restoration efforts. The data gathered could also serve as a baseline from which the effectiveness of restoration efforts and the long-term health of SeaTac's forests and natural areas can be assessed in the future.

Table 2 | Tree-iage Legend

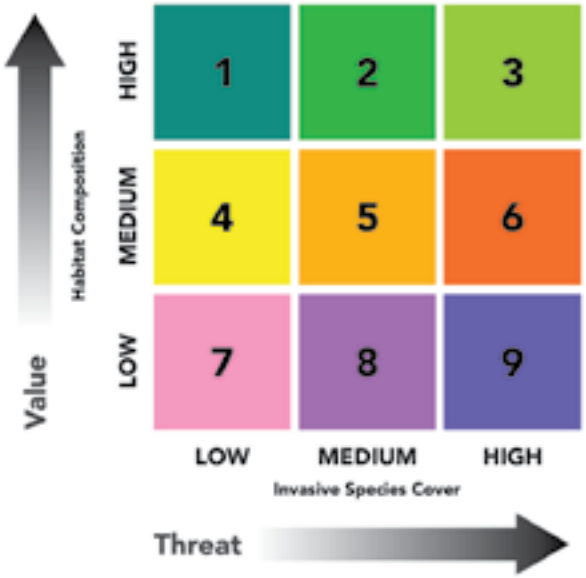
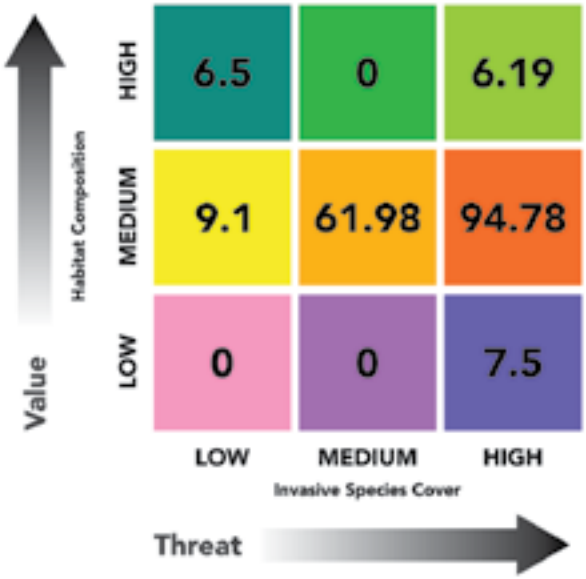


Table 3 | Distribution of Acres in Each Tree-iage Category



Results

Tree-iage Matrix

From the data gathered on all MUs during the FLAT assessment, a picture of SeaTac's forests and natural areas begins to form. Table 3 shows the distribution of acres in each tree-iage category. By summing the acres in each row and column, we can see how much of the total project area (186 acres) currently has low, medium, or high habitat value, and how much currently has low, medium, or high threat from invasive species. This data informs the cost model discussed in Chapter 7 and is used to develop high-level cost estimates for the Partnership to consider when planning in the future.

As seen in Table 3, 6.5 of the acres in the Green SeaTac Partnership project area are in exceptional condition (tree-iage category 1), with high-value habitat and low invasive-cover threat. Looking only at the first axis of the tree-iage matrix, habitat composition, categories 1, 2, and 3 combined represent 4% of the acreage . Of the acres surveyed, 92% have medium canopy composition (categories 4, 5, and 6). That leaves a little less than 4% of areas that are in the lowest condition, a 7, 8, or 9 on the tree-iage scale.

The second axis of the tree-iage matrix is the threat from invasive species, which is based on the percentage of the MU that is covered by invasive species. Of SeaTac's forested and natural area parklands, 58% have a high invasive species threat (categories 3, 6, and 9), a little over 33% of the project area falls in the medium category (categories 2, 5, and 8) for invasive species threat, and 8% of lands surveyed have low invasive species threat (categories 1, 4, and 7).

Overstory Species

The 2017 FLAT results show that SeaTac's forested parks and natural areas are dominated by older stands of primarily deciduous tree species, including red alder and black cottonwood; 84% of lands surveyed had an overstory that was dominated by deciduous trees. Red alder was the dominant overstory tree in more than half of the surveyed acres. This short-lived species, although a native, is characteristic of forest that grew back after logging. We recommended increasing conifer dominance by planting more native conifer seedlings because these trees are longer-lived and provide year-round shade, thus decreasing the ability for invasive species to grow. Bigleaf maple, Douglas-fir, and willow were documented as the other dominant overstory species (see Figure 12). In this figure, "primary" refers to acres where the species is dominant, "secondary" is second most dominant within a given MU, and "tertiary" is where the species is third most dominant within a given MU, measured in acres of each respective MU.

Regenerating Overstory Species

The top five regenerating tree species documented were bigleaf maple, Douglas-fir, red alder, western red cedar, and black cottonwood. Bigleaf maple was the most prevalent regenerating tree species in the Green SeaTac project area (see Figure 13). Regenerating trees are indicative of the sustainability and future of the forest canopy, as these trees serve as the next generation of dominant overstory in SeaTac's parks and natural areas. **About 8 acres of land had no regenerating species at all** — this is potentially due to the inability for natives to reseed because of pressures from invasive species and prior development.

Native Understory Species

SeaTac's forested parks and natural areas have a variety of native species in the understory, which contributes to the biodiversity of the urban forest and supports wildlife such as birds and pollinators. Many of these plants produce fruits and seeds that are food for larger animals. Osoberry, sword fern, and beaked hazelnut are the most common understory plants found in the surveyed sites (see Figure 14). **About 5 acres had no native species in the understory at all, and 33 acres had very low levels of native species.**

Invasive Species

Invasive species pose a very large threat to the understory in SeaTac's parks and natural areas, but with some intervention, they can be significantly reduced. Almost 60% of the acres in the project area were categorized as having a high level of invasive cover (more than 50%).

In each MU, the top five most abundant invasive species were documented. Figure 15 illustrates the top six shrub and ground species, as well as the top two invasive trees, across all MUs. Himalayan blackberry, English ivy, and English holly are the biggest threats. Out of 186 total acres in the project area, Himalayan blackberry was either the primary, secondary, or tertiary invasive species found in 92% of acres. English ivy was present on 68% of acres. English holly and English laurel were also common, with other invasive species found throughout the project area.

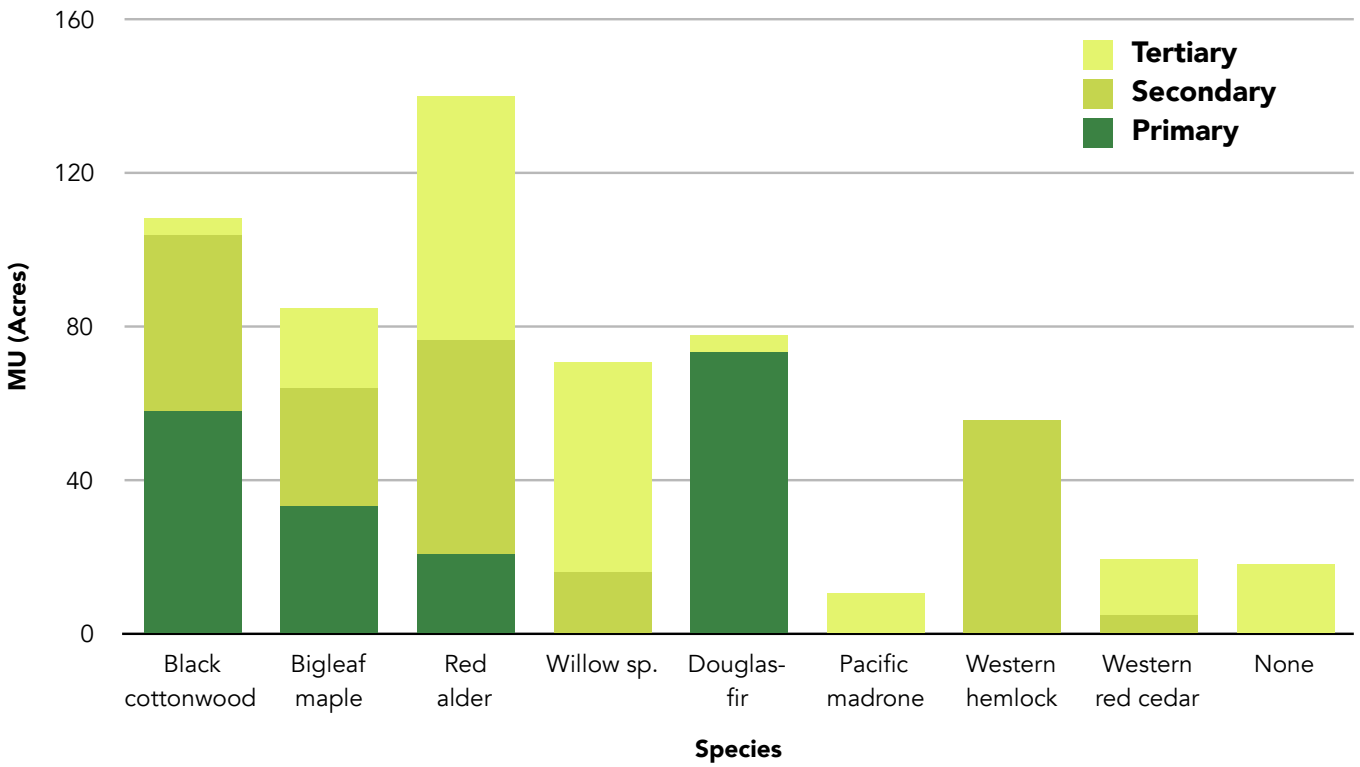


Figure 12: Overstory species distribution across MU acres

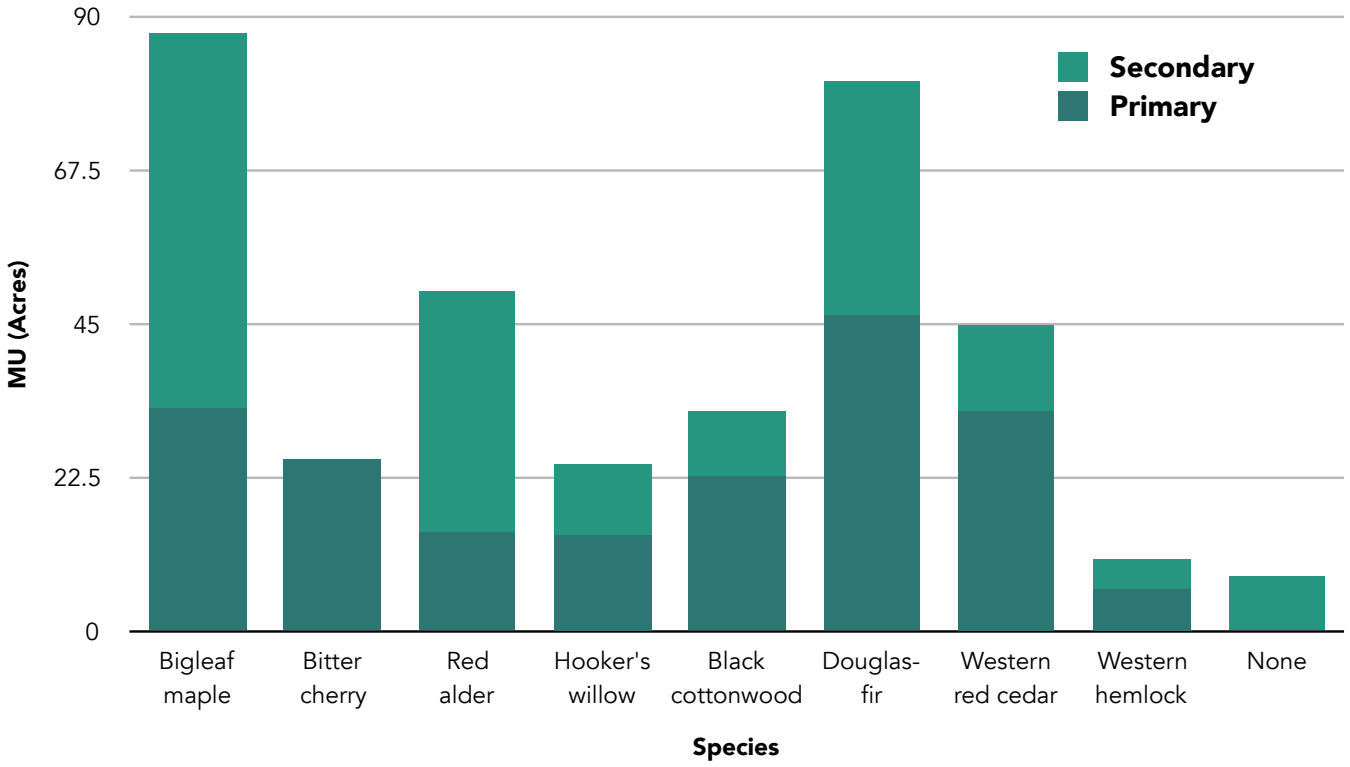


Figure 13: Distribution of the top regenerating overstory species by MU acres

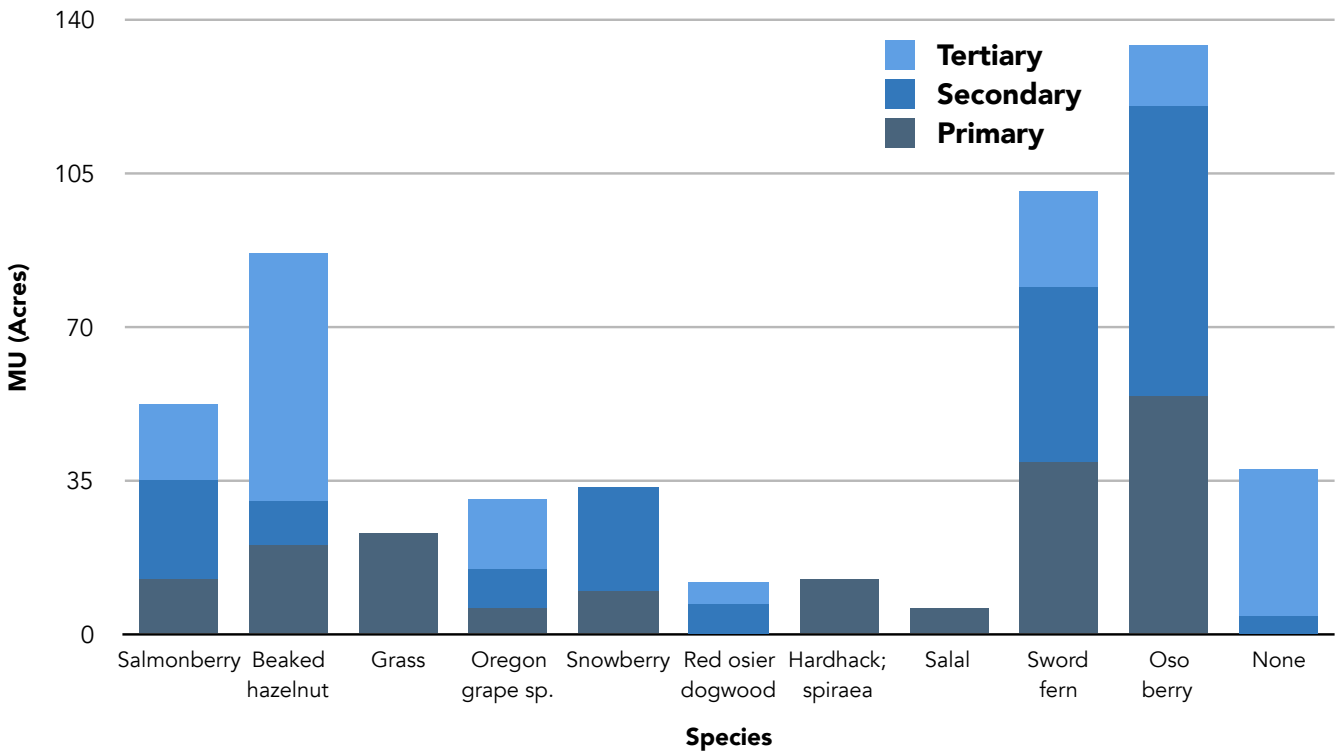


Figure 14: Distribution of the most common native understory species by MU acres

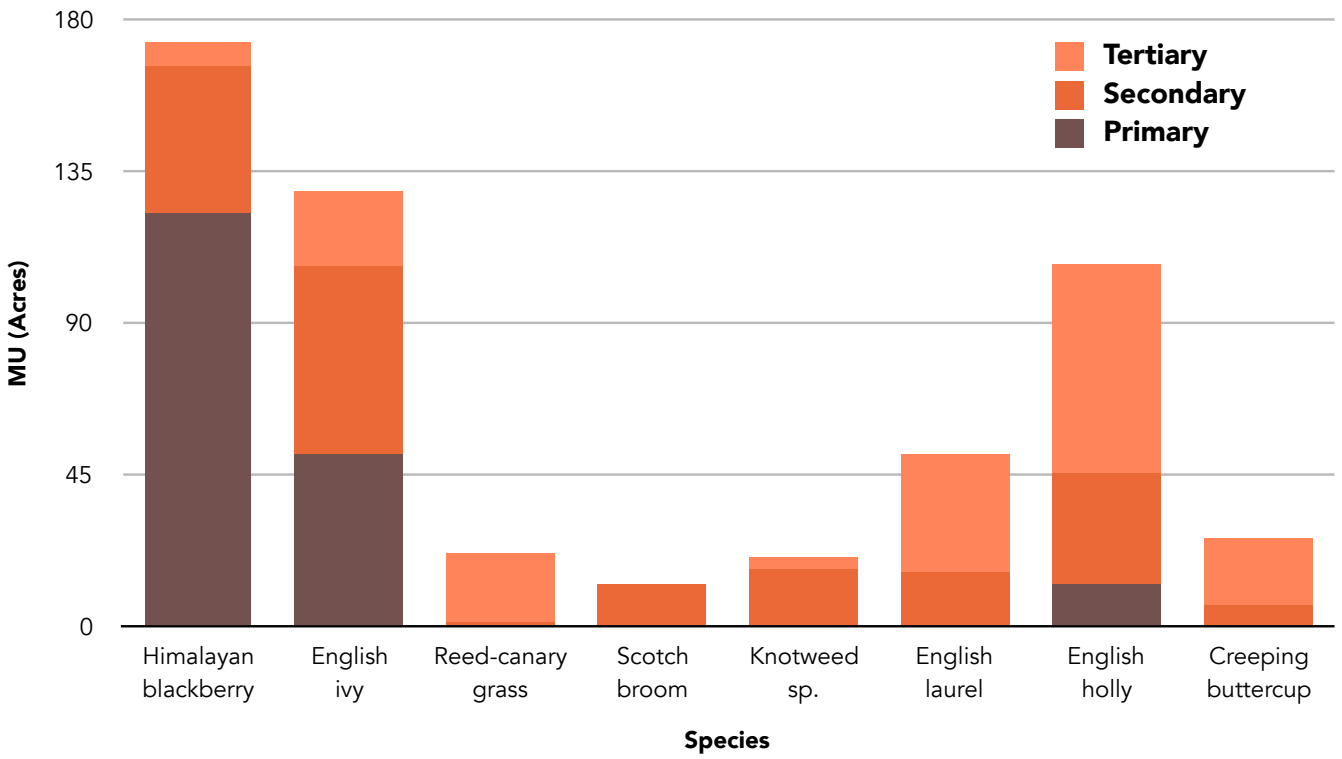


Figure 15: Distribution of the most common invasive species by MU acres

Slope

Slope is also an important consideration, as it greatly affects the difficulty of restoration activities. For safety reasons, volunteers can only work on relatively flat terrain, and even professional crews need special equipment for very steep work. As a general rule, work on slopes steeper than a 40% grade requires additional professional resources and increases the cost of restoration significantly. According to the findings of the FLAT analysis, only 5% of the Green SeaTac Partnership project area includes slopes steeper than 40%. Many of these areas have extensive infestations of English ivy that is already impacting the canopy. We suggest that these areas be considered when developing stewardship plans and that professional crews be employed in these areas. The cost model in Chapter 7 factors the need for this specialized experience in the cost of restoring these areas.

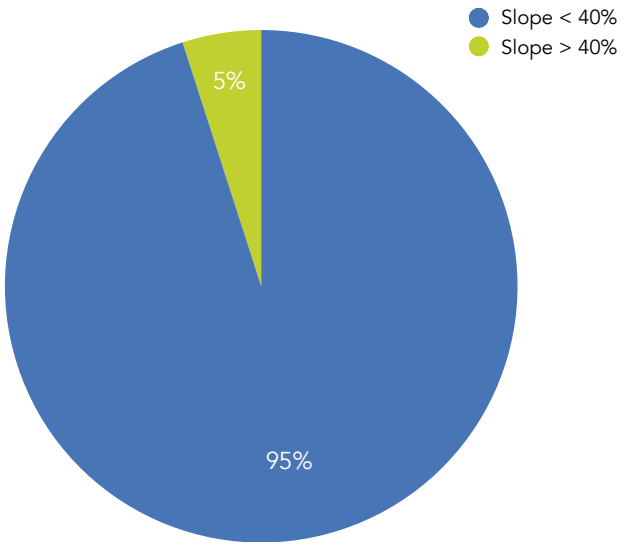


Figure 16: Slope of SeaTac's forested parkland

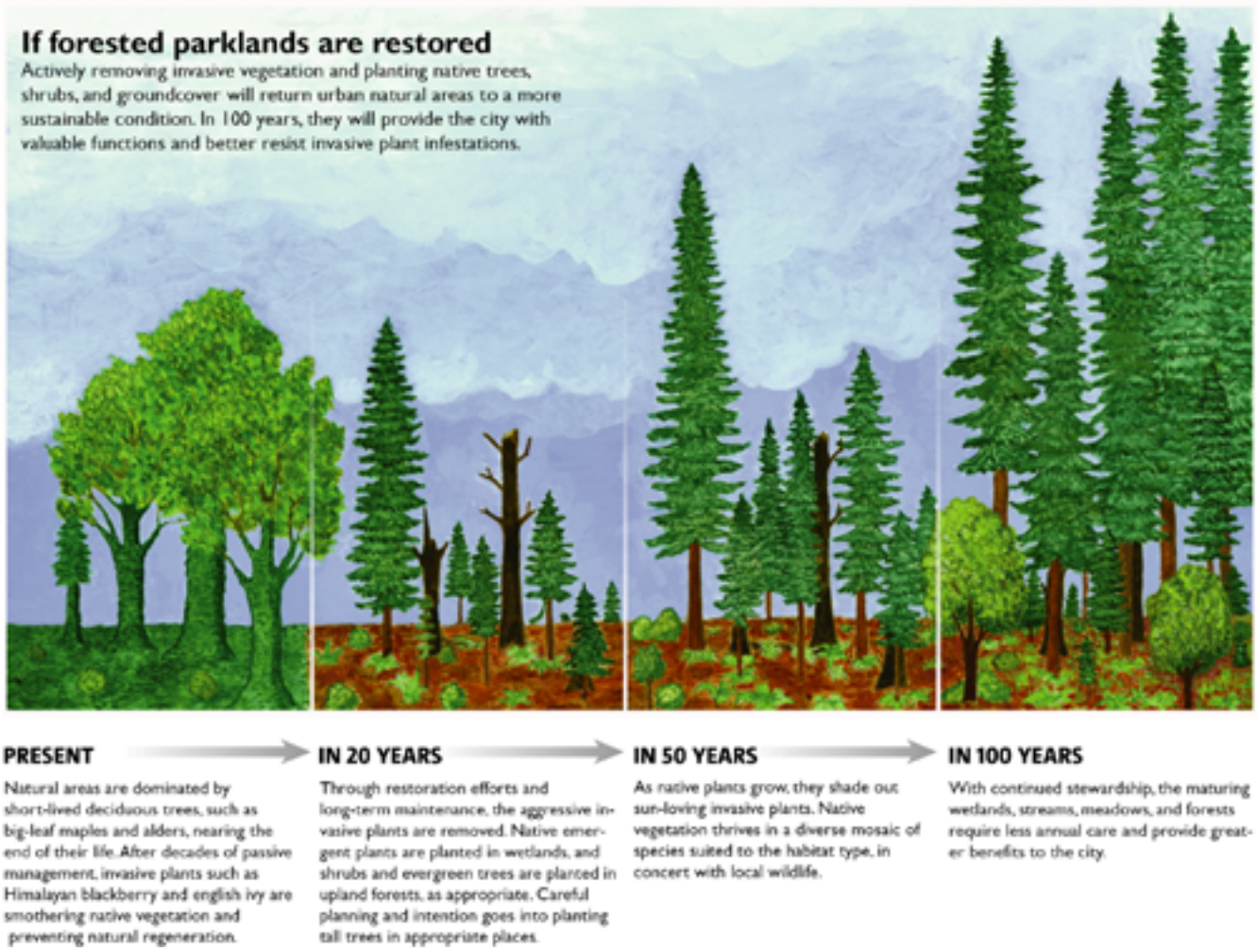


Figure 17: Illustration of the potential of restored forest

7. MOVING FORWARD

As in the other Green City Partnerships, a focus on field, resources, and community objectives is the key to moving forward and enhancing SeaTac's urban forest. Using a three-pronged approach the Green SeaTac Partnership can begin to restore SeaTac's forested parkland and increase canopy cover throughout the city.

The FIELD element looks at how on-the-ground strategies could be carried out to restore and promote SeaTac's urban forest.

The COMMUNITY element assesses how to maintain an engaged community and a prepared workforce in the long term, and how private landowners could be educated and encouraged to complement the Partnership's efforts.

The RESOURCES element examines how sufficient financial, staff, and volunteer resources could be garnered to implement the plan.

The three elements have reciprocal relationships. For example, volunteers are critical to accomplishing fieldwork, while demonstrating progress in fieldwork is essential to motivating and retaining volunteers. Similarly, community support is needed to secure the financial and volunteer resources to restore and monitor sites in the long term. By looking at the complete picture in layers that build on one another, it is possible to coordinate efforts across various work areas so that activities are interconnected and mutually supportive.

Field

Across SeaTac, the field component (Recommendations 1 and 2) would be to enhance the urban forest by increasing canopy cover through tree planting, tree giveaways, and tree-related trainings. Using the land-cover analysis and areas the community has identified as priorities for planting, we recommend centering equity when determining projects.

Active management of Green SeaTac Partnership sites in parks and other natural areas (Recommendations 3 to 6) would target removing invasive plants and establishing native vegetation in each site. The citywide habitat assessment of SeaTac's parks and natural areas would be used to assess progress in acres already enrolled in restoration, characterize baseline ecological site conditions of new acres, prioritize restoration efforts, and guide goal development.

Field Recommendation 1: Begin to equitably increase canopy cover.

In order to increase canopy cover, we recommend hosting community tree-planting events on public lands, such as libraries, schools, and community gardens. Watering, maintenance, and monitoring of these plantings should be considered before initiatives take place.

Through Port of Seattle funding, residents will be able to apply for and receive trees for their homes in the first year. Also, tree-related trainings and walks, outlined in the Community section, will empower people to care for trees across the entire city.

Field Recommendation 2: Monitor and maintain trees throughout the City of SeaTac.

All who work and reside in SeaTac can be a part of keeping their urban forest healthy. Landowners, privately owned schools, churches, and businesses can monitor their trees for signs of aging and disease. Instead of simply removing a mature tree, well-informed owners can monitor and care for their tree; with proper maintenance, such as pruning and watering, our mature trees can continue to give us the myriad ecological, social, and health benefits mentioned in Chapter 2. City policies can protect these trees in the long term by regulating how and when mature trees can be removed.

Field Recommendation 3: Prioritize parks and natural open-space sites.

Tree-iage analysis results show that there are 186 acres of forested parks and natural open spaces in SeaTac in need of various levels of restoration, maintenance, and long-term stewardship. Using this guide as comprehensive look across the city, it may be easier to coordinate projects at different sites into a single overarching effort.

Field Recommendation 4: Prioritize restoration work zones within sites.

The first priority should be supporting existing restoration projects, such as those at the Angle Lake Park Nature Trail or North SeaTac Park, to ensure that current restoration efforts continue moving forward. If they do not, these areas could revert to pre-work condition; "backsliding" is not only expensive, but also particularly discouraging to the public. The second priority we recommend is to expand sites already enrolled in

restoration by continuing to clear invasive species in areas contiguous with previously cleared sites.

As new sites are brought into restoration, the tree-iage model can be used within parks and sites with multiple MUs as a guide to anticipate needed restoration. For example, MUs with high-quality habitat and few to no invasive plants (tree-iage category 1) can immediately be given the protection of annual monitoring and maintenance. Other high-value habitats, including conifer-dominated forests or wetlands made up of a mosaic of native shrubs and emergent plants (tree-iage categories 2 and 3), will be considered high priorities for protection and restoration. Additional factors, such as public access and safety, and the presence of wetlands, streams, or shorelines should also be also taken into consideration. Providing maintenance for recently restored sites should be a priority as well.

Field Recommendation 5: Identify areas that are appropriate for professional crew intervention.

As noted above, not all restoration sites in the project area are suitable for volunteers; some require the use of professional, trained field staff. Sensitive areas such as steep slopes, wetlands, and riparian buffers require the expertise and training of such staff. In addition, some best management practices (BMPs) require the use of herbicides, such as cut-stump treatments for invasive trees such as English holly and cherry laurel, or stem injection for knotweed species that aggressively invade critical riparian habitat. Herbicide treatment must be conducted by a licensed professional staff member.

Many sites in the identified areas will require this level of expertise. With English holly being one of the most-present invasive species and English laurel following close behind, the use of crews will be essential to enrolling all acres in active management. Sites with slopes above a 40% grade are not appropriate for volunteers and should be restored by professional crews. Sites that have support available through the City or otherwise-funded crews should be given priority status for restoration, as well as sites where noxious weed control is mandated by and has support from the King County Noxious Weed Control Program (www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds/program-information.aspx).

Field Recommendation 6: Implement best practices in restoration and stewardship on all project sites.

Best Management Practices

Restoration ecology is an interdisciplinary science that draws from the fields of ecology, forestry, and landscape horticulture. As more restoration projects are completed in urban environments, field practices are refined and improved. Field experience and best available science will continue to be integrated to improve techniques and restoration success now and in the future. These BMPs include site planning, invasive control methods, planting and plant establishment, and volunteer management.

In 2012, the Green Seattle Partnership created a Forest Steward Field Guide of BMPs suitable for volunteer restoration work, which has since been updated by and adapted for other cities in the Green Cities Network. Through the Port funding, Forterra will create this field guide for SeaTac's volunteers and staff. Supplemental coursework and training programs are recommended for all staff involved in restoration and maintenance of SeaTac's forested parks and natural areas.

The Four-Phase Approach to Restoration Fieldwork

An important BMP, developed by the Green Seattle Partnership, is the four-phase approach to restoration fieldwork, which has been highly successful. It recognizes that restoration activities fall into four major phases, and that, at some sites, it takes several years to move through all the phases:

1. Invasive plant removal
2. Secondary invasive removal and planting
3. Plant establishment and follow-up maintenance
4. Long-term stewardship and monitoring

These activities should be tracked on work logs, and these work logs inform which phase each site is in. Because habitat health varies from site to site, and some work is ongoing, not every site will start at phase 1. Each site, however, will need to receive an on-the-ground assessment before work begins in the appropriate phase.

Phase 1; Invasive Plant Removal

The first phase aims to clear the site of invasive plants, focusing on small areas at a time in order to ensure thoroughness and minimize regrowth. Specific removal techniques will vary by species and habitat type, and it may take more than a year to complete the initial removal.

Major invasive-plant reduction will be required on sites

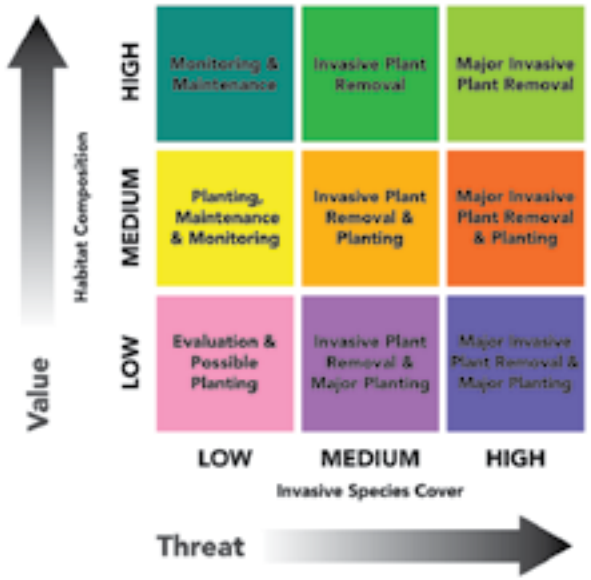
with 50% or greater invasive cover (high threat from invasive species: tree-iage categories 3, 6, and 9). Many of these areas will require skilled field crews or special equipment. Given the extent of invasive cover, these sites will also require a large investment of both funding and community volunteers to help ensure restoration success. Areas between 5% and 50% invasive cover (medium threat from invasive species: tree-iage categories 2, 5, and 8) will also require invasive removal. Invasive growth in these spots is patchy. Generally, projects in these sites are appropriate for community volunteers. Areas with 5% invasive cover or less (low threat from invasive species: tree-iage categories 1, 4, and 7) require little or no removal, and phase 1 work in these areas may simply involve walking through to check that any small invasive growth is caught before it becomes a larger problem.

Phase 2; Secondary Invasive Removal and Planting

Before planting, a second round of invasive removal is done to target any regrowth before it spreads, and to clear the site for young native plants to be established. Staff will work with each site on a case-by-case basis to develop an appropriate plant palette and work plan.

For example, forested habitats with more than 50% conifer canopy cover (tree-iage categories 1, 2, and 3) will require the least amount of planting but may need to be filled in with ground cover, shrubs, and small trees in the understory. Areas with more than 25% native tree cover

Table 4 | Restoration Strategies and Tree-iage Categories



but less than 50% conifer cover (tree-iage categories 4, 5, and 6) will generally be filled in with native conifer species. Areas with less than 25% native tree-canopy cover that can support tree canopy cover (tree-iage categories 7, 8, and 9) will require extensive planting with native trees, shrubs, and ground cover. Restoration practices and planting requirements will, of course, vary, depending on the habitat type and target native-plant population. Most phase 2 planting projects are appropriate for community volunteers.

Phase 3; Plant Establishment and Follow-up Maintenance

This phase repeats invasive plant removal and includes weeding, mulching, and watering newly planted native plants until they are established. Although native plants have adapted to the area's dry summer climate, installed container plantings and transplanted plants both experience shock, which affects root and shoot health; therefore, most plants require at least three years of establishment care to help ensure their survival. Sites may stay in phase 3 for many years.

Phase 4; Long-Term Stewardship and Monitoring

The final phase is long-term site stewardship, including monitoring by volunteers and professionals to provide information for ongoing site maintenance. Monitoring may be as simple as neighborhood volunteers patrolling park trails to find invasive species, or it could involve regular measuring and documentation of various site characteristics and plant survivorship rates. Maintenance will typically consist of spot removal of invasive regrowth and occasional planting where survivorship of existing plants is low. Individual volunteers or small quarterly or annual work parties can easily take care of any needs that come up, as long as they are addressed promptly before problems spread.

Without ongoing, long-term volunteer investment in monitoring and maintenance of areas in restoration, SeaTac's natural areas will fall back into an unhealthy state. For that reason, volunteer commitment needs to be paired with resources. Work is then compared against the best available science to define optimal plant stock and sizes, watering regimes, soil preparation, and other natural open-space restoration techniques.

In 2012, the Green Cities program developed a Regional Standardized Monitoring Program in order to understand the success, value, and effectiveness of restoration activities throughout the Partnerships. These protocols

provide procedures for baseline and long-term data collection that can be replicated in the future to measure changes in site characteristics. The data shows the composition and structure of a site, which can be an important indicator of overall habitat health.

Application to the Tree-iage Categories

The four-phase approach can be applied to the tree-iage categories as shown in Table 4. Each tree-iage category can be assigned appropriate management strategies.

TREE-IAGE CATEGORY 1:

High Habitat Composition, Low Invasive Threat
Acres in project area: 6.5

- Angle Lake Park
- Grandview Park

Condition

This category contains the healthiest forest areas in SeaTac's system of natural open spaces. Typical stands have more than 50% evergreen canopy. This category includes stands of mature conifers and the mixed conifer/deciduous stands found in forested wetlands. In scrub-shrub or emergent wetland areas, where full conifer coverage would not be appropriate, this category has full cover by native vegetation appropriate to the site. These stands are under low threat because the invasive cover is less than 5%.

Management Strategy: Monitoring and Maintenance

Work is focused on protecting these areas' existing high quality and making sure that invasive plants do not establish themselves.

TREE-IAGE CATEGORY 2:

High Habitat Composition, Medium Invasive Threat
Acres in project area: 0

Condition

Similar to category 1, these forest stands contain more than 50% conifer or evergreen broadleaf canopy or appropriate native wetland vegetation. Forests in this category are at risk because the invasive cover is between 5% and 50%. In these areas, invasive growth is expected to be patchy with diffuse edges.

A forest in otherwise good condition but subject to a number of moderate threats may degrade if left untreated. If unattended, this level of invasive coverage could prevent native seedlings from establishing and could compete with existing trees for water and nutrients. However, the forest would persist in good condition if threats were mitigated in a timely manner.

Management Strategy: Invasive-Plant Removal and Prompt Action

The main activity is removing invasive plants. Typically, these sites will also require site preparation (e.g., mulching) and infill planting. Projects in these areas are appropriate for volunteers. Removing invasive plants from these areas is a very high priority for the first five years.

TREE-IAGE CATEGORY 3:

High Habitat Composition, High Invasive Threat
Acres in project area: 6.19

- Des Moines Creek Park

Condition

As in categories 1 and 2, forest stands in this category have mature conifers, madrones, forested wetlands, or wetland vegetation where appropriate. Category 3 areas have a high threat from greater than 50% invasive cover.

A forest in this category is in a high-risk situation and contains many desirable trees or highly valuable habitat or species. If restored, forests in this category can completely recover and persist in the long term.

Management Strategy: Major Invasive-Plant Removal and Prompt Action

Without prompt action, high-quality forest stands could be lost. Category 3 areas require aggressive invasive removal. Soil amendments and replanting are needed in most cases. Restoration efforts in this category are a top priority for the first five years.

TREE-IAGE CATEGORY 4:

Medium Habitat Composition, Low Invasive Threat
Acres in project area: 9.1

- Des Moines Creek Park
- Grandview Park

Condition

Forests assigned a medium tree-composition value are typically dominated by native deciduous trees but have at least 25% native tree cover. Between 1% and 50% of the canopy is made up of native conifers. In wetland areas not suitable for conifers, these areas have between 1% and 50% cover by appropriate wetland vegetation. Category 4 areas have low levels of invasive plants, covering less than 5% of the MU.

Management Strategy: Planting and Monitoring

We expect planting in these areas to consist of infilling with native species and establishing conifers to be recruited into the next generation of canopy. Often these sites require some invasive removal and site preparation (e.g., amending with woodchip mulch). Many of these sites may be converted to a conifer forest by the addition of appropriate conifer trees.

These sites offer a high likelihood of success at a minimum investment and are well suited to community-led restoration efforts.

TREE-IAGE CATEGORY 5:

Medium Habitat Composition, Medium Invasive Threat
Acres in project area: 61.98

- Des Moines Creek Park
- Bow Lake Wetland
- Grandview Park
- North SeaTac Park

Condition

Areas in this category have between 5% and 50% invasive cover. Invasive growth is expected to be patchy with diffuse edges. These areas are estimated to have greater than 25% native canopy cover but less than 50% coniferous or broadleaf evergreen canopy cover. In the case of wetland forests, it is greater than 50% native tree canopy cover. In wetland areas not suitable for conifers, these areas have between 1% and 50% cover by appropriate wetland species. These forest stands contain many desirable native trees that are under threat from invasive plants.

Management Strategy: Invasive-Plant Removal and Planting

These sites will require invasive removal and infill planting.

TREE-IAGE CATEGORY 6:

Medium Habitat Composition, High Invasive Threat
Acres in project area: 94.78

- Bow Lake Park
- Grandview Park
- Site 101
- Des Moines Creek Park
- Sunset Park
- North SeaTac Park

Condition

These areas are typically dominated by native deciduous trees but have at least 25% native tree cover. Between 1% and 50% of the canopy is made up of native conifers. In wetland areas not suitable for conifers, these areas have between 1% and 50% cover by appropriate wetland vegetation. Invasive plants cover more than 50% of the MU.

A forest that retains important plant elements but is already partially degraded by a high-level risk factor may still have the potential to recover if remediation is prompt. Because these stands are at greater risk than category 5 forests, they also require greater labor investment.

Management Strategy: Major Invasive-Plant Removal and Planting

Extensive invasive removal, site preparation (e.g., amending with woodchip mulch), and replanting with native plants are required. Initial invasive removal may be done with the aid of mechanical tools and equipment, and may require professionals. Planting in these areas consists of infilling with native species.

TREE-IAGE CATEGORY 7:

Low Habitat Composition, Low Invasive Threat
Acres in project area: 0

Condition

These forests are estimated to have less than 25% native canopy cover in a setting that could support full canopy cover under good conditions. Forested wetlands will have less than 25% trees or shrubs appropriate to the site. Levels of invasive plants are low. Parks in this category may include areas with large canopy gaps (perhaps due to windthrow or die-off of mature deciduous trees), sites of recent landslides, unstable slopes, sites with large amounts of fill, and/or areas dominated by nonnative trees.

Management Strategy: Evaluation and Possible Planting

The reasons underlying these sites' low value can differ greatly, and the stands will be addressed on a case-by-case basis. Because of low levels of invasive plants, restoration may be quite cost-effective in some sites. Sites will be evaluated to determine whether conditions and timing are appropriate to move these areas toward a more native forest and what the appropriate composition of that forest should be. In some cases, it may be desirable to remove nonnative trees, especially if they are aggressive. Areas that are ready for conversion to native forest would be a high priority during the first five years.

TREE-IAGE CATEGORY 8:
Low Habitat Composition, Medium Invasive Threat
Acres in project area: 0

Condition

Areas that are estimated to have less than 25% native tree-canopy cover or forested wetlands with less than 25% cover by trees, and 5% to 50% invasive cover fall into this category. Invasive growth in these areas is likely to be patchy with diffuse edges. A forest in this category might be chronically degraded by a variety of threatening processes and might have lost much of its value in terms of habitat quality or species complement.

Management Strategy: Invasive-Plant Removal and Major Planting

Restoration efforts in these areas require a large investment of time and resources. Although some work will be directed here, this is not a priority category for the first five years. These sites will require major invasive removal and site preparation, such as mulching and infill planting. Planting within these areas will consist of infilling with native species.

TREE-IAGE CATEGORY 9:
Low Habitat Composition, High Invasive Threat
Acres in project area: 7.5

- Grandview Park
- Robert Morris Earthwork
- Des Moines Creek Park
- Sunset Park

Condition

Areas estimated to have less than 25% native tree-canopy cover or appropriate forested wetland vegetation and greater than 50% invasive cover fall into this category.

Management Strategy: Major Invasive-Plant Removal and Major Planting

Category 9 sites are not likely to get much worse during the next five years. These sites require many years of major invasive removal and site preparation in the form of mulching and infill planting, and will almost definitely require the attention of professionals.

Community

Community Recommendation 1: Promote community awareness about, and engagement with, trees in neighborhoods and public spaces.

Through social media, a Partnership website, large community celebrations, community work parties, tree plantings, trainings, and educational walks, the first year of programming will help create excitement about, and advocacy around, our shared urban forest. Based on the community feedback we received, many initiatives and messages should focus on the positive community health aspects of the work, especially cleaner air and water. The community also expressed a desire for more food trees planted through the Partnership's effort, and careful planning should occur to prioritize safe and accessible locations for these trees.

A tree-disbursement initiative will create an opportunity for residents to deeply engage with trees. Applicants can be matched with a species of tree that best fits their living arrangements, including size options, pipe- or power-line-safe options, and even patio-safe options. Efforts to extend the tree disbursement for those who rent should include assistance with gaining permission from landlords or a commitment from apartment managers to allow for the planting of trees at their homes.

Through work parties and other volunteer events, participants can assist in enhancing the urban forest by planting new trees and restoring and monitoring project sites in parks. Each event should include a warm welcome; training on the tasks to be accomplished that day; something warm or cool to drink, depending on the weather; a chance to get to know other volunteers; and an invitation to have some fun. Whenever possible, barriers to participation should be addressed, such as making the

event child-friendly, having an interpreter at larger events, planning a variety of tasks that accommodate many ability levels, encouraging rest and hydration, and providing meals, or, at the very least, snacks. For tree-related walks and trainings, providing verbal explanations in addition to printed materials can create a more inclusive event. These practices will be utilized in the first year of program and should be continued for any future projects.

It is vital that participants are made to feel welcome in all aspects of the work. Providing opportunities for diverse community members to connect around a cup of coffee or a newly planted western red cedar are foundational to success. Because this work will take place on public land, it is important to ensure events are inclusive and welcoming to all. By working together, the residents of SeaTac can help prevent the loss of precious resources. With an active and engaged community, SeaTac will not only be "greener" — it will be a better city for everyone who lives and works there.

Community Recommendation 2: Use Partnership efforts to prioritize and contribute to SeaTac's public safety.

Safety should be a key priority. Active maintenance and regular community events promote more active use of public spaces. As both volunteers and staff frequent a site, care and stewardship become evident and decrease the sentiment that parks are forgotten, abandoned places; as well, providing more "eyes" on the park discourages illegal activity. Volunteers should be provided with training and tools for how to avoid dangerous situations and how best to protect themselves (e.g., from discarded needles), when necessary.

Information on Crime Prevention Through Environmental Design (CPTED), a set of landscape-design principles aimed at increasing safety, could be offered to city staff. From relatively straightforward trail-planning and maintenance best practices to optimize safe view corridors to complex challenges for activating spaces, these principles will provide valuable insights.

Community Recommendation 3: Develop and implement a community outreach and engagement plan to equitably serve SeaTac's diverse residential population.

SeaTac's population is incredibly racially and ethnically diverse. Creating programs that are culturally relevant, accessible, and enjoyable for the many people who call SeaTac home is essential to serving this community.

There are existing programs that have already had success in engaging SeaTac's recent immigrant and refugee community, and it would be a great asset to collaborate with them on stewardship efforts. Green SeaTac staff should work with these programs to create events and experiences that traditionally underrepresented residents can relate to and enjoy. In speaking with experts and community members, we recommend that the Partnership begin to engage new residents by providing information about parks and green spaces, including a warm welcome to use these places. Initial tree engagement could include information about the benefits of trees, including their importance for public health.

Community Recommendation 4: Work with local businesses to encourage corporate support.

Corporate support could come in the form of encouraging employees to volunteer, providing in-kind resources, or lending financial support through grants and donations to the Partnership and its events. Green SeaTac events could, in turn, support city businesses and promote the businesses who support projects and events.

Community Recommendation 5: Seek opportunities to engage youth and provide education.

Studies have shown that students' productivity and creativity is increased by experiencing natural surroundings, due to nature's calming effect and its ability to reduce mental fatigue (Kaplan 1995; Hartig et al. 1991). By working with local partners to provide engagement opportunities for youth of all ages, it is possible to create a pathway of engagement from elementary school through high school, and job-skills training for the post-high school years. The Student Conservation Association and US Youth Conservation Corps summer crews are a great opportunity for paid summer work and restoration-skills training for high school-age students. EarthCorps and DIRT Corps are local training crews for young people, who can make a living while contributing to projects that improve local environmental health. All these programs are currently available to SeaTac youth. It is possible to pursue funding opportunities that would provide support for efforts and additional opportunities for youth and families to volunteer together in their local parks and green spaces, further improving their access to safe and healthy outdoor public places.

Community Recommendation 6: Support a Steward Program to promote and support community leadership.

We recommend building upon the existing Green SeaTac Steward Program so that there is an educated, engaged, and active volunteer base around management, monitoring, and stewardship of SeaTac's urban forest. The program should provide volunteers with an opportunity to take on leadership responsibilities, expand their skill set, tackle larger challenges associated with restoration and maintenance, and receive support and guidance to complete projects that improve the health of public spaces they care about.

Trained Stewards will work with the Partnership in the first year in the following ways:

- Attend training events, including a program orientation and more skill-specific training as resources allow.
- Organize and lead volunteer events and activities with support from Forterra staff.
- Coordinate with City staff to develop site-restoration plans.
- Request tools, materials, and assistance as needed.
- Track and report progress on activities via a work log.

We recommend that SeaTac seek to continue this program either through a City-run initiative or contracting with a consultant to lease this work. The program could be supported in the future with grants and other funding, and these volunteers could be relied upon to assist City staff with work plans. Seeking funding to continue this program would be beneficial, especially to Parks staff. These volunteers could also help with community tree plantings and other related projects.

Community Recommendation 7: Appreciate volunteers and publicly celebrate Partnership successes.

It is vital to celebrate volunteers' achievements and emphasize the crucial role they play in restoring and maintaining SeaTac's urban forest. We recommend hosting volunteer-appreciation activities, such as an annual celebration for Green SeaTac Stewards and volunteer appreciation at community planting events.

Community Recommendation 8: Engage and educate residents and private landowners.

While stewardship of public forest and natural areas is an important step toward protecting wildlife habitat, improving air and water quality, and providing public recreational opportunities, private properties cover a greater portion of SeaTac's land area. Plantings on private lands can either greatly enhance or greatly degrade the condition of the city's urban forest despite best efforts to restore, maintain, and steward it.

Alternatively, landowners can be a great resource for their neighborhood parkland by engaging their neighbors, schools, community groups, clubs, and businesses to help support the Partnership's efforts. Private land can also be a main source for enhancing tree canopy and expanding current forest canopy and habitat. Privately owned forest and natural areas in good health, such as at homes, schools, and churches, can serve as important buffers to adjacent public lands and help mitigate habitat fragmentation and edge effects.

Resources

Estimating Program Costs

In 2005, the Green Seattle Partnership estimated the costs of restoring 2,500 acres of forested parkland for a 20-year period. It relied on estimates of past costs for removing invasive species, replanting, and ongoing maintenance, as well as staff needs and costs associated with additional fieldwork, materials, planning, program design and management, funding development, outreach and marketing, and field and office overhead. For this guide, we used a cost model adapted from the Green Seattle Partnership's original estimates (inflated to 2019 dollars), adjusted to reflect the experience of the other Green Cities. Given that SeaTac's park system is much smaller than Seattle's, the Green SeaTac Partnership will require lower overall field costs, fewer staff, and lower overhead than the Green Seattle Partnership. For this plan, all cost estimates and leverage volunteer values are listed in 2019 dollars.

We used a cost model that enrolls a percentage of acres from each tree-iage category every year over 20 years, as this is the standard in other Green Cities. To explain that cost, the average cost per acre going through the four phases of restoration and ongoing maintenance can be calculated (see Table 5). For the Green SeaTac

Table 5 | Estimated Cost of Restoration per Tree-iage Category

Tree-iage Category	Acreage	Average Restoration Cost/Acre	Total Cost per Tree-iage Category
1	6.50	$13,600	$88,400.00
2	0.00	$0	-
3	6.19	$31,700	$196,223.00
4	9.10	$20,800	$189,280.00
5	61.98	$26,800	$1,661,064.00
6	94.78	$39,100	$3,705,898.00
7	0.00	$0	-
8	0.00	$0	-
9	7.50	$49,500	$371,250.00
Total	**186.05**		**$6,212,115.00**

Partnership, the model estimates that enrolling all 186 acres in active management will cost from $13,600 per acre for tree-iage category 1 acres to $49,500 per acre for tree-iage category 9 acres. This estimate includes projected program and administrative staff, plus field supplies and support, with a built-in 15% overhead on field expenses and 7% overhead on staff time. These costs per tree-iage category are specific for SeaTac and a potential 20-year time frame; they would need to be adjusted for use in other areas and program durations.

The cost per acre for each tree-iage category is the total estimated cost from the time it is enrolled until the end of the 20 year timeframe offered. For example, the model recommends enrolling 1.5 new acres in 2019, with a combined first-year program cost of $80,000 for staff, field expenses, and overhead.

Based on the adjusted estimates, the model forecasts that it will cost approximately $6 million in 2019 dollars to restore the entire 186 acres in 20 years. Although the total is a high number, the cost of effectively managing these lands solely using commercial crews or City staff would be more expensive — and more importantly, would not ensure long-term success from community ownership in the program.

Resource Recommendation 1: Leverage City funds through partnerships and develop long-term funding to support the work.

Forterra and the Port of Seattle are already active partners with the City, working on restoration projects within the Green SeaTac project area through the end of December 2020. By bringing in additional partners, strengthening partner relationships, and seeking outside funding to support partners working together, City funds could be leveraged to use this guide as a plan for further urban forest stewardship.

Resource Recommendation 2: Provide sufficient staff and resources to support fieldwork, volunteer outreach and management, community engagement, and program administration.

Volunteer Management

Currently, volunteers are providing an unknown number of hours each year supporting restoration and tree-care in SeaTac. The Partnership intends to create a system for tracking this work and reporting these hours in a way that is efficient for staff.

The City of SeaTac Parks, Community Programs & Services Department does not currently have a dedicated volunteer coordinator who could manage Green SeaTac volunteers. Forterra will initially play a major role in volunteer management, conducting regular volunteer events to help incorporate the experience gained through implementing the other Green City Partnerships. As a structure becomes established, the City or another partner could take the lead in volunteer management internally or contract these services with a professional provider.

Steward Program Management and Training

Within the initial year of the Partnership, Forterra will attempt to recruit and train site Stewards, supported by Forterra, at two sites within the project area, chosen with direction from Parks staff and building off of existing efforts. Stewards could eventually lead volunteer events, create work plans, track restoration progress, and apply for small grants to manage their sites. This program will also keep regular volunteers interested by providing a challenging and diverse array of work, and increased ownership of the results.

We recommend addressing staff capacity so that the Steward Program can continue in the future. This is dependent upon a staff member being able to coordinate the program, including training new stewards, working with them to develop site plans, providing support and encouragement, coordinating their efforts with other City staff, and keeping track of their accomplishments in relation to Partnership goals. This role could be incorporated into the duties of the volunteer coordinator mentioned above or filled by a different staff member if the City chooses to continue the program.

Other potential tasks that could be addressed with more staff capacity:

- Outreach and education
- Communications and marketing of the Green SeaTac Partnership
- Fund development and management

Resource Recommendation 3: Coordinate efforts by partner staff and volunteers to maximize joint success and share resources.

We recommend working across ownership boundaries with landowners, such as the City of SeaTac, King County, and the Port of Seattle, and project partners, such as Forterra. All partners need to communicate and coordinate their efforts so that work on the ground and in the community is conducted in a way that addresses needs in a comprehensive, rather than piecemeal, manner.

Resource Objective 4: Increase volunteer engagement to leverage support from the community.

The 2019 Independent Sector valuation of a volunteer hour is $31.72 in Washington State. To put this number in perspective, if every SeaTac resident contributed just 1.45 hours over a 20-year program, the volunteer effort would have a value of more than $2 million.

8. ADAPTIVE MANAGEMENT

Adaptive management is the process of hypothesizing how an ecosystem works, monitoring the results of actions taken, comparing these observations with expectations, and modifying management plans and procedures to better achieve objectives. The process systematically improves management policies and practices. It is a repeating cycle of six steps: theory of how the system works, strategy development, implementation, monitoring, evaluation, and strategy adjustment (see Figure 17). Once we have taken actions, managers use monitoring and evaluation to determine how our actions have affected the system and use that data to adapt our understanding of how the system works. Once an evaluation is complete, new information gathered from monitoring is used to reassess the problem and develop new strategies as needed. Then implementation, monitoring, and evaluation occur, and the cycle begins again. Adaptive Management allows staff to track the resources and community support necessary for accomplishing the fieldwork while considering the changing ecological and social realities of the urban forest.

Measuring Success

Two types of information help in analyzing potential effectiveness: program monitoring and field monitoring. Monitoring allows for improvement in Partnership program design and performance by measuring the effectiveness of strategies and techniques used. The results of monitoring should be fed back into planning and methodology to increase effectiveness. Monitoring and evaluation can also provide accountability to funding sources and supporters, and help ensure that goals and benchmarks are met.

Figure 18: Adaptive management cycle

Program Evaluation

At the close of each year, metrics such as volunteer attendance, retention, work accomplished, and basic demographic information should be used to measure program effectiveness and reach. Successes and lessons learned should be shared with partners and elected officials. Progress should be celebrated, and effectiveness evaluated.

Field Monitoring

As the field program proceeds, routine monitoring of planting and restoration sites should continue to be conducted to track the condition and health of restored sites and gauge progress. On forested land, success will rely on developing and refining effective strategies to remove and control invasive plants and keep newly planted natives healthy. Refining plantings may need to occur if areas change due to climate, development, or other realities. Newly planted street or community trees will need to be monitored for disease, drought, and other potential threats. Maintenance of these street trees includes regular pruning, removal of aggressive weeds, watering in the dry season, and more.

To monitor fieldwork, new acres should be tracked as they are brought into active restoration and mapped in GIS. Volunteer and skilled-field-crew time should be devoted to revisiting sites that have been previously worked on and assessing their ongoing needs as they move through the four phases of restoration. One component of monitoring is to track plant survival rates. Although the work needed decreases dramatically each year that an area goes through the program, phase 4 of restoration continues indefinitely.

As SeaTac enrolls more acres in restoration and plants more community trees, tracking can become complicated. Managing data entry and paperwork as the program grows has proven to be expensive in other Green Cities. The Partnership has piloted a database to assist in tracking these projects that greatly reduces the need for staff management and streamlines the project-reporting

process. Thanks to Port of Seattle funding, this database will be offered to SeaTac staff as an optional system to use in perpetuity.

Resource Distribution

It is assumed that Green SeaTac Partnership funding will continue to be housed entirely within current active partners — the City of SeaTac, Forterra, and the Port of Seattle — for at least the first two years of the program (until December 2020). After that, we recommended that the City oversee program funding and work toward generating additional public funding (both from City and non-City sources) and donations from outside sources.

At the front end, resources will be directed toward recruiting and supporting Stewards, demonstrating on-the-ground results and success in the field, and hosting highly visible community events that foster engagement with Green SeaTac sites.

Reporting and Knowledge Sharing

The Green SeaTac Partnership will report its first-year progress to the SeaTac Parks, Community Programs & Services Department, Port of Seattle staff and commissioners, volunteers, and the public.

Because SeaTac is now a member of the Green Cities Network, SeaTac staff will continue to have opportunities to share successes and challenges with other cities (including Issaquah, Shoreline, Seattle, Tacoma, Kirkland, Redmond, Kent, Everett, and Puyallup) that are dedicated to a similar goal and vision. Written materials, including this guide, will be posted on Forterra's Green SeaTac Partnership website (www.GreenSeaTac.org), and all parties using these resources will be given the opportunity to provide feedback to Forterra and the Port of Seattle.

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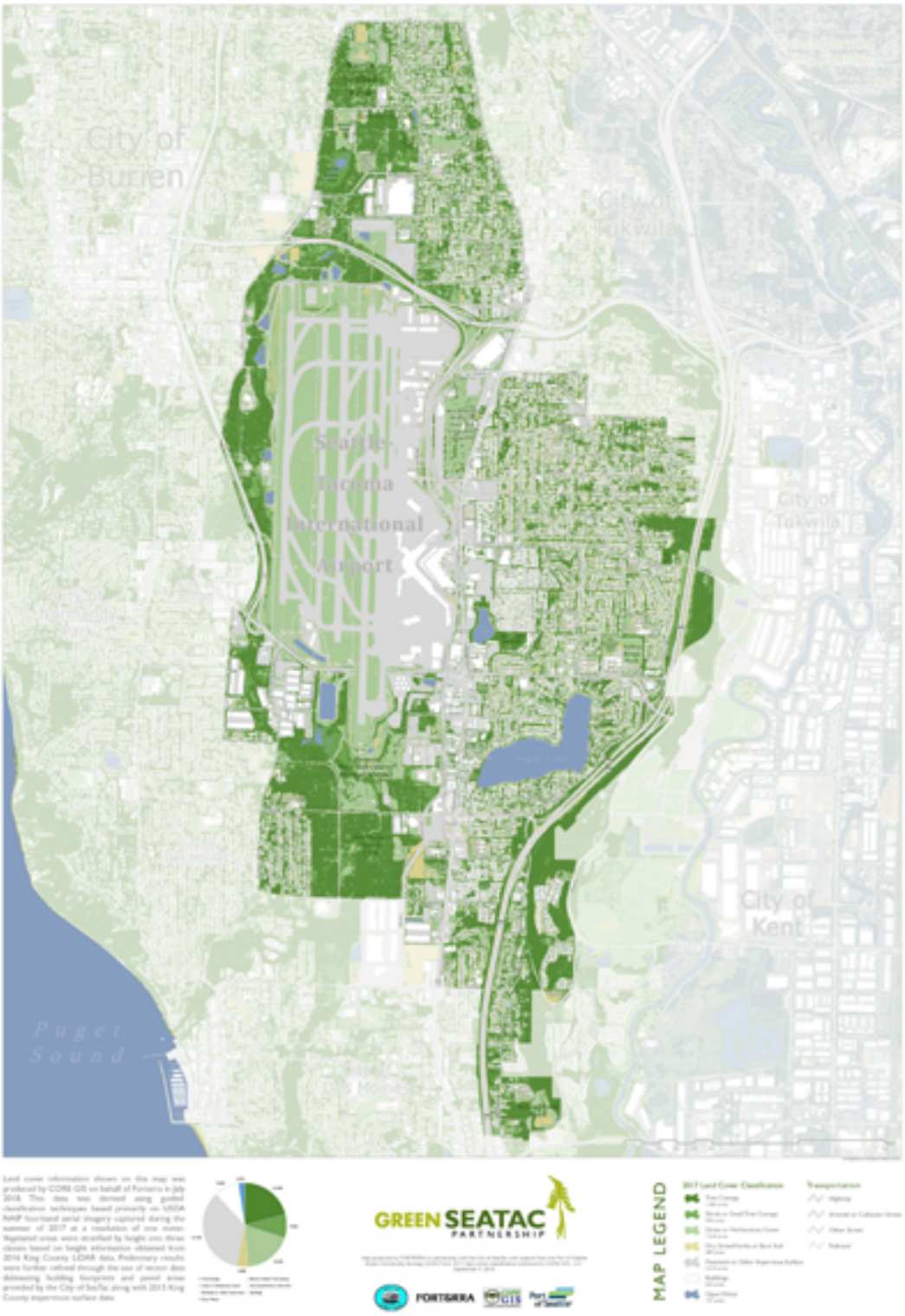
10. APPENDICES

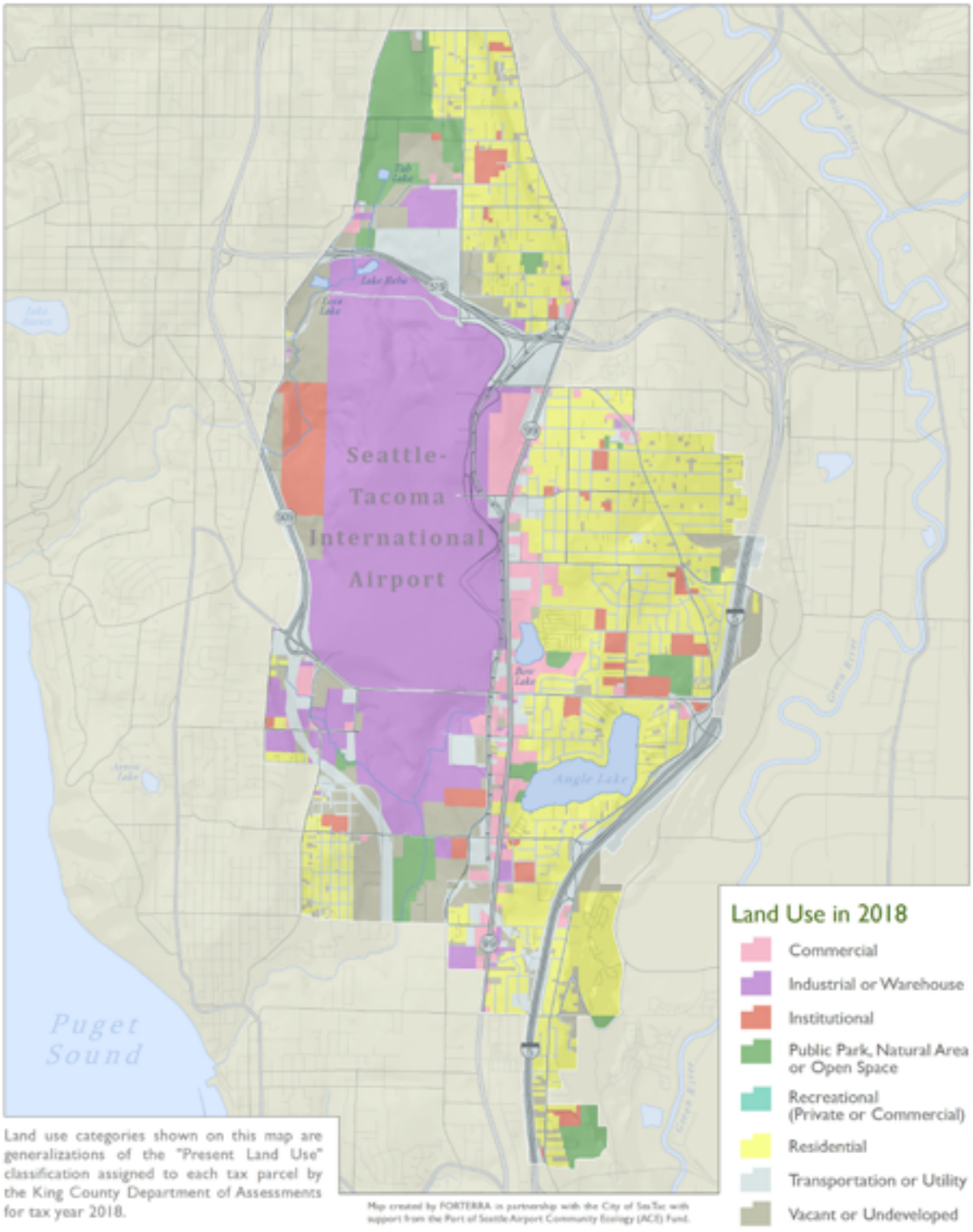
Appendix A.

Map of Land-Cover Classifications in the City of SeaTac in 2017



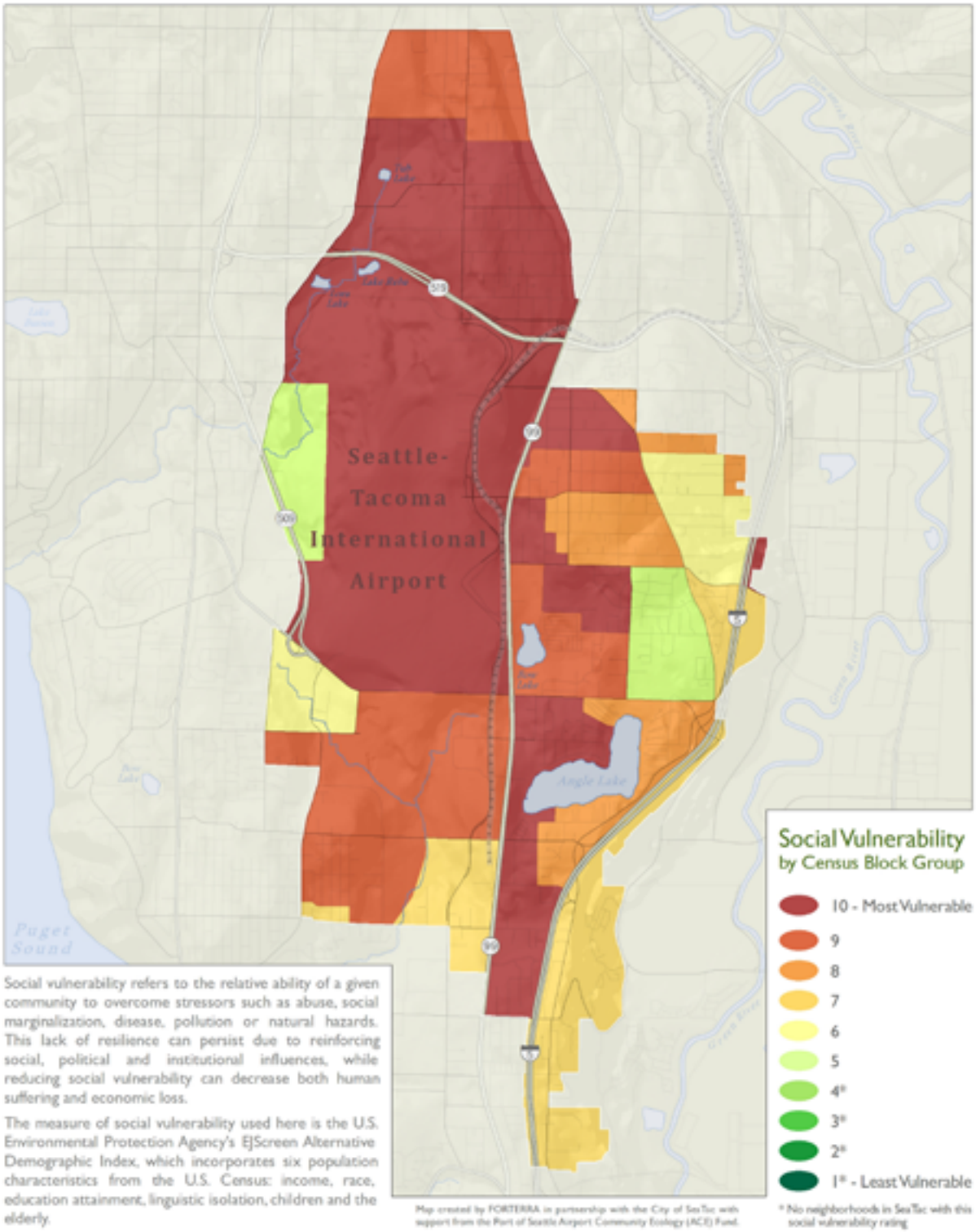
Appendix B.

Map of Land Use in the City of SeaTac in 2018



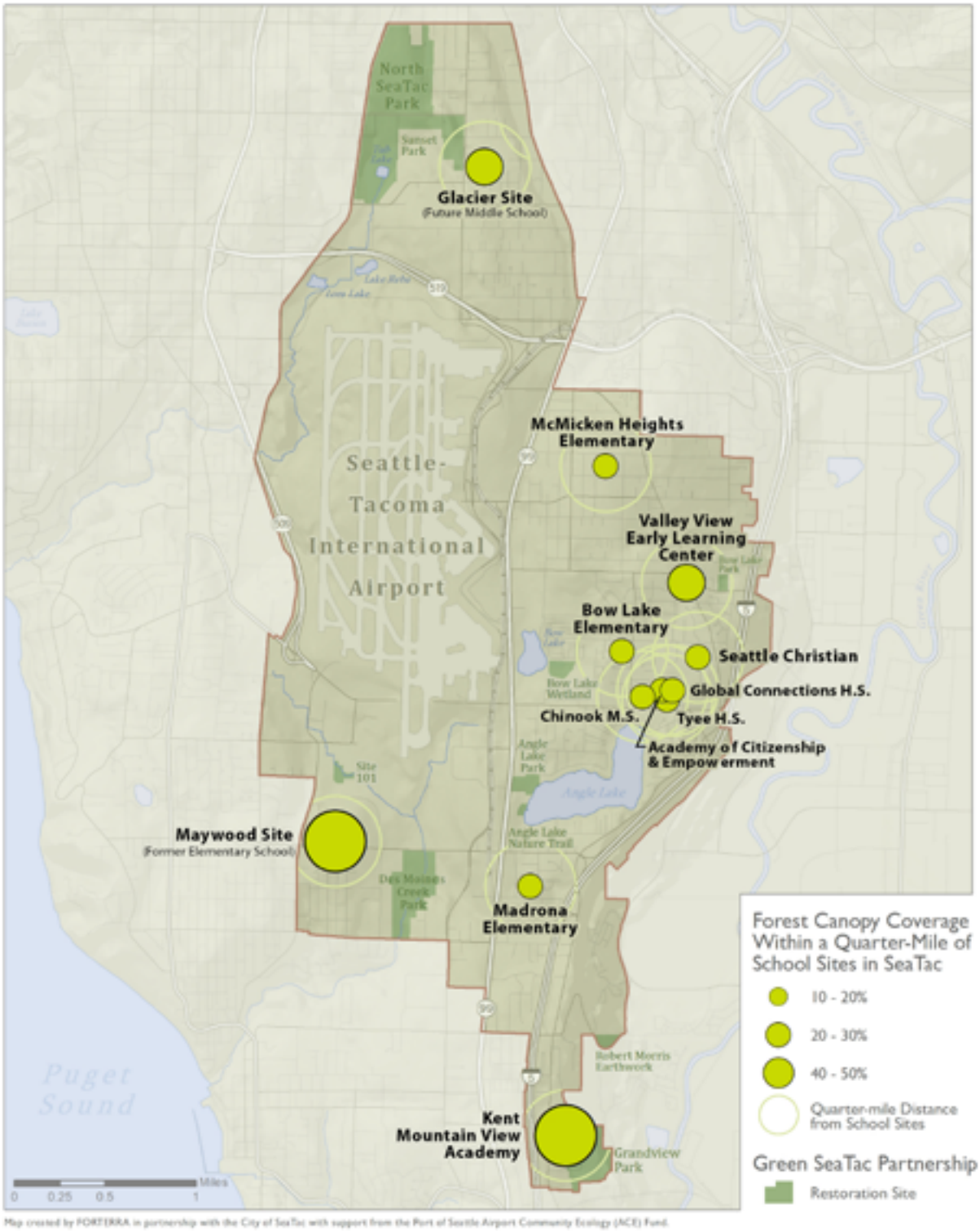
Appendix C.

Map of Social Vulnerability by Census Block in the City of SeaTac in 2019



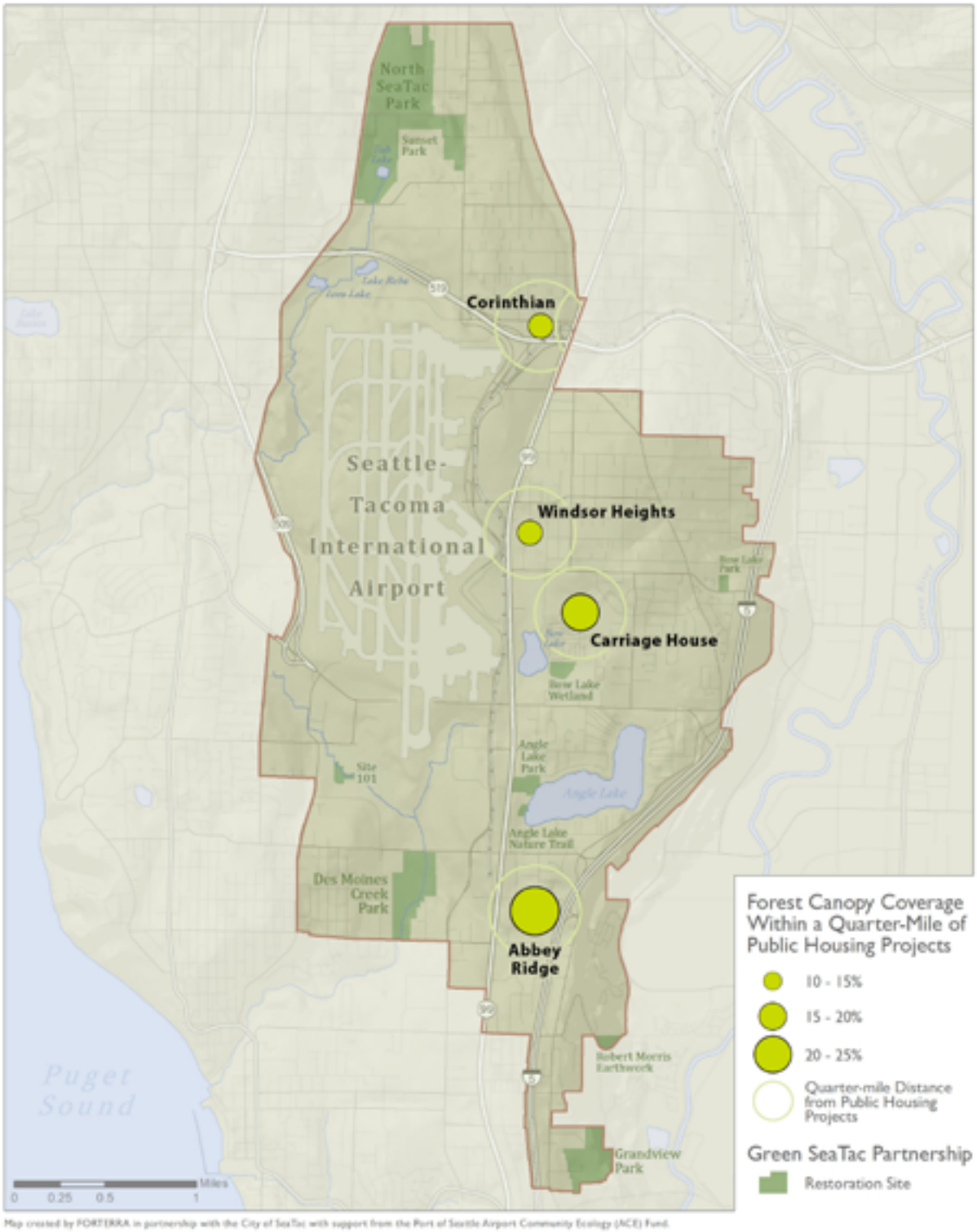
Appendix D.

Map of Canopy Cover within a Quarter Mile of Schools in the City of SeaTac



Appendix E.

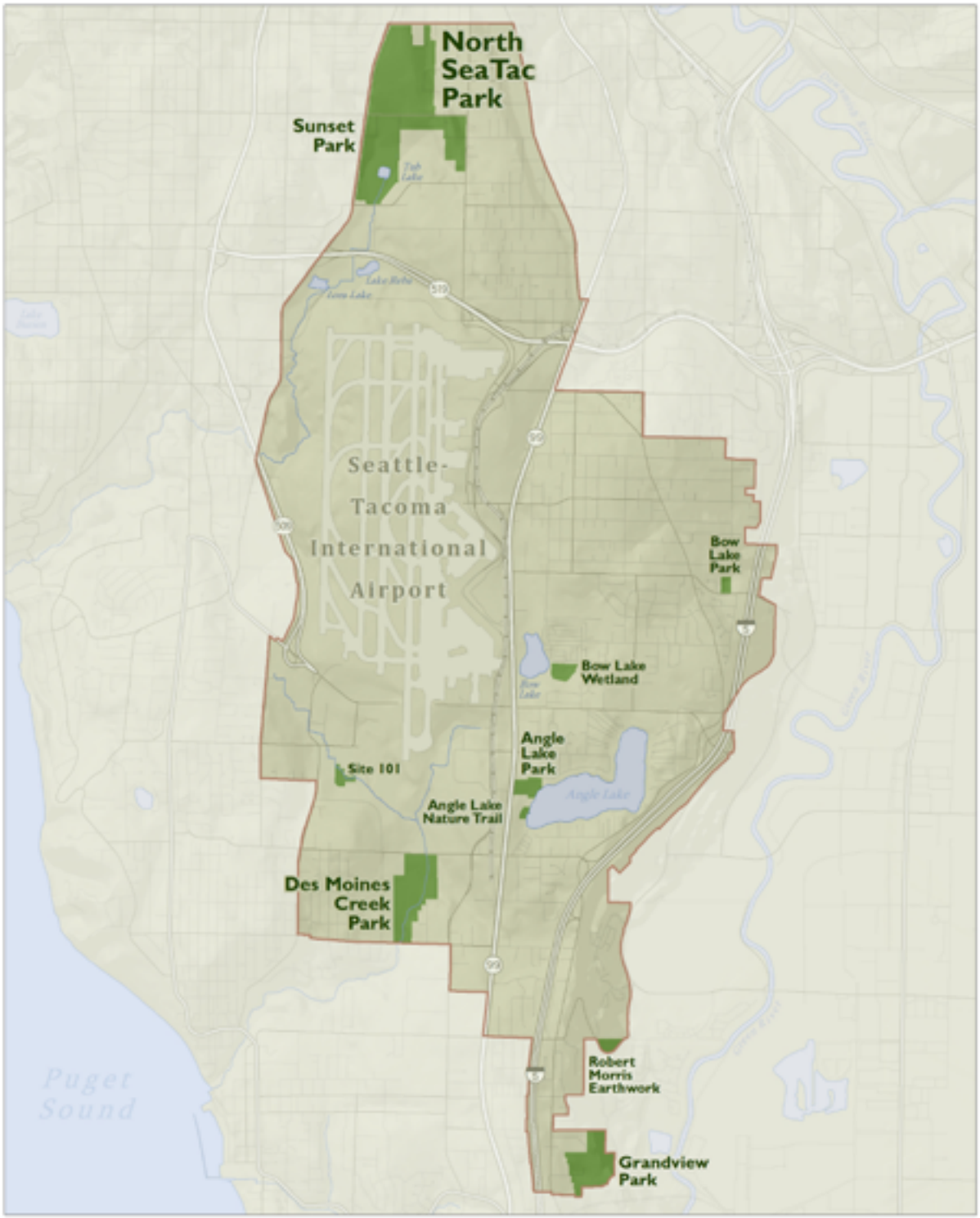
Map of Canopy Cover within a Quarter Mile of Public-Housing Sites in the City of SeaTac



Map created by FORTERRA in partnership with the City of SeaTac with support from the Port of Seattle Airport Community Ecology (ACE) Fund.

Appendix F.

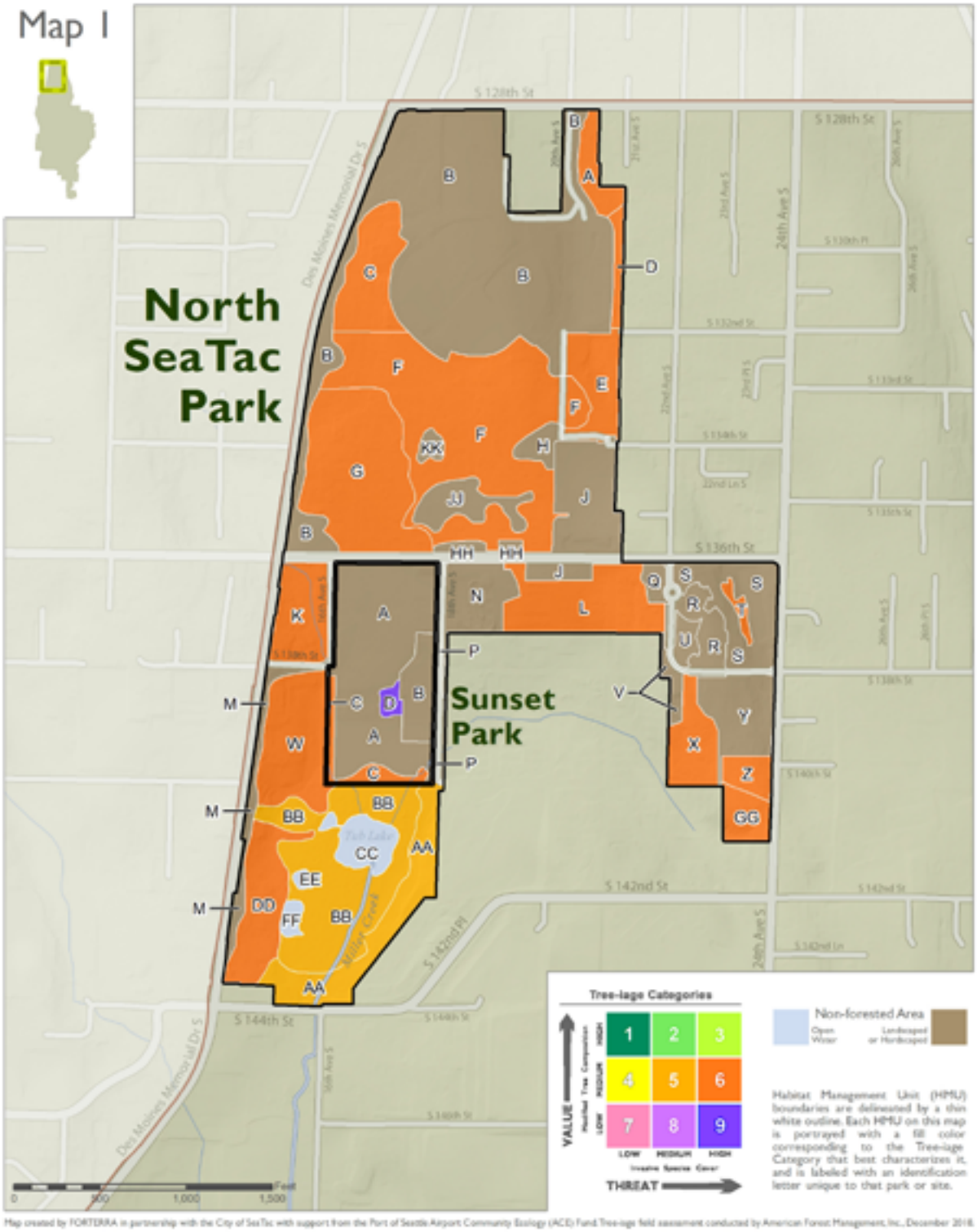
Map of Green SeaTac Partnership Sites: Forested and Natural Parkland



Map created by FORTERRA in partnership with the City of SeaTac with support from the Port of Seattle Airport Community Ecology (ACE) Fund.

Appendix G1.

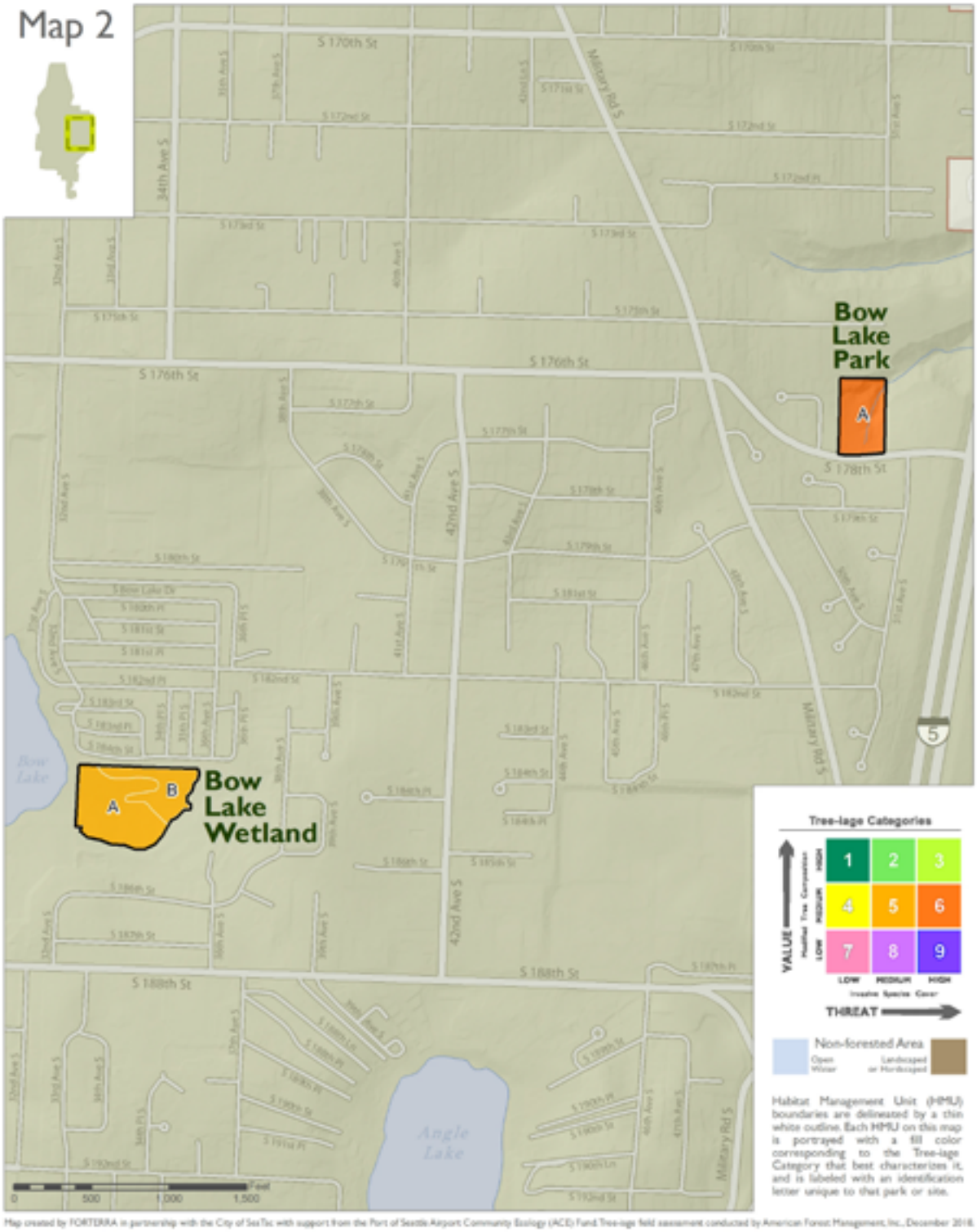
Restoration Sites with Tree-iage Categories by MU



Map created by FORTERRA in partnership with the City of SeaTac with support from the Port of Seattle Airport Community Ecology (ACE) Fund. Tree-iage field assessment conducted by American Forest Management, Inc., December 2018.

Appendix G2.

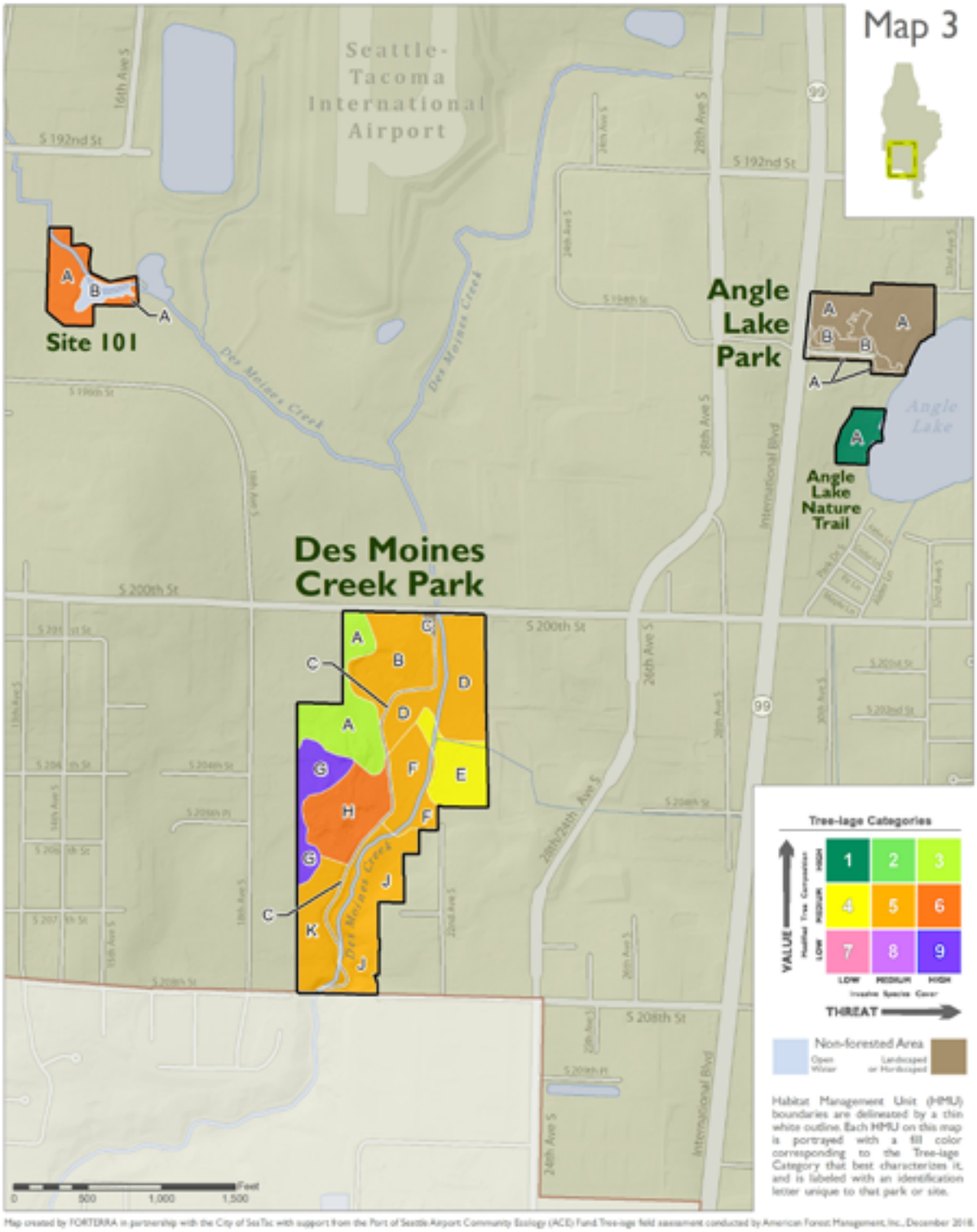
Restoration Sites with Tree-iage Categories by MU



Map created by FORTERRA in partnership with the City of SeaTac with support from the Port of Seattle Airport Community Ecology (ACE) Fund. Tree-iage field assessment conducted by American Forest Management, Inc., December 2018.

Appendix G3.

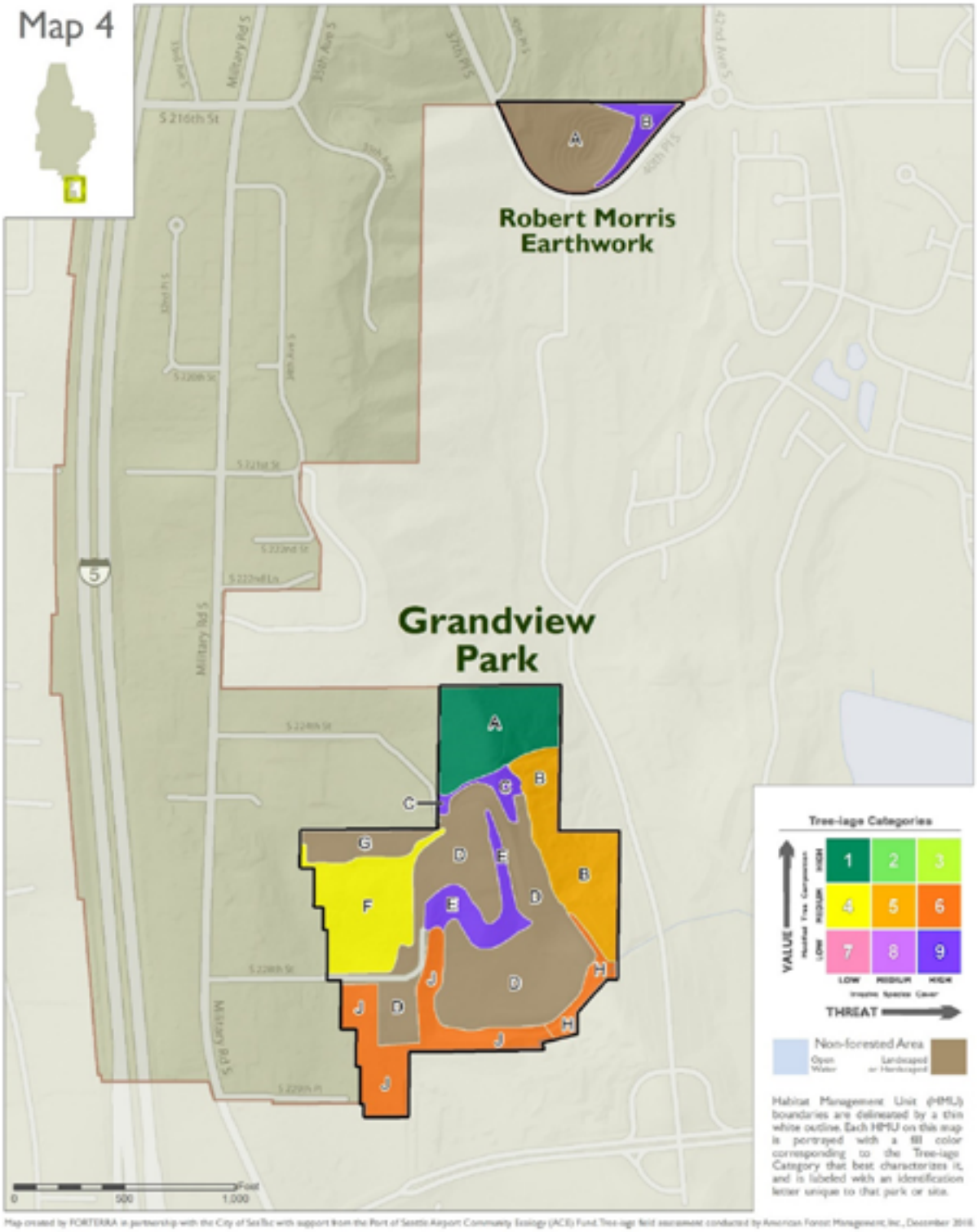
Restoration Sites with Tree-iage Categories by MU



Map created by FORTERRA in partnership with the City of SeaTac with support from the Port of Seattle Airport Community Ecology (ACE) Fund. Tree-iage field assessment conducted by American Forest Management, Inc., December 2018.

Appendix G4.

Restoration Sites with Tree-iage Categories by MU



Map created by FORTERRA in partnership with the City of SeaTac with support from the Port of Seattle Airport Community Ecology (ACE) Fund. Tree-iage field assessment conducted by American Forest Management, Inc., December 2010.

Appendix H: Public Outreach Report

Green Cities Partnerships in SeaTac, Burien, and Des Moines Public Outreach Report

Written by: Jessica Vu with assistance from Ali Yeates Lakehart, Forterra

Project Background

Forterra's Green City Partnerships bring together local government agencies, businesses, schools, nonprofit groups, and community members to create a sustainable network of healthy forested parks and natural spaces in urban areas throughout the region. These Partnerships create and implement community-based models that ensure ongoing restoration and stewardship of these vital outdoor spaces. Forterra works with cities to identify restoration opportunities within the jurisdiction, and recruits, trains, and supports passionate volunteers to participate in stewardship activities. The current Green Cities Network consists of Partnerships in 14 cities throughout Western Washington.

Airport Community Ecology Fund

Acknowledging the longstanding impacts of Port of Seattle activities on surrounding residents' quality of life and health outcomes, the Port Commission adopted the Airport Community Ecology (ACE) Fund in 2016, dedicating $1 million to support environmental stewardship in SeaTac, Burien, and Des Moines. Half of the fund was made available for the Small Matching Grants Program, which allowed local community organizations to apply to receive funding for stewardship projects. The Port allocated the remaining funding to support long-term urban forestry efforts through the development of new Green Cities Partnerships in SeaTac, Burien, and Des Moines.

Given the high level of concern among local residents about the environmental impacts of Port activities, as well as the socioeconomic disparities present in South King County that serve to further exclude communities of color from decision-making processes, the Port and Forterra prioritized the role of public engagement in the Partnerships' first year. Our community engagement work in SeaTac, Burien, and Des Moines represents Forterra's first comprehensive effort to engage communities around the development of new Green Cities Partnerships. Our goal was to ensure that community perspectives — particularly those of residents from historically marginalized groups — informed the priorities and activities of the new Partnerships from the outset.

Outreach Approach

Forterra conducted outreach in two main ways: tailored engagement via the Community Connectors model, which targeted individuals from difficult-to-reach communities; and traditional engagement in the form of open houses and surveys, which was meant to gather feedback from a broad audience. A summary of outreach activities and associated metrics are included below this report.

Community Connectors

In order to engage community members that are representative of the diverse populations of SeaTac, Burien, and Des Moines, Forterra used the Community Connectors model as a key element of our outreach strategy for the new Green Cities Partnerships. The model involves recruiting community leaders to act as liaisons between their communities and program/agency staff.

Forterra originally developed the Community Connectors program for the City of Tukwila in 2012, in partnership with the community-health organization Global to Local. The original intent of the program was to serve as a model for incorporating the perspectives of underrepresented communities in City processes. Since then, Forterra and Global to Local have continued to work together to employ the model for various outreach efforts in South King County, including the new Green Cities Partnerships in SeaTac, Burien, and Des Moines.

Connectors are leaders from a variety of language and cultural groups who represent communities that may be underrepresented in conservation efforts due to a history of exclusionary practices within the movement. Connectors have deep connections in their communities, the skills to facilitate outreach to and communicate with their respective communities, and the ability to provide culturally sensitive guidance to program staff on how to design and undertake effective outreach efforts. Forterra acknowledges that cultural groups cannot be represented by a single Connector, and that Connectors often identify

with many different communities at once. We therefore believe that Connectors should not be viewed simply as representatives of a particular demographic group, but rather as "bridge-builders" who have the skills and knowledge necessary to make connections with historically underrepresented communities in SeaTac, Burien, and Des Moines.

Green Cities Connectors

Global to Local was tasked with recruiting and supporting Connectors for the new Green Cities Partnerships in South King County. In total, nine Connectors were recruited, representing the Somali, Latinx, Filipino, and Kenyan communities, including four youth Connectors.

Connectors attended two trainings run by Forterra and Global to Local that oriented them to the Green Cities program and the expectations for the Connector role. They were also given the opportunity to provide feedback on the outreach materials and activities, including survey language and open house times/locations.

In addition to attending trainings, the Connectors were tasked with the following responsibilities:

- Distribute and collect paper surveys
- Distribute open house promotional flyers to community networks
- Recruit individuals to attend open house events
- Help identify, coordinate, and facilitate small community meetings

Forterra and Global to Local recognize that a key element to the success of the Connector model is mutual respect and commitment on behalf of both the project host and the Connectors. In order to acknowledge and encourage the level of commitment expected, we compensated Connectors for the time spent engaging in the above activities. See Appendix H2 for a detailed outline of Connector responsibilities and associated compensation levels.

Small Community Meetings

The Partnership conducted two small community meetings in SeaTac and six, in total, in all three cities. These meetings were focused around groups not already represented in the surveys or community open houses.

Traditional Outreach

In addition to engaging Connectors, Forterra also conducted public outreach through more traditional channels. Our main avenues for soliciting feedback from the general public were hosting a series of open house events and distributing a survey. See Appendix H1 for a summary of these activities.

Open Houses

Forterra hosted three open house events throughout the fall of 2018: one in SeaTac on Saturday, October 20th; one in Des Moines on Monday, October 29th; and one in Burien on Wednesday, November 7th. The two weekday events were held in the evening in order to accommodate individuals with daytime work schedules. The open houses served a dual purpose: to provide information to community members about the project and to gather input from residents about stewardship priorities in their neighborhoods.

Each event lasted two hours and used a drop-in model that allowed guests to come and go as they pleased. There were several "stations" set up around the room that provided participants the opportunity to learn more about Green Cities Partnerships, engage with research that has been conducted thus far, and provide both site-specific and general feedback on areas where they would like to see more trees and/or restoration efforts. The Port of Seattle also hosted a table with information on ACE Fund priorities and activities.

Survey

In addition to holding open house events, Forterra also developed an eight-question survey designed to gather more quantifiable data on community members' priorities related to urban forestry and green space. The survey contained questions meant to gain insight into residents' relationships with parks, which environmental issues were most important to them, and ways that they would like to be engaged in stewardship and restoration activities as the partnerships evolve. The full survey is included in Appendix H3.

When designing the survey, our main goal was to develop questions that were broad enough for the average resident to be able to answer meaningfully, yet specific enough to the topic of urban forestry to be able to inform the more technical restoration work of the Green Cities Partnerships. Following survey-design best practices, we aimed to make the survey language as simple and jargon-

free as possible. We also commissioned a translation agency to translate the survey into three non-English languages that are commonly spoken among the communities represented by the Connectors: Spanish, Somali, and Filipino. These translated surveys served to lower barriers for non-English speakers to provide input into the program.

After the survey was developed, Global to Local distributed paper copies to the Connectors in their requested languages, and Forterra published an online version through Google Forms. Forterra also brought paper surveys in all languages to the open house events for guests to complete.

Promotion and Communications

In order to publicize the open house events and community feedback survey, Forterra promoted the events and the online survey through new and established communication channels. We created a flyer with information on the open houses and had it translated into the three priority languages: Spanish, Somali, and Filipino. We then disseminated the flyer and a link to the online survey through Forterra's social media networks, the Cities' communications channels, Highline Public Schools, and community partners to share with their networks. In addition to sharing the flyer, we promoted the events and survey link on Forterra's website, drafted a press release, and leveraged the Connectors' recruiting efforts.

Findings

As a result of our public-engagement efforts, Forterra gained valuable insight into community priorities related to stewardship and restoration activities in SeaTac, Burien, and Des Moines. Our findings from the community feedback survey, open house events, and Connector-led small community meetings are summarized below.

Survey Responses

In total, we collected survey responses from 162 individuals. Of these surveys, 58 came through Connectors, 26 were completed at one of the open house events, and 14 were completed at small community meetings. The remaining 64 surveys were completed online. Of the 162 respondents, 91% live in one of the three new Green Cities, indicating that the survey respondents are reflective of the program's overarching target audience of residents from the three cities. Looking at the demographic breakdown of the respondents, we can see that they very roughly reflect the overall population of the three cities: of the 130 respondents that specified their race, 48% identified as White/Caucasian, 23% identified as Black, 12% identified as Asian, and 12% identified as Latinx/Hispanic. In terms of gender identity, male-identifying individuals were underrepresented in this sample, making up only 35% of the respondents. It should be noted that approximately 22% of respondents declined to specify their race or gender, which may impact the accuracy of the above figures.

Survey Results

The most popular activity that respondents participate in when they visit parks in their neighborhood is "view[ing] nature, trees, flowers, birds, wildlife, etc.", which was closely followed by "relax[ing]." These top two responses indicate that many community members see their neighborhood parks as peaceful and calming places to enjoy in a passive fashion.

When asked to select the three health- or environment-related issues that were most important to them, 70% of respondents chose air pollution and 55% chose water quality, the two most common responses. While clean air and water were the top environmental priorities for community members, a significant proportion of respondents also indicated that they valued access to nature/natural beauty; quality of life/mental health; and safe spaces for relaxing and having fun — these issues were each chosen by 41% of respondents.

In terms of potential stewardship activities, respondents indicated that they would be most interested in attending volunteer events to plant trees and engage in restoration activities (57% of respondents); receiving free trees to plant near their homes (54% of respondents), and learning more about forests, trees, and native plant species (51% of respondents). A significantly smaller proportion of people expressed interest in teaching others to plant trees at parks in their neighborhoods (30% of respondents).

When asked to identify areas in their city where they would like to see more trees, respondents identified sites that were both specific and general in nature. Overall, it was clear that parks were a priority for many participants, as well as community/public spaces such as churches, libraries, schools, and bus stops. Many people also mentioned roadways, indicating that street trees are also in demand among survey respondents. The

idea of planting more trees to serve as a visual/sound buffer between residents and industry (e.g., airport activities, construction, warehouses) was also commonly mentioned. Finally, some respondents were interested in developing ways to incentivize homeowners to plant trees on their property.

See Appendix H5 for the comprehensive results from the survey.

Open House Findings

Overall, we engaged 74 guests at our open house events: 25 in SeaTac, 20 in Des Moines, and 29 in Burien. These numbers reflect individuals who signed in at the events, and therefore may underrepresent the actual number of people who participated in the open houses.

From the open house feedback activities, we gained general community feedback, as well as input related to site-specific stewardship priorities and types of landscapes where residents want to see more trees.

Much of the site-specific feedback reflected what we found in the surveys — many residents wanted to see restoration and stewardship activities take place in parks, near schools, and along streets. There were also several comments about planting trees near areas undergoing development in order to provide a buffer between residents and development activities. In terms of landscapes where residents would like to see more trees, most participants indicated that parks and schools were the top two priorities. When it came to general community feedback, many participants provided useful information on potential community partners to engage in our stewardship efforts. See Appendix H6 for a full listing of feedback collected at the open house events.

Community Engagement Challenges

While Forterra succeeded in gaining valuable feedback from stakeholders regarding the development of the Green Cities Partnerships in SeaTac, Burien, and Des Moines, we nonetheless faced challenges throughout the outreach process. These challenges presented opportunities for further aligning our work with community needs in order to ensure the long-term success of the project.

First, we found that we had difficulty recruiting community members to attend the open house events. Some Connectors mentioned that, while many of their contacts expressed interest in participating in stewardship events such as tree plantings, it was difficult to get people to provide meaningful feedback on the narrow topic of urban tree canopy, let alone take the time to participate in the open houses. The lack of community interest in the topic of urban forestry was particularly pronounced among historically marginalized groups. Community partners that were affiliated with these groups noted that the topics of urban forestry and urban tree canopy were not identified as priorities for many of these communities, as they oftentimes face more immediate needs such as affordable housing, attainable education, and employment opportunities.

In addition to challenges engaging communities around the specific topic of urban forestry, we also faced issues with Connector attrition throughout the project cycle. Many Connectors worked full-time or were in school, and therefore had competing priorities that prevented them from being able to participate in outreach activities to the degree expected. This decline in Connector involvement throughout the course of the project may have been associated with the existing lack of community interest in the subject area, and ultimately served to compound the difficulties we faced recruiting community members to participate in outreach activities.

Finally, there were larger political issues outside Forterra's control that nonetheless posed challenges to our engagement goals. We found that some community members associated our work with the Port's larger development activities and their related impacts on surrounding residents, and were consequently unreceptive to our outreach efforts. Some of these stakeholders attended our open house events and strongly vocalized their opposition to the Port's development approach, which served to disrupt feedback activities.

Appendix H1: Summary of Outreach Activities

Activity	Date	Location	Metrics
Connector Training #1: Introduction to Green Cities Partnership	August 23, 2018	Global to Local	
Connector Training #2: Preparing for Outreach for Events & Surveys	September 17, 2018	Global to Local	
Survey Distribution	October 2 – November 7, 2018	N/A	148 surveys completed
SeaTac Open House	October 20, 2018	Tyee High School	25 attendees
Des Moines Open House	October 29, 2018	Des Moines Beach Park	20 attendees
Burien Open House	November 7, 2018	Burien Library	29 attendees
Small Community Meeting #1	December 12, 2018	SeaTac Community Center	18 contacts
Small Community Meeting #2	December 13, 2018	Waskowitz Environmental Leadership School	24 contacts
Small Community Meeting #3	December 21, 2018	Tyee High School	6 contacts
Small Community Meeting #4	January 11, 2019	Wesley Housing Community	32 contacts
Small Community Meeting #5	January 15, 2019	Des Moines Senior Center	52 contacts
Small Community Meeting #6	January 23, 2019	Highline College	28 contacts

Appendix H2: Connector Responsibilities and Associated Compensation

Responsibility	Compensation
Attend Connector Training #1: Introduction to Green Cities Partnership	$80 per training session
Attend Connector Training #2: Preparing for Outreach for Events & Surveys	$80 per training session
Attend at least 1 Community Open House (1 to be held in each city) and recruit 10 community members to participate	• $100 per open house event attended • $10 per recruited individual that also attends (up to 10 attendees)
Help identify, attend and lead one community meeting	$100 for one community meeting
Help design and conduct surveys with 10 community members to gather feedback on stewardship goals	$10 per individual surveyed (up to 10 surveys)
Attend two check-in meetings with staff from Global to Local	$25 per check-in meeting

Appendix H3: Community Feedback Survey (English)

We are collecting feedback from community members about your relationship with local parks and urban forests. The information you provide will help us improve the environment so you can enjoy it the most. This survey is anonymous, unless you choose to provide contact information to learn more. Thank you for taking time to fill out the survey!

1. What city do you live in?
   - o Des Moines
   - o SeaTac
   - o Burien
   - o Other (please specify): _____

2. Do you visit parks or other outdoor areas in any of these cities?
   - o Des Moines
   - o SeaTac
   - o Burien
   - o Other (please specify): _____
   - o I don't visit parks or outdoor areas anywhere

3. If you visit parks in these cities, what activities do you do when you're at the park? (Select all that apply)
   - o Relax
   - o Play sports and games
   - o Have picnics / gather for meals
   - o Go to the dog park or walk dogs
   - o Exercise
   - o Go to the playground
   - o View nature, trees, flowers, birds, wildlife, etc.
   - o Other (please specify): _____

4. What are the three (3) most important environmental and community health issues to you? (Select 3)
   - o Air pollution
   - o Water quality
   - o Safe places for relaxing and having fun
   - o Access to healthy food
   - o Access to nature/natural beauty
   - o Quality of life and mental health
   - o Wildlife protection
   - o Other (please specify): _____

5. If you were able to get involved, what activities would you participate in? (Select all that apply)
   - o Learn more about forests, trees, and native plant species
   - o Attend volunteer events to plant trees and take care of the environment
   - o Teach others to plant trees at a park in your neighborhood
   - o Receive free trees to plant near your home
   - o None of the above

6. Please list any locations in Des Moines, SeaTac, or Burien would you recommend for planting trees or making more beautiful outdoor spaces: _____

7. Where did you hear about this survey?
   - o City website / social media
   - o Local media / news
   - o Friend / family
   - o Community event
   - o Other (please specify): _____

8. Are you interested in learning more about forests in parks near you? Y / N (Circle one)
   - o If yes, please provide your email address: _____
   - o Phone number if you prefer to be contacted by phone: _____

Demographic Questions

These questions are optional, but will help us understand more about you and your community so that we can better address your concerns about urban forests and parks.

9. What race or ethnicity do you identify with? _____

10. What gender do you identify as?
    - o Female
    - o Male
    - o Other (please specify): _____

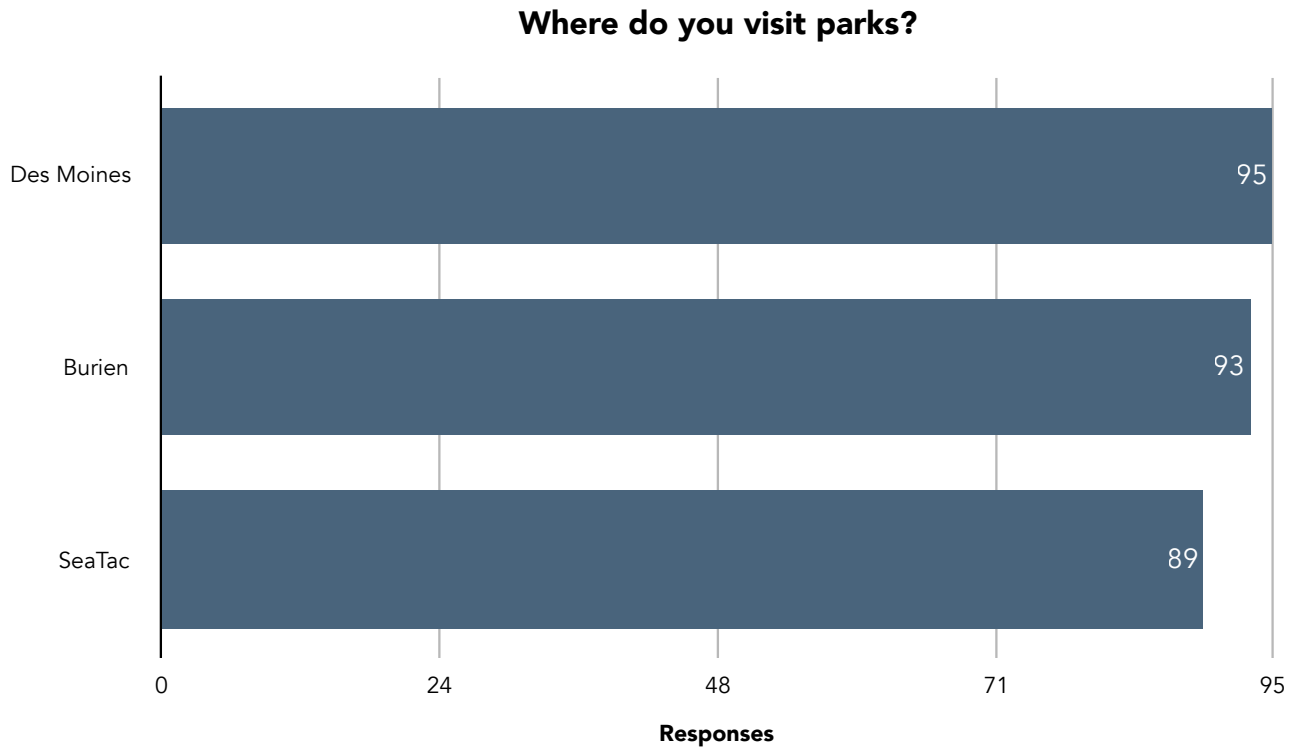
11. What is your age? _____

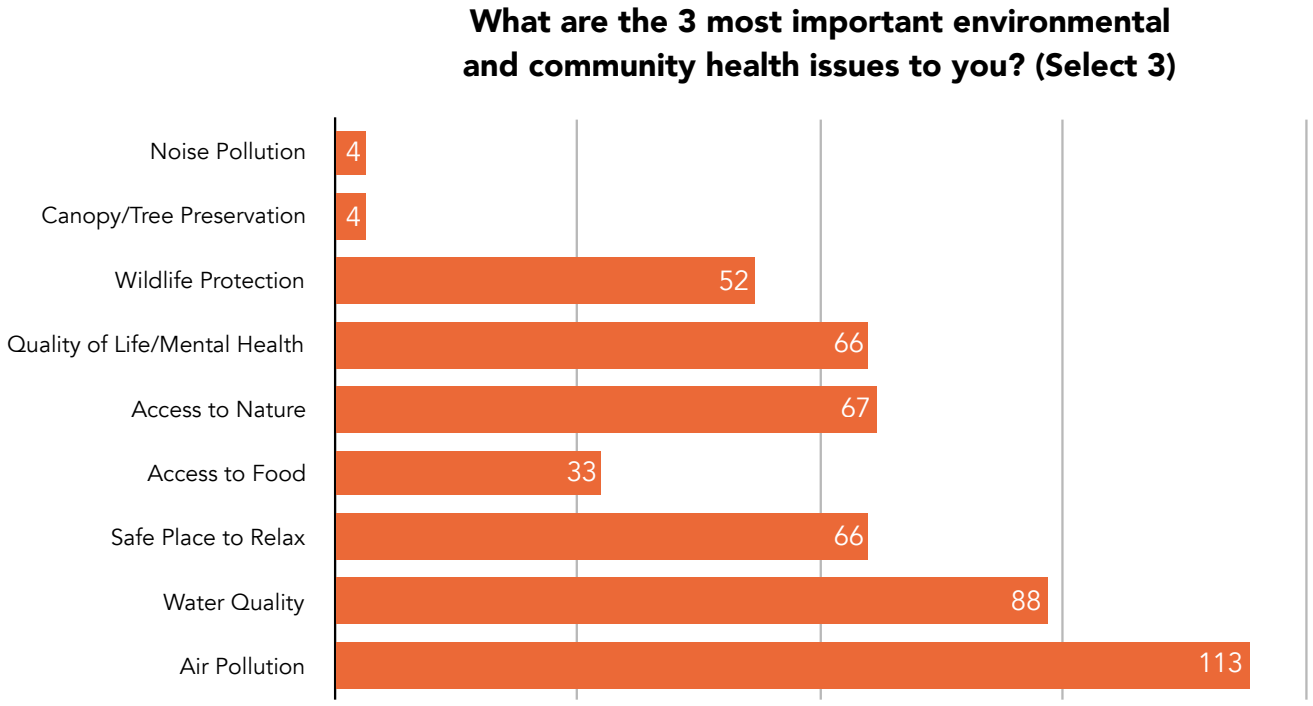
Appendix H4: Communications Activities

To promote the Open House events and the community survey, Forterra engaged in the following communications activities:

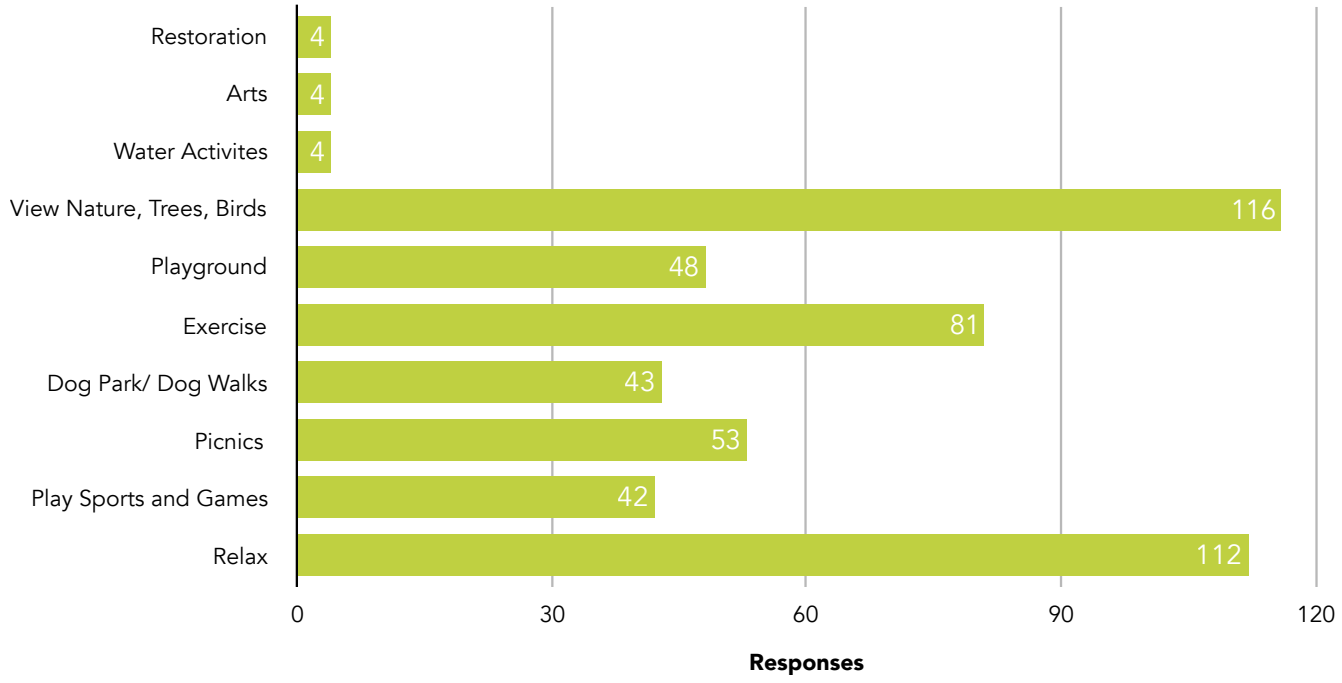
- Developed a flyer with dates, locations, and contact information for the Open House events, and had the flyer translated into the three priority languages.
- Posted paper version of the flyer at community sites in SeaTac, Burien, and Des Moines.
- Posted all Open Houses as events on Forterra's website, and posted the dates, flyer, and link to the online version of the survey on Forterra's Green Cities webpage.
- Invited other ACE Fund recipients to attend the Open Houses, and encouraged them to promote the events with the flyer.
- Sent a communications toolkit to each of the three cities that included a flyer (in the three priority languages), a link to the survey, links to event pages, and sample promotional language.
- Drafted and sent a press release to local media.
- Sent the flyer in English to 6,482 households in the Highline School District through Peach Jar, a network that distributes information to parents within the district.
- Distributed flyers and surveys to Connectors (in the three priority languages) to use in their recruiting efforts.
- Shared the event links (hosted on Forterra's webpage) on Forterra's Facebook page as each Open House event approached, and tagged partner agencies so that partners could amplify the Facebook posts through their own networks.

Appendix H5: Survey Results

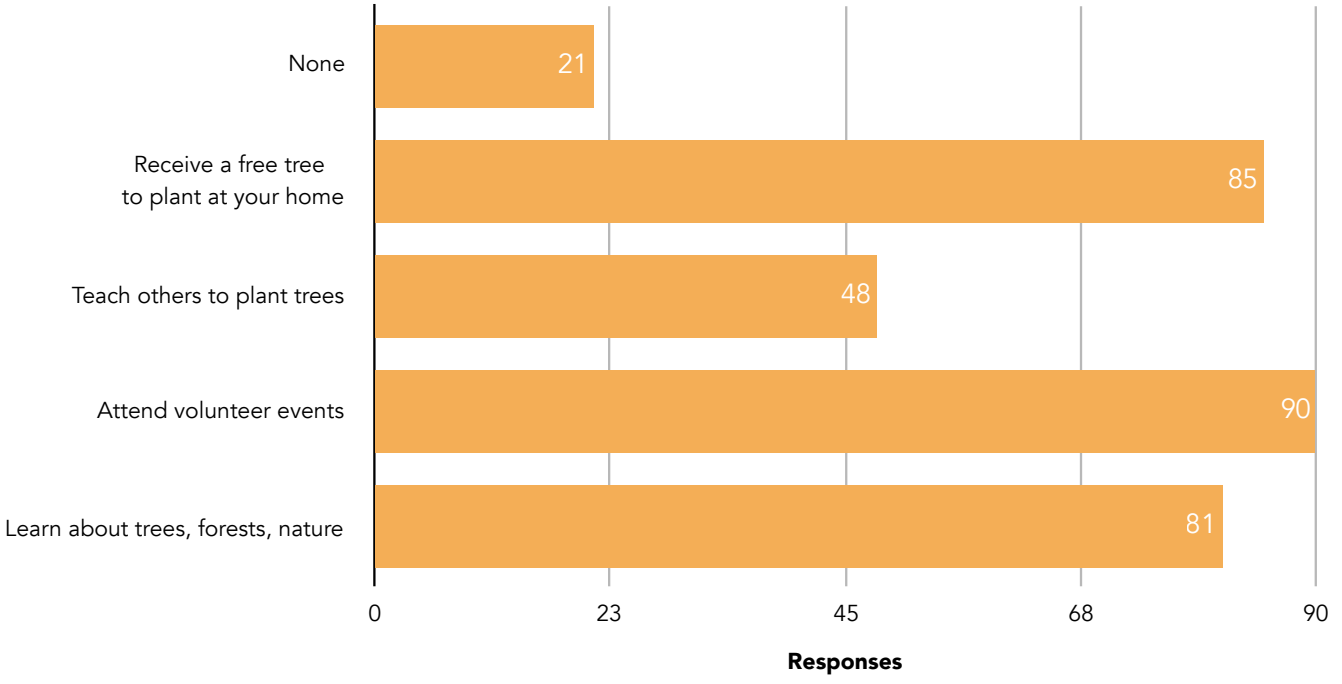


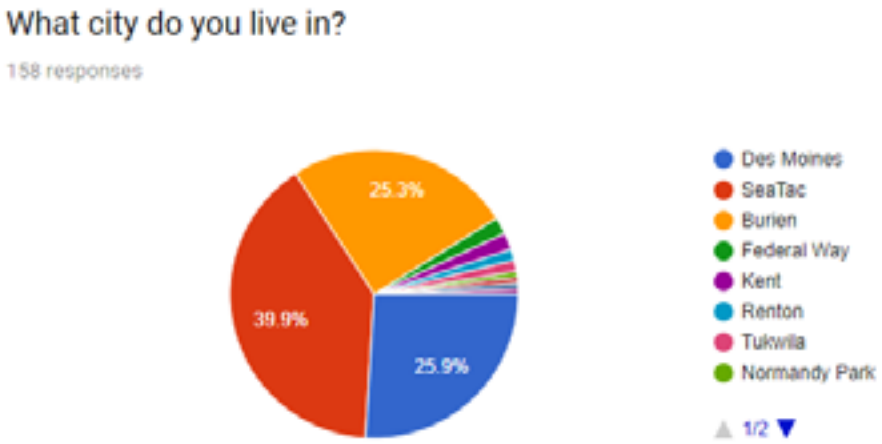


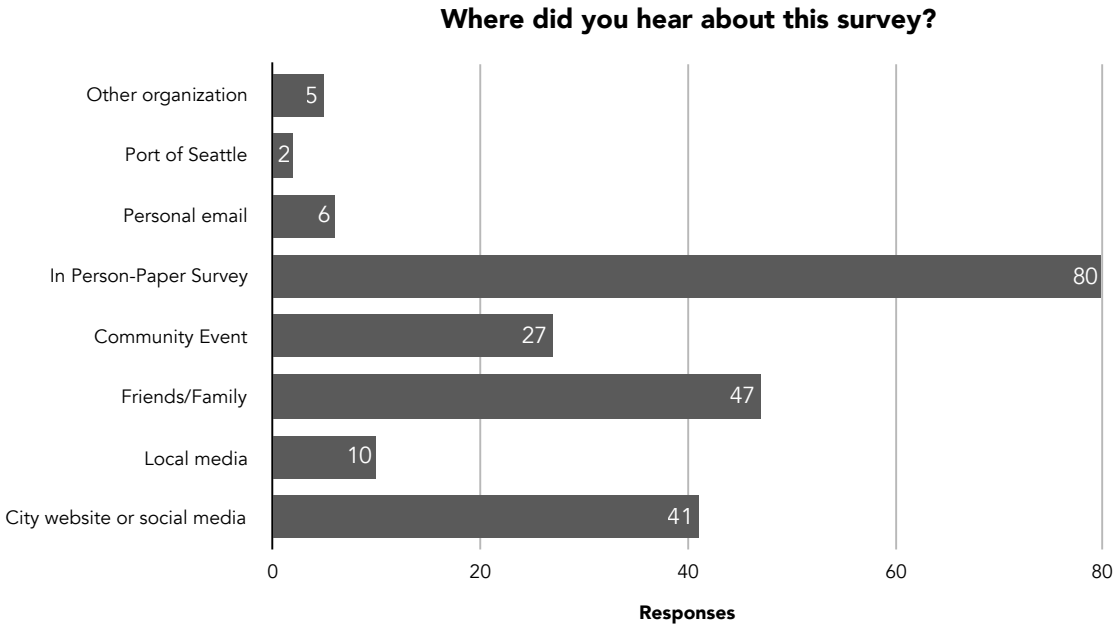
What activities do you do at the park?



How would you like to be involved with the Green City Partnerships?







***Contact information and self-reported demographic information are not shown.**

Please list any locations in Des Moines, SeaTac, or Burien would you recommend for planting trees or making more beautiful outdoor spaces.

100 responses

the old golf course area south of the airport and the buffer zone immediately north of the airport between the end of the runway and south of 518. this is where the airport clear-cut 3000 trees!

North SeaTac park

The area by Des Moines Creek Trail, where the Port of Seattle is raping the land for warehouses!! There is no tree buffer between the runway & school on 24th in Des Moines. We need trees to filter the emissions. Horrible monsters at the Port of Seattle GREEDY!

North Hill neighborhood of Des Moines

I live in Des Moines, in the North Hill area, it would be great to have residential streets to be tree lined for beauty and air quality.

Along 200th, and anywhere along the flight path

Park area off S 178th in Seatac (not sure of the street, but close)

Conifers at N Seatac park

I'm going with all major thoroughfares for $1000, Alex. Many along the SR-99 are now established and it's time to add trees so that in 50 years it looks more mature along with our cities.

I hope you will give us recommendations about places that you see which could be beautified and which could benefit from more trees and natural spaces - places that maybe we see every day but don't realize could be used as green space. I hope a plan for preserving nature in these communities will take into account the need to preserve what is already here, what people are already enjoying, in addition to protecting this and adding more. Also, the reason I will not be participating in the tree events that you list above is because I already do these things, and I think that the Port should be doing most of this work. The Port is the one taking out all of the trees and green spaces and polluting, and then they want to recruit volunteers from the communities around the airport to replant trees, and they want us to apply for grants from them to do this work? That is ridiculous and unjust. I think it's important to educate folks about the importance of nature and I'm pretty sure my neighbors and I already know about it. We are not the ones destroying our greens spaces and trees, we are mourning them. I would urge part of the 20 year plan to hold the Port accountable to funding this work and doing this work, with communities helping if they choose, but not required. I would also urge part of the 20 year plan to include Seatac, Normandy Park, Des Moines, Burien, Tukwila, and Federal Way to come together to preserve green spaces as we are all affected by tree canopies in these cities since the cities are so close together and so close to the airport. There is also non-airport development happening in these cities which is removing tree canopy, and which needs to be accounted for.

Downtown Des Moines's many empty Lots, Parks, Schools, Port of Seattle empty land

16th Avenue between 251st and 240th.

At the new Des Moines Elementary School, at the new Wesley Gardens, at any new construction where the land has been raped by bulldozers.

roadways
Tyee HS
Burien backyards. Tree give-away for people to plant trees in yards.
Des Moines, especially the Pacific Ridge neighborhood. We've lost significant Vegetation due to development and will lose the little vegetation strip that buffers us from I-5 when Sound Transit comes through
North Burien. Specifically, we need more street trees. Puget Sound Park and Hazel Valley Park. Also, focus on areas around schools.
I am not aware of any.
Lakeview Park and adjacent woodland area
All over to protect from airplane emission
Restore Tub Lake. Allow public access to Lake Burien.
North Hill

Des Moines Marina, downtown Des Moines
Boulevard Park! Recently incorporated into Burien, we're often forgotten about, whether it's stores that have healthy local food options, community arts and events, or making space for more shared beautiful outdoor space. We have a amazing resource in the North SeaTac Park just South of BP, but more could be done to make this neighborhood a more beautiful and inviting place.
I don't know

Seahurst elementary has room for more around the edges of the park - esp replacing those cut down ... reforest Eagle landing as trees fall naturally in the park. Encourage more trees in residents yards and near businesses on First ave. AND MOST OF ALL PLANT MORE CLOSER TO THE NOISY AIRPORT!!!!!!
Ambaum Blvd SW; First Ave So from 116th SW to 136TH.; Trees along 4th Ave SW from SW 128th to SW 116th.
The exit closest to the freeway
1st avenue
1 st avenue, Burien
Crystal Springs Park
valley ridge
Various places surrounding my neighborhood
Valley Ridge - mostly all the parks would be more beautiful if there was more green
Tyee High School playground - we should plant more trees instead of grass
Valley Ridge

the areas along Des Moines Memorial Drive that are being paved over by warehouses. the areas around 216th that are now filled with warehouses. There could be a lot more trees in that area, for example near the parking lots. Or replace some parking places.
Water District 54
Near the airport
Curbside trees in residential neighborhoods. Provide lists of pre-approved species of plants and trees residents can plant between streets and sidewalks without requiring costly permits and insurance. These will beautify neighborhoods and don't take up square footage of the host property.
Lake burien park could benefit from a few more trees along the perimeter. Keep the wonderful open grass playfield but ring it with rows of trees, two deep. Great for shade and air quality. Turn vacant properties into bird sanctuaries. There's plenty of former commercial and even residential areas where we can get rid of the concrete and plant a bunch of trees and shrubbery.

Bus stops, train station, sidewalks
schools, churches, apartments
Sidewalks, bus stops, churches
Pavement, bus stops, public parking lots
sidewalks, bus stops, playgrounds, schools
SeaTac 192nd Street (currently no trees)
Everywhere! As many as possible since Port has cut down hundreds of trees
En los parques (" in the parks")
Valley Ridge Park
homeowners need help in reforestation &removal of invasive species; purchase of slope to east of I-5 from 204th N to 188th? to preserve green space on sensitive slope
Saltwater Park, parks in Des Moines, neighborhoods in Des Moines
Saltwater PK. Parkside Wetlands.

I would love to see more tree planting on private property to help connect the urban forest. It would be great if there were more incentives or education for developers and home builders regarding existing trees and maintaining tree canopy.
1st Ave corridor
All schools, many street trees (and care for existing street trees - in Burien on 6th Ave. near police station please), community centers and clubs, along all streams, native plants at libraries, along I-5 and 518 to create buffer of green
I'm a photographer and I love parks, to capture the nature & wildlife. So seasonal trees really make the difference so there is something to have for each quarter.
North Part of Hazel Valley and JBLM campus
Wherever there are monstrous new developments **advice on what and where to plant native plants
Angle Lake
library
Schools, library

Des Moines Beach Park Along 16th Ave S
Midway, Redondo, All the Parks

Busstops, libraries, schools
Crestview Park Tukwila
bus stop & school
bus stops & school
seatac parks & Tyee HS
The area around the airport. Pier in Des Moines
any location honestly would be good for new trees.
Bus Stops
bus stops
Veteran's drive in Kent
Burien apartments and parks
everywhere in Burien

food gardens, roadways,
roadways, food gardens,
ways- side walks, roadways
houses, schools,
gardens, houses, schools
houses, schools, gardens
schools, homes,
roadways, schools
roadside, parking lots, lightrail station
parks, libraries, schools
playgrounds, churches, community centers
public parks, stadiums,malls

schools, mosques, roadsides
Apartment buildings, bus stops, playgrounds
Community centers, schools, mosques

Seatac
Sea Tac/ Des Moines
around any store and apartment complex
Des Moines Creek Trail
Seahurst beach/park
The marina in Des Moines

Appendix H6: Feedback from Open House Events

Site-Specific Feedback

Event	Comment	City referenced in comment	Park/Location if applicable
Port ACE Fund Celebration	Opportunity to coordinate restoration efforts with the possible expansion and development of Disc Golf at Sunset Park, SeaTac	SeaTac	Sunset Park
Port ACE Fund Celebration	Opportunity to add more trees to Riverton Heights Park	SeaTac	Riverton Height Park (developed park)
Port ACE Fund Celebration	Pacific ridge (Des Moines) is losing a significant amount of vegetation due to development and light rail. We are wedged between 1-5 and Hwy99, SeaTac Airport and soon 509. We need vegetation to mitigate pollution	Des Moines	Pacific Ridge
Port ACE Fund Celebration	This slice of land should not be developed; it is a steep bank with many springs. Tukwila wants to incorporate and zone for business and SeaTac City council ignored recommendations of its planning staff and rezoned to high density residential. This remnant of forest serves as the green lungs of our community between 1-5 and the industrialized valley floor	SeaTac	Along I-5 adjacent to Kent near Angle lake
Port ACE Fund Celebebration	Opportunity to partner with Friends of Saltwater Park and include in Green Des Moines efforts -note Saltwater Park is not included in FLAT because it is state property.	Des Moines	Saltwater Park
Port ACE Fund Celebration	Opportunity to collaborate with Env. Science Center at Seahurst Park	Burien	Seahurst Park

Event	Comment	City referenced in comment	Park/Location if applicable
Port ACE Fund Celebration	Opportunity to add trees/green landscaping at Gregory Heights School	Burien	Gregory Heights School
Port ACE Fund Celebration	Opportunity to partner with Highline School District, and Highline Council that oversees all the PTAs to engage schools and families	ALL	
Port ACE Fund Celebration	Comment: Think about integrating tree canopy and green stormwater infrastructure (talk to Futurewise) -Amy Wateman	ALL	
SeaTac Open House	Long-term opp at aviation site, no longer school after other schools rebuilt	Des Moines	Aviation High School
SeaTac Open House	Barnes Creek Trail from Des Moines Creek Park south - a lot of restoration opps	Des Moines	Barnes Creek Trail / Des Moines Creek Park
SeaTac Open House	Des Moines Elementary shut down - what happens? TBD. Community asset?	Des Moines	Des Moines Elementary
SeaTac Open House	Improving water quality w/ Massey Creek - salmon bearing. Creek needs invasive species work.	Des Moines	Massey Creek

Event	Comment	City referenced in comment	Park/Location if applicable
SeaTac Open House	At the new Des Moines Elementary at Zenith Park	Des Moines	Zenith Park
SeaTac Open House	Highline Campus	Des Moines	Highline College
SeaTac Open House	SeaTac Park needs more trees b/w Des Moines (?)	SeaTac, Des Moines	SeaTac Park
SeaTac Open House	Port-owned, took down houses. Still trees + ppl walk dogs - retain as green space	SeaTac	Pat Ryan Memorial Field?
SeaTac Open House	Perimeter of new school	SeaTac	Glacier Site (future middle school)
SeaTac Open House	Around the airport	SeaTac	SeaTac Airport
SeaTac Open House	More trees near Tyee	SeaTac	Tyee High School
SeaTac Open House	New sidewalk near 200th from SeaTac boundary to Des Moines Creek trailhead	SeaTac	200th St, Des Moines Creek trailhead
SeaTac Open House	Plan for old golf course? Very few trees, short plants.	SeaTac	Former Tyee Golf Course
SeaTac Open House	Lower growing greenery - not used as school	SeaTac	Maywood Site (former schoolo
SeaTac Open House	New rd. construction - check w/ WADOT re new 509 connections so not impacted	SeaTac	509, 99, Military Road

Event	Comment	City referenced in comment	Park/Location if applicable
SeaTac Open House	Save trees by Grandview	SeaTac	Grandview Park
SeaTac Open House	Residential yards from 204th + Military Rd East - neighbors have erosion problems, want to plant trees + remove ivy	SeaTac	204th and Military Rd East (private residences)
SeaTac Open House	Public purchase of land along slope to preserve green space?	SeaTac	Slope east of I-5
SeaTac Open House	Erosion issues here	SeaTac	Near S 178th st east of I-5
SeaTac Open House	More kid friendly. Trees (needed) not utilized	Burien	Saint Bernadette School, Jacob Ambaum Park- Based on location of post-it
SeaTac Open House	Replace trees that Port cut down	ALL	none
SeaTac Open House	Near hospitals for patient views	ALL	hospitals in general
SeaTac Open House	Apt. complexes	ALL	
SeaTac Open House	Trees that don't cause allergies	ALL	
SeaTac Open House	Trees that won't be too tall + fall on houses	ALL	
Des Moines Open House	Sidewalks in Des Moines	Des Moines	
Des Moines Open House	Work with wastewater treatment plant near Des Moines Creek Park	Des Moines	Des Moines Creek Park

Event	Comment	City referenced in comment	Park/Location if applicable
Des Moines Open House	Creek could use restoration along the banks	Des Moines	Des Moines Creek
Des Moines Open House	Increase coniferous canopy	Des Moines	
Des Moines Open House	Midway Elementary School	Des Moines	Midway Elementary School
Des Moines Open House	ST development -- crosswalk from HCC to Light Rail station with green features?	Des Moines	Area between Highline College and new Light Rail station
Des Moines Open House	More educational opportunities w/ streams/green space in the more urban areas	Des Moines	Where McSorley Creek goes through Sonju Park/Parkside Elementary
Des Moines Open House	More greenery around streams	Des Moines	
Des Moines Open House	Woodmont Park & Creek	Des Moines	Woodmont Park & Creek
Des Moines Open House	Restoration near Woodmont Park	Des Moines	Woodmont Park
Des Moines Open House	Greenery on walkway from the Light Rail station to the Airport	SeaTac	SeaTac Airport
Des Moines Open House	Blackberry near track & only grass - good place for more trees	SeaTac	Tyee Complex/Valley Ridge Park
Burien Open House	Trees at Puget Sound Park	Burien	Puget Sound Park

Event	Comment	City referenced in comment	Park/Location if applicable
Burien Open House	More residential trees (E. of 509 - 10th and 128th)	Burien	
Burien Open House	Trees for kids, kids for trees	ALL	E. of 509 - 10th and 128th
Burien Open House	More trees on streets in Seatac	Seatac	
Burien Open House	Replant trees on Des Moines memorial Drive	Burien	
Burien Open House	No more cutting trees at port!	SeaTac	Des Moines memorial Drive
Burien Open House	Trees and food forest at Woodside School campus	Burien	SeaTac Airport
Burien Open House	More trees along 1st Ave S	Burien	Woodside School
Burien Open House	Favorite tree in Burien standing in harm's way	Burien	1st Ave S
Burien Open House	Food Forest behind community garden	Burien	SW 154th St near Burien Library
Burien Open House	Need trees along every stream	ALL	Near 'the annex' and highline community center
Burien Open House	Trees along 2nd Ave SW	Burien	2nd Ave SW between SW 124th St. and SW 122nd St.
Burien Open House	Wastewater treatment at Salmon Creek is ruining the park	Burien	Salmon Creek Park

Event	Comment	City referenced in comment	Park/Location if applicable
Burien Open House	Remove Ivy at Salmon Creek Ravine	Burien	Salmon Creek Ravine
Burien Open House	Salmon Hatchery	Burien	Salmon Creek Ravine
Burien Open House	Remove invasives, plant natives at Salmon Creek Ravine near Ambaum Blvd.	Burien	Salmon Creek Ravine near Ambaum Blvd.
Burien Open House	Trees planted need to be nurtured	ALL	
Burien Open House	More/healthier trees in Seahurst Park	Burien	Seahurst Park
Burien Open House	Trees are getting old and dying, time to plant is now	Burien	Seahurst Park
Burien Open House	Japanese Smoke trees are beautiful in landscaping	Burien	
Burien Open House	Would be great to see retention/planting of native trees in private properties along parks	Burien	
Burien Open House	Lots of restoration work to be done at Seahurst Park	Burien	Seahurst Park
Burien Open House	Lots of restoration work to be done at Salmon Creek	Burien	Salmon Creek

Event	Comment	City referenced in comment	Park/Location if applicable
Burien Open House	More fish?	SeaTac	Miller Creek
Burien Open House	River Basin	Tukwila	
Burien Open House	Took down trees for condos, need more trees	SeaTac	SW portion of Angle Lake

General Feedback

SeaTac Open House

- General
  - The Port cut down hundreds of trees + now they want our input on planting shrubs??? Hypocritical to say the least
- What would be good to have at future events?
  - How about some plant give-away raffles?
- What would make it easier for you to volunteer/give feedback?
  - Online calendar of events?

Des Moines Open House

- General
  - Connection between trees + salmon + streams + sound = healthy orca!
  - Do not take down trees
  - We need our trees
  - Study the schools on 24th & 216th to Kent Des Moines Rd.
  - Citizen scientists can be trained
  - Better community awareness that an open house is happening
    - I agree!
  - Small replanted trees will NOT filter emissions as mature growth
  - Public Engagement:
    - Des Moines Community Page – FB
    - Des Moines CAN – FB
    - Next Door
    - Waterland Blog
    - Make a FB page – use it by boosting info videos
    - Farmers Markets
- Who else should we talk to?
  - Make sure you work with cities as you create plan
- What would make it easier to volunteer/give feedback?
  - Earth Day Event/Arbor Day Event

Burien Open House

- Who else should we talk to?
  - Local Audubon chapters
  - WABI
  - Community Visions
  - School District
- What would make it easier to volunteer/give feedback
  - Fun, kid friendly
  - School credit for involvement
  - Work with YMCA
- What would be good to have at future events?
  - Nature sounds
  - Have better BMPs for tree maintenance under power lines to stop topping & stop letting big trees grow up
    - Seattle City Light
- What did you like about today? What could be better?
  - Like the native plants we brought
  - Would love to hear more about the benefits of reforesting for the environment
- General
  - Educate people about ivy, knotweed, etc. to encourage them to remove/limit on their own
  - Water runoff from street gutters into sound – no washing cars
  - Incentives for planting on private property

Appendix I. Green Cities Toolbox Information

Available at: https://forterra.org/service/green-cities-toolbox, the Green Cities Toolbox provides a wealth of information for Cities and Stewards.

In-depth information on these topics:

Restoration planning & implementation

Tools and expertise to plan and implement restoration at the park or site level. Includes step-by-step guides for site planning and best management practices (BMPs) for invasive plant removal, native plant installation, mulching, and maintenance.

Community engagement & volunteer management

Best practices for engaging youth, families, and diverse communities in stewardship activities, as well as tips for recruiting, managing, and retaining volunteers and running successful community restoration events.

Native plants

Native plant identification and propagation resources such as image libraries, keys, databases, and how-to guides.

Site safety

Information on Crime Prevention Through Environmental Design (CPTED) and other safety issues to consider in community-based stewardship.

Invasive species

Resources on the identification and management of aggressive non-native plants and insects.

City–specific volunteer resources

For current stewards and volunteers: Visit your Green City Partnership webpage for reporting forms, maps, and other documents specific to your Green City.

Restoration monitoring

Protocols and instructions for implementing short- and long-term monitoring of restoration sites.

Appendix J. Glossary of Terms Used in This Guide

Adaptive Management

A structured, repeating process of decision making aimed at better understanding a management system through monitoring, evaluation, and development of new management strategies. The Green SeaTac Partnership utilizes an adaptive management strategy to inform its administrative and restoration practices over time.

Biomass

The amount of living matter (as in a unit area or volume of habitat).

Canopy Cover

The percentage of a forest floor or specific geographic area covered by tree crowns. Assessed using aerial orthophotographs (see definition below) and ground-based techniques, it can be calculated for all trees in a given geographic area or specific individual tree species. Canopy cover has been shown to be an important ecological indicator for distinguishing plant and animal habitats, as well as assessing on-the-ground conditions in urban areas.

Climate Change

A change in global or regional climate patterns; in particular, a change apparent from the mid- to late 20th century onward and attributed largely to increased levels of atmospheric carbon dioxide produced by the use of fossil fuels.

Conifers

Cone-bearing trees, most of which are evergreen, with needle or scale-like leaves. Examples include pine, fir, hemlock, and spruce. The dominant conifers found in SeaTac's urban forest are Douglas-fir, western red cedar, and western hemlock.

Deciduous

A tree or shrub that loses its leaves or needles during the fall and winter months (in contrast to an evergreen plant). Examples found in Puget Sound forests include bigleaf maple, red alder, and snowberry.

Ecosystem

The interactive community or relationships of living (biotic) organisms such as plants, animals, and microbes with nonliving (abiotic) components such as air, water, soils, and weather.

Edge Effects

The change in habitat quality and plant species that occurs in the transition zone between two disparate habitat types. Urbanized forests and natural areas that are fragmented and isolated experience negative ecological changes at the abrupt transition between the built and natural environments. These include an increased susceptibility to encroachment by invasive plants; loss of plant-species diversity; loss of contiguous habitat for birds, amphibians, and mammals; and impacts from human activity.

Evapotranspiration

The process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants.

Forest Restoration

Actions and management to reestablish or enhance processes that support a healthy forest's structure, ecological functions, and biodiversity levels. Restoration actions may include removal of nonnative invasive plants, applying mulch, and planting native trees, shrubs, and ground cover. In an urban environment, the natural ecological processes may never be fully restored; therefore, forests will need ongoing management with long-term maintenance and monitoring.

Geographic Information System (GIS)

A computer program used for visualizing, storing, and analyzing data related to positions on the earth's surface. The Green City Partnerships use GIS to map and assess land cover, habitat types, and canopy cover. It is also used to track and assess acres enrolled in restoration.

Green Cities Network

The combined regional group of Green City Partnerships, which currently include Seattle, Kirkland, Tacoma, Redmond, Kent, Everett, Puyallup, Tukwila, and

now SeaTac, Burien, and Des Moines. Three other municipalities — Issaquah, Shoreline, and Snohomish County — are currently in the planning phase and have committed to joining the Network. The Network is not a formally defined entity; rather, it is made up of the city partners, Forterra staff, other nonprofits, and participating volunteers who contribute to achieving the goals of each Green City. Network participants are invited to share best management practices, current relevant research, and funding opportunities.

Green City Partnership

A public-private venture involving a local municipality (e.g., parks departments, public works, utilities, and other government agencies), community groups, and Forterra. The vision of each Green City Partnership is to create a healthy, livable city with sustainable urban forests and natural areas that connect people to nature through community-based stewardship.

Infiltration

The process by which water on the ground surface enters the soil.

Invasive Plants

Introduced nonnative plant species with traits that allow them to thrive outside their natural range and outcompete native plants. Invasive plants are typically adaptable and aggressive, with high reproductive capacity, and are likely to cause economic and/or environmental harm.

Madrone

Arbutus menziesii (aka Pacific madrone, madrona) is a broadleaf evergreen tree native to western North America, particularly to Puget Sound lowland forests. The bark is a rich orange-red color that when mature naturally peels away in thin sheets, leaving a smooth, greenish appearance. The Pacific madrone is in decline, especially in urban areas, and is a difficult species to reestablish. The species is found on drier slopes along shorelines or in areas with well-drained sandy or rocky soils. Areas with madrone trees offer important habitat that often supports unique plant communities.

Management Unit (MU)

A defined geographic area within a park characterized by the vegetation type or conditions present. Open-space areas within the Green SeaTac Partnership sites were grouped into MUs based on one of five categories: forested, natural (nonforested), open water, hardscaped, or landscaped. Forested and other natural areas were further subdivided based on tree-iage values.

Mulch

A protective covering, usually of organic matter such as leaves, straw, bark, or wood chips, placed around plants to prevent weed growth, moisture evaporation, and the freezing of roots. Covering the ground with mulch is a maintenance practice used in urban forest restoration following invasive plant removal and native plant installation.

Natural Areas

Undeveloped parkland with less than 25% tree cover, in contrast to "forested areas," which have more than 25% tree cover.

Orthophotograph

An aerial photograph that has been adjusted for topographic relief, lens distortion, and camera tilt. Because it is an accurate representation of the earth's surface, it can be used to measure true distances, and is often used with geographic information systems (GIS).

Overstory

The uppermost layer of branches and foliage that forms the forest canopy. Common overstory trees found in Puget Sound forests include Douglas-fir, western red cedar, western hemlock, and bigleaf maple.

Photosynthesis

A process used by plants and some algae to convert light energy from the sun, carbon dioxide, and water into carbohydrates that provide sustenance for those organisms. Photosynthesis takes place in the chloroplast cells of leaves. The primary by-product of photosynthesis is oxygen.

Phytoremediation

The treatment of pollutants or waste (as in contaminated soil or groundwater) by the use of green plants that remove, degrade, or stabilize the undesirable substances (such as toxic metals).

Riparian

Pertains to the terrestrial area along the banks of a river, stream, or lake.

Runoff

Runoff refers to unfiltered rainwater that reaches nearby water bodies by flowing across impervious surfaces such as roads, parking lots, driveways, roofs, and even compacted soils in landscapes. Where the landscape is undeveloped or soils are not compacted, rainwater soaks into forest and meadow soils, where it is filtered by natural processes, slowly feeding into underground aquifers, streams, and lakes. The filtration process removes pollutants such as motor oils, gasoline, fertilizers, and pesticides.

Scrub-Shrub Wetland

A forested wetland classification that includes areas dominated by woody vegetation less than 6 meters (20 feet) tall. The species present include willow, red osier dogwood, and hardhack.

Seed Bank

The natural storage of dormant and viable seeds present in the soils of an ecosystem. Soil seed banks play a critical role in the natural regeneration of many plant communities. In urbanized or highly disturbed forests and natural areas, the native seed bank is often destroyed due to soil degradation and colonization by invasive plants.

Stormwater Runoff — see Runoff.

Tree Canopy

The uppermost layer of the forest, formed by the leaves and branches of dominant tree crowns. The tree canopy forms the forest overstory.

Tree-Canopy Vigor

Vigor refers to a tree's active, healthy growth. Plants with low tree-canopy vigor have stunted growth, premature leaf drop, late spring-leaf development, sparse foliage, light-green or yellow foliage, twig and branch die-off, or other abnormal symptoms. A combination of factors (e.g., flooding, shifts in environmental conditions, or physical damage) reduces a tree's vigor. Stress on a tree can make it vulnerable to diseases and insects that accelerate its decline.

Tree-iage

A prioritization tool, modeled after traditional medical triage, used to assess urban habitat conditions and inform restoration-management planning. The tool uses measurements of habitat quality and invasive plant threat to assign each management unit a tree-iage category from 1 to 9. One represents high-quality habitat and low invasive species threat, and 9 represents low-quality habitat and high invasive species threat.

Understory

The vegetation that grows below the forest canopy. Understory plants consist of saplings of canopy trees, together with smaller understory trees, shrubs, and herbs. Examples of understory plants found in Puget Sound forests include vine maple, beaked hazelnut, tall Oregon grape, salal, and sword fern.

Urban-Heat-Island Effect

The increase in surface and atmospheric temperatures of urbanized landscapes caused by the replacement of vegetation and natural areas with impermeable surfaces such as roads, buildings, and other built infrastructure. Lack of vegetation in the built environment results in elevated energy consumption (due to increased demand for cooling and electricity), an increase in greenhouse gases and air pollutants, water-quality impairment (due to the heating of stormwater runoff entering streams and lakes), and human health problems such as respiratory illness, heat exhaustion, heat stroke, and heat-related mortality.

Urban Natural Areas — see Natural Areas.

Appendix K. Common Plants Referenced in This Plan

Invasive Plants		Native Plants	
	**Himalayan blackberry** *Rubus armeniacus*		**Douglass-fir** *Pseudotsuga menziesii*
	**English holly** *Ilex aquifolium*		**Red alder** *Alnus rubra*
	**Reed canary grass** *Phalaris arundinacea*		**Bigleaf maple** *Acer macrophyllum*
	**English ivy** *Hedera helix*		**Black cottonwood** *Populus balsamifera*
	**Bindweed** *Convolvulus arvensis*		**Western red cedar** *Thuja plicata*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